4^{TH} PARTY CYBER LOGISTICS FOR AIR CARGO

Recent titles in the
INTERNATIONAL SERIES IN OPERATIONS RESEARCH & MANAGEMENT SCIENCE
Frederick S. Hillier, Series Editor, *Stanford University*

Ramík, J. & Vlach, M. / *GENERALIZED CONCAVITY IN FUZZY OPTIMIZATION AND DECISION ANALYSIS*
Song, J. & Yao, D. / *SUPPLY CHAIN STRUCTURES: Coordination, Information and Optimization*
Kozan, E. & Ohuchi, A. / *OPERATIONS RESEARCH/ MANAGEMENT SCIENCE AT WORK*
Bouyssou et al. / *AIDING DECISIONS WITH MULTIPLE CRITERIA: Essays in Honor of Bernard Roy*
Cox, Louis Anthony, Jr. / *RISK ANALYSIS: Foundations. Models and Methods*
Dror, M., L'Ecuyer, P. & Szidarovszky, F. / *MODELING UNCERTAINTY: An Examination of Stochastic Theory, Methods, and Applications*
Dokuchaev, N. / *DYNAMIC PORTFOLIO STRATEGIES: Quantitative Methods and Empirical Rules for Incomplete Information*
Sarker, R., Mohammadian, M. & Yao, X. / *EVOLUTIONARY OPTIMIZATION*
Demeulemeester, R. & Herroelen, W. / *PROJECT SCHEDULING: A Research Handbook*
Gazis, D.C. / *TRAFFIC THEORY*
Zhu, J. / *QUANTITATIVE MODELS FOR PERFORMANCE EVALUATION AND BENCHMARKING*
Ehrgott, M. & Gandibleux, X. / *MULTIPLE CRITERIA OPTIMIZATION: State of the Art Annotated Bibliographical Surveys*
Bienstock, D. / *Potential Function Methods for Approx. Solving Linear Programming Problems*
Matsatsinis, N.F. & Siskos, Y. / *INTELLIGENT SUPPORT SYSTEMS FOR MARKETING DECISIONS*
Alpern, S. &Gal, S./*THE THEORY OF SEARCH GAMES AND RENDEZVOUS*
Hall, R.W./ *HANDBOOK OF TRANSPORTATION SCIENCE - 2nd Ed.*
Glover, F. & Kochenberger, G.A. / *HANDBOOK OF METAHEURISTICS*
Graves, S.B. & Ringuest, J.L. / *MODELS AND METHODS FOR PROJECT SELECTION: Concepts from Management Science, Finance and Information Technology*
Hassin, R. & Haviv, M./ *TO QUEUE OR NOT TO QUEUE: Equilibrium Behavior in Queueing Systems*
Gershwin, S.B. et al/ *ANALYSIS & MODELING OF MANUFACTURING SYSTEMS*
Maros, I./ *COMPUTATIONAL TECHNIQUES OF THE SIMPLEX METHOD*
Harrison, T., Lee, H. & Neale, J./ *THE PRACTICE OF SUPPLY CHAIN MANAGEMENT: Where Theory And Application Converge*
Shanthikumar, J.G., Yao, D. & Zijm, W.H./ *STOCHASTIC MODELING AND OPTIMIZATION OF MANUFACTURING SYSTEMS AND SUPPLY CHAINS*
Nabrzyski, J., Schopf, J.M., Węglarz, J./ *GRID RESOURCE MANAGEMENT: State of the Art and Future Trends*
Thissen, W.A.H. & Herder, P.M./ *CRITICAL INFRASTRUCTURES: State of the Art in Research and Application*
Carlsson, C., Fedrizzi, M., & Fullér, R./ *FUZZY LOGIC IN MANAGEMENT*
Soyer, R., Mazzuchi, T.A., & Singpurwalla, N.D./ *MATHEMATICAL RELIABILITY: An Expository Perspective*
Talluri, K. & van Ryzin, G./ *THE THEORY AND PRACTICE OF REVENUE MANAGEMENT*
Kavadias, S. & Loch, C.H./*PROJECT SELECTION UNDER UNCERTAINTY: Dynamically Allocating Resources to Maximize Value*
Sainfort, F., Brandeau, M.L., Pierskalla, W.P. / *HANDBOOK OF OPERATIONSRESEARCHAND HEALTH CARE: Methods and Applications*
Cooper, W.W., Seiford, L.M., Zhu, J./ *HANDBOOK OF DATA ENVELOPMENT ANALYSIS: Models and Methods*
Sherbrooke, C.C./ *OPTIMAL INVENTORY MODELING OF SYSTEMS: Multi-Echelon Techniques, Second Edition*

**** A list of the early publications in the series is at the end of the book ****

4TH PARTY CYBER LOGISTICS FOR AIR CARGO

by

Sung-Chi Chu
Lawrence C. Leung
Yer Van Hui
Waiman Cheung

KLUWER ACADEMIC PUBLISHERS
NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW

eBook ISBN: 1-4020-7801-3
Print ISBN: 1-4020-7800-5

Created in the United States of America

Visit Kluwer Online at: http://kluweronline.com
and Kluwer's eBookstore at: http://ebooks.kluweronline.com

Contents

Chapter 2 Evolution of e-Commerce and Modern Air Cargo Logistics

Chapter 3 Frameworks for a 4th Party Air Cargo Logistics e-Business Platform

Preface

This is a book introducing the many aspects of planning and control of air cargo logistics processes in an e-Business environment. We approach this subject matter from the perspective of the logistics service providers. We would like to show the tremendous potential of achieving industry-wide collaboration between agents of the air cargo industry via an e-Business community platform.

We believe that a proper third-party information infrastructure, operated as a **4**th party platform in cyber space, will enable e-Business to be performed at the industry level. Such an e-Platform can help logistic service providers to provide customization to client companies at the cost level of mass production. The platform can also allow information exchange involving other industries such as financial institutions, insurance brokers, and government agents.

The idea of putting together such a book first came up several years ago when we were conducting air cargo-related research for several companies in Hong Kong. During the process, we realize that quite a bit have been written about the management of supply chains from the perspectives of companies. However, we found very little about the logistics aspects of supply chains from the perspective of logistics service providers. We feel that such a book would benefit researchers, practitioners, policy makers and students interested in this topic.

This is a timely endeavor. The emergence of globalization, outsourcing, and e-Commerce and e-Business has meant fast-growth in air cargo.

Today's air cargo logistics requires integration – physical as well as virtual. There are many intellectually challenging problems regarding the architecture, ownership, decision support environment, and knowledge management of the e-Business platform. In this book, we believe we are merely scratching the surface of this interesting and exciting subject.

We would like to acknowledge the support of the Center of Cyber Logistics (a joint effort of the Chinese University of Hong Kong and the City University of Hong Kong). Our appreciation goes to Winnie Lo and Collin Wong both of the Center of Cyber Logistics for their help in the preparation of the manuscripts.

Our deepest appreciation must go to our wives and children who have to put up with our preoccupation with cyber logistics. The opinions expressed and statements made in this book are those of the authors and should not be ascribed to those persons or organizations whose assistance is acknowledged above.

Chapter 1

AIR CARGO LOGISTICS AND INFORMATION TECHNOLOGY

1. INTRODUCTION

The air cargo logistics industry consists of many agents. The principal agents are freight forwarders, integrators, warehousing and distributing companies, airlines, airport authority, and cargo terminal operators (see Figure 1-1). These agents work together to provide effective logistics management for client companies. Modern logistics management requires intensive information to be exchanged among agents. Information exchange involving other industries such as financial institutions, insurance brokers, and government agents has also added to the diversity of handling information and knowledge.

Air cargo logistics typically involve high value goods and need to be time-definite. Information technology has been widely used in logistics management (Londe and Masters, 1994; Lewis and Talalayevsky, 1997; Euwe and Wortmann, 1998; Whipple et al., 2002). In this book, we will use the term IT to include Internet technology and Web technology. The current IT trend is driving towards a connected globe where information flows unobstructed and safe. There are key developments in computing hardware, networking infrastructure and software technology that have effected and will continue to affect the air cargo logistics industry.

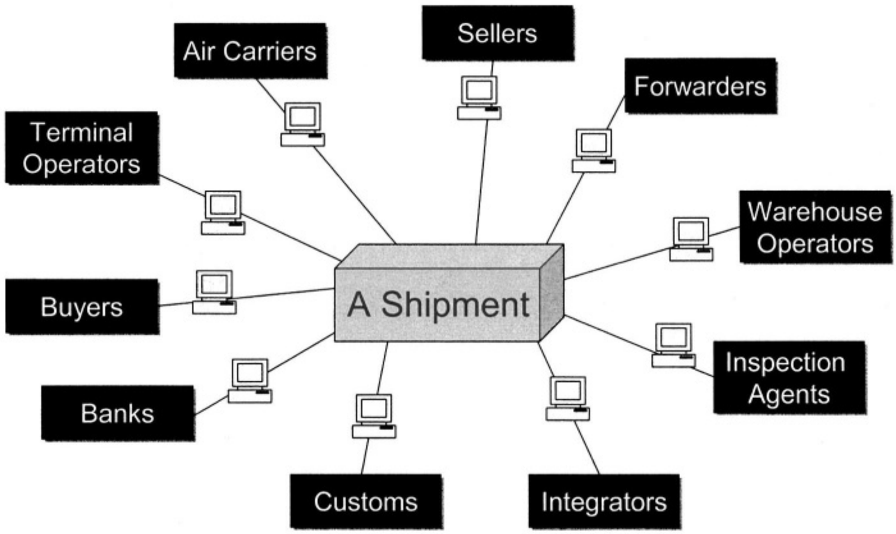


Figure 1-1. Air Cargo Logistics Communities

Hardware. Desktop computers have become an integral part of most businesses and commonly come with integrated networking hardware for both wired and wireless communications. Each computer can access to external informational resources and can establish connectivity to other computers quite easily. Such ubiquitous connectivity is enabled by advanced network infrastructure. Agents, at the desktop or at portable devices, are now connected to their clients. The fast processing speed and network connection result in quicker response to client's need and timely decision making for management. Using the Internet, an air cargo logistics agent can perform multiple tasks simultaneously such as preparing customs declaration of a shipment and negotiating with other agents.

Networking Infrastructure. Internet technology was successful in creating a global network of systems for electronic mails, distributed computing, and information sharing. Internet, and the emerging Internet2[1], will continue to dominate the networking infrastructure for global communication. Web technology creates a web of information portals and aggregates a huge user base in cyber space. It provides a new channel for agents to reach new customers and for clients to access logistics information from the agents. Wireless and mobile network infrastructures are also fast becoming another effective means to access Web resources. The mobile communication is

[1] www.internet2.org

useful in tracking and tracing in-transit shipments. Wireless network can aptly create localized network in a logistics facility.

Software. The current software development efforts focus on bringing traditional business software to operate in the Web environment. These Web-based client-server applications offer agents a single browser interface to conduct business activities online. Server-side software implements core business logics that are componentized. Agents with proper system configuration can enable clients to perform e-Commerce and e-Business activities with plug-and-play software components in the market. E-Business software such as those by i2[2], Seibel[3], and BEA[4] are helping logistics firms to establish their Web presence with e-Business capability. New concerns such as information and network security must be dealt with, protecting agents from information hijack and malicious attacks. Emerging Web services development could shift the Web to a service-oriented environment, and into a semantic Web[5]. As a result, a request for logistics services can be dynamically processed and responded by discovered service provider's system.

The Web has become an open environment for businesses. Firms leverage the Internet to begin online commerce. As e-Commerce proliferates across industries, e-Business has also become imperative to allow concurrent management of business processes online. Logistics services arising from e-Commerce transactions require agents to interact with customers in the electronic environment. Agents need to be ready to effect logistics e-Commerce (the online trading of logistics services) and to conduct logistics e-Business (the online management of logistics processes). This trend of e-Business in the logistics sector is sustained by the developments in IT - advances in hardware, robust network connectivity, and net-enabled business components. The air cargo industry must take heed and appropriate steps to reap the benefits and gain efficiency with IT, e-Commerce and e-Business. We believe that the nature of air cargo logistics has been irrevocably changed by concurrent online trading and management capability. And the potential for developing new markets and new business practices are unprecedented.

[2] www.i2.com (e.g. supply chain management and optimization software components)
[3] www.siebel.com (e.g. CRM modules)
[4] www.bea.com (e.g., Applications Server Suite)
[5] www.w3c.org has information on many more such developments.

The Internet has gained tremendous popularity worldwide and is beginning to revolutionize the way business processes are conducted. Open Internet technologies, which allow interconnections between people and businesses at very low cost (Hoffman et al., 1996), have provided the prerequisite technology for globalization. Large manufacturers and SME's are now able to sell their products directly to the other side of the globe in small quantities via virtual marketplaces.

Focusing on its core competencies, firms have outsourced their logistics needs. In-house management of logistics processes is not economical. Outsourcing to third-party logistics agents is becoming an accepted business practice; there has been significant increase in demand for effective management of air cargo logistics. The globalization further accentuates the internationalization of the logistics companies. There will be less frictions at borders and less restrictive policy for air cargo. Transaction costs are reduced as business is conducted online. The open economy no doubt presents opportunities to extend competition from national standpoint or within, to regionally and globally. The joint effects of outsourcing, globalization, and e-Business collectively have amplified the need of air cargo logistics.

2. A NEW ERA FOR AIR CARGO LOGISTICS

The air cargo industry as a whole must act to reach a new era cohesively. The global trend of e-Business and the use of information technology are creating new challenges and opportunities for agents of the air cargo industry. SCM describes a company's IT-supported integration of logistics activities via alliances with suppliers and customers (Chiu, 1995; Williams et al., 1997). Adopted by many multinational companies, SCM is pushing for more integration and cooperation amongst air cargo agents in the chain. With the changing global economy and market uncertainty, logistics firms seek strategic alliance to lower risk and to engage in global logistics. Benefits are many – improve service quality, ease of market entry, costs reduction, and skills enhancement, etc. (Moore, 1998; Varadarajan and Cunningham, 1995).

As integrators such as Federal Express and DHL have moved into the air cargo logistics sector, new levels of service standards through the extensive use of IT has been introduced (Melbin, 1997). Services such as cargo tracking, typically offered by integrators and now airlines, are fast becoming industry norm. The role of IT in air cargo handling, growing partnerships for competitiveness, and the growing integrator challenge have been topics of importance in industry (Air Cargo News, 1999a).

Both information technology and collaboration among agents of the industry are critical competitive elements in global logistics. Efficient integration and consolidation are crucial aspects of modern logistics management. Integrators are leaders in adopting network integration and information technology in logistics. They have addressed the challenges and opportunities brought on by e-Business and globalization, around which the future of air cargo logistics will evolve.

However, many agents in the air cargo industry cannot reach the level of IT capability of the integrators. We believe that the key component in logistics e-Business is in the setting up of a proper third-party information infrastructure, operated as a 4th party platform in cyber space. It is an information infrastructure that enables e-Business to be performed at the industry level, a level where trading transactions and business transactions are interrelated and linked. With careful planning and cooperation among industry agents and with e-Business as an enabler, they can provide customization to individual shippers at the cost level of mass production. Such a platform will be introduced next.

3. CYBER LOGISTICS – THE 4TH PARTY LOGISTICS E-BUSINESS PLATFORM

Cyber logistics is logistics realization in cyber space. It is the process of planning logistics services and its subsequent integrative management. These services are implemented and facilitated by pervasive accessibility of logistics information online. The intent of the book is to present a comprehensive view of cyber logistics for the air cargo industry. We provide two key aspects in the following chapters: 1) the new issues and technical framework of air cargo logistics industry in the new era, and 2) the intellectual problems emerged in the cyber logistics environment. The ensuing discussion outlines two concepts that are fundamental to the 4th party logistics e-Business platform - also referred to as a community platform or e-Platform throughout this book.

The first concept has to do with the nature of business processes in air cargo logistics. Each of these processes (e.g. shipping, inventory management, customer relationship management, etc.) consists of a chain of linked and interdependent services. In an electronic environment, the information management of inter-related activities of a business process cannot be properly addressed without an integrated view. More importantly, it should be further highlighted that many of these logistic processes utilize interdependent information and can be managed more effectively with integrative data service.

A second concept is the 4th party role of e-Platform. It is the role with respect to those who operate in the e-Platform environment. We use the term 4th party platform to designate an IT infrastructure that can be used by 3rd party service providers to perform integrated logistics services (discussion on 1st-4th parties is provided at a later section).

3.1 Managing Logistics Services in a Business Chain

The span of cooperating business entities from the point of raw materials to the point of consumption subscribes to a conceptual view of a chain of related and interdependent business processes. These business processes are usually and individually a part of many independent organizations. If the management of these business processes as a whole is to provide benefits such as elimination of waste and production flexibility, different levels of intra- and inter-organizational integration will have to be realized. Integration includes bidirectional flow of products (materials and services) and information. Information exchange tightened the coupling between business processes in the chain. The tight coupling can be accomplished at data, application, system and managerial level.

The aforementioned "chain" has been captured in parts in various frameworks over the years. Supply Chain Management (SCM) describes the upstream effect of each business process has from the suppliers to the customers. Its goal is to reduce inventory and increase efficiency across the chain. The International Center for Competitive Excellence in 1994 gives the following definition of SCM: "Supply chain management is the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers" (Cooper et al., 1997).

Supply chain is also viewed as "the network of organization involved, through up- and down-stream linkages, in the different processes and activities that produce value in the form of products and services." (Christopher, 1998).

Value chains project a different view of a supply chain from its value-added effect, while demand chains' effects are projected downstream from the customer to the producers and manufacturers. Selling-chain (Kalakota & Robinson, 1999) concerns with entities starting from the point a customer enquires on a product to when a product is ordered.

From here on, we term this "chain" as business chain. The management of the logistics services required of this chain, via the e-Platform, forms the basis of discussion in the book. Logistics management is needed for these complex logistics services, ranging from a simple door-to-door delivery of a product to the consumer from a retailer, to a managed warehouse where parts are scheduled to arrive, repackaged, relabeled, and the finished products then redistributed to different buyers, across different regions and of different countries. Performing logistics services of the chain involves many partners. These partners together collaboratively manage a chain of logistics processes/activities, providing the end-to-end delivery of physical products generated from these business chains.

Cyber Logistics is the ability to effect partnership, anywhere and at anytime of participants in cyberspace to plan logistics services. These service processes are encapsulated as information objects in the e-Platform, and organized as a chain of service processes in accordance with logistics requirements. These services are inter-related and dependent in time and space. As agents collaborate on these logistics services, information objects will need to be created, manipulated, exchanged and eventually managed on the e-Platform.

For those logistics services which form a chain of end-to-end logistics services or activities, we term this as a *logistics chain.* A shipment chain (the shipping activities of an air cargo from origin to destination) is an example of such a logistic chain (See Figure 1-2).

3.2 First, Second, Third, and Fourth Party Logistics

There are two perspectives in the discussion of $\mathbf{n}^{\mathbf{th}}$ party logistics. Both views converge at 4PL in terms of the accomplished objectives, with different labeling. To gain an understanding of the idea behind the use of the term, we will begin our discussion of the traditional labeling of parties in general. From the traditional labeling of party of the first, second & third, we extend the discussion to logistics party of the first, second, third &

fourth. The second perspective is to label logistics parties according the level of integration.

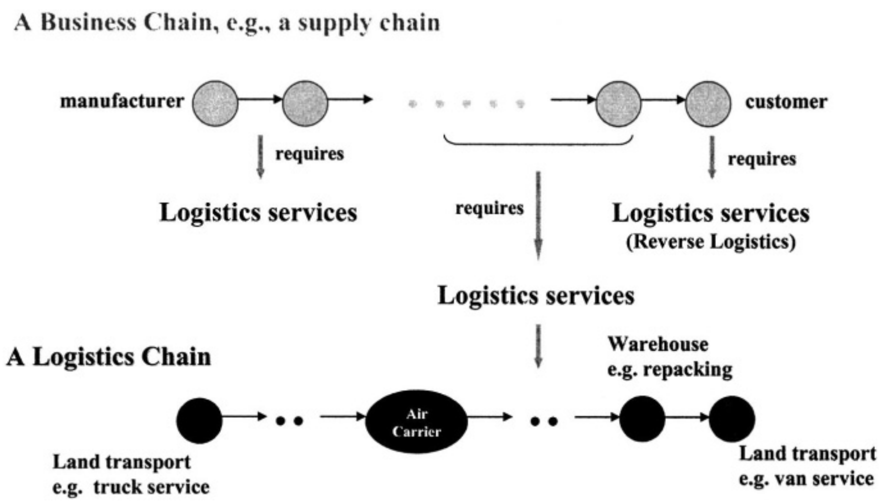


Figure 1-2. A Logistics Chain

3.2.1 Party Logistics – Traditional Labeling

The traditional labeling is needed to clearly identify parties involved in some situation. There will not be any misunderstanding in communication or responsibility.

3.2.1.1 Party of First, Second, Third and Fourth

First party is frequently used to highlight the person in question, and not anybody else for that matter, even others parties may be involved. In auto insurance, a 'First party' coverage is needed to protect the insured as the first party when damages is claimed as a result of an accident, independent of responsibilities. This is sometimes referred to as 'no-fault benefits.' From a technology point of view, according to MicroForte (October 2002), an electronic game developer, Microsoft has formed a 'First-Party' Publisher Relationship with them. This 'First-Party' relationship implies that Microsoft is the first party to publish the software for Xbox™, not MicroForte[6].

Second party is used to clearly dissociate in exact fashion from the first party. Without the labeling, there would be a possible misplacement of importance or credit to the first party unknowingly. Second party can be used to simply complete a description of two phone lines are in use – first party in on line one, and second party is on the second line. It is more of a counting reference logically follows first party. In the business world, a 'second party' is also needed to validate if certain criteria that the first party is expected to accomplish is met without bias. This is usually initiated by the first party. For example, a company requires certification must seek an independent approved second party entity to establish if certain guidelines or performance level are met.

Typically, the use of *third party* is for the identification of the entity that carries out tasks that are not for themselves, but for both other pre-existed parties – the first and the second. For example, when the relationship between two parties is needed to be verified, a third party entity will come in and completes the job. The request can be directed from either one or agreed by both of the parties. It was not important to label who is first and who is second to determine the third. A trusted entity to hold funds during transactions between buyers and sellers (e.g. escrow.com) is a third party. The authentication of users in a heterogeneous computing environment can be carried out by a third-party security entity, e.g. TrustedPortal for Oracle by Baltimore Technologies[7],

Fourth party, naturally extends from above discussion to label the entity that provides services or assistance to three other distinct parties of **1st, 2nd** and third. A first party (participant) could use a third party website to send a notice to the second party. For example, Community Electric Cooperative (third party website) provides a service for a person (first party) to send a notification to a friend or neighbor (second party) that certain utility will be discontinued in due course – the service is called 'Second-party Notices."[8] This requires the interaction of all three parties involved. Similarly, an auction website is a third-party website. When there is a dispute between any combination of these **1st, 2nd**, and **3rd** party, a fourth party mediator may be needed to resolve the conflict. Another example will be an inspection

[6] http://wire.ign.com/articles/375/375744p1.html?fromint=1

[7] www.baltimore.com/solutions/TrustedPortalSuite/OraclePortal/index.asp

[8] www.comelec.coop/Second-Party%20Notice.htm

agent of a house that is on sale – the agent is a fourth party, the realtor is a third party, the potential buyer and the seller would the 2nd and the 1st respectively.

It is clear that this labeling exercise is to ensure when parties are involved, there would not be any conflicting issues as to whom responsibilities rest. Based on this ad hoc classification, we will discuss next the logistics parties.

3.2.1.2 Party Logistics of the First, Second, Third, & Fourth

Party logistics refers in here of logistics performed by a party. From the traditional labeling practice, first party logistics (1PL) is simply logistics carried out by a first party entity, e.g., a firm that transports its in-house developed products, such as ads posters, or custom-made ball bearings for certain machine, to its customers or distributors.

Similarly, 2PL (second-party logistics) is the party that receives the products or goods from the first party. For example, importers and buyers/suppliers are carried out 2PL if logistics is performed to obtain goods from the first party. If the first party provides door-to-door logistics, then virtually there is no 2PL. When first party provides part (e.g., Freight on Board - FOB) or none of the logistics for goods to be received by the second party, then 2PL is needed by the buyers or the importers.

3PL is logistics performed by a third party – the logistics tasks are for either first party (e.g., a wireless equipment OEM[9] in Taiwan), or second party (e.g., FOB purchase by a university). Freight forwarders are typical 3PL providers (3PLp), so is DHL air express for international document delivery. 3PLp's relieves 1st or 2nd party in the management and coordination of different modal transportations and/or warehouse management, and the like. As global logistics needs become more complex, involving multi-modal transportations and their coordination, quite often complete services are provided by more than one 3PLp.

4PL is the provision of logistics services to the 3PL. Physical infrastructures such as airports, cargo terminals, community logistics centers can be viewed as 4PLp. Companies that offer information infrastructure to 3PLs are also examples of 4PLp. A community platform for 3PLp to

[9] Original Equipment Manufacturer

collaborate, plan logistics services, and to manage these services online is also a 4PLp.

3.2.2 Party Logistics – Levels of Integration Labeling

N[th] party logistics has been defined within the framework of supply chain management, with respect to the level of integration in the management of supply chains.

In a Morgan Stanley report (2001), the manufacturer who carries out the logistics by itself is a 1PL entity. A 1PL manufacturer owns all logistics assets and manages all its logistics functions. A 2PLp is a "commodity capacity provider." From the "evolving demand" perspective, as the 1PL entity expands geographically, its logistics needs are provided by 2PLp's. These 2PLp's are niche service providers and often offer "a single function in the supply chain." As these 2PLp's expand their capabilities to handle and integrate different logistics functions, they become 3PLp's. These 3PLp's such as freight forwarders, provide logistics services to, and involve in some management capacity of the supply chain. Some 3PLp's have no assets, only leveraging their services on the management know-how of the integrated logistics functions. 4PL is an integrator of services provided by 2PLp's and 3PLp's, achieving a "one-point" contact for the 1PL manufacturer. A 4PLp ensures that an end-to-end service is sustained and managed in a supply chain.

Gattorna (1998) discusses the different characteristics of 4PL[10] from an organizational aspect, also from the perspective of SCM. A 4PL organization manages all aspects of a client's supply chain, connecting the client and the 3PLp's via a single interface. The 4PL organization manages the integration of these different 3PL providers for the clients. A similar view from the outsourcing perspective is offered by Bade, Mueller, & Youd (1999). 4PL is considered a new concept in 'supply chain outsourcing" from an evolutionary perspective. They define a 4PL provider as "a supply chain integrator that assembles and manages the resources, capabilities, and technology of its own organization with those of complementary service providers to deliver a comprehensive supply chain solution."

In sum, 4PLp's, from the perspective that logistics processes are part of a supply chain, play the management role for a manufacturer (a 1PL) over

[10] 4PL™ is a registered trademark of Andersen Consulting (now, Accenture since January 1, 2001)

various 2PLs (niche operator such as a trucking company or a warehouse operator) and 3PLs (operators with tightly coupled logistics knowledge that can provide a major portion of a client's supply chain). The 4PLp serves as a single contact point for end-to-end solutions to logistics needs.

3.2.3 Remarks – 4th Party Logistics

The above discussion merely brings out the different views of 1PL, 2PL and 3PL as how they are referenced and used. The interpretations of 4PL do not create any discernable conflicts. Concepts of 4PL share similar underlying objectives with the same aspirations – efficiency in the logistics processes. From a supply chain perspective, the gain in logistics efficiency contributes to efficiency of the supply chain in terms of costs reduction and time-to-customer compression. From the cyber logistics view, the efficiency is at the air cargo logistics industry level, and as a result, contributes to the benefits of business chains, or any business process with logistics need.

4. KEY CONCEPTS OF CYBER LOGISTICS

In this book, we will present the key concepts of the cyber logistics era. We consider the impact of the World Wide Web (WWW) to the business world from an evolutionary perspective. A clear and deliberative conceptualization of website development into four defining eras will be put forth. These eras lay the foundation for the conceptual development of a framework of community-based cyber logistics platform, where the emerging trend of e-Business management presides. One must also carefully look at the ownership aspects of such an e-Platform since many stakeholders are involved in the process.

To complete the cyber logistics picture, we provide a technical discussion on how this e-Platform could be designed and implemented. The e-Platform environment also lends itself for decision support and knowledge management considerations. An online decision support capability for effective optimization of shipments by consolidation and integration will be discussed. Also, an exploratory approach to knowledge management on the e-Platform will be provided to illustrate the importance of on-line business intelligence for agents. The following is a brief summary of the next six chapters on each of these emerging subjects on 4th party cyber logistics.

4.1 Eras of Websites

Prior to the 1990's, business information exchanged digitally was achieved using EDI, where connections between businesses had to be pre-arranged. In the early 1990's, with the commercialization of Internet and the advent of open computer technology, connectivity becomes affordable not only for businesses but also for individuals. The interconnections have formed the World Wide Web (WWW). Here, WWW evolves from merely an information resource to become a virtual place for commerce activities. As e-Commerce activities extend across businesses, enterprises, and industries, this opens up the challenge for a genre of websites that can provide online integrative management of business processes – e-Business processes. In here, we provide an evolutionary perspective of e-Commerce/e-Business websites. We propose that there have been four eras: Pre-Web (prior to 1990), Reactive-Web (early 1990's), Interactive-Web (mid-1990's), and emerging Integrative-Web (end of 1990's to early 2000's). To be able to chart the evolution of e-Commerce websites, a conceptual framework is developed to characterize such websites. We propose that the principal elements of an e-Commerce website comprise of a host, participants, and a website core. The core consists of core functions, core technology, and information base. We analyze the elements individually and examine their historical development collectively. We provide observations and insights on the interplay between e-Commerce and e-Business activities, website functions and web technology. Emerging e-Business developments are identified.

4.2 Frameworks for a 4th Party Air Cargo Logistics e-Business Platform

E-Business has brought new challenges as well as opportunities to the air cargo industry. With careful planning and cooperation among industry agents and with e-Business as an enabler, the air cargo industry can be transformed into one that can provide customized services to business chains at the cost level of mass production. The key component is in the setting up of a 4th party integrative logistics e-Business platform. This e-Platform serves all the communities in the logistics industry. An illustrative example is given to demonstrate the complexity of logistics processes and the corresponding integration issues. A conceptual framework for such a community platform is formed which extends the traditional business-to-business e-Commerce between two firm-level entities to e-Business at the industry level online. The proposed infrastructure differs from traditional portals in that it features the online integration of business transactions. It provides a virtual platform for agents of the air cargo industry, enabling them to develop and engage in logistics integration. This platform supports a market entity and a management entity, both co-exist in the same operating environment. A 3-tier architectural framework is also given, shedding lights in the technical challenges in the design and implementation of such an e-Platform. Two near term key factors – common interface and information standards, will be discussed.

4.3 A Benefit, Cost and Risk Analysis for the Stakeholders of e-Platform

The global trend of e-Business and the use of information technology are transforming the business structure of many industries. The air cargo industry is no exception. The requirement for information integration is unprecedented in the air cargo industry. The establishment of a 4^{th} party e-Business platform as proposed could allow client companies or agents to simply plug in and engage in logistics e-Business activities. The success of such an e-Platform depends on the views of stakeholders of the e-Platform. Major stakeholders are Government, Investor, and Users, each having a very different set of costs, benefits and risks. The e-Platform design that would ultimately satisfy the stakeholders must be selected carefully, balancing properly the costs, benefits, and risks to individual stakeholders. In this chapter, we approach the design selection and conflict resolution between stakeholders using a series of Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) models. It is shown that the proposed models can be used to examine the sharing of benefits, costs and risks such that a design agreeable to all parties can be determined.

4.4 Design and Implementation Issues of e-Platform

The pace of e-Business evolution has been phenomenal. A simple browsable site of static information has quickly evolved to that of cross-website integration of dynamic business processes. It has realized connectivity, interactivity, interoperability, and integrability. Along the way, the problems of protocol standardization, tracking, security, and data interfacing have to be solved. A platform aims to facilitate the communities to conduct both commerce activities and business processes has been proposed. In the chapter, a technical design for such an e-Platform for the air cargo industry is discussed. This community platform is a 4th party community infrastructure where air cargo logistics services can be designed, traded, and managed. The online process design is enabled by the e-Business decision support system, which is capable of editing, integrating, and consolidating the respective shipments that are being negotiated. The objective is to show the technical issues involved in designing a platform of this genre. The principal aspects of system requirement, system architecture, interface design, and information representation requirement are addressed. We also examine the difference of designing such a platform with more traditional website, as well as highlighting the complexities and issues involved.

4.5 E-Platform Decision Support: Optimizing Shipment Design

The global trend of e-Business and use of information technology is transforming business operations of the air cargo industry. A 4th party e-Business platform is a web-based information infrastructure that allows the online integration of business transactions. Such an e-Platform enables e-Business processes between agents of the air cargo industry to be conducted. A principal feature of this infrastructure is a decision support system that optimizes the integration and consolidation of air cargo logistics activities. In here, we will focus on how a single agent (freight forwarder) could use the e-Platform to optimize his job design. We will also discuss the decision-making environment of air cargo forwarding and the role of a freight forwarder. A mixed 0-1 linear program will be formulated to optimize the integration and consolidation of activities. The formulation covers consolidations across different agents and shipments. An illustrative numerical example, solved using a Tabu search, is given.

4.6 Business Intelligence on the e-Platform

In a world where the competitors are only a mouse click away, customers are demanding than ever before. Intelligent use of the vast amounts of data generated by logistics transactions, fulfillment, and management in the e-Platform can give the managers and executives the knowledge they need to develop logistics plans, nurture customer relationships and stay ahead of the competition. The ability to derive e-Business intelligence from both internal and external data sources, along with online transactional data in possible e-Platform data warehouses holds the key to achieving these goals. With the new knowledge, and online management tools, the executives are poised to develop innovative strategies and profitable business practices in air cargo logistics.

5. CONCLUDING REMARKS

The global logistics landscape will see more strategic presence of 4PL's in various forms. Issues such as diffusion of technological innovations, cultural adaptation, learning and training, executive buy-in, and attitude and latitude for change will need to be handled judiciously and simultaneously to ensure an integrative reach into cyber logistics. One may argue that with e-Business, SCM will come into prominence in the new digital era. On similar ground, the logistics industry must prepare to leverage e-Business to ascend to the new cyber logistics era. Nonetheless, the 4th party e-Platform serves the industry, and at the same time, facilitates such 4th party logistics provider role for SCM. That is, e-SCM, or many e-Business processes, can be plugged into the e-Platform, and virtual 4PLp's will be 'formed' to meet their global logistics needs.

There are two information technology innovations on the horizon that will surely affect and further propel cyber logistics into the mainstream. One such technology is the ability to allow information flows with the goods. With the innovative technology, RFID (Radio Frequency Identification), information is the goods. The ease of identification gives track and trace a whole new meaning. The capability of identifying products at all stages of a supply chain has been pursued for quite a while. The Global e-ID initiative of EAN-UCC has developed technology based on barcoding and on sight scanning to provide tracking of manufactured items throughout the supply chain. If such tracking technology can be incorporated and carried through into the logistics chain by the RFID technology, then, product tracking can be accomplished from end to end.

The second technology that is already on the horizon is the continuing development of the semantic Web - proposed in 1999 by Tim Berners-Lee. Semantic Web is one of the key research areas that will further extend the Web of informational resources to a Web of *computable* resources. With this information technology, cyber logistics would be more agile and tolerant to the dynamicity of global trade. Logistics services, not partners, can be discovered for online virtual integration.

Chapter 2

EVOLUTION OF E-COMMERCE AND MODERN AIR CARGO LOGISTICS*

1. INTRODUCTION

Innovative Web-based trading has provided the business world new online channels to extend their corporate reach. This evolutionary trend has allowed creative approaches such as reverse bidding, and trust building and partner matching to take shape. Yet, a holistic view from the enabling technology perspective of doing business in an electronic environment is lacking. In this chapter, we chart the evolutionary changes of websites and mark the eras that are important in its own right. This paves the way for the understanding of how Web technology is leveraged for a fourth-party electronic environment in which all industry agents operate.

The protocol suite TCP/IP that provides the communication backbone of the World Wide Web has existed in simpler form since the late 1970's. Academic institutions, research centers and government agencies have benefited from this interconnection of networks, e.g., effective asynchronous communication using emails, on-demand document exchange by file transfer, and interactive manipulation by direct remote communication using telnet, etc. As Web technology takes hold in the early 90's, new e-Merchants like *Amazon.com* and *Dell.com* have successfully sell products and services via only the e-Commerce channel. E-Merchants such as

* Leung, L.C., Chu, S-.C., Hui, Y.V., and Cheung, W. (2003) "The Evolution of e-Commerce Website: A Conceptual Framework and Analysis," Working Paper, Center of Cyber Logistics

Priceline.com and *eBay.com* created a new business relationship that is consumer-driven. The adaptation of Web technology into core business processes requires also the integration of partners' technology in use. An understanding of the impact of the e-Trends and their role in modern air cargo logistics is needed. The conceptualization presented here, in large part, is based on our working paper in the analysis of websites.

1.1 Websites – e-Commerce & e-Business

The beginning of e-Commerce can be traced all the way back to when businesses first use telex, telegram, telephone and fax to conduct commerce activities. During the 1980's, a major effort to standardize business information exchanged digitally was achieved using EDI (Threlkel and Kavan, 1999). Here connections between businesses had to be pre-arranged, normally based on a value-added network (VAN). This improves the efficiency of conducting business but has limited commercial viability because of the high cost of connectivity. In the early 1990's, with the commercialization of Internet and the advent of open computer technology, connectivity becomes affordable not only for businesses but also for individuals. The interconnections have formed the World Wide Web (WWW). The powerful search engines and the proliferation of websites turn the WWW into a rich information resource, attracting browsers on a global scale (Brewington and Cybenko, 2000). Businesses begin to reach their potential customers through the Internet and provide them with marketing information and/or product catalog online (Baron et al., 2000; Bieber and Vitali, 1997; Kambil, 1997).

