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Information Technology at COSCO

To operate globally, a company like COSCO can't rely on human brains alone. We just wouldn't be able to stand up. In order to be a true multinational, you must have information technology to support you. We are now the second-largest shipping company in the world, and the world number two must rely on IT.

—Wei Jiafu, COSCO Chairman

In January 2005, Captain Wei Jiafu, chairman of Beijing-based COSCO Group, noted with pleasure the impact of COSCO's investments in information technology (IT). COSCO had just placed ninth in an annual ranking of China's 500 most IT-intensive companies, up from 33rd the year before, and Wei had been cited as a "most far-sighted IT enterprise leader." Among Asia-Pacific companies, Hewlett-Packard and *Business Weekly* had just named COSCO an "adaptive enterprise" for its IT achievements. More importantly, IT had delivered plenty of practical benefits. Wei noted: "This year's operating profit is RMB 12 billion,[a] over three times that of last year. Last year's profit was three times that of the year before. This is the heavy impact of IT." The benefits of IT stemmed primarily from COSCO's recent implementation of SAP's enterprise resource planning (ERP) system for financial functions and IRIS-2, a back-office system that managed container ship bookings and cargo. With this foundation laid, COSCO was now building new capabilities. Several initiatives were under way in early 2005: the consolidation of IT functions from across the group into COSCO Network, the extension of IRIS-2 beyond containers to breakbulk and other shipping, and the less tangible but no less important task of using IT to enhance COSCO's service friendliness to customers.

Ocean Shipping in 2004

By 2004, the vast majority of the world's cargo by value was shipped via container, including 75% by value of all cargo from outside North America to and from the United States.[1] This was the culmination of a trend that had transformed the shipping industry since the introduction of the container 50 years before. In contrast to "breakbulk" vessels, which carried a variety of products of nonuniform sizes, often bound on pallets, containerized vessels were specially equipped to optimize the stacking of containers. Containers were standardized metal cargo boxes typically either 20 or 40 feet long (commonly referred to as a TEU, short for "twenty-foot equivalent unit") that could be mounted atop truck chassis or railcars for further "intermodal" transport. A typical container ship

[a] The RMB:US$ exchange rate was 8.27:1.

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carried 2,500–4,000 containers, though the largest ships could carry nearly 8,500, and some shipyards were considering designing and building 10,000-TEU and even 14,000-TEU ships in pursuit of better economies of scale—the depth of ports and shipping channels permitting.[2]

Since containerization reduced the number of times cargo changed hands on the way to its final destination, the consequent streamlining of inland transportation blurred or eliminated the roles of some parties in the shipping value chain over time. Large shippers (not always cargo owners, but often freight forwarders) typically loaded goods directly into containers at the factory rather than truck them to a warehouse for further handling. Freight forwarders, the intermediaries between the shipper of the cargo and the shipping lines, frequently offered door-to-door pickup in one country and delivery in another. They arranged inland container transportation by road, rail, or river vessel to the port of departure, where the containers were loaded on the vessel of the shipping line with which the forwarders had contracted. Freight forwarders also accepted delivery of containers from the shipping line, picked up cargo from the destination port once unloaded, and arranged for its onward transportation to the "consignee," or ultimate recipient. Logistics—the coordination, data management, and data communication required to facilitate the flow of cargo—were performed either by the freight forwarder or by a third party. Containerization increasingly allowed parties in the shipping value chain to minimize distribution and storage costs, and the industry gradually became driven less by labor and more by technology.

Many shipping lines created freight-forwarding and logistics subsidiaries, both to complement and feed business to their fleets and to offer their biggest shippers and consignees fully integrated service.[3] Shipping lines that took advantage of such opportunities protected themselves against the thinner margins faced by firms that focused strictly on ocean transport. Such vertical integration initially diminished the business of freight forwarders but subsequently created opportunities for forward-thinking firms of all kinds to offer value-added door-to-door logistics and IT services.

Many types of cargo did not fit into a container, and some did not need to. Steel, bagged food, forest products, rubber, and other goods and commodities were still shipped primarily in breakbulk form.[4]

Industry Structure and Alliances

Container shipping was traditionally a low-margin, highly competitive market (see **Exhibit 1**), and the major players grew bigger in the late 1990s through mergers and acquisitions to boost market share. The most significant consolidation was the merger of two of the top three carriers in 1999, when Denmark-based Maersk Line acquired U.S.-based Sea-Land's container business in 1999 to become Maersk-Sealand. In addition, Singapore-based Neptune Orient Lines (NOL) acquired American President Lines (APL) in 1997, and P&O and Nedlloyd merged in 1996. Other top 10 carriers included COSCO, Taiwan-based Evergreen Line, South Korea-based Hanjin Shipping, and Nippon Yusen Kaisha (NYK) (**Exhibits 2** and **3**).

"Carrier conferences" were a key aspect of pricing international liner shipping. Through these, corporate-member shipping lines or "carriers" operating in specific routes agreed to fix and maintain the rates charged to shippers, to rationalize sailing dates and ports of call, and sometimes to enter into revenue- or cargo-sharing agreements. Conferences provided a huge advantage to the largest carriers by restraining competition, severely limiting a member's ability to compete on price alone, and restricting their ability to enter into confidential service contracts. Shippers' organizations, in contrast, disliked the conferences' pricing power and urged carriers to strike confidential agreements with individual shippers and to price their services on the basis of actual costs.[5]

Competitors in the container shipping industry commonly worked together not only through conferences but also in "slot-sharing" agreements, by which carriers subcontracted part of their vessel's container capacity on particular sailings to another carrier in order to improve vessel utilization. Vessels involved in vessel- or slot-sharing agreements accounted for 73% of world containership capacity (TEUs) at year-end 1998.[6]

By the end of 2001, a growing number of slot-sharing agreements and other types of partnerships had begun to replace the traditional dominance of carrier conferences. By autumn 2001, most shippers in the United States were negotiating one-on-one with individual carriers for confidential service contracts instead of with rate-setting conferences or groups of carriers. Independent carriers such as COSCO had to cope with less public information about what their competitors were charging.

