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Olympic Logistics Centers and their Adjustment to Specific Requirements and Distribution Applications

Comparing the Olympic Summer Games 2000-2008

Master's thesis within Business Administration

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Master's Thesis in Business Administration

Title:	Olympic Logistics Centers and their Adjustment to Specific Requirements and Distribution Applications – Comparing the Olympic Summer Games 2000-2008
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Subject terms:	Olympic Games, logistics centers, warehousing, distribution centers, distribution applications, warehouse management systems, RFID, bar coding, JIT, cross-docking, ownership, challenges

Abstract

Problem:	Since there is not much inside information available, the problem that will be handled by this thesis is the coordination of warehousing activities within the logistics centers put to use by the Olympic Summer Games from 2000 to 2008. A special attention is given to certain requirements such as layout, capacity management, ownership and distribution applications.
Purpose:	The purpose of this thesis is based on warehouse requirements and their specific adjustment to the Olympic Summer Games, further emphasizing on distribution applications influencing the capacity and ownership.
Theory:	The theoretical section touches upon event logistics, the Olympic Games and more importantly, logistics centers as a generic term for distribution facilities and warehouses. Further, types of warehouses, capacity management, ownership and distribution applications are examined in order to be able to compare the various Games.
Method:	The method for this research is based on a case study conducted by semi-structured interviews with several people involved in the logistics organization of the Games. All interviews are conducted over the telephone and analyzed accordingly. However, secondary data was of high importance due to the limited number of interview respondents.
Conclusion:	All analyzed features of a warehouse facility had to be more efficiently and effectively performed in order to serve the great approach for the Olympic Summer Games. The implementation of distribution applications was not sophisticated enough to benefit capacity savings. The leased ownership situation and outsourcing to third party logistics providers were advantageous, but did not further influence the planning and utilization phase of the Olympic Games.

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List of Abbreviations

ACOG	Atlanta Committee for the Olympic Games
A.D.	Anno Domini
ATHOC	Athens Organising Committee for the Olympic Games
B.C.	Before Christ
BOCOG	Beijing Organising Committee for the Olympic Games
DC	Distribution Center
IMS	Inventory Management System
IOC	International Olympic Committee
JIT	Just-In-Time
OCOG	Organising Committee for the Olympic Games
OLC	Olympic Logistics Center
RFID	Radio-Frequency Identification
SKU	Stock-keeping-unit
SOCOG	Sydney Organising Committee for the Olympic Games
UPS	United Parcel Service
WMS	Warehouse Management System

1 Introduction

The introduction will present background information about the Olympic Games and the importance of warehousing as they are the main topic of this thesis. Further, the problem and the purpose including the research questions are given as well as certain delimitations.

As the whole of the logistics sector faces the challenges of today's industry, such as growing diverse markets, globalization, new businesses with new solutions and the convergence of the industries; so does event logistics.

Event Logistics is one of the four sub-divisions of logistics and is defined as follows: "The network of activities, facilities, and personnel required to organize, schedule, and deploy the resources for an event to take place and to efficiently withdraw after the event" (Langley, Coyle, Gibson, Novack, & Bardi, 2008, p. 36). This sub-division of logistics can be split into three parts which are: general events, concerts, and sport events. This thesis will focus on logistical interactions of sporting events with special attention on the Olympic Games during the summer.

The Olympic Games history reaches back to 776 B.C., when the Games were held to honor Zeus in Olympia, Greece. The winner of one of the disciplines, such as running, wrestling, boxing or horse and chariot races, got a wreath made from an olive tree as well as praise and admiration. The time between the games lasted one Olympiad (four years), which is nowadays the term used for the modern Olympic Games.

The modern Olympic Games started their history in the end of the 19th century because since 394 A.D. the Games have not been taking place. On proposal of the French Baron Pierre de Coubertin, the Olympic Games have been carried out again since 1896. They were interrupted by the World Wars, but afterwards they were consistently further developed to the international world sports meeting with all the disciplines we know today. The Olympic Games are open to all sportsmen and sportswomen on this planet, who participate in any sport ranging from basketball to kayaking. The Games are carried out in strict following of the rules of the Olympic Games of the antiquity. In addition to that, the Olympic Winter Games have been taking place since 1924 (Olympic Games History, 2000).

In total, the Olympic Games have taken place 26 times since their re-establishment in 1896. The last Olympic Games were held in 2000 in Sydney (Australia), in 2004 in Athens (Greece) and in 2008 in Beijing (People's Republic of China). Latest, the Olympic Winter Games took place in 2002 in Salt Lake City (USA), in 2006 in Turin (Italy) and in 2010 in Vancouver (Canada) (Norddeutscher Rundfunk, 2012).

In 2012, the Olympic Games will be hosted in London (United Kingdom) and in 2016 in Rio de Janeiro (Brazil). The next Olympic Winter Games will be held in Sochi (Russia) in 2014 and four years later in Pyeongchang (South Korea) (Olympic Games, 2012).

"The Summer Olympic Games are considered by many experts to be the greatest, non-defence related, world-wide logistics event. It is the gathering of over 15,000 of the world's finest athletes competing in over 28 sports" (SOCOG, 2001), in a period that spans approximately three weeks.

Recent Games typically attract 20,000 members of media (both international broadcasters and press), are supported by about 150,000 staff members and volunteers, host over 5.5 million ticketed spectators and are watched by billions of TV viewers (ACOG, 1997; SOCOG, 2001). In order to stage this great event, there are immense logistics challenges that focus on "planning, managing and executing the receipt, tracking, storage, transportation, distribution, installation and recovery of all equipment and materials" (Minis, Paraschi, & Tzimourtas, 2006, p. 621). Hence, the planning and scheduling needs to be handled by a team with proven logistics expertise in coordinating everything to run like clockwork (Sportworks Logistics, 2012).

The Olympic Games require perfect timing, from the beginning to the end. All venues, competition and non-competition, need to have the necessary and ordered equipment for the athletes, varying from tennis balls and canoes to computers and scoreboards. Further, the Olympic village and the broadcast village need to be taken into consideration in terms of amenities and catering. Being ready by the opening time and tidying up when the Games are finished are the highest priorities. There is no space for a second chance.

The focus is set on the massive logistics involvement in creating the Olympic Games, in the spotlight of the world. This refers to transportation, storage, distribution, handling customs clearance, procurement and other working processes, ensuring that everything needed for the duration of the Games is provided. In order to accomplish the goal of hosting smooth Olympic Games, warehouses and distribution facilities play a major role.

1.1 Problem Statement

The Olympic Games are not only a major sporting event for the world's best athletes and masses of spectators. They are at the same time a logistics masterpiece that involves thousands of people in the background dealing with the smallest needed items up to broadcasting equipment and floor coverings going through the logistics centers. Therefore, especially logisticians and students of logistics and related subjects should pay attention to this topic.

The literature is providing detailed information about logistics centers and their requirements in general as well as the Olympic Games. Nonetheless, literature about the logistics activities in warehousing connected to the Games is rather scarcely spread. That provided the perfect gap for the authors to conduct their research.

The problem that will be addressed throughout the thesis is focusing on the coordination of logistics activities, especially emphasizing on logistics centers, a network of warehouses and distribution facilities, utilized for former Olympic Games. The comparison of the engagement of the Olympic host cities in adjusting the traditional characteristics of warehouses towards special features, needed for such a mega-event, will be prioritized. The application of certain distribution systems could act beneficial during the short and intense activity phase. Further, the question of ownership and after-use are of great interest for this paper.

1.2 Purpose & Research Questions

The purpose of this master thesis refers to the change of traditional requirements of logistics centers towards a specific approach matching the needs of a mega-event, the Olympic Summer Games.

The following research questions provide an understanding for the reader as well as guidance through the literature review and an appropriate research method:

- How are requirements such as type of warehouse, layout and capacity management adapted towards the Olympic Summer Games and their specific logistics prerequisites?
- How are those attributes adjusted by specifically matching the space requirements and using distribution applications to the Olympic Summer Games?
- How does ownership affect the planning and utilization of the logistics centers before, during and after the Olympic Summer Games?

1.3 Delimitations

In order to fulfill this purpose, the Olympic Games from 2000 to 2008 will be compared with a special focus on the impact and importance of warehousing. More in detail, considering the characteristics and the contribution of logistics centers towards a cost-efficient and effective utilization prior, during and after the games. This involves that all venues, competition and non-competition, have the necessary and ordered equipment for the athletes and other involved parties, varying from tennis balls and canoes to computers and scoreboards. Therefore, general literature, as well as literature with the emphasis on logistics centers of the Olympic cities from 2000 to 2008, will be analyzed which only concerns the Olympic Summer Games.

2 Literature Review

The first part of the literature review will give the reader information about event logistics and its concepts. The second part will follow up on the Olympic Games, its lifecycle and disciplines. The third and final part of the literature review handles logistics centers. Literature regarding logistics centers has been reviewed focusing on types of warehouses, layout, capacity management and distribution settings. Further, distribution applications, among them warehouse management systems, bar coding, radio-frequency identification, cross-docking and Just-In-Time, are described.

2.1 Event Logistics & Olympic Games

The following two sub-chapters will describe event logistics for a better understanding of how the Olympic Games are planned and executed. Afterwards, a closer look is taken at the Olympic Games as a mega-event and the Games host city selection process and its duration.

2.1.1 Event Logistics

Event logistics provides a huge field of events such as special occasions (weddings, business meetings/conferences, charity events, etc.), concerts, exhibitions, destination management and, of course, sports and mega events. This is why companies specializing in event logistics offer a wide variety of services starting with the planning of an event, to the entire execution and revocation of events. All these activities can include several tasks from project management to finding a venue, hiring personnel, acquiring respective technical equipment and insurance to transportation, storage and event evaluation (Humphreys & Howard, 2008).

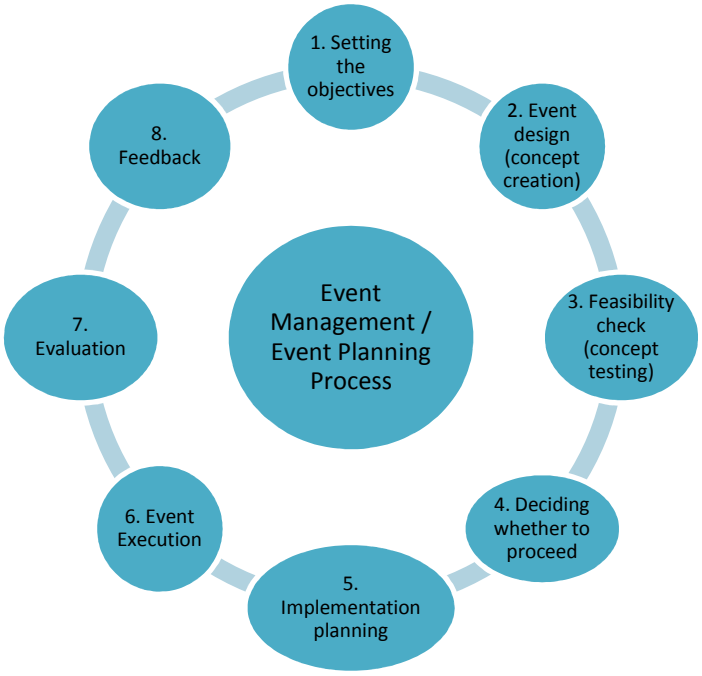

Illustration 2.1: The Eight Stages of Event Planning (Adapted from Kovacic, 2010, p. 980).

Events are always linked to being a project and product at the same time. Large scale sporting events require planning and therefore, project management within event logistics is one of the most important aspects.

Contemporary project management is based on three incentives (Baccarini, 1999):

(1) Complexity – Growing complexity of tasks and a need for a greater degree of specialization.

(2) Change – Increasingly dynamic environments with constant pressure within organisations to implement change due to global competition.

(3) Time – Demand for tasks to be completed as quickly as possible.

These three incentives can be processed and reached by eight stages of event management or rather event planning (see illustration 2.1). The eight stages are useful for any kind of sporting event and were further described by Kovacic (2010) in his article "Sports event logistics in tourism".

Event organization as a system, based on logistics principle appliance, should be structured under the logistics manager supervision. "Information flows connect the event system components top-down, bottom-up, internally and outside the system – to destinations management in the pre-event stage, expanding gradually to public information sharing and community involving" (Mrnjavac, 2005, p. 237).

Sporting events use a big quantity of resources and assets with no different approach towards logistics. "All flows of logistic scope are equally important and the logistic opportunity to manage them the best possible way makes management skills outweigh on the path to success." (Kovacic, 2010, p. 988).

2.1.2 Olympic Games

The Olympic Games have a history that reaches far back into ancient Greek times. Today the Games involve a massive amount of logistics which is not only due to the world evolving technology of broadcasting a mega-event, but also owing to the wide variety of disciplines the athletes are competing in such as athletics, gymnastics, horseback riding, sailing or football. The entire list of disciplines of the Olympic Summer Games and the Paralympics Games, following right after the Summer Games, can be found in the appendix section (Appendix 1).

The hosting cities are selected in a two step procedure. The cities that are willing to apply to become an actual host city/country have to have certain aspects sorted, such as: financial coverage (own capacities and sponsoring), infrastructure, tourism measures (hotels, etc.), sport and logistics capabilities. The International Olympic Committee (IOC) elects host cities following a two-stage process.

Cities wishing to stage the Games in question become 'Applicant Cities'; the IOC Executive Board then selects a number of applicants to be considered 'Candidate Cities' from which one is chosen by a vote of the IOC session (Olympic Games Host City Election, 2012).

