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A Generic Systems Model for Ocean Shipping Companies in the Bulk Sector

Abstract

Ocean shipping transportation has been studied mainly from an economic and management point of view. This article follows an operations management approach, adopting a Business Systems Engineering methodology with the assistance of process modeling. It aims to identify, understand, and document the factors or activities within the ocean shipping management companies via the creation of Generic Systems Model (GSM). Two case studies from different sectors – dry bulk and liquid bulk – assist in the validation of the model.

The ocean shipping industry is a sector of increasing importance in world trade as it is the only mode that is used for the transport of large consignments and offers the cheapest and most cost-effective transportation compared to rail, road, and air. Almost 90 percent of the European Union's trade with other countries and over 30 percent of the intra-community trade is done with sea transport (ESPO 1997), and approximately 60 percent of all international U.S. shipments move by water transportation (Murphy et al. 1991). The extensive usage of ocean shipping transportation reinforces the significant role of ocean shipping companies within the supply chain system context since there is a relationship between the efficiency and effectiveness of these companies with that of the supply chain.

Until now, the ocean shipping industry has been studied mainly from an economic point of view, focusing more on macroeconomic and microeconomic factors and less on strategic and management issues. This study, which takes a Business Systems Engineering (BSE) approach, aims at understanding and documenting the processes that take place in the ocean shipping management environment with the assistance of process modeling. The literature review indicates that, unlike other industries such as manufacturing (Parnaby 1979) and, more recently, construction (Cooper 2000), no specific or generic process models exits of shipping companies.

A systems approach has been selected for this study for two main reasons: It lets companies engineer their activities better and it many companies have implemented this approach successfully (Parnaby 1994). According to Watson (1994), for a BSE program to succeed it should follow the ''understand-document-simplify-optimize'' (UDSO) engineering cycle. A number of similar methods exist, as presented in Table 1, illustrating their applicability in the different industrial sectors (Naim et al. 2002).

Process modeling encapsulates the first two steps of the engineering cycle described by Watson: understanding and documenting. With the use of Quick Scan methodology Naim et al. (2002) have applied the first two steps of UDSO methodology to a number of value streams in order to show the level of their integration. In general, process thinking is considered of crucial importance for companies since it enables them to improve their flows and their internal political alignment, focusing on the customer's real needs (Towill 1996a).

This article intends to identify the activities that take place in the ocean shipping companies via the creation of a Generic Systems Model

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Table 1. Comparison of Different Methods vis-à-vis the UDSO Method

UDSO stages (Watson 1994)	ASIA stages (Small 1983)	Information systems reengineering stages (Jacobson et al. 1995)	Manufacturing systems reengineering stages (Parnaby 1991)
1. Understand	1. Analyze	1. Envisioning - including understanding the business and capturing requirements	1. Market analysis
2. Document		2. Reverse engineering - including the development of models of the existing business and legacy information systems	2. Business process analysis - including process mapping
3. Simplify	2. Simplify	3. Forward engineering - including the simplification of software coding when interfacing new systems to legacy systems and creating information system itself	3. Steady state design - including ensuring that the system is balanced and synchronized
4. Optimize	3. Integrate 4. Automate		4. Dynamic design 5. Information and control design and system integration

Source: Naim et al., 2002

(GSM). The article's primary objective is to create a model that will support a case-based approach to problem solving without necessarily reinventing the wheel (Parnaby 1979). The generic model with the assistance of process modeling provides the appropriate template to work on this basis within and between different sectors by identifying the key processes that directly affect the optimum solution.

This article specifically uses the Input-Output process modeling technique first developed by Parnaby (1979) and which has been used by industry and academics subsequently (Berry et al. 1998). This is not to be confused with the classic economic input-output modeling previously used in economics (Leontief 1936), although there are similarities. The process modeling used in this article identifies the functional units and flows that define the processes in a company; that is, understanding and documenting phases of UDSO. From this, opportunities for simplification and optimization should be sought to re-engineer the process. We suggest that economic analysis comes at the optimization stage. While at first it may seem unnecessary to merely identify the functions and flows, in fact considerable time and effort should be put in at these early stages of a systematic methodology to ensure that the problem, system boundaries, function, and variable flows are well defined. As Towill (1996b) has identified, in a typical process reengineering project 45 percent of effort is required in the understand-and-document phase and similar time and effort (45 percent) in implementing the outcomes of the analysis of the documented processes. That means, in fact, only 10 percent of effort is required for analysis.

Methodology

In this article, systems theory is applied with the use of Parnaby's (1979) Input-Output model on an ocean shipping company operating in different markets of the ocean shipping industry; the dry bulk and the liquid bulk or tanker sector. This model will enable comparison between the operations that take place within the same ocean shipping company for the different types of vessels it manages. It

should be pointed out that the company's experience in the industry of more than forty years was an additional factor in its selection.

To understand the nature of the ocean shipping business the route of action research was selected by the authors. The objective of this decision was to create a pilot study that would allow safer and closer to reality observations, which will form the basis for future research. The time spent in the company was three months, during which period there was direct involvement in the everyday operations and functions of the company. This direct involvement was achieved through rotation in different departments, which enabled the identification of interdepartmental relations apart from those existing with customers and suppliers.

The article begins with an overview of systems theory, systems thinking, and business systems engineering methodologies that exist today, followed by the nature and characteristics of the ocean shipping industry. Then the various modeling methodologies that exist in the ocean shipping industry literature are mentioned. After the presentation of the theoretical framework, the GSM is presented and validated with two case studies. Finally, conclusions and the contribution of this article are discussed.

Systems Thinking and Business Systems Engineering

A system is defined as a group of interacting, interrelated, or interdependent elements forming a complex whole. It comes from the Greek word *óýóôçiá* (sustema), which means to combine (Thorndike and Barnhart 1988). The concept of the system is not new. It appears in the works of the Greek philosophers Plato (428 - 347 BC) and Aristotle (384 - 362 BC). Plato in the *Republic* (White 1979) states that in order for a city to function properly and to be able to satisfy the needs of its members it should be constructed so that each of its members has a specific role. Aristotle, who was influenced by Plato, in his *Theory of the State* perceived the city as a system consisting of parts, having a common code of communication that enables them to operate and function properly within the system and thus the system as a whole.

Systems theory has been around in modern literature for more than fifty years. Its thinking is based on being systemic, or thinking of entities, situations, and problems as a complex of interacting parts, which can be divided into specific systems and subsystems. Problem-solving applications of systems thinking have been categorized into "hard" and "soft." "Hard" are those systems that have objectives and problems that are or can be well defined. Their relationships can be accurately depicted and qualification is possible. "Soft" systems are those with ill-structured objectives and problems, which aid decision making (Checkland 1981). In general terms, systems theory intends via the understanding, simplification, and analysis of certain problems and situations, to assist as a decision-making tool.

In the literature different methodologies are used to explain the system under study. The viable System Method applied in cybernetics (Beer 1966), Control Theory (Ashby1966), Soft Systems Methodology (Checkland and Scholes 1999), Input-Output analysis (Parnaby 1979), General System Theory (von Bertalanffy 1962) and Process Modeling (Waters 1996) are some of the methodologies that have appeared in literature over the last fifty years.

The aim of the above methodologies is to comprehend and at the same time manage or eliminate complexity (Gharajedaghi and Ackoff 1984). Business systems engineering enables the task of understanding and documentation with the use of process modeling since it combines the skills of analysis, innovation, synthesis, and implementation (Jenkins 1969). The systematic methodology adopted by BSE helps a company not only achieve its aims and objectives but also maximize the value of its customers (Towill 1997). The importance of process modeling as the first step of BSE can also be derived by the seven-point checklist that Meyer (1993) proposes for its successful implementation. These steps are as follows:

Rule 1: Relate process improvement to business strategy

Rule 2: Involve the right people in the right way

Rule 3: Give task forces a clear brief and the necessary accountability to achieve it

Rule 4: Do not confuse endless re-organization with effective re-engineering

Rule 5: Understand how process changes affect people

Rule 6: Always focus on successful implementation

Rule 7: Ensure task forces leave effective monitoring systems in place

In this article, with the use of Parnaby's (1979) Input-Output analysis, a GSM is created for the ocean shipping industry, which will assist in the understanding and documentation of the processes involved in the system. With the use of case studies from an ocean shipping company operating vessels in the dry and liquid bulk sectors, an attempt will be made to validate the model.