Shippers chose a given shipping line because of its routes and schedules, relationships with particular freight forwarders, success record and experience, and ability to service them in other ways—such as with full-service logistics or time-saving e-commerce applications. Shipping companies enhanced their profitability with pricing strategies, cost management, as well as diversification into more profitable niches such as logistics and e-commerce. This was not unlike the airline industry, which used company size, load factors, equipment utilization, and code-sharing alliances to manage costs and boost profitability.

Trends in the Shipping Industry

For several years before 2005, the shipping industry failed to anticipate demand. The result was equipment shortages and strained capacity, which some analysts blamed on China's hard-to-forecast yet booming export business.[7] Terminal operators at California ports in particular were unprepared for the volume and struggled with severe labor shortages. Once taken off the ships, containers commonly sat in the terminal for several days, awaiting intermodal rail or truck transport. In 2004, 17 ships were diverted to other ports because of these delays.[8] Analysts described this as a long-term problem at the import end of the transport chain, observing that Chinese exports were forecasted to rise dramatically and could nearly double by 2008.[9] Chinese port traffic, which rose 35% in 2002, 31% in 2003, and 27% in 2004, supported this claim and projected continuing annual growth of 20%.[10]

Port-expansion plans in China, particularly at Shanghai, were in place to cope with the anticipated expansion. In the West, however, port development lagged. By 2003, the U.S. had only three ports capable of handling two million TEU a year, Europe had seven, and the Far East had developed 21.[11]

Port congestion could also be viewed as a symptom of a strong market. Ship owners enjoyed high earnings, freight rates were buoyed by strong trade growth and demand for shipping capacity,[12] and new ships were being ordered at a record-setting pace. Shipping lines were scheduled to take delivery of more than 200 post-Panamax[b] container ships and at least 250 smaller container vessels between 2005 and 2008 (see **Exhibit 3**).[13] Few shipbuilders had excess capacity, and there was intense competition for yard space from the bulk and liquefied natural gas (LNG) sectors of the merchant marine.[14]

Accordingly, shipping lines increasingly invested in container-terminal operations to ensure that they could manage port congestion. Clarkson predicted that this would mean small carriers would find it difficult to compete for berth space.[15] One analyst predicted that terminal ownership would

[b] Panamax ships were the largest-sized vessels still capable of fitting through the Panama Canal.

figure prominently in carriers' purchase plans and noted that carriers would be foolhardy to order more ships unless they owned their own berths in key ports.

Carriers also faced the challenge of rising costs created by both demand and regulation. Soaring steel prices increased new ship prices.[16] Daily operating costs increased, too, particularly in crewing and insurance. Crew salaries—primarily for officers—grew by 2.5%–7.8%, depending upon the type of ship.[17] Insurance rates increased at double-digit rates, up to 30% for hull, protection and indemnity, and machinery insurance.[18]

COSCO in 2004

Despite some diversification, COSCO in 2004 remained primarily an ocean shipping company, sailing to over 1,300 ports in 160 countries. The company operated 637 ships (including 123 container ships) of 36 million gross deadweight tons (dwt), making it the world's second-largest shipping line by fleet capacity or size, according to the U.K.-based Clarkson consultancy.[19] About 470 of these were owned outright; the remainder were leased. COSCO carried 270 million tons of cargo in 2004, an increase of 23% over 2003, of which containers accounted for 4.7 million TEU, an increase of 13% over 2003.[20]

By 2010, COSCO hoped to be known as a "shipping-based logistics company" and in 2002 set up a logistics subsidiary toward this end. As a result, the company in 2005 described its organization as "One Core, Two Foci, Five Pillars." The unified core referred to COSCO's comprehensive transportation business, though this comprised two focal emphases: shipping and logistics. Supporting shipping and logistics were five pillar business activities that included (1) bunker and ship trade; (2) ship construction and repair; (3) listed companies, primarily COSCO Pacific (Hong Kong—container leasing, construction, and terminal operations and logistics), COSCO International (Hong Kong—real estate and ship agency services), COSCO Corporation (Singapore—ship repair and services), and COSCO Container Shipping (Shanghai—heavy and specialized cargo shipping); (4) finance (asset management, leasing and insurance, and equity investments including a stake in China's Merchants Bank and venture capital); and (5) IT.

Following the 1993 creation of COSCO Group, its five primary geographic bases within China began to specialize by cargo type. Thus, COSCO Container Shipping (COSCON) was based in Shanghai, oil and chemical tanker shipping in Dalian, general cargo in Guangzhou, and bulk and commodity shipping in Tianjin, Hong Kong, and Qingdao.[21] Within China, the company's strength lay in its feeder system in the Pearl River Delta (running south from Guangzhou past Shenzhen toward Hong Kong and Macau), the Yangtze River as far inland as Chongqing, Sichuan Province, and Bohai Bay. In 2004, there were some 280 Chinese freight-forwarding firms for COSCO to draw upon. Outside China, COSCO's regional headquarters were in Secaucus, New Jersey (for the Americas) and Hamburg, Germany (Europe). COSCO organized its companies into tiers of subsidiaries, capped by group headquarters in Beijing. Second-tier firms were the primary operating companies, including the shipping companies and COSCO Logistics. The subsequent tiers included the operating companies' subsidiaries and joint ventures (see **Exhibit 4** for an outline of COSCO's structure in 2004).

COSCO historically worked to maximize opportunities created by market conditions. For example, in response to increased port congestion, COSCO took equity interests in 19 different terminals and port facilities (specified in **Exhibit 5**). Drewry Consulting ranked COSCO Pacific as the world's fifth-largest container terminal operator at the end of 2004. Additionally, in response to customer requests for reliable access to COSCO's shipping capacity to assure themselves a steady

supply of production inputs, the company launched a series of strategic partnerships with major Chinese firms, including Baosteel (steel making), Sinopec (oil and gas refining), and Haier (home appliance exports). These agreements provided the Chinese firms with multiyear service contracts while locking in the high shipping rates of 2003–2004 for COSCO.