Nevertheless, the entire Games lifecycle is far longer as the following illustration shows. After the host city has been selected, the city, and the respective hosting country, has nine years to prepare everything necessary to hold the Olympic Games in a steady and uncomplicated way.

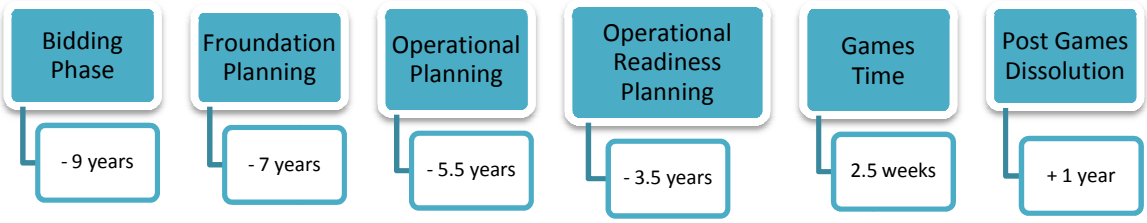

Illustration 2.2: Games Lifecycle (Adapted from Olympic Games Host City Election, 2012).

The Olympic Summer Games try, as all others, to keep the Olympic values of excellence, respect and friendship alive. Today's Olympism stands for these three values and six main activities in order to build a better world through sport. The mentioned six activities are at grassroots level, education through sport, development through sport, environment, peace through sport and women and sport (Olympism in Action, 2012).

The Olympic Games face a growing audience through new ways of broadcasting. Hence, the Games become more and more recognized and valued. Due to this, the Olympic Games are so called mega-events. The list of mega-events is long. Among them one can find Formula 1 races, the Super Bowl, the European and World soccer championships and the Olympic Games. "'Mega-events' are large scale cultural (including commercial and sporting) events which have dramatic character, mass popular appeal and international significance. They are typically organized by variable combinations and thus can be said to be important elements in 'official' versions of public culture" (Roche, 2000, p. 1).

2.2 Logistics Centers

Logistics centers can be characterized as areas where all operations concerning transportation, logistics and distribution of freight, nationally and internationally, are handled (Erkayman, Gundogar, Akkaya, & Ipek, 2011). For this specific case, the Olympic logistics centers can be described as a network of warehouse and distribution facilities, being one of the most important parts to be considered in the planning and preparation phase of the Olympic Games.

The importance of "storage, distribution, consolidation and transition of different types of cargos" (Ling, Fotwe, & Ng, 2008, p. 470) is significant during all three stages; in the pre-phase of the Games when already delivered items will need to be stored or even finally assembled before distribution. Logistics centers are mainly needed by the Olympic Games organizers and consequently by athletes, broadcasting companies and so on. Nevertheless, the foremost users are logistics providers so they can deliver goods to a certain place and store them as long as necessary until a product is required for its specific purpose. During the Olympic and Paralympic Games, the distribution facilities are used for short-term storage or repacking. After the Games, the facilities are important in terms of waste management and reverse logistics.

Despite all important functions described above, logistics centers generally "intend to maximize customer service by positioning inventory as close to the customer as possible while still impacting on cost reductions" (Viale, 1996, p. 60). The customer here is the Olympic Organizing Committee from the prevailing host city, still aiming for efficient operations and maximum work space utilization with the lowest costs involved (Mangan, Lalwani, & Butcher, 2010). Hereby, the logistics centers for the Olympic Games try to combine the traditional role of long-term storage with the newer concept of achieving a higher activity level with lower inventory, shorter life cycle times and better customer service (Langley et al., 2008). Products of the long-term storage are involved in the final assembling process, using the space efficiently and procuring the final distribution. The logistics centers operate 24 hours every day, each day of the week (Traffic World, 2008).

2.2.1 Distribution Center vs. Warehouse

A distribution center is characterized by providing a great number of different services to their customers such as, "storage, cargo tracking, inland transport service, customs clearance service, consolidation, packaging, labeling, assembly, and documentation services" (Chin-Shan, 2004, p. 53). A warehouse on the other hand is plainly focused on the storage of products with no space, no customer focus or experience of additional service (Lynch, 2003).

Nevertheless, many authors and actors of the logistics world have started to use the word warehouse as a synonym for distribution centers as goods stored in the warehouse are also part of a distribution system. They act as the intermediate storage point between manufacturer and retailer, who nowadays, require more than simple storage of goods. Hence, even warehouses offer value-adding activities such as: cross-docking, order fulfillment, labeling and packing – all activities to complete the order cycle (Lynch, 2003).

Warehouses started to be more customer focused in order to meet their needs with the most cost-effective and efficient method while providing great service. The implementation and use of technologies such as warehouse management systems, bar coding and track & trace are not only reserved for distribution centers (Chin-Shan, 2004).

Thus, in the following context, the authors are not differentiating between plain storage facilities and centers with technology, customer focus and value-adding activities. The word warehouse will also be used as a synonym for distribution centers. The opinion is shared that nowadays, and especially referring to the Olympic Games, plain warehouses are not required, as all involved goods move rather rapidly and demand immediate action.

2.2.2 Types of Warehouses – Location, Ownership, Product Storage

There are many ways to differentiate the types of warehouses. Langley et al. (2008) categorizes these facilities by location, by ownership and by the types of products to be stored. Considering the fact of location, the warehouse is either built near the manufacturing facilities or close to the customer, which might have "significant competitive advantages" (Viale, 1996, p. 65). The logistics centers built for the Olympic Games should be located close to the venues served. This could lead to quick and flexible access from the warehouse to the Olympic venues, lower distribution costs and an improved service for the customer.

Differentiating according to the items stocked is only important for companies with multiple warehouses. From the strategic point of view, specific items could be gathered in one storage facility while general stockings are kept separately (Mangan et al., 2010).

Furthermore, a warehouse can be owned privately or publicly, or a combination of both. It always depends on the regional market conditions and other influencing components, such as fluctuations in demand and supply because of different seasons. The advantage of public warehouses refers to the availability of space whenever it is needed for a specific price. The company renting or leasing the space has no total share of fixed costs to carry and is not responsible for any decisions taken (Harrington, 1993). As soon as the warehouse is privately owned, facts like size, capacity, layout and material handling equipment are important issues right from the beginning. Especially when a facility is planned and constructed, it is rather cost intensive to modify the settings. Further, fixed costs and slowly increasing variable costs are fully carried (Viale, 1996).

Considering the logistics center for the Olympic Games, these facilities need to handle specifically great volumes in the preparation phase and do operate only for a limited period of time. Therefore, it would be most efficient if those facilities are privately owned as the fixed costs could be spread over a large amount of output. Langley et al. point out more benefits of private warehouses, which relate to "physical control, customer service competition, information system for inventory control and ordering processing, and regional needs" (Langley et al., 2008, p. 418).

Nevertheless, the decision about the most suitable type of warehousing needs close attention. When companies have made the right choice, they do experience improvement in efficiency and productivity and closer interaction with other areas of the logistics network.

2.2.3 Warehouse Layout

The design layout of a warehouse is of significant importance, as this ensures an optimal utilization and a greater efficiency. Referring to Viale (1996, p. 64), important factors to consider are "space for storing items, areas for receiving and shipping docks, areas for staging, picking, assembly and packaging, and equipment". Mangan et al. (2010) defined equipment as the necessity of having automated handling systems, such as cranes, conveyors, forklift trucks and automated guided vehicles (AGVs) available. This will standardize the processes, which simultaneously reduce human errors and maintain or even increase the quality of products.

Furthermore, Viale (1996) sees a connection between the layout of a warehouse and the efficiency of storage and handling. He states that storage is of high significance, if the inventory turnover is low, whereas a great amount of fast moving goods require a more efficient handling. Nevertheless, all activities within a logistics centre refer to four major functions. The following figure by Fleischmann and Klose (2005) depicts all involved stages:

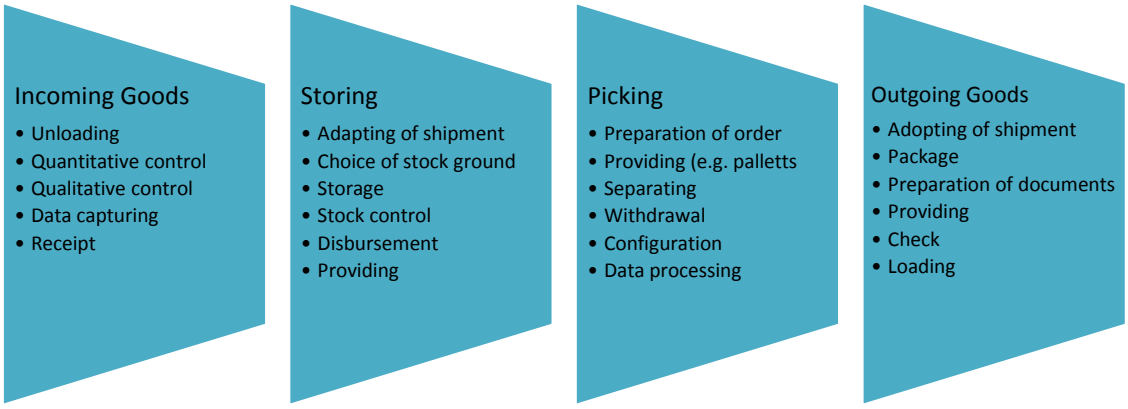

Illustration 2.3: Functions of a Logistics Center (Fleischmann & Klose, 2005, p. 30).

After freight is received and the core activities such as unloading, unpacking and quality inspection are performed, the goods are either stored at predetermined locations or they bypass the storage area and move directly to dispatch area. This cross-docking process takes only a few hours and even provides the opportunity to perform any value-adding activities while still saving the costs of storage. Customers receive faster their orders because the lead time is reduced and the involved service is improved (Mangan et al., 2010).

Value-adding activities are achieved in various ways. Jonsson (2008) names amongst others assembly, product mixing, sorting, adjusting, packing, labeling, and consolidation as activities to improve the quality of the product or the service it is connected with. Furthermore, those services reduce the costs, while minimizing packaging or administration costs and reducing the lead time of the process through cross-docking.

The logistics centers of the Olympic Games are able to use the layout of the warehouse and the considerable space available to add value in terms of combining certain units and postponing the final assembly shortly before distributing the goods to the venues. Modern information technology enables the organizers to track the products perfectly, which can be accounted for another activity of adding value.

2.2.4 Capacity Management

In order to get an idea of the capacity needed for the warehouse, firstly it needs to be known what the demand of the goods handled will be. It is important to balance supply and demand to neither overstock the warehouse nor run out of stock. The basic storage space needed can be estimated traditionally from forecasts or from forwarding the point-of-sales data from the customer (Mangan et al., 2010). Nevertheless, demand fluctuations due to seasonality as well as fluctuations in supply, product variation and quantity need to be considered.

Jonsson (2008) considers capacity management as the space needed for receiving and shipping the goods, space required for order picking and assembly and actual space necessary for storage. Further, Gallmann and Belvedere (2011) state that an unbalance between quantity of stock and capacity of the facility might affect safety settings negatively for the warehouse labor and the flexibility of picking the goods required.

As the Olympic Games are a one-time event, the capacity management is under great pressure to be most efficient in terms of space utilization and cost involvement. The logistics departments usually start their planning phase and centers' operations two to five years prior the event. There is no time, money or effort to reinforce the logistics space after miscalculating it in the first place.

2.2.5 Distribution Settings

Before the items are prepared for their final distribution, it is important to know where the stored goods are located. Usually the products with a short storage time are placed close to the receiving and shipping dock, whereas goods with a longer stocking time are positioned in areas where the simplicity of getting access is not as significant. Further, Viale (1996) and Langley et al. (2008) depict the categories of size and similarity of products in order to differentiate their storage space – small parcels are placed on shelves near the shipping area, bulk units are stored in the assigned areas further away from the distribution docks, and items with specific characteristics are located by fulfilling the government requirements.

2.3 Distribution Applications

There are many distribution applications that can be used to make logistics centers more efficient and productive. In order to increase the efficiency, while minimizing the warehouse space, goods that involve non-value added services have to be eliminated from the storage space. Hence, cross-docking as well as Just-In-Time will be considered more closely. Furthermore, to be more effective and accurate in finding the right products and keeping the inventory up to date, the characteristics of a warehouse management system connected to bar coding and radio-frequency identification will be examined.

2.3.1 Warehouse Management System

Warehouse management systems control the different information processes within a distribution center or warehouse. These computer-based softwares support various operations such as receiving, put-away, picking, packing, shipping, storage location, work planning, warehouse layout, and analysis activities. (Mangan et al., 2010)

Friedman (2005) suggests that it is mainly important to involve all employees as well as the top management in the selection process of a WMS even though some of them may not be directly affected by using such a system. Further he points out that a WMS should always be in line with the business system otherwise this kind of investment might backfire. Each warehouse management system is dependent on the business system, which is operated for sales, inventory tracking, and procurement.

"The primary purpose of a WMS is to control the movement and storage of materials within an operation and process the associated transactions." (Piasecki, 2004, p. 60) Therefore, WMS offers many benefits compared to the conventional paper-based systems, that are the following (summarized from Langley et al., 2008, p. 427f):

- Improved warehouse productivity, efficiency and accuracy
- Improved labor productivity
- Reduced number of personnel
- Improved order-picking accuracy
- Improved managerial control
- Effectiveness through point-of-work confirmation, accountability, performance measurement, and what-if scenario planning

As Olympic logistics centers are bound to accuracy and short lead times, the usage of a WMS is highly recommended and necessary as the throughput volume will be high especially during the Games phase. This can be achieved by operating the warehouses with a specifically adjusted WMS, which is most likely supported by bar coding and radio-frequency identification (RFID). Furthermore, another advantage is the higher productivity of warehouse labor because less time is needed to find the requested items and fewer personnel is necessary to perform the job.