During the mid-1990's, WWW evolves from merely an information resource to become a virtual place for e-Commerce activities, which in turn require a more secured and interactive environment (Hoffman et al., 1999; Wang et al., 2001). The secured and interactive features transform e-Commerce activities from a single buyer-seller connection to a multiple buyers-sellers exchange (Elofson and Robinson, 1998; Jutla et al., 1999). Additionally, websites can be customized or even personalized. Businesses also begin to adopt wireless technology to the Internet (Senn, 2000; Siau et al., 2001). The more recent e-Commerce need is to enable business-to-business exchange, which requires interoperability across businesses, as well as within a business enterprise (Kaplan and Sawhney, 2000; Wise and Morrison, 2000; Yang and Papazoglou, 2000). As e-Commerce activities extend across businesses, enterprises, and industries, this opens up the opportunity and challenge for a genre of websites that can provide online integrative management of business processes – e-Business processes (Kwan, 1999; Gebauer and Shaw, 2002).

In this chapter, we provide an evolutionary perspective of e-Commerce websites. We refer to the period prior to 1990 as the *Pre-Web era,* the early 1990's as the *Reactive-Web era,* the mid-1990's as the *Interactive-Web era,* and the period towards the end of the century as the emerging *Integrative-Web era.* To be able to chart the evolution of e-Commerce websites, we need a systematic and comprehensive conceptual framework to characterize such websites – as simplistic characterization such as B2B and B2C fails to capture the essence of differing e-Commerce and e-Business websites. Such a framework must be based on a fundamental understanding of the elements of a website, as well as their inter-relationships.

Here, we propose that the principal elements of an e-Commerce website comprise of *a host, participants,* and a website core consisting of *core functions, core technology,* and *information base.* We then provide an analysis for each of these elements.

With respect to the aforementioned Web-eras and concentrating on three principal elements – the host, core functions and core technology, we postulate on the historical development of websites and identify the emerging future development. The information base holds data and information of the websites, and could also include business intelligence facilitation in the form of data warehouses and data mining. Such executive decision support will be discussed in chapter 7.

It should be pointed out that the discussion here does not address the hardware aspects of an e-Commerce or an e-Business website such as application servers and web servers (Tenenbaum, 1997; Fraternali, 1999; Glushko et al., 1999; Smith and Poulter, 1999; Fingar, 2000; Smith, 2001). Nor we will consider the design aspects of a website's architecture; such issues are addressed elsewhere (Kuo and Lin, 1998; Shim et al., 2000; Wu 2000; Griffith et al., 2001; Lechner and Hummel, 2002). Furthermore, other perspectives of characterizing e-Commerce websites have been presented (Zwass, 1996; O'Keefe and McEachern, 1998; Storey et al., 2000; Yang and Papazoglou, 2000; Chaudhury, 2001; Rappa, 2001) but none has addressed websites from the perspectives of enabling technology.

2. ELEMENTS OF AN E-COMMERCE WEBSITE

In general, the principal parties of an e-Commerce website are the participants and the website management body, referred to as the *Host* (Figure 2-1).

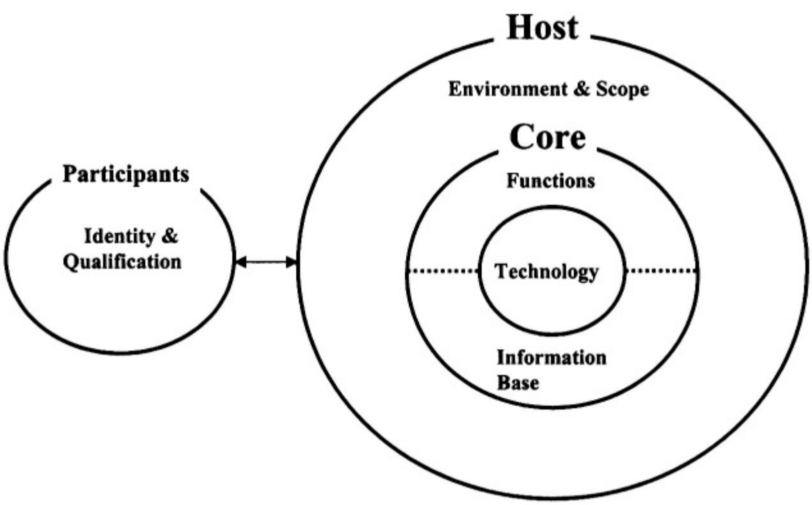


Figure 2-1. Elements of an e-Commerce Website

2.1 Participants

Participants can be buyers/sellers or shippers/consignees, whether they are individuals or businesses, who utilize the website to engage in commerce activities. Depending on the website design, participants may be registered members or licensed members, who may have access to each other or may be stand-alone. Referring to the descriptors of the participants as *participant objects,* we propose that the participant objects consist of two components: *identity objects* and *qualification descriptors.* The identity objects (e.g. individuals, businesses, buyers, sellers, etc.) profile the participants of the website. The qualification descriptors (e.g. registered, licensed, selected, etc.) describe the status or the conditions of participants. With identity objects and qualification descriptors, we may characterize participants using such terms as registered sellers, licensed forwarders, spot customers, etc. It should be pointed out that participants could be characterized using multiple identity objects or qualification descriptors.

2.2 Host

The website management body, *Host,* enables all the online activities with coordination of the core and participants. The descriptors of *Host* are referred to as *Host objects,* which are stipulated to have two components: *environment objects* and *scope-structure descriptors.* The environment objects are the attributes that define the boundary of the website, outlining the general business nature of the e-Commerce website. Examples of environment objects are merchant, broker, mall, portal, etc. Within the environment, commerce activities may be structured according to certain relationships or properties between participants and the Host. Examples of such properties are cooperative, collaborative, neutral, etc. The attributes describing such relationships or properties are referred to as *scope-structure descriptors.* Using environment objects and scope-structure descriptors, one can characterize a host using such descriptions as a neutral portal (e.g. yahoo.com), a third-party exchange (e.g. oraclexchange.com), a first-party distributor (e.g. lifung.com), a vertical exchange (e.g. covisint.com) and a collaborative horizontal exchange (e.g. e2open.com). Similar to participants, a host may be characterized using multiple scope-structure descriptors or environmental objects.

2.3 The Website Core

At the core of the Host is the management system, which is broken down into *core functions, core technology,* and the *information base.* Core functions (e.g. registering, browsing, matching, etc.) are the set of functions that essentially define the capabilities and intelligence of the website. Depending on the business model of the website, these functions collectively define how participants are admitted into the website, how negotiations are performed, and how transactions are established and managed as well as fulfilled. The core functions are supported by the core technology, which can be organized into four areas: information presentation & representation (e.g., HTML[11]), communication (e.g., HTTP), business logic programming language (e.g., Java), and information storage & retrieval (e.g., SQL server). The information base is the information content of the website, which includes persistent and transitional data as well as information that facilitate all prescribed e-Commerce and e-Business activities. The data and information are carried in various information objects such as text, audio, video, etc. The information structure can be organized as data warehouses;

[11] HyperText Markup Language

data mining techniques can be used to extract specific knowledge to allow decision making for management needs.

3. ANALYSIS OF WEBSITE ELEMENTS

The objects for information base are document, file, and video, and should not require detailed analysis. Stored information is characterized by the format it is represented in, thus defining its level of interoperability. For example, a Microsoft Word document can be viewed and interpreted by applications that are specifically built as such. Information recorded as text (or as ASCII characters) can be read by most text editing software and processed without conversion by most computers.

Also self-explanatory are identity objects for participants, which can be buyers, sellers, individuals (consignors, forwarders), business (airlines), etc. Their qualifications can be open, selected, registered, community, licensed, etc. The remaining elements (host objects, core functions, core technology) are considerably more complicated and are discussed in the ensuing sections.

3.1 Analysis of the Host Objects

Host objects characterize the boundary and the nature of the website (using environment objects), as well as the structural relationships between participants and the host (using scope-structure descriptors). Environment objects can be organized into a) information-based entities such as webpage, portal, classified, advertiser, platform, b) market-based entities such as marketplace, distributor, broker and exchange, and c) organization-based entities such as company, enterprise, store, mall, industry and hub. Scope-structure objects could define the host's role in the business relationship such as third-party and fourth-party, and could also characterize the host-participant relationship in such terms as neutral, generalized, specialized, and personalized. The following tables provide a description of relevant environment objects (See Table 2-1) and scope-structure descriptors (See Table 2-2).

Table 2-1. Environment Objects

Environmental Objects		***Definition and Example***
Information-based	*Webpage*	A document on WWW. (personal webpage)
	Portal	A website that provides a search engine. (google.com)
	Classified	A website that provides listings of items for sale or purchase. (classifieds.lycos.com)
	Attention-Advertiser	A website that provides contents and services, to draw customers' attention on advertising messages. (tom.com)
	Platform	A website that provides on-line facilities with which participants can perform on-line operations. (aol.com)
Market-based	*Broker*	A website that draws buyers and sellers together and facilitates transactions. (travelocity.com)
	Distributor	A catalog-type website that connects a group of product manufactures with the retailers. (necx.com)
	Marketplace	An open market for buyers and sellers. (b2b.yahoo.com)
	Exchange	A website that provides a market for products and services between anonymous parties. (aeroxchange.com)
Organization-based	*Company*	A website for a company. (intel.com)
	Merchant	A website that advertises and sells products. (walmart.com)
	Mall	A website that hosts many online merchants. (activeplaza.com)
	Enterprise	A website for a company, its subsidiaries, and its partners. (disney.com)
	Industry	A website that provides a range of products and services within an industry. (transportweb.com)
	Community	A website that provides services to a business community. (polysort.com)
	Hub	A website that hosts many marketplaces and uses various market-making mechanisms to mediate any-to-any transactions among businesses. (e-hub.com)

Table 2-2. Scope-structure Descriptors

Scope-Structure Object	***Definition and Example***
First-party	A website provided by and in the interest of the seller(s). (amazon.com)
Second-party	A website provided by and in the interest of the buyer(s), (aeroxchange.com)
Third-party	A website without particular interests in any parties. (shopping.yahoo.com)
Fourth-party	A website that provides services to the third-party service providers. (nte.net)
Neutral	An indifferent website that is not engaged in either side. (britannica.com)
Generalized	A website that provides diversified contents and services (yahoo.com)
Personalized	A website that customizes the contents and services to meet the customer's personal needs. (my.yahoo.com)
Specialized	A website that provides a theme. (nba.com)
Fellowship	A knowledge website with information contributed by users and professional experts. (askme.com)
Vertical	A website that involves products in vertical markets. (covisint.com)
Horizontal	A website that involves products in horizontal markets. (oraclexchange.com)
Cooperative	A website that aims to allow cooperative relationships among participants. (world-exchanges.org)
Collaborative	A website that aims to allow collaborative relationships among participants. (e2open.com)

3.2 Core Functions of a Website – A Transaction-based Hierarchy

A website's e-Commerce and e-Business activities, or e-Activities, are based on many core functions, which are defined as the manipulation and transformation of information without reference to any particular objects – that is, core functions are not object-specific, It is important to distinguish a core function from an e-Activity. For example, buying is not a core function but rather an e-Commerce activity, which requires a series of specialized functions (register, search, match, offer, contract, authenticate, etc.) and involves objects (buyer and seller) as well. Similarly, personalizing and brokering are examples of e-Commerce activity and not functions.

The core functions of a website are essential to its conduct of e-Commerce activities. Here, we propose to organize these functions into the following hierarchies: transaction incubation, transaction negotiation, transaction formation, and transaction management (Figure 2-2). This framework is based on the developmental phases of preparing, negotiating, and forming of a business transaction – and after a transaction is formed, the necessary functions needed for the various aspects of managing a collection of transactions.

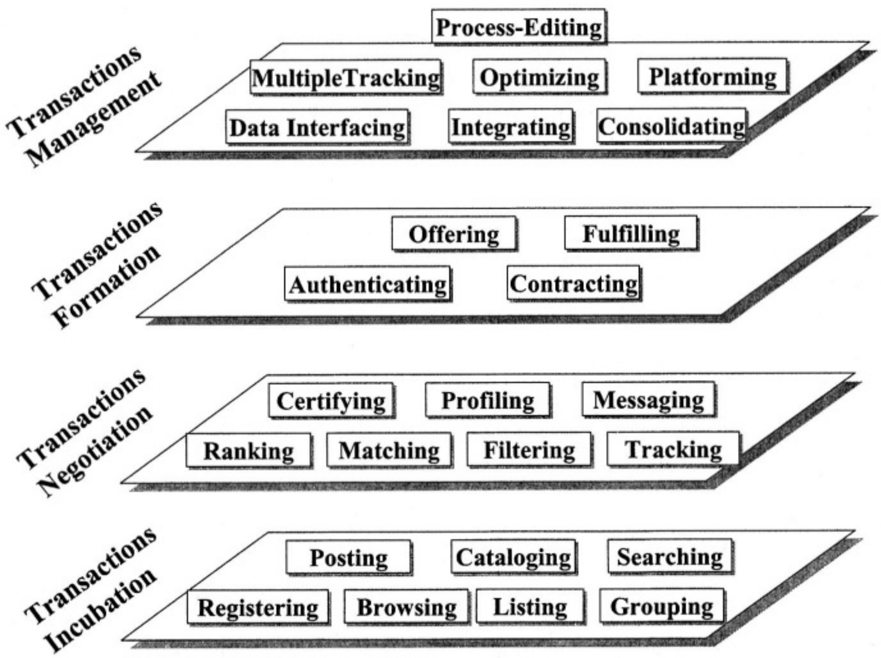


Figure 2-2. **A Transaction-based Hierarchical Structure of e-Commerce Functions**

Transaction incubation functions. These are functions that prepare the participants and the host with basic information processing capabilities. These functions can be used to set up and validate the qualification of the participants, to respond to the request of participants, and to guide and/or organize the retrieval and storage of information. Collectively, they form the basis of such e-Commerce incubating activities as broadcasting, advertising, information-searching, publishing, and aggregating. The relevant transaction incubation functions are:

- Searching – enable guided retrieval of specific information
- Registering – enable receipt and storage of requested information
- Browsing – enable unguided information viewing

- Listing – provide information in linear representation
- Posting – deliver selected information
- Grouping – enable guided association of selected information
- Cataloging – organize information in a specific structure

For example, an information-searching activity would involve functions such as registering, browsing, and searching; an advertising activity would involve browsing, cataloging, posting, etc. These core functions are essentially based on one-way information requests, originated from the participants to the host.

Transaction negotiation functions. These are functions that facilitate the negotiation of a commerce transaction. After the initial information search to narrow the focus, participants need certain negotiating functions to engage in the exchange of information before deciding whether a transaction should be made. These core functions collectively enable such e-Commerce negotiating activities as personalizing, customizing, shopping, brokering, bidding, auctioning, etc. The relevant transaction negotiation functions are:

- Tracking – maintain/keep records of tracked information
- Messaging – send asynchronized information
- Certifying – establish the existence of specific information
- Profiling – create preference information
- Filtering – sieve through information
- Matching – search then link related information
- Ranking – sort information in accordance with specific criteria

An important aspect in the negotiation process is the system's ability to customize and personalize. Customizing requires the core functions of profiling, filtering, and posting; while personalizing is simply customizing with registering. To enable process continuity in the negotiation process in such activities as shopping and brokering, the system requires the core function tracking, which is essentially for two-way interactivity. Typically, the activities of shopping, brokering, bidding, auctioning all requires some form of matching and ranking.

Transaction formation functions. Once the negotiation process is complete, the participants enter into the transaction-formation phase. This is the phase where transactions are finalized, where participants are typically authenticated for payment, and where digital products are fulfilled. The following core functions are required to conduct or conclude e-Commerce activities such as buying, selling, paying, gaming, pay-per-view, fulfillment of digital products etc.

- Authenticating – verify by matching of certified information
- Offering – receive information within a prescribed range
- Contracting – accept then record offered information
- Fulfilling – transfer of requested or approved digital information

To form a commerce transaction, offering would first be confirmed, followed by the contracting step. Here, authenticating is typically needed for identity check as well as credit check. The subsequent fulfilling steps of payment and transfer of the digital product conclude the buying and selling process.

Transaction management functions. These are functions that enable online coordination of multiple interrelated e-Activities. They can be used to provide the online management of business processes – enabling integration, consolidation, optimization, and control of these processes – commonly referred to as e-Business processes. The e-Commerce activities and e-Business processes that can be supported by these functions are online process design, e-Collaboration, e-Procurement, e-Supply-chain-management, e-Reengineering, e-Customer-relationship-management, etc. The relevant transaction management functions are:

- Platforming – set up exchange of dynamically shared information from multiple sources
- Data Interfacing – standardize representation of shared information from multiple sources
- Multiple tracking – link multiple tracked information
- Process-editing – search and group multiple tracked information
- Consolidating – combine matched tracked information of multiple sources
- Integrating – combine consecutively ordered information
- Optimizing – select best process-edited information

These core functions collectively provide an online integrative capability to the website. Platforming sets up the structural framework for communication among multiple sources. Data interfacing allows sharing of information between any participants. Process-editing provides the basic mechanism for designing and editing multiple processes online. Consolidation is used to achieve the online merging of component tasks across processes plausibly to share the same resource; while integration is to achieve the linking of component tasks across processes to realize potential operational and/or economic efficiency. Optimization is to attain the best process design among alternatives. These management functions are essentially complex and have not been pervasive among websites. More detailed discussions are provided in Section 4.4.

3.3 Core Technology

The evolution of e-Commerce website is closely related to the evolution of website core technology. Core technology is crucial in enabling core functions, allowing e-Commerce activities to be conducted in cyberspace. Here, we breakdown this enabling core technology – web-based information technology – into the following four major areas: Communication, Information Presentation and Representation, Language, and Storage and Retrieval. We have not come across such breakdown in the literature.

Figure 2-3 depicts the four areas along with representative examples. We will first discuss the nature of such technology; the evolution of core technology within the context of e-Business websites and activities will be covered in Section 4.

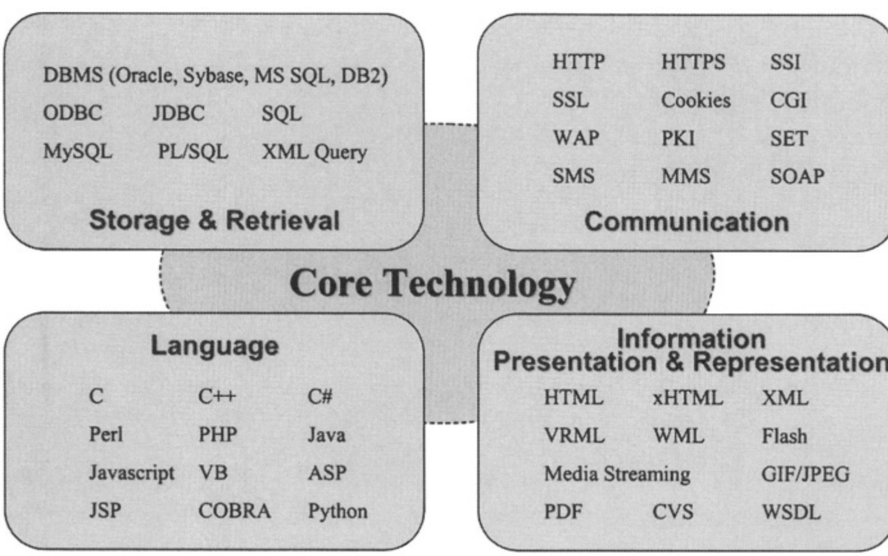


Figure 2-3. The Core Technology Areas

Communication. It establishes a virtual channel over some network infrastructure for any two parties to exchange digital data by following prescribed procedures. For participants to initiate or take part in e-Activities, communication must first be established. HTTP (Hyper Text Transfer Protocol) is a set of procedures that provides a request-response mechanism, which allows the requesting party to receive information on the network using the URL (Universal Resource Locator) reference. The communication channel is established per exchange and is always initiated by the requesting party. Data can be attached according to the interface standard, CGI (Common Gateway Interface). The responder can use cookies, a data item that stores the requestor's footprint at the requestor machine, to keep personal information of a requestor or the environment where the communication should be carried out. For secured data transfer, protocols using encryption such as SSL (Secured Socket Layer) and PKI (Public Key Infrastructure) can be used. Communications can be achieved at application level across the network using RPC (Remote Procedure Call) or RMI (Remote Method Invocation).

The Wireless Application Protocol (WAP) is a communication technology that creates an added channel for information exchange using wireless devices, and plays a role in the delivery of MMS (multimedia Messages Service).

Information Presentation & Representation. It specifies how information should be organized when presented, as well as the corresponding presentation format; and defines how the information should be organized for exchange. A website must present information in a format viewable by participants using required tools. Information can be represented as simple text, graphical images, sound and video or a combination of them. HTML (Hypertext Markup Language) is a language that formats the information for presentation, which is viewable by a commonly available browser. A HTML page also has the capability of including multimedia information and links to other external document, as well as providing a form structure to accept data from the participant. XML (eXtensible Markup Language) captures the essence of HTML while adding data structure and data markers to the content, thus providing an information structure for efficient processing and storage. For delivery of content to wireless devices, WML (Wireless Markup Language)[12] specifies a different information structure suitable for wireless usage.

[12] Basic XHTML is adopted later also for wireless communication.

Language. It expresses and formulates precise logical steps to manipulate data and computing resources. Language is the critical component that forms the building blocks in a website's intelligence capabilities. Programming languages that exist before WWW include COBOL, FORTRAN, and C. These languages lack networking interface mechanisms to acquire data via the Internet as well as direct querying capability of databases, both of which are necessary features of e-Commerce. For some existing languages (e.g. PERL, C++, Ada, VB), web-based capabilities are incorporated to collect data from remote websites, retrieve stored data or information from external databases, and to generate HTML or XML pages. Further improvements are provided by PHP and Java to dynamically manage information delivered to participants. Java also provides interactivity and functionality for the participant. C# in the .Net framework offers another choice with similar net-targeted programming features.

Storage & Retrieval. It provides system structure for the recording and retrieval of data and information. A website requires the capability and the capacity to store and retrieve information. Before the web, DBMS (Database Management Systems) has been used for recording and retrieval of shared data and information for many years. Proprietary access – the proprietary ability to query databases – is the principal obstacle for traditional DBMS to adapt to an open Internet environment. ODBC (Open DataBase Connectivity) is a standard interface for accessing a database. Any database that is ODBC-compliant can be accessed using a simple query language, e.g. SQL (Structured Query Language), along with most programming languages. This interface arrangement format has been adopted by many websites. JDBC (Java Database Connectivity)[13], a special feature for Java, incorporates the functionality of both SQL and ODBC, thus allowing direct connectivity between programming languages and databases.

4. EVOLUTION OF E-COMMERCE WEBSITES

In this section, a detailed evolutionary perspective of e-Business websites will be provided. Discussion focuses on the evolution, individually and collectively, of the three principal website elements, host, core functions, and core technology. We refer to the period prior to 1990 as the Pre-Web era, the early 1990's as the Reactive-Web era, the mid-1990's as the

[13] java.sun.com/products/jdbc

Interactive-Web era, and the period towards the end of the century as the emerging Integrative-Web era (Figure 2-4).

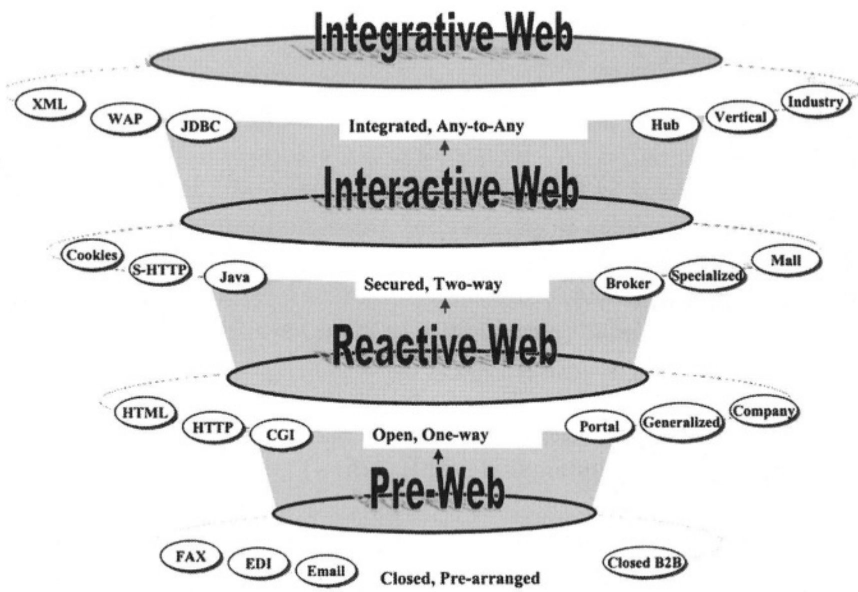


Figure 2-4. Evolution of e-Commerce Websites

4.1 Pre-Web Era

Prior to the WWW, commerce activities can be characterized as closed in that businesses can only communicate with each other using specific communication mechanism. To engage in business activities digitally, the channel of communication must be prearranged. There are no standards in communication protocols to exchange business information, thus limiting business activities to be conducted on a one-to-one basis. While Internet provides connections between any two parties, however, open communication cannot be established because a common message format for encoding business activities has yet to be developed. This means that commerce activities can only be participated by designated parties, typically by selected businesses and not open to the general public.

Designed for a network environment, but not web-based, EDI is a standard to define a syntax for interchanges between business partners. However, EDI is rigid and is difficult for general use by the public – even a simple function such as browsing is not possible. In this era, there are no discernable web-based business functions as individual business functions are accomplished according to their own set of formats. As for the core technology, they can be characterized as stand-alone with no interface built-in features. The relevant core technology is:

Communication	**Representation & Presentation**	**Language**	**Storage & Retrieval**
FTP, Telnet, EDI, SET, EFT	ASCII	FORTRAN, C, Perl, C++	DbaseIII, SQL

The four areas of core technology are developed with no consideration or motivation to create interface between them. The technology in this era simply does not have web-based capabilities to take advantage of the full potential of the Internet. This pre-web era is largely a period of closed, pre-arranged, one-to-one, business-to-business commerce.

4.2 Reactive Web Era

At the beginning of the 1990's, commerce activities on the Internet evolve from a closed environment to one that is open and easily accessible. Internet has become a virtual place where information can be easily shared. The WWW is formed, marking the beginning of web-based e-Commerce. The open access is due to the development of a simple effective communication protocol HTTP, enabling exchange of information in HTML. Sharing and viewing of information become much easier with the unified URL identifier and freely available browsers. Communication between users is no longer prearranged.

The proliferation of websites follows. Primitive websites such as webpage and classified begin to populate the Web. Together with the development of powerful web-based search engines, WWW has become an effective channel for businesses to reach potential customers. The powerful search process is enabled by CGI, which identifies what users want, and by the core language technology, which efficiently locate matching information. In this era, the websites are typically information resources. Generalized portals – with core functions such as listing, cataloging, posting, and grouping – are most common during this period.

While communication is open, the request for information remains one-way. Business can only react to requests by customers, creating a reactive website environment – from hosts to participants. This means difficulty in personalizing a response. Further, the information represented in HTML cannot be extracted, thus not permitting interoperability between website users. Without interactivity and interoperability, e-Commerce activities are limited to online searching of products and services, with any transactional steps thereafter having to resort back to pre-Web dealings. Furthermore, e-Commerce activities are impeded by the lack of secured transmission of confidential information. The features of the reactive Web era are summarized in Table 2-3.

Table 2-3. **Reactive Web Era**

– open, one-way –				
e-Commerce Activities: Browsing, Information-searching, Broadcasting, Cataloguing, Advertising, Publishing, Aggregating, etc.				
Host	Scope-Structure		Environment	
	First party, Second party, Neutral, Generalized		**Webpage, Portal, Classified, Company**	
Core Functions	Transaction Incubation Functions: Listing, Posting, Browsing, Grouping, etc.			
Core Technology	Communication	Pres. & Repres.	Language	Storage & Retrieval
	HTTP, CGI	HTML	C, C++, Perl	DbaseIV, Access, Oracle, SQL

The reactive Web has opened up communication channel for the general public, with websites continuing to build up their contents. It has become important for existing DBMS to have better interface with common languages that implement the business functions – yet many websites do not possess the necessary interface, due to the restriction of proprietary language to its database.

4.3 Interactive Web Era

In the Interactive-Web era, e-Commerce activities evolve from predominantly a simple one-way browsing activity to a two-way commerce process of transaction negotiation and formation. As e-Commerce websites take root in the Web, the need for interactive two-way negotiation of buy-sell transactions becomes imminent. Interactivity is achieved primarily due to the emergence of the core technology, cookies (Kristol, 2001). By tracking the footprint of a participant, cookies enables interactivity, a necessary feature for the continuity of a transaction-building process on the Web.

With process continuity, many new e-Commerce activities can now be conducted. Online shopping (Lohse, 1998), a negotiation process consisting of a series of shopping-cart steps, is now a viable e-Commerce activity – a shopping cart is essentially a cookies-driven recording scheme. Personalization (Cingil et al., 2000) and mass customization are also achievable due to the interactive process. Both personalization and mass customization are accomplished using new language technology (e.g. JSP and PHP), the former is based on the participant's identity and the latter is derived from the website's information base. Here, new online shopping environments of various scope-structures emerge – an example of which is a personalized mall, where a shopper can engage in a personalized shopping process involving a variety of products. Online brokering, a transaction negotiation-and-formation activity, is also created largely because of interactivity. By developing online linkages of participants, websites can now match sellers and buyers of products and services (Bakos, 1998).

Both shopping and brokering are steps towards buying and selling. To complete buy-sell activities, agreements must be reached between buy-sell parties. However, WWW is a public domain. Thus, for online buying and selling activities to flourish, the problem of secured information exchange on the Web must be resolved. Here, well-established cryptography systems are used to develop SSL on the Web, guaranteeing confidentiality and integrity between two parties. The secured transfer of information is essential for closure of a contractual agreement, which concludes the dual activities of online buying and selling – two online activities that would not be possible in prior eras.

Buying and selling can also be practiced with auctioning and bidding, thus extending the buy-sell coverage to groups of participants. An exchange website is an online marketplace with auctioning and bidding by buyers and sellers anonymous to one other (Bakos, 1998). With buying and selling comes the e-Commerce activity of online paying, which requires websites to check the participant's credit-worthiness and to authenticate the participant's identity. As host environment evolves from specialized malls to third-party marketplace for procurement, the online buying-selling paradigm extends into brokering of information. Gaming, a noteworthy e-Commerce activity that has its genesis in this era, is a case in point. The principal features of the reactive Web era are summarized in Table 2-4.

Table 2-4. **Interactive Web Era**

– secured, two-way –				
e-Commerce Activities: Shopping, Personalizing, Brokering, Customization, Bidding, Auctioning, Buying, Selling, Paying, Gaming, etc.				
Host	Scope-Structure		Environment	
	Third party, Personalized, Specialized, Fellowship, Horizontal		**Exchange, Marketplace, Merchant, Distributor, Broker, Mall**	
Core Functions	Transaction Negotiation & Formation Functions: Tracking, Profiling, Matching, Ranking, Offering, Fulfilling, etc.			
Core Technology	Communication	Presentation & Representation	Language	Storage & Retrieval
	Cookies, SSL	Javascript, SSI, Flash (plug-ins), VRML	Java, PHP, Python	ODBC, SQLPlus, SQLServer

To support the new e-Commerce activities of shopping, personalizing, brokering, buying, and selling, a set of new core business functions are developed. In general, the core functions in this era are those of transaction negotiation and transaction formation (e.g. matching, ranking, authenticating, contracting). The Interactive-Web era makes personalized buying or selling possible. Interactivity solidifies buy-sell e-Commerce on the Web, demanding different core technology areas to consider their impact on one another. Core technology continues to evolve to handle heavy website traffic, to provide sophisticated interface to databases such as ODBC, and to improve language interface to databases.

4.4 Emerging Integrative Web Era

As new and old e-Commerce activities are made in the previous eras, the management of these transaction-based activities becomes an imperative evolutionary impetus. Towards the end of the century, the new dimension – interoperability – is beginning to emerge in some websites. Coupled with interactivity, websites seek to develop capability to integrate processes online. No longer are websites used merely for online trading activities – e-Commerce activities, but also for the online management of business processes – e-Business processes. This is the era that witnesses the emergence of e-Business processes such as e-Supply-chain-management, e-Collaboration, e-Reengineering, and e-Procurement. Here, e-Commerce activities and e-Business processes are intertwined online, creating a genre of websites that are both marketplaces and management platforms. Management of business processes can be conducted concurrently with commerce activities to achieve online concurrence in design, marketing, and business-process management. Such websites facilitate collaborations, strategic alliances and provide one-stop business services. In essence, websites have evolved from a two-way interactive environment to an any-to-any integrative platform of business management and commerce.

Interoperability – the ability for multiple parties to mutually use and share information – is supported by data interfacing, which addresses three principal needs. First, identification needed for information extraction must be established. By providing an identification syntax, XML – a new information representation scheme introduced in this era – achieves such extraction. With XML, information exchanged can now be usable for immediate processing in legacy systems, or by software from different vendors within a website. Second, standardized identification is needed to support communication between any participants, allowing management of business processes across different websites, intranets, and extranets. Information representation using one-for-all DTD (Data Type Definition)[14] with XML provides this core data-interfacing functionality (Riggins and Rhee, 1998). Third, cross-website access of databases is necessary for online management of business processes, requiring that knowledge be obtained from different information bases on demand. Such online cross-website information retrieval can be enabled by using JDBC with Java – a vendor-independent interface to databases.

An operating environment is also needed for online integration. The provision of such an online mechanism – typically a platform – is referred to as platforming. The platform is where e-Business processes are tracked, linked, edited, and displayed. Each e-Business process is designed dynamically, with information interoperability as well as interactivity from participants and the host website. Another major evolution during this era is the need for online decision support systems (DSS) (Aiken, 1995; Bhargava et al., 1999; Gregg and Goul, 1999; Carlsson and Turban 2002; Shim et al., 2002). As the decision-making for the management of e-Business processes is complex, the need to develop online decision support systems is imminent. The core functions for an integrative website must be able to analyze complex processes with differing objectives and constraints. During the process design, it is important that the website can provide relevant decision support to identify consolidation and integration of component tasks across business processes, as well as the capability to perform optimization of business processes (Leung et al., 2000).

[14] www.w3.org/XML/Schema

Integrative websites are well-suited to handle vertical integrative management of e-Business processes, managing such processes within a company, within an enterprise, as well as across different companies and enterprises of an industry. These features are particularly useful for cross-company processes such as e-Collaboration, e-Supply-chain-management, e-Customer-relationship-management, e-Procurement, and e-Logistics. Websites that integrate cross-company processes are essentially third-party agents. Fourth-party websites, which manage e-Commerce activities and business processes of third-party service providers, have also emerged. The integrative websites may continue to evolve to provide integrative management for horizontal companies. It has been suggested that a website could function as a "e-Hub" that hosts many marketplaces and uses various market mechanisms to mediate any-to-any transactions among businesses (Kaplan and Sawhney, 2000). The principal features of this era are summarized in Table 2-5.

Table 2-5. Integrative Web Era

– integrated, any-to-any –				
e-Commerce Activities and e-Business Processes: e-Collaboration, e-SCM, e-Procurement, e-CRM, e-Reengineering				
Host	Scope-Structure		Environment	
	Vertical, Cooperative, Collaborative, Fourth-party		**Platform, Enterprise, Community, Industry, Hub**	
Core Functions	Transaction Management Functions: Data Interfacing, Platforming, Process-editing, Consolidating, Integrating, Optimizing, etc.			
Core Technology	Communication	Presentation & Representation	Language	Storage & Retrieval
	WAP, PKI, SMS, SOAP	XHTML, XML	ASP, JSP, C#, EJB	JDBC, SQL, XML Query

It is quite clear that motivation to integrate complex process online has also meant the need to integrate the four areas of core technology. Prior to 1990, the four areas develop largely independently. Since then, language and storage have worked together (e.g. Java with JDBC); communication, information representation and language are featured together in SOAP (Simple Object Access Protocol)[15], and business logics in ebXML[16]. The merging of the four areas is likely to continue.

[15] www.w3.org/TR/SOAP
[16] www.ebxml.org

5. CONCLUDING REMARKS

We have charted the evolution of e-Commerce websites. We propose that there have been four eras. We examine collectively the historical development of the principal elements – host, core functions, and core technology. Observations and insights on their interplay are provided.

The four areas of core technology, as we define them, are likely to be fused together in different fashion in the near future. One major trend based on the definition of XML has garnered developments in all four areas of core technology. Languages, typically with add-on components, or API's, are XML-aware and XML-capable. For example, SAX (Simple APIs for XML) is still a leading source for quick manipulation of XML information across network. XML-based data storage hides the conversion from raw data in XML format into database format.

Integrability – the ability for multiple collaborating parties to integrate their e-Business processes together – is supported by *interoperability* and *collaboration.* Interoperability is the technology-based approach to provide the ability for parties to mutually use and share information. Level of integration is used to delineate what information and how it can be used, and the degrees of collaboration.

Integrative can be taken in two different directions, both are necessary in order for the role of Semantics Web in air cargo logistics. As the Web weaves its way to every corner of business processes, the exchange of information must be supplemented with embedded or inherent semantics such that the Web is truly on its own. No more push or pull but of reactive to changes on the information Web, not to a direct stimulus – a request. The move towards a service-oriented Web has begun. Services such as bidding and auction will be provided by smart agents that 'live' in the Web.

Transactional activities remain in force as the applicability of core technology is extended into the core business of individual corporations and into the inter-organizational aspects of partnerships. Collaborations are now occurring online, initially as managed activity such as new bidding mechanisms that are managed across different auction websites (Anthony and Jennings, 2003) and will become ad hoc and dynamic.

The ease of strategic alliances would mean that there would likely be a period of consolidation. It has also been suggested that exchange websites will consolidate into a relatively small set of mega-exchanges, and that a handful of independent but reputable solution providers will grow alongside such mega-exchanges (Wigand, 1997). Trust, especially between businesses, will remain a prevailing issue to be addressed in the new digital economy.