Building IT Capabilities

Early Days

Prior to 1993, COSCO Group's five predecessor firms operated their own computing centers for scheduling, finance, container management, and business statistics. The incompatibility of their independently developed software deterred the integration of group IT resources. The company tried various ways to address this challenge, one common to firms built this way.

COSCO's first dedicated IT department was a science and technology office set up in 1978. Over the next eight years, COSCO's sister companies imported punch card-based, small- and medium-scale information systems to manage ship scheduling, finance, equipment control, and shipping statistics. Japan's Fujitsu and NYK shipping line helped develop the financial software. In 1988, COSCO bought an IBM AS/400 mainframe computer with "dumb" terminals for user access and began migrating all applications, one by one, to the new platform. The thinking was that the consistent IBM hardware series would lay the basis for data sharing across the companies.

Software was developed in-house and supposedly was common to the five sister companies, "but we had problems doing it all ourselves," said Cao Yongsheng, deputy general manager of COSCO Network Ltd. Each company developed its own patches and interfaces, which reduced the compatibility of the supposedly common software applications. "So we then bought Tradeware in 1994, software with equipment control, documentation, and accounting modules," which Cao attempted to implement for two years, with limited success. In the end, COSCO implemented only the equipment control module. As Gu Qianbin, general manager of COSCON's computer center, summarized: "Internal development failed. Off-the-shelf external packages—Tradeware—also failed, through our lack of experience integrating a package with legacy code."

After the 1993 reorganization, COSCO in 1996 set up a central electronic data interchange center in the group's Beijing headquarters research and development (R&D) center to coordinate communications with shipping agents, port terminals, and customs, as well as between its Chinese and foreign offices. Information systems running on an IBM AS/400 or PCLAN were implemented for COSCO agents. Over RMB 100 million was spent on EDI upgrades and improvements.

By the mid-1990s, COSCO was sharing its shipping manifest database among group headquarters and primary operating companies. COSCO also had access to external real-time financial and business information via Bloomberg terminals. It had also begun building its own centralized global settlement and clearing system. In the late 1990s, some 45 employees worked in IT at group headquarters in three separate departments (planning, operations, and EDI); additional IT staff were scattered throughout the organization. By 2001, COSCO employed 349 people across its five main geographic centers (in Shanghai, Tianjin, Dalian, Qingdao, and Guangzhou) to handle operations-related IT; subsidiaries and overseas offices employed still more.

Office automation was significant and included an e-mail system and a corporate intranet that permitted videoconferencing. As a result, during its first eight months of operation, the number of meetings increased 33% while their total cost declined 21% from the same period a year earlier. By

2004, over 80% of the meetings of group headquarters staff and the staff of the 37 offices linked to the system were conducted via videoconference.[22] Information sharing and the integration of headquarters with the operating companies had improved.

Even so, the company still relied on some of the core systems installed 10 years earlier. Both the homegrown financial software system and the IBM mainframe it ran on—the first that IBM had sold in China—remained in operation. Partly in consequence, a commissioned report by China's Academy of Sciences concluded, "COSCO's IT level and situation significantly lags that of the best international carriers."[23]

In response, Wei mobilized over RMB 1 billion for near-term IT spending, in addition to the RMB 20 million regularly budgeted to support IT. Investment objectives included improving data flow both vertically and horizontally within the company, improving ship scheduling, conducting feasibility studies for customer relationship management (CRM) and ERP systems, and developing e-commerce and online logistics business.[24] The central objective was to structure IT systems to put COSCO on a unified global footing. In so doing, the company planned to modernize its capabilities to a level commensurate with the best of its peers, though further development was also planned.

COSCO's three primary IT projects were the deployment of SAP to create a common platform for financial management and reporting throughout the group, IRIS-2 to manage cargo bookings and back-office functions including container management, and a fleet management capability (of both ship and crew) that included safety and sailing parameters previously left solely to captain discretion. In addition, COSCO marshaled its own staff to develop four key software products: logistics software, e-business software, software to manage spare parts and materials purchasing (not yet completed at the end of 2004), and management support systems, including office automation.

The SAP Financial Management System

After soliciting proposals from several vendors, COSCO hired IBM Global Services to help implement SAP, dedicating 40 of its own IT and financial staff to the task and tapping up to 20 IBM consultants as well. The first stage ran for the year beginning April 2002 and included implementation at the level of group headquarters and COSCO Container Lines, an operating company. The goal was to complete high-level design of the system and to set up the basis of the group's future financial management as an amalgamated whole. With phase one complete, April 2003 saw the start of the project's second phase, implementation at the level of the domestic shipping firms, including COSCO Shipping, COSCO Breakbulk, and the Guangzhou, Dalian, Qingdao, and Xiamen shipping companies. By February 2004, SAP was in place for COSCO's primary firms within China and had replaced their homegrown financial software. In June 2004, SAP implementation began in COSCO's key overseas companies, including COSCO Hong Kong, COSCO Singapore, COSCO Americas and 19 related local companies, plus COSCO Logistics. With the completion of this phase in 2006, COSCO's main overseas firms would all be networked to the group. COSCO expected its SAP investment to total RMB 200 million.

In practical terms, one manager recalled, "We ran into a lot of problems. I told the SAP managers that the software is both too complex, hard to deploy, and not sufficiently secure." Without a specific SAP module for the shipping industry, COSCO chose to limit its deployment to financial management rather than operational control functions. Not everyone welcomed the changes SAP required. In commenting on this, the manager said: "The problem is always that people think that the way they are doing things is fine. They grumble about anything new, especially when their expertise lies with the old system and they know nothing about the new one." Another problem was cultural, added another manager: "Even if everyone agrees publicly with the new plan, opposition starts to

build immediately, which creates pressure for the implementation process. Complaints only emerge after the fact."

Despite these challenges, SAP succeeded in providing COSCO for the first time with a unified financial platform for group activity. This platform contained four functions: (1) general ledger, accounts receivable/payable, capital accounting, treasury management, and credit management; (2) profit- and cost-center accounting, internal-orders accounting, and profitability analysis; (3) inventory management; and (4) consolidated reporting. COSCO dedicated 36 people to support and maintain the system across the organization and put SAP data centers in Beijing and Shanghai, with two servers in each location. A third data center was to be opened at COSCO America's New Jersey headquarters.

