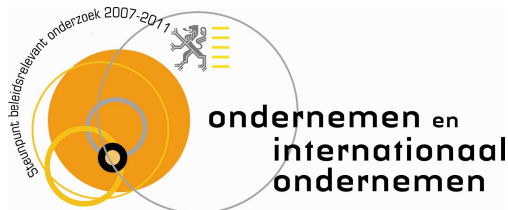


## A TYPOLOGY OF DISTRIBUTION CENTRES IN FLANDERS

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## **1. Introduction**

Belgium is situated at the heart of a dense important economic market. It excels at crucial economic factors such as accessibility and low land prices. As a consequence, the transport and logistic sector has become a crucial cornerstone in the Belgian economy (Sleuwaegen and Van Dierdonck, 2002). According to Cushman & Wakefield (2004), Belgium, and especially Flanders, ranks even as the top country in Europe to operate a distribution centre. However, the potential of Central and Eastern European Countries as key markets in an enlarged EU is increasing rapidly (Roland Berger, 2003). Therefore we need to attract new and retain existing distribution centres to Flanders. However, not all types of distribution centres are equally interesting as economical activity in a region. Distribution centres create employment and as such add to the wealth of a region. On the other hand they generate transportation, which puts a burden on a region.

The goal of this research is to understand the opportunities for Flanders to attract new distribution centres and to help companies further develop their logistic activities. By analyzing the location factors and the characteristics of the distribution centres in Flanders, we aim to obtain a footprint of the current situation and to develop a typology of logistic real estate. This will enable us to understand which types of distribution centres are situated in Flanders, which ones have the biggest opportunity to survive in Flanders, and which ones are the most beneficial to attract to Flanders.

## **2. Overview of the research project**

The first step in our project has been to review the literature. The objective of the literature review has been to identify existing taxonomies of distribution centres, and to compile a comprehensive list of characteristics of distribution centres. These characteristics will be translated into a questionnaire that will be used in the second, empirical phase of the research. The survey will allow us to identify the different types of distribution centres present in Flanders. In a later phase, it can be used to benchmark Flanders against some other regions.

Quite some research has been done on the strengths (and weaknesses) of Flanders as a region for logistic activity. Our literature review summarizes the main insights from those research studies. It will allow us to confront the needs of distribution centres with the strengths of Flanders, thus offering insights into how Flanders can attract other types of distribution centres that add value to the region.

This paper reports on the literature study that has been conducted. The literature review has focused on three main aspects:

- identifying existing taxonomies/typologies of distribution centres
- identifying the characteristics (other than those underlying the existing taxonomies/typologies) of distribution centres
- identifying the strengths and weaknesses of Flanders with respect to the requirements of distribution centres

### 3. Taxonomies/typologies of distribution centres

The following taxonomies have been found in the literature:

- Sleuwaegen (2002) divides the distribution centres in national, regional and European distribution centres:
  - He defines a national distribution centre (NDC) as a distribution centre that delivers to customers in a single country.
  - The term regional distribution centre (RDC) is used when the goods are delivered to customers in two to four countries.
  - The warehouse is called a European distribution centre (EDC) when the goods are delivered to five or more European countries.

Before the foundation of the European Union it was common practice for companies to operate national production plants and distribution centres due to the customs regulations, product characteristics and market diversity. These national distribution centres delivered to customers in a single country. As a result of the restructuring due to the liberalization of the markets and the deregulation with the arrival of the European Union, the necessity to operate national production plants and national distribution centres disappeared and these activities were exploited on their natural centralization level. These relatively small NDCs were replaced by bigger warehouses.

- According to Witlox (2000), five categories of EDCs can be distinguished:
  - Overseas EDCs distribute goods coming from overseas production plants (outside Europe) on the European market. These EDCs often do important value added activities.
  - Product-oriented EDCs distribute goods coming from European production facilities onto the European market. These EDCs are often located next to the production facility.
  - Mixed EDCs distribute goods coming from both overseas and European production facilities, in more than five European countries.
  - Spare parts EDCs distribute spare parts from both overseas and European production plants in Europe. When these spare parts are critical, the EDCs are most of the time located next to an airport.
  - Shared EDCs are shared by different companies. They contain products from one or more multinational companies.