On the other hand, online decision support system is still at its infancy. Decision support for a singular outfit can be met by existing standalone, group or Web-based DSS. As the management of e-Business is to be conducted as it happens, then a platform infrastructure must be developed to support decision making and facilitate the decision process.

We believe that online DSS is likely to play a significant role in the next phase of e-Evolution. Particularly, DSS is a key to the provision of online knowledge management and sharing, a critical e-Business process of the future. As companies leverage the knowledge-rich Web to conduct effective e-Business processes, websites with knowledge management capability will proliferate. In the logistics industry, companies will need to re-engineer their internal and external processes to tap into this powerful resource. The industry itself has been going through a number of changes and in the last chapter, an exploratory discussion of this and other business intelligence issues will be provided.

Chapter 3

FRAMEWORKS FOR A 4TH PARTY AIR CARGO LOGISTICS E-BUSINESS PLATFORM*

1. INTRODUCTION

The Web eras bring challenges and opportunities to the air cargo logistics industry. The Interactive- and Reactive-Web eras nurture a virtual environment with trading capability for logistics services. The emerging Integrative-Web era suggests a platform environment for logistics e-Business to be conducted and managed. Despite the need of such an electronic platform environment is well acknowledged, a viable framework of such entity is still missing, especially one for the air cargo logistics industry.

A 4th party air cargo e-Business platform enables the functioning of both a market entity and a management entity. The e-Platform serves a multitude of communities individually, and as one networked community of communities collectively, including communities from other industry sectors. Thus, the e-Business platform is sometimes referred to as a community platform.

Single community networks are not new, and the concept is actually one of the earliest developments that manifests itself in the integrative era. Network of participants for a community are now commonly found in the World Wide Web. These networks provide services to a group of related users, or users that share a common interest (e.g., the book club in amazon.com) or a common goal (e.g., purchase club as the multi-product club www.columbiahouse.com).

The concept of multiple communities, thus multiple agents that interact online at the same time is new. Each party, as a member of a specific logistics community, aggregates online and competes for logistics services via e-Commerce. The platform environment is aptly enabled for such multi-party logistics chains to be formed, validated and managed. Logistics services owned by an agent over different chains can be optimized and managed online. This community platform enables interoperability of information exchange among communities, integration of business processes of different communities, and the management of activities across divisions, companies and industries.

For the air cargo logistics industry, the e-Platform will pioneer how 3rd party agents (and even 1st and 2nd parties) can engage in all facets of process design online. Agents can also seek and negotiate with new customers, other agents, or new partners, track and trace shipments, respond quickly to emergency situations (such as disruption in routes, or impeding inclement weather conditions) and can better manage logistics fulfillment processes. With this e-Platform agents can react to the marketplace at the firm-level, or can respond to changes in part of a supply chain it serves/manages strategically and effectively. The 4th party e-Platform provides a level playing field to all air cargo logistics communities, especially for those SME's that lack the skill sets and resources.

In this chapter, a conceptual framework of a 4th party air cargo logistics e-Business platform (e-Platform) is proposed, along with a discussion of specific current and emerging technologies that will enable the key framework components. These components provide services to plug-and-play clients, managing and trading functions, and business intelligence online. A 3-tier architectural framework paves for the discussion of the technical and implementation issues in the next chapter.

First, an example is provided to illustrate the complexity and variability of the air cargo logistics industry. This example offers a good basis for later discussion of the conceptual framework.

2. AN EXAMPLE OF MODERN AIR CARGO LOGISTICS

In here, we illustrate how logistics processes are manifested in such community platform. The number of different agents involved in a shipment chain is highlighted.

Let us take Hong Kong as an example. Hong Kong is a major transportation center for air cargo with a tonnage ranked second in the world in 2002[17]. It is a gateway for Southern China, especially the Pearl River Delta (PRD) region. The PRD region is the manufacturing hub with much of the goods for air shipment originated. Most of the commodities reach Hong Kong by road, support by the trucking community here in Hong Kong. Air cargo shipped through Hong Kong consists mostly of live seafood and high-tech products, which have high time-value and demand express service.

Air cargo traffic passes through the one Hong Kong International Airport (HKIA). This airport, opened in 1998, has an annual cargo capacity of 9 million tons, with over 60 airlines serving more than 160 cities. There are two terminal operators at the airport, Asia Airfreight Terminal (AAT) company and Hong Kong Air Cargo Terminals Limited (Hactl). The latter handles about 80% of the throughput and provides a number of electronic information exchange services (e.g., COSAC and HEx) that enhance the efficiency of air cargo handling with IT[18].

The shipping process would typically go through the following sequence of activities (see also Figure 3-1).

1. Seller (Shipper) and Buyer (Consignee) establish contract.
2. Seller (or Buyer) posts jobs on marketspace of community platform.
3. Forwarders (or Virtual Integrators) form partnerships and submit quotations.
4. Shipper (or Buyer) selects bid and booking is confirmed.
5. Forwarder picks-up cargo from shipper; cargo tracking begins via the platform.
6. Forwarder conducts necessary logistics at warehouse/logistics center; Forwarder sends shipment to Terminal Operator.
7. Customs Department processes shipment based on information submitted via community platform.

[17] www.airports.org
[18] www.hactl.com.hk

8. Terminal Operator delivers cargo to Carrier, which in turn delivers cargo to designated airport; inbound processes proceed.
9. Buyer receives shipment and completes remaining settlement activities.

Activities 1-2 are information activities that are processed in the marketspace. Activities 3-4 are negotiation activities requiring virtual integration, while activities 5-9 are in-transit and settlement activities. These activities are manifested online in the community platform. We will identify some key components that provide such support for logistics realization.

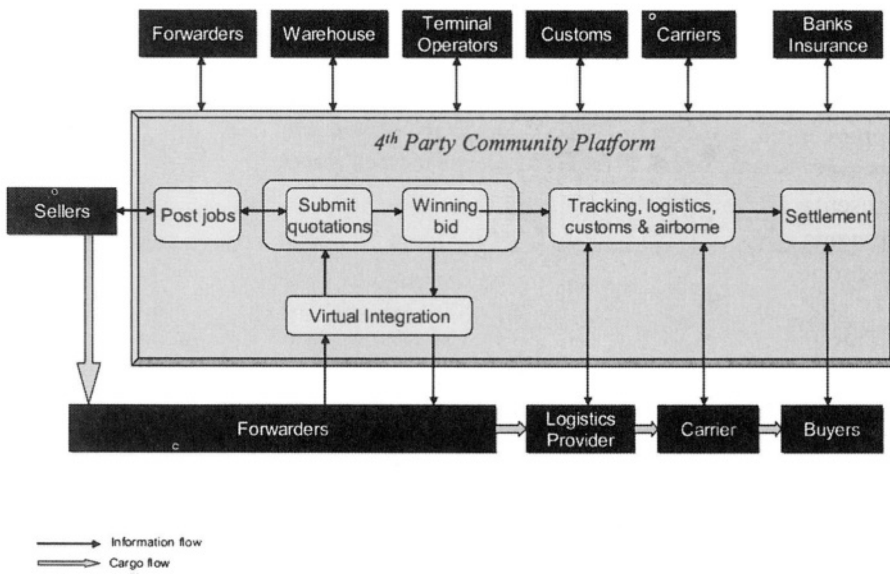


Figure 3-1. **The Logistics e-Commerce Process**

A virtual marketspace platform provides collaborative mechanism for shippers/buyers and industry agents to locate each other and negotiate terms of service. In this marketspace, a forwarder may get a job from a shipper in Southern China through match making. The forwarder then conducts an on-line virtual integration. For example, necessary cargo space may be obtained from an airliner, e.g., Cathay Pacific through e-Auction. The forwarder divides the job and forms alliances to complete the whole job by using the collaboration function in the marketspace. Facility providers such as warehouse operators, terminal operators and airlines may also trade their cargo space and services on the marketspace. As a result, big forwarders can align with small local handlers in Hong Kong or Southern China for special delivery and handling, or small local niche forwarders can provide global coverage by aligning with international forwarders.

After transaction formation activities are done, the management of related business processes online will continue. During settlement, bank credits, payments and airway bills are processed on the community platform, communicated through web-based EDI or XML-based messages. Cargo status is sent from handling agents to the platform, providing track-and-trace functionality to shippers and participants in the logistics chain. Information on fulfilment is fed back to the community platform, designed to handle the variety of information standards in the logistics and other related industries.

If logistics is considered along with a supply chain, the following scenario would exist. Modern air cargo logistics offers more services to shippers and retailers. Figure 3-2 shows transhipment and repackaging activities found in a logistics chain as an object model. The model represents a personal computer shipment that involves the kitting of sub-shipments (i.e. monitor, keyboard, and mouse) from various Asian countries and a series of logistical handling transactions (T's).

This punch out activity of the manufacturer is now transformed into a logistics service request. The logistics service provider must be able to react to such a request and provide necessary information to the manufacturer to allow adjustment to the supply chain management tasks. The community platform provides a ready link to overseas air cargo e-Business systems, thus enhancing the global competitiveness of the Hong Kong air cargo industry.

In this scenario, there will be a need for a third-party logistics center such as a bonded warehouse or company owned warehouse. This facility is most needed by small forwarders who have limited logistics facilities. In Hong Kong, a large number of forwarders fit this description and can lease space at the logistic center. All logistic activities conducted in the center are supported by the information available at the platform. This drives the vertical integration of 3PL service providers to own warehouses across their service regions to provide on demand assembly of products with parts originated from different parts of the world.

The formation of such a 'virtual enterprise' or VE to handle the specific 'logistics chain' constitutes what we call a 'virtual logistics service'. The VE could be one-time or could be long-term; the logistics chain can be a common practice which is then based on a template stored on the community platform; or the logistics is a special one-time deal. The need for an infrastructure is indispensable and pressing. The benefits of such an infrastructure and what it can offer will be discussed next.

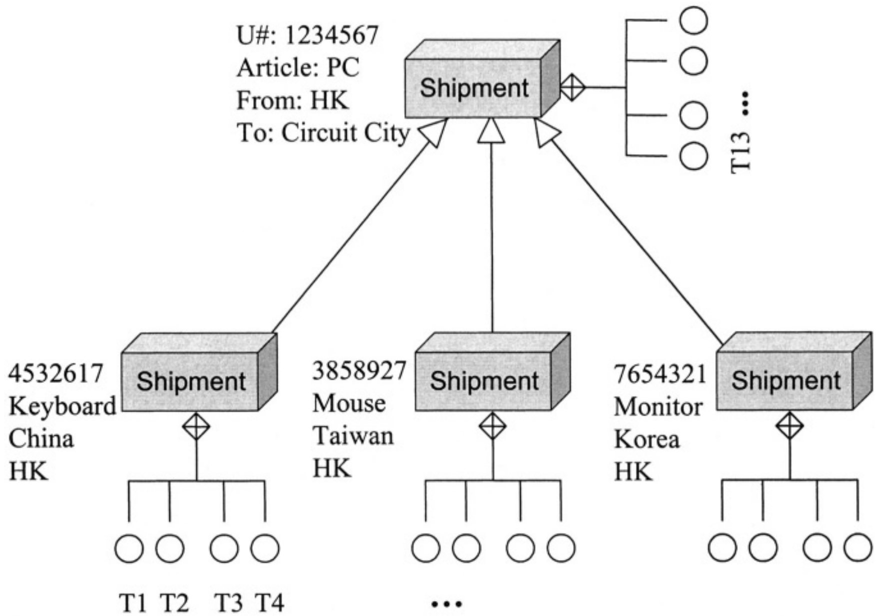


Figure 3-2. Coordinating Transactions Using an Intelligent Agent

3. AN E-BUSINESS INFORMATION INFRASTRUCTURE

Some key issues can be identified from the above discussion: a marketspace where collaboration is carried out online, and the management of logistics processes and its fulfillment cycle is available in one single integrated operating environment. An e-Business information infrastructure is proposed here to facilitate these and other e-Platform activities. The benefits of such an infrastructure are discussed next.

Typical e-Commerce addresses the relationship between individual enterprises, their respective customers, clients, or business partners. Typical SCM addresses the pipeline management for a single company. They address respectively the demand and supply dimensions of an individual enterprise. In the integrative era, the new challenges call for linked relationships across enterprises, and with customers. The creation of a platform for communities would contribute huge benefits to both the demand and supply dimensions of the entire industry.

The proposed infrastructure differs from existing portals (e.g., Yahoo Online Mall and Commerce One) in that they inherently lack the integrative needs of a community platform. The proposed infrastructure has the following important features: marketspace, virtual integration, customization at low cost, quality shipping at low cost, strategic alliances, e-Business capability, and decision support. This extends the traditional business-to-business or business-to-customer to the next level – the online integration of businesses. To focus our discussion, the ensuing issues and concepts will be placed within the context of an air cargo industry.

3.1 Marketspace for Trading

The air cargo industry needs an information infrastructure for all its agents to engage their e-Business and e-Commerce activities. It is a marketspace for collaborative aviation logistics and other supporting activities. The practice of having an electronic market for an industry is of course not new. A stock market is a case in point, whereby agents and clients of the financial industry can engage in commerce via an electronic marketspace. However, the air cargo industry does have its own unique set of issues to address. Due to such features as the industry's information intensiveness, its global orientation and strategic partnerships, and the need to coordinate the physical movement and consolidation of shipments, the industry can benefit as a whole and individually from such a community platform. The marketspace will provide a platform for marketing and market activities, and will facilitate innovations in aviation logistics for both the industry's products and processes.

3.2 Virtual Integration

Integrators such as DHL and UPS have set new standards in aviation logistics and lead in the use of IT in logistics matters. With the proposed marketspace, small companies can have the whole industry behind them and small forwarders can use available information and electronic market functions to form virtual alliances. It is a marketspace where virtual integrators can be formed for individual jobs. It is a third-party total-information service provider for the air cargo community. Small companies can derive the efficiency of integration without the need of major capital expenditure in infrastructure, and can concentrate on their core business without worrying about the problems of integration. This integrated e-Commerce infrastructure could be connected with the government and other related systems, to form a seamless connection supporting the client company's own e-Commerce. Companies and agents of the industry can conduct their customized e-Commerce using this third-party infrastructure.

3.3 Customization at Low Cost

The community platform can be perceived conceptually as a level higher than the typical marketspace/portals of business-to-business e-Commerce. The network allows individual air cargo businesses to design their own customized e-Commerce at a low cost. With such a community network, many smaller companies and innovative entrepreneurs can enter the air cargo industry. According to Hsu and Pant (1999), such e-Commerce at the industry level is a form of:

> "*Mass customization - customizing for the client companies at a cost of mass production, similar to the general portal sites providing free personal home pages... It emphasizes extended enterprises and directs the focus of e-Commerce unambiguously to the core production processes of the user enterprises.*"

The capability to configure a virtual integrator for each job is analogous to the presence of multi-dimensional process teams in the industry. Tasks are performed naturally with minimal reconciliations throughout the entire process. The community network allows the customization flexibility of a job shop, with the smoothness of a flow shop. There is only one external contact point. This is business process reengineering at the industry level.

3.4 Quality Logistics at a Low Cost

With the community platform, companies and agents of the industry can now manage their logistics processes at low cost. The industry will benefit from better coordination of the shipments, thus reducing waiting time and inventory cost. It is SCM at the industry level. Not only will the productivity of the industry be increased; the level of quality and flexibility will be substantially raised as well, due to improved coordination and handling. This means that the industry can serve customers at a lower cost, but at a better performance level. It will make air cargo an attractive mode of shipping, and will also create new customers who would otherwise not purchase because of poor performance.

3.5 Strategic Alliances

The marketspace permits strategic alliances to be formed easily. Not only will small companies and small forwarders benefit from such virtual alliances; integrators can also benefit from outsourcing many of the heavy physical logistics to specialized handlers of bulky shipments. They can develop their networks by concentrating on certain service areas, and subcontracting logistics services in other areas to smaller forwarders. Further, integrators can develop air routes for certain strategic hubs and make use of commercial carriers for other areas. Airlines can easily enter the logistics business by forming alliances with forwarders. Distributors may also outsource physical warehousing and movement to logistics specialists. Logistics providers can form alliances with multi-national companies to develop strategies in sourcing, merchandising, and inventory planning.

3.6 Third-party e-Logistics Center

With the community platform, there is also a need for a physical community logistics center to support the physical aspects of logistics management. This community logistics center should be designed such that all center activities are driven by the community platform. The logistics center may manage the community platform. There will be many design issues regarding such a community logistics center. In essence, the air cargo industry would be supported by an information infrastructure in the form of a fourth-party community platform, and by a physical infrastructure in the form of a third-party logistics center. Ideally, both systems would be operated by the same management body and client companies or agents of the industry can simply plug in and engage in logistic e-Business activities.

3.7 e-Business Capability

The platform provides continual support to link up transactional information of a logistics chain to the internal business processes of individual parties. It also allows at a higher level the management of logistics for business chains. E-Business processes are enabled and individually managed, but linked for logistics processes of a business chain. Intranets promote the work flow management of a corporation. The virtual community intranet enabled by the e-Platform, on the other hand, promotes the logistics flow management of air cargo within an industry.

3.8 Decision Support

The dynamic global environment offered by the community platform often creates a void for decision support that cut across all parties. The goal of one party does not lead to the goals for all agents in a shipment. Decision support takes on a multiplicitive dimension that decision support systems (DSS) of singular nature no longer can provide appropriate business intelligence for executive decisions. Decisions are spontaneous and driven by market dynamics, and most importantly, made as it is required.

4. A CONCEPTUAL FRAMEWORK FOR A 4TH PARTY E-BUSINESS PLATFORM

In here, the conceptual framework of a 4th party air cargo logistics e-Business platform is detailed. The air cargo logistics industry is a community-centric industry. The e-Platform serves a community of communities in a 4th party capacity. The e-Platform is not just for a firm or for a participant. Nor it is for one community in particular. It is for the industry. The platform is for all agents among all communities to collaborate.

Existing e-Communities are created for various reasons such as economic, social and managerial needs (Stanoevska-Slabeva, 2002). Technologies used in the communities are that of agent-based (Case et al., 2001), peer-to-peer networking (Parameswaran, 2001), and more generic tools such as chat rooms, BBS, and newsgroups (Stanoevska-Slabeva, 2002).

These existing portals provide many-to-one-to-many platforms for business-to-business and business-to-customer e-Commerce. Their main functions are to complete business transactions by supporting activities such as browsing, price quoting, payment, and transaction recording. These transactions are unrelated. In our proposed community network, business transactions are interrelated and may need to be settled in a particular sequence. At the system level, virtual integration in the marketspace can be interpreted as creating interrelated business transactions online.

From the perspective of the shipper and the buyer of a shipment, the community platform does facilitate high degree of availability, flexibility and manageability in the handling of their logistics needs. From the perspective of the air cargo logistics industry, it is the time and opportunity to leverage information technology to promote the industry to a higher level of e-Readiness and efficiency, and enable e-Logistics in the global economy.

Next, we present the framework and key components of the community platform. A schematic framework for the logistics community platform is shown in Figure 3-3. This industry-wide information network connects all major agents in the logistics community, as well as supporting government agents and peripheral parties such as banks and insurance companies.

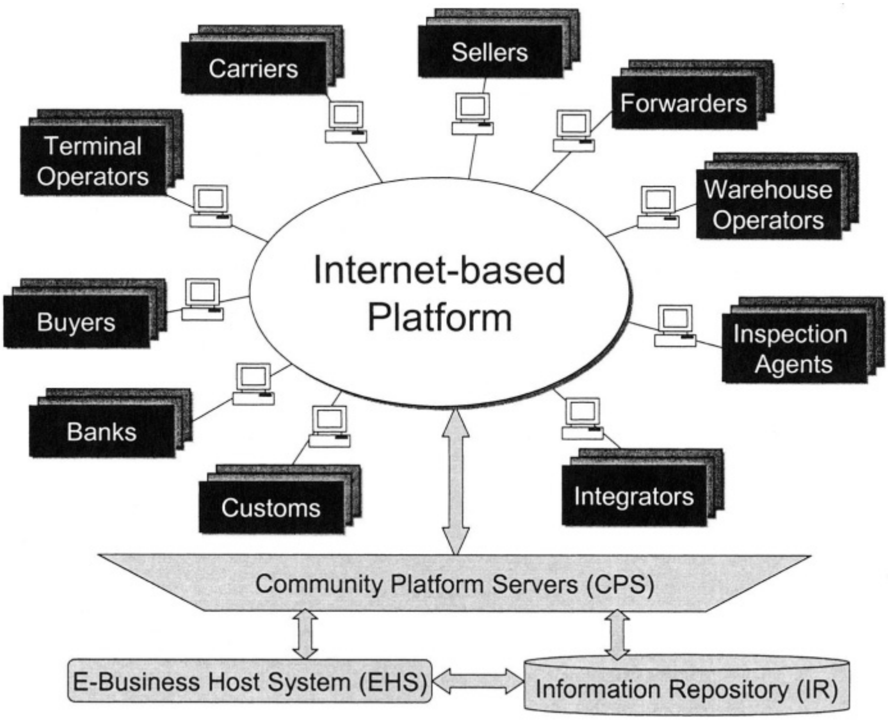


Figure 3-3. **A Schematic Framework of Logistics Community Platform**

The platform is Internet based with openness and easy access. Agents and parties can subscribe to the network as members with authentication, such as digital certificates. A Plug-in Client software is downloadable to access the community platform. Carriers and terminal operators alike may connect to the community platform individually or through their corporate network service provider such as Societe Internationale de Telecommunications Aeronautiques (SITA).

Other major components of this third-party information infrastructure include a Community Platform Server (CPS) acted as the front-end processor, an e-Business Host Systems (EHS) as the back-end engine for conducting and managing e-Business, and an Information Repository (IR) that holds transactional data, filtered information, and platform knowledge with intelligent deductive and supportive tools.

4.1 Functions of e-Business Platform

The major functions of the community platform are to provide a common interface to facilitate all participants to request logistics services, an e-Business engine to handle transactions safely and securely, providing a concurrent management environment for industry level virtual integration. These functions mainly provide the marketing and management environments for the participants. The discussion of these functions is viewed from a technology standpoint, illustrating how far along we are at in technological development to allow such a community platform to exist in cyber space.

4.1.1 Community-aware Services

The CPS is connected to EHS through a private secured network. As a front-end processor for the EHS, CPS is responsible for service dispatching, authentication, and message routing. All messages are automatically routed to the CPS, which are then dispatched based on their type and nature. Automatic acknowledgment, message protocol conversion, and encryption and decryption are some of the routine tasks performed by the CPS. To prevent a potential communication bottleneck, multiple CPSs can be implemented to provide load sharing and high resilience. The component architecture of a CPS is shown in Figure 3-4.

Service Dispatching. All services are network accessible objects, e.g., specified in CORBA/IDL and stored as Java objects. The dual interfaces, web interface and service interface will respond to HTTP requests from a web client, as well as object requests from a Plug-in Client respectively. For example, while browsing the community platform web pages, a member requests a service, the service interface will in turn send the corresponding service object as a bytecode Java applet. The applet will run on a Java virtual machine included in the web browser at the client workstation. Routine service requests can be initiated by the messaging object resident in the Plug-in client without going through web browsing. Keeping all the service objects at the CPS facilitates the maintenance of these objects. Modifications of objects become transparent to the Plug-in Client. This also simplifies the Plug-in Client design.

Authentication. Each sensitive message is authenticated by the security module at the CPS for proper membership status. Members' public keys, certificates, and general information are stored in a secured database for the authentication process. An incoming message is decrypted using the private key of the community platform and the enclosed digital certificate will be validated. On the other hand, an outgoing message is encrypted with the receiving member's public key. As authentication is a very time consuming process, multiple CPSs will significantly reduce the computation workload of the EHS.

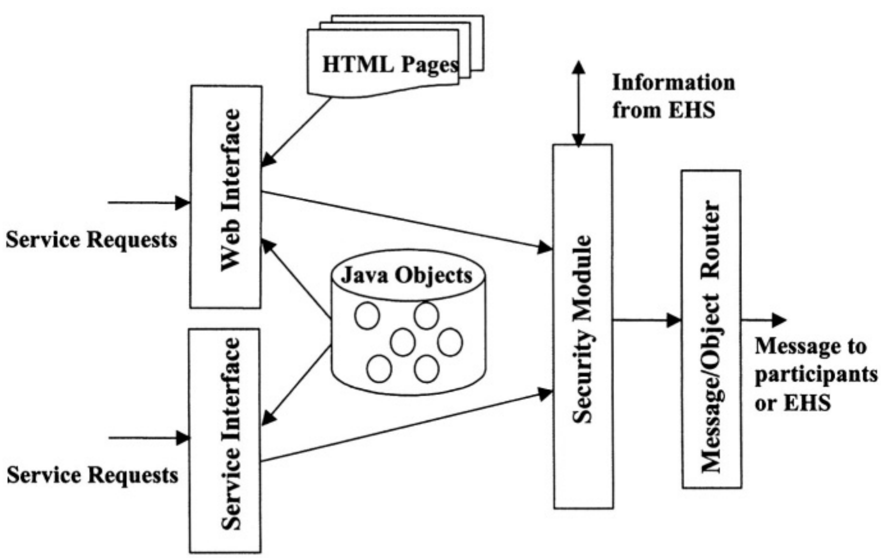


Figure 3-4. Component Architecture of a Community Platform Server

Message Routing. CPS is also a traffic controller that schedules and directs messages to the EHS and corresponding members. The message router can disseminate information for the EHS according to a mailing list. More importantly, it can also establish communication channels for members without revealing their identities, which is often required at the early stage of a business communication.

4.1.2 e-Business – Marketspace and Management Core

The E-Business Host System (EHS) which consists of an Information Manager (IM), an IR, and a Virtual Marketspace (VM), is an object-based information system at the heart of the framework. It is here that virtual integration is performed. A conceptual framework of the EHS is shown in Figure 3-5.

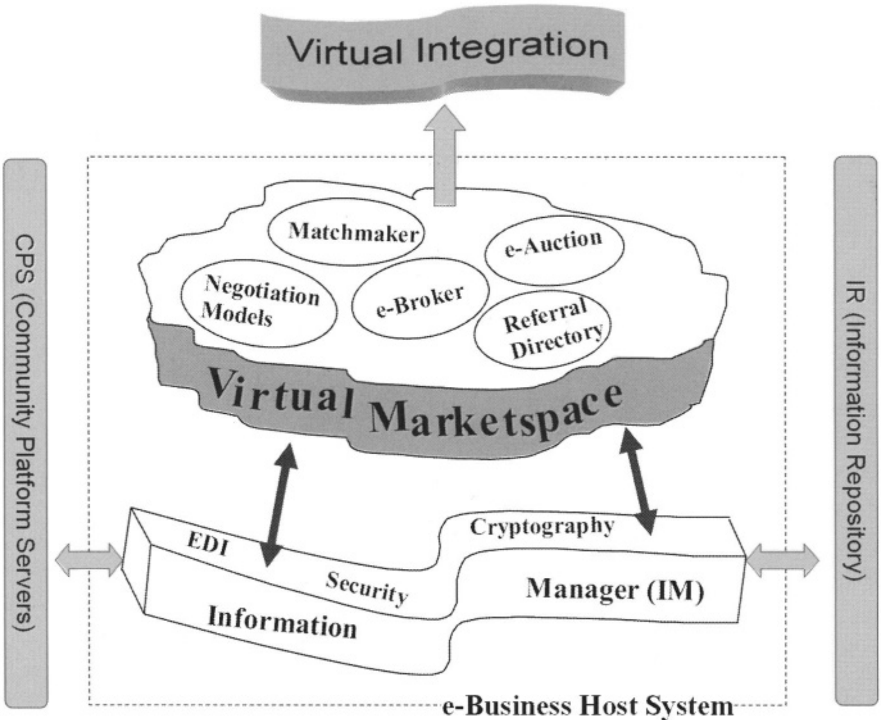


Figure 3-5. Conceptual Framework of the e-Business Host System

4.1.2.1 Virtual Market with Multiparty Collaboration

The EHS certifies all transactions completed within the community platform. To facilitate certification, transactions in progress, payment records, and transactions completed are all stored in the IR for future reference. The IM manages (queries and updates, etc.) the IR and jointly they serve the activities at CPS and VM. As a back-end engine for e-Business, the EHS supports all three phases of market interactions: information, negotiation, and settlement – supported by the core functions of the transactional hierarchy in Chapter 2.

Information Phase. At the information phase, transactions incubation core functions are at work. The IM facilitates sellers in searching for buyers and vice versa. For instance, the IM regularly updates flight schedules and connections information in the repository obtained from airlines for later inquiries by members. The IM responds to the inquiry by querying the IR and sends the query result as a message. Besides managing the IR, the IM also disseminates information (e.g. a new request for a quotation) to relevant members who are identified by matching their profiles stored in the IR with the requirement of the request.

Formation Phase. The formation phase includes necessary negotiations to arrive at a contract – formation. It is supported mainly by the a marketspace with a collection of marketware tailored for multiparty negotiation and collaboration for a contract. Marketware such as Matchmaker, e-Collaborator, e-Broker, e-Auction, Referral and Directory are incorporated as easy accessible tools supporting common and current value-added market services. By invoking marketware applications, participants are brought together to negotiate on price, contract terms, and payment schedules, etc.

More importantly, the Virtual Market facilitates virtual integration by allowing agents to form alliances using the market functions, effectively turning small forwarders or logistics operators into virtual integrators. Detailed discussion of this important feature is presented in a later subsection.

Settlement Phase. Electronic payment and shipment tracking are the essential functions supported by the EHS. The IM can handle any payment settlement including direct electronic funds transfer with pre-set accounts, credit card payment via payment gateways offered by bona fide financial institutions, or electronic cash. Shipment tracking will rely on a unified, internationally recognized numbering system such as the Serial Shipping Container Code (SSCC), with a secure barcode symbology[19]. In this case, a shipment is identified by an UCC/EAN-128 barcode. Status scanning on these barcodes is sent to the EHS for status updates on the IR.

[19] www.ean-int.org

4.1.2.2 Online Virtual Integration – Online Management

Facilitating online virtual integration at the industry level is what distinguishes the proposed community platform from current multi-faceted service portals. A key player in the virtual integration process is the industry agent, who performs the task of integrating other agents in the industry for the respective phases of aviation logistics into a logistics chain. All integrating tasks can be done on-line using the EHS. This agent functions as a broker in the marketspace. We call this player a virtual integrator. In the air cargo industry, using the community platform a licensed freight forwarder can be a virtual integrator.

Figure 3-6 depicts a freight forwarder (virtual integrator) who obtains a logistics request and subsequently forms customized service alliances through the marketware in the marketspace. A virtual integrator collects, collates, disseminates, and interprets vast amounts of information made available by the IM and IR. The virtual integrator divides the job and solicits, on-line, appropriate agents for respective activities of the job using e-Broker or other marketware. This example illustrates how the freight forwarder can link other industry agents together, to form a virtual alliance for the job posted. In the integration process, the freight forwarder would also have access to vital information such as consolidation and in-process time. The integration is engineered by the virtual integrator and made possible via the marketspace. The alliance provides a highly customized service as well as cost effectiveness.

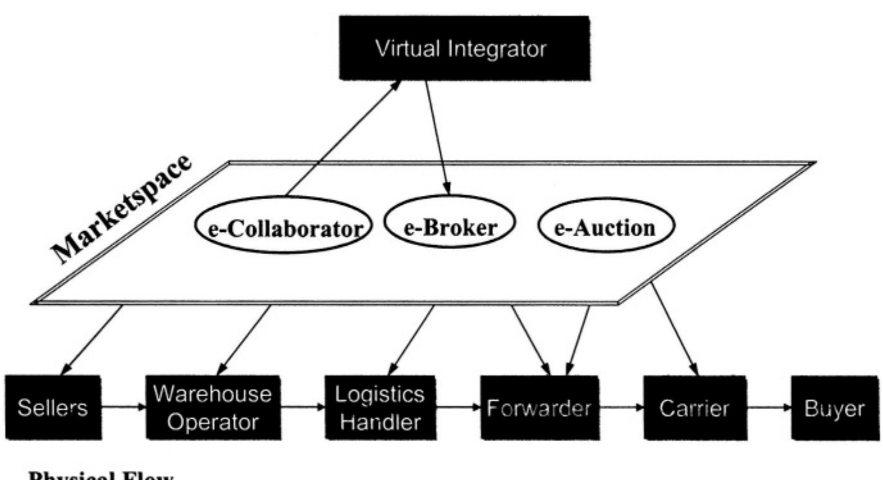


Figure 3-6. An Example of Virtual Integration

The community platform shares many similar design issues with any websites that provide services to participants with financial implications. Issues such as connectivity, interoperability, and security are of industry level among multiple parties, instead of firm level among participants of one party. The design will be significantly different in most aspects, and will be highlighted in the technical design chapter. There is no doubt that some proven technologies will be used and Web technology in specific will be selected. Even though Web technology is still going through a period of changes and improvements, some has already established its place with mass adaptation. For example, for connectivity, we adopt all standard Internet networking protocols such as TCP/IP and HTTP. Interoperability is achieved by text-based messages using MOM (Message-oriented Middleware) and platform-independent solutions such as Java objects. At the application level, HTML with embedded XML (Extensible Markup Language), and Web-based EDI are used for electronic document interchange. Similarly, a PKI that supports digital certificates from different country CA's and public key encryption are used to provide authentication and confidentiality.

5. AN ARCHITECTURAL FRAMEWORK OF THE E-BUSINESS PLATFORM

We will discuss in here the architectural framework for the design of the e-Platform. The framework enables seamless *information exchange* as logistics processes are *collaborated,* and later as the logistics chains are *managed* among agents. The architectural framework of e-Platform has three unique platforms that work together - the Information Exchange Platform, the Collaboration Platform, and the Management Platform (see Figure 3-7). Individually, each platform provides distinct activities. Each tier can operate independent of the others, and as a whole as an e-Business platform. Though the e-Platform is designed to handle the complexity of air cargo logistics, it is suitable also to those industries where managed collaborative efforts of multiple parties prevail in business processes.

5.1 Technical Framework of e-Platform

An integrative e-Platform bears new dimensions that are not common in browsable websites. These new dimensions are:

- Connectivity – dynamic grouping of users and resources,
- Interactivity – concurrent interaction with individualized views,
- Interoperability – interoperable at data and application levels,
- Integrability – integrating users and activities online, and,
- Security – single authentication point, and mobile credibility.

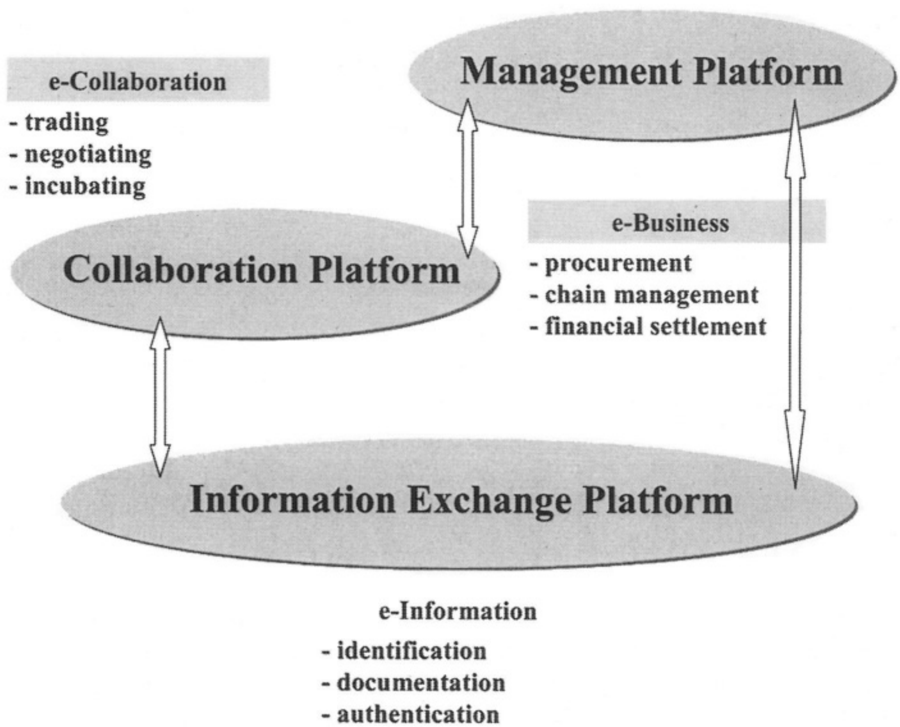


Figure 3-7. A 3-tier e-Platform Architectural Framework

These new dimensions allow new management functions such as platforming, conferencing, data interfacing, and process-editing (e.g., integrating and consolidating) discussed in the preceding chapter to be performed without bias.

5.1.1 The Management Platform

The e-Platform is a community infrastructure where air cargo logistics services can be designed, traded, and managed. The management platform provides online management capabilities of logistics business processes.

The online process design is enabled by the e-Business decision support tools, which is capable of editing, integrating, and consolidating the respective shipments that are being negotiated.

One challenge in this platform is the ability to recognize and handle business activities online, such as purchasing, invoicing, and certifying. Most of these business activities have been well defined in different industries, and well vested in the core business processes of firms. We must borrow experiences gained in workflow management development, business process specification efforts such as BPML[20], OAG[21] and ebXML to devise an appropriate management e-Infrastructure for air cargo logistics in this platform.

5.1.2 The Collaboration Platform

This real-time platform allows collaboration among agents, e.g., trading, negotiating, and conferencing, and supporting e-Business process. The integrative e-Platform links up activities that are previously isolated or are managed off-line. This linking allows collaborative trading of a logistics job, resulting in a more efficient cooperation by multiple agents to partake in the handling of logistics processes in a business chain.

Rounds of negotiation, bargaining, and/or coordination usually precedes a contractual agreement. This collaborative behavior often accomplishes via telephone contacts, faxes and emails at best. To carry this collaboration online as required involves the development of a new any-to-any communication model in the electronic environment based on Web technology.