2.3.2 Track & Trace – Bar coding and RFID

Bar coding and RFID are two ways to track and trace products. Nowadays, RFID can be considered as the enhancement of bar coding. Nevertheless, both methods are used and enable companies to work cost-effective once the systems are implemented within the whole supply chain.

Crossley (1995) defines bar coding as "the basis for automating many functions surrounding the movement of merchandise, including shipping, receiving, ordering, inventory management, and point-of-sale data gathering." (Cited in Roadcap, Smith & Vlosky, 2000, p. 33)

Bar coding bears many advantages such as the possibility to process enormous amounts of data to reduce errors, increase speed, improve inventory management of inbound and outbound products, and enhance communication. Further, "bar coding has become a key aspect of the overall profitability, service, and success of the wide variety of companies that have implemented it into their quick response systems." (Roadcap et al., 2000, p. 33).

RFID "technology tracks retail inventories through computer networks connected with microchips "tagged" to any type of product. Each chip broadcasts a unique ID code that can yield a wealth of information, such as an item's origin, owner, location, expiration date and time of purchase" (Bauhoff, 2003, p. 59).

Hence, RFID is closely linked to tracking and tracing which is not only done in a single warehouse. RFID enables companies to follow their products from one end to the other of an entire supply chain network. Tracking refers to following goods as they proceed through the entire supply chain, whereas tracing concerns obtaining information about a precise product. Tracing is usually performed at the end of the supply chain (Symonds & Parry, 2008).

RFID has advantages as well disadvantages. Table 2.1 summarizes reasons for implementing and not implementing the track-and-trace system by companies gathered by Vijayaraman and Osyk (2006, p. 11ff).

Table 2.1: Reasons to adopt and not adopt RFID

Reason to adopt	Reason not to adopt
Inventory visibility	Lack of foreseeable benefits
Supply chain visibility	Costs (e.g. tags, hardware)
Better store and shelf inventory	Lack of funding
Cost reduction	Lack of understanding
Security	Lack of integration
Asset tracking	Lack of customer demand
Efficiency gains, e.g. labor efficiency	Technical limitations
	Privacy issues
	Reliability concerns

Even though one has to be concerned with privacy issues, visibility and information, bar coding and RFID are the keys to modern day business and supply chain management. The more details are provided by RFID the better is the real time information. According to Heinrich (2005), functional integration can be achieved when each supply chain member has an overview of the product movement from one end of the supply chain to the other (Cited in Symonds & Parry, 2008).This integration of information technology makes it possible for the logistics centers of the Olympic Games to work according to schedule, manage the inventory level and prepare necessary information of their goods to run the Games smoothly.

2.3.3 Cross-Docking

"A cross-dock is a facility that transfers items between carriers or vehicles with minimal use of warehousing in between. (…) The meaning of cross-docking has become more ambiguous as companies have applied and then modified it to suit realities of their supply chains" (Saxena, 2007, p. 24). Even the performance of value-adding services and a short-term storage can be categorized as cross-docking (Mangan et al., 2010).

Cross-docking can be done in several ways according to Schaffer (2000, cited in Gümüs & Bookbinder, 2004, p. 200):

- "Manufacturing cross-docking:
  - Current - finished goods move right off production line to a waiting truck
  - Future - items produced are staged for later shipment
- Distribution center cross-docking:
  - Current/active - items are loaded immediately on a vehicle
  - Current/same day - products are staged on a conveyor for release later that day
  - Future - involves the holding of items until they become current/same day
- Terminal cross-docking: Products from various DC`s are sent to a break-bulk terminal for shipment of mixed loads to customers"

The main benefits of cross-docking are improved service and product quality, reduced transportation costs and moreover cross-docking is an effective, economical strategy (DelBovo, 2011).

This is also true for the goods that are dealt with throughout the lifecycle of the Olympic Games. As "cross-docking is increasing for products with a short shelf life" (DelBovo, 2011) it could become a major trend within event logistics and especially the Olympic Games. Most of the goods are only supposed to come in and leave immediately in order to serve the right athlete at the right time and the right place. Nevertheless, some goods require longer-term stays in the warehouse as they are brought into the logistics center in order to be ready when they are needed. Early deliveries may include Olympic village supplies such as beds and construction materials for sport set ups, as well as sport equipment, which is not needed anymore by athletes for other sport events before the Olympic Games.

2.3.4 Just-In-Time Delivery

Initially, the JIT concept was invented by Henry Ford and during the last decades, the Japanese industry clarified and further developed that idea (Burt, Petcavage & Pinkerton, 2010). The concept is perfectly applicable to the distribution and transportation process. The four major features of the JIT concept are summarized by Langley et al. (2008, p. 373) as:

- "Zero inventories
- Short lead times
- Small, frequent replenishment quantities
- High quality, or zero defects"

As the inventory is reduced to even down to zero, the handling process is much faster, more flexible, less costive and more accurate. The lead time of the distribution process is shortened, which brings products required faster to the customer and improve simultaneously the customers' satisfaction.

While enhancing the process of material handling as components are provided accordingly to the specific job at the right time required, this influences the frequency of products being replenished and the quality produced (Viale, 1996).

Overall, it can be clarified that the JIT concept involves considerable cost reductions, higher customer satisfaction through higher quality, faster process accomplishment, and minimized waste output as the products are delivered in the quantity needed at the exact time required. Nevertheless, this is in theory easily described but requires in practice "tight delivery schedules that emphasis on control of quality and performance, and the joint resolution of problems with suppliers" (Burt et al., 2010, p. 478).

In terms of deliveries to the venues of the Olympic Games, the organizers take the advantage of implementing the JIT concept as well, in order to reduce their costs on storage. If shipments are completely assigned to one venue, it would be more efficient and effective to distribute the goods with prior notification.

2.4 Review

The table below presents a quick overview of all the literature reviewed, which will help to identify the key findings among the great amount of information.

Table 2.2: Literature Review Summary

Author (Year)	Literature Topic	Key Findings
Baccarini (1999)	Event Logistics	Contemporary project management incentives (complexity, change, time)
Bauhoff (2003)	Logistics Centers	Definition RFID
Burt, Petcavage & Pinkerton (2010)	Logistics Centers	Definition of JIT JIT in practice
Chin-Shan (2004)	Logistics Centers	Characteristics of distribution centers Distribution applications not only for distribution centers
Crossley (1995)	Logistics Centers	Definition of bar coding
DelBovo (2011)	Logistics Centers	Benefits of cross-docking
Erkayman, Gundogar, Akkaya & Ipek (2011)	Logistics Centers	Definition of logistics centers
Fleischmann & Klose (2005)	Logistics Centers	Functions of logistics centers (see illustration 2.3)
Friedman (2005)	Logistics Centers	Selection of WMS
Gallmann & Belvedere (2011)	Logistics Centers	Capacity management
Gümüs & Bookbinder (2004)	Logistics Centers	Ways of cross-docking
Harrington (1993)	Logistics Centers	Public warehousing
Humphreys & Howard (2008)	Event Logistics	Areas of event logistics (special occasions, concerts, exhibition, destination management, sports and mega-events)

Author (Year)	Literature Topic	Key Findings
Jonsson (2008)	Logistics Centers	Value-adding activities Capacity management
Kovacic (2010)	Event Logistics	Eight stages of event planning (see illustration 2.1) Importance of management
Langley, Coyle, Gibson, Nowack & Bardi (2008)	Logistics Centers	Impact of long-term storage on logistics centers Types of warehouses (location, ownership, product storage) Private warehousing Distribution settings Benefits of WMS Major features of JIT
Ling, Fotwe & Ng (2008)	Logistics Centers	Activities in logistics centers
Lynch (2003)	Logistics Centers	Definition of a warehouse Value-adding activities within a warehouse
Mangan, Lalwani & Butcher (2010)	Logistics Centers	Advantages of warehouse functions Product storage Importance of handling equipment Functions of logistics centers Capacity management Definition of a WMS Definition of cross-docking
Mrnjavic (2005)	Event Logistics	Importance of information flows in event logistics

Author (Year)	Literature Topic	Key Findings
Olympic Games Host City Election (2012)	Olympic Games	Host city application process Games lifecycle
Olympism in Action (2012)	Olympic Games	Olympic values
Piasecki (2004)	Logistics Centers	Purpose of a WMS
Roadcap, Smith & Vlosky (2000)	Logistics Centers	Benefits of bar coding
Roche (2000)	Olympic Games	Definition of mega-events
Saxena (2007)	Logistics Centers	Definition of cross-docking
Symonds & Parry (2008)	Logistics Centers	Tracking & Tracing Functional integration
Traffic World (2008)	Logistics Centers	Logistics center operation hours
Viale (1996)	Logistics Centers	Advantages of warehouse functions Importance of warehouse location Private warehousing Warehouse layout Connection of warehouse layout and efficiency Distribution settings Features of JIT
Vijayaraman & Osyk (2006)	Logistics Centers	Advantages & disadvantages of RFID

3 Methodology

The following chapter describes the research approach as well as the choice of the right strategy and method in order to collect primary data. Furthermore, an insight on implementation concerning the interview cluster and the selection frame developed is going to be presented. Finally, the data collection process is introduced, followed by limitations that might hinder the research.

The research questions, established during the previous chapter, allow the authors to formulate more specified research objectives. A close orientation on the research objectives determines the direction of the study. The objectives are:

- To analyze the changes from general warehousing applications towards specific logistics requirements for mega-events.
- To discuss attributes to implement distribution applications while affecting the space conditions desired.
- To examine the ownership of logistics centers and their impact on planning and utilization throughout the Olympic Games lifecycle.

3.1 Research Approach

The research approach and the associated method are influenced by the research objectives which are going to be answered (Maxwell, 1996). Therefore, it needs to be distinguished between the qualitative and quantitative approach.

Qualitative research approaches cover historical, social and environmental perspectives of a special case (Leavy & Hesse-Biber, 2004). It is mostly based upon the inductive approach to collect primary data. Inductive means that a theory is only to be built after having analyzed the collected data (Saunders, Lewis, & Thornhill, 2000). Darlington and Scott (2002) state that the qualitative research approach generates specific conditions to general facts; words are more important than statistical numbers. Hence, at first information is collected and analyzed and then a certain theory is created.

Selecting the right method highly depends on the results the researchers strive for. The qualitative research is, for example, more suitable for "areas of social reality which statistics cannot measure" (Silverman, 2001, p. 32). Thus, one can conclude that the aim of qualitative research is to get insight into a certain situation and get a better general understanding of the actual problem and no numerical, statistical results are essentially required (CCH Business Owner's Toolkit, 2007a; Silverman, 2001). The problem with qualitative research is that it takes more time to carry it out properly (Saunders et al., 2000), which leads to a smaller number of respondents than in the case of quantitative research. Therefore, qualitative research cannot automatically be taken as representative of the population (Silverman, 2001). Qualitative researchers also have to bear the risk of not finding a useful pattern, which will allow an appropriate theory. Another disadvantage is that qualitative research is always exposed to the researcher's interpretation of "trivial, but often crucial, pauses, overlaps or body movements" (Silverman, 2001, p. 11). However, due to the explanatory nature of qualitative research results, it might still be more attractive to certain interest groups, and it can in general more easily contribute to the public understanding of the researched problem (Silverman, 2001).

The exact opposite is the quantitative approach. This approach is based on deductive research. It refers to the meaning that a theory is firstly invented and secondly tested. This method has its origin in natural sciences.

Hence, it involves numerical measurement and reliable statistical predictability of the results (Hakim, 2000; CCH Business Owner's Toolkit, 2007b). Further, "laws provide the basis of explanation, permit the anticipation of phenomena, predict their occurrence and therefore allow them to be controlled" (Hussey & Hussey, 1997, p. 52).

The research involves a large number of people, which represents the population, and it results in a multivariate analysis (Hakim, 2000). Furthermore, the quick completion is a great advantage of this research approach. In general, doing quantitative research is lower risk than doing qualitative research. However, there is a risk of questionnaires not being returned. Therefore, it might be tempting for researchers to manipulate the results, which can easily be done by filling in questionnaires themselves (Saunders et al., 2000).

The table below by Saunders et al. (2000, p. 91) summarizes the most important characteristics of the deductive and inductive research approaches. It emphasizes on which type of data collection is more favorable, quantitative or qualitative.

Table 3.1: Major Differences between Deductive and Inductive Research Approach

Deductive Approach	Inductive Approach
• Scientific principals	• Gaining an understanding of the meanings humans attach to events
• Moving from theory to data	• A close understanding of research context
• The need to explain casual relationships between variables	• The collection of **qualitative** data
• The collection of **quantitative** data	• A more flexible structure to permit changes of research emphasis as the research progresses
• The application of controls to ensure validity of data	• A realization that the researcher is part of the research process
• The operationalisation of concepts to ensure clarity of definition	• Less concern with the need to generalize
• A highly structured approach	• The necessity to select samples of sufficient size in order to generalize conclusions
• Researcher independence of what is being researched	

According to this project, the authors decided to approach the research qualitatively because a particular situation at a particular time was chosen. Therefore, only a small number of individuals will be studied (Maxwell, 1996; Saunders et al., 2000). This results in a deeper perception of the process and its circumstances and gives the possibility to associate connections and relationships with different elements (Darlington & Scott, 2002).Nevertheless, the authors were aware of any negative effects, such as the findings taken could not be associated for the whole population and possible interpretations of the results by the researchers.