Business impact of SAP Specific improvements due to the implementation of SAP were dramatic and included moving cash-flow and floating-capital reporting from a monthly to daily basis. Annual financial reports for COSCO's government supervisors, which previously were compiled annually by 10 people over a two-week period, could now be generated on a daily basis by one person in a few hours. From his desktop, Wei could now review the profit and loss (P&L) of each of COSCO's primary constituent businesses daily. More broadly, SAP implementation allowed COSCO to move from a mind-set focused on acquiring and maintaining financial control to one that now made financial considerations a new element of corporate decision making.

The IRIS-2 Container Management System

By 1998, the pressure to deploy an effective container management system was immense. Wei recalled COSCO's predicament:

> Before I became president [in 1998], COSCO already had a team of experts to develop a container management system. But they said it could not be ready until 2002. That was too late. We couldn't wait that long. If the product design started in 1998, would it be good enough to match the capabilities of whatever IT systems were operating in 2002? Probably not. Instead, I figured that buying and deploying today's leading product could be done relatively quickly. I think I made the right decision. We have a good pool of talented people, and we also hired brains from IBM, HP, and China Netcom.

One of those brains was Gu Qianbin, a 20-year COSCO veteran who had worked on the business side for 15 years—including four years in London—before moving to IT management for another five years. Gu managed the global implementation of IRIS-2. He agreed with Wei that time was COSCO's primary constraint by the late 1990s:

> Time was crucial. Development cost was a lower priority, since you can't buy time. To us, time was most important. You can see why: we wasted a lot of money on this already between 1993 and 2000. So when I took this job four years ago I was very afraid. This is a $100 million investment and a huge risk. I'm proud of Captain Wei. The decision he made was very brave, because COSCON was not doing well at the time. We had so little, we had to lease rather than own our data center. So it was courageous of top management to give me $100 million for IT development. There were many risks. We had no experience in implementing a global system. I had implemented one system before, but all the groundwork had been done by another company. We didn't know the UNIX platform, or HP, or about the SmallTalk development tool we'd use. But without deploying a system, the company would go nowhere. You would cease to exist.

In November 2000, COSCO paid Hong Kong-based shipping line OOCL to become the first licensee of its back-office system for the booking, tracking, and documentation of container cargo, IRIS-2 (Integrated Regional Information System, version 2).

IRIS-2 implementation A primary internal implementation risk lay in the fact that COSCO had committed a substantial sum of money to a project with unknown returns at a time when COSCON was not profitable during a bearish period of the shipping business cycle. Further, the project teams lacked professional project managers and experienced technical engineers. No one had previous experience with IRIS-2, so COSCO relied for guidance on OOCL, which was not a technical services company and had its own shipping business to run. End users within and without COSCO also had complaints. As a result, Gu found it challenging to maintain the focus needed to implement IRIS-2 globally over a period of three years.

Nonetheless, immediate implementation began with on-site investigation of local business practice, network requirements, and the existing IT system. With these data, project teams drew up implementation definitions and began system customization to meet the needs of local regulations, business practices, and technical configurations. In each location, IRIS-2 ran in parallel with the existing system for two months before the legacy system was shut down. Business and technical support was on-site, though internal users who ran into trouble could also call a Shanghai-based help desk that routed queries it was unable to answer to first- and second-level business and technical support staff on a 24/7 basis.

Global implementation began with a pilot project in North America, which went live in October 2001, providing control over transpacific bookings and equipment. China went live in February 2002, followed by Asia-Pacific in August 2002 and Europe in early 2003. By the end of 2003, COSCON had extended IRIS-2 to provide global logistical coverage of all COSCO shipping routes. This permitted identification and booking of the most cost-effective routes to be made online instead of by phone, fax, or e-mail. This complemented the online availability of inbound and outbound sailing schedules and cargo spaces. IRIS-2 allowed bills of lading to be printed remotely, in consignor or agent offices. The system also notified agents and shippers by e-mail, fax, or pager as soon as each step in the shipment's progress was complete. In 2004, over 4,500 end users in 160 offices in 41 countries used IRIS-2 daily. By 2005, 70% of user queries were resolved without recourse to the second level of support in Shanghai.

Built into the system were disaster-recovery features that protected IRIS-2 and its data from extensive outage, including complete primary-site failure. COSCON held emergency drills four times annually, twice in Shanghai and twice globally. After shutdown, the system could be up and running in 18 hours, with only 20 minutes of data loss for later recovery. IRIS-2 followed ISO 7799 for information security, and in 2005 Gu was planning to separate and insulate IRIS-2 from outside access or corruption by other user applications. (The organization and staffing of Gu's IT department within COSCON is detailed in **Exhibit 6** and **Exhibit 7**.)

Business impact of IRIS-2 Before IRIS-2, COSCO could calculate its profit and loss on an entire voyage only after the sailing was complete. IRIS-2 allowed COSCO to know the profit and loss earned on each container on each segment of its voyage in advance. Further, the system allowed COSCO to plot the most cost-effective means of returning empty containers. For example, said Wei:

> Previously for trips from the U.S. back to Tianjin, we would transship through Japan and then put the resulting empties on a frigate to Tianjin. But IRIS-2 told us it was cheaper to transship through Qingdao [China] instead. The same holds for bookings. You would think that a cost of $800 per container to the U.S. is pretty reasonable, but IRIS-2 will tell us that it's

not enough to cover our costs. You will lose money. People can't keep track of this kind of thing. For COSCO, this kind of IT is revolutionary.

Wei assessed IRIS-2's span of control this way:

> IRIS-2 is the largest global network of any Chinese company operating internationally. Each ship carries up to 8,500 containers. Each container carries its own bill of lading and manifest. To process that paperwork by hand is extraordinarily time consuming. And the information we had we knew was, at best, an approximation. IRIS-2 has had impact on documentation, production, management, cost control. From the perspective of container management and customer acquisition, the results have been terrific. I've invested RMB 1 billion in IRIS-2. I guarantee you it's going to pay for itself in just a couple years.