5.1.3 The Information Exchange Platform

This exchange platform enables information exchange between any users of the platform, thus allowing logistics providers to communicate among different modal agents and electronic agents such as Tradelink for customs clearance and Traxon for airline flight information. This e-Information platform unifies differing standards and protocols seamlessly, allowing information to be recognized, processed and stored.

[20] www.bpml.org
[21] www.openapplications.org

The difficulties in exchanging business information seamlessly arise from the differing legacy information system, or the lack of it, and the different information contents that drive each community operations. Efforts have been ongoing to bring congruency to information format and representations. EDI used in the pre-Web era started a global effort to come to a formatting agreement along with a communication infrastructure. The representation is sufficient to carry specific information yet too rigid to allow changes and new updates. Other efforts have been proposed by the United Nations and some non-profit standards organizations. These efforts are successful in guiding standards development in certain sectors of the industry. We will provide a more detailed discussion in the next sections.

5.2 e-Platform Challenges

The technical design and implementation of this e-Platform is one major challenge that will be handled in Chapter 5. There are also two pressing issues that will affect how well the e-Platform will be accepted and used by the industry from a technological viewpoint. We will briefly evaluate the current technology landscape, with a focus on how to facilitate industry agents to get online to the e-Platform, and conduct trading of logistics processes in a trusted non-intrusive fashion. Another pressing issue is the standards and protocols currently in use in the logistics industry. Vested practice with technology such as EDI in the Pre-Web era cannot be neglected as the industry moves into the integrative Web era. The magnitude of the problem will be discussed and how it should be handled will be suggested.

5.2.1 Technology Landscape

The pre-Web era technology and the integrative-Web era technology is at a cross-road. The conceptual framework brings out important technological issues with respect to the current and emerging Internet and Web technology landscape. We believe the continual research and development in IT and the maturity of some defining technologies will no doubt help build the e-Platform. The e-Platform must equivocally accomplish these two feats: *free for all* participants and *all for free,* i.e., any industry can "plug" into the e-Platform. The following discussion serves two purposes: 1) begin to comprehend the complexity of the e-Platform and the technical challenges, and 2) begin to appreciate that emerging technology is in favor and in the same direction of the spirit of the e-Platform concept. It is not intended to influence the design and implementation of the community platform.

5.2.1.1 Common Interface – Downloadable Client

One of the dimensions of the e-Platform is interactivity – the ability for participants to interact with partners online in real-time. To appeal to all logistics participants, getting connected to the e-Platform should be simple. A Web browser is used, not because it is versatile, but because it is universally available for free. The Web browser alone will not enable participants to establish interactivity on the e-Platform. A downloadable client software will be needed to enhance the Web browser environment.

Current browser technology supports any conforming plug-in, thus extending its capability. There are two notable components: Java applets and Flash components. The latter has strength in animation, but lack the advanced language constructs for GUI, networking and database programming that Java has. Thus, a software client, i.e. a Java applet, can be downloaded via the Internet into the browser at any time and anywhere. Client software update is transparent to the participants. Specific to Java, the client software can be componentized such that only active components are downloaded. The default security model (i.e. the sandbox) of Java can be resolved with authentication (e.g. signed applet) to allow standardized access to local resources specific to an agent.

This client software can be very versatile - it is a gateway to the virtual logistics world. It provides a secure access channel to EHS via the CPS. Interactivity to other members for electronic data interchange is enabled by a common message channel to all, or secure individual message channel per partner participant. That is, the client is message-driven. The Java client, with appropriate network connectors, can access other external networks, public or private, after mutual authentication. Content-sensitive messages are encrypted using the public key of the e-Platform with the participant's digital certificate enclosed. Incoming messages are decrypted with the member's private key. Authentication is completed at the CPS. External shipment status can be fed into using a scanner reader, or via wireless technologies such as Bluetooth and IrDA, for host system status updates. Message resilience and communication fault tolerance are handled by CPS.

5.2.2 Information Standards

Messages in the e-Platform carry information. Information is encoded in certain way that the sender and the receiver both concur on what is being communicated. To avoid information chaos, some standards are usually adopted and followed by agents of the industry.

Applicable standards and protocols in the logistics industry are those that provide specifications in terms of enabling information exchange. We will continue to see updates and ongoing efforts in bringing standards to operate over the Web. The scope of these standards can be viewed in three abstract layers: coding, message, and communication (See Table 3-1).

Table 3-1. Standards Layers for Information Delivery

Coding Standards
• Native coding standards, e.g., UNICODE • Identification standards, e.g., Global Trade Item Number (GTIN)
Message Standards
• Message structure standards, e.g., XML-based message such as xCBL, and EDI-based such as UN/EDIFACT • Document standards, e.g., bolero.net, CSV
Communication Protocols
• Application layer protocols, e.g., FTP • Transport layer protocols, e.g., TCP • Network layer protocols, e.g., IP • Physical and data link layers protocols, e.g., IEEE 802.11x

An agent of the industry could use a set of coding, message and communication standards to communicate with other agents. For example, a message is composed in CSV format delivered via FTP. The message data of, say, the arrival flight number CX980, is coded in UNICODE. In order for the receiving agent to be able to quickly extract CX980 and schedule for a pickup at the appropriate arrival time of the air freight, the agent must have the right IT infrastructure (e.g., an FTP-capable server for public or private access), and software. As these standards used are managed by different organizations, synchronized and cooperative efforts among these organizations and the industry agents are crucial to eliminate unnecessary service interruptions. As the Information Echange Platform matures, it paves the way for logistics business process integration and management (the Management Platform), preceded by online collaboration among agents in an open marketspace (the Collaboration Platform).

With the many communities, and across different industries, various standards will be used in electronic information exchange in the execution of a logistics chain. Thus, many standards are expected, and successful communication is always accomplished, governed by the dominating partner in the chain. To bring all these standards to operate in the new Web environment will not be an easy task, but doable. One short-term approach is to carry out conversion automatically between messages of two differing standards. The other is for the industries to proactively leverage the standardization process to effect congruent approach, and towards a Web-friendly rework of standards. We will provide basic analysis of standards and standardization next to displace any doubts for the need in information interoperability.

5.2.2.1 Standards and Protocols

Standards serve many purposes, from enforcing a disciplined approach for quality control, to harmonizing a community of different opinions/ requirements. Standards that entail a description of procedural sequences with a formatting specification are called protocols. Protocols provide etiquette for parties to follow, eliminating communication chaos. Standards in here include protocols. On the other hand, over adoption of varying standards in the same sector of an industry lead to market fragmentation and cooperation stigma. Worse, the costs of interoperability proportionally increase with the number of adoptions, and further complicate the effort in bringing harmony to an industry that is moving towards virtual integration.

The ubiquitous adaptation of the Web for information flow cannot be denied. Thus, a new dimension of standards is the Web. Efforts to unify old and design new standards and protocols to achieve interoperability in information exchange in the Web environment are carried out in full speed. One such effort will have undeniable impacts to existing standards is based on the XML specification (e.g., SWIFTStandards XML[22], and EDIINT[23]). Thus, we must examine the standardization process to help the industry to gain a sense of how standards come into being and how they evolve.

5.2.2.2 Standardization Process

Each standard comes into existence through a standardization process. The process examines the initial design of the standard and its subsequent maintenance. During the process, such issues as benefits (e.g., functionality, interoperability, adaptability, etc.), costs (e.g., set-up cost, maintenance cost, etc.) and risks (e.g., level of acceptance, etc.) must be evaluated. Some

[22] www.swift.com
[23] www.ietf.org

standards are long-lived. Some evolved over time with continuous updates and changes to adjust to the change of time and technology advancement.

There are many standardization organizations in the world. Many of these organizations involved in standards that will have some effects, directly and indirectly, of the air cargo logistics industry. Committees, associations and consortiums, or organizations in general, are created to see through the whole process of standardization and its maintenance, management and future extension. Participation of any standardization process can be voluntary or mandatory. The formation of these organizations could be driven by international bodies such as the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT[24]) and the World Wide Web Consortium (W3C). Standards can be proposed by software companies (e.g., Microsoft's SOAP, etc.), computer companies (e.g., IBM's WSFL, etc.), and professional organization (e.g., IEEE's 802 standard suite, etc.).

There are numerous standards committees, non-profit organizations and consortiums that oversee the development and enforcement of standards in different industries (e.g., manufacturing, financial, etc.). We will organize these standards organizations based on two perspectives: 1) standards organizations that mainly develop standards related to Internet and the Web, and 2) those that do not but have direct and indirect influence to the logistics industry.

Key international non-governmental organizations for the development of global standards include ISO, ITU, IATA, EAN.UCC, ASC X12, and UNECE. Table 3-2 provides a short description of these organizations and some standards examples that are relevant to the logistics industry.

[24] www.unece.org/cefact/

Table 3-2. **International Standards Organizations**

ISO (International Organization for Standardization) – www.iso.ch
Profile: a non-governmental organization, established in 1947, with 140 strong member countries to promote standards development to facilitate exchange of goods and services internationally **Example:** The ISO 10646 character set for international character encoding, compatible to Unicode.
ITU (International Telecommunication Union) – www.itu.int
Profile: ITU, formerly Consultative Committee for International Telephone and Telegraphy (CCITT), based in Geneva, Switzerland (since 1865), now known as the International Telecommunication Union, recommends standards and oversees their development related to telecommunications standards. **Example:** audio compression/ decompression standards, V.34 standards for modem speed and compression, X.400 for message handling services, X.500 for accessing distributed directories.
IATA (International Air Transportation Association) – www.iata.org
Profile: IATA was founded in 1945 to provide safe and reliable air services, now covering approximately 280 airlines worldwide. **Example:** The association supports a number of EDI standards for airlines including the key Cargo-IMP[25] message standard. It also provides guidelines in dangerous goods handling, airline coding, and airport handling manual. Services provide to airlines include CardAXS for centralised management of credit card settlement.
EAN.UCC (European Article Numbering.Uniform Code Council) – www.ean-ucc.org
Profile: EAN International and the Uniform Code Council Inc. are voluntary standards organizations charged by their respective Boards with the management of the EAN.UCC System. EAN International has a decentralized structure with a membership of Member Organizations that manage the EAN system in a country or economic region. The UCC manages the numbering system for the U.S. and Canada. **Example:** The UCC administers the Universal Product Code (UPC) and in joint cooperation with EAN International, the UCC functions as a primary resource for business and industry, developing worldwide standards for identification codes, data carriers, and electronic commerce. EAN International was established formally in 1977 with a head office at Brussels. It is a non-profit organization that aims to develop a unique set of labeling and numbering schemes to identify products, shipping units, assets, locations and services. Their contributions include barcoding, EANCOM, and more recently, Global Data Dictionary (GDD).

[25] Cargo Interchange Message Procedures

ASC X12 (The Accredited Standards Committee X12) – www.x12.org
Profile: ASC X12 was chartered by ANSI (American National Standards Institute[26]) in 1979 to develop uniform standards for inter-industry electronic interchange of business transactions, EDI. Its main objective is to develop standards to facilitate electronic interchange relating to such business transactions as order placement and processing, shipping and receiving information, invoicing, and payment and cash application data, and data to and from entities involved in finance, insurance, education, and state and federal governments. It has developed more than 275 transaction sets of standards that can be used to electronically conduct business-to-business operations. **Example:** ASC X12 develops, maintains, interprets, publishes and promotes the proper use of American National and UN/EDIFACT International EDI Standards.
UNECE (United Nations Economic Commission For Europe) – www.unece.org
Profile: UNECE was set up in 1947 by United Nations Economic and Social Council (ECOSOC) as one of five regional commissions of the United Nations. In 1986, the UNECE launched UN/EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport), a single international standard for electronic data interchange flexible enough to meet the needs of governments and private enterprise worldwide. Also, UNECE has recently enhanced its work on trade facilitation by creating a Centre for Trade Facilitation and Electronic Business (CEFACT[27]). **Example:** The Centre is a unique body within the United Nations system responsible for simplifying international trade procedures, harmonizing and standardizing information and documents and promoting best practices in trade facilitation worldwide.

There are a number of key standards organizations that overlook the development of standards and protocols for the Internet and World Wide Web. IETF oversees the continued development of standards and protocols that are in line with the technical aspects of the Internet. There are other organizations that also produce relevant standards and protocols with an industry focus. For example, OASIS focuses on enabling electronic business. For standards developments with respect to the Internet and World Wide Web, there are several key organizations (See Table 3-3).

Table 3-3. Standards Organization Targeted for Internet and World Wide Web]

IETF (Internet Engineering Task Force) – www.ietf.org
Profile: IETF is an open organization that accepts an Internet Draft submission from anyone on creating and reviewing standards and protocols for the Internet. Many existing protocols such as TCP starts out as a draft or a Request for Comment (RFC). **Example:** The EDIINIT is one of its current drafts that deals with information exchange enabled in an Internet domain.

[26] www.ansi.org
[27] www.unece.org/cefact

W3C (World Wide Web Consortium) – www.w3c.org
Profile: W3C focuses on the "plumbing" of the Web. Its standards are referenced and implemented in a much diverse Web technology base. This consortium ensures the technical developments stayed in course to realize the idea of making the Web a semantic Web. **Example:** XHTML[28] and SMIL[29] are just two of the many pivotal standards and protocols coming out from W3C, mostly with recommendation status.
IEEE (Institute of Electrical and Electronic Engineers) – www.ieee.org
Profile: IEEE is a non-profit association, with over 377,000 strong professional members, responsible for the development of more than 860 active standards, with 700 more under development. **Example:** Key standards in telecommunication infrastructure include the wireless technology standards of IEEE 802.11x.
OASIS (Organisation for the Advancement of Structured Information Standards) – www.oasis-open.org
Profile: OASIS is a non-profit consortium involves in promoting the adoption of e-Business standards. It has more than 600 corporate and individual members in 100 countries to cooperatively to develop and disseminate methodologies and technologies. OASIS, as it stated in its website, is not "yet another standards body", but a forum to make standards easy to adopt in real-world applications. **Example:** Jointly with the United Nations sponsors ebXML – an architectural specification for e-Business; SAML, a standards to guide the security development across user domains.

Thus, it is important for the industry to comprehend the current status of standards and the ongoing standardization process. It is obvious that any changes and newly developed standards have a far reaching effect to operators of the logistics industry – they must equip with and improve their existing e-Readiness accordingly.

5.2.2.3 Information Exchange

To manage the information standards matrix, there are two clear choices. One is not to disturb established operations by creating a framework to guide the interoperability development. Or, the industry takes one giant step to consolidate to one common standard. Obviously, both choices are needed. The degree of e-Readiness of the communities ranges from pre-web era technology to some integrative era technology adoption by key integrators. Standardizing organizations are clearly moving towards Web-based information exchange such that efforts are to drive the standards

[28] Extensible Hypertext Markup Language
[29] Synchronized Multimedia Integration Language

development to mostly XML-based syntax and schemas. Thus, to catch up with the information explosion and the need to provide timely information flow for efficient air cargo logistics, an intermediary step will be taken. A case in point is an effort by the Hong Kong government to build information exchange platform (DTTN) to allow industry players to seamlessly exchange information.

The proposed Digital Trade and Transport Network (DTTN) off HKSAR[30] provides a third party platform to link up players in the trade and logistics community. The platform, similar to the Information Exchange Platform, offers a reliable environment for effective information exchange and service integration, and a state of the art technology portal for innovative value-added service deployment. The platform ensures global logistics community connectivity at minimal costs to trade and logistics Small and Medium Enterprise (SME), and serves as a 'catalyst' for SMEs to adopt e-Business practice to 'improve the overall competitiveness of the logistics industry.' DTTN is anticipated to offer many effective services for the logistics industry, such as 1) different secure channels for information exchange with parties in the logistics community, 2) format and character encoding conversion of messages among commonly adopted message standards in the community, 3) end-to-end reuse of relevant business data, and 4) capability to access **3rd** party value-added services.

DTTN provides transaction accountability and ensures overall and appropriate confidentiality in a non-intrusive platform for SME to access and use. Key technology and standards supported include protocols like HTTP (Web-based), SMTP (e-mail), and FTP (File Transfer), industry standards such as UN/EDIFACT, ANSI X12, and Cargo-IMP, and file types including Microsoft Excel, Text file, and CSV file. SMS will be supported and specific language character sets including English and Chinese (Simplified, Traditional, and Hong Kong Specific - HKSCS) will be enabled.

6. CONCLUDING REMARKS

In here, we provide a conceptual framework for a community information infrastructure for the air cargo industry. The proposed infrastructure enables the online integration of logistics business processes for business chains. From the conceptual framework, a 3-tier architectural framework projects three tightly coupled platforms, highlighting the key

[30] Hong Kong, Special Administrative Region

elements for online e-Business management. Efforts are ongoing to bring unified information exchange to bear within the industry. The e-Platform will promote innovative products and processes, and no doubt will motivate the reengineering of business processes in the air cargo industry.

Also, the proposed e-Platform provides integrated information for marketing, banking, distribution, warehousing, inventory planning, consolidation, carriers booking, and customs processing. Transaction records and cargo information kept on the community platform is a content-rich resource for knowledge management. A systematic process of extracting relevant industry and market information from the community database provides valuable knowledge for global air cargo logistics. This enhancement of knowledge enables air cargo agents to make smarter, faster and better business decisions.

Although the e-Platform addresses the need of the air cargo logistics industry, the framework, as well as the concepts, presented in here are general and can easily be adapted to other industries, such as the hospitality industry.

Chapter 4

A BENEFIT, COST AND RISK ANALYSIS FOR THE STAKEHOLDERS OF A 4TH PARTY LOGISTICS E-BUSINESS PLATFORM*

1. INTRODUCTION

We have previously proposed that an e-Business logistics platform would enable agents of the industry to design and develop logistics integration, that industry agents can use the platform to seek and negotiate with new customers or partners, plan and control their logistics processes, and to process fulfillment transactions (Leung et al., 2000). Client companies or agents of the industry can simply plug in and engage in logistics e-Business activities. In this chapter, we discuss the costs, benefits and risks to the stakeholders of the e-Platform. In general, the major stakeholders are: Government, Investor, and Users, with each having a very different set of costs, benefits and risks. The e-Platform design that would ultimately satisfy the stakeholders must be selected carefully, balancing properly the costs, benefits, and risks to individual stakeholders. We approach the design selection and conflict resolution between the stakeholders using Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) models.

* Adapted from Inderscience Enterprise Limited, International Journal of Internet and Enterprise Management, 1 (1), 2003, "Designing a Fourth-party e-Commerce Logistics Center: A Benefit, Cost and Risk Analysis using AHP and ANP models", Hui, Y.V., Leung, L., Fu, G., and Cheung, W.

1.1 The Stakeholders: Government, Investors, and Users

The Government, Investors, and Users are important parties involved in the 4th party e-Platform (Figure 4-1). The e-Platform is an information infrastructure. Analogous to building physical infrastructures, the e-Platform's construction and design should involve government efforts. Here, the Government can be that of a municipality, or a provincial region, or that of an entire country. The Government has an important role as a regulator, first in selecting the appropriate investors and in safeguarding the e-Platform's neutrality, and then in establishing the regulations between Investors and Users as well as between Users themselves. Investors are external companies who will design, finance, build and manage the e-Platform. Users include shippers, forwarders, airlines, integrators, terminal operators, warehouse operators, distributors, ground carriers, etc. They are the customers of the platform. The various forms of ownership are an important design choice. Government-owned company, service and management contract, leases and concession contract, private company are common options for public-private involvement in large projects (Gresham and Shlaudeman, 2000). Not only does the form of ownership decide the allocation of interests and control-power between different parties, it also affects the incentives and behaviors of the parties.

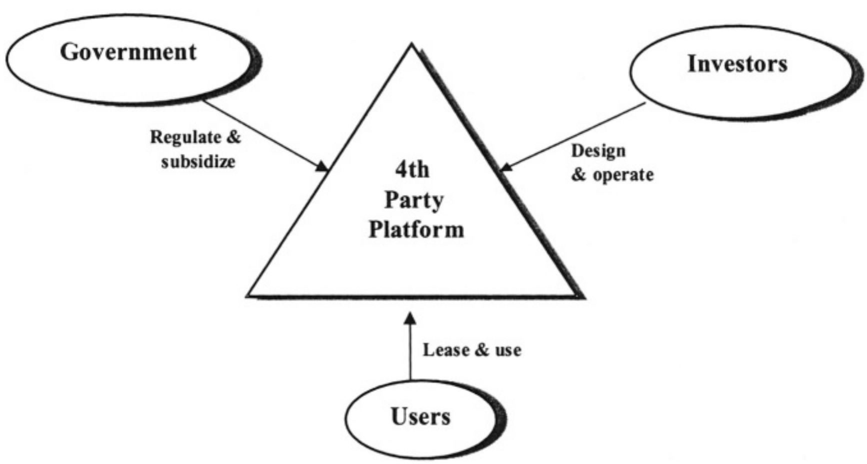


Figure 4-1. Major Parties Involved

Other than ownership designs, there are also many design issues on the various features of the information infrastructure (see Figure 4-2). Features of the information infrastructure can range from stand-alone transactions to full information integration at the industry level. The desirability of individual designs depends on the level of involvement between Investors, Users and the Government. If both the Government and the Users take on minor roles, the Investors would assume all the risk and be unlikely to venture into a large-scale commitment. Investors' commitment would likely differ, if the Government supports the platform financially in some form. Both the Government and Investors would likely be enthusiastic if Users of the industry show commitment of support by assuming a portion of the platform's ownership (via their professional associations such as forwarders association, shippers association, trucking associations, etc.). The Government or Investors could provide loans to these associations, secured by their member's future patronage of platform. Each individual design of the logistics platform has its own sets of benefits, costs and risks for each party.

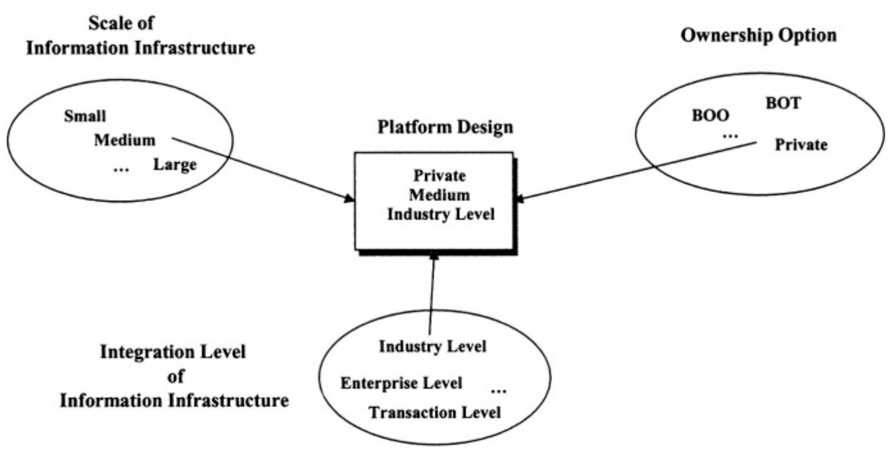


Figure 4-2. Design Choices for the Platform

1.2 Modeling the Benefits, Costs and Risks of the Stakeholders Using AHP and ANP

The success of such a fourth-party e-Business platform depends on the commitment of the Government, Investors, and Users. While each party plays an important role towards the platform's success, their interests might differ and in some cases be conflicting. No one single party would like to assume the inherent vast risk and the need to have risks shared among concerned parties is critical to the success of the platform. However, a systematic approach to address risks sharing is missing in the literature. A main reason for this void is largely due to the formidable task of evaluating tangible and intangible risk elements inherent in such an infrastructure project.

Developed by Saaty (1980), AHP is a widely used multi-criterion decision theoretic that can incorporate both objective and subjective information. AHP first breaks the problem into a hierarchy of attributes and sub-attributes. Typically, the overall goal is at the top with the choice alternatives at the very bottom. The relative importance of sub-attributes with respect to a given attribute is determined by using ratio scales and paired comparisons. Then, the methodology respectively aggregates weights of sub-attributes at a lower level to form weights at a higher level. The final result would be the relative importance of each alternative with respect to the overall goal. An important feature of AHP is its capability to evaluate intangibles, a feature due to its use of relative preferences and ratio scales. When there exists relationships between attributes in the same level or of different levels, ANP must be used (Saaty, 1996).

2. BENEFITS, COSTS, AND RISK TO GOVERNMENT, INVESTORS, & USERS

In this section, we provide benefit, cost, and risk models in the form of either AHP or ANP for each individual party.

2.1 Benefits to Government

For any economy, it is important that the government ensures that its air cargo industry is able to compete regionally and worldwide. The 4^{th} party e-Platform for air cargo will enhance that logistics and transportation sectors, which contributes substantially to the economy's GDP and employment. Job creation takes place in several ways: jobs for the e-Platform itself, jobs from expansion of peripheral industries, and jobs from the incremental economic growth that the industry creates. Figure 4-3 shows an ANP model depicting the benefits to the Government. The directed arc represents inner-dependency (Saaty, 1996). Table 4-1 gives the descriptions of the criteria.

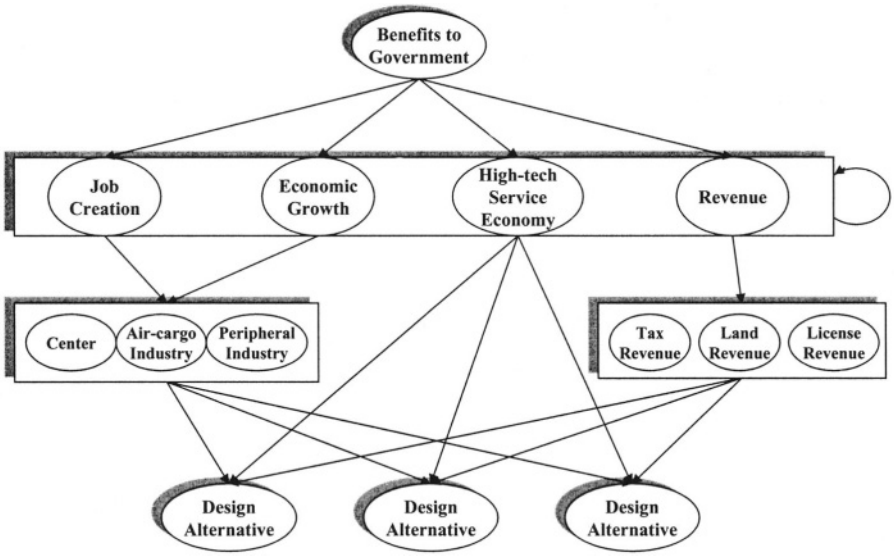


Figure 4-3. **ANP Model for the Benefits to Government**

Table 4-1. Benefits to the Government

Criteria	Description
Job Creation	New job opportunities from the logistics platform.
Economic Growth	Overall Economic Growth to the region.
- Platform	Platform's contribution.
- Air Cargo Industry	Contribution by corresponding development of air cargo industry.
- Peripheral Industry	Contribution by corresponding development of peripheral industries, such as real estate and telecommunication industries.
High-tech Service Economy	Contributes towards the region's high-tech knowledge-based service sectors.
Revenue	Government's revenues that directly come from the platform.
- Land Revenue	Incomes due to land sale or rental.
- Tax Revenue	Tax collected over the revenue of logistics platform.
- License Income	Payment from selected Investors for the right of building and operating the platform.

2.2 Costs to the Government

The Government may be involved in the platform's ownership by forming joint venture with Investors. In that case, the Government's costs will be those of an Investor and will be discussed in a later section. Whether or not the Government involves with the ownership of the platform, the Government incurs costs in other forms. Firstly, it will have to expend efforts in identifying and selecting Investors. A great deal of information standards for logistics will need to be established. The platform's trading processes will have to be regulated, much like that of a stock exchange. The Government needs to form an administrative entity to monitor the development and construction of the platform and to safeguard the platform's neutrality during its operation. It is also likely that some kind of licensing arrangement will have to be in place. The Government must design a contingency plan in the event that the platform does not perform accordingly. Contingency cost can be a significant cost item. Figure 4-4 shows the AHP model according to the costs of the Government. Table 4-2 gives the descriptions of the criteria.

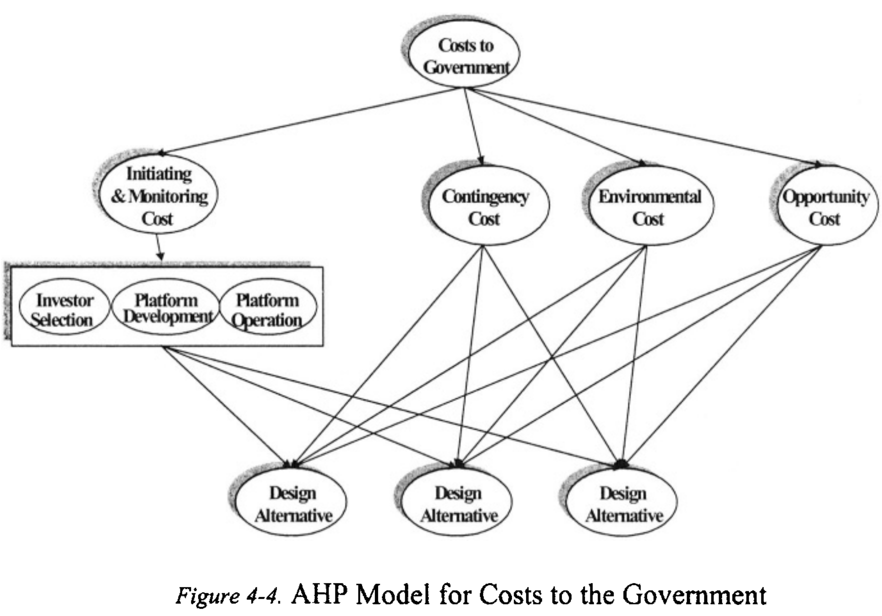


Figure 4-4. AHP Model for Costs to the Government

Table 4-2. Costs to the Government

Criteria	Description
Contingency Cost	Cost in the provision of contingency measures.
Initiating & Monitoring Cost	Expenses in initiating the platform and monitoring its construction and operation.
- Investor Selection	Cost of selecting Investors and examining platform designs.
- Platform Development	Cost of monitoring the construction and further development of the platform.
- Platform Operation	Cost of monitoring the regular operation of the platform.
Opportunity Cost	Opportunity lost for alternative usage of the resources

2.3 Risks to the Government

For any infrastructure projects, the Government needs to address the risk of failure and its consequences. It must address whether the macro economic environment supports the long-term establishment of the platform. An important risk is related to the issue of regulating air cargo infrastructures. It must evaluate the risk of not being able to properly monitor the development of the platform as well as the risk of not being able to safeguard the neutrality of the platform. The risk of improper contingency measures is another risk consideration. The Government's involvement can be a market interference issue, which needs to be carefully examined. Moreover, the Government's contractual commitment should be judicious, balancing unnecessary fiscal burden with prudent commitment to helping the air cargo industry – this issue is more applicable to smaller economies. Figure 4-5 shows the ANP risks model. Table 4-3 gives the descriptions.

2.4 Benefits to Investors

The primary direct revenue will come from users' rental fees. This revenue source will largely depend on the volume of users who lease the service. As the fourth party information infrastructure is an e-Business platform for the industry, there are many revenue generation prospects from the platform. The platform will likely be the central source of market activities, through which Users obtain their business and it could be developed into a major regional market to be linked with other international networks. The potential income from knowledge management and knowledge discovery activities on the platform can be substantial. There are also opportunities in developing partnerships with other electronic businesses. Figure 4-6 shows the ANP model for benefits of Investors. Table 4-4 gives the descriptions of the criteria.

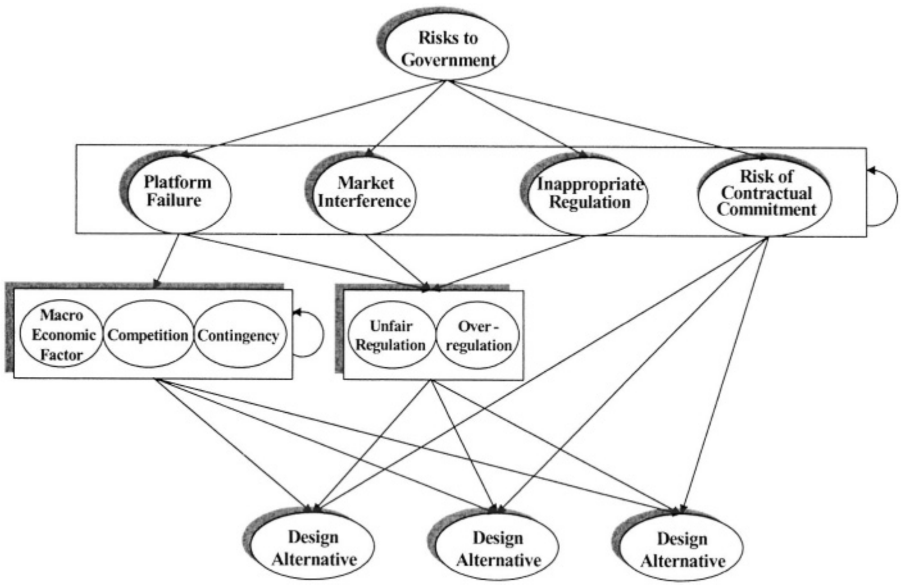


Figure 4-5. ANP Model for Risks to the Government

Table 4-3. Risks to the Government

Criteria	**Description**
Platform Failure	Risk of project failing.
- Macro Economics Risk	Downturn of global or regional economies.
- Competition	Risk due to competition.
- Contingency	Risk of unsuccessful contingency measures.
Market Interference	Government interference in the free market.
Inappropriate Regulation	Risk of not providing proper regulation.
- Unfair regulations	Neutrality.
- Over-regulations	Over-regulating brings difficulty to the running of platform, while inadequate regulating is open to abuses.
Risk of Contractual Commitment	Contractual commitments may bring unnecessary fiscal burden to the Government and taxpayers.

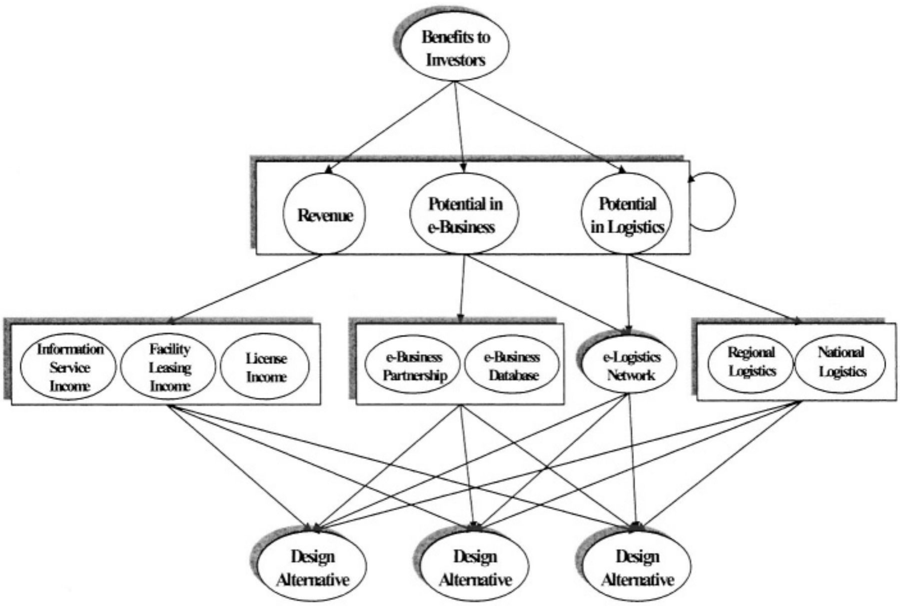


Figure 4-6. ANP Model for Benefits to Investors

Table 4-4. Benefits to Investors

Criteria	**Description**
Revenue	Investors' incomes from the platform.
- Information Service Income	Revenues of offering information infrastructures to Users.
- Facility Leasing Income	Revenues of leasing related facilities to Users.
- License Income	License income from Users.
Potential in Logistics	Business potential in logistics from the platform.
- Regional	Opportunities for the logistics industry in the region.
- National level	Opportunities in the logistics industry beyond the region
Potential in e-Business	Business potential in e-Business from the platform.
- Partnership	Partnerships with Users and operators of other e-Business platforms.
- E-Business Database	Business potential from data mining of logistics-related information.
- E-Logistics Network	Business potential from developing the platform's information infrastructure into a vertical e-Logistics network.

2.5 Costs to Investors

During the initial preparatory stage, investors incur the costs of designing, bidding, and business development. In the development phase, Investors incur major costs in the construction of IT infrastructure. The amount of investment varies greatly with the scale of the platform. The design of the IT infrastructure dictates the amount of investment required in the acquisition of hardware and software. Major investment will be needed for IT-skilled human resource both in the development and the maintenance of the IT infrastructure. Financing cost is a major cost item in such a large project. The opportunity cost of investing in the project should be taken into account as well. When the platform is in operation, there would be direct and indirect costs of operating the platform. Figure 4-7 shows the AHP model according to the costs of Investors. Table 4-5 gives the descriptions of the criteria.