The aim of the GSM is to identify the necessary inputs needed by a company operating in the modern ocean shipping industry environment to become operational; analyze the service processes that take place in everyday operations; and finally, determine the final result or output of these processes.

The Ocean Shipping Industry

The transport industry, and specifically the ocean shipping industry, has mainly been studied from a macro- and microeconomic point of view (Stopford 1997; Beenstock and Vergotis 1993; Evans and Marlow 1990). Within the macroeconomic approaches, Koopmans (1939) created econometric applications investigating the sensitivity of the freight rates to changes in the level of demand on the one hand and the factors affecting the supply of ships on the other. Wergeland (1981) created an aggregated model of the dry bulk freight market. Strandenes (1984) studied the determinants of time-charter rates and secondhand prices of ships. Hawdon (1978) got involved in the tanker market as well and created a model that determines freight rates in the short and long term. Finally, Charemza and Gronichi (1981) developed an integrated model of the ocean shipping markets, which consists of a freight market, a shipbuilding market, and a scrap market and was applied in both dry cargo and tanker markets.

From the microeconomic point of view, emphasis has been on the cost of transport and its minimization with the use of a variety of strategies such as unitization, size, speed and reliability, selection of the appropriate nodes for the operators, and others. For instance, McLellan (1997) studied the size of vessels and the level their size can reach, whereas Glen (1997) studied the market of secondhand ships and how this is affected by different variables. Brown and Savage (1996) studied the economics of the double-hulled tankers and Schoyen and Erichsen (1995) made a similar study by investigating the replacement of very large and ultra large crude carriers. Bendall and Stent (1996) focused their research on the container sector, estimating the productivity gains of new technologies. Along the same lines is the research of Lin (1995), who studied the economics of container ship size, and that of Talley (1990), who investigated the optimal container size for different routes, distances, and destinations. In terms of carrier selection, a number of studies have been made by Bagchi (1987; 1989), Brooks (1990), and Bardi (1973). Finally, Frankel (1991) focused on the economics of technological change in shipping, and Evans (1994) analyzed the efficiency of the bulk shipping markets.

In terms of their organizational structure, ocean shipping management companies have been studied based on the traditional (Hunger and Wheelen 1996; Gareth 1998) management tools and theories, such as the simple (Galbraith and Kazanjian 1986), functional (Mintzberg 1979), multidivisional (Channon 1973), holding company (Johnson and Scholes 1999), and matrix (Bartlett and Ghoshal 1990) structures. In many cases (Goulielmos 1996; Ircha and Thomas 1993; Lu and Marlow 1999; Panagides and Gray 1997) they have been analyzed, based on these methodologies, as independent and isolated elements, focusing on their internal structure and functions without paying attention to the external environment and how this affects their operations.

As can be observed, most of the studies, whether they focus on the industry in general or on the ocean shipping management companies, have as their main objective to observe, understand, and analyze the internal dynamics of the industry, paying little attention to external factors. The Input-Output Analysis, which follows a more holistic approach with an operations management perspective, is intended to identify the widest possible variety of factors that determine and affect the functions and operations of the ocean shipping management companies in the modern business environment.

Analysis of Generic Systems Model

The primary aim of an ocean shipping management company is to transport any kind of product in a reliable, efficient, and effective way by offering the best service possible and thus meeting any customer requirement. The question that arises is, How is this achieved in a dynamic business environment? In other words, what are the processes a company follows in order to manage and cope with uncertainty and the continuously changing characteristics of its customers?

In the case of a shipping company, the Input stage includes those processes that are essential to operate at the *strategic* level. At this level, actions that affect the present and future operations of the company, its efficiency and effectiveness, and, therefore, its competitiveness, take place. At the Service Process stage the processes that take place at the *tactical* level of the company are included. This is the stage where the service level and quality offered to the customers are guaranteed through the integrity of the processes followed. At the Output stage the processes that take place at the *operational* level are included. The processes and actions encapsulated in each stage are illustrated in Figure 1. It should be pointed out that the processes and actions that take place at each stage or level have a knock-on effect on the processes and actions that follow. For instance, the processes that take place at the *strategic* level affect those at the *tactical* level, which in turn affect the processes at the *operational* level and vice-versa.

As can be seen in Figure 1, at the Input stage there are six main processes that take place, which are related to the foundations of any ocean shipping company. These processes are the mission statement, financing, asset introduction, classification society selection, flag selection, and recruitment. Each of these processes plays a substantial role in the organizational structure of the company and affects its competitiveness.

The mission statement does not include only the aims and objectives of the company. It also includes the time required to analyze the market status and forces where the company intends to operate. This analysis is time-consuming and crucial, as all strategic decisions are based on it.

Financing includes the processes necessary to acquire the necessary capital, which will enable the company become operational. These processes are directly related to the processes encapsulated in the mission statement because any justification of the company's future investments is based on the analysis and predictions, which are the result of the above actions. Demolition, mortgages, selling of options owned for the construction of new vessels, and selling of owned vessels are some of the strategies a company can follow to achieve better financing.

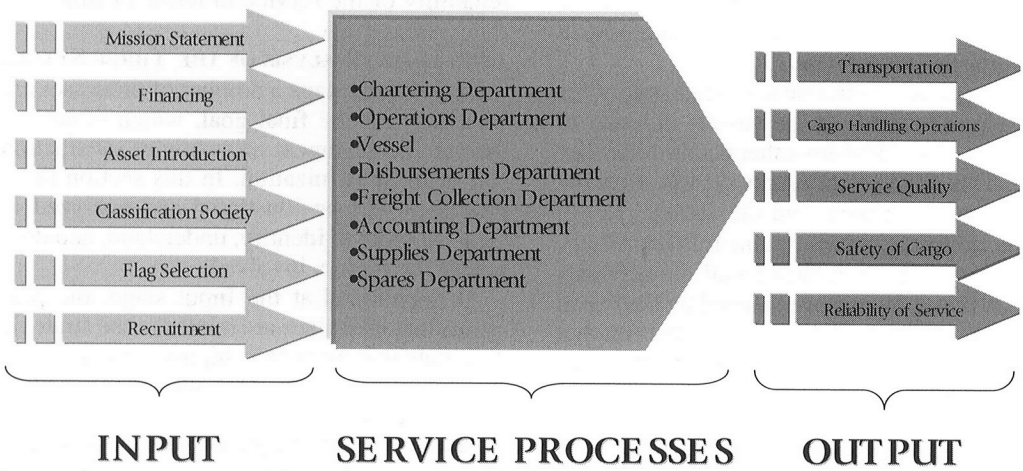
Asset introduction is probably the most important strategic decision that a shipping company has to make because the type of vessel(s) the company plans to put into service and the way these will be deployed around the globe will determine the type of customers the company will attract. This will affect the company's profitability since the capital that will be tied up in these assets is rather high and a minor misleading estimation of market forces can be disastrous. These vessels can come either from the new building or from the secondhand market.

Classification society selection is the process that assures the quality and reliability of the company's assets. The importance of this process is extremely high as the primary criterion for the selection of a vessel by the charterers is the classification society it is under. If the integrity of the classification society is not of absolute global recognition, this may be an obstacle to the chartering of the specific vessel as the charterers will be reluctant to charter a vessel that does not meet the worldwide accepted safety and reliability standards.