Witlox thus uses a combination of criteria underlying his classification of distribution centres: the region of origin of the goods (inside versus outside Europe), the type of goods (end products versus spare parts) and the number of users of the distribution centre (single versus shared).

- Notteboom (2004) classifies distribution centres in two categories based on their activities:
  - Distribution centres that are purely focusing on the traditional functions (warehousing and distribution).
  - Distribution centres that combine these logistic functions with manufacturing activities (value-added activities).

It is striking that the literature on distribution centres, contrary to the literature on manufacturing plants, offers few typologies that help managers to design and manage their logistic network. There is a quite rich literature on manufacturing plants, offering different classifications of plants. Hayes and Schmenner, for example, identify three different types of plants, based on their specialization or “focus”: product focused plants, producing a limited part of the product range; market focused plants, producing a broad range of products for their local market; and process focused plants, focusing on a single phase in the supply chain (Hayes and Schmenner, 1978). Ferdows discusses the strategic role of plants in manufacturing networks: his typology departs from the observation that the location of the plant offers capabilities to the network; secondly, he observes that the activities carried out in plants range from production activities to more knowledge creating activities. The combination of those two criteria result in six different types of plants, which he labeled off-shore plants, source plants, servers, contributors, outposts, and lead plants (Ferdows, 1997). Vereecke et al. developed a typology that classifies plants according to the position they take in the network of know-how in the company: from isolated plants to active network players (Vereecke et al., 2006).

These different typologies of plants offer frameworks to the manager who has to design his or her manufacturing network. They allow him to make a “footprint” of the network, and to assess whether the network has the required degree of focus and balance. The literature on distribution centres lacks a comparable set of typologies, and thus fails to offer such assessment frameworks.

It is therefore our objective to study the existing distribution centres in depth, and to develop a typology of distribution centres based on empirical data. In order to be able to do so, we need a comprehensive list of factors identifying distribution centres. In what follows, we will compile this list, based on the existing literature.

Since this literature study serves as the basis for a survey that will be set up in a second stage of our research project, we report on the literature with this survey in mind. In the remainder of this paper we will discuss these characteristics more in detail and define proper ways how to measure them.

#### **4. Characteristics of distribution centres**

The typologies mentioned earlier classify distribution centres according to the geographical scope of the market they serve (national, regional, European) and the scope of activities carried out in the distribution centre. There are several other variables that characterize distribution centres, which may be interesting as distinguishing factors between different types of distribution centres.

We have therefore “scanned” the logistics literature in order to compile a comprehensive list of characteristics of distribution centres. In what follows, we have structured this list of characteristics into three categories:

*a) Design characteristics of the distribution centre*

This group of characteristics describes the distribution centre as it has been designed. The design of the distribution centre is considered as fairly stable and difficult to change in the short term. It sets the constraints within which activities can be developed.

*b) Current activities in the distribution centre*

In the second subdivision we have grouped all the characteristics that are related to the current activities of the distribution centre. These characteristics will give an impression of the operations as they are currently carried out.

*c) Future potential of the distribution centre*

The distribution centre may have some unique resources, competencies or design advantages that are not yet exploited in the current activities, but that offer potential for future activities. We have labelled these characteristics “future potential of the distribution centre”.

#### **4.1. Design characteristics of the distribution centre**

The identity of the distribution centre can be defined as its location, its age, its owner and the “nationality” of its owners. The VAT number will also be asked in order to be able to link the data from each distribution centre with data from other databases.

In line with the model developed by Ferdows for manufacturing plants as discussed earlier, an important element in the description of the distribution centre is the strategic advantage offered by its location. A first location advantage can be the access offered to low cost input factors. That is, the cost of labour, the cost of land and/or the building cost in the region. Other strategic reasons for exploiting the distribution centre in a certain region can be: minimisation of the distance to the suppliers or the market; a high availability of labour, skills and know-how; the presence of an advantageous socio-political climate; or it may be to capture market share from competitors (Vereecke, 2007). The accessibility of the distribution centre is influenced by the presence of an airport, seaport, pipelines and dense network of roads and highways (ProLogis, 2004) in combination with its degree of congestion (Cushman&Wakefield, 2006). An important location advantage for a warehouse can be the proximity to other units of the mother company, such as a production plant, headquarters or a call center. In this respect, it is important to know the timing of the investments. Research has shown that a distribution centre often is the first step into a region, and is often followed by investments in activities that bring more employment to a region, such as administrative offices or production facilities (Sleuwaegen, 2002).