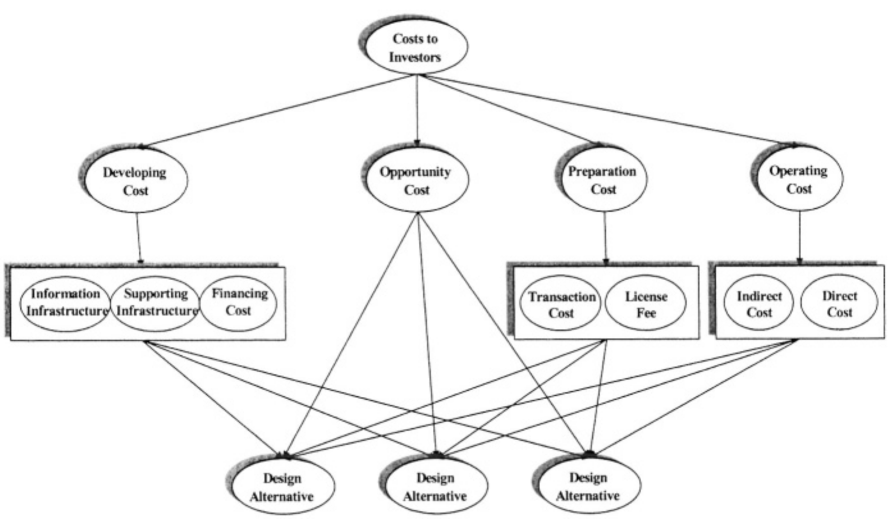


Figure 4-7. AHP Model for Costs to Investors

Table 4-5. Costs to Investors

Criteria	Description
Preparation Cost	Investors' costs in the preparation phase.
- License Fee	Fees to Government for permission to construct and operate the platform.
- Transaction Cost	Costs of designing, bidding, negotiating etc.
Development Cost	Investors' costs in the development of the platform.
- Information Infrastructure	Cost of establishing information infrastructures offered to Users, including hardware and software.
- Supporting Infrastructure	Cost of other necessary infrastructures, such as management information system for internal use.
- Financing Cost	Cost of financing the investment.
Operating Cost	Operating costs of the platform.
- Indirect Cost	Overheads and other indirect costs.
- Direct Cost	Direct operating cost of the platform.
Opportunity Cost	Opportunity lost for alternative usage of the resources.

2.6 Risks to Investors

The overall risk that Investors must address is the risk of not able to achieve the targeted return during the planning horizon. There are several categories of risk factors that could contribute to this overall risk: construction, economic, competition, e-Commerce, regulatory, and level of acceptance by Users. Construction risks involve the risk of having cost over-runs and the risk of not able to build the platform according to the technical specifications. The principal economic risk is that of slow growth in trading, distribution, and marketing sectors. Competition is also a major risk concern.

Obviously, the success of the platform depends on the volume of Users that lease the infrastructure. The uncertainty on the level of User satisfaction is a critical risk factor that is related to the quality, reliability, pricing, and neutrality of the services provided. Today, competition for B2B e-Commerce platforms is fierce and such platform for air cargo logistics is no exception. This is the main attraction for the Users but there is a great deal of uncertainty regarding its success and failure as well as its competition. The risk of the Government over-regulating the logistic platform is a plausible concern. Figure 4-8 shows the AHP model according to the risks of Investors. Table 4-6 gives the descriptions of the criteria.

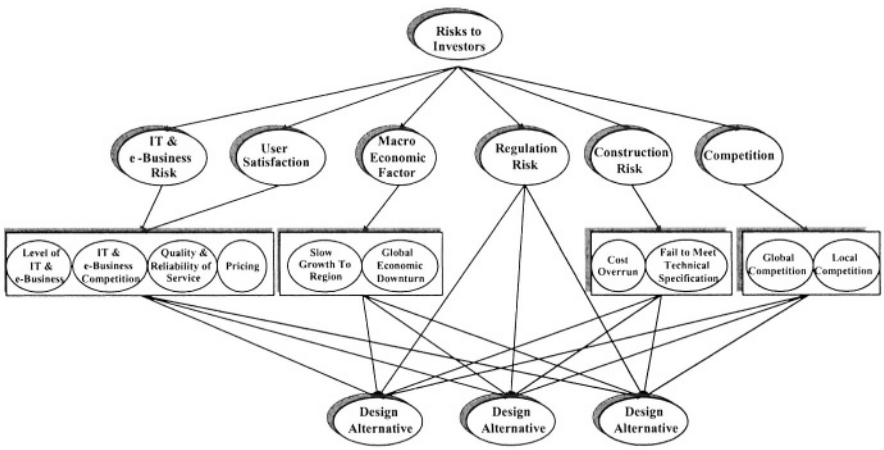


Figure 4-8. AHP Model for Risks to Investors

Table 4-6. Risks to Investors

Criteria	Description
Macro Economic Risk	Global and regional macro economic risk.
- Slow Growth to Region	Risk of economic downturn in the region.
- Global Economic Downturn	Risk of global economic downturn.
Construction Risk	Risks incurred in the construction process.
- Cost Overrun	Construction cost exceeds budget.
- Fail to Meet Specifications	Failure to meet the designed technical specifications.
Competition	Competition in logistics business is fierce.
- International	Competition from major global competitors.
- Regional	Competition from similar projects within the region.
Users Satisfaction	Users' satisfaction level with the platform.
IT & e-Commerce Risk	The uncertainty as well as attractiveness of IT & e-Commerce.
- IT & e-Commerce Level	Whether the designed IT & e-Commerce level is desirable.
- E-Commerce Competition	Competition for e-Commerce is fierce.
- Quality & Reliability	Quality & reliability of services offered by the platform.
- Pricing	Risk of inappropriate pricing.
Regulation Risk	Risks of regulatory problems.

2.7 Benefits to Users

Logistics agents are primary Users of the platform. The overall planning and control of operations are improved due to better coordination of shipments. Users will be able to provide better inventory control, and have more effective coordination of integration and consolidation of air cargo. Waiting time during transit will be minimized and unnecessary intermediaries will be eliminated as well. The resulting shipping process is streamlined, alleviating unnecessary costs in space, handling and inventory. The quality and reliability of delivery is likely to be improved. With tracking and tracing, Users can update the status of shipments in process, notice problems immediately and prescribe solutions effectively. Outsourcing IT capability as well as physical facilities allow logistics service provider to concentrate on their innovation of processes.

Via the fourth party platform, logistics agents can customize their services as well as introduce innovative services at low costs. They can provide e-Business management service such as Supply Chain Management and Customer Relationship Management to their customers. And with strategic partnerships, Users become very flexible to adapt their services to the dynamic market. From a technology perspective, the Users of the platform would enjoy benefits such as scalability, security, accessibility and user friendliness. Interoperability might also be developed. Figure 4-9 shows the AHP Model according to the benefits of logistics agents. Table 4-7 describes the criteria.

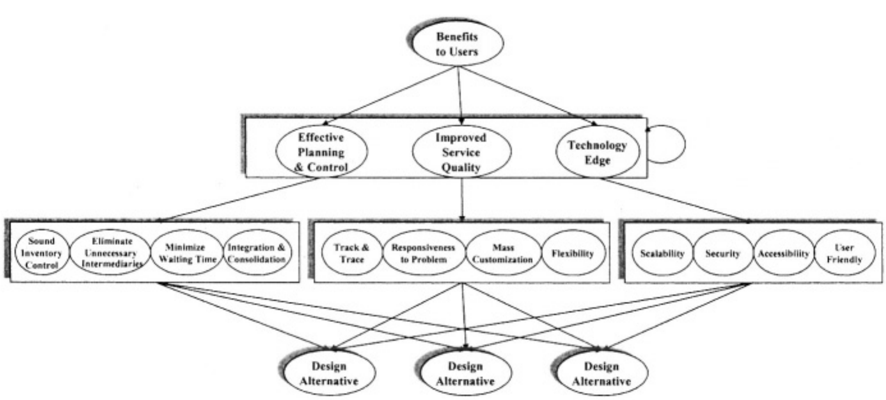


Figure 4-9. ANP Model for Benefits to Users

Table 4-7. Benefits to Users

Criteria	Description
Effective Planning and Control	Efficiency of logistics operations
- Inventory Control	Able to develop effective inventory planning for client companies.
- Eliminate unnecessary intermediaries	Efficient information avoids unnecessary intermediaries.
- Minimize waiting time	Use the integrated information system to forecast and plan their work, thus reducing waiting time at interfaces.
- Integration & Consolidation	Allow effective coordination of integration and consolidation of shipments.
Improved Service Quality	Quality of services is improved.
- Track and Trace Accuracy	Accuracy in monitoring shipments and logistics services.
- Responsiveness to Problems	Minimize human errors, damage and theft, and can identify problems and prescribe solutions quickly.
- Mass Customization	Flexibility in customizing processes to meet customers' different requirements at low cost.
- Capacity Flexibility	Virtual partnerships create more options to deliver goods.
Technology Edge	Help Users establish their high-tech capability.
- Security	Users' information will be protected by the technology of authentication, authority and audit.
- Accessibility	Easy accessibility.
- User Friendship	Ease of use.
- Scalability	System upgrading is economical.

2.8 Costs to Users

Startup costs for the Users include the membership fees of the platform. To be connected to the IT infrastructure, initial investment will have to be made on interfacing or hook-up devices and integration of corporate system. Users will need to recruit or train IT-skilled staff to become conversant with the operating environment of the IT infrastructure. Figure 4-10 shows the AHP model according to logistics agents' costs and Table 4-8 gives the descriptions of the criteria.

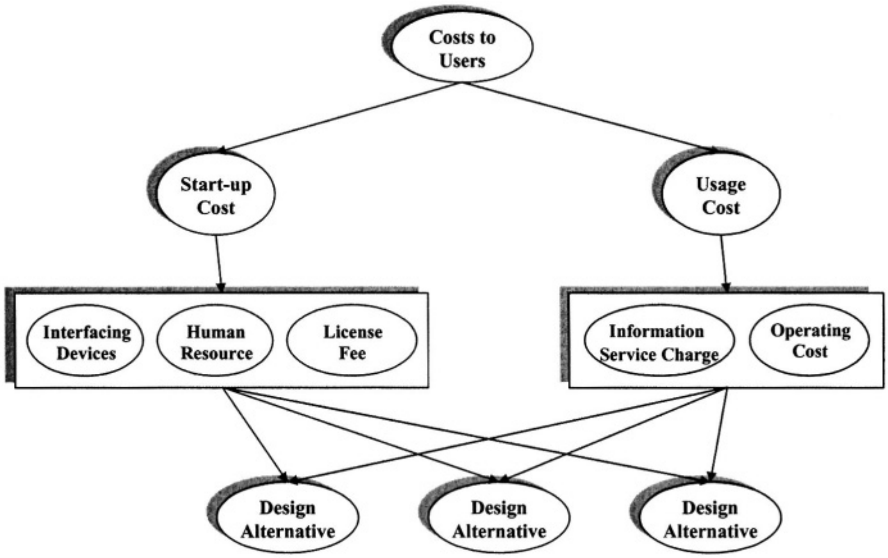


Figure 4-10. AHP Model for Costs to Users

Table 4-8. The Costs to Users

Criteria	**Description**
Startup Cost	Users' costs to start using the platform.
- Interface devices	Investments on compatible mechanisms to use the platform.
- Human Resource	Recruiting and training of new staff.
- License Fee	Payment to Investors for use of the platform.
Usage Cost	Users' costs to use the platform's infrastructures.
- Information Service Charge	Payment to use the information infrastructure of platform.
- Operating Cost	Additional operating cost related to the using the platform's facilities.

2.9 Risks to Users

For a fourth-party e-Logistics platform, a great deal of users' business information is processed through the platform. A User's major concern is whether the platform will be capable of providing secure information processing. Also, since competing companies will be using the same facilities, neutrality of the platform is of paramount importance. Further, once the e-Logistic platform becomes the central market of air cargo shipments, Investors would control the market and may levy unreasonable leasing charges. Users should seek guarantee of neutrality as well as a reasonable pricing policy. While the fourth-party platform means the availability of IT resources, it also means that the playing field is now levelled. Some Users might lose their previously established competitive edge. The process of change is risky in itself. It is common that the employees object to new ideas and new technology. Figure 4-11 shows the ANP model according to logistics agents' risks. Table 4-9 gives the descriptions of the criteria.

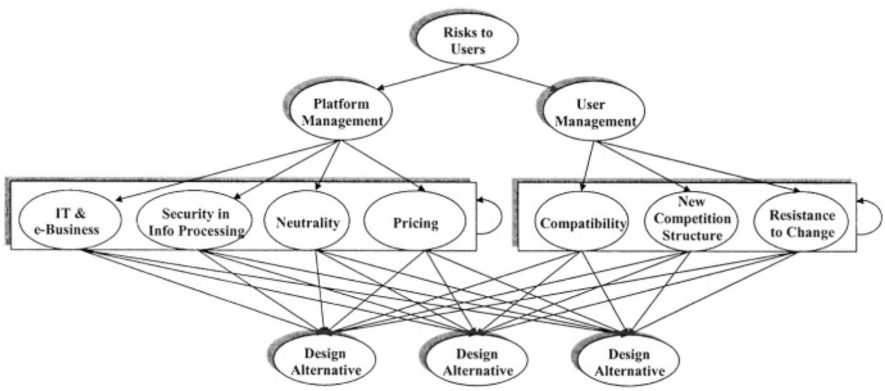


Figure 4-11. ANP Model for Risks to Users

Table 4-9. Risks to Users

Criteria	**Description**
Platform Management	Users' risks from the platform.
- E-Commerce	Uncertainty regarding e-Commerce.
- Security	Security of information processing at the platform.
- Pricing	Uncertainty on the future pricing policy of the platform.
- Neutrality	Uncertainty on the platform's neutrality.
User Management	Users' risks from themselves.
- Compatibility	Incompatibility in integrating with the platform's management as well as infrastructure.
- New Competition Structure	The platform changes the competition scenarios.
- Resistance to Change	Resistance by employees of Users.

3. RISK SHARING IN PLATFORM DESIGN: AN ILLUSTRATION

In the preceding sections, we have provided Benefits, Costs, and Risks models for Government, Investors, and Users. In this section, we illustrate how a design of logistics platform can be selected using these models. Firstly, it is important to point out the difference between AHP and ANP. In general, two attributes are independent if they are unrelated (e.g. color and smell of food) and are dependent when they are related (e.g. taste and temperature of food). In the latter case, the preference determination between the two attributes requires assessment of the extent of dependency between them. Problems with dependency may be implemented using an AHP framework if the decision-maker is capable of factoring in all the interactions and can directly provide preferences between attributes. For example, when assessing the relative importance between taste and temperature of food, the decision-maker can somehow incorporate the impact that these two attributes have on each other with respect to a certain criterion and can come up with their relative preference. However, if the decision-maker is not capable of doing so, ANP should be used. Within an ANP context, the property of having interactions between a cluster of sub-attributes is called *innerdependency,* and those between attributes of different hierarchy is called *interdependency* (Saaty, 1996). There is no interdependency in our formulations.

3.1 Solution Methodology of Aggregating Benefits, Costs and Risks in ANP and AHP

A commonly used methodology of ranking alternatives based on Benefit-Cost-Risk is to determine the ratio of (benefits)/[(costs)×(risks)], where the values inside the brackets are the corresponding weights from solving individual networks or hierarchies (Expert Choice, 1998). This method has two implicit assumptions. First, it assumes that the criteria of benefits, costs and risks are equally weighted. Second, it assumes that the alternatives are relatively close in terms of scale. If the decision maker finds these two assumptions to be applicable, then the ratio of (benefits)/[(costs)×(risks)] can be used.

Alternatively, we construct an aggregated benefit-cost-risk model for each party (Figure 4-12). The purpose is to have benefits, costs and risks as three primary criteria under the overall goal, and to attain their weights by pairwise comparisons. Here, to be able to compare benefits with costs and risks, we need to seek the decision-maker's preferences in terms of their relative importance. For example, we would ask questions such as "With respect to the overall goal of User, what is the relative *importance* between benefits and costs in designing the platform?" For preference determination for sub-attributes under costs and risks, the questions would be designed such that the relative importance of the respective sub-attributes would correspond to their relative levels of positive contributions.

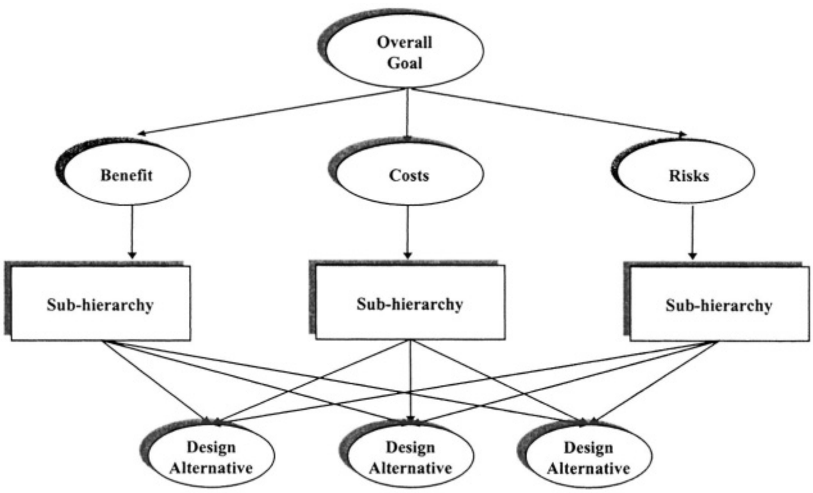


Figure 4-12. Aggregated Benefit-Cost-Risk Model

3.2 Aspects in Determining an Agreeable Solution

There are three aggregated benefit-cost-risk models, representing the interests of the Government, the Investor and the Users. Different parties might not prefer the same design and we need to examine how to adjust the design such that we can arrive at a design that satisfies every party. While solving the problem, there are four possible scenarios:

1. An agreeable solution is found immediately. An agreeable solution is a design that attains the highest priority for every party.
2. There is no immediately agreeable solution but such a solution can be obtained if a design can be acceptably modified. The acceptable ranges of design changes are provided by the decision-makers.
3. There is no immediate agreeable solution but an acceptable solution – one that attains satisfying priority weights or is a close choice to

the top-ranked design – can be obtained immediately or after acceptable modification.

4. No agreeable or acceptable solution exists.

For the last three scenarios, sensitivity analysis is helpful in identifying the critical design elements, as well as examining the risk sharing between different parties.

3.3 A Solution Procedure Based on Sensitivity Analysis

A solution procedure (Figure 4-13), based on sensitivity analysis, to determine an agreeable solution is now provided. Sensitivity analysis assesses how the change of data input affects the overall result. Thus we can adjust some model parameters purposely, and change the results of AHP and ANP models in a desired direction. There are two popular forms of sensitivity analysis: the one-factor-at-one-time approach and the scenario analysis. The first approach is more suited to our problem, because it is relatively easy to be interpreted and understood while the scenario analysis may require too many data inputs.

For AHP, we use a sensitivity analysis approach developed by Triantaphyllou and Sánchez (1997). The performance measures under individual criterions are examined one by one. The sensitivity of a performance measure is determined by its smallest relative modification that would change a potential agreeable solution to the top choice. We then make acceptable modifications on the design. To ensure that the modifications do not make the design undesirable to other parties, their impacts on the performance measures of other parties are examined. Since the ANP formulations in our current problem only involve innerdependency, we construct individual supermatrix for these clusters and attain the limiting priorities of their sub-criterions. The limiting priorities become the weights of the sub-criterions. The ANP models are now in AHP form and we could perform sensitivity analysis in a similar fashion.

Using the solution procedure, we might find that there is no feasible solution from the original designs. We can introduce a new set of design alternatives, which are likely to be feasible, since our understandings of the problem must be improved during the procedure. On the other hand, it is also possible to find several agreeable or acceptable solutions. If it is the case, we can exclude the infeasible solutions, and retain the priority weights using the original comparisons between the remaining designs. Judgment can be made based on the new priority weights.

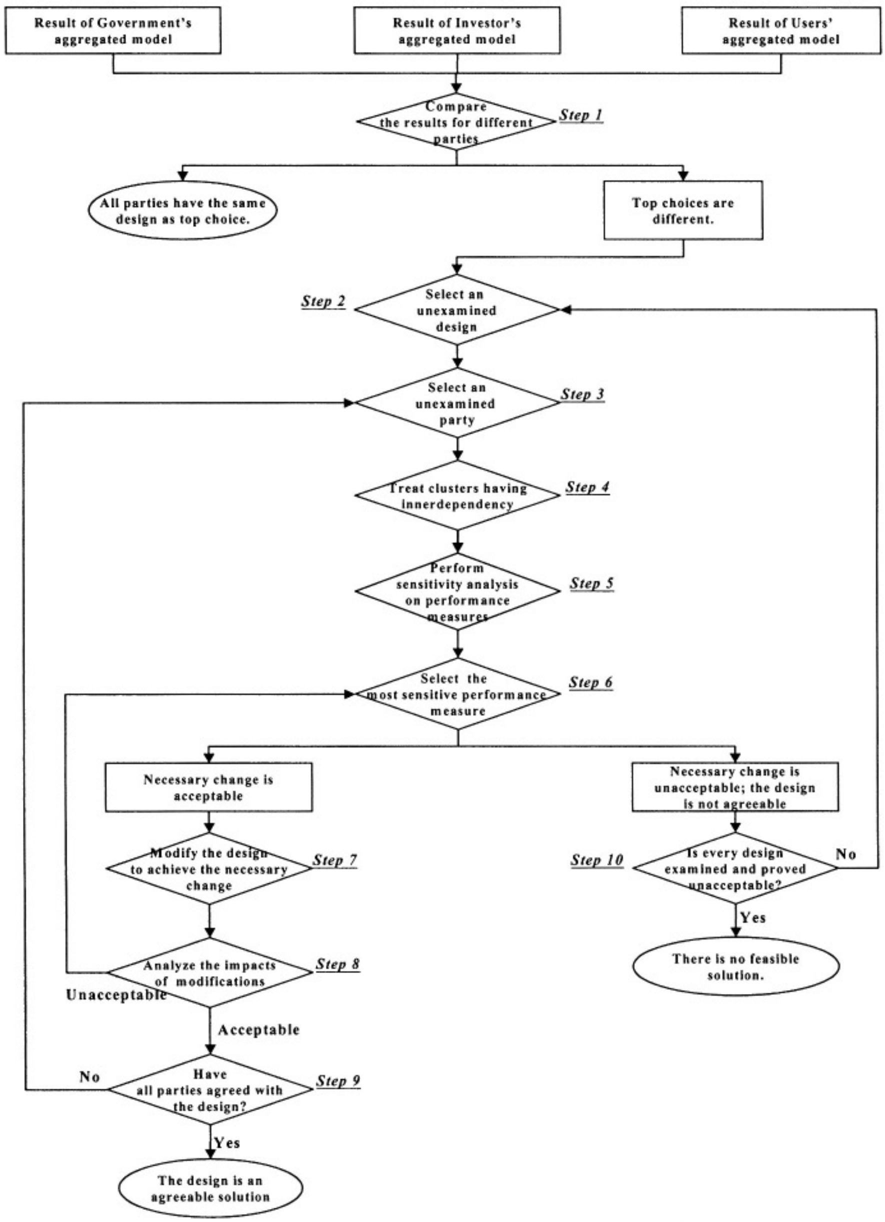


Figure 4-13. Procedure to Determine the Agreeable Solution

We apply simple rules to certain steps in order to improve the efficiency of the procedure. For example, at Step 2, we examine modified designs that have a relatively high geometric mean of the scores. A high value of the mean implies that there are no extremely low scores, and the design is likely to be acceptable to every party. At Step 3, we examine designs that are unlikely to be accepted, in order to exclude any infeasible designs as soon as possible. At Step 8, when examining the impacts of design modifications, we only refer to the sensitivity performance measures.

4. AN ILLUSTRATIVE NUMERICAL EXAMPLE

To illustrate the conflict-resolving procedure, we develop the following numerical example. There are three types of designs in this example. We contrive paired comparisons according to abridged benefit-cost-risk models. The problem is solved in the following iterations (Figure 4-14):

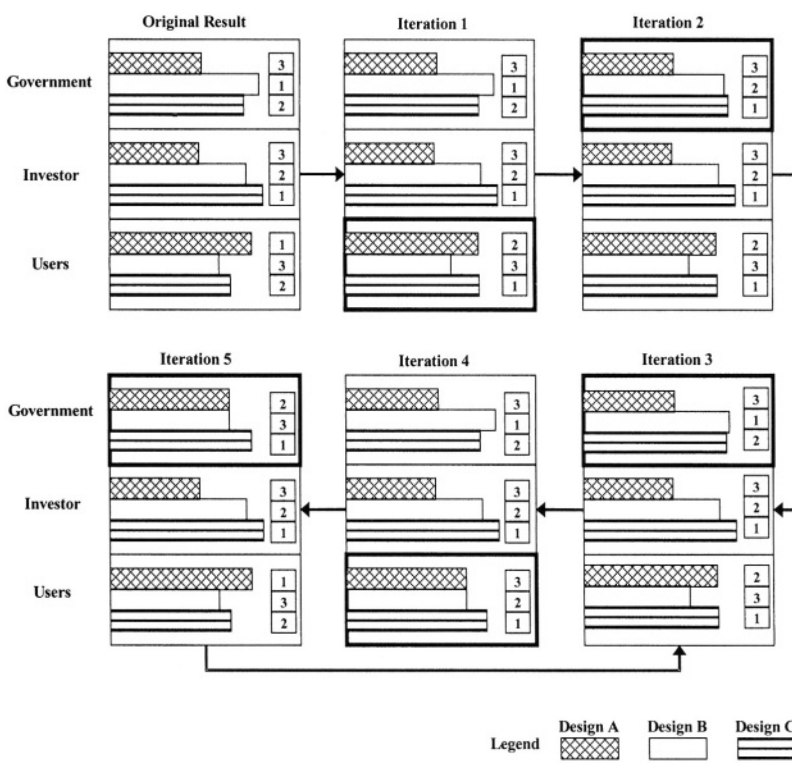


Figure 4-14. Iterations in Converging the Choices of Different Parties

Iteration 1. Design B is the top choice for the Government, Design C for the Investor, and Design A for the Users. Here, Design C is to be examined at first. Of the three parties, Users are most unlikely to agree with it. Sensitivity analysis for Users shows that the performance measure of Design C under the criterion User Management is the most critical. A 32% increase could make Design C the top choice. Here, an electronic network that is highly compatible with the Users' legacy systems can be designed for Design C. This modification reduces risks of Compatibility and Resistance-to-Change, which are major sub-criterions of User Management. It has no major negative impacts on the performance of Design C for any party. Such modification is acceptable. Hence, Design C is agreeable to Users.

Iteration 2. For Government, the performance measure of Design C under Service Economy is the most critical, which requires a 26% increase to give Design C the top ranking. However, to achieve this increase, we need to adopt innovative e-Commerce measures and latest information technologies for Design C. It raises Users' risks of New Technology and Security, and the performance measures of Design C under these criteria are quite sensitive. The modification seems to be infeasible.

Iteration 3. The performance measure of Design C under Economic Growth is the next most critical for Government. It requires an increase of 40%. However, the performance measure can only be increased as much as 30%, by enlarging the scale of the platform within an acceptable range. With the 30% increase of the measure, the priority weight of Design C for Government is very close to that of the top choice. Its priorities for Investor and Users are not obviously affected. Hence, Design C is acceptable to Government with the modifications. It is now an acceptable solution to all three parties

Iteration 4. We continue the solution procedure to examine whether Design B is an agreeable solution. Users are examined first. Sensitivity analysis shows that the most critical performance measure requires a 38% reduction to make the priority weight of Design B exceed that of the original top choice (Design A). However, with this change, Design C attains the top ranking instead of Design B. The next most critical performance measure for Users requires a 48% change, which is unacceptable. Design B is neither agreeable nor acceptable to Users.

Iteration 5. Design A is the last design to be examined. For Government, the most critical performance measure requires a change as large as 62% to make the priority weight of Design A higher than that of the top choice. Moreover, this change gives Design C the top ranking. Design A is not a feasible solution.

All design alternatives have been examined, and the solution procedure stops as there is no further agreeable solution. With acceptable modifications, Design C attains satisfying priority for every party.

5. CONCLUDING REMARKS

A fourth-party logistics e-Platform can enhance the competitiveness of the air cargo industry, especially in this era of e-Business and globalization. The Government, Investor and Users play important roles in the development and operation of such a platform. It is important to select a platform design that satisfies all three parties. This selection task is a challenging one as there are a multitude of tangible and intangible attributes.

In this chapter, we provide a series of AHP and ANP models that can be used to evaluate various design alternatives. These models identify and organize the major attributes of the benefits, costs and risks to the Government, Investor and Users. They provide a conceptual framework for the design problem. The three principal parties might differ in their criteria of platform selection and a conflict resolution or risk-sharing approach is needed to seek convergence. Here, we introduce a solution procedure based on sensitivity analysis. It examines the risk-sharing problem, and leads to an agreeable solution by modifying the original platform designs within acceptable ranges. Such use of AHP and ANP to resolve conflict between different parties has received little attention in the literature.

In general, the evolution of Web-based information technology has reached the stage where e-Commerce activities and e-Business processes are intertwined online, creating a genre of websites that are both marketplaces and management platforms. For the air cargo logistics industry, such platforms can take the form of a 4^{th} party logistics e-Infrastructure. An important aspect in designing such an infrastructure is the assessment of the platform's benefits and costs, as well as the judicious sharing of risks among interested parties. We believe the present work has provided a framework as well as a solution methodology for such an endeavor.

Chapter 5

TECHNICAL DESIGN AND IMPLEMENTATION OF THE LOGISTICS E-PLATFORM

1. INTRODUCTION

The one-to-one nature of the Interactive-Web era websites cannot support the any-to-any dynamic interactivity of cyber logistics. The idea of a dynamic online marketspace where participants meet and transact for trading does not provide the tools and facilities for collaborative business process management. Both current and new Web technology must be identified and developed for the e-Platform. New approach and innovative design must be effected.

The technical issues involved in designing a platform of this genre are examined in this chapter. In general, the principal aspects of system requirement, system architecture, interface design, and information representation requirement will be discussed. In particular, we describe the design and a prototype of the integrative e-Platform for the air cargo industry. In this e-Platform, as and when logistics services are negotiated and traded, members can concurrently design the actual logistics process of business chains. The online process design is enabled by the e-Business decision support system, which is capable of editing, integrating, and consolidating the respective shipments that are being negotiated. In the ensuing sections, we will first discuss the general characteristics of such an e-Platform in general and the issues involved in its design. We will then look at the specific design of the 4^{th} party logistics e-Business platform.

2. CHARACTERISTICS OF AN INTEGRATIVE E-BUSINESS PLATFORM

The integrative platform conducts jointly e-Commerce activities and e-Business processes online (Figure 5-1). E-Commerce activities are activities that lead to the trading of a product or service via WWW. E-Business processes are the management of business processes online. Procurement, distribution, supply chain, customer relations are typical business processes that have been conducted or managed via the Internet (Welty and Becerra-Fernandez, 2001). The concurrent treatment of trading activities and management processes require that the platform – along with the traditional issue of connectivity, security, and interactivity – to be interoperable and integrative.

In Chapter 2, we understand that in traditional e-Commerce, participants each operate within their independent environment and there are no online linkages with each other. The integrative platform must be able to link up activities that are previously isolated or are managed off-line. This raises a whole new set of system requirements that traditional websites do not need to acquire. Next, we discuss the general functions that the platform must possess, followed by a discussion of system design issues.

2.1 e-Platform Core Functions

Different e-Platform core functions support different stages of e-Business with respect to transaction view are detailed in Chapter 2. These functions are carried out in the Collaboration Platform and the Management Platform. Incubation functions have basic information processing capabilities. Negotiation functions facilitate the negotiation of a commerce transaction. Transaction formation functions finalize a commerce transaction. These three function categories are commonly found in more traditional websites.

Transaction management functions are unique to integrative platforms. These are functions that enable online coordination of multiple interrelated business processes. We will expand the discussion in here on the relevant transaction management functions.

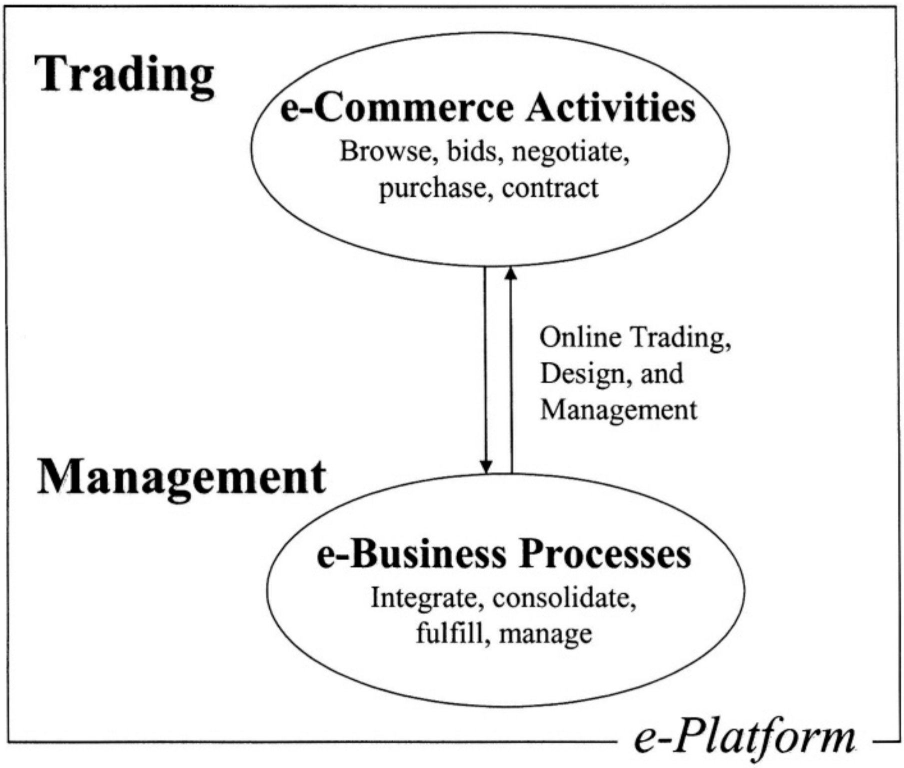


Figure 5-1. Integrative Platform of Business Management and Commerce

Platforming. The platforming function provides an online exchange environment for users to trade and manage activities. Here individuality of users is maintained, any-to-any (i.e., from one-to-one, one-to-many, and many-to-many) communicating environment is provided, and concurrency in activities is allowed.

Conferencing. This function is used by online users for real-time interactions (e.g. collaboration, negotiation and cooperation).

Data Interfacing. Data interfacing provides frictionless exchange among online multiple parties. It enforces a common representation format with which senders can compose data and information, enabling receivers to effectively extract identifiable information item. A common domain-specific representation is needed to avoid information ambiguity.

Multiple Tracking. This tracking function actively associates related activities from multiple sources. Such association provides references for individual activities as well as business processes as a whole.

Process-editing. This function provides users the capability of grouping tracked information (created by the multiple tracking function) for content and organization editing. New groupings can be created for more advanced editing or can be improved and saved to facilitate future business processes with similar traits. Advanced editing include the following core functions:

- ***Integrating.*** This integrating function is to combine respective consecutive activities within a group (e.g. a logistics process).
- ***Consolidating.*** Consolidating achieves the merging of similar activities (component tasks) across multiple tracked groups (e.g. logistics services across business chains).
- ***Optimizing.*** This function determines the best grouping (for either a process component or a whole process), according to predetermined criteria.

2.2 Platform Environment

To facilitate these transaction management core functions, a different and dynamic operating environment must be provided. We need to reconsider the implications of interoperability, interactivity, connectivity, security, and integrability in this new platform environment (See Figure 5-2).

Connectivity. Connectivity extends from the linking of participants to the platform, to the linking among participants (peer-to-peer) within the platform as well as the linking of resources to other resources. Connectivity between any two entities should use the same interface.

Interactivity. Interactivity, traditionally viewed as a strict alternating sequence of request and response, is no longer adequate for the new platform requirement. Participants of the platform must be able to interact with other participants online. A new form of interactivity is needed, where there are neither sequences of request and response nor requests that are manually driven. Instead, response is automatic. There are multiple participants that interact concurrently with each other. A participant's action and its corresponding effect to the environment must show up immediately and appropriately in other participants' environment. That is, each participant can create, interact, and manage multiple channels of transaction flows.

Interoperability. Interoperability is needed at different levels in this integrative platform. E-Business processes require interoperability. Here e-Commerce activities need to be interoperable as well, since they are included within business processes. Thus, interoperability is required across all core functions to realize the integrative nature of the platform. Further, interoperability may also be needed for compatible linking to external resources, electronic agents (e.g., among regional, of same industry, or across industries, etc.), special purpose systems as well as more international software or agents, government systems, banking systems, protocol standards, etc.

Security. New data exchange in this platform requires additional security features. The platform environment must provide facility to support security using established techniques such as encryption at the transmission level, the data level, the user level, etc.

Integrability. This is the consequential capability of integrating participants and activities online such that actions are logically related. Here, online decision support functions such as consolidating and integrating can be used to analyze complex processes with differing objectives and constraints. Other more advanced decision support functions, similar to the optimizing function, will need to be identified and developed. The incorporation of decision support systems (DSS) into a website environment is a new facet in website design. It is also a major feature of an e-Business integrative platform. A website environment with DSS would mean additional considerations on interface mechanisms among DSS, database, and the operating system.

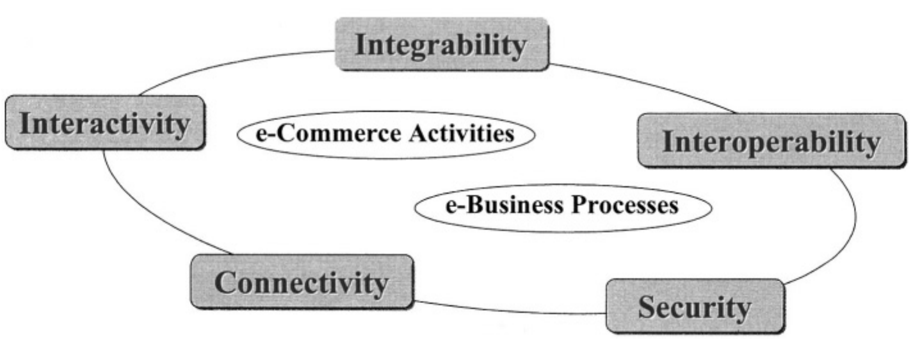


Figure 5-2. Five e-Environment Dimensions of Platform

3. PLATFORM DESIGN: ARCHITECTURE & ISSUES

In a traditional e-Commerce website, participants never cross path online. Participants are not connected, transactions not related, and e-Business activities are not collaborative. The reverse is generally true in the integrative e-Platform. The e-Platform is chain-based. We define an activity chain as the encapsulation of a chain of events created by transaction flow manifested in a business process (or a sub-process) online. Multiple chains can be created for a given business process by different participants or different groups of participants. This chain-based concept is crucial to the platform architecture design, enabling the following unique combination of features: 1) any-to-any dynamic interaction, 2) linking and managing of transactions, and 3) end-to-end integrative information handling. Transaction management functions are the only ones that require chaining.