The flag selection process affects the reliability of the company and its customers. It is a strategic decision that affects the company's profitability in a direct and indirect way. For different flags different laws apply, which affect the operations of the vessels and their costs. Tax regimes and crew synthesis are determined by flag selection and are the two most important factors that affect a vessel in cost terms along with the insurance costs.

Recruitment and certificate processes are complex due to their dependence on the flag selection. Each flag regime has different laws in terms of crew synthesis and the certificates

Figure 1. Generic System Model Overview



Source: Authors

that should be obtained. The selected human capital should be adequately trained and capable to operate efficiently, effectively, and safely the expensive assets that it has under its responsibility. Manning both the headquarters and the vessels is a difficult task for an ocean shipping company since the expertise needed for the operation of each vessel is critical and yet hard to find. The more diversified and specialized the fleet owned by a company, the harder it gets to obtain the appropriate personnel.

At the Service Processes stage, the processes that take place within the grounds of the shipping company and its customers and suppliers are included. These processes encapsulate the actions taken in the chartering, operations, freight collection, disbursements, supplies and accounting department, and the vessel. The port authority at each port of call and the representative agent are also included at this stage even though they are not related to the internal affairs of the company. They are external factors that affect the company's operations.

The chartering department is the business generator for the company. In this department the required processes for the chartering of the company's vessels are made. In other words, this is the department that undertakes the necessary negotiations in order to bring customers to the company and create a wide and loyal customer base.

The operations department is considered the heart of the shipping company. Thanks to the processes that take place here, the company is able to follow the status and needs of its assets around the globe 24 hours a day, 365 days a year. Apart from the positioning of the vessels that this department is responsible for, it undertakes other processes and actions, the most important being coordination. Such coordinating actions involve those of navigation guidelines to the vessels and giving advice in terms of time and location that specific supplies such as fuel and provisions should be given to them.

The freight collection department traces any payments related to each vessel for every single voyage. Such payments are apart from the actual freight, those of demurrages and dispatches as well, depending on the time lost or saved during the loading and unloading process undertaken respectively at each port of call. In general, the processes that take place in this department are for the protection of the company's interests against its customers and the parallel assurance of keeping customers satisfied in terms of payment methods via the provision of any feasible payment facilities.

The processes that take place in the disbursements department ensure that the amounts charged at each port of call for each vessel are aligned with the official or pre-arranged tariffs agreed between the company and the respective

port. This department again acts in the company's interests and makes sure it keeps the harmonic coordination and cooperation with the company's suppliers.

The supplies department is responsible for satisfying the needs of the vessels in terms of fuel, provisions, and any other needs these may have. This department works closely with the operations department and the vessel.

The accounting department follows all appropriate processes related to all the accounts of each vessel owned or managed by the ocean shipping company. It is the department that keeps record of all expenses and revenues per vessel per trip.

The vessel is responsible for carrying out any "mission" assigned by the headquarters. To fulfill successfully any assigned mission, it has to carry out a series of processes-actions in a systematic way in order to leave the customer satisfied. These processes will be analyzed later in more detail.

The port authority is the supplier of services to the ocean shipping company. The level of provided services affects the reliability of the company towards its customers. The processes that take place within the port of call are crucial to the fast turnaround of the operating vessel since they affect its efficiency and effectiveness, which in turn affects the company's overall profitability.

The representative agent takes appropriate action to enable quick vessel turnaround and the efficient, effective, and safe loading and unloading of cargo. These processes work to the benefit of both the shipping company and the charterer—the fewer problems during the vessel's stay at the port of call, the more savings are achieved for both parties.

At the Output stage the processes that reassure the provision of the final product to the end customer take place. At this level, the processes that guarantee the integrity of the transportation of the cargo, the cargo handling operations, the safety of the cargo, service quality, and reliability of the service are included.

Cargo handling operations require processes to be well coordinated by the vessel and port officials in order to provide a high service level. Within the grounds of high service level is cargo safety, which is achieved through the proper transportation process, and the provided reliability of the service in terms of time.

Detailed Analysis of the Three Stages

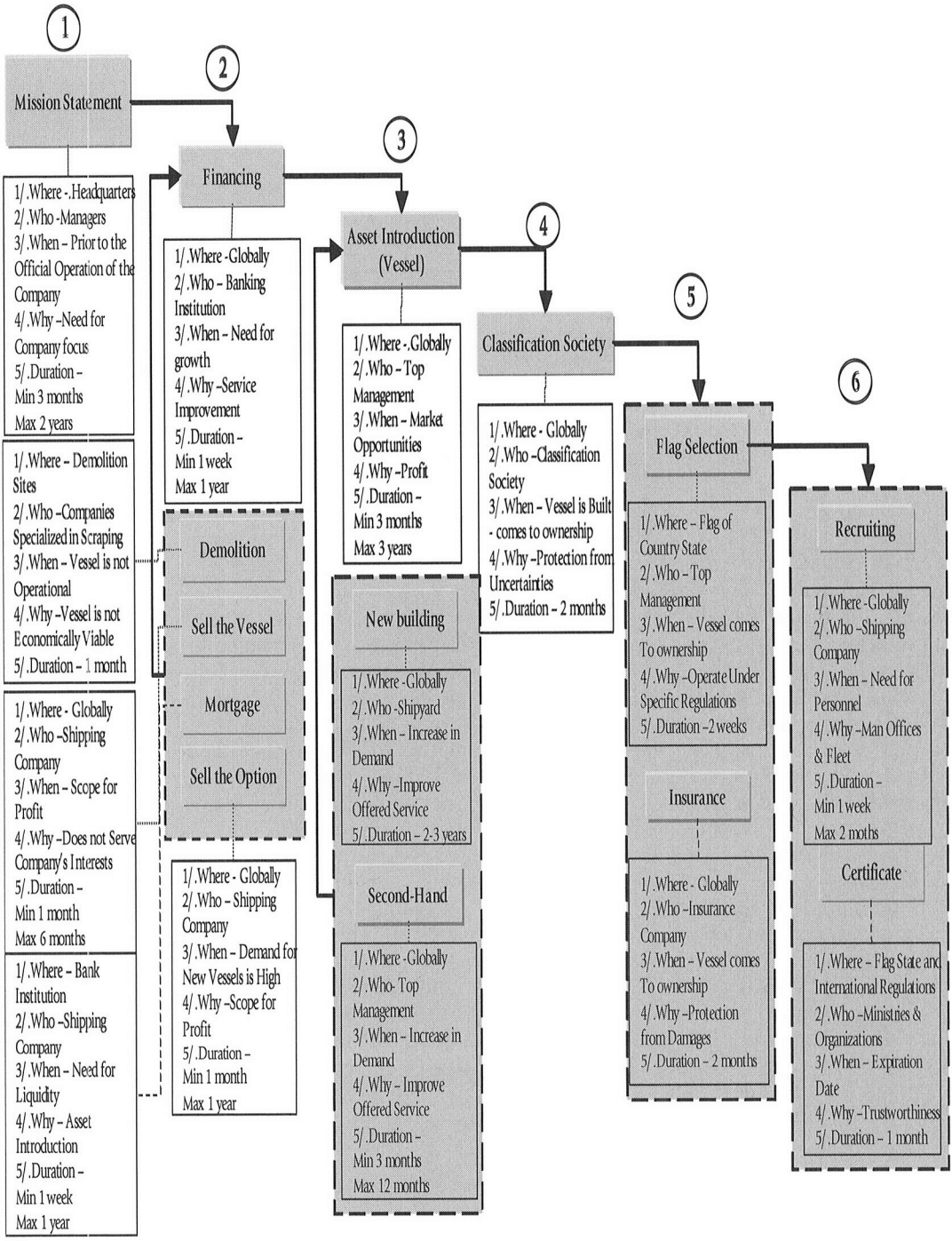
Within each stage a number of processes are necessary for the final goal, which is no less than the achievement of customer satisfaction and profit maximization. In this section these processes will be illustrated and analyzed in detail in order to identify, understand, and document the factors involved.