Gu agreed: "Before, people spent all their time disagreeing about whether we had 60,000 or 100,000 empty containers in the United States. Now we know exactly how many there are, and we can focus on the implications of that number instead of arguing about what the correct number is."

There were other direct benefits as well. Bills of lading were previously issued by a document center located in the United States. The centralization of IRIS-2 in Shanghai allowed the document center to be transferred to China, a much lower-cost location. As of 2004, all documentation was done from Shanghai and printed remotely in agent and shipper offices. Similarly, financial documentation previously done at the shipment's origin was centralized in Shanghai. Greater automation also reduced errors, ensuring, for example, that goods meant for Birmingham, England were not mistakenly shipped to Birmingham, Alabama instead.

Wei described his expectations for the future expansion of IRIS-2: "The impact of IT will manifest itself gradually across all our operations. As we implement IRIS-2 in each unit, we will convert the operating results of the unit into better financial results. Each company's revenues, cost, net profits will be accessible at all times, not only numbers but charts, graphs, and queries."

Global Navigation Intelligence System

COSCO had also worked with external specialists to develop a world-class global navigation intelligence system, a satellite-based ship-position monitoring system that enhanced the safety of oceangoing ships and could track the location of individual containers with greater accuracy and control than ever before. Fleet management included not only the location and pace of every ship in COSCO's fleet but onboard Internet access to facilitate any necessary repairs and diagnostics. Weather information available centrally could be accessed on ship and appropriate course and schedule adjustments made.

Going Forward

In over 20 years of building up COSCO's IT capabilities, COSCO managers had learned important lessons that remained at the forefront of their thinking on the subject. IT's value to the business was now beyond question, and managers were convinced that the company's competitive future rested upon strong and leading-edge IT capabilities. Scientific planning and standards underlay all IT success, as did regular and adequate capital investment and the cultivation of dedicated and innovative talent within the organization. To direct staff energies and talents, COSCO had developed several important slogans. For the IT organization, this included, "Driven by business demand, led

by advanced technology." On implementation, this included, "Combine technology input with knowledge transfer."

Between 1998 and 2003, COSCO's IT spending totaled about RMB 1.5 billion, of which IRIS-2 made up RMB 1 billion. The return on that investment could be seen in COSCO profits, which rose steeply during 2003 and 2004. The company estimated the implementation of IRIS-2, SAP, and its other IT initiatives generated annual direct benefits exceeding RMB 100 million within COSCON alone, both as savings, such as reductions in container management costs, and new revenues, such as more profitable cargo. (**Exhibit 8** breaks down the benefits in percentage terms.)

In early 2005, COSCO was moving to integrate and better coordinate both the IT functions and the 432 IT specialists who were spread throughout the company. In 2003, as part of the effort to consolidate the gains from IT, Group IT (located at headquarters in Beijing) became the responsibility of Ma Zhihong's COSCO Network. Ma then worked to gradually integrate and coordinate with the other IT groups throughout the organization. It was anticipated that four further IT companies would be set up under Ma, who had formerly worked as assistant for IT for both Wei and his predecessor in the chairman's office.[25] Their primary purpose would be to support COSCO operations, but they would also serve third-party customers as opportunities arose (see **Exhibit 9**). In addition to COSCO Network, two of the four IT companies were running in early 2005. These were COSCO Logistics IT Company and COSCO Network (Beijing), the group headquarters' IT organization. In addition, Ma planned to create a new IT firm dedicated to COSCON and a fourth to support other shipping operations, including their global-tracking as well as crew-roster management. COSCO Network was expected to tap capital markets to fund further development and acquisitions.

In the meantime, COSCON operations now ran on a real-time basis; the successful creation of an interface between SAP and IRIS-2 allowed IRIS-2 data to be uploaded once every minute. Previously, such information transfers had been done by hand. SAP and IRIS-2 also for the first time made data mining possible, an activity run by a new business intelligence group, created with an RMB 200 million investment. COSCO managers were increasingly aware of the opportunities created both by IT and by the resulting information. As one manager noted, "We pay more attention now to structural change and modernization than we used to." The question was how to make best use of this new knowledge.

Exhibit 1 Operating Profits as a Percentage of Revenue, Selected Shipping Lines, 1996–2000

	Operating Profit (US$ million)					Operating Profit as % of Revenues				
Carrier/Group	**1996**	**1997**	**1998**	**1999**	**2000**	**1996**	**1997**	**1998**	**1999**	**2000**
APL	99	--	--	--	--	3.6	--	--	--	--
ACL	39	48	48	18	37.2	14.0	15.1	16.6	6.7	11.9
CP Ships	80	96	119	88	163	9.9	9.9	6.7	4.6	6.4
Hanjin Shipping Company	170	140	98	203	213	8.9	6.8	4.2	7.5	7.2
Hapag-Lloyd[a]	27	48	27	46	198.5[b]	2.0	3.1	2.4	4.9	11.5
K Line	77	38	195	247	291	1.8	1.1	4.2	5.5	6.5
Matson Navigation	82	100	66	84	93.7	12.4	14.0	9.1	11.2	11.0
Mitsui OSK Lines	330	323	486	578	631	5.0	5.6	7.0	7.0	8.8
AP Moller[c]	547	703	725	885	1,056	10.6	17.5	13.1	14.5	11.5
NOL	8	-43	64	381	593	0.6	-2.8	1.6	8.9	12.7
NYK	416	317	433	572	707	4.7	4.3	6.4	6.4	7.7
OOCL[d]	100	46	21	123	169	5.3	2.4	1.1	5.7	6.9
P&O Nedlloyd	19	73	81	7	201	0.5	2.2	2.4	0.2	4.9
Samudera Shipping Line Ltd.	7.4	8.3	10.5	12.6	12.7	5.4	4.8	5.5	5.8	4.9
Sea-Land Service/CSX Lines	318	278	133	115	0	7.8	7.0	3.4	3.0	--
Zim Israel Navigation Co.	14	7	63.7	96	118.3	0.9	0.5	4.3	6.0	6.6

Source: Drewry Shipping Consultants and company records.