3.2 Research Strategy

After deciding on the particular research approach, the strategy will provide guidance towards the problem of how to address the research objectives. Several strategies can be applied depending on the certain needs of the research. Saunders et al. (2000) identified them as follows: experiment, survey, case study, grounded theory, ethnography, action research.

Hereby, an experiment refers to the research of causal links between different components or, more complex, between two or more independent variables. Surveys can be categorized as the most multi-purpose of all research designs and generally are connected to deductive research approaches which allow to collect quantitative data. Considering the strategy of a case study it is most appropriate when a great understanding of the field to be researched is essential. It offers a significant flexibility, especially in the choice of technique to achieve representative results. The grounded theory would be the best strategy for the inductive approach as it helps to invent a theory based on the findings. A very time consuming research process is ethnography as it discusses and clarifies the social world of the research subject. Whereas, action research focuses on the action performed, specifically emphasizing the change within an organization. (Saunders et al., 2000).

It was chosen by the authors to emphasize on a case study, which provides for the particular situation of the Olympic Summer Games detailed and intensive knowledge, which helped to compare the results with different years and come to conclusions by generalization.

The aim of a case study is to analyze one or more specific examples of the society such as communities, social groups, organizations, events, and families. They are then interpreted on the basis of various data collection approaches (Hakim, 2000, p. 59). The purpose is to gain a broad understanding of the context and of how different factors interact. The results of case studies often answer questions such as "why?", "what?" and "how?" and will either challenge an existing theory or provide a source of new hypotheses (Saunders et al., 2000).

The topic can be classified as ordinary, not artificially formed (Darlington & Scott, 2002). It needs to be transferable to other cases, nationally or even internationally; and presented as complex as possible. Looking at the occurrence as a whole gives the opportunity to investigate the details and receive a special insight. Using a case study may reveal important information better than approaching by a different strategy (Yin, 1998).

During the research, it was possible to concentrate specifically on the Summer Games rather than including all of Olympic Games events. Moreover, certain historical facts, involved logistics service providers as well as general approaches of warehousing were explored and their connection and relation to another evaluated.

3.3 Research Method

Within the context of a case study as the research strategy, the methods, in order to collect the qualitative primary data, are the following: questionnaires, interviews, observations, or documentary analysis (Saunders et al., 2000). In this process, all information, which was supportable and dependable to encourage the clarification of the research objectives, was assembled.

Selecting the right technique is essential. The questionnaire offers standardized data which is easy to compare with a considerable number collected. Nevertheless, there is a limit to the amount of questions asked and high capacity to be achieved in order to be representative. Interviews are a conversation between a number of people with the purpose to reveal valid and relevant information to answer the research questions and objectives. Observations involve watching, documenting, examining, and explaining the performance of people. Especially, connecting it to the qualitative research technique, it focuses on the interpretation of people's action (Saunders et al., 2000).

The appropriate research method for this particular case were interviews. Denscombe (1998) declared that the use of interviews requires the knowledge and contacts of the key players in the prevailing area and direct access to them, in order to explain the purpose of the research work. Due to the focus of the topic on the Olympic Games, which were realized on three different continents during the previous years, the costs of time and travel needed to be taken into consideration as well. Therefore, telephone interviews were chosen with the advantages of low expenses, direct access and speed.

An interview can be differentiated between structured, semi-structured and unstructured. But it needs to be said that even an unstructured interview follows a certain path (Yin, 1998). Structured interviews refer to a standardized set of questions, which are read out and answered accordingly. It is important to read every written word and to keep the same voice tone in order to eliminate any bias. More interaction is granted with semi-structured interviews. The researcher has a set of questions to be discussed, but can act freely in changing the number of questions for different interviews, only keeping the research objectives in mind. Unstructured interviews are informal. There is no fixed list of questions, simply the idea what to research. The respondent speaks freely about the topic, associated events, beliefs and behaviors (Saunders et al., 2000).

The authors used semi-structured interviews for their research to be able to take the opportunity and investigate further, based on the answers of the interviewee. Therefore, a list of questions which needed to be answered was available. A predetermined framework of the questions was sent out in advance to enable the interviewee to have an appropriate preparation time. This procedure gave the interviewee and interviewer certain control (Darlington & Scott, 2002). Furthermore, the reliability of the interview increased due to verified numbers in advance.

During the telephone interview, the researchers tried to orientate the course of the conference on the predetermined questions but also acted flexible in terms of different order and additional issues. New ideas and explanations were developed by the interviewee and supported by the open-minded and active questions from the researchers.

3.4 Secondary Data

The use of secondary data was not only important for the literature review, but also as preparation for the process in collecting primary data. Hereby, the authors focused their search on academic journals, magazine articles and newspapers. Those bases of information were sourced through different databases such as Emerald, Science direct, and ABI/inform. The search was specialized by applying keywords associated with the topic. Unfortunately, the authors were not able to get specific access to material connected to warehousing and the Olympic Games. They were successful in enhancing their knowledge about transportation related topics regarding the Summer Games.

Furthermore, the Olympic Reports of Sydney, Athens and Beijing were examined. These reports were published after the Games were completed, and provided an overview of the accomplishments of the Organizing Committees of each host city. It was possible to receive information on the preparation efforts, including the history of the country, the bidding procedure, introduction of the organization and operations as well as venues and all important aspects which had to be considered. Further, details about the actual celebrations were given with facts and figures, for example about the visitor numbers, broadcasting numbers, winning athletes and nations. Sadly, only little information referred to the logistics center and their operation. Hence, searching only secondary data would not have answered the specific purpose of our research questions and objectives.

3.5 Implementation

This section provides an overview of the collection of questions developed for the interview by similarity, as well as presents the most appropriate frame of selection used in this context.

3.5.1 Interview Cluster

The interview cluster outlines the broad topics that were questioned during the interviews. Saunders et al. (2000) define a cluster as groups of individuals or objects of the same type that appear more similar to one another, than to other individuals or objects in other clusters.

Some of the clusters were not relevant for the case study but contributed to a great extent of general understanding in the market. The assembling of related questions enabled the interviewee to be focused and answer the questions comprehensively. The possibility of a one-sided answer has been minimized, as not only one question was asked.

Table 3.2: Interview Cluster

Interview Cluster	What to express
Warehousing – general	• Type • Location • Layout • Capacity Management
Warehouse management	• Using distribution applications • Matching space requirements
Ownership	• Status • Outsourcing or do-it-yourself • Changes in process • After the Games
Personal comments	• Challenges • Complaint Management • Learnings or Recommendations

While including a greater number of issues in each interview cluster, encouraging the interviewee to a more detailed answer, which simultaneously increased the reliability of the primary data.

3.5.2 Selection Frame

Various techniques were available in order to select an appropriate sample, because it was not possible to test the whole population. Even to consider the participation of a greater amount of people would have required an investment, time and knowledge about specific topics.

Therefore, the non-probability sampling appeared to the authors as adequate as the samples were not statistically chosen at random. The sampling size in this case was rather small and referred to achieving a great amount of information to answer the research questions (Saunders, et al., 2000). The sampling frame concentrated on representatives of the logistics department of the Organizing Committee of the respective hosting cities and heads of the logistics providers. As already mentioned, the sample size was rather low due to the limited number of responsible people of each hosting city.

During the process of attracting potential interviewees, a start was made by contacting the heads of the logistics departments of the Organizing Committees. They were sometimes named in the Olympic Reports. Using the given e-mail addresses was mostly unsuccessful as the former actors moved on to different fields of interest. Searching for their names in the Internet granted at least one contact.

Furthermore, the authors were able to built on existing contacts to the freight forwarder Schenker Australia, which helped to identify other contacts. Those various associates were involved in all previous Games and willing to help with in-depth information and experiences.

The utilization of the internet search engines eased the process a lot to identify representatives. Nevertheless, appropriate contacts were hard to determine in China. The authors believe that strict governmental restrictions as well as the language barrier made the sampling process more complicated.

Due to the enormous time pressure of finalizing the preparation phase for the Olympic Games of London for July, the confirmed contacts from the Organizing Committee and UPS were not able to provide time for a telephone interview. Hence, the authors were lacking in-depth information and decided to remove London from the comparison short before the final deadline.

In the end, the authors were delighted to have four respondents, who were involved in the logistics planning and operations of the Olympic Games from Sydney over Athens to Beijing. Comparing the sent requests to the answers of participation for an interview, a response rate of approximately eleven per cent can be considered.

3.6 Data Collection

The former head of the logistics department of the official Organizing Committee Athens, Apostolos Tzimourtas, guaranteed some time for an interview. He is now the head of Orphee Beinoglou International Forwarders S.A., a Greek logistics company. The authors were able to conduct an interview with him on Friday, 30th March 2012 for approximately 45 minutes.

The second interview was organized with Sabine Schlosser. She is the head of the department Fairs & Exhibitions of Schenker Australia. Schenker Australia was responsible for the freight forwarding and customs clearance for the Olympic Games Sydney 2000. She answered the provided questions on Tuesday, 10th April 2012 within 45 minutes.

In order to receive a comprehensive overview the authors were able to carry out an interview with Matthew Clarke. In 2000, he was the logistics and procurement head of the Organizing Committee Sydney. For the Olympic Games in Athens and Beijing, he worked for the freight forwarder Schenker. Now he is working as a consultant, mainly with DB Schenker sportevents. On Thursday, 19th April 2012 he was able to discuss the questions during 75 minutes of telephone conversation.

After many difficulties identifying a representative of the Olympic Games in Beijing, the authors were capable to arrange an interview with a member of the logistics operations team of Schenker Beijing. Nowadays, he is working within the contract logistics area for Schenker in Essen, Germany. He was able to give a short overview of the warehouse situation in Beijing for 30 minutes on Friday, 20th April 2012.

Table 3.3: Overview of Interview Partners

Interview partner	Position	Type of Involvement	Date and Length of Interview
Apostolos Tzimourtas	Head of Orphee Beinoglou International Forwarders S.A.	Logistics department of Organizing Committee Athens	30th March 2012; 45 min
Sabine Schlosser	Head of the department Fairs & Exhibitions, Schenker Australia	Freight Forwarding and customs clearance	10th April 2012; 45 min
Matthew Clarke	Head of DB Schenker sportevents; Consultant to Schenker AG	Logistics department of Organizing Committee Sydney	19th April 2012; 75 min
Employee	Contract Manager, Schenker Germany	Logistics Operations, Schenker Beijing	20th April 2012, 30 min

During the interviews none of the respondents named issues of anonymity. Only the employee from Schenker Beijing was promised to be anonymous during this research. All in-depth information received, did not undergo any specific confidential declarations. The interviewees gave their permission to use all details named freely throughout the paper.

3.7 Limitations

In order to develop a case study, the inductive approach, to collect primary data, was used. Interviews via telephone with representatives from Athens (Greece), Sydney (Australia), Arona (Italy) and Essen (Germany) were undertaken. Nevertheless, certain limitations in the researching processes refer to problems which occurred especially while collecting this primary data.

The access for students on certain topics or even certain business areas and contacts are limited. Therefore, the responding rate to e-mail requests was rather low. Especially in the case of Athens and Beijing, the language barrier had a great impact. Potential interviewees did not reply due to the lack of conducting an interview in the English language.

The main constraints referred to financial and time limitations. The financial issues were poor, which did not allow the method of personal interviews. Thus, the impersonal contact could result in missing out information or even the establishment of trust. Furthermore, time constraints played an important role.

Due to the research method chosen, telephone interviews require some time. Hence, the interviewees had to make some space in their daily agenda, in order to answer the authors' questions. This led to the fact that the authors were dependent on the participants and the ability to offer a time frame for the interview.

3.7.1 Reliability

According to the reliability of the data collection, it is not sure if a different set of researchers would have developed the same research objectives concerning the current topic. But the input of the interviewee would not have changed, because experts in the field of logistics and the Olympic Games were involved. The participants were highly reliable as they would have provided the same answers to the same questions whenever they were asked (Bailey, 2007).

According to Flick (2006), the quality of the data obtained is the central base for evaluating the reliability and successful interpretations. Hence, the interviewer was trained to conduct the interview in a flexible manner, still orientating the flow along the guide and the interview guide was tested beforehand, as recommended by Flick (2006). Due to those facts, a certain degree of standardization in the interview, as well as the documentation of the interview for a better analysis and interpretation, increased the reliability.

3.7.2 Validity and Generalisation

The research study is specifically tailored to the Olympic Games and its specific warehousing requirements. The authors were able to gain knowledge and a different meaning from the interviewees, as the interviews were flexible and interactive. It provided the opportunity to investigate any upcoming matter much more in detail (Bordens & Abbott, 2011). However, the authors needed to distinguish between the judgment of the interviewee and the presentation of phenomena. According to Flick (2006), the validity is limited, if the interviewee created, consciously or unconsciously, a specific variation of their own understanding which does not interact with the overall assumption. As the interview guide referred to the experiences gained during the organization phase of the Olympic Games, this research might have limited validity.

Nevertheless, the generated findings were only based on a small and unrepresentative number of cases (Saunders et al., 2000). Usually, research should be directed towards an application of findings to a real-world example or large population (Bordens & Abbott, 2011). This often involves a "lack of comparable settings and small, non-probability samples", which weakens the generalization of a research, but is accepted (Bailey, 2007, p. 182).