As mentioned at the Input stage, the processes that take place are related to the strategic decisions that an ocean shipping management company has to take. This subsystem is illustrated in Figure 2.

The first processes prior to the physical creation of the shipping management company are related to decisions about its aims and objectives. Via the market search and analysis, managers have to make a number of strategic decisions, such as the market segment where the company will operate, the geographic location of its operation, the type of customers it will serve, the location of its headquarters, the organizational structure it will have, and, of course, the type of service or services it will provide. All these considerations are included in the mission statement process, the first process within the Input stage. This process may take from three months to two years because external factors may impede the quick implementation of the management team's decisions. For instance, a very high secondhand market with soaring prices for vessels may discourage the company to buy the specific type of vessel it is after since the prices may exceed the company's budget.

The process that follows is that of financing. Capital acquisition is important to the ocean shipping company and difficult to obtain, especially when the sector is in recession. Financing comes mainly from banking institutions that are reluctant to provide loans when the liquidity of these companies is not satisfactory or the sector is in recession, as mentioned above. Therefore, a shipping company has to examine closely any alternative solutions that will bring additional capital in. These alternative scenarios can be the demolition of very old vessels if the company owns any, the selling of owned vessels that are not of any use to the company

Figure 2. Processes Involved in the *Input* Stage



Source: Authors

(or the value of these assets has gone up due to market forces), the mortgage of existing vessels, or even the selling of options that the company may own for the building of new vessels. As can be seen, the above four scenarios are strategic decisions that managers have to consider seriously as any liquidity problems or misleading investment decisions will affect future processes and operations. This process takes between one week and one year, depending on the company's access to banking institutions.

Once the necessary capital has been obtained, the next process is asset introduction. At this stage the company has to examine the market from where the vessel(s) that it has planned to operate will come from. The options are the new building and the secondhand market. Which way the company goes depends on a number of parameters, such as the urgency of the asset introduction, status of the freight market, and price of the new against the secondhand vessels. This process can take between three and twelve months for a secondhand vessel and between two and three years for building a new one.

The classification society under which the vessel will operate is the next step. This is an important process as it guarantees the vessel's reliability. All charterers make their selection based on the classification society that the vessel had since its construction. If the society selected is not well established globally and not of the appropriate reputation, some shippers may be dissuaded from using the specific vessel to transport their shipment. This process takes no more than two months.

The next step is to determine the operating costs of the vessels owned or operated by the company. These costs come mainly from the flag that the vessel is under and the crew that mans them. Therefore, flag selection and recruiting processes are essential. The former is important because it determines the tax regime under which the vessels will be and affects other costs as well, such as of securing the necessary certificates and insurance. These factors own a big share of the operating cost of a vessel. The flag selection process, along with the actions taken for certificate and insurance, takes roughly two months. Apart from its importance in terms of cost, recruiting is even more important since the crew's professionalism will affect the vessel's efficiency, effectiveness, and efficacy. The crew selection process, which is the last process within the first part of the Input stage, takes between one week and two months. Factors such as availability of personnel and urgency affect the time it takes to find the appropriate person to cover the company's needs.

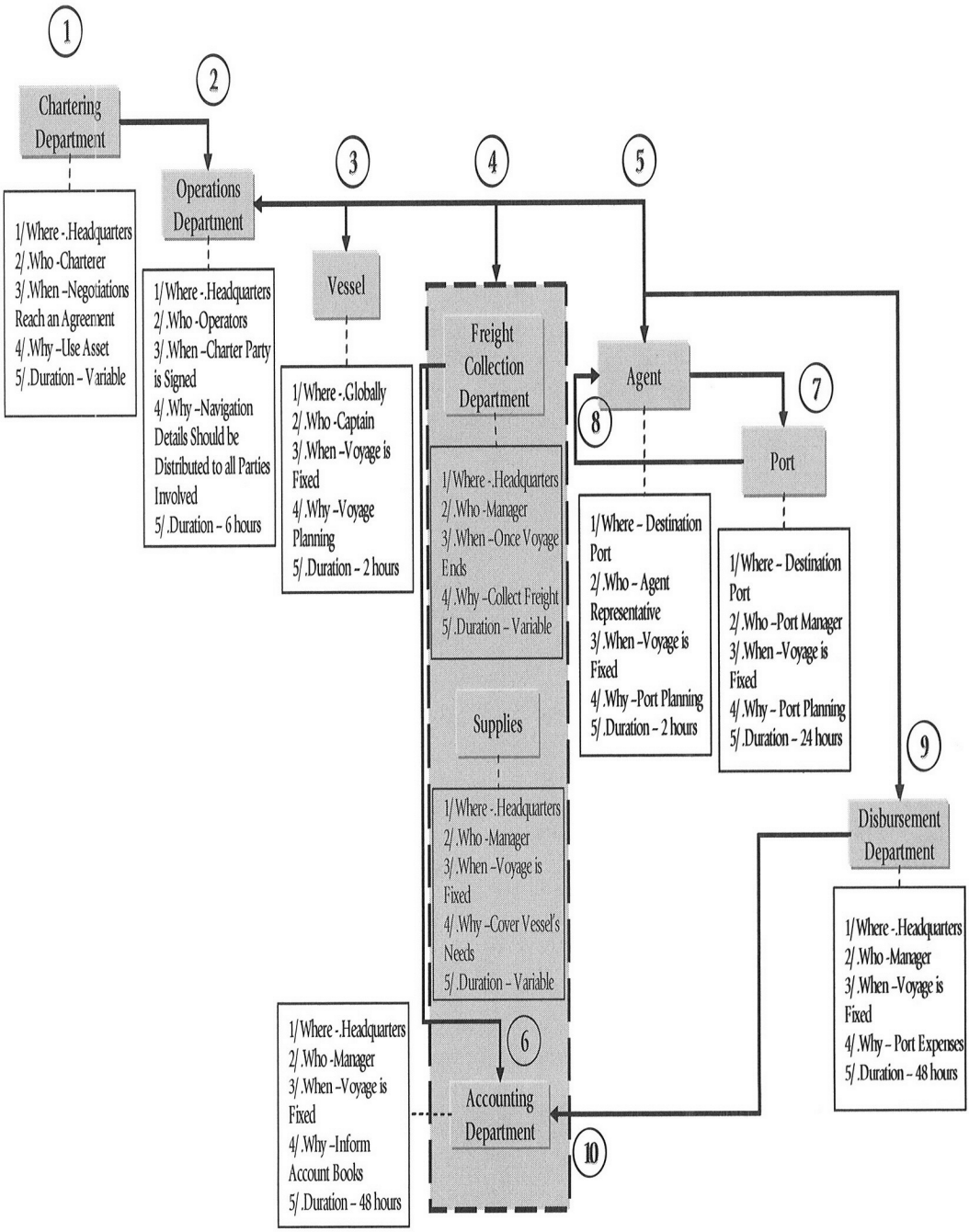
At the Service Processes stage, which is the second level of the GSM, the processes that take place in the everyday activities among the shipping company and its customers and suppliers are included. These processes are illustrated in Figure 3. At this level, the first process is chartering, which actually brings customers to the company. In other words, it is the business generator. The time required to fix a job depends mainly on the supply of world tonnage capacity and the demand for it, which depends on the world production of goods and products. Therefore, it can take from one day, which is the best-case scenario, to two weeks, if not more, if the demand for tonnage capacity is low.