[a]Shipping division.

[b]Fiscal year 1999–2000, which ended September 30, 2000.

[c]Results are from Tankers and Liners in Partnership.

[d]Group results.

Exhibit 1 (continued) Operating Profits as Percentage of Assets, Selected Shipping Lines, 2001–2003

Company	2001	2002	2003
APL	6.4	4.6	6.9
Evergreen Marine Corp.	3.1	1.5	4.0
Hyundai Merchant Marine	4.5	-0.6	6.7
Mitsui OSK Lines	6.9	5.5	4.3
NYK	6.3	4.9	5.4
Hanjin Shipping	4.4	0.2	8.1
K Line	7.0	3.6	5.7
OOCL	5.0	10.5	32.1
CP Ships	7.2	3.3	7.2
CMA CGM	2.4	8.1	6.1
P&O Nedlloyd	5.0	-12.1	4.3
Yangming	-1.8	0.3	7.3

Source: Containerization international data supplied by COSCO.

Exhibit 2 Volume Carried by Top Container Lines, 2001–2003 (in TEU, excluding empties)

		2001	2002	2003
1	Maersk Sealand	7,000,000	7,500,000	8,000,000
2	COSCO	3,890,000	4,000,000	3,984,000
3	Evergreen & Uniglory	4,140,000	4,440,000	4,900,000
4	P&O Nedlloyd	3,183,900	3,559,600	3,743,195
5	American President Lines (APL)	2,813,960	3,000,000	3,040,000
6	Hanjin Shipping	2,170,000	2,300,000	2,576,000
7	Nippon Yusen Kaisha (NYK)	1,980,000	1,600,000	1,904,000
8	Mediterranean Shipping Co. (MSC)	n/a	n/a	n/a
9	Hyundai Merchant Marine	n/a	n/a	n/a
10	CP Ships	1,842,000	2,010,000	2,200,000

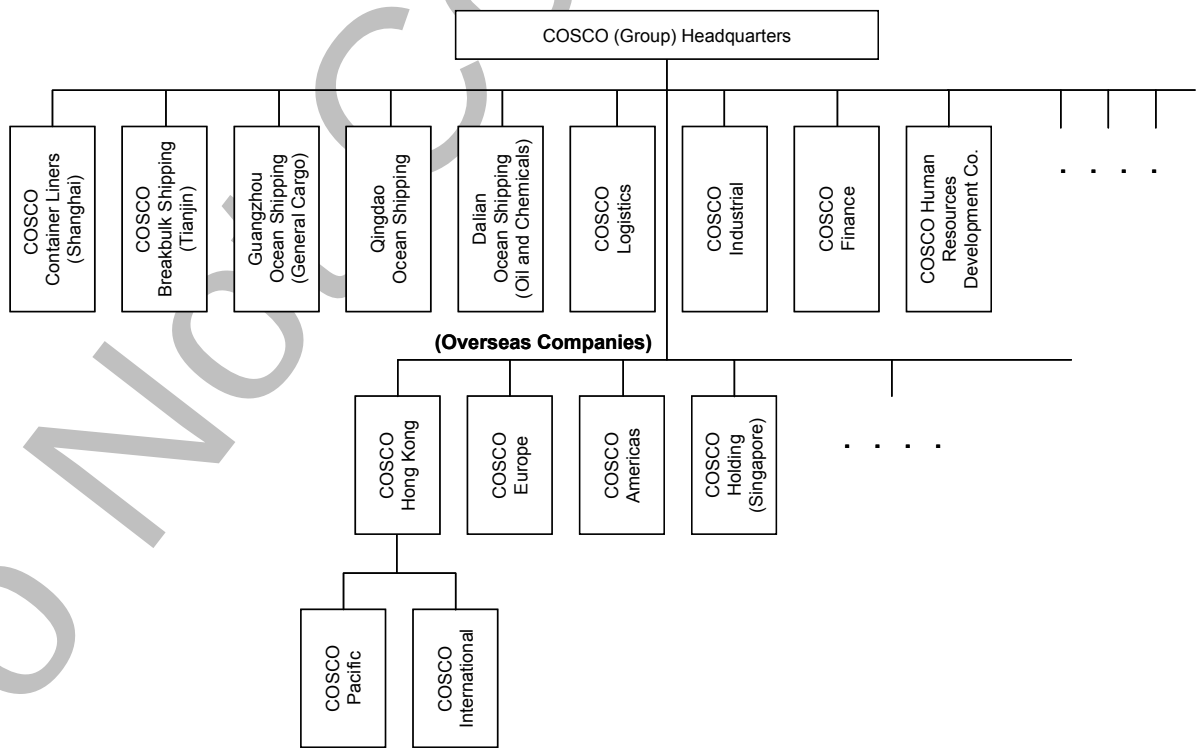
Source: Containerization international data supplied by COSCO.

Exhibit 3 Leading Container Fleets (deployed and projected TEU, December 2004)

Company	Rank (2003)	Existing Fleet		Ships on Order	
		No. Ships	TEU	No. Ships	TEU
Maersk Sealand	1 (1)	351	928,668	78	431,121
Mediterranean Shipping Co.	2 (2)	244	636,032	46	344,637
Evergreen	3 (3)	157	450,649	29	182,564
P&O Nedlloyd	4 (4)	157	434,952	36	195,078
CMA CGM	5 (5)	186	405,445	39	219,944
APL	6 (7)	96	307,094	8	44,516
COSCO	7 (8)	123	300,624	26	170,811
Hanjin	8 (6)	72	278,966	10	69,775
China Shipping	9 (13)	104	247,996	41	246,135
NYK	10 (9)	74	243,339	16	104,000
Total		7,645	9,058,401	988	3,854,846

Source: Containerization international data supplied by COSCO.