4 Empirical Data

The following segment will present the data which was received during the telephone interviews with qualified participants of the Olympic Games 2000 till 2008 as well as during the literature study about the Olympic logistics centers. Hereby, the developed interview cluster was allocated to the defined research objectives of the methodology which will act as a guideline of the different section.

4.1 Sydney 2000

For all logistics activities, the Olympic organizing team was supported by United Parcel Service, Inc. (UPS) and Schenker International. UPS became the Olympic sponsor worldwide in 1994, and was able to develop a high degree of experience handling the Games in 1996 in Atlanta (USA) and the Winter Games in Nagano (Japan) in 1998 (Sowinski, 2000). Schenker International was responsible for the freight forwarding as well as handling customs clearance.

4.1.1 Warehouse Requirements

Already in the budget plans of 1996, the Organizing Committee analyzed the required size, location, time of utilization and market rental, or rather acquisition costs, of the logistics center. Nevertheless, when Matthew Clarke was appointed to his position, he changed the budget and reduced the warehousing space, while increasing storage areas for containers, truck holding yards, and screening facilities. The location of the Olympic logistics center was chosen under the parameters of being close to the venues and with a central location, still considering industrial centers of Sydney and the infrastructure.

By the time the logistics department of the Organizing Committee started with their search for suitable facilities, the warehouse market in Sydney was booming. Hence, space was not really available. With only ten to fifteen percent of vacancies, it was hard to search the market for a 40,000 to 50,000 square meters warehouse or three to four facilities of each 15,000 square meters. Further, with low vacancies in the market, the prices were at a premium, which would affect the tight budget.

The preferences of SOCOG referred to a new, clean and dust-free environment for the sports and broadcasting equipment. Unfortunately, this was not affordable at that time. According to Matthew Clarke's memories, building a new facility in an ideal location would have been close to 200 percent on the budget. Hence, the answer was obvious; a compromise had to be found. In the end, SOCOG was able to utilize a warehouse of 40,000 square meters, which was already vacant for six years and located right across the road from the Olympic Park. They were responsible for the warehouse system, equipment and labor as well as for the warehouse operations. Furthermore, Schenker Australia provided a warehouse of 25,000 square meters of space in the Botany area, which is close to the port. This location was favored as most of the freight, required for the Olympic Games, arrived via ocean.

Sabine Schlosser referred to the warehouse of Schenker as a cross-docking center, as it has handled all freight for the athletes and conducted security checks of freight, which was delivered by other logistics providers. That was not very often the case, as Schenker Australia managed the majority of shipments. The warehouse of the Organizing Committee was mainly a storage facility for IOC sponsors, controlled and rented products.

The IOC sponsors were Samsung, Panasonic and Swiss Timing. According to their contracts, the Organizing Committee of each hosting city is obliged to provide storage capacity for their products prior to their delivery to the venues. Furthermore, the OCOG purchased products and rented goods purely for the purpose of the Games.

Hence, according to Sabine Schlosser, items like flags of each country, podia for ceremonies, copy paper, copy machines, water for staff, office supplies were to be stored in the Olympic logistics center. All other storage functions were handled by third party logistics providers, which had a great impact on the needed storage capacity. The layout chosen for both warehouses was nothing special, only basic setups. Having some racks implemented and open spaces for boats on trailers and rowing boats on racks on their trailers. The biggest issue concerned security. The warehouses were categorized with a high safety level by the security department. Guards and CCTV cameras were placed to make sure that a zero tolerance of theft, damage or other matters is granted.

The logistics centers of Sydney offered several value-adding activities. The most important activity named by Sabine Schlosser and Matthew Clarke was furniture assembling. Laminated furniture in flat-packs arrived from China. Those packs were delivered to the warehouse and put to the rear end. There, a crew of 30 people started to assemble beds, bedside tables, chairs, tables, wardrobes, whatever went into the rooms for the athletes in the Olympic village. After the assembly process, the furniture got stuffed into containers outside in the yard. Matthew Clarke specifically remembered, up to 1,000 containers were filled until the village became available and the installation crew could start receiving the containers in the village, and setting up the rooms before sending the empty containers and packing material back to the warehouse.

4.1.2 Warehouse Management

For the SOCOG logistics center a Canadian company developed an inventory management system. Everything that went into the warehouse was bar coded and scanned into the system. Hence, it provided a perfect overview of what went where and when and how much was stored in the warehouse. Unfortunately, not all venues were equipped with the precise system at that time. Matthew Clarke identified the International Broadcast Center and the Main Press Center as the only competition venues with the system. Other than that, manual updates on the inventory were necessary and goods were labeled for further identification. Furthermore, a master delivery system linked all warehouses with the competition and non-competition venues in order to provide a guidance to deliver the right product at the right time to the right place. Nevertheless, Sydney was not able to work with a warehouse management system. It was rather a stock or inventory control system as there was no connection to any financial or accounting parameters.

Sabine Schlosser characterized the Schenker warehouse as a cross-docking center, as most of the freight was not stored, but rather delivered directly to the venue. Moreover, JIT and urgent deliveries were conducted most of the time. Sabine Schlosser mentioned the example of the broadcasting equipment. It usually arrived last minute as it was needed somewhere else before. All replenishments were JIT deliveries as well. Those were handled in cooperation with the logistics department of the Organizing Committee, but no storage space was needed. SOCOG even created a logistics command center in the warehouse where a team of logistics managers took care of computers and telephones 24/7. They coordinated all deliveries requested, as these had to be registered 24 hours in advance, in order to get scheduled and recorded. This was mainly related to security and limitation of congestion as explained by Matthew Clarke.

4.1.3 Ownership

The Olympic logistics centers in Sydney were divided into the warehouse owned and operated by Schenker and the warehouse of SOCOG. The Organizing Committee of Sydney did not own their warehouse. They rented the facility from a logistics company because of the good location, its vacancy, its low cost, and because it had a huge land holding around the warehouse. It also contained a staff canteen, offices, other buildings, which were used as security offices, and plenty of parking spaces. It even provided the possibility of renting office space to many other third party logistics providers. The whole area offered a great degree of flexibility. SOCOG signed the renting contract for one and a half years which supported the storage requirements for the test events, the Olympics, the Paralympics and for reverse logistics and disposal. The warehouse was handed back after those 18 months without any further responsibilities.

4.1.4 Challenges

Matthew Clarke mentioned during the conversation that Sydney was one of the first Games where all functional areas started to interact and where cross-functional integration was applied. Nevertheless, from a logistics perspective, he thought, it still occurred too late. Many last minute requests were directed to the logistics department in order to be fixed. The model planned had still a lot of gaps and put a lot of pressure on logistics, especially during the last 100 to 150 days prior the Games. Other challenges of the Games were the strict Australian customs regulations on food, alcohol, guns, and horses. Furthermore, budget constraints were present as Sydney was under enormous financial pressure.

Sabine Schlosser did not identify any specific challenges. She referred to handling the Olympic Games as taking care of hundreds of different projects at the same time in the same location: deliveries to the venues, art exhibitions, coordinating customers of timing and scoring equipment (Swiss Timing), establishing different seating structures, deliveries to hospitalities and deliveries at night time were the main activities to concentrate on. Furthermore, she identified time and space as important challenges, especially during the bumping out process of the Olympic Games, shortly before the Paralympics were about to start. Top urgent freight had to go out, and the Broadcasting as well as the Main Press Center needed to be moved to new locations. Another obstacle focused on the lack of historical data. Sydney was not able to refer to Atlanta's data on basic questions, such as the amount of barriers and fencing needed or the amount of water required. Sydney started to gather these data to transfer the knowledge to the next Organizing Committee in order to ease the process.

4.2 Athens 2004

The logistics service provider Schenker AG was able to provide their experience gathered during the Olympic Games in Sydney in 2000, while being responsible for freight forwarding and customer clearance. As already four years ago, a third party logistics provider was engaged in all activities relating to managing the warehouse facilities, transportation and distribution to all competition and non-competition venues as well as supporting the management of materials and distribution of goods (Delatolas, 2009 & Minis et al., 2006).

The entire logistics operation started in October 2001 with the help of two venue managers from Sydney. In cooperation they helped to develop concepts for operations, a customs manual, a freight forwarding manual and other manuals for all the Olympic Committees, athletes and others. That could be described as step number one. Step number two referred to creating the entire infrastructure, namely the distribution centers, trucks, material handling equipment, people, and all the resources needed.

4.2.1 Warehousing Requirements

In order to find the right space for the logistics undertaking, Apostolos Tzimourtas started to conduct workshops towards the end of 2001 and invited all people in Greece that were associated with logistics; such as contract logistics companies, freight forwarding companies, people from the government board, custom officers and customs officials; to inform everybody about the strategy and the concept of operations. Throughout the workshop several matters were clarified. Some of the duties were outsourced and only controlled; others were done internally by the logistics department of ATHOC. It has been analyzed that approximately 100,000 square meters of warehousing space were necessary to run the Games smoothly. Further, emphasize is put on the fact, that a team of professionals have to run the Olympic logistics centers (OLC). The contract logistics companies should participate and help running the warehouse as sub-contractors without having any influence on the administrational, financial and operational part. These sub-contractors provided labor and the management of the warehouse.

All in all two warehouse sites were rented that provided in total 85,000 square meters and very good access to the roads as the Olympic venues were widely spread around Athens. This meant that logistics had two main gravity points. One was the Olympic Complex, the other was the so called Beach Complex. The Olympic Complex was located near the Olympic Stadium, where most events were taking place dealing with fields and tracks. The Beach Complex was serving another 12 to 13 venues dealing with beach volleyball, fencing, boxing, and so on.

Olympic Logistics Center 1 at Magoula started its operations in August 2003 and served as the logistics command center. It accommodated most of the logistics things during the last year of the Games. In OLC 2 at Aspropyrgos, the security was located, which supplied among other things the scanning of trucks. OLC 2 was utilized in March 2004 and with 45,000 square meters it was the bigger warehouse, only for the purpose of storing and being used for rehearsals during the Opening and Closing Ceremony production. Nevertheless, it continued operating and was the main facility handling the reverse logistics for materials and equipment after the Games (ATHOC, 2004). Furthermore, two complexes in the area of Marshalling Yards managed security inspections of trucks distributing shipments directly to the venues, being utilized with truck scanners, x-ray scanners and pallet scanners (ATHOC, 2004).

These two warehouses were located in the suburb of Athens and very close to the biggest Greek port, the port of Piraeus. Furthermore, the port of Patras was only two hours away, where most of the goods from Europe, usually through Italy, arrived by ship. In addition, a new highway, which is called "attiki odos" crosses these two areas. Attiki odos leads to the airport of Athens, avoiding the traffic of Athens roads. According to Matthew Clarke, Athens received 4,000 to 5,000 truckloads of equipment for the Games from Germany, Italy and Spain coming into the country via road, ferry and rail. Therefore, the strategic positioning of the logistics centers was crucial and well chosen.

As being the first tenants, the logistics committee had a say regarding the layout of the warehouse. They used a minimal amount of shelves, because most of the items that entered the distribution centers were neither palletized nor standardized. Many items were sound and vision equipment such as scoreboards, timing machines, big screens, poll votes or athlete equipment like boats. Even things as copy machines were not put into shelves as they were taken in and out of the venues for the test events and then for the Games again.

Value-adding activities were performed to some degree, always depending on the item. Apostolos Tzimourtas named mainly assembly of timing equipment. All big chronometers had to be assembled first in the warehouse to make sure it was functioning properly, before being disassembled and sent to the venues. Other items like big copy machines were half assembled, then delivered to the venue to finalize the work. This space in the warehouse was allocated to equipment testing space.

4.2.2 Warehouse Management

The warehouse management system used in Athens was a local system. It was developed by a Greek company. Logistics Vision had a data base that had to be fed with all bar codes and all items. Nevertheless, the software had to be customized to be able to follow the requirements of OLC 1 and 2. Every time an item was coming into the warehouse or leaving, this article was taken from the actual warehouse to a virtual warehouse that had been created inside the venues. This process helped to track down every single unit item and to place it where it needed to be. Whenever the items had bar codes, the system would use the one from the supplier. Whenever, it did not have a bar code it would be given one, which was basically its name tag.

Nevertheless, the usage of a warehouse management system did not reduce the human labor, but it helped to get organized and supported the bump out, which started immediately the night after the last medal ceremony was performed. Especially high value items such as TVs, laptops, and big copiers were affected in order to minimize theft and loss of material. The products delivered were Just-In-Time and products that would stay for a short time in the warehouse. A short time refers to a month or a little bit more than a month. Consolidation was majorly used for copiers, fax machines, telephones, desks and tents and others.

JIT gave the logistics committee the opportunity to use the empty spaces of the warehouse to store things such as boats and golf carts. These items required a dry, dust-free environment. On the other hand, JIT sometimes created problems when delays forced goods to be delivered directly to the venue without going through the logistics center for further quality and security checks.

4.2.3 Ownership

The warehouses were new facilities that did not have other tenants before. In the beginning of the planning, it was assumed that a renting contract over two and a half years would be sufficient. In the end the lease period amounted to three and a half years. The two logistics centers were populated in the beginning of 2003 as the test events had to be prepared. OLC 1 needed to be empty right after the Games as it was further leased to a British electric retailer as of January 1st 2005. OLC 2 was not leased out right away, as it had been the property of a Greek organization. They were more flexible based on the fact that they already owned another warehouse for their spare parts and equipment.

The OLC 2 was used for approximately 18 months after the Games. During the course of the Paralympic Games a lot of the items came back from the venues and were disposed to the next owners. Many things were given to government organizations such as all the copy machines. The leased infrastructure was given back to the hiring company. Unfortunately, most of the material receivers were not ready to obtain their products. Either because they did not have space or they did not dispose the items that were to be replaced. So there was a lot of friction and disorganization with the original owners which led to the fact that the logistics committee had to keep the warehouse for additional six to seven months before the warehouse could be returned.