3.1 Platform Architecture

Based on the 3-tier architectural framework, we have identified seven major components in the community platform (Figure 5-3). Three components – *e*-Environment (action-based), and Data Store Keeper (query-based) – collectively provide the more traditional website functions of the platform, and with expanded platform capabilities. A Dispatcher (event-based) component provides the key functionality of the Information Exchange Platform, along with the dispatching of e-Commerce and e-Business messages.

In the Management Platform, to achieve chaining of activities in the platform, a new component – e-Fabricator – is introduced to control the fabrication of these activity chains. To link and manage transactions, two additional components – Pattern Builder and Mosaic Generator – are also needed. The Pattern Builder tracks and links multiple activities for a given chain; different patterns can be built for the same business process. The Mosaic Generator edits and combines chains into various mosaics of business processes, providing the key decision support functions in process editing.

Under the chain-based environment, the Dispatcher takes on a new responsibility of enabling the data interfacing function, which ensures that information flow in a chain is without friction. To create the any-to-any dynamic interaction environment for collaboration, the Communicator provides private communication channels for conferencing activities among users, while the *e*-Environment provides the graphical user interface. That is, the Communicator provides the mechanism and the *e*-Environment provides the policy. The Data Store Keeper is the keeper of platform information, with which other components need to realize and carry out their individual functions.

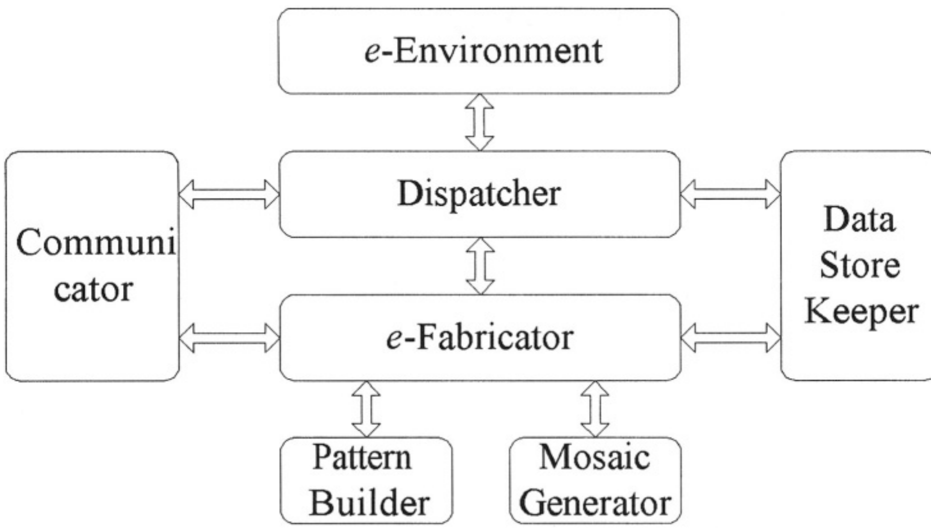


Figure 5-3. **Platform Architecture - Major Components**

***e*-Environment**. This action-based component provides each user a new interactivity environment where deterministic and opportunistic actions can be taken. All information and functions that a user may need for creation and management of activity chains are packed in this environment for access. Real-time, up-to-date, individualized view of all or selected activity chains is provided in this component.

Communicator. The component provides the any-to-any communication setup in the platform. Users that require interaction will be logically grouped together into a conferencing session. The Communicator handles all the handshaking, agreement, security setting needed between all communicating parties. The communicator can log all conversations if such a need for an activity chain is requested by the parties.

Dispatcher. The Dispatcher centrally collects and acts on all actions from online participants. This event-based component generates events for other components to trigger their specific tasks. It ensures that interfaces between components are consistent, and that interfaces to external information sources are correctly done. In addition, the Dispatcher must provide concurrency control and safeguard the timely delivery and receipt of each action and generated events. Thus, the Dispatcher is the platform's global time keeper and the clearinghouse for all actions.

***e*-Fabricator.** An activity chain can be owned by one user or by multiple users. In managing activity chains of the platform, the e-Fabricator forms an *activity fabric* for each chain. Each activity fabric has a pattern. A pattern depicts how the chain of events are manifested online. When events involve e-Business processes, process information in the form of a mosaic will be requested from the Mosaic Generator. The actual stitching of these events is provided by the Pattern Builder.

Pattern Builder. This component has the multiple tracking ability to stitch events of a chain correctly together into a pattern for the corresponding fabrics.

Mosaic Generator. A mosaic is a representing business process. The Generator prepares mosaics for an activity chain. Moreover, the Generator provides the process editing function to allow users to actually manage their own activity chains, and/or sequences in a chain. As these chains are visually presented to the users by the *e*-Environment component, more advanced editing functions can be applied and carried out by the Generator on selected chains.

Data Store Keeper. This component handles all storage and retrieval requests. It batches all non-time-critical requests before a query, or before an update to the data store is performed. This Keeper provides the mechanism for the platform components to interface with data resources. Based on data schemas, the Keeper has the knowledge of where data is stored and retrieved.

3.2 Technical Design Issues

Technical design issues do not hinge on the complex data structure needed to represent an activity chain, as well as the relationships among chains. It is how chain objects are created, accessed, represented, and viewed that presents new design challenges in the platform environment. Figure 5-4 shows the relationships among chain objects and processes in a platform. Action processes create and access chain objects. The chain objects are then presented to the view processes. Based on these individual views, action processes manipulate chain objects in an opportunistic manner. The complexity of the design issues for this Web-based platform comes in when there are many of these distributed processes operating concurrently on many different chain (information) objects. Distributed processing and centralized object management individually has previously been addressed in different contexts and in different environments (Kramer et al., 2000; Wieczerzycki, 2000; Jorng and Chen, 2001; Kuo et al., 2001; Puustjarvi, 2001). However, dynamic relationships of platform characteristics and the Web-based operating environment introduce new considerations on these issues.

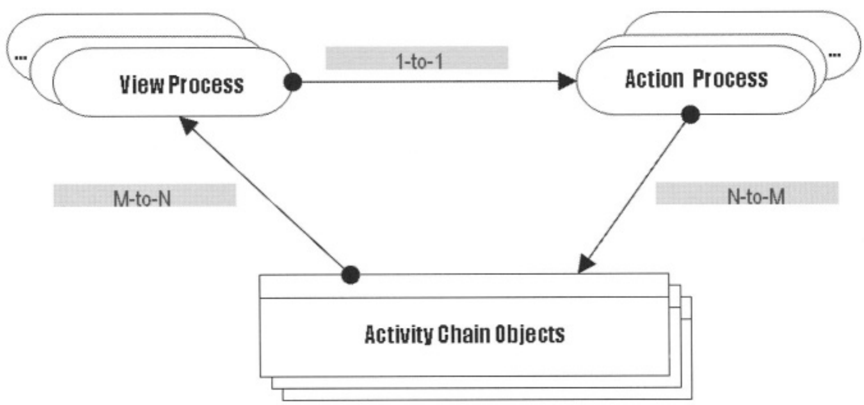


Figure 5-4. View Processes, Action Processes, and Objects in the Platform

Distributed Action Processes. Distributed action processes appear in the platform to manipulate one or more chain objects. Each action process can interact with other processes as a group and in different groups. Each group can concurrently engineer a new chain object, or operate on part of an existing chain object. Concurrent engineering of an object by distributed user processes is not new (Hasselbring, 2000). For example, using a system defined data exchange format in concurrent engineering, distributed users cooperate on the development of a product in a networked CAD/CAM environment (Chao and Wang, 2001). The framework was proposed in a networked environment but not Web-based. Similarly, distributed processes in a Web-based environment (e.g., online games) operate on a known object in a well-defined sequential manner. In both cases, processes operate on one pre-existing structured object. In an integrative platform, the following differences contribute further to the complexity of the design:

- There are no pre-existed chain objects. They are to be constructed. Its structure and content are not predefined – this means that actions from processes are not handled as straightforwardly as content fulfillment of an existing structure. Flexibility must be provided to manipulate a chain object during construction.

- Which distributed action processes would participate in the construction of a chain is not known a priori – this requires that the relationships between processes and objects must be updatable.
- The composition of the group that operates on a chain object can change dynamically – this requires that chain objects must be adaptable to dynamic number of contributing processes and simultaneous constructions at different points of a chain.

Concurrency control common to a distributed processing environment where shared objects are used must also be considered. The many-to-many process-object relationship requires a tighter formulation of concurrency. Processes are decoupled with each other operationally, but logically they must be linked. In this platform, concurrency control must guarantee the correctness of chains construction based on which processes are participating and when are they participating. In general, the design must be able to keep track of

- a group of processes that operate on an object asynchronously
- multiple groups on an object
- multiple groups on multiple objects concurrently being created

Individualized View Processes. Action processes operate on object chains, but corresponding view processes must be individualized as part of the requirement of the platform, to maintain information separation among users. The Web-based environment adapts best for centralized chains management due to its limited client-side capability in a browser environment. The design difficulty of these view processes is how centralized data can be distributed consistently to view processes such that information secrecy and confidentiality can be maintained in this new platform environment. That is, for each change in the centralized data, how each view process will visualize the change depends on the process's role. The role of each online game player is the same since the view will be the same for all other players. The role of each user in the platform will be different. To accomplish individualized views locally from a centralized data source, the difficulty lies in the design of the one set of information that must be passed on to all view processes, such that each can render the information sufficiently and appropriately based on its role. Data structures for this platform would not be simple. A suitable design would have to address the complexity issues discussed above.

3.3 A System Construct

A platform system construct is proposed here to resolve some of the design issues. To address the need of providing an activity fabric to facilitate centralized management, a fabric data structure is defined here. An activity fabric is an object consists of a set of attributes that identify the users and conditions as when the chain is created, and a pattern. The pattern object is organized as a set of connected *icons,* in a temporal or a spatial manner. An icon encapsulates information of a trading activity (*ecommerce* icon), an e-Business process trigger point (*trigger* icon), or another fabric (*fabric* icon). Each trigger icon contains one or more mosaics. A mosaic denotes a component business process, each component consists of a sequence of tasks. Each task is a template in itself, listing the steps required to accomplish the task. Templates can be generic business task templates, or modified for individual needs. Each step identifies the information and/or action needed. This recursive data structure is sufficient to capture the possible combinations of that a chain can take on.

This centrally managed data structure also reduces the concurrency control problem associated with distributed action processes to a problem of serialization. When proper time stamping is use to serialize the distributed actions, the many-to-many process-action issues are resolved in this case. For any-to-any online communication, an underlying communication mechanism using sockets must be established to allow dynamic communication links to be setup between the parties. There are middleware that provide such functionality for quick adoption. After communication channels are established, parties can request that specific information items in the conferencing are to be gathered for an activity chain. This can be done by using conferencing template to guide the parties on which information items they must settle.

When dealing with the individualized view processes, roles are used to guide each view process to properly and securely visualize new or update information. Two basic roles are defined. One, of course, is the originator role with respect to an action, the other is the bystander role. For the originator, the action will be visualized with full disclosure of content. The bystander role reflects only the effect of an action, no specific content will be shown. A user can specify filtering parameters (what to show and what not to show) and presentation parameters (how to show). Lastly, end-to-end information flow is coded as template-based messages. These templates follow a common data representation standard, e.g., XML, to consolidate the data interfacing between components to one common implementation issue.

4. A 4TH PARTY INTEGRATIVE PLATFORM FOR THE AIR CARGO LOGISTICS INDUSTRY

The industry is unique in that a logistics chain (i.e. an activity chain) involves many agents. As and when logistics services are negotiated and traded, members can concurrently design the actual logistic chain. We will provide a discussion next on the design and implementation of such e-Platform.

4.1 System Design

Figure 5-5 shows the system design of the logistics platform. Two sub-components, Message Transport and Optimizer, require some explanation. Message Transport, a sub-component of the Dispatcher, uses MOM to accomplish the transport capability of the Dispatcher and at the same times, handles all the communication needs of the platform – a message-based integrative platform. Optimizer, a sub-component of the Mosaic Generator, is the e-Business support module that handles advanced process-editing of air cargo logistics processes.

4.2 Web Technology

Web technology revolves around four major areas, namely, communication, representation, language and storage. The trend is towards the fusing of the four technology areas, from integrated query language into programming language environment, such as JDBC for Java, to embedding data representation scheme and procedure invocation mechanism into the payload of a protocol such as SOAP. In general, XML provides data interoperability at a time where the prevailing HTML cannot offer (Seligman and Rosenthal, 2001). Using XML to enable an electronic marketplace in a global scale to allow collaborations between enterprises has been proposed in ebXML (Business Process Team, 2001; ebXML Technical Architecture Project Team, 2001). We have chosen XML as the platform's data and information representation format to encode end-to-end information flow. XML schemas are defined for different levels of the platform, from logistics data such as Bills of Lading and Master Airway Bills to actions, events, and data store requests. This unified approach in using XML to represent all data and information simplifies the implementation of interfaces for all components in the platform.

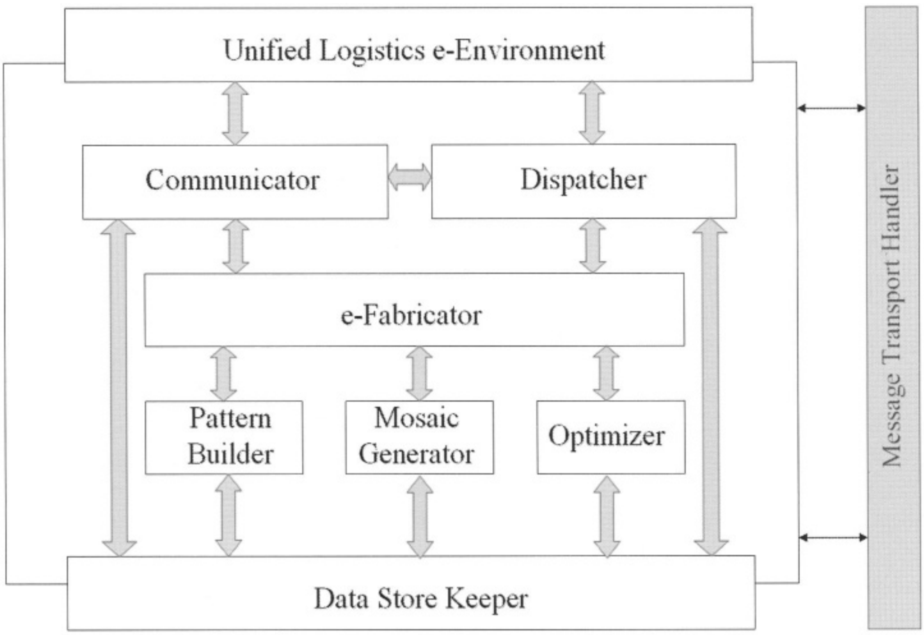


Figure 5-5. **System Design of the Logistics Platform**

Java's applet technology is chosen to realize the Unified Logistics *e*-Environment capability in a Web browser with JVM. This common Web-client browser interface provides anywhere access to the platform anytime, meeting the needs of logistics industry users with different levels of technology readiness. Signed Java applet is used to override the security sandbox to provide extended functionality such as retrieving local personal information for use in online processes. The Java Swing set provides sufficient underlying interactivity (event-listener model) and visualization (separation of control and model) API's to capture the functionality of the action and view processes in one interface.

To provide the transport of interactions between the *e*-Environment and other components of the platform, we borrow from the realm of distributed computing to use message passing (Argonne National Laboratory) for data and information across the network. Marshalling of data is not necessary since XML is the underlying data encoding format. One key reason why other technology such as Java's RMI (Remote Method Invocation), XML-RPC (St. Laurent et al., 2001) or SOAP is not used in the client side, is because of the choice to implement the e-Environment component as just an interface component. Through this interface, participants can come online to carry out activities the platform provides. We choose a message-oriented middleware (MOM), e.g., Progress's SonicMQ, to handle all message passing of the platform. The messaging system provides brokerage functions, point-to-point and collective communications, and secured, failsafe message delivery control. The flexibility of the platform design allows the use of more than one copy of MOM to provide the fault tolerance capability of the platform.

4.3 View & Action Processes

Specific logistics platform implementation with respect to the design issues will be discussed. First, the Unified Logistics *e*-Environment (ULE) component provides the solution for distributed action processes and individualized view processes in one unified interface. ULE is implemented as a trusted personalizable Java applet that is deployed over the network to be executed by the client's machine browser (using the same JRE). The ULE has two sub-components – a set of Padlets and the Communication Container.

Communication Container. The container is both a controller/facilitator of small and distinct workpad GUI objects, or padlets, and a provider of communication mechanism for padlets to communicate with external components. The communication mechanism, provided by the wrapper, works as follows. All action and view messages are in XML-format. For incoming view messages, the wrapper fires a signal to all padlets – effectively a broadcast operation. The event listener of each padlet works as a separate thread, which checks if any view updates are needed for that message received. A multicast operation is not used, even it is more efficient, to reduce the need to maintain groups. By decoupling the messages with padlets, new padlets can be added with ease, providing the extensibility characteristics of the ULE. For outgoing messages from any padlet, the padlet composes the messages and sends out the message by simply invoking a 'send' method in the wrapper. The container allows simple customization of each padlet with respect to layout and presentation.

Workpads or Padlets. Each padlet has the same action interface design, providing an unified generation of actions across all padlets (Figure 5-6). The padlet has three functional areas plus one real-time informational area. One of the three function areas is a 'Common Area' where general housekeeping functions are available (such as email, etc.) and it is common to all padlets. The real-time informational area is where real-time data will be displayed, e.g., how many participants are on-line, how many logistics service requests are active in the market.

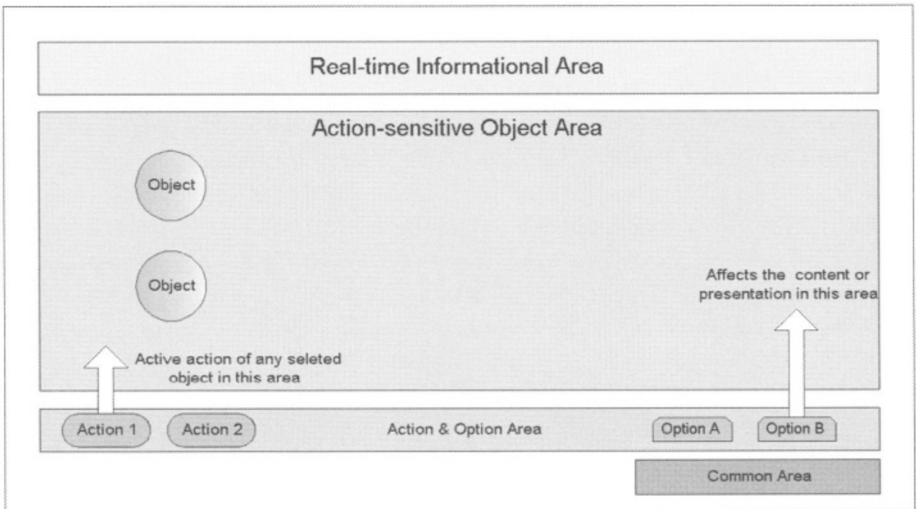


Figure 5-6. **Design of a Padlet**

The other two key function areas are 'Action-sensitive Object Area' and 'Action & Option Area.' The latter area has specific action buttons to register the user's next intended action without specifying an object to act on. Effectively, the padlet instantiates a specific action message template. When an action-aware object (i.e., equipped appropriately with an internal event listener) is selected, the particular participantID, object ID and specific information is encoded in action message template, and then is forwarded to the wrapper to send to the Dispatcher.

For the ULE to accomplish the view process functionality, each padlet will receive action messages from the Dispatcher, including action messages sent out by itself. Each update has a time-stamp of when this action is taken. Each padlet visualized the action message based on either one of the roles: an originator or a bystander.

Such padlet design extends the virtual viewing area of users. The environment can be extended easily by adding more padlets. It is easy to update the functionality of an existing padlet since the ULE is downloaded each time when a user logs on to the platform. Six different padlets for users in the logistics platform are designed, each differs substantially in its functionality. Switching between padlets is easy and similar to selecting a folder tab. Three of the padlets involve the presentation of action-aware objects in a table form. We extend the capability of JTable to allow sorting by column, allowing users to view information with respect to specific cargo properties such as dimension and origin.

4.4 Any-to-any Interaction

The Dispatcher opens up a few communication channels at startup to provide the basic communication needs of the platform. It sets up a private publish-subscribe channel to each online user's ULE. Each channel can have properties such as persistent messaging, time-to-live (this is important since we do not want outdated messages to remain in the publish topic), and security encryption. The Dispatcher maintains a hash table of all online users' profiles, and chains currently owned. When an action message is validated by other components, the Dispatcher then simply sends the action message back to the originator and all online users for individualized view processing. When a user requires conferencing, the Dispatcher will forward an event to the Communicator to handle the setup of any-to-any interaction.

The Communicator creates a temporary channel for any group of users that like to communicate online. This requires some handshakings between negotiating communication parties before the channel name is created and released to the group. Members of the group, using the 'Communicator' padlet, begin the interaction online. The padlet provides action buttons to request, join and exit a conference, and record the interaction. Option buttons are available for security level setting, anonymity and guided conferencing. When a XML-based conference template is requested to guide the interaction, information items needed are shown in the padlet. When an item is confirmed online by a user, a drag-and-drop action will mark the item, effectively creating an XML element tag over that item. We have implemented fault-tolerance mechanism to allow either the Dispatcher or the Communicator to take the role of each other if the message broker (SonicMQ) is down.

4.5 Concurrency Control

As action events are passing into the *e*-Fabricator from the Dispatcher, concurrency control is logically carried out by the Message Transport Handler as it puts a time stamp on the action message as it arrives. This soft time stamping does not reflect the true ordering of the actions taken by users due to network latency and traffic pattern of the Internet at that time. The hard time stamp with time zone adjustment is not possible in this Web-based environment at this time. As these events are serialized with respect to the time stamp, corresponding logistics fabrics will be updated. Each logistics fabric is implemented as a data structure as suggested in section 3.3 (Figure 5-7).

The logical structure supports parent-child node relationship of infinite breadth and depth in principle. The logical structure has also one primary root node that denotes the owner of the fabric. This node defines the accessibility of information by others for sharing. If the fabric involves more than one user, it is the Builder who guarantees based on participantID, the intertwined relationship of partners in a logistics activity chain is logically maintained, and protected.

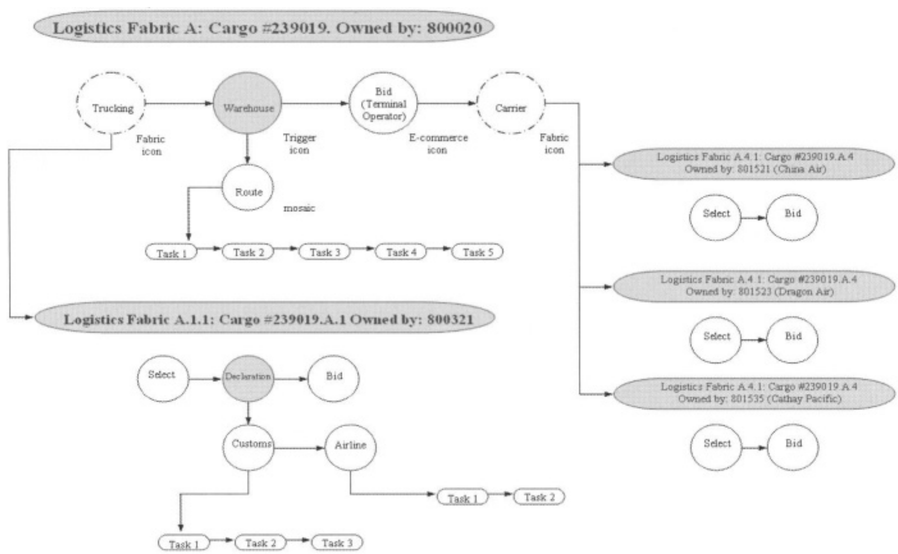


Figure 5-7. Logistics Fabrics for One Logistics Chain

5. A PROTOTYPE OF THE E-PLATFORM

We have built a prototype of integrative e-Platform using technology available at the time of this writing. Key platform components are designed and implemented as containers in a J2EE environment deployed on BEA Weblogic Application Server. Both data and information interchange will be handled as XML-based messages. Data store will be handled by a traditional DBMS (e.g., Oracle 9i).

Figure 5-8 shows the e-Environment provided as a signed Java applet, with different panes implemented as on-demand Java classes. The panes are padlets. The pane shown is a *real-time* view of the marketspace. E-Commerce activities can be conducted, while collaboration with other online users can be effected in the same environment (upper right corner window) as dynamics of the marketspace is shown.

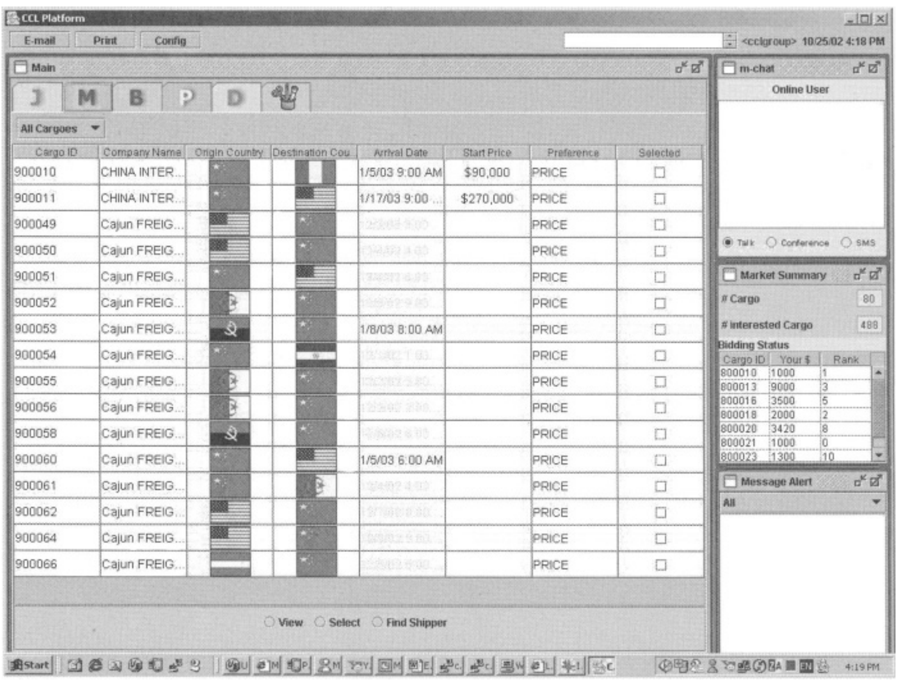


Figure 5-8. Marketspace Activities

Figure 5-9 shows the planning process of a logistics chain. This chain can be owned by a participant. The participant can be collaborating with other agents to provide such logistics service to the client. There are other padlets that support the management of logistics services, online decision support and document management of the participant.

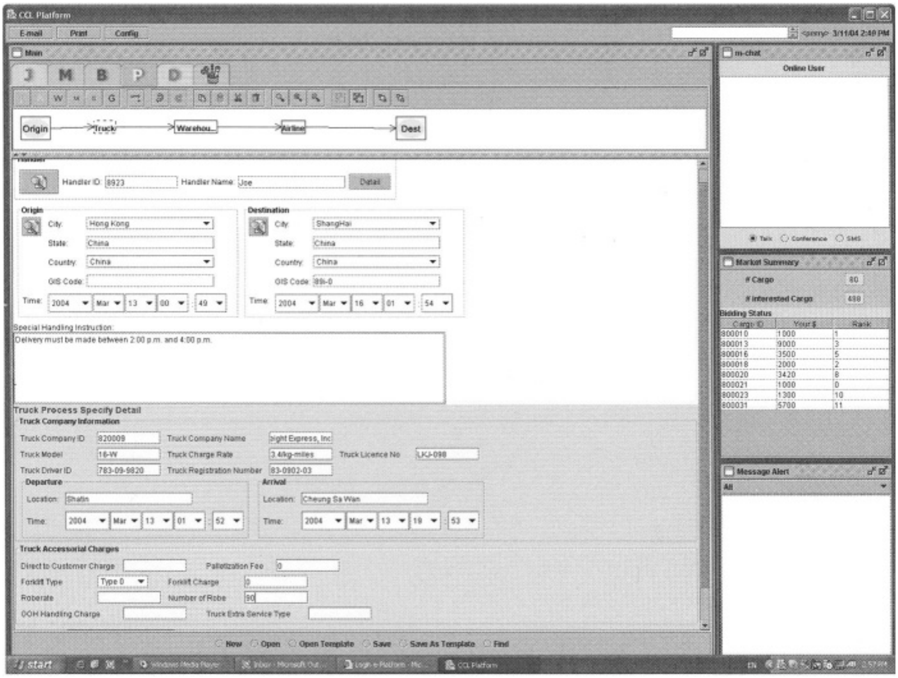


Figure 5-9. **A Planner Session of the e-Platform**

The prototype is also designed for connecting to Web services directories to locate needed logistics services that an agent could not provide.

6. CONCLUDING REMARKS

In this chatper, we have examined the technical issues involved in designing an integrative trading and management platform. We discussed in general the principal aspects of system requirement, system architecture, interface design, and information representation requirement. A chain-based platform architecture is presented to characterize the structure of such a platform. It is identified that the principal design difficulties lie with the combined features of 1) chaining of related activities, 2) any-to-any interactions, and 3) end-to-end integrative information handling. These three joint features require a system structure that is capable of handling distributed action processes with concurrency control and individualized view processes. Such a system structure has not been addressed within a Web environment in the literature. We solve the chaining problem by using a fabric data structure with patterns, icons and mosaics. The concurrency control of distributed action processes is resolved by using a soft time stamp of the platform to serialize incoming events. Generation of individualized views of centralized activity chains of the platform is accomplished by re-using the action messages which are sensitive to each view process's role. Finally, we showed how such an integrative platform is implemented for the air cargo logistics industry.

Chapter 6

E-PLATFORM DECISION SUPPORT: OPTIMIZING SHIPMENT DESIGN

1. INTRODUCTION

The 4th party e-Platform provides an environment whereby multiple logistics service providers can engage in effective online decision making. Such an online environment allows agents of business logistics processes to share dynamically changing information, thus enabling decisions that are well-informed, timely and flexible to customization. Strategic alliances or partnerships can be readily established even for individual jobs. It is entirely conceivable that individual logistics agents can be performing their own job design optimally while having inputs from each other interactively. The key factor in enabling such a decision making environment is the development of online decision support system.

In this chapter, we provide a simple scenario to illustrate the potential use of Web-based decision support systems. Here, we discuss a principal on-line decision support feature of the 4th party e-Business platform: the optimization of integration and consolidation of air cargo logistics activities. The efficiency of an air cargo depends on two important service designs: 1) the integration of consecutive activities for a given shipment and 2) the consolidation of similar activities across shipments. Optimizing the integration and consolidation of shipments should be a principal feature of the e-Platform. Such a Web-based optimization process is new to practitioners as well as researchers, and needs to be supported by an appropriate intelligent decision support system (Figure 6-1). This problem also represents the plausible use of 4^{th} party e-Platforms in providing decision support systems for multiple participants to solve their individual problems simultaneous and interactively.

For the present chapter, we will not consider the interactive aspects. Instead we will focus on how a single agent (freight forwarder) could use the e-Platform to optimize his job design. Next, we discuss the decision-making environment of air cargo forwarding and the role of a freight forwarder. We then formulate a mixed 0-1 linear program to optimize the integration and consolidation of activities. The formulation covers consolidations across different agents and shipments. An illustrative numerical example, solved using a Tabu search, is included.

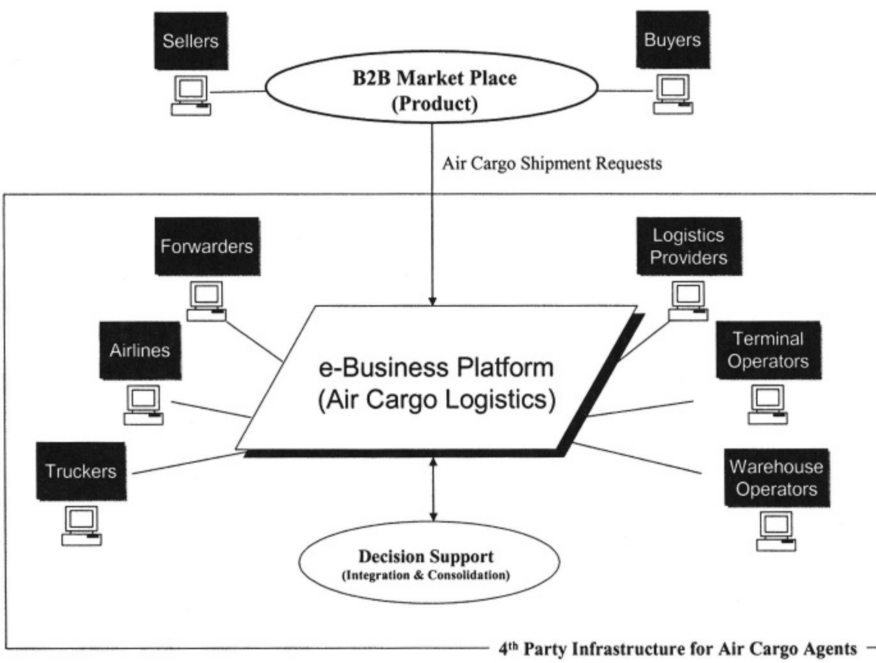


Figure 6-1. 4th Party Platform with Decision Support

2. THE PROBLEM ENVIRONMENT

The 4^{th} party e-Platform allows agents of the air cargo industry to operate simultaneously. An agent might specialize in the provision of a single logistics service (warehousing, trucking, etc.) or might provide a range of services (e.g. 3rd party service providers) or might even be able to provide logistics support for the entire shipment process (e.g. 4th party service providers, integrators). And logistics agents commonly form alliances. Among the agents, freight forwarders have a unique role. Analogous to a travel agent, a freight forwarder handles a shipper's request and is typically responsible the management of a shipment and acts as a liaison with other agents for the client. Forwarders also provide a range of logistics services.

During the process of selecting agents for individual activities of a shipment process, a forwarder must assess the efficacy of the overall logistics process. Here, the effectiveness of individual agents should not be evaluated at the activity level but at the overall process level, taking into account the decisions and constraints of inter-related activities. The objective is to select the logistics agent(s) such that the cost, benefit, and risk of the logistics process is optimized.

To simplify the discussion, we focus on a single freight forwarder. It is quite common that a forwarder handles quite a number of shipments (jobs) concurrently, whose responsibility is to assign the respective activities of each job to the respective industry agents (processing units). These processing units represent trucking, warehousing, air carrier, logistics services, etc. For the assignment of individual activities, a forwarder has a range of choices including assigning in-house resources, alliance resources, or brokering the processing to other agents of the industry (or to other forwarders) etc.

The shipment-design problem consists of two basic design characteristics. If consecutive activities of a job are assigned to the same agent or an alliance agent, then a saving can be achieved – this is saving due to integration. Integrating two consecutive activities reduces setup cost and setup time. It is also quite common that agents of the air cargo industry frequently collaborate to offer "package deals" where a discount is offered for an integrated series of activities. If activities of different jobs are consolidated into one to be performed by a single agent, then a saving can be realized – this is saving due to consolidation. Consolidation of shipments is the primary means to lower costs among shipments by achieving better utilization of resources.

A forwarder manages many jobs, which can be put into two categories: active jobs and frozen jobs. Active jobs include new jobs as well as jobs whose assignments are tentative and have not been frozen. Frozen jobs are ones whose assignments are final because it has passed, or is too close, to the action time. A forwarder's objective is to be able to achieve efficiency for all the active jobs.

There are clear tradeoffs issues in integration and consolidation, and between themselves as well. While integrating consecutive activities of the same job lowers setup cost, it may also mean not using a more efficient processing unit elsewhere. Similarly, while consolidating activities of different jobs lowers the cost for those activities, it may cause a delay for the activities and may increase cost for subsequent activities as well. Integrating consecutive activities could also create problems in consolidating activities across shipments and vice versa. There are also tradeoffs in terms of shipping reliability as well.

Historically, forwarders had to tackle this problem of integration and consolidation of shipments. Typically, the design process was not supported by reliable information and could be sketchy due to a considerable amount of guesswork and judgment. Collaborations between industry agents were largely limited as forwarders resort to previously agreed collaborations. This also meant a much higher level of uncertainty regarding whether a shipment could be successfully delivered. Such uncertainty resulted in a relatively large window for frozen jobs, thus diminishing the possibility of re-shoveling assignments.

The 4^{th} party platform permits forwarders to have access to updated shipping information and to form alliances online. There would be higher clarity regarding a shipment's cost and time as forwarders design jobs online with explicit information, current as well as archived. It opens up great opportunity for collaborations as industry agents function in an interoperable manner, thus resulting in dramatically better service. The 4^{th} party platform, along with its decision support systems, could revolutionize the decision-making process of air cargo logistics.

3. A MIXED 0-1 LP MODEL FOR INTEGRATION & CONSOLIDATION

In assigning the activities of a job, a forwarder may have many objectives including cost minimization, delivery time minimization, and minimizing risk in loss and damage. In this chapter, we will use cost minimization to illustrate how the problem can be formulated and solved. Leung et al. (2003) has earlier provided a similar formulation for this problem. However, resource constraints were not considered.