Exhibit 4 Simplified COSCO Group Structure, 2004



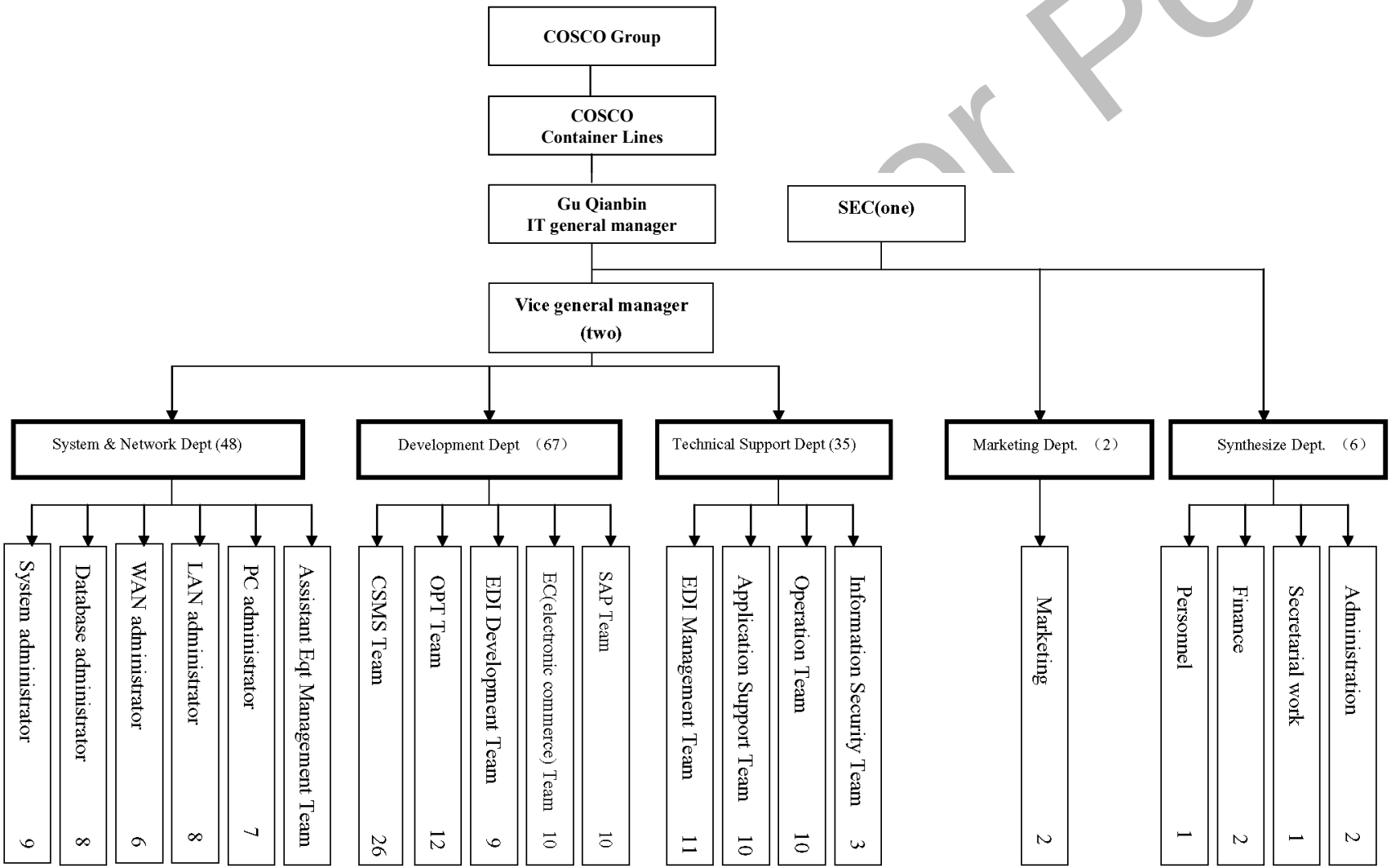
Source: Company document.

Exhibit 5 COSCO Port and Terminal Equity Stakes, 2004

	Terminal Name	COSCO's Stake (%)	Date Established
1	Shekou International Container Terminal	17.5	August 1991
2	Hong Kong COSCO-International	50	October 1991
3	Zhangjiagang Yongjia Container Terminal	51	October 1992
4	Shanghai International Container Terminal	10	August 1993
5	Yantian International Container Terminal	5	November 1993
6	Qingdao Yuangang International Container Terminal	50	January 1996
7	Yingkou COSCO International Container Terminal	50	October 1996, March 2004 reorganization
8	Bangkok DBS Container Terminal	40	September 1997
9	Taicang Yuantai Container Terminal	45.87	May 1998, December 2003 reorganization
10	COSCO Long Beach Port	51	June 2001
11	Naples, Italy	50	October 2002
12	Shanghai Pudong International Container Terminal	20	March 2003
13	Qingdao Qianwan International Container Terminal	20	July 2003
14	Singapore COSCO-PSA Container Terminal Company	49	November 2003
15	Dalian Auto Shipping Terminal	30	January 2004
16	Yangzhou Yuanyang Port	51	March 2004
17	Tianjin Wuzhou Container Terminal	12	June 2004
18	Dalian Dayaowan Phase 2 Container Terminal	20	May 2004 signing
19	Antwerp, Belgium	25	November 2004 signing

Source: Company document.

Exhibit 6 COSCON (Cosco Container Lines) IT Organization (and staff levels), 2004



Source: Company document.