4.2.4 Challenges

According to Apostolos Tzimourtas, the biggest challenge was that a lot of the people did not have a logistics mindset. He compared the situation of asking for a truck to make a distribution with ordering a pizza; everything should be there within 15 minutes with all ingredients. That was sometimes difficult to realize. Having a logistics mindset would have helped to be more organized.

Matthew Clarke named time constraints as a big challenge for Athens. The Organizing Committee was late in delivering the venues, late in developing a proper functional infrastructure of airport, roads, and rails. Time limitations and the enormous pressure of the world and IOC forced ATHOC to react quickly before the Games would have been assigned to another country.

In retrospect, Apostolos Tzimourtas said that more involvement in the organization of the Games would be beneficial, rather that just being involved in setting up the event. More responsibility and acknowledgement should have been given to the venue logistics managers, as they and their experience have been taken for granted. Horizontal hierarchies would have had a positive effect on the venue management.

Fortunately, there were no serious complaints throughout the process. Transportation delays were handled by the international freight forwarding companies. Issues and complaints with security had to be solved by the logistics committee.

Further the marketing and promotion of the Olympic Games were lacking success. Not a lot of people came for the Games. Most people came because they were visiting Greece anyway for vacation. Athens did not sell a lot of tickets for the Games, which was actually a shame as the Olympics were born in Greece, and so most people watched the Games from home from their TV. All in all, Greece, as such, did not benefit from the Games as much as they could have.

Sabine Schlosser emphasized that Athens developed a modern infrastructure and a proper train line at the same time the Olympics boosted the building industry and the city got cleaned up. Nevertheless, most Greeks were not really positive about the Games. The Olympics modernized many things but nowadays, many of the constructions are left dilapidated and unused.

4.3 Beijing 2008

For the Olympic Games of 2008, United Parcel Service America accompanied by other experts, provided their expertise and experience as the official logistics and express delivery sponsor to the organizing committee of Beijing. Schenker in the role as the exclusive supplier for the Beijing Olympic Games, was able to contribute their knowledge in terms of freight forwarding, land transportation, customs clearance, and warehousing.

Nevertheless, the effect of language and multicultural business barriers might have an impact on the effectiveness and efficiency of handling material and distribution. Hence, one of the organizing partners, the University of North Carolina's Frank Hawkins Kenan Institute of Private Enterprise, started to educate the Organizing Committee in order to be better prepared for the upcoming challenges (Cross, 2008).

4.3.1 Warehouse Requirements

All cargo could have been handled or stored at one of the four warehouse facilities, covering an area of 185,800 square meters (Traffic World, 2008). These huge warehouses accounted for the largest single customer facility in Asia operated by UPS, offering all necessary services, such as receiving goods, warehousing, picking & packing, and shipping off the products to their assigned Olympic venues. The equestrian events were held in Hong Kong, whereas the other 37 venues were located in Beijing (Cross, 2008). The major warehouse, Shunyi, was located close to the airport, 27 kilometers from the major Olympic venues and with a connection to many motorways, guaranteeing an appropriate distribution (BOCOG, 2008). This warehouse was separated into different storage areas and further divided according to their functions like material storage, backyard, living space, and parking lot (Shunyi, 2008).

Matthew Clarke pointed out that the Beijing Organizing Committee was provided with warehouse space and UPS, as logistics sponsor, provided all warehouse services such as the warehouse management system. That was part of the sponsoring, which referred to no costs for the organizing committee whether it was 40,000 square meters or 80,000 square meters. An even bigger warehouse sat empty for one year, because it was owned by the government and they did not pay attention to it.

Schenker operated their own warehouse facilities. They were built by a local Chinese company linked to the local government. Only 18 months before the Games, started the operational phase for Schenker. In the beginning, a warehouse with 10,000 square meters was planned but it the end, the total warehouse space contained of 20,000 square meters. The logistics centers were populated 12 months prior the Games.

The location was chosen according to its closeness to the airport, which was crucial for the bump in and bump out phase, and its nearness to the customs offices. Due to the good infrastructure of Beijing, the establishment of a warehouse close to the venues was of lesser importance.

The layout of the warehouse was self-determined and depending on supply and demand. In the beginning, Schenker thought that storing the items on the ground was sufficient and eased a fast in and out process. After a while, they realized that racks were necessary due to a shortage in space. Some of the capacity within the warehouse was reserved for special customers. These customers had special requirements for their layout and equipment that had to be realized as well as their required value-adding activities.

Furthermore, Schenker offered especially for their foreign key accounts additional services such as inventory control, truck disposition, pick and pack, and freight consolidation.

Remarkable was the level of security required by the Chinese government. All warehouses and venues had the highest level of security. The warehouses had to be fenced and incoming trucks were screened, searched and controlled by representatives of the Chinese security department. Further, Schenker was obliged to invest into 24/7 CCTV cameras, scanning every corner and saving the recording material for one month. Nevertheless, the implementation of cameras helped to keep the tolerance of theft and damages close to zero.

4.3.2 Warehouse Management

Schenker did not invest in RFID and bar coding, as the Olympic Games were only temporary. Nevertheless, the warehouse had a simple warehousing or inventory management system, basically a web-browser supported tool. The technology kept track of the inventory and required manual data input of the items coming in and going out, as they were not scanned. This required additional human labor.

According to Matthew Clarke, the Organizing Committee had the major advantage by using an inventory management system, which was present in all venues. The main system was based on the former system used in Sydney and Athens. Nonetheless, it had to be enhanced by UPS for Beijing.

Most of the items were stored according to the JIT approach, especially sport equipment. But it was also depending on the athletes' schedule. For example, if a rower had a different competition shortly before the Games, his boat had a very short duration in the warehouse. Whereas, if a racing cyclist had no competition and was ready to send his bike to China, it was possible, that this bike was staying in the warehouse for two months. In contrast to that, broadcasting equipment would get to the warehouse one day before it was needed, consolidated and then sent to the right venues.

4.3.3 Ownership

Referring to the ownership, the BOCOG (2008) mentioned in their official report that they rented all warehouses by May 2008 during the time of operations from March 8th, 2007 to September 30th, 2008.

Schenker, as well as BOCOG, rented all their needed storage space. Schenker's bump in and bump out phases accumulated to three weeks each. This short period led to the fact that one warehouse could be given back immediately after the Games, whereas the second warehouse was emptied during a two to three months period after the final ceremony. Schenker even kept one of the warehouse for own purposes.

4.3.4 Challenges

The contact person mentioned communication and the establishment of a trustful relationship with the local government and BOCOG as challenges. They had very strict security measures which led to additional investments such as the mentioned CCTV surveillance and fences. Further, the local authorities had strict rules regarding employee and truck accreditation. Moreover the employee recruitment was difficult because good warehouse personnel were hardly available and more expensive than usual.

Beijing had events in two different areas, for example the equestrian events were taking place in Hong Kong, whereas sailing was carried out in Qingdao. Matthew Clarke pointed out that this was ideal for Schenker but hard from an organizing and financial point of view. Cost control was a major issue for Beijing as well as logistics as such.

Complaint Management was handled over several levels. Most of the complaints were dealt with by the project team or the project leader. Others had to be solved by regional or Olympic authorities. These complaints referred to employee treatment or wages.

Sabine Schlosser explained that hosting the Olympic Games had great effects on the people's perception of China. The Olympics lifted Beijing and China up to the Western world. Nonetheless, the people in the background experienced difficulties with customs and getting the Chinese people to actually import into their country as China is mostly known for being the world's largest exporter.

4.4 Review

The table below presents all gathered information from primary and secondary data about the warehousing details of the Olympic Games from 2000 to 2008. All given facts are classified by the respective Olympic city.

Table 4.1: Logistics Centers of the Olympic Cities

	Sydney 2000	**Athens 2004**	**Beijing 2008**
Warehousing, transportation & distribution	UPS	Team of Greek logistics providers	UPS
Freight forwarding & customs clearance	Schenker	Schenker	Schenker
Location	Close to Olympic Park	Close to the 2 gravity points	Close to airport & customs offices
Total warehouse space	65,000 m^2	85,000 m^2	185,800 m^2
Number of locations	2	2	4
Distance to logistics center	40 minutes	n.A.	Ø 40 kilometers
Layout	Open storage space, a few racks	Open storage space, a few racks	Open storage space, a few racks
VAA	Mainly furniture assembly	Assembly to check functionality before delivery	Schenker: for foreign key accounts
WMS	Inventory management system	Own developed WMS	BOCOG: WMS linking all venues. Schenker: simple manual WMS

	Sydney 2000	Athens 2004	Beijing 2008
Delivery	JIT, short-time storage	JIT, short-time storage	JIT, short-time storage
Ownership	SOCOG (rented), Schenker Australia (ownership)	ATHOC (rented), 3 PL	BOCOG (rented), Schenker Beijing (ownership & rented)

Table 4.1 lists the responsible operators for warehousing and freight forwarding. Further, it provides an overview about the location, total warehouse space, number of location, distance to logistics center, layout, value-adding activities, distribution applications such as warehouse management system. Moreover, the preferred delivery option as well as the owners of all storage facilities are presented.

The stated facts of the Games, that took place in Sydney, Athens and Beijing, are presented in a nutshell to add to the overview character. All in all, the chart serves as a good preparation for the upcoming analysis and discussion part.

5 Data Analysis

The following chapter combines the literature reviewed in chapter two and the empirical data collected during the interviews. Therefore, it emphasizes on the following important sections: adjustment of requirements, comparison of warehouse sizes with distribution applications, ownership, and challenges. Within each part, it is discussed how the requirements of warehouses were adjusted to suit their special needs of the Olympic Games. The authors focused on the exercise of distribution applications and ownership. Furthermore, various challenges were named during the interview which are compared with each other and analyzed.

5.1 The Adjustment of Requirements

The logistics centers are to be considered as a network of warehouses and distribution facilities. The authors compare traditional requirements of those premises with the special demands for the Olympic Games. Those products involved have a much shorter life cycle, a higher activity level, require shorter storage time than usual and request-better customer service. Hence, the following measures are going to be considered more in detail: location and product storage, layout and distribution settings, value-adding activities, security, and capacity management.

5.1.1 Location & Product Storage

As Viale (1996) already emphasized, in order to achieve a competitive advantage, the location of a warehouse should be either close to the manufacturing facility or close to the venue. The Organizing Committees decided on latter. They focused on storage facilities close to the competition and non-competition venues, Olympic athletes' village, and hospitality premises. Choosing a location close to the venues, allows even to transport smaller items without adding some extra costs, according to Langley et al. (2008). Nevertheless, the warehouses were established in industrial areas with a good infrastructure, in order to be more flexible, have quicker access to the venues and improve the overall service.

Furthermore, each hosting city focused on a different mean of transportation. Sydney received most of its freight via ocean, hence, Schenker Australia, a third party logistics provider, was able to offer their warehouse close to the port of Botany, where most of the freight came in. Matthew Clark mentioned, that Athens positioned their facilities with a good access to both ports, highway and railway, as 4,000 to 5,000 truck loads arrived by road, rail and ferry from Germany, Italy and Spain. Beijing established their warehouses close to the airport with a good connection to the motorway. Indicated by the employee of Schenker Beijing, even the Schenker warehouses were located close to the airport to simplify the customs clearance and the process of bump in and out of freight.

Mangan et al. (2010) further classified the types of warehouses by the products stored. They mentioned that, from a strategic point of view, specialized items should be kept together and more general goods are gathered in separate premises. According to this assumption, the Organizing Committees stored items belonging to the IOC sponsors, controlled products and rented goods in their leased warehouses. Referring to Sabine Schlosser's statement, they stored items like flags of each country, podia for ceremonies, water for staff, and office supplies. Often they included their logistics command center in this facility as well. The premises of the third party logistics providers served as cross-docking centers, like in Sydney, and handled all freight for the athletes and additional security measures, such as scanning and screening and most of the reverse logistics. Hence, the theory by Mangan et al. (2010) was confirmed and successfully implemented.

5.1.2 Layout & Distribution Settings

Viale (1996, p. 64) defines important areas to consider for an efficient layout of a warehouse as "space for storing items, receiving and shipping docks, areas of staging, picking, assembly and packaging, and equipment". Especially Beijing emphasized on specific storage and functional areas in their warehouses. The functional areas comprised material storage, living space, backyard, and parking lot. Moreover, the storage areas provided reserved spaces for special customers, who were granted a special layout, equipment and value-adding activities.

The Organizing Committees implemented a significant layout, as indicated by Fleischmann and Klose (2005), that supported a connection between the layout of the warehouse and the efficiency of the working processes on storage and handling, This enables them to manage low inventory turnover and fast moving goods at a high level of productivity and efficiency. The utilization of automated handling equipment, as stated by Mangan et al. (2010), did not reduce the impact of labor as neither products nor processes were standardized to ease the process.

Categorizing the products stored in a warehouse, by size and similarity, as offered by Langley et al. (2008) and Viale (1996), was not suitable for the Olympic logistics centers. More in favor was the differentiation by smaller and greater items. Hereby, smaller units were supposed to be placed on shelves and bigger pieces were located in greater assigned areas. Unfortunately, this theory was not completely considered for the warehouses rented by the Organizing Committees. All interviewees named great open spaces with a limited number of shelves as their prerequisite. They were more focused on the storage of boats on trailers, golf carts and having capacity for non-palletized and non-standardized shipments which eased the in-and-out process.