Once a vessel is fixed, all fixture information is passed on to the operations department. This department becomes responsible for a series of processes that are related to the specific voyage. The first action it takes is to notify the master of the vessel of the necessary preparations that should be made. Information on routes, availability of appropriate charts, bunkers, and provisions status is given to the vessel. Once this is finished, a number of departments within the company are notified, including freight collection, accounting, and supplies. This is step four shown in the Services Processes stage. Once these departments are notified, the representative agent at the port of call is to be notified. This is process five presented in Figure 3. The time required to notify all the above parties involved is about six hours.

Once the vessel is given the details of the voyage, the captain assigns responsibilities and activities to the officers and the rest of the crew to prepare the vessel for the voyage. At this point, activities on board the vessel take no more than two hours.

The freight collection department is responsible for the chasing up of any debt against the

Figure 3. Processes Involved in the *Service Processes* Stage



Source: Authors

company from its customers. The process of collecting the agreed freight of a specific voyage varies as it depends on the agreed methods of payment. In the case of very good and loyal customers, the final installation may be paid even a month or two after the end of the voyage. This department works in close coordination with the accounting department, which sorts out all the accounts of every voyage depending on the payment agreements.

The supplies department, once informed of the vessel's needs, checks the validity of those needs and then approves the order. This process takes about three days, excluding the transportation time required to send the provisions to the vessel. Delivery time depends on the vessel's location, degree of accessibility to the vessel, and cost of the order. If, for instance, the same order can be satisfied in another, cheaper geographic location from the one where the vessel is, the order will be delayed for a few days if it is not urgent.

The representative agent at the port where the vessel is scheduled to call informs the port authority, giving details of the vessel and the purpose of its call. The representative agent at the port of call is not always assigned by the ocean shipping management company but can be appointed by the charterer as well. This process takes no more than thirty minutes.

The ninth process at the Service Process stage is for the representative agent to notify the company's disbursements department of the vessel's bills. This notification takes about twenty minutes. The disbursements department needs two days to check the integrity of the bills based on the official or agreed tariffs; once the accounts have been checked they are sent to the accounting department.

The Output stage is the third and last level of the GSM. It is the stage where customer satisfaction is met via a number of carefully and well-coordinated processes. Customer satisfaction is met when and only when the on-time transportation is achieved via the safe and reliable delivery of the transported goods, which depends on a number of systematic cargo handling operations procedures. The required processes, along with the times needed for the above goals to be achieved, are illustrated in Figure 4.

Service reliability and goods transportation are guaranteed via the maintenance and the navigation processes. Regular surveys and maintenance during the vessel's navigation guarantee its trustworthiness and safe transportation of the goods. Safety is also achieved through the appropriate and updated navigation details, provided with charts and modern navigation equipment.

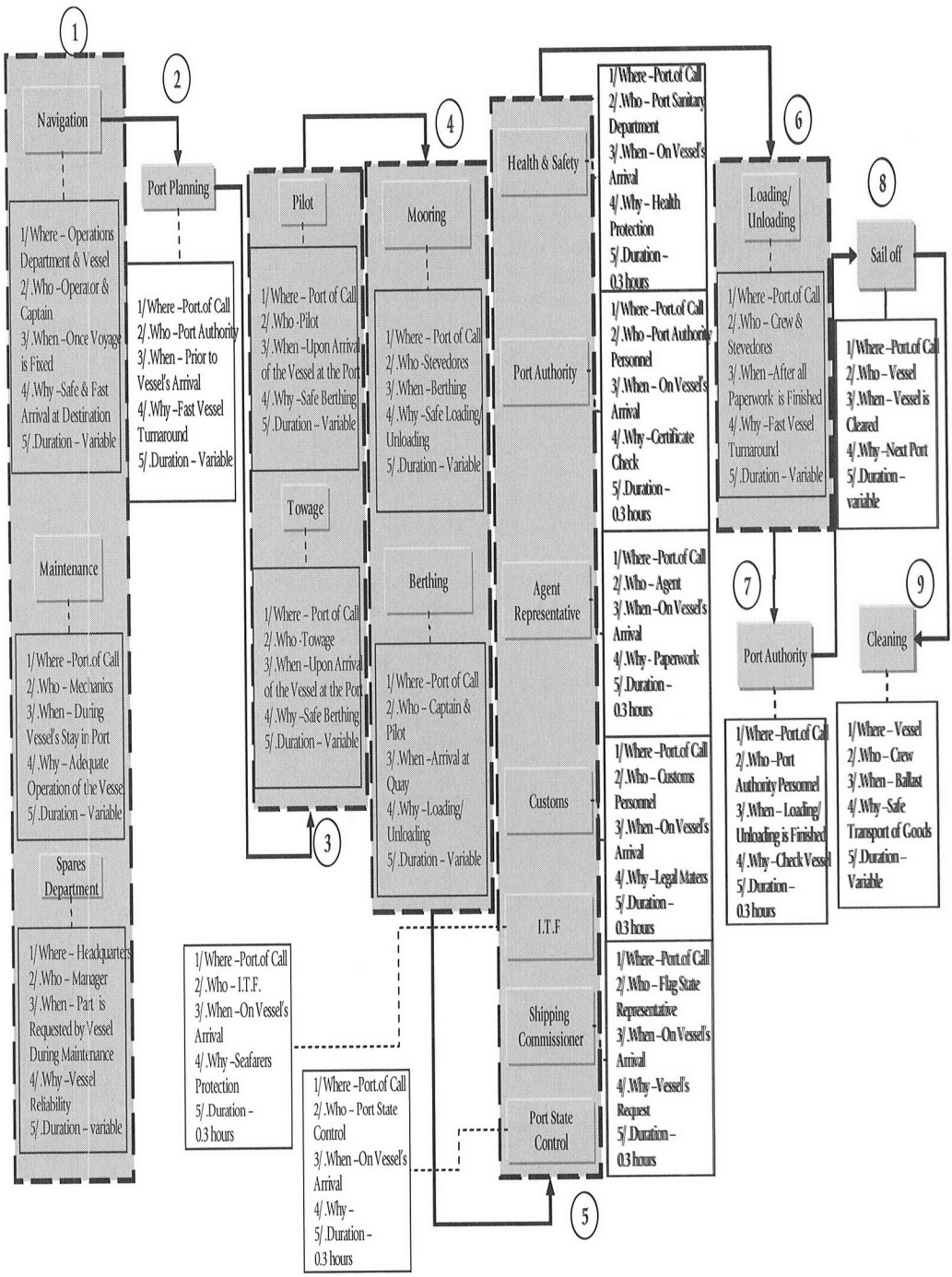
The maintenance process is variable as it depends on the equipment that needs to be maintained. Another issue that should be mentioned is that the vessels are not only maintained during the voyage but undergo different surveys at different times, which oblige them to spend a substantial amount of time to meet the standards of the classification society. These surveys guarantee the quality of the service offered and are of four types: annual; intermediate, which takes place every two and a half years; dry-dock, which takes place every two and a half years as well; and special, which takes place every five years.

The navigation process depends on the length of time the vessel is chartered for. This means that it is a variable process since most contracts in both dry bulk and liquid bulk sectors are voyage charters.

Port planning is related to the well planned and on-time cargo handling operations, which guarantee the vessel's quick turnaround. The use of modern, top-quality and appropriate equipment reassure this operation's integrity. Thus, cooperation between the port and the company is crucial and must be at an optimum level. The processes related to port planning are pilot, towage, mooring, and berthing. These processes are variable as they depend on the specific port's accessibility. For example, it takes longer for a vessel to berth at a port in a river passing than a port on the coast. The above four processes take place when the vessel sails off after completion of all cargo handling operations.

Service quality is validated via compulsory checks by the Port Authority, Health & Safety, Customs, International Transport-Workers Federation, Port State Control, and Shipping Commissioner. These processes are fixed and, provided that these authorities do not come across any irregularities, they do not take more

Figure 4. Processes Involved in the *Output* Stage



Source: Authors

than two hours in total. The average time required for each process is illustrated in Figure 4. Another process that guarantees service quality is the cleaning of the holds after unloading of the vessel. This process is variable as it depends on the dirtiness of the transported cargo.