Exhibit 7 COSCON (COSCO Container Lines) IT Staff Age and Education, 2000 and 2004

Time (end of month)	Quantity	Education						Age						
		Doctorate	Master's Degree	Under-graduate	Associate Degree	Technical Secondary	Senior High School and Under	30 Years and Under	31~35 Years	36~40 Years	41~45 Years	46~50 years	51~54 years	55 Years and Up
April 2000	73	0	5	43	11	11	3	50	9	4	3	4	2	1
December 2004	162	0	6	116	29	6	5	125	13	6	8	3	4	3

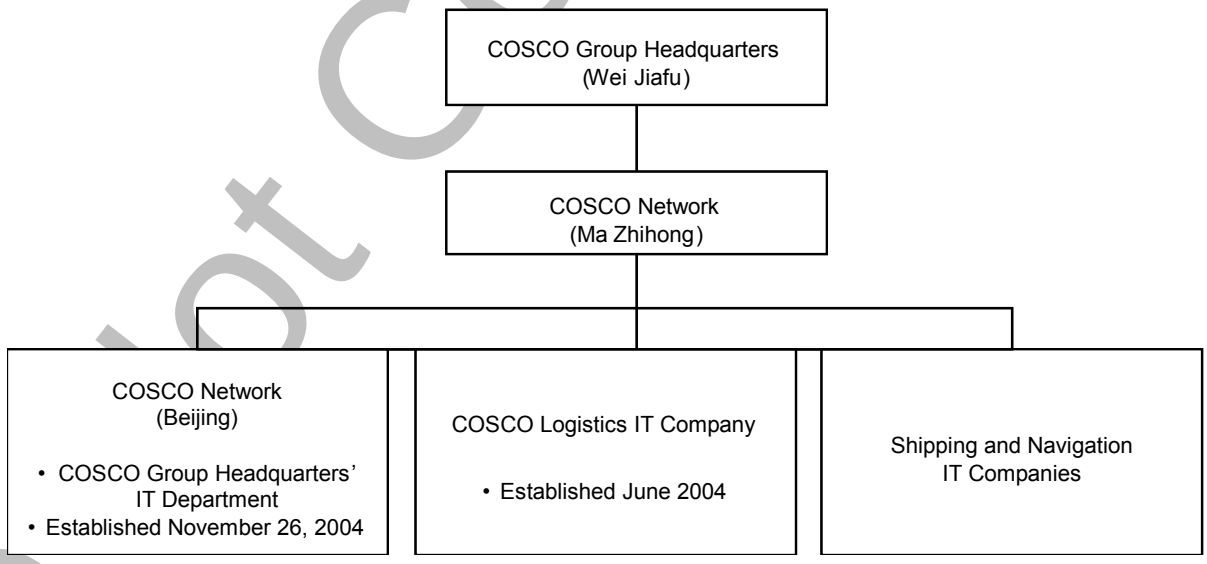
Source: Company documents.

Exhibit 8 Direct Benefits of COSCON IT Initiatives, 2004

Source of Benefit	Percentage of Total
Reduced container rent, repair, and management cost	26%
Increased revenues from higher-quality services	21%
More efficient use of ship stowage capacity	17%
Increased revenue from the transport of more high-value goods	17%
Savings from migrating global documentation to China	10%
Improved transport quality, reduced claims of all kinds	7%
Reduced interest expense due to improved cash management	2%
Total	100%

Source: Company document.

Exhibit 9 Proposed COSCO IT Organization



Source: Company document.

Endnotes

[1] Henry H. Willis and David S. Ortiz, "Evaluating the Security of the Global Containerized Supply Chain," Rand Corporation Technical Report 214 (Santa Monica, CA: Rand Corporation, 2004), p. 1, available from http://www.rand.org/pubs/technical_reports/2004/RAND_TR214.pdf, accessed January 28, 2005.

[2] See Philip Siekman, "The New Wave in Giant Ships," *Fortune*, November 12, 2001.

[3] This paragraph draws upon "China's Freight Forwarding and Logistics: The Path after Entering WTO," Hong Kong Trade Development Council, July 2000.

[4] "Breakbulk Operators Resist Box Threat," *Journal of Commerce Online*, October 2, 2001.

[5] Jane Boyes, "E-commerce Heralds Sea Change for Liner Shipping," *Containerisation International Yearbook* 2001, p. 5.

[6] "Water Transportation," U.S. Industry and Trade Outlook 2000.

[7] Bill Mongelluzzo, "Coming up short," *Journal of Commerce*, September 6, 2004, accessed January 14, 2005 through ProQuest.

[8] Ibid.

[9] Paul Berrill, "Capacity crunch to hit box ports," *Tradewinds*, January 14, 2005, accessed January 17, 2005 through Factiva.

[10] Ibid.

[11] Ibid.

[12] Stephen Matthews, "Cost Control," *Lloyd's Shipping Economist*, December 1, 2004, accessed January 14, 2005 through Factiva.

[13] Bill Mongelluzzo, "No Time to Waste," *Journal of Commerce*, January 10, 2005, accessed January 17, 2005 through Factiva.

[14] "Basking in the Sun," *Petroleum Review*, December 6, 2004, accessed January 14, 2005 through Factiva.

[15] Paul Berrill, "Capacity crunch to hit box ports," *Tradewinds*, January 14, 2005, accessed January 17, 2005 through Factiva.

[16] "Basking in the Sun," *Petroleum Review*, December 6, 2004, accessed January 14, 2005 through Factiva.

[17] Stephen Matthews, "Cost Control," *Lloyd's Shipping Economist*, December 1, 2004, accessed January 14, 2005 through Factiva.

[18] Ibid.

[19] "Zhongyuan Jituan Chao'e Wancheng 2004nian Gexiang Shengchan Jingying Zhibiao," COSCO company document, January 2005.

[20] Ibid.

[21] Before their consolidation under the umbrella of the COSCO Group in 1993, each of COSCO's five constituent companies in Dalian, Guangzhou, Qingdao, Shanghai, and Tianjin offered a complete range of container, breakbulk, and specialized shipping services. The problem created by such separate yet full-service companies was clear well before 1993; Shanghai might be short on containers and Guangzhou in surplus, but the resources were not being shared across company lines.

[22] "Dazao 'Shuzihua Zhongyuan,' Tuijin Guanli Chuangxin, Jiakuai Shixian Zhongyuan Jituan de Zhanlue Mubiao" ("'The Data-fication of COSCO': Promote Management Innovation and Speedily Reach COSCO Group's Strategic Targets"), COSCO Group mimeo, 2004, p. 8.

[23] "Zhongyuan Jituan 'Shiwu' Keji Fazhan Guihua (COSCO's "十五" Science and Technology Development Plan)," April 2001, p. 2.

[24] Ibid.

[25] In addition to his IT responsibilities, Ma also headed the COSCO (Hong Kong) Industry and Trade holding company.