Schenker Australia utilized their own warehouse for the Olympic Games, which offered open space and some racks. Further adjustments were not undertaken. Schenker Beijing's employee referred to the layout as self-determined, depending on supply and demand. They also implemented only a few racks in the beginning. This number had to be increased as a shortage in storing capacity occurred.

5.1.3 Value-adding Activities

Value-adding activities are, according to Jonsson (2008), amongst others assembly, product mixing, sorting, adjusting, packing, labeling, and consolidation. These activities were of high importance by all Organizing Committees. In the case of Sydney, furniture assembling and filling up 1,000 containers before the process was completed in the athletes' village, was remarkable. Athens rated the assembly of timing equipment as most significant. The equipment was checked for their functionality before their delivery to the venues. Other items were halfway constructed, transported to the right place and finalized. Schenker Beijing offered, especially to their foreign clients, value-adding activities such as consolidation, pick-and-pack, and inventory control.

Overall, these activities aimed to improve the quality of the product. While already pre-assembling a product in the warehouse, certain failures were eliminated before the product entered the venue. This procedure offered suitable time for finding the right solution. Simultaneously, as indicated by Jonsson (2008), costs were reduced while minimizing packaging or administration costs, as especially furniture sent to the village, contained almost no packaging material. When the container returned, the waste was gathered and could easily be disposed. Furthermore, lead time was reduced through the intensive use of cross-docking.

5.1.4 Security

Security measures are usually implemented in rented facilities, as well as in the properties of third party logistics providers, as mentioned by Langley et al. (2008). All Olympic hosting cities installed CCTV cameras and employed guards in their warehouse to ensure a high level of security and zero tolerance for theft or damage. Furthermore, all trucks and vehicles had to be screened and reported, while drivers had to be identified according to earlier notification.

Nevertheless, the authors believe that the aspect of security and its effect on the Olympic Games has changed and grown in importance. After the events of 9/11, mega-events, such as the Olympic Games, started to be seen as very high profile events with maximum impact to harm a huge amount of people. Back in 2000, the Organizing Committee of Sydney never thought of these dramatic effects. New perspectives on safety led to higher investments in security and training measures to protect the Games and all participants against terroristic attacks.

5.1.5 Capacity Management

The capacity required for the Olympic Games cannot be calculated in the traditional way. Mangan et al. (2010) referred to forecasts or forwarded point-of-sales data. Nevertheless, it is important to have a certain understanding of the amount of goods to be handled. This influences the balance of supply and demand and ensures to neither run out of stock nor to overstock.

Unfortunately, the theory by Mangan et al. is not applicable to this certain case. Jonssons (2008) approach is more reasonable, as he considered capacity management as the space needed for receiving and shipping the goods, capacity required for order picking and assembly and the actual space necessary for storage. This definition is vital for the Organizing Committees, as they have to calculate their warehouse space needed before outsourcing the remaining activities to third party logistics providers. For further orientation for the required space calculation, historical data of previous Olympic Games were used. Obviously, Sydney re-calculated their needed capacity and minimized their requirements down to 40,000 square meters with additional 25,000 square meters provided by Schenker Australia. It was more important to have outside storage for containers and truck holding areas instead of huge warehousing space. Athens increased their capacity to up to 85,000 square meters for two warehouses. Beijing more than doubled the area of Athens' warehouses and utilized four warehouses with a total size of 185,800 square meters. Schenker Beijing contributed with additional 20,000 square meters to the storage area. However, all logistics centers needed to include some spare capacity to act flexible towards unknown projects, such as ceremonies and their props that might be used.

The great difference in numbers shows clearly the enormous pressure the Organizing Committees were und and set to be most efficient in their space utilization and the costs involved. Master delivery schedules helped to coordinate and organize the shipments in advance. Nevertheless, there is no time and money for any corrections, if the capacity has been miscalculated. Hence, the Organizing Committees took their experienced logistics managers and their knowledge of the market to either reduce the planned space and save money, or to play on the secure side and adhere to the calculations. However, if a warehouse with too less space for the great quantity expected was initiated, that could result in negative effects. Gallmann and Belvedere (2011) indicated that this unbalance would negatively influence the safety settings for the warehouse, as well as the flexibility of fulfilling value-adding activities.

5.2 The Comparison of Warehouse Size with Distribution Applications

In the following section the distribution applications will be related to the warehouse size. This is done in order to analyze to what extent distribution applications; such as warehouse management systems, bar coding, radio-frequency identification, Just-In-Time and others; influenced the space requirements.

5.2.1 Warehouse Management System (WMS)

According to Mangan et al. (2010) and Piasecki (2004), a warehouse management system is a computer software system, which basic function is to control movement and storage of materials within a warehouse. Sydney, Athens and Beijing used a warehouse management system (WMS) on different development levels. Even though, they were working with a WMS, the systems were not sophisticated. Sydney rather used an inventory management system (IMS). Matthew Clarke described the system as simple, as it used bar codes, scanners and labels that had to be put on every single item and manual updates had to be provided. A further issue was that not all venues were linked to the IMS.

Athens made some progress and followed the technological advancement by implementing a simple WMS. This system was customized for the purpose of the Games and followed the requirement of OLC 1 and OLC 2. This meant that all bar codes had to be put into the WMS in order to track their position. As items were going in and out of the logistics center, the WMS moved the goods into a virtual warehouse to be able to have an overview of all items and their amount and remains, as Apostolos Tzimourtas explained. This system improved to some extend the labor productivity, one benefit identified by Langley et al. (2008). Unfortunately, further enhancements, named by Langley et al. (2008), referring to warehouse productivity, efficiency and precision, as well as advanced order-picking accuracy and managerial control, only started to count for the Games in Beijing.

Beijing had a higher developed WMS provided by UPS, their logistics sponsor. UPS installed the system in all venues, which gave logistics operations a time, space and productivity advantage. Nevertheless, single warehouses, which were not operated by UPS had an own approach in their facilities, for example Schenker. The employee of Schenker Beijing illustrated their simple WMS as a web-browser supported tool that kept track of all items, but required manual labor for further data input.

Even though, the logistics operators were aware of the benefits offered by the WMS and the impact in saving warehouse space and personnel, it was not worth to invest in a sophisticated system, covering all venues and all products. Hence, simpler versions were implemented to ease the process. Still, those systems developed over time and were more capable during the previous years. Labor might not have been reduced, but employees were able to work more efficient and productive. The WMS enabled the logistics operators to enhance capability and efficiency with the resources available in each Olympic hosting city, still aiming for improvements.

5.2.2 Bar coding & Radio-frequency identification (RFID)

In an ideal situation an effective WMS is supported by RFID. Nonetheless, this ideal case did not occur throughout the Games of 2000, 2004 and 2008. The same progress, as with a warehouse management system, can be found when examining the usage of bar coding and RFID.

Bar coding, according to Crossley (1995), provides the basic function of the transfer of freight including shipping, receiving, ordering, and so on. Roadcap et al. (2000) referred to the advantage of saving a great amount of data, and therefore reducing errors and increasing speed. It can be considered as a key characteristic in the logistics process. Bauhoff (2003) described RFID as a track and trace technology based on a computer network, which is connected to a microchip. Here, all necessary information about the product and owner are kept. While Vijayaraman and Osyk (2006) identified many benefits of RFID, such as a greater visibility and higher security, especially the weaknesses are important to consider for the Olympic Games. The authors mentioned technical limitation, a lack of understanding and the great cost of implementation, amongst others. As the Olympic Games are a temporary event with changing location, restrictions on technique and labor become obvious. Especially the tight budget prohibits spending on extra labor training or special procedures. Hence, the former Olympic cities emphasized only on cost and efficiency factors and decided in favor of bar coding.

Sabine Schlosser pointed out that Sydney used labeling and bar codes, where they were available, in order to avoid spending money on further technology. But their technology was far behind in those days and not as sophisticated as today. Athens followed this approach and used mainly the bar codes of suppliers. If there was no bar code, simply a name tag would be provided which helped to stay organized and supported several operational processes. When it comes to Schenker in Beijing, the contact person clearly approved the disadvantages, mentioned by Vijayaraman and Osyk (2006), and indicated that no investment in RFID or specialized bar coding was necessary.

Even though, RFID is enabling users to follow items within the entire supply chain once implemented by all participants, all logistics committees did not see the greater usage due to the great investment, which most likely would have expanded the calculated budget. As the implementation would have been an extra cost factor, so was manual labor, which was a necessity. Warehouse management and bar coding/RFID required, in all considered cases, manual labor. It was necessary to have people setting up the system and preparing the items with tags and bar codes, as well as having manual updates on the entire system. Nevertheless, this impact must have been lower than the utilization of a sophisticated system of track and trace.

5.2.3 Just In Time (JIT)

In order to increase the warehouse efficiency and productivity, Just-in-Time played an important role. In general, Burt et al. (2010) explain, that JIT involves considerable cost reductions, higher customer satisfaction through higher quality, faster process accomplishment, and minimized waste output, as the products are delivered in the quantity needed, at the exact time required.

Considering the Olympic Games, the JIT approach was majorly important for the broadcasting equipment. In most cases this type of appliances were delivered one day before it was required, as pointed out by Sabine Schlosser, Apostolos Tzimourtas and the Schenker Beijing employee. The same can be said for replenishment deliveries. Here, the restaurants and canteens were supplied with food and beverages on a regular base.

Athens exercised the opportunity JIT provided, to utilize the empty space in the warehouse to store boats and golf carts. Despite giving storage capacity, JIT also created problems for Athens. JIT requires fixed delivery schedules with granted quality and fulfillment (Burt et al., 2010). The logistics operations were on a tight time schedule, where delivery delays or trouble with the quality received, caused additional difficulties. The Committee was forced to dispatch delayed goods right to the venue without going through the warehouse for any quality and security checks. Security measures were undertaken, but sending items straight to venues required a higher level of trust for all participants.

Nevertheless, the logistics departments of the Organizing Committees emphasized, not as much as expected, on the JIT approach. Considering the fact that a delivery directly to the venues, especially for products with a lower security level, could have reduced the warehouse space initiated in the beginning. However, as mentioned by all interviewees, most of the freight had to undergo several quality and assembly checks, as well as security checks, before being transferred to their right place. On the other hand, only items of lower value could be delivered and gathered in the competition and non-competition venues long before the opening ceremony, as otherwise the risk of theft or damage would have been too great. Hence, those products needed to be stored in advance.

5.2.4 Consolidation & Cross-docking

Athens and Beijing supported their JIT approach with consolidating items before sending them to the venue. This saved transportation costs, but required to some extent extra space. Sydney on the other hand focused on cross-docking, which requires according to Saxena (2007), transferring goods between carriers or vehicles with the minimal usage of warehousing between the stops. Further, Mangan et al. (2010) refer to the performance of value-added services and a short-term storage, which can also be categorized as cross-docking. Especially Sydney exercised the advantage, stated by DelBovo (2011), of improving service and product quality, while reducing transportation costs and lead time.

Unfortunately, Athens and Beijing did not focus much on cross-docking. Mostly, for products with a shorter shelf life, as the majority of the freight for the Olympic Games, would this be an advantage referring to DelBovo (2011). Only Sydney intensified the approach and was able to work efficiently and productively with a much smaller warehouse capacity compared to Athens and Beijing. This could lead to a connection of emphasizing on cross-docking and reducing actual storage space, as to be seen in the case of Sydney.

5.3 The Question of Ownership

Considering the question of ownership, one of the most important issues to think of is risk. Whether, which party holds the risk in owning a facility, is the risk shared in taking up a part of the facility's possession or are public premises only rented for a certain period of time.

The utilization of a private facility is more favorable for a high volume of goods running through the warehouse. Viale (1996) mentioned that there is a certain amount of fixed costs to be considered and variable operating costs, which increase slower than for public warehouses. Furthermore, Langley et al. indicated that property owners have a greater authority in terms of "physical control, customer competition, information system for inventory control and ordering processing, and regional needs" (Langley et al. 2008, p. 418). Hence, all those advantages actually speak for the use of private warehouses for the Olympic Games.

Nevertheless, due to the temporary utilization of only 18 to 42 months, a private warehouse would be highly inefficient. Matthew Clarke pointed out, that a great financial investment is needed, which is very difficult to realize as all Organizing Committees have to work with a tight budget. Moreover, he even mentioned that building a new facility with all required features in Sydney would have been 200 percent on budget.

Further, Sydney's Organizing Committee was one of the only Organizing Committees, who decreased the calculated warehouse space down to only 40,000 square meters in order to save money. Usually the Organizing Committees tried to plan on the safe side and considered more space as actually needed. This became more than obvious comparing the sizes of warehouse rented. Whereas, Athens increased their space required only by 20,000 square meters, Beijing utilized almost three-times as much space as Sydney did.

The Organizing Committee of Beijing rented their warehouse space from the logistics provider and sponsor of the Olympic Games, UPS. Thereby, BOCOG did not really care about the costs involved as UPS invested a great amount of money in realizing the logistics activities prior, during and after the Games. One of the huge warehouses even set empty for almost one year as it was ready for utilization, but no shipments were stored yet.