Finally, the cargo handling operations process is a variable activity in terms of time since the volume transported at each voyage is different and the equipment used at each port is of different productivities. Apart from the variability of the transported amount of cargo, a number of factors, such as diverse weather conditions and machinery breakdowns, make the time required for loading and unloading even more uncertain.

To see the application of the created Generic Systems Model, two case studies are presented below. The aim of these case studies is to (1) illustrate the uncertainties mentioned in the various processes, especially in the tactical (Service Processes) and operational (Output) level; and (2) present the degree of homogeneity between the two sectors, the dry and the liquid bulk.

Empirical Implementation—Case Studies

Company Characteristics

This is a management company that has in its fleet a total of 50 vessels. Of these 50 vessels 18 are dry cargo bulk carries, 31 are tankers, and one is a container vessel. The capacity of the tanker fleet is about 3,000,000 dwt (dead weight tons) and its dry cargo fleet reaches the level of 827,000 dwt. Its land personnel members are approximately 150, distributed in 19 departments, and it has 2,000 sea personnel.

The company operates its fleet around the globe with main areas for its tankers being the European Continent, the United States of America, Black Sea, Northwest Africa, the Arabian Gulf, and the Far East. These vessels transport cargoes such as crude oil, fuel, gas oil, naphtha, jet fuels, diesel, gasoline, and vegetable oils.

Its dry cargo fleet operates primarily in areas such as the European Continent, the United States of America, South America, the Mediterranean, the Black Sea, the Arab Peninsula, East and West Africa, and the Far East. Cargoes such as grain, timber, minerals, ores, fertilizers, cement, scrap, steel products, and agricultural products belong to the range of transported commodities.

In general the company's core activity is sea transport of dry and liquid commodities or finished products. It is not involved in any other business activity. So it can be considered a specialized company since its expertise is in a specific field.

Case Studies

The processes that will be analyzed in the following examples are those included in the tactical and operational level. For the strategic level, we assume it takes roughly half a year to set up a business.

Case Study A – Dry Bulk

The vessel in this example has a capacity of 40,000 dwt. The voyage presented here begins from South America and ends in the Black Sea. The transported cargo is 38,000 MT (metric tons) of sugar. The details of each process and time needed within the tactical and operational level for that specific voyage are illustrated in Figures 5 and 6.

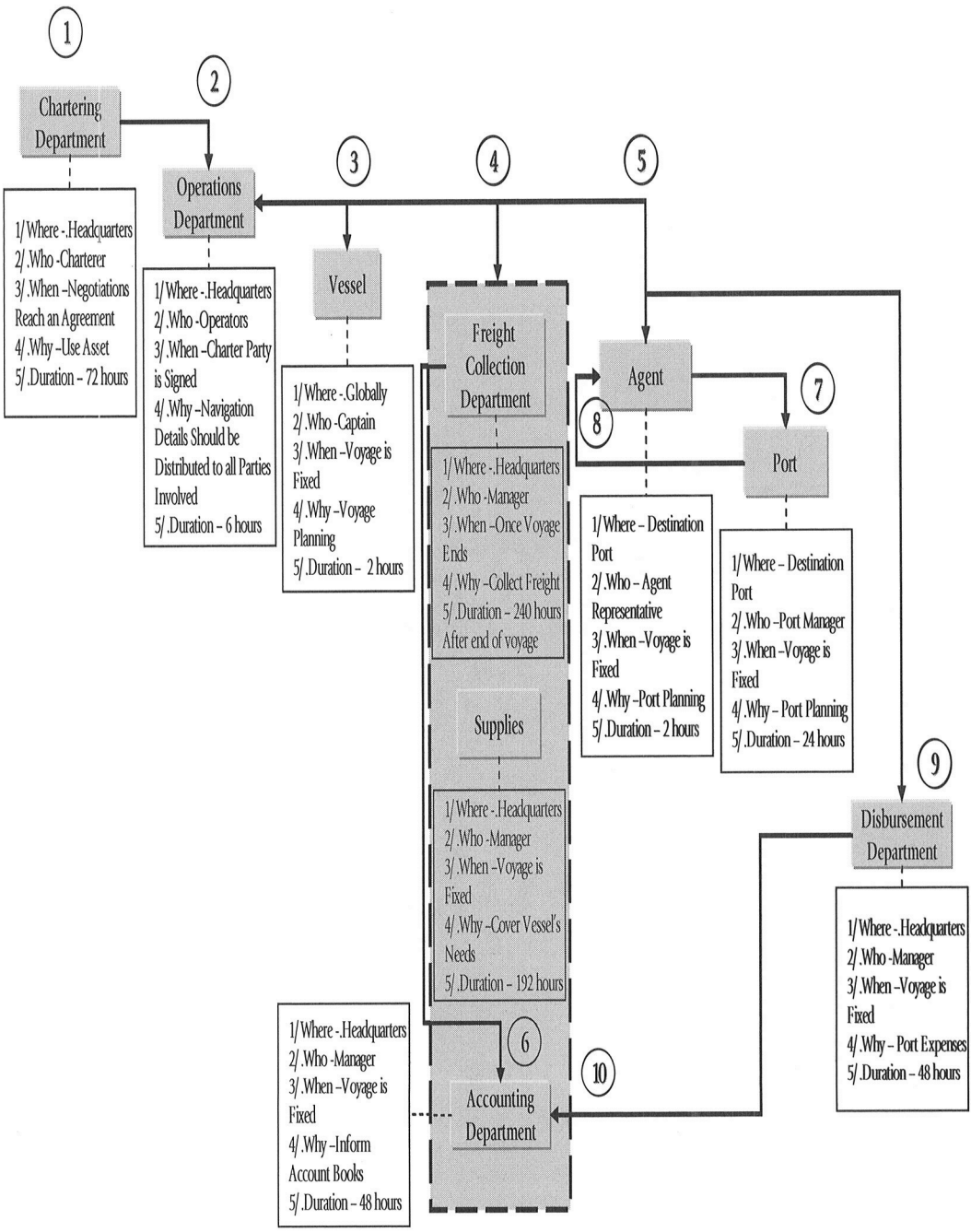
The most important processes in terms of time are listed in Table 2 and are represented in grey. As can be seen, the critical processes are those in the chartering department, freight collection department, accounting department, and disbursements department in the Service Processes stage and those of navigation and loading and unloading at the Output stage. The rest of the processes do not directly affect the functions of the company or the vessel as they happen in parallel and take a very short time in their execution (exempting the process of supplies).

Case Study B - Liquid Bulk

The vessel in this example has a capacity of 65,000 dwt. The voyage presented here begins in the Black Sea and ends in the Mediterranean Sea. The transported cargo is 64,000 MT of crude oil. The details of each process and time needed within the tactical and operational level for that specific voyage are illustrated in Figures 7 and 8. The most important processes in terms of time are listed in Table 3 in grey.