3.1 Objective Function

The goal of the model is determine the assignments, with or without integrations or consolidation, that would minimize the total cost of shipping a given number of jobs. The objective is the minimization of the sum processing cost of a set of jobs, which can be expressed as follows.

$$\textbf{Min:}\ \sum_i \sum_j \sum_k \{s_{ijk} + a_{ijk}\} x_{ijk} - \sum_m w_m y_m - \sum_n r_n z_n \qquad (1)$$

where

x_{ijk} = 1, if *i*th agent is assigned to activity *j* of job *k*, 0 otherwise.
y_m = 1, if all activities in the *m*th set are integrated, 0 otherwise; where each set defines a series of consecutive activities.
z_n = 1, if all similar activities in the *n*th set are consolidated, 0 otherwise; where each set defines a combination of similar activities.
s_{ijk} = setup cost of activity *j* of job *k* if *i*th agent is assigned to the activity.
a_{ijk} = processing cost of activity *j* of job *k* if *i*th agent is assigned to the activity.
w_m = setup cost savings due to integration of activities in set *m*.
r_n = cost savings due to consolidation of activities in set *n*.

3.2 Logical Constraints

There are two sets of constraints. The first set consists of logical constraints. They are as follows:

- *Assignment of agents to activities.*

$$\Sigma_i x_{ijk} = 1 \qquad \forall j, k \qquad (2)$$

- *Integration of two or more consecutive activities.*

$$y_m \le x_{ijk} \qquad \forall x_{ijk} \in \textit{integration set } m \qquad (3)$$

- *Consolidation of same activities.*

$$z_n \le x_{ijk} \qquad \forall x_{ijk} \in \textit{consolidation set } n \qquad (4)$$

- *Logic constraints for integration.* First, we need to ensure that the assignment of multiple integrations must be preceded by the assignment of its corresponding basic components. We partition all possible integrations into two groups $\{\Pi_1, \Pi_2\}$ where Π_1 is the set of single integrations (integration involving only one pair of activities) and Π_2 is the set of multiple integrations (integration of more than two consecutive activities). Here, y_{π_2} = 1 when all $x_{i,j,k}$ = 1, $\forall x_{i,j,k} \in \pi_2$ and $\pi_2 \in \Pi_2$. That is,

$$\sum_{x_{i,j,k} \in \pi_2} x_{i,j,k} - q_1 + 1 \le y_{\pi_2} \qquad (5)$$

where q_1 equals to the total number of elements in set π_2.

Then we must also ensure that when a multiple integration takes place, the corresponding constituent sub-combinations will not be assigned.

$$\sum_{\pi_2^{(1)} \subset \pi_2^{(2)}} y_{\pi_2^{(1)}} \le (1 - y_{\pi_2^{(2)}})L, \qquad (6)$$

where $\pi_2^{(1)} \subset \pi_2^{(2)}$ means $\pi_2^{(1)}$ is a proper subset of $\pi_2^{(2)}$ and L is a very large number.

- *Logic constraints for consolidation.* Similarly, we ensure that the assignment of multiple consolidations must be preceded by the assignment of the corresponding components. We partition all possible consolidations into two groups $\{\Omega_1, \Omega_2\}$ where Ω_1 is the set of single consolidations (consolidation involving only one pair of activities), and Ω_2 is the set of multiple consolidations (consolidation of more than two similar activities). That is z_{μ_2} = 1 when all $x_{i,j,k}$=1, $\forall x_{i,j,k} \in \mu_2$ and $\mu_2 \in \Omega_2$.

$$\sum_{x_{ijk} \subset \mu_2} x_{i,j,k} - q_2 + 1 \le z_{\mu_2} \qquad (7)$$

where q_2 equals to the total number of elements in set μ_2

To ensure that when a multiple consolidation takes place, the corresponding constituent sub-combinations will not be assigned.

$$\sum_{\mu_2^{(1)} \subset \mu_2^{(2)}} z_{\mu_2^{(1)}} \le (1 - z_{\mu_2^{(2)}})L, \qquad (8)$$

where $\mu_2^{(1)} \subset \mu_2^{(2)}$ means $\mu_2^{(1)}$ is a proper subset of $\mu_2^{(2)}$.

3.3 Resource Constraints

The second set of constraints consists of resource constraints. These constraints ensure that the consolidations do not exceed capacity constraints, that the target cost of a particular job is not deviated, and that the shipment must be able to arrive on time.

- *Capacity Limit*

$$\sum_j \sum_k v_{jk} x_{ijk} \le V_i \; \forall i \tag{9}$$

where v_{jk} is the resource requirement of activity type *(j,k)* and V_i is the capacity of agent *i* for this activity type.

- *Target Cost*

$$\sum_i \sum_j \{s_{ijk} + a_{ijk}\} x_{ijk} - \sum_m w_m y_m - \sum_n r_n z_n \le b_k \tag{10}$$

where $\sum_m w_m y_m$ is savings due to integration for job *k,* $\sum_n r_n z_n$ is savings due to consolidation of activities *(j,k),* and b_k is the target cost of job *k.*

- Target Completion Time

$$t_{ij} - d_m y_m + T^{h-1} \le T^h \tag{11}$$

$$t_n + T^{h-1} \le T^h \tag{12}$$

where t_{ij} is the processing time for agent *i* perform activity *(j,k),* d_m is the time saving due to integration and t_n is the time needed to complete a set of activities given they are consolidated. T^h is the completion time after activity *(j,k)* of job *k,* and the completion time of the last activity of job *k* would be the job's target completion time.

3.4 The Model

Both constraints (6) and (8) are needed to ensure that the costs involving multiple integration or multiple consolidation do not include the constituent sub-combinations. Such constraints can be deleted if we redefine the incremental cost of multiple integration or consolidation as follows:

$\Delta w_m = w_m - \sum_{\pi \subset \text{integration } m} \Delta w_\pi$, incremental cost for having integration *m.*

$\Delta r_n = r_n - \sum_{\mu \subset consolidation\ n} \Delta r_\mu$, incremental cost for having consolidation *n*.

For example, if the savings of integrating activities A and B is \$6, of integrating B and C is \$5 and of integrating A, B, and C is \$9, then Δw_m for ABC would be -\$2. With the redefinition, the model's objective function and the constraints are now as follows:

$$\textbf{Min: } \sum_i \sum_j \sum_k \{s_{ijk} + a_{ijk}\} x_{ijk} - \sum_m \Delta w_m y_m - \sum_n \Delta r_n z_n \qquad (13)$$

$$\sum_i x_{ijk} = 1 \qquad \forall j, k$$

$$y_m \le x_{ijk} \qquad \forall x_{ijk} \in m,$$

$$z_n \le x_{ijk} \qquad \forall x_{ijk} \in n,$$

$$\sum_{x_{ijk} \subset \pi_2} x_{ijk} - q_1 + 1 \le y_{\pi_2}$$

$$\sum_{x_{ijk} \subset \mu_2} x_{ijk} - q_2 + 1 \le z_{\mu_2}$$

$$\sum_j \sum_k v_{jk} x_{ijk} \le v_i$$

$$\sum_i \sum_j \{s_{ijk} + a_{ijk}\} x_{ijk} - \sum_m w_m y_m - \sum_n r_n z_n \le b_k$$

$$t_{ij} - d_m y_m + T^{h-1} \le T^h$$

$$t_n + T^{h-1} \le T^h$$

$$x_{ijk},\ y_m,\ z_n \in \{0,1\} \quad \text{and} \quad T^h \ge 0$$

The above formulation is a mixed 0-1 linear program. In general, for solving such problems, there are two basic approaches: optimization and heuristic. The following reviews a sample of the respective approaches.

Optimization approaches are typically based on branch and bound, and branch and cut. These implicit enumeration approaches seek to exploit the specific nature of the problems to develop bounds and fathoming criteria. Examples of such are Kaku and Thompson (1986), where a quadratic assignment problem is linearized and decomposed into n^2 sub-problems; Madan and Gilbert (1992), where the objective function is split into three parts; and De Farias et al. (2000), where three families of facet-defining valid inequalities for a generalized assignment problem.

In assignment problems, heuristics with relaxation procedures and/or simple rules have been used. Relaxation procedures include D'Alfonaso and Ventura (1995), where the problem of assigning tools to machines is decomposed into several knapsack sub-problems and are solved using subgradient algorithm. In Antonio et al. (1995), a subgradient algorithm is used on the problem of assignment with capacity constraints, with Lagrangian or surrogate relaxation.

Many lot sizing and grouping problems have been formulated as linear 0-1 programs for which heuristics have been proposed. A LP-based heuristic for lot sizing is developed in Maes and McClain (1991). Katok et al. (1998) designed a heuristic for lot sizing in general assembly system. Bertazzi et al. (2000) developed a heuristic method that can solve lot sizing in a special case in pseudo-polynomial time. For grouping, Lee and Kim (2000) suggested rule-based heuristic algorithms for a loading problem with partially grouped machines; and Dobson and Nambimadom (2001) proposed a set of heuristics a batching and scheduling problem.

Some sequencing problems (0-1 LP) have also been solved using heuristics. Belhe and Kusiak (1997) used the beam search method to the problem of dynamic scheduling of design activities. Lee et al. (2001) provided a fathoming bound instead of the mathematical bound and developed a branch and fathoming algorithm for the operational sequencing problem. Tabu search has also shown to be viable approach to solve setup-dependent problems formulated as MIP problems (Laguna, 1999; Sun et al., 1999).

4. AN ILLUSTRATIVE EXAMPLE SOLVED USING TABU SEARCH

In this section, we provide an illustrative example. There are 3 jobs, each have 3 activities, and there are 3 agents capable to perform the activities. The activity cost, time and resource requirement of each job are shown in Table 6-1. The activity capacity limits and the target completion times are also given in Table 6-1. The cost and time savings for integrations and cost saving for consolidations are shown in Tables 6-2 and 6-3.

Table 6-1. Basic Activity Costs, Times and Resource Requirements

		Activity 1	Activity 2	Activity 3	Completion Time Limit
		cost, time, resource			
Job 1	**Agent 1**	10, 4, 8	34, 3, 15	23, 8, 16	15
	Agent 2	Not available	36, 7, 15	24, 4, 16	
	Agent 3	Not available	33.5, 15	22, 3, 16	
Job 2	**Agent 1**	15, 5, 12	25, 5, 17	34, 4, 20	17
	Agent 2	Not available	27, 8, 17	32, 7, 20	
	Agent 3	12, 5, 12	Not available	33, 6, 20	
Job 3	**Agent 1**	Not applicable	45, 5, 24	50, 5, 25	10
	Agent 2	Not applicable	47, 3, 24	52, 7, 24	
	Agent 3	Not applicable	44, 7, 24	54, 4, 23	
Capacity	**Agent 1**	30	78	100	
Limit	**Agent 2**	Not available	85	50	
	Agent 3	15	50	70	

Table 6-2. Cost and Time Savings for Integrations

		Activities 1 & 2	Activities 2 & 3	Activities 1, 2 & 3
		cost saving, time saving		
Job 1	Agent 1	3, 3	3, 2	5, 4
	Agent 2	Not applicable	1,2	Not applicable
	Agent 3	Not applicable	2, 2	Not applicable
Job 2	Agent 1	2, 3	5, 2	6, 4
	Agent 2	Not applicable	3, 2	Not applicable
	Agent 3	3, 0	2, 3	3, 0
Job 3	Agent 1	Not applicable	2, 4	Not applicable
	Agent 2	Not applicable	1, 1	Not applicable
	Agent 3	Not applicable	1, 1	Not applicable

Table 6-3. Cost Savings for Consolidations

		Jobs 1 & 2	Jobs 2 & 3	Jobs 1 & 3	Jobs 1, 2 & 3
		cost saving			
Activity 1	Agent 1	1	Not applicable	Not applicable	Not applicable
	Agent 2	Not applicable	Not applicable	Not applicable	Not applicable
	Agent 3	Not applicable	Not applicable	Not applicable	Not applicable
Activity 2	Agent 1	1	2	2	4
	Agent 2	3	4	1	6
	Agent 3	Not applicable	Not applicable	2	1
Activity 3	Agent 1	2	2	1	4
	Agent 2	1	1	2	3
	Agent 3	3	3	1	4

This problem is solved using a basic Tabu search algorithm (Glover and Laguna, 1997). Detailed discussion of the algorithm can be found in Wong et al. (2003). The initial solution is as follows and the cost is 228.

Activity assignment (X_{ijk})	111	321	331	312	122	232	323	133
Cost	10	33	22	12	25	32	44	50

Here, both activities 2 and 3 of job 1 are assigned to agent 3. There are 2 units of cost saving and 3 units of time saving due to integrations. Next, since activity 2 of job 1 and job 3 are assigned to agent 3, 2 units of cost saving due to consolidations, but the processing time of job 1's activity time increases from 5 to 7 regardless there is time saving due to integration. On the other hand, as time constraint of job 3 is violated, we add a penalty of 1,000 to the total cost. The total cost is 228-2-2+1000 = 1224; best cost is 1224.

Iteration Number 1

The length of the Tabu Queue is set to be 4. We find all the neighboring solutions of the current solution, i.e. if the activity was originally assigned agent 2, we calculated the cost by assigning it to either agent 1 or 3. The neighboring solutions of the current solution are:

Add	Drop	New Cost
211	111	2214
221	321	1231
231	331	1230
212	312	2215
222	122	1230
132	232	1230
332	232	1229
223	323	229
233	133	1229

Activity assignment (X_{ijk})	111	321	331	312	122	232	223	133
Cost	10	33	22	12	25	32	47	50

The cost is 229 and best cost is updated to 229. For this solution, there is no consolidation. In job 1, with the integration of activities 2 and 3, there is a time saving of 2 units. Next, node 323 is dropped and put into the Tabu Queue, it must wait for 4 iterations before it is eligible for consideration. The Tabu Queue after iteration 1 is: **(323, __, __, __)**

Iteration Number 2

The neighboring solutions in iteration 2 are:

Add	Drop	New Cost
211	111	1219
212	321	234
231	331	232
212	312	1217
222	122	1224
132	232	231
332	232	227
123	223	225
323	223	1226
233	133	1227

The cost is 225 and best cost is 225. The solution after iteration 2 is:

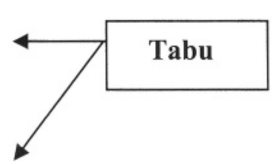
Activity assignment (X_{ijk})	111	321	331	312	122	232	123	133
Cost	10	33	24	12	25	32	45	50

For this solution, there are 2 sets of integration: 321 and 331; 123 and 133, with no constraints violation. Node 223 is dropped and added into the Tabu Queue. The Tabu Queue is **(323, 223, __, __)**.

Iteration Number 5

After 5 iterations, the neighboring solutions are:

Add	Drop	New Cost
211	111	1215
221	321	227
131	231	1224
331	231	221
212	312	1213
222	122	234
232	132	227
223	123	231
233	133	1226



Nodes 331 and 232 are still in the Tabu Queue, and they do not fulfill the aspiration criteria. We choose the other best result with the cost of 227 instead. The Cost is 227 (no constraints violation) and Best Cost is 221 (with no update in best cost). The solution is:

Activity assignment (X_{ijk})	111	221	231	312	122	132	123	133
Cost	10	36	22	12	25	33	45	50

After 5 iterations, the best result now is 221. To test whether this is a local optimum or a global optimum, Tabu search starts to search for other good solutions from iteration 4. With this adaptive memory and responsive exploration, it can quickly get close to the optimum solution and escape from the local optimum.

The solution procedure is a service available to all participants in the e-Platform. Coded in Java, the service can be implemented as a Web-based server-side application using a browser interface, or it can be deployed as an optimization component remotely by a Plug-in Client. Computationally, the Tabu search requires very little time.

5. CONCLUDING REMARKS

We believe Web-based e-Business platforms, in general, provide an excellent environment for integrating business processes with multiple processing agents. This is particularly true for vertical business processes such as air cargo shipping. The success of such e-Platforms depends on the development of intelligent decision support systems that allow complex decisions and knowledge management to be performed online. In this chapter, we propose that a 4^{th} party e-Business platform that allows the online integration of business transactions would be of great benefit to the air cargo industry. We also formulate the basic problem of shipment integration and consolidation as a mixed 0-1 linear program.

The problem presented in this chapter merely scratches the surface of this research topic. The problem can be considered as the simplest problem in that a job involves only a single origin and a single destination with the same content throughout. But a complex job could require shipments from several origins to several destinations where the content of individual component shipments may be different. There are also many variations to the model formulation, including minimizing cost subject to time constraint, minimizing time subject to cost constraint, minimizing risk subject to cost and time constraint, or simply some composite objective criterion.

We believe that air cargo logistics in an e-Business environment is a very challenging topic. The online environment permits access of dynamically changing information between multiple agents, allowing clarity and lowering risks for decisions that are previously difficult to make. The environment also enables strategic alliances or partnerships to be formed for individual jobs. As logistics service providers are increasing their participation in managing the supply chains of enterprises, the decision environment is likely to become even more complex. Lastly, a powerful decision-making scenario of online integration with multiple agents is that individual agents can be optimizing their own problems but with inputs from each other. Such interactive collaborations could suggest modeling interplay of agents within a game theoretic setting – but the complicating factor is that these games would be played online thus requiring tremendous computational efficiency.

Chapter 7

BUSINESS INTELLIGENCE FOR AIR CARGO LOGISTICS

1. INTRODUCTION

In the digital economy, competitors are only a mouse click away. Customers are more demanding and selective than ever before. To gain competitive advantage and to provide customized services, decision makers must have at their disposal business intelligence tools to report/view business activities, to assess firm performance, and to plan strategically their position in the global market. That is, knowledge needs to be managed to sustain renewal of competitiveness. Firm level information systems, such as management information systems (MIS) or executive information systems (EIS), are often used to fulfill the executives' decision making information needs.

In the new integrative era, innovative approaches and new tools are needed for executives to act and respond in a timely manner *online*. On any online trading platform, a new kind of business intelligence system must be able to deal with vast amounts of data captured online, and capable of extracting knowledge that is actionable. Such needs remain crucial to executives of each community in the 4th party logistics e-Platform. Moreover, business chains that link up to this e-Platform for logistics support require performance data of logistics service providers, route resilience, and risk evaluation to accurately predict the chain cycle time.

The nature of data in the e-Platform is special – it is trusted and community-rich, uncommon features in the pre-Web era. E-Platform data are job-oriented and sequential since the platform is chain-based, and consequential because business transactions are finalized and usually reach completion. CRM tools can be included in the e-Platform if after sales activities are to be supported.

Thus, knowledge management on the e-Platform is multi-faceted (e.g., of the logistics chain, and for a supply chain) and cross-functional (e.g., among logistics communities and across industries). Knowledge discovery is fact-based, deductive and conclusive. For example, on the e-Platform, users from the same and different communities work together on a logistics chain. The process includes collaborative interactions and transactional exchange among participants. The activities include shipment-based logistics chain incubation, negotiation and formation in the online marketspace, and real-time management of the cross-provider fulfillment services. These related transactional market and business data are new and must be handled discretely, stored anonymously and exposed securely to allow their full usefulness in knowledge discovery.

In this chapter we identify valuable information that is available on this community platform, and establish how the information can be mined to extract relevant and specific information to guide participants to stay competitive and act efficiently in this information-rich economy. We focus on business intelligence systems in general, briefly discuss its role in the new integrative era for the air cargo logistics industry, and give a discussion of data mining in the context of air cargo logistics.

2. BUSINESS INTELLIGENCE

Business intelligence (BI) is knowledge gained from using technology to gather, manage and analyze vast amounts of data to drive strategic business decisions. BI provides executives with decision support that is fact-based and often with actionable information. BI technology includes data warehousing, data mining, and on-line analytical processing (OLAP).

In this chapter, a business intelligence system (BIS) is used as a broad term to include MIS, EIS, and DSS (decision support systems). Fundamental to these different systems is the need to report business activities and to mine knowledge for decision making from vast and diverse data sources. An MIS extracts information from internal corporate data to help managers to act and respond to daily operational requirements. An EIS discovers knowledge from internal and external data sources to help executives to project long-term trends to steer the firm's strategy in the right and profitable directions. Decision support systems provide analytical tools to sift through stored current and historical data to provide credibility and assertions for decisions to be made. Clearly, these supportive processes remain crucial to business operations at different levels.

These traditional information systems must make changes to operate effectively in the new integrative era. What is needed is for the systems to adapt to the changing landscape of how data can be and is collected, stored and retrieved. New tools are required to facilitate users to access and manipulate data online, offline and across corporations and industries. Current BIS development is geared towards such issues. A brief discussion of a traditional EIS next illustrates the challenges and the important role of a BIS in the integrative era.

2.1 Executive Information Systems (EIS)

Traditional EISs are specially designed information systems that extract knowledge from internal and external data sources. They enable executives to monitor and track critical success factors (i.e., indicators) of their enterprise via customized reports and presentation formats.

Internal data sources are characterized by the firm level scope and its one-dimensional aspect. The scope of data or databases is limited to the corporation, and recently with technology, is accessible via the intranet. Other dimensional perspectives must be supported with external data sources, via extranet to a partner's database, or from Web-based public information portals.

A traditional EIS has a simple and easily managed architecture. The two major components are:

1) a centralized database – a repository for storing data extracted from various sources, and,
2) an analytical engine – for data analysis and knowledge presentation and reporting.

The centralized database offers efficiency in the processing of queries and analyses. However, data from different sources often poses an incompatibility problem when populating or updating the centralized database. Sometimes, these incompatibilities are manually resolved in an ad hoc manner. Moreover, traditional EIS architecture only supports predefined and primitive data analyses. These analyses cannot satisfy executives' analytical needs, which are usually innovative and multidimensional in nature in the integrative era. Hard-coded resolution of data incompatibilities makes this architecture inadaptable. The difficulties associated with the use of a traditional EIS have led researchers to study ways of:

1) integrating and accessing data from distributed, heterogeneous data sources, and,
2) analyzing data in a multidimensional manner.

These two new requirements are fundamental to the operators on the e-Platform. Data interoperability among participants is enabled in the e-Platform due to the need to handle existing diverse and incompatible systems used by participants from different communities. Multidimensional aspects are concretely established in the e-Platform since data originating from different communities are inherently linked and related. In addition, these EIS capabilities must be conducted online, alongside e-Business.

Thus, to advance an EIS to an interoperable and multidimensional state, one must review carefully the role of the EIS in the Web-based net-enabled environment, and review its functional architecture used to support multidimensional business intelligence. Collectively, a BIS possesses these capabilities, and we describe one approach in storing and managing e-Platform information in data warehouses, and suggest an approach for a BIS to take advantage of this new information vault to provide intelligent support to executive decision makers in the air cargo logistics industry.

2.2 Business Intelligence System in e-Platform

In a B2C context, information such as customer profiles, buying habits, product profitability and competitive analysis can be extracted from online data. In the context of air cargo logistics, information such as business chain profiles, logistics needs, route profitability, and partner cooperation could be obtained. For example, sector-specific service portals such as Portnet (in Singapore) or Tradegate (in Australia) each has data in container shipping and air cargo respectively. In addition to this kind of individual firm-level business intelligence, e-Platform could provide other information that cut across multiple logistics chains, and to certain extent, the business chains the logistics fulfillment is for. This kind of business intelligence is crucial to the facilitation of conducting e-Business online. Comparative information is often available such as success rates, logistics chain efficiency, business practices, and a global view of logistics need. An online BIS will be able to provide participants with a precise portrait of the online business climate, and itself can be becoming a regular aspect of online e-Business processes.

The objective of a BIS is to transform quite often unstructured or semi-structured data into useful information. The transformation may involve analyzing volumes of data for unsuspected, but valuable, associations and interdependency. The information obtained is not from one data source, but a combination of data sources, in databases or data warehouses.

Most new tools developed for BIS are based on the concept of information aggregation. Operating in the e-Business environment, user requirements tend to be spontaneous, changing and vague. Data needs may conflict at times. To overcome these strenuous demands, information aggregation can be conducted in two separate steps: to aggregate, and then to distill, structured and unstructured data. The two steps are here called populate-on-demand (Population) and access-with-accuracy (Information Access).

Population acts to apply data collection techniques such as extraction, cleansing, restructuring, and combining to prepare needed data in a usable form. Information access applies software technology to discover knowledge from the prepared raw data. The most challenging aspect of these BIS tools is to be able to operate online, that is, Web-based and net-enabled. To facilitate the development of these new tools, we need an understanding of e-Platform data and its structure and the proposed data warehouses and data mining techniques.

3. MIS ON THE E-PLATFORM

An e-Platform participant, such as a forwarder, can benefit from the availability of firm level historical information. Past experience can help the participant to evaluate the feasibility and profitability of providing services to a particular logistics requirement on the e-Marketplace. This competitive decision can further be augmented by regional fulfillment patterns to gauge its urgency (e.g., time-to-settlement) and dominancy (e.g., an airline is the dominant player because of its preferential routing – the sole carrier). How this new knowledge can be discovered hinges on a number of factors of the e-Platform:

- Information model, i.e., security and privacy,
- Information structure, i.e., data warehouses, and,
- Knowledge discovery tools, i.e., BIS.

3.1 Information Model

As participants from different communities in the e-Platform trade and manage logistics processes online, enormous amounts of data are captured. Information derived from these data is used on the e-Platform to drive its operations, and facilitate online logistics design cooperatively and collaboratively. Data collected are shipment-centric. That is, information is primarily organized with respect to each shipment posted on the marketspace. The information model defines two stages of information flow in the e-Platform. The virtual stage in the collaboration platform, and the actual stage of the management platform (See Figure 7-1).

The virtual stage captures dynamicity of the marketspace, the temporal relationships of partners, the demographic influences on cooperation and collaboration, and more. The actual stage ties the information flow to the actual physical flow of the shipment. The effectiveness, or the lack of it, can be revealed and improved over time. Alternatively, we can look at the virtual stage as being market-driven, and the actual stage as business-driven.

At the platform level, participant identity and their respective transactional data are secured. That is, at the user level, each participant is anonymous to any other participants online by default. Data transparency and identity transparency are enabled and at the discretionary control of participants. As logistics services are traded and planned online, offering many varying solutions to fulfill a shipment's need, virtual logistics chains are created, edited, and one is eventually selected. These transactional data are recorded in the virtual stage of the model. The selected virtual logistics chain will become an actual logistics chain, entering the actual stage where hard data are collected until the shipment is complete.

To ensure privacy, a random anonymizer can be applied to the actual data to protect individual business secrets, while the relational information among participants in providing the eventual services is maintained.

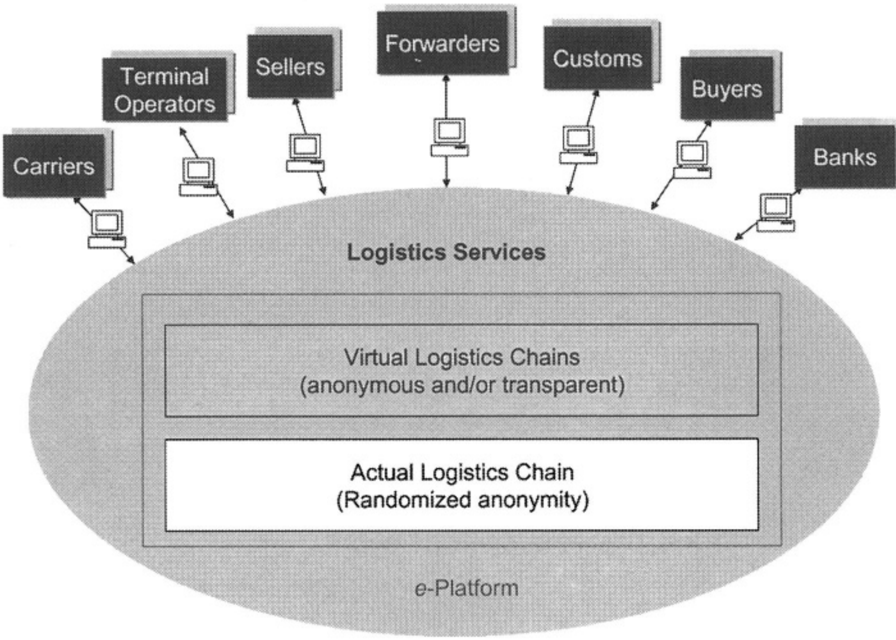


Figure 7-1. The Information Model

3.2 Information Structure

Participants in the e-Platform carry out their management and collaboration tasks online, creating a vast amount of transactional data, both casual and directed. We refer to such data, both collected and collectable, as e-Platform data. An information structure is suggested to manage the data (See Figure 7-2). The data have a number of characteristics that are unlike other online data.

Two types of transactional data are apparent in the platform. One is community specific, for example, airline transactional data with respect to a shipment. The other is collaborative data between communities. The first dataset is important in the sense that it characterizes services that an individual community provides to a shipment – capacity levels, demographic distribution, and bottlenecks if any. The other dataset provides both temporal and decision support information that can be used to project and quantify the behaviors of community players as partners and their cohesiveness.

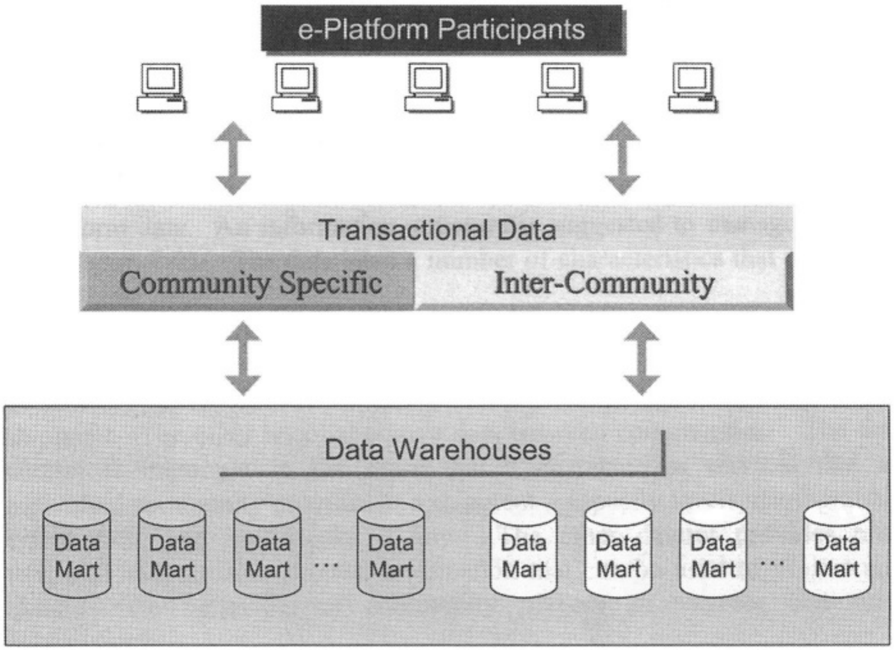


Figure 7-2. The Information Structure

As these data are collected, they are stored and organized into different data marts, each representing a particular segment of the participant group and the interactivity of participants. The data collected serves a number of purposes in the e-Platform:

1. the operational functions of e-Platform,
2. individual participants' operational needs,
3. the efficiency control of business chains,
4. the control of the physical flow of the goods during fulfillment periods, and,
5. management analysis and knowledge generation.

To support a BIS in the e-Platform, we need to realize the functionalities needed in the BIS and the data architecture that can be used. Here, e-Platform data are stored in three distinct types of data store:

- Factual data store: The actual stage data store plus e-Platform usage data – users, access, demographic.
- Participant data store: This data store contains community-specific, company-based participant data. These are detailed, reconciled, and historical data structured to provide as firm level data sources for management to extract business intelligence.

- Operational data store: This data store holds all the transactional data manifested on the e-Platform. This is for the operational aspects of the e-Platform in a read-only format. Only data from the virtual stage is stored.

The question of how these characteristics can be leveraged by executives relies on the sophistication of BIS tools to make use of the new data in the decision support process. Some issues and suggestions are discussed next.

3.3 BIS in the Integrative Era

The role of BIS in the integrative era remains unchanged – executives need timely decision support to plan and to stay ahead of the competition. What is changing, firstly, is the operating environment, which has been shifting towards becoming Web-based and online. Secondly, it is increasingly the case that analytical tools must be able to deal with large volumes of multidimensional data available internally and/or externally. Lastly, business intelligence serves 'internally' of participants in the e-Platform, and 'externally' of business chain management.

Thus, a new EIS must be flexible, adaptable and deployed online, e.g., as a Web-based analytical tools. Flexibility refers to the ability to accommodate executives' changing needs in data analysis while adaptability refers to the ability to adapt to changes occurring in internal and external data sources.

Both the data warehousing technology and OLAP techniques rely on a predefined data schema and can therefore provide only limited flexibility and adaptability. Contemporary e-Business operation not only generates rich operational data on-line but also calls for the capability of analyzing these data in an ad hoc manner (i.e. on-line, flexible, and adaptable).

A new BIS must improve OLAP techniques. Although OLAP techniques support multidimensional data analysis, these techniques operate based on a pre-defined database schema, for example, a star schema. Data are stored into a proprietary multidimensional database or a relational data warehouse according to this schema. As a consequence, executives' needs in data analysis often cannot be entertained dynamically. New EIS architecture must afford tools with proper interfacing to allow real-time access to data warehouses, along with integration to the centralized database.

Furthermore, this vast amount of transactional data can be made available anonymously, indiscriminately, and collectively to support judicious decision making of individual participants and within the logistics chain as a whole. A BIS must be redesigned to adapt to the online demand of business intelligence and real-time data. If the data is organized and structured for access over time, new knowledge can be discovered. A BIS for the e-Platform must take on a distributed model and establish connectivity to external Web-based data sources or data services.

Data warehousing technology alleviates the data integration problem between participants' BIS. E-Platform data is standardized and has adopted the popular e-Business data representation of XML. E-Platform data schemas provide an integrated approach to ensure data can be interpreted without ambiguity for selection and analysis. Difficulties arise when data from different participants' local systems are extracted, cleansed, and transformed into according to e-Platform data schema. This data interoperability requirement could be solved by implementing connectors to these differing system interfaces.

Data must be collected, organized and structured for online processing with BIS tools with capabilities such as drill-down analysis, trend analysis, exception reporting, extensive knowledge visualization, and predictor extrapolation tools. These tools must be able to give executives rapid scenario estimation of expected and unexpected changes in the environment precipitated by the e-Platform activities, which are ad hoc or routine. Consequently, a BIS must be able to provide intelligent analysis on demand. The bottom line is the performance of the firm or an enterprise, and to increase the logistics chain velocity and on-target customer services.

An e-Platform BIS (or the BIS of a corporation connected to the e-Platform) has to deal with the platform data sources that are commonly not available in a traditional company-based BIS. The e-Platform data has an industry dimension and comes from different players operating on the e-Platform, e.g.,

- Business process oriented transactional data
- Connected business processes – chain data
- Market data
- Sector performance data

Intelligent use of the vast amounts of data generated by business transactions and on air cargo flows in the e-Platform can give managers and executives the knowledge they need to develop logistics plans, nurture customer relationships and stay ahead of the competition. The ability to derive e-Business intelligence from both local (with respect to a participant's own firm), internal (with respect to the e-Platform) and external data sources, along with online transactional data in possible e-Platform data warehouses, holds the key to achieving these goals. With the new knowledge and online management tools, the executives are poised to develop innovative strategies and profitable business practices in air cargo logistics.

4. DATA MANAGEMENT ON THE E-PLATFORM

How data can be collected and how they are to be stored pose an important problem for the design of an e-Platform with intelligent decision support. We describe how the Web-enabled data warehouse, the center of business intelligence, supports this purpose.

4.1 The Community Data Warehouse

The community data warehouse is an information infrastructure that accesses, transforms and organizes operational data and tables into useful information, and then distributes it to different participants in the e-Platform community. Figure 7-3 depicts the components of a community data warehouse.

On-line transaction processing (OLTP) and OLAP on the e-Platform produce huge volumes of data kept at various locations. In general, three types of independent data marts are generated in the operational environment. Private data marts are created at the user's server, which contains corporate and private business information. Shared data marts and public data marts are created at the e-Platform. Shared data marts include business information shared by the participant and designated partners. Public data marts report activities and information available to participants in the community.

The Community Warehouse Administrator retrieves and aggregates relevant data from independent data marts in the operational environment and transforms the data into useful information for industry needs. The organization and transformation of data is governed by the metadata structure, which describes the context and the association of the data located at various places. Companies work with the Community Warehouse

Administrator to build their customized data warehouse with personal and shared data stores.

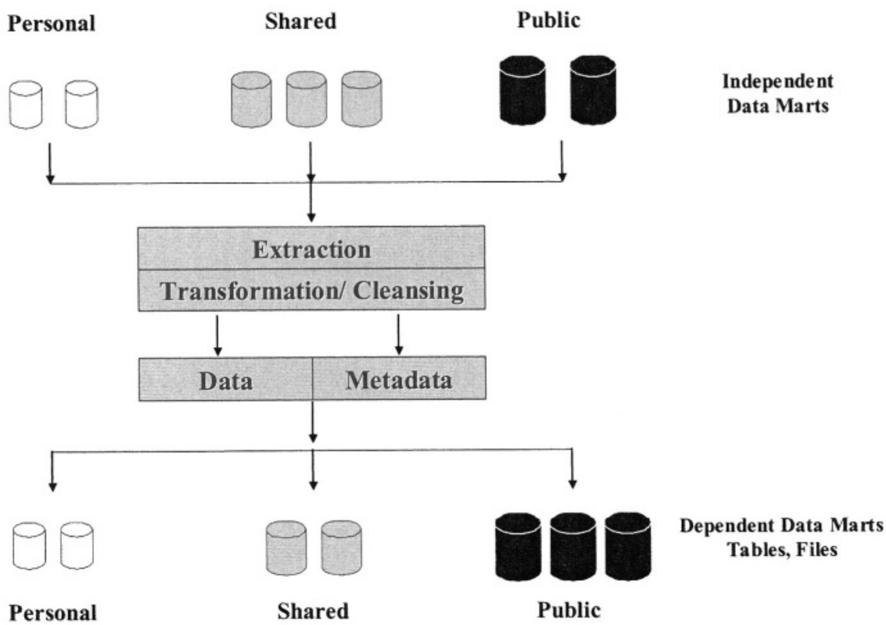


Figure 7-3. The Community Data Warehouse

Dependent data marts are reports, tables, forms and data sets generated from the community and company data warehouses. Organized data and information are distributed to dependent data marts at various locations according to business rules and needs. Private data marts are created at the user level for corporate use. Shared and public data marts are kept at the e-Platform for restricted and open access respectively.