SOCOG leased a facility for a period of 18 months and returned it after the Games were finished and the reverse logistics process was completed. This duration of renting contracts could be considered as a normal period. The warehouses in Beijing were also released after 18 to 19 months. The situation for Athens was different. The Organizing Committee terminated their renting contracts for one location right after the Games and for the other warehouse after 42 months. Initially, the contract for the Olympic Logistics Center 2 was supposed to end after a total period of 30 months. Due to friction and disorganization in reversing all equipment and emptying the facility, the public warehouse offered the flexibility in prolonging the contract for an additional year. However, this greater flexibility carried, according to Harrington (1993), more costs as a public warehouse offers space whenever it is needed for a specific price per square meter. If more space was necessary in the end, higher costs were involved or even the search for a new facility had to be undertaken. Nevertheless, the public property offered the Organizing Committees the easiest and most cost efficient way for the planning and operation phase, as well as for reverse and disposal logistics.

Additional space was provided while outsourcing the storage activities to third party logistics providers. Remarkable were the attempts by Athens. Apostolos Tzimourtas explained that right from the beginning of the organizing process, the Organizing Committee had gathered all Greek logistics actors and composed a team of third party logistics providers with strong knowledge and experience in all vital areas. Nevertheless, all processes were controlled from the outside or internally by the logistics department of ATHOC, especially the fields of finance, administration and operations. In Sydney, storage and transportation activities were handled by Schenker Australia. They offered their own warehouse with 25,000 square meters for utilization. In Beijing, Schenker participated with storage space of first 10,000 and later 20,000 square meters. Those facilities were also rented, whereas, one warehouse was further contracted by Schenker and the other property was returned to the owner right after the Games were brought to an end.

The process of outsourcing basic warehousing activities enabled the Organizing Committees to focus on their core competencies, such as the organizing process to operate more effectively and efficiently.

Langley et al. (2008) emphasized that third party logistics providers offer a wide range of services for their customers. Most of the time, the facilities were well equipped and experienced personnel working in the property, were included in the contract. The already implemented security measures were taken as the base for further improvements, as required by the Organizing Committee or the hosting country, for example in the case of Beijing. All those factors reduced the error rate and the effects on budget and time.

Theoretically, the literature preferred the ownership of private warehouses, as all characteristics named by Viale (1996) and Langley et al. (2008) supported this opinion. In practice, the Organizing Committees have decided to either rent facilities for their limited use or work closely with third party logistics providers. These actors know the market, their resources and have a great network of assets, which benefits the planning and utilization phase of the Organizing Committee. Moreover, after completing the Games and accomplishing the activities of reverse logistics and waste management, the Organizing Committee had no further commitments, as the facilities were only leased.

In the beginning, the choice of ownership was most important and influenced all operations involved. It helped the organizers to work with a tight budget as well as to improve the efficiency and productivity, especially when other departments started to interact, as emphasized by Matthew Clark on the example of Sydney. Nonetheless, the ownership situation did not further affect the planning and utilization phase of the Olympic Games lifecycle.

5.4 The Challenges for the Olympic Games

Throughout examining the personal comments, the most striking statements were the ones about challenges. Every event, no matter if small or big, faces challenges, so do the Olympic Games. When comparing Athens with Sydney and Beijing, it can be pointed out that Athens clearly relied on data and experiences from Sydney. Beijing had much more people as other Games and therefore a much broader organization. This circumstance can be evaluated as advantage in terms of speed.

According to Sabine Schlosser, Sydney were the first Games that put a focus on closer interaction leading to cross-functional integration. Even though Sydney could not access any historical information, they were helping the following Games by gathering data about their achievement, working with this new approach as well as specific requirements and needs. This gave Athens and Beijing a certain advantage, as they could rely on information and data collected by the SOCOG.

Further, all Games were confronted with certain customs regulations and security measures. Sydney needed to follow the strict Australian customs regulations on food, alcohol, guns, and horses as Matthew Clarke described in detail. Beijing had to implement extraordinary security measures for every warehouse in terms of 24/7 surveillance of every corner of the property. Moreover, the Schenker employee reported that the goods had to go through rigorous controls before entering the country or the logistics centers.

Other challenges led back to time, budget as well as space constraints. Sydney and Athens were both on a rather tight budget, which resulted in decreasing storage space calculated or even outsourcing most of the warehousing activities. In contrast to that, Beijing did not have issues with money. Nevertheless, they were all facing time problems as things did not get there on time or operations could not follow the time planning of the strategy made beforehand.

Especially, Athens suffered from difficulties in providing the venues and a functional, proper infrastructure on time. This could have had negative influences on the Olympic Games but due to their experience and know-how, all Organizing Committees were able to handle those activities under enormous time pressure with a positive outcome. According to Apostolos Tzimourtas, Athens was suffering from a further drawback, which was to a certain extent self-made. Due to a lack of marketing and promotion efforts, the Olympic Games had fewer visitors than expected. Most Greeks were watching the competitions from home rather than getting outside and going to the venues to follow this major event.

Beijing's logistics managers were facing communication issues as well as concerns with culture and employee recruitment. The matter of communication with officials and the establishment of trustful relationships with local and governmental authorities and BOCOG were hindering the logistics work. Strict rules were required for security, and therefore they also applied for employee accreditation. This made it even harder to recruit sufficient and experienced labor.

6 Conclusion

In order to conclude this thesis, the authors will provide theoretical contributions and managerial implications. The final reflection will indicate the authors encountered problems, their consequences and how future research could look like.

The thesis referred to the adjustment of traditional requirements of logistics centers towards the specific approaches necessary to act most efficiently and effectively during the Olympic Summer Games life cycle. In more detail, the research aimed to analyze the changes from general warehousing requirements towards specific logistics prerequisites, to discuss the implementation of distribution applications while affecting the space conditions desired and to examine the ownership of logistics centers and their impact on planning and utilization throughout the Olympic Games.

In order to pursue this purpose, the authors were able to collect in-depth information while conducting telephone interviews with heads of the logistics departments of the prevailing Olympic cities; Sydney, Athens and Beijing; as well as receiving an insight from the freight forwarder viewpoint. Moreover, secondary data helped to receive a better understanding of the findings.

6.1 Theoretical Contributions

All described features of a warehouse facility are more specific and extraordinary when it comes to plan, utilize and manage a logistics center during a mega-event in this order of magnitude. This research makes several contributions to the adjustment of requirements for warehousing in order to suit the specific prerequisite of the Olympic Summer Games. Traditional aspects of choosing a location with a great infrastructure, the storage of similar and specialized products as well as providing areas for conducting value-adding activities, eliminate errors and enable a more effective performance. These attributes are associated with the theory.

On the other hand, the Organizing Committees as well as the involved third party logistics providers, had to change their approaches in terms of capacity calculation, which were not based on forecasts or point-of-sale-data. Here, experience as well as historical data helped to determine the right size. The design of the layout offered more open space and fewer racks. Furthermore, the study estimated that security aspects of the warehouses and the Olympic Games in general are of growing importance. Overall, the authors are able to conclude that all analyzed features of a warehouse facility have to be more efficiently and effectively performed, in order to serve the great approach of being productive for the Olympic Summer Games.

Further, the distribution applications have to be adjusted in order to meet the warehouse facility's requirements. The utilization of technology in this context is not necessarily related to the highest standards and newest developments. It is rather important to adapt to the purpose of the usage, in this case a temporary mega-event. The investment in a sophisticated WMS, as well as initiating bar coding and RFID, needs to be addressed to the specific usage. Moreover, applications such as cross-docking and JIT, were able act more productively within the warehouse space required. Nevertheless, not all former Organizing Committees emphasized on those possible savings and kept some extra capacities and resources, which influenced the budget negatively.

The question of ownership was solved by the Organizing Committees while searching for warehouse space and leasing those facilities rather than buying. This was more in favor, due to the limited time frame of ownership for the temporary purpose of the Games. Such solution involved lower risk, was less costly and offered the possibility to prolong the rental contract in emergency cases. Nevertheless, after deciding on the storage facility and the required layout and equipment, the further planning and utilization was not influenced by the ownership. After finishing the process of reverse logistics and disposal management, the Organizing Committee returned the facility and had no further commitments.

6.2 Managerial Contributions

Based on their research and findings, the authors can provide several learnings that may be applied by future logistics managers handling mega-events, such as the Olympic Summer Games.

The first proposals that can be made, are the usage of gathered information of former Games in order to learn from the problems and challenges other Organizing Committees were facing, as well as from the positive discoveries that might have been made. This might help to prepare for the unknown. There are always issues, which were not considered, that can be identified by studying former knowledge and experience. Being prepared for the unknown can relate to security standards, to warehouse capacity, technology failures and much more.

Attentive planning is crucial to avoid mistakes and errors. Planning well ahead, regarding time as well as budget, is essential when managing mega-events logistically. Economically, it is wise to start the organization with experienced employees to rule out last minute decisions. These decisions may influence measures, such as warehouse location, space, layout, technology and labor negatively. A further aspect that should be considered timely is gathering and spreading knowledge about customs and freight regulations, and labor laws of the respective country. Familiarizing with the requirements and procedures minimizes complaints from involved logistics partners, athletes, personnel and so forth.

6.3 Suggestions for Further Research

The Olympic Games have a long history stretching over several decades. Therefore, they bear a lot of topics for research. Most importantly to underline are the changes occurring over time. The authors recognized major enhancements in terms of handling the logistics activities and technological impact, while comparing the Olympic Games from 2000 to 2008. It might be of great interest, how all analyzed aspects will improve in 2012 and towards 2016.

The logistics aspect of carrying out a mega-event like this, is based on technological developments, as is warehousing. Nowadays, the use of technology cannot be denied when keeping track of all goods. Constant developments are made to enhance the efficiency of warehousing and to reduce errors of manual labor. This refers to the decision on layout, capacity, all warehousing activities as well as the products that are handled. The implication of improved technology may result in less warehousing space and fewer personnel required. This could act in favor of the budget. Nevertheless, that would require better scheduling, better coordination and reliability of the fulfillment of agreements. However, this assumption would suggest additional research and, if applicable, approval.

A further aspect, that needs to be reflected on, is security. Security measures are also based on technology, but they face a greater public interest. Security is not only related to warehousing. It connects to the venues itself, to personnel, participants and spectators of all kinds. Since 09/11 the world has changed significantly when it comes to security and safety. People and companies have become more careful when attending and participating in public events, especially events of a scope as the Olympic Games. When it was not a major concern for Sydney, it clearly became one for Athens and Beijing. Nowadays, impacts of security are worth to be considered. As emphasized earlier, significant changes might be visible in terms of budget and time requirements.

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Appendix 1: Olympic and Paralympic Disciplines

Table A.1: The Olympic Disciplines (Official site of the London 2012 Olympic and Paralympic Games, 2012)

Olympic Disciplines	Paralympic Disciplines
Archery	Paralympic Archery
Athletics	Paralympic Athletics
Badminton	Boccia
Basketball	Paralympic Cycling • Road • Track
Beach Volleyball	Paralympic Equestrian
Boxing	Football 5-a-side
Canoe: • Canoe Slalom • Canoe Sprint	Football 7-a-side
Cycling: • Mountain Bike • Road • Track	Goalball
Diving	Paralympic Judo
Equestrian: • Dressage • Eventing • Jumping	Powerlifting
Fencing	Paralympic Rowing
Football	Paralympic Sailing
Gymnastics: • Artistic • Rhythmic • Trampoline	Paralympic Shooting
Handball	Paralympic Swimming
Hockey	Paralympic Table Tennis
Judo	Sitting Volleyball
Modern Pentathlon	Wheelchair Basketball
Rowing	Wheelchair Fencing
Sailing	Wheelchair Rugby
Shooting	Wheelchair Tennis
Swimming	

Synchronized Swimming	
Table Tennis	
Taekwondo	
Tennis	
Triathlon	
Volleyball	
Water Polo	
Weightlifting	
Wrestling	

Appendix 2: Interview Questions

1. What was your task during the Olympic Games?
    a. How did you get appointed for this specific position?
    b. What is your profession now? Did you stay in the logistics sector or even have a long-term position within the Olympic Games?

2. Location
    a. When did the planning phase start for the Olympic Logistics Centers (OLC)?
    b. How many centers were utilized or even newly built?
    c. How was the location chosen?
    d. How did the infrastructure influence the strategic positioning? (Highways, ports, workers, etc.)?

3. Capacity
    a. What did you want the OLC to do?
    b. How was the total size of the OLC calculated?
    c. What were important issues to think of?

4. Layout
    a. What did you use as orientation for the set up?
    b. How was the layout of the OLC implemented?
    c. How did technology support the layout?
    d. How did equipment support the layout?
    e. Were value-adding activities (VAA) such as consolidation, final assembly, repacking considered and done? If so, how did the number of VAA influence capacity and layout?
    f. Which security measures were taken into consideration (guards, surveillance cams, etc.)?

5. Distribution applications
    a. How were you able to combine space requirements with distribution applications?
    b. How did RFID benefit efficiency and effectiveness of the working processes?
    c. How did WMS benefit efficiency and effectiveness of the working processes?
    d. To which extent was human labor involved or reduced?

6. Ownership:
    a. How could the ownership situation be described? What kind of ownership?
    b. Which situation was more preferable outsourcing or do-it-yourself?
    c. How did it influence the planning and execution phase?
    d. Did the ownership situation change over the lifecycle?
    e. Who was taking over the risk of ownership for the OLC (the company, the Olympic committee, the region, etc)?
    f. What happened afterwards?

7. Personal comments:
    a. Which challenges did you face during the Games? Give reason and/or examples?
    b. How were complaints handled? (What happens in emergencies, e.g. if equipment is missing?)
    c. How would you compare "your" Games to previous or following ones with regard to logistics centers and there functioning?
    d. What could have been done better? Learning's? Recommendations?
    e. What could have been or might be challenges for other Games?
    f. What is your opinion about the importance of the Games and their influence on the local economy as well as the country's economy?