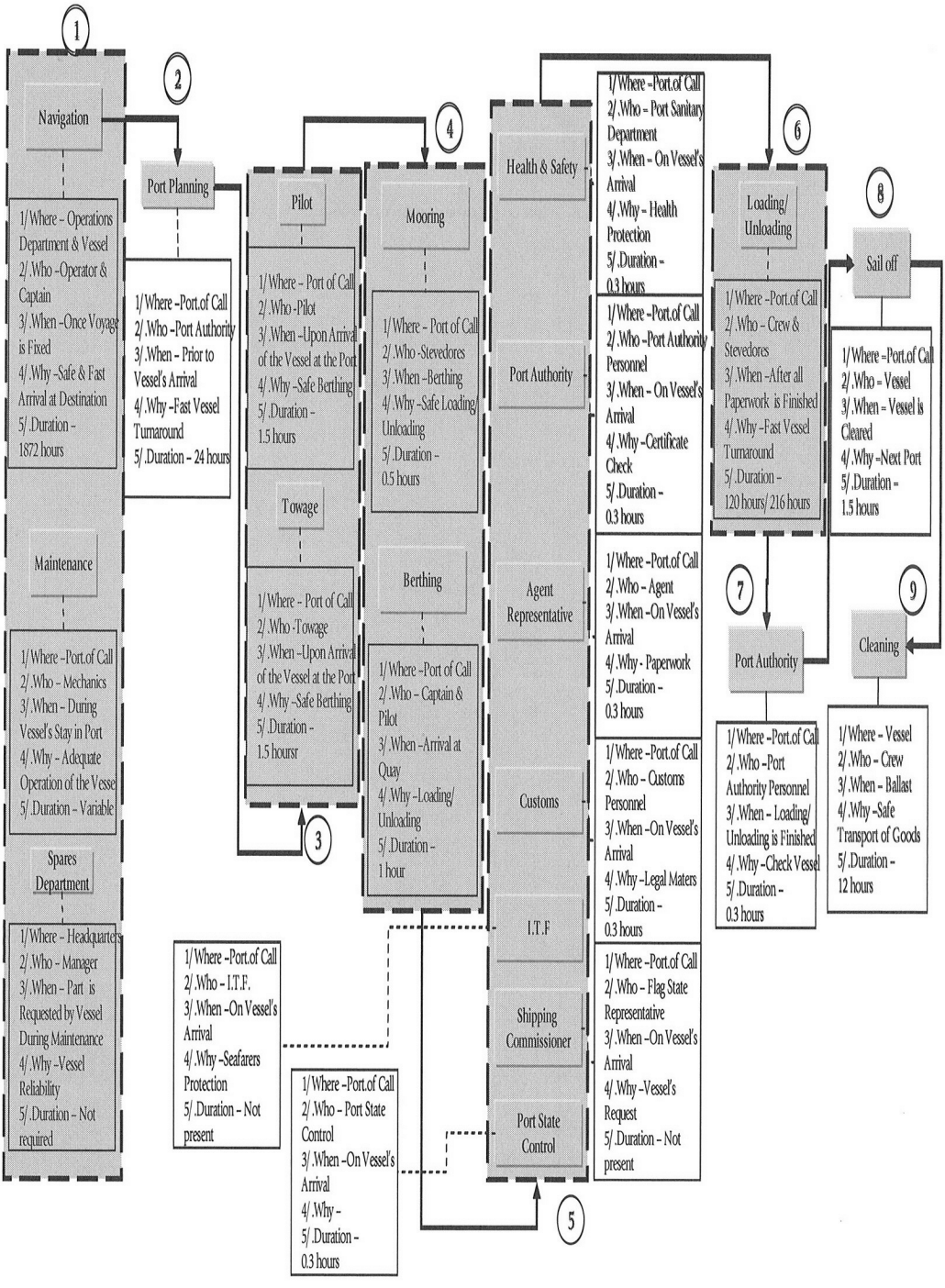
Comparing the two sectors based on Table 4, it can be seen that there is no difference in the processes followed.

Figure 5. Service Processes for the Dry Bulk Example



Source: Authors

Figure 6. Output Processes for the Dry Bulk Example



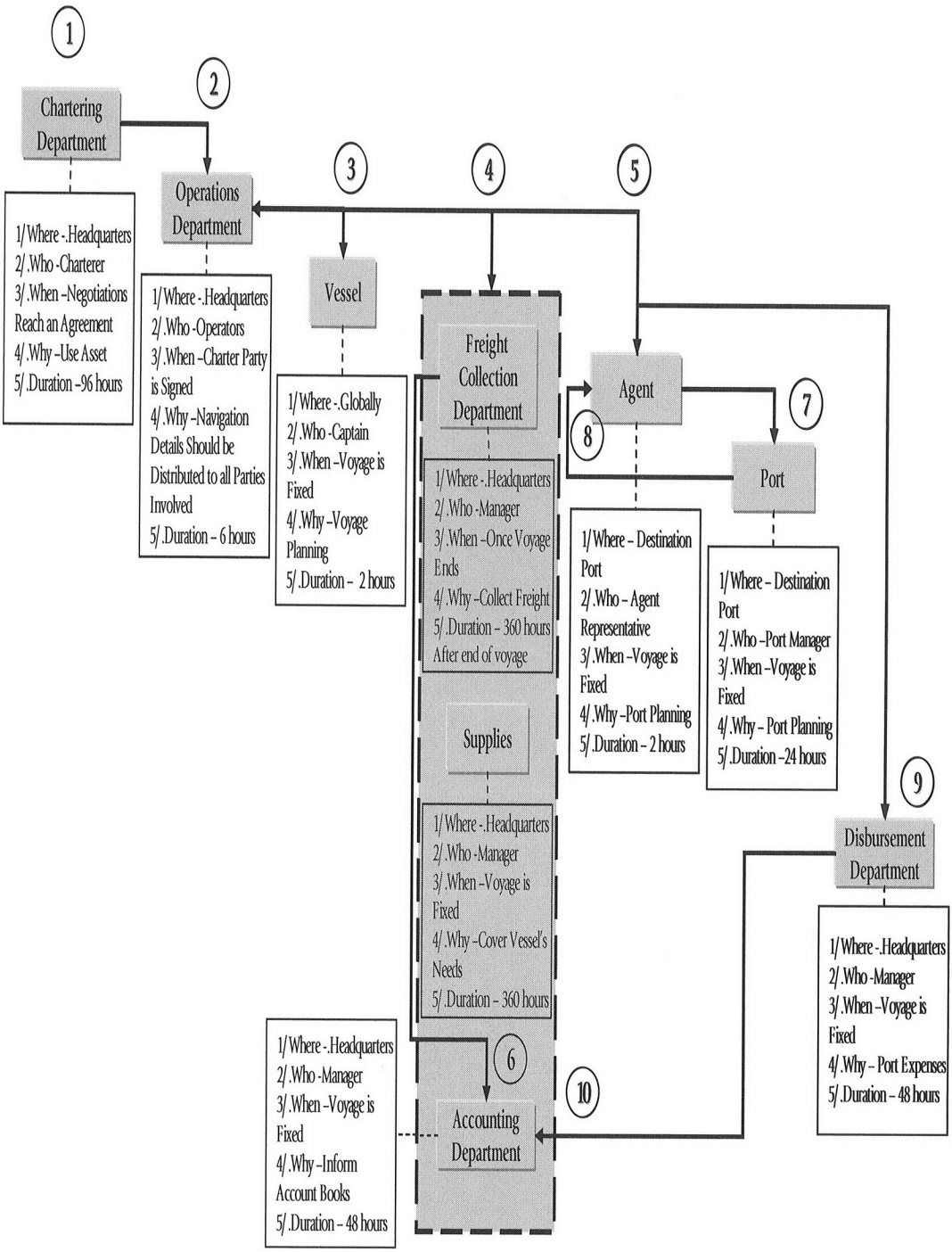
Source: Authors

Table 2. Duration of Service and Output Processes for the Dry Bulk Example

Service Processes	Duration (Hours)
Chartering Department	48.0
Operations Department	12.0
Vessel	2.0
Freight Collection Department	240.0
Supplies Department	192.0
Accounting Department	48.0
Representative Agent	2.0
Port	24.0
Disbursement Department	48.0
Output Processes	**Duration (Hours)**
Navigation	1872.0
Maintenance	-
Spares Department	-
Port Planning	24.0
Pilot	1.5
Towage	1.5
Mooring	0.5
Berthing	1.0
Health & Safety	0.3
Port Authority (Arrival)	0.3
Agent Representative	0.3
Customs	0.3
I.T.F.	-
Shipping Commissioner	-
Port State Control	0.3
Loading	120.0
Unloading	216.0
Port Authority (Sail)	0.3
Sail off	1.5
Cleaning	12.0