4.2 Data Warehouse on the e-Platform

Traditional data warehouses are designed in a static mode where periodic reports and tables are generated. The community data warehouse (or the data webhouse, as it is called in Kimball and Merz, 2000) on the e-Platform is dynamic and interactive where business and market information is generated as it happens or is required. The community data warehouse is distributive and requires the coordination between the community (master) data warehouse and company (participant) data warehouses (see Figure 7-4).

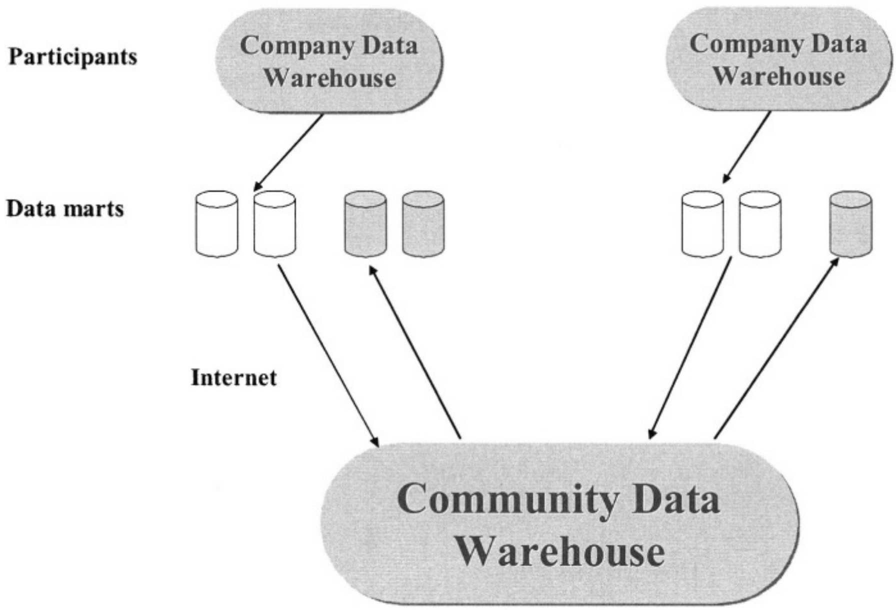


Figure 7-4. Distributed Data Warehouse

The dynamic retrieval and exchange of data on the Web call for a different environment when setting up a data warehouse. Here we discuss some of the issues in setting up a community data warehouse on the e-Platform that are not addressed in the traditional data warehouse design. Compatibility and integration are the key issues in building a successful community data warehouse.

Web-enabled. The Web-enabled community platform is accessible to all participants anytime and anywhere. Business activities are traced and integrated through clickstreams on the Web. Data and information are exchanged through Web interfaces. The Web environment levies special requirements in retrieving, processing, and distributing data between the community platform server and the participant servers.

Distributed Web Servers. The community data warehouse is built on a distributed set of divergent databases/data warehouse located at the platform server and the service provider servers. A well-designed hardware and software solution is required for communicating and exchanging information among a set of heterogeneous Web servers.

Synchronization. The community data warehouse records business processes and market information from various sources. Synchronizing all the clocks in the distributed Web servers and data sources is vital in integrating logistics activities where time is a major decision factor.

Interoperability. Data retrieved from different activities and various sources often poses the incompatibility problem. A structured and interoperable data format is required for exchanging and combining information among participants.

Integration. The integration and consolidation of dependent/independent logistics activities is one of the key success factors for the e-Platform. The design of addressing, labeling and sequencing of logistics activity information kept at various locations provides integrated information for a logistics chain.

Dynamic. Logistics activities are nonstop and conducted all over the world. Information is fed and updated around the clock at service provider servers. The design of data retrieval and reporting in getting the right information to the right people at the right time is crucial in satisfying user needs.

Identification. The e-Platform is a collaborative platform that provides opportunities for individual and partnering business activities. The identification of participants and on-line partners at various levels on the e-Platform needs to be facilitated.

Query. Query processing is one of the most commonly used functions in a data warehouse. The query language, technique, processing, data assessment and optimization are critical in the community data warehouse design.

Security and Privacy. Security and privacy in the storage and retrieval of corporate information, partner information and public information adds to the design problem. The risk and liability in releasing information to unauthorized users is obvious.

5. DATA MINING

In the logistics business, industrial operations' competition is shifting to information competition. Companies who concentrate on cost minimization will be at risk in the long run unless the company directly addresses market demand and provides specific solutions to customer needs. A successful logistics company commands the power of information technology and benefits from economies of scale and scope in task integration, consolidation and close customer relationships. Everyday, companies perform a large number of business operations and exchange information with customers and business partners at various points. More attention has been made on the expertise that satisfies customer needs, improves business processes, and personalizes services through mass customization. Customers purchasing products and services or visitors acquiring information leave valuable information with the company. The data repository that records business activities and customer profiles are the company's experience and memory, and they provide the company with learning opportunities.

5.1 Data Mining – A Definition

In the e-Business era, the swipe of barcode scanner on a piece of cargo generates a record and a click on the Web jumping from one page to another page creates another data record for the company. It is extremely important for a company to manage, analyze and transform the large amount of data into valuable information. A knowledge company will turn its experience and memory into actionable business strategy and better customer relationship management, in return enhancing the company's competitiveness.

Data mining digs out valuable information from large and messy data. It is also known as knowledge discovery in databases. We define data mining in a more general context as a knowledge discovery process. Data mining is the integration of business knowledge, people, information, statistical modeling and computing technology. In general, knowledge discovery is the art and science of collecting data, building business models through statistical and computing techniques, and summarizing valuable information into actionable business strategies. Data mining is an art that requires expert analysis and business judgment. It is also a science that requires the familiarization of data and information, and analytical skills in statistics and computing.

A typical data mining process includes the following steps:

1. Understanding of business and problem identification;
2. Collecting relevant data and information;
3. Creating a data mining database and data cleansing;
4. Model building and choice of methodology;
5. Interpretation and recommendation of business strategies; and

6. Action taken and evaluation.

The data mining process is a cycle that repeatedly updates the knowledge gained from business experience and improved strategies. Data mining has wide business applications in sales, marketing, inventory, banking, and electronic commerce. We focus on knowledge discovery on the e-Platform.

5.2 Data Mining on the e-Platform

The air cargo logistics e-Platform facilitates interrelated sequential activities between multiple parties such as shippers, consignees, forwarders, transport operators, warehousing and logistics service providers, customs, banks and insurance companies. Customers and service providers trade interrelated logistics services on the collaboration platform and service providers manage interrelated logistics activities and business processes on the management platform, both of the e-Platform. Daily transactions, logistics activities and business operations generate huge amount of information kept at the data repository. It is highly desirable to discover hidden information from the stored data.

The integration and aggregation of business records on the e-Platform provides a unique data source for digging out valuable information for the industry. From the technical standpoint, data mining can be done online and off-line. Online data mining is now restricted to discovering information from an organized data structure. Most sophisticated data mining tasks are done in the background mode where data mining data marts are updated periodically. The current trend is to develop a Web-interface environment where data mining functions can be performed and the resulting business rules can be implemented.

There are two levels of data mining on the e-Platform. Data mining at the company level utilizes private data and restricted partner transactions and logistics process records kept on the community e-Platform. Intra-company data mining discovers business information for an individual company while inter-companies data mining evaluates business activities among partners. Data mining at the industry level examines all available data in the community to extract valuable information for the logistics industry. From the view of scope and data structure, intra-company data mining usually deals with single logistics activity and inter-company data mining works on activities in one or more logistics chains. Industrial (community) data mining studies logistics networks at the industry level.

A number of applications that apply to risk assessment, customer relationship management and operations management at the company level and market analysis at the industry level are discussed.

5.3 Prediction and Logistics Risk Analysis

We estimate a response and come up with future values in prediction. There is a response (dependent) variable which depends on a set of input (independent) variables. The problem here is to estimate the value of the response variable based on a set of known input values.

Prediction models are widely applied in business and engineering. They are used in business forecasting as well as in customer relationship management. A business analyst may want to forecast the sales of products and services. A marketing manager may want to predict the probability of a response to a business campaign. Prediction models in data mining are classified as model-based and non model-based. Statistical modeling is model-based and includes multiple regression models and logistic regressions. A functional relationship is assumed between the dependent variable and the independent variables. The unknown coefficients are estimated statistically from a set of records including the observed response given the known values of input variables. Neural networks are non model-based prediction models that mimic the pattern-finding capability of the human brain. The input-output relationship is modeled through a set of connected neurons (input/output units) where each connection has a weight associated with it. These weights are then estimated from the observed data through a trial-and-error training process where training records are fed into the network to search for a set of weights that gives the most precise prediction. A decision tree is another non-model based prediction technique that has been widely used in data mining.

Risk assessment is important in logistics management. Shippers, consignees, logistics service providers and insurance companies all want to have good estimates on the risks of cargo shipments. Taking away the shipper names and consignee names, data can be extracted for each transaction from the transaction records (e.g. manifests and customs). This includes insurance information (amount of insurance, insurance claimed, etc), commodity information (commodity type, value, quantity, packaging, etc), and transport information (origin, destination, transport route, transport mode, etc).

A multiple regression model to estimate the insurance premiums can be constructed from the available transaction records by choosing "amount of insurance" as the target variable. Both model-based and non model-based techniques can be applied in predicting insurance premiums for cargo shipments.

A logistics regression model for predicting the probability of insurance claims can be constructed using the "claim flag" as the target variable. This prediction model estimates the risk of a cargo shipment based on the transport route, transport mode, commodity type and packaging. Decision tree analysis provides an alternative model in predicting claims.

The amount of the claim can also be predicted using a multiple regression model with the insurance claim records. The target variable is then the "insurance claimed".

The insurance claim probability model provides a risk assessment model for shippers and insurance companies on evaluating transport risk. The regression models used for predicting insurance premiums and insurance claims also provide a basis for the insurance companies in calculating insurance premiums and predicting claim amounts.

5.4 Clustering Analysis and Customer Segmentation

Clustering analysis is the grouping and identification of objects into clusters (or groups) based on the similarity of object characteristics. The similarity or dissimilarity between two objects is characterized by the attributes describing the objects and how close these characteristic variables are. Clustering analysis is a form of learning by observation. It does not depend on predefined grouping and the clustering patterns are obtained from minimizing the within-group variances and maximizing the between-group variances. As a result, objects belonging to the same cluster have a higher degree of similarity compared with one another. Objects belonging to different clusters are very dissimilar.

Clustering analysis is an important tool in customer relationship management where personalized (or customized) services can be provided to the right customer groups. Customer segmentation is a clustering process used to divide customers into different groups based on customer profile, transaction behavior and the analysis of market patterns. Target marketing is usually based on the clustering result where special arrangements or actions are applied to the selected customer groups.

On the logistics e-Platform, logistics job segmentation and customer segmentation are the two major applications for clustering analysis. This also includes market segmentation, which highlights potential opportunities that the industry may capitalize on.

Logistics job segmentation is the process of identifying and categorizing the logistics jobs traded and activities processed on the e-Platform. Job attributes include: origin, destination, transport mode, route, commodity type and quantity. The understanding of the main characteristics of different job clusters will assist the industry in designing and customizing services for different types of logistics jobs and activities. A typical logistics job cluster obtained from a cluster analysis may be:

Commodity type:	*automobile electronics*
City of Departure:	Hong Kong
City of Destination:	Chicago
Transport Mode:	Air

The benefit of knowing one's business and customer is a crucial factor of success. Customer segmentation classifies shippers based on customer attributes and job attributes. Customer attributes include company profile such as location, business type, company size and ownership. Clustering analysis divides shippers into shipper groups with similar characteristics. Customer segmentation enables logistics service providers to prioritize the customer groups and develop marketing and servicing strategies for different customer groups and different logistics service needs. It is also a powerful tool used to identify the most profitable or potential customers.

5.5 Association Rules and Consolidation

Association analysis finds interesting correlation relationships among a large set of data records. Association rules identify combinations of events or items that are frequently observed together. A typical example of association rule mining is market basket analysis where sets of items frequently bought together are examined. Managers could use this correlation information for cross-selling and promotion and help the company to develop successful marketing strategies.

An association rule can be described as an implication rule of the form

$$X \Rightarrow Y \text{ (If } X \text{ then } Y\text{)},$$

where X and Y are disjoint subsets of the transaction item set. The potential use of an association rule is evaluated by the confidence value, which is the conditional probability of the occurrence of Y given X, and by the support value, which is the probability of the occurrence of X and Y in the transaction records. The task of discovering association rules is to find all implication rules with at least the specified values of confidence and support.

Suppose that we have a dataset which is composed of shipment records. Each shipment contains a set of commodities and each commodity is regarded as an item in the shipment record. Association rules discovered in the market basket analysis show a pattern of commodities that shippers tend to ship together. A typical example may be the discovery of association between the shipment of jewelry and watches. The following rule is observed in an association analysis on air freight from Hong Kong to New York:

> If the customer ships jewelry from Hong Kong to New York, then the customer also ship watches with confidence value 0.7 and support value 0.09.

The association analysis result may lead to the special design of marketing strategies for cross selling. At the same time, a better consolidation and transport service can be devised to meet the customer needs in shipping specific groups of commodities such as jewelry and watches.

5.6 Link Analysis and Logistics Hubs

Link analysis identifies association patterns between groups of entities such as individuals, venues and organizations. It is a process of detecting and exploring connections among investigated entities. Link analysis uses shortest path algorithms to find the significant association pattern between two or more entities. It discovers valuable knowledge on the domain-specific network structure.

Results of link analysis are often displayed as a graph of linked entities. The visual output facilitates the understanding of networking among entities and the discovery of hidden structure. Examples include identifying customer purchase patterns in database marketing and analysis website popularity in website analysis.

In transport logistics, cargo moves in and out through a number of consolidation points which are called hubs. It is important to identify transport hubs where infrastructure is built and personnel are assigned to facilitate integration and consolidation.

Suppose that China outbound air cargo routes to US are analyzed using a link analysis based on shipment records. Three Chinese international gateways are observed including Hong Kong (HKG), Peking (PEK) and Shanghai (PVG) with US destinations Los Angeles (LAX) and New York (JFK). The link graph (Figure 7-5) summarizes the cargo flow pattern among the five airports where the nodes denote the airports and the directed links represent the cargo traffic volume between airports. The size of the node represents the number of trips through the airport and the traffic volume/intensity between two airports is illustrated by the link weight. The result clearly identifies HKG as the major hub in China air cargo transport. Hong Kong is a major source of China's outbound air cargo to the US and it is also an intermediary point for cargo from PEK and PVG.

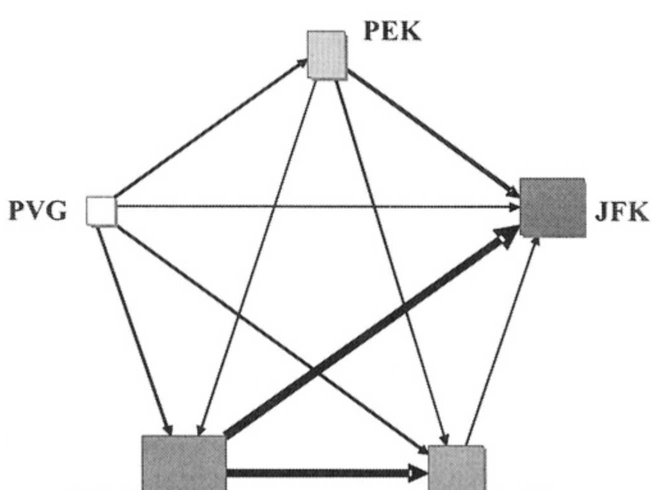


Figure 7-5. Link graph of air cargo traffic between five airports

6. CONCLUDING REMARKS

Decision support capability of the e-Platform is paramount in contributing to unprecedented efficiency in global air cargo logistics. The vast amount of data that manifested on the e-Platform as logistics e-Business is conducted constitutes the most diverse and complete data vault for business intelligence. Decision support can be realized based on the e-Platform information model with innovative data management, warehousing schemes, and data mining tools. Knowledge management innovation must be able to deal with the scope of the data - from local company level, to community level, and industry level simultaneously. It must be noted that decision support of the e-Platform must extend to other business chains. For example, a dominant partner of a supply chain in real time could like to make a decision based on the past performance of a 3PL logistics provider. Such information should be readily available by external query from the BIS of the e-Platform.

Nonetheless, research in different aspects of the e-Platform decision support design and mechanism is needed. We anticipate that a decision support platform coexists in the same operating environment as the e-Platform, providing real-time decision support, leveraging the factual e-Platform data.

References

Aiken, M. (1995) "Group Decision Support Systems," Review of Business, 16 (3), 38-42.

Air Cargo News (1999a) "Information Technology, Service Drive Increasing Market Competition".

Anthony, P., and Jennings, N.R. (2003) "Developing a Bidding Agent for Multiple Heterogeneous Auctions," ACM Transactions on Internet Technology, 3 (3), 185-217.

Antonio, L., Lorena, N., and Narciso, M.G. (1995) "Relaxation Heuristics for a Generalized Assignment Problem," European Journal of Operational Research, 91, 600-610.

Bade, D., Mueller, J., and Youd, B. (1999) "Technology in the Next Generation of Supply Chain Outsourcing - Leveraging Capabilities of Fourth Party Logistics," In Achieving Supply Chain Excellence through Technology (ASCET), Volume 1.

Bakos, Y. (1998) "The Emerging Role of Electronic Marketplaces on the Internet," Communications, ACM, 41 (8), 35-42.

Baron, J.P., Shaw, M.J., and Bailey, Jr, A.D. (2000) "Web-based e-Catalog Systems in B2B Procurement," Communications, ACM, 43 (5), 93-100.

Belhe, U., and Kusiak, A. (1997) "Dynamic Scheduling of Design Activities with Resource Constraints," IEEE Transactions on SMC part A: Systems and humans, 27 (1), 105-111.

Bertazzi, L., Speranza, M.G., and Ukovich, W. (2000) "Exact and Heuristic Solutions for a Shipment Problem with Given Frequencies," Management Science, 46 (7), 973-988.

Bhargava, H.K., Sridhar, S., and Herrick, C. (1999) "Beyond Spreadsheets: Tools for Building Decision Support Systems," IEEE Computer, 32 (3), 31-39.

Bieber, M., and Vitali, F. (1997) "Toward Support for Hypermedia on the World Wide Web," IEEE Computer, 30 (1), 62-70.

Brewington, B.E., and Cybenko, G. (2000) "Keeping Up with the Changing Web," IEEE Computer, 33 (5), 52-58.

Business Process Team (2001) "Business Process and Business Information Analysis Overview v1.0," UN/CEFACT and OASIS, 11.

Carlsson, C., and Turban, E. (2002) "Introduction DSS: Directions for the Next Decade," Decision Support Systems, 33 (2), 105-110.

Case, S., Azarmi, N., Thint, M., and Ohtani, T. (2001) "Enhancing e-Communities with Agent-Based Systems," IEEE Computer, July, 64-69.

Chao, P., and Wang, Y. (2001) "A Data Exchange Framework for Networked CAD/CAM," Computers in Industry, 44 (2), 131-140.

Chaudhury, D.N., Mallick, and Rao, H.R. (2001) "Web Channels in e-Commerce," Communications, ACM, 44 (1), 99-104.

Chiu, H.N. (1995) "The Integrated Logistics Management System: A Framework and Case Study," International Journal of Physical Distribution & Logistics Management, 25 (6), 4-22.

Christopher, M. (1998) Logistics and Supply Chain Management, 2nd Ed., Pearson Education.

Cingil, A., Dogac, and Azgin, A. (2000) "A Broader Approach to Personalization," Communications, ACM, 43 (8), 136-141.

Cooper, M.C., Lambert, D.M., and Pagh, J.D. (1997) "Supply Chain Management: More Than a New Name for Logistics," The International Journal of Logistics Management, 8 (1), 1-13.

D'Alfonso, T.H., and Ventura, J.A. (1995) "Assignment of Tools to Machines in a Flexible Manufacturing System," European Journal of Operational Research, 81, 115-133.

de Farias, I.R., Johnson, E.L., and Nemhauser, G.L. (2000) "A Generalized Assignment Problem with Special Ordered Sets: A Polyhedral Approach," Mathematical Programming, ser. A, 89, 187-203.

Dobson, G., and Nambimadom, R.S. (2001) "The Batch Loading and Scheduling Problem," Operations Research, 49 (1), 52-65.

ebXML Technical Architecture Project Team (2001) "ebXML Technical Architecture Specification v1.0.4," www.ebXML.org., 16 February 2001.

Elofson, G., and Robinson, W.N. (1998) "Creating a Custom Mass-production Channel on the Internet," Communications, ACM, 41(3), 56-62.

Euwe, M.J., and Wortmann, J.C. (1998) "Logistics Control Enabled by IT – A Window in the Future," Human Systems Management, 17 (2), 123-136.

Expert Choice (1998) *Computer Software,* Expert Choice Inc., Pittsburgh.

Fingar, P. (2000) "Component-based Frameworks for e-Commerce," Communications, ACM, 43 (10), 61-67.

Fraternali, P. (1999) "Tools and Approaches for Developing Data-intensive Web Applications: A Survey," ACM Computing Survey, 31 (3), 227-263.

Gattorna, J. (1998) Strategic Supply Chain Alignment: Best Practice in Supply Chain Management, Editor, Gower Publishing Limited.

Gebauer, J., and Shaw, M. J. (2002) "Introduction to the Special Section: Business-to-Business Electronic Commerce," International Journal of Electronic Commerce, 6 (4), 7-17.

Glover, F., and Laguna, M. (1997), Tabu Search, Kluwer Academic Publishers.

Glushko, R.J., Tenenbaum, J.M., and Meltzer, B. (1999) "An XML Framework for Agent-based e-Commerce," Communications, ACM, 42 (3), 106-114.

Gregg, D.G., and Goul, M. (1999) "A Proposal for an Open DSS Protocol," Communications, ACM, 42 (11), 91-96.

Gresham, Z.O., and Shlaudeman K.E., (2000), "Lessons from the Field: Private Sector Involvement in Water Projects," Water Engineering & Management, 147 (2), 26-34.

Griffith, D.A., Krampf, R.F., and Palmer, J.W. (2001) "The Role of Interface in Electronic Commerce: Consumer Involvement with Print Versus On-Line Catalogs," International Journal of Electronic Commerce, 5 (4), 135-154.

Hasselbring, W. (2000) "Programming Languages and Systems for Prototyping Concurrent Applications," ACM Computing Surveys, 32 (1), 43-79.

Hoffman, D.L., Kalsbeek, W.D., and Novak, T.P. (1996) "Internet and Web Use in the U.S.," Communications, ACM, 39 (12), 36-46.

Hoffman, D., Novak, T.P., and Peralta, M. (1999) "Building Consumer Trust Online," Communications, ACM, 42 (4), 80-85.

Hui, Y.V., Leung, L.C., Fu, G., and Cheung, W. (2003) "Designing a Fourth-party e-Commerce Logistics Centre: a Benefit, Cost and Risk Analysis Using AHP and ANP Models," International Journal of Internet and Enterprise Management, Vol. 1 (1), 53-74.

Hsu, C., and Pant, S. (1999) *Innovative Planning for Electronic Commerce and Enterprises: A Reference Model,* Kluwer Academic Publishers.

Jorng, J.T., and Chen, C.W. (2001) “A Mechanism for View Consistency in a Data Warehousing System,” Journal of Systems and Software, 56 (1), 23-37.

Jutla, D., Bodorik, P., Hajnal, C., and Davis, C. (1999) “Making Business Sense of Electronic Commerce,” IEEE Computer, 32 (3), 67-75.

Kaku, B.K., and Thompson, G.L. (1986) “An Exact Algorithm for the General Quadratic Assignment Problem,” European Journal of Operational Research, 23, 383-389.

Kalakota, R., and Robinson, M. (1999) *e-Business: Roadmap for Success,* Addison-Wesley Longman, Inc.

Kambil (1997) “Doing Business in the Wired World,” IEEE Computer, 30 (5), 56-61.

Kaplan, S., and Sawhney, M. (2000) “E-Hubs: The New B2B Marketplaces,” Harvard Business Review, May-June, 97-103.

Katok, E., Lewis, H.S., and Harrison, T.P. (1998) “Lot Sizing in General Assembly Systems with Setup Costs, Setup Times, and Multiple Constrained Resources,” Management Science, 44 (6), 859-877.

Kimball, R., and Merz, R. (2000) *The Data Webhouse Toolkit,* John Wiley & Sons, New York.

Kramer, J., Noronha, S., and Vergo, J. (2000) “A User-centered Design Approach to Personalization,” Communications, ACM, 43 (8), 44-48.

Kristol, D.M. (2001) “HTTP Cookies: Standards, Privacy, and Politics,” ACM Transactions on Internet Technology, 1 (2), 151-198.

Kuo, G.-S., and Lin, J.-P. (1998) “New Design Concepts for an Intelligent Internet,” Communications, ACM, 41 (11), 93-98.

Kuo, T.W., Liang, M.C., and Shu, L. (2001) “Abort-oriented Concurrency Control for Real-time Databases,” IEEE Transactions on Computer, 50 (7), 660-673.

Kwan, A.T.W. (1999) “The Use of Information Technology to Enhance Supply Chain Management in the Electronics and Chemical Industries,” Production and Inventory Management Journal, 40 (3), 7-15.

La Londe, B., and Masters, J.M. (1994) “Emerging Logistics Strategies: Blueprints for the Next Century,” International Journal of Physical Distribution & Logistics Management, 24 (7), 35-47

Laguna, M. (1999) “A Heuristic for Production Scheduling and Inventory Control in the Presence of Sequence-dependent Setup Times,” IIE Transactions, 31 (2), 125-134.

Lechner, U., and Hummel, J. (2002) “Business Models and System Architectures of Virtual Communities: From a Sociological Phenomenon to Peer-to-Peer Architectures,” International Journal of Electronic Commerce, 6 (3), 41-53.

Lee, D.H., and Kim, Y.D. (2000) "Loading Algorithms for Flexible Manufacturing Systems with Partially Grouped Machines," IIE Transactions, 32 (1) 33-47.

Lee, D.H., Kiritsis, D., and Xirouchakis, P. (2001) "Branch and Fathoming Algorithms for Operation Sequencing in Process Planning," International Journal of Production Research, 39 (8), 1649-1669.

Leung, L.C., Cheung, W., and Hui, Y.V. (2000) "A Framework for a Logistics e-Commerce Community Network: The Hong Kong Air Cargo Industry", IEEE Transactions on System, Man, and Cybernetics, 30 (4), 446-455.

Leung, L.C., Chu, S.C., Hui, Y.V., and Cheung, W. (2003) "The Evolution of e-Commerce Website: A Conceptual Framework and Analysis," Working Paper, The Chinese University of Hong Kong.

Leung, L.C., Hui, Y.V., and Wang, Y. (2003) "Air Cargo Logistics Integration and Consolidation on a 4th Party e-Business Platform," Working Paper, The Chinese University of Hong Kong.

Lewis, I., and Talalayevsky, A. (1997) "Logistics and Information Technology: A Coordination Perspective," Journal of Business Logistics, 18 (1), 141-157.

Lohse, G.L., and Spiller, P. (1998) "Electronic Shopping," Communications, ACM, 41 (7), 81-88.

Madan, M.S., and Gilbert, K.C. (1992) "An Exact Solution Algorithm for a Class of Production Planning and Scheduling Problems," Journal of the Operational Research Society, 43 (10), 961-970.

Maes, J., and McClain, J.O. (1991) "Multilevel Capacitated Lot Sizing Complexity and LP-based Heuristics," European Journal of Operational Research, 53, 131-148.

Melbin, J.E. (1997) "The Need for Speed," Distribution, 96 (8), 58-64.

Moore, K.R. (1998) "Trust and Relationship Commitment in Logistics Alliances: A Buyer Perspective," International Journal of Purchasing and Materials Management, 34 (1), 24-37.

Morgan Stanley (2001) "Spot the Early Bird," Equity Research, October 5, 2001.

O'Keefe, R.M., and McEachern, T. (1998) "Web-based Customer Decision Support Systems," Communications, ACM, 41(3), 71-78.

Parameswaran, M., Susarla, A., and Whinston, A.B. (2001) "P2P Networking: An Information-Sharing Alternative," IEEE Computer, 31-38.

Puustjarvi, J. (2001) "Workflow Concurrency Control," The Computer Journal, 44 (1), 42-53.

Rappa, M. (2001) Managing the Digital Enterprise, North Carolina State University, http://digitalenterprise.org/models/models.html

Riggins, F.J., and (Sue) Rhee, H. (1998) "Toward a Unified View of Electronic Commerce," Communications, ACM, 41 (10), 88-95.

Saaty, T.L., (1980), *The Analytic Hierarchy Process,* McGraw-Hill, New York.

Saaty, T.L. (1996), *The Analytic Network Process,* RWS Publications, Pittsburgh.

Seligman L., and Rosenthal, A. (2001) "XML's Impact on Databases and Data Sharing," IEEE Computer, 59-67.

Senn, J.A. (2000) "The Emergence of M-Commerce," IEEE Computer, 33 (12), 148-150.

Shim, J.P., Warkentin, M., Courtney, J.F., Power, D.J., Sharda, R., and Carlsson, C. (2002) "Past, Present, and Future of Decision Support Technology," Decision Support Systems, 33, 111-126.

Shim, S.S.Y., Pendyala, V.S., Sundaram, M., and Gao, J.Z. (2000) "Business-to-Business e-Commerce Frameworks," IEEE Computer, October, 40-47.

Siau, K., Lim, E., and Shen, Z. (2001) "Mobile Commerce: Promises, Challenges, and Research Agenda," Journal of Database Management, 12(3), 4-13.

Smith, H., and Poulter, K. (1999) "Share the Ontology in XML-based Trading Architectures," Communications, ACM, 42 (3), 110-111.

Smith, R.A. (2001) "Trends in e-Business Technologies," IBM Systems Journal, 40 (1), 4-7.

St. Laurent, S., Johnston, J., and Dumbill, E. (2001) *Programming Web Services with XML-RPC,* O'Reilly.

Stanoevska-Slabeva, K. (2002) "Toward a Community-Oriented Design of Internet Platforms," International Journal of Electronic Commerce, 6 (3), 71-95.

Storey, V.C., Straub, D.W., Stewart, K.A., and Welke, R.J. (2000) "A Conceptual Investigation of the e-Commerce Industry," Communications, ACM, 43 (7), 117-123.

Sun, X., Noble, J.S., and Klein, C.M. (1999) "Single-machine Scheduling with Sequence Dependent Setup to Minimize Total Weighted Squared Tardiness," IIE Transactions, 31 (2), 113-124.

Tenenbaum, J.M., Chowdhry, T.S., and Hughes, K. (1997) "Eco System: An Internet Commerce Architecture," IEEE Computer, 30 (5), 48-55.

Threlkel, M.S., and Kavan, C.B. (1999) "From Traditional EDI to Internet-based EDI: Managerial Considerations," Journal of Information Technology, 14 (4), 347-360.

Triantaphyllou, E. and Sánchez, A. (1997), "A Sensitivity Analysis Approach for Some Deterministic Multi-Criteria Decision-Making Methods," Decision Sciences, 28 (1), 151-194.

Varadarajan, P.R., and Cunningham, M. (1995) "Strategic Alliances: A Synthesis of Conceptual Foundations," Journal of the Academy of Marketing Science, 23 (4), 282-296.

Wang, W., Hidvégi, Z., and Whinston, A.B. (2001) "Designing Mechanisms for e-Commerce Security: An Example from Sealed-Bid Auctions," International Journal of Electronic Commerce, 6 (2), 139-156.

Welty, B., and Becerra-Fernandez, I. (2001) "Managing Trust and Commitment in Collaborative Supply Chain Relationships," Communications, ACM, 44 (6), 67-73.

Whipple, J.M., Frankel, R., and Daugherty, P.J. (2002), "Information Support for Alliances: Performance Implications," Journal of Business Logistics, 23 (2), 67-72.

Wieczerzycki, W. (2000) "Transaction Management in Databases Supporting Web-based Negotiations," INFOR, 38 (3), 245-271.

Wigand, R.T. (1997) "Electronic Commerce: Definition, Theory, and Context," The Information Society, 13 (1), 1-16.

Williams, L.R., Nibbs, A., Irby, D., and Finley, T. (1997) "Logistics Integration: The Effect of Information Technology, Team Composition, and Corporate Competitive Positioning," Journal of Business Logistics, 18 (2), 31-41.

Wise, R., and Morrison, D. (2000) "Beyond the Exchange: The Future of B2B," Harvard Business Review, November-December, 86-96.

Wong, C., Leung, L.C., and Hui, Y.V. (2003) "Solving a Mixed 0-1 LP Model of Air Cargo Logistics Integration and Consolidation using Tabu Search," Working Paper, The Chinese University of Hong Kong.

Wu, D.-J. (2000) "Artificial Agents for Discovering Business Strategies for Network Industries," International Journal of Electronic Commerce, 5 (1), 9-36.

Yang, J., and Papazoglou, M.P. (2000) "Interoperation Support for Electronic Business," Communications, ACM, 43 (6), 39-47.

Zwass, V. (1996) "Electronic Commerce: Structures and Issues," International Journal of Electronic Commerce, 1 (1), 3-23.

Index

Early Titles in the
INTERNATIONAL SERIES IN OPERATIONS RESEARCH & MANAGEMENT SCIENCE
Frederick S. Hillier, Series Editor, *Stanford University*

Saigal/ *A MODERN APPROACH TO LINEAR PROGRAMMING*
Nagurney/ *PROJECTED DYNAMICAL SYSTEMS & VARIATIONAL INEQUALITIES WITH APPLICATIONS*
Padberg & Rijal/ *LOCATION, SCHEDULING, DESIGN AND INTEGER PROGRAMMING*
Vanderbei/ *LINEAR PROGRAMMING*
Jaiswal/ *MILITARY OPERATIONS RESEARCH*
Gal & Greenberg/ *ADVANCES IN SENSITIVITY ANALYSIS & PARAMETRIC PROGRAMMING*
Prabhu/ *FOUNDATIONS OF QUEUEING THEORY*
Fang, Rajasekera & Tsao/ *ENTROPY OPTIMIZATION & MATHEMATICAL PROGRAMMING*
Yu/ *OR IN THE AIRLINE INDUSTRY*
Ho & Tang/ *PRODUCT VARIETY MANAGEMENT*
El-Taha & Stidham/ *SAMPLE-PATH ANALYSIS OF QUEUEING SYSTEMS*
Miettinen/ *NONLINEAR MULTIOBJECTIVE OPTIMIZATION*
Chao & Huntington/ *DESIGNING COMPETITIVE ELECTRICITY MARKETS*
Weglarz/ *PROJECT SCHEDULING: RECENT TRENDS & RESULTS*
Sahin & Polatoglu/ *QUALITY, WARRANTY AND PREVENTIVE MAINTENANCE*
Tavares/ *ADVANCES MODELS FOR PROJECT MANAGEMENT*
Tayur, Ganeshan & Magazine/ *QUANTITATIVE MODELS FOR SUPPLY CHAIN MANAGEMENT*
Weyant, J./ *ENERGY AND ENVIRONMENTAL POLICY MODELING*
Shanthikumar, J.G. & Sumita, U./ *APPLIED PROBABILITY AND STOCHASTIC PROCESSES*
Liu, B. & Esogbue, A.O./ *DECISION CRITERIA AND OPTIMAL INVENTORY PROCESSES*
Gal, T., Stewart, T.J., Hanne, T. / *MULT1CRITERIA DECISION MAKING: Advances in MCDM Models, Algorithms, Theory, and Applications*
FOX, B.L. / *STRATEGIES FOR QUASI-MONTE CARLO*
Hall, R.W. / *HANDBOOK OF TRANSPORTATION SCIENCE*
Grassman, W.K. / *COMPUTATIONAL PROBABILITY*
Pomerol, J-C. & Barba-Romero, S. / *MULTICRITERION DECISION IN MANAGEMENT*
Axsäter, S. / *INVENTORY CONTROL*
Wolkowicz, H., Saigal, R., & Vandenberghe, L. / *HANDBOOK OF SEMI-DEFINITE PROGRAMMING: Theory, Algorithms, and Applications*
Hobbs, B.F. & Meier, P. / *ENERGY DECISIONS AND THE ENVIRONMENT: A Guide to the Use of Multicriteria Methods*
Dar-El, E. / *HUMAN LEARNING: From Learning Curves to Learning Organizations*
Armstrong, J.S. / *PRINCIPLES OF FORECASTING: A Handbook for Researchers and Practitioners*
Balsamo, S., Personé, V., & Onvural, R./ *ANALYSIS OF QUEUEING NETWORKS WITH BLOCKING*
Bouyssou, D. et al. / *EVALUATION AND DECISION MODELS: A Critical Perspective*
Hanne, T. / *INTELLIGENT STRATEGIES FOR META MULTIPLE CRITERIA DECISION MAKING*
Saaty, T. & Vargas, L. / *MODELS, METHODS, CONCEPTS and APPLICATIONS OF THE ANALYTIC HIERARCHY PROCESS*
Chatterjee, K. & Samuelson, W. / *GAME THEORY AND BUSINESS APPLICATIONS*
Hobbs, B. et al. / *THE NEXT GENERATION OF ELECTRIC POWER UNIT COMMITMENT MODELS*
Vanderbei, R.J. / *LINEAR PROGRAMMING: Foundations and Extensions, 2nd Ed.*
Kimms, A. / *MATHEMATICAL PROGRAMMING AND FINANCIAL OBJECTIVES FOR SCHEDULING PROJECTS*
Baptiste, P., Le Pape, C. & Nuijten, W. / *CONSTRAINT-BASED SCHEDULING*
Feinberg, E. & Shwartz, A. / *HANDBOOK OF MARKOV DECISION PROCESSES: Methods and Applications*

***** A list of the more recent publications in the series is at the front of the book *****