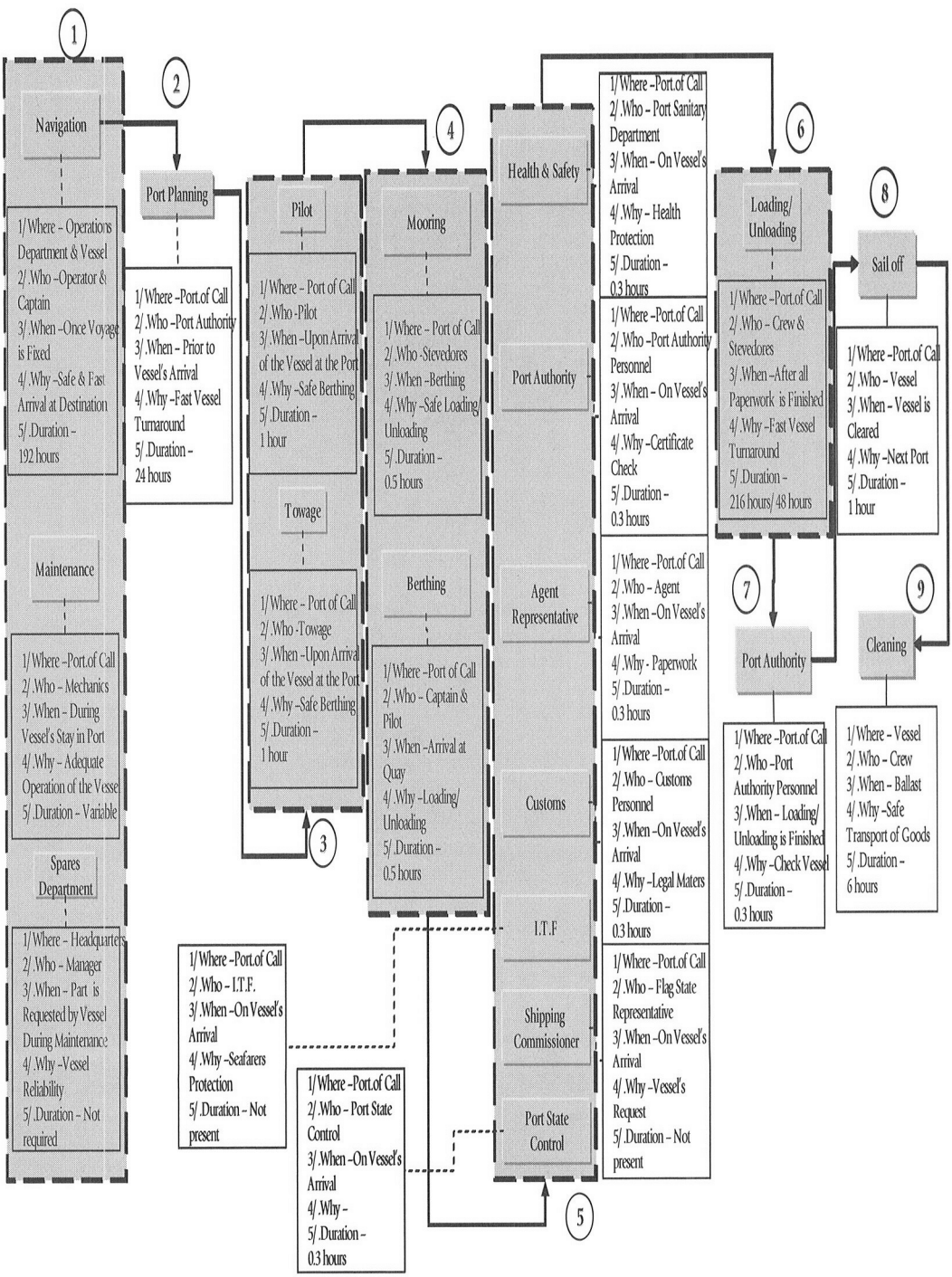
Source: Authors

Figure 7. Service Processes for the Liquid Bulk Example



Source: Authors

Figure 8. Output Processes for the Liquid Bulk Example



Source: Authors

Table 3. Duration of Service and Output Processes for the Liquid Bulk Example

Service Processes	Duration (Hours)
Chartering Department	96.0
Operations Department	12.0
Vessel	2.0
Freight Collection Department	360.0
Supplies Department	360.0
Accounting Department	48.0
Representative Agent	2.0
Port	24.0
Disbursement Department	48.0

Output Processes	Duration (Hours)
Navigation	192.0
Maintenance	-
Spares Department	-
Port Planning	24.0
Pilot	1.0
Towage	1.0
Mooring	0.5
Berthing	0.5
Health & Safety	0.3
Port Authority (Arrival)	0.3
Agent Representative	0.3
Customs	0.3
I.T.F.	-
Shipping Commissioner	-
Port State Control	0.3
Loading	216.0
Unloading	48.0
Port Authority (Sail)	0.3
Sail off	1.0
Cleaning	6.0

Source: Authors

Table 4. Comparison between the Two Case Studies

	Dry Bulk	Liquid Bulk
Tactical (Service Processes)		
Chartering Department	●	●
Operations Department	●	●
Vessel	●	●
Freight Collection Department	●	●
Supplies Department	●	●
Accounting Department	●	●
Representative Agent	○	○
Port	●	●
Disbursement Department	●	●
Operational (Output)		
Navigation	●	●
Maintenance	●	●
Spares Department	●	●
Port Planning	●	●
Pilot	●	●
Towage	●	●
Mooring	●	●
Berthing	●	●
Health & Safety	●	●
Port Authority (Arrival)	●	●
Agent Representative	●	●
Customs	●	●
I.T.F.	○	○
Shipping Commissioner	○	○
Port State Control	●	●
Loading	●	●
Unloading	●	●
Port Authority (Sail)	●	●
Sail off	●	●
Cleaning	●	●

● Process always takes place
○ Process does not always take place

Source: Authors

Conclusions

With the Input-Output approach a detailed mapping of the processes that take place in the ocean shipping business environment was achieved. We have understood and documented the basic functions and processes shipping management companies follow, adopting a process management approach different from the existing economic and management approaches. Particularly we hope we have established a model generic enough to guide future research in this sector. While at first sight the models seem rather sequential in nature, this is typical of generic models that aim to represent the fundamental functions and flows found in a particular industry (Parnaby 1979; Kagioglou et al. 2000). This is often seen as a limitation of such generic models as they cannot capture each and every nuance that may be found in a specific business. But as with all such models, it is pertinent to perceive stage gates at the end of each activity at which point decisions are made whether to proceed as expected or to rework the activity.

The results of this study are of considerable importance as the wider perspective achieved with the Generic Systems Model allows the understanding and documentation of the fundamental activities developed in the modern ocean shipping business environment. Thus, as has been found in other sectors, principally manufacturing but also construction, when researchers undertake further studies and analyses they will have a template by which to guide their investigation. Our success in achieving a model sufficiently generic will be determined by the degree of subsequent take-up by other researchers.

What has not been studied here is the exact effect of each variable on shipping management companies' performance. A quantitative and/or qualitative analysis should be undertaken to classify the importance of these factors. Of course, this is not an easy task. Many of the variables, such as market changes and delays in ports due to strikes, are difficult to measure, and it is even more difficult to determine their impact on the companies' operations and functions. But once these measures can be established the results of such a study will give insight into which variables have the most impact. Further research is being undertaken by the authors and is subject to the content of a Ph.D. program (Lagoudis 2003).

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