An important design characteristic of the warehouse is its scale. There are multiple ways to define and measure the scale: the surface area of the warehouse, the volume of the warehouse or the number of docks for loading and unloading.

Several technical characteristics are important in describing the infrastructure of the distribution centre: the degree of floor flatness of the warehouse, the floor loading capacity, the presence of atmosphere control or temperature control and the level of security of the site and the goods. Flat floors are helping companies and logistics providers to maximize the number of inventory turns during a year. Workflow analyses on a number of warehouses indicated indeed that variations in the floor gradient impaired the truck's ability to find and pick the right product and even decreased the number of accidents where the vehicles collided with the racks (Frasca, 2003). Temperature control is required to store food (Terrerri, 2007) and atmosphere control can be used to hasten ripening or extend the season of several fruits (Cobe, 2007).

Warehouses can be described in terms of the technologies that are installed:

a) Material handling technologies

The material handling technologies can be divided into conventional and automated handling methods. The advantage of using a conventional method is its flexibility, simplicity and the lower investments required compared to automated handling methods (Van Zele, 2007). Automated storage and retrieval systems (ASRS) are used more frequently nowadays. The main advantage of ASRS includes maximum cube utilization, precision accuracy and greater efficiency (Terrerri, 2007). Mechanization also includes some pitfalls: the technical focus becomes more important than the overall flow vision and a problem occurs if the necessary capacity is higher than the available one.

b) Tracking and tracing technologies

Tracking and tracing can be installed between two companies within the supply chain, in the warehouse or both (Johnson, 2007). Multiple systems are available for tracking and tracing: barcode, RFID, RTLS and GPS. Barcodes are well-known and can be printed by modestly priced printers at very low cost. Radio frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags. These tags are objects that can be applied to or incorporated into a product for the purpose of identification using radio waves. These tags can be read from several meters away and beyond the line of sight of the reader. The cost of RFID is much higher than the one for barcodes (Mills, 2007). Real-time location systems (RTLS) are capable of providing real-time location information as it is programmed to broadcast a signal identifying its location at regular time intervals, in contrast with an RFID tag that is only identified when it passes by a reader (Trebilcock, 2006). A final tracking and tracing technology is the global positioning system (GPS) that uses satellite connections (Macharis, 2004).

The goods can be tracked and traced by an automated order picking system such as "pick-to-light" and "voice-pick". When using "pick-to-light" a light illuminates on the rack where the operator needs to take products. The advantages of this system are an increase of the order picking speed and the fact that this system is paperless. When using "voice-pick" the operator wears a headset that is linked to a central computer system. Through the headset, the computer tells the operator to which rack he should go. A check digit is written on the rack and read out loud by the operator. In this way the computer is able to check if the operator is standing at the correct rack and can tell

the amount of products that the operator should take. The main advantages are increasing productivity, the fact that this is a paperless system and the quality increase due to the check digit (Van Zele, 2007).

#### c) Information and communication technologies

Information and communication technologies (ICT) may be defined as “electronic means of capturing, processing, storing and disseminating information” (Duncombe, 1999). It is suggested that passing information to all businesses in the supply chain via ICT will improve performances (Disney, 2004). Examples of information and communication technologies that can be used are Electronic Data Interchange (EDI), Warehouse Management System (WMS), Internet, e-commerce, Electronic Order System (EOS), Mobile Data Communication (MDC), Freight and Fleet Management System, Container Storage Planning System, etc. (Feng, 2006).

#### d) Safety technologies

Warehouses present a particular fire risk to local communities and a major fire could have a devastating effect both economically and environmentally. Warehouses can choose for passive fire protection methods such as robust fire rated products to construct the building or active methods such as sprinklers to control and extinguish the fire. These sprinklers can be installed in the roof or in the rack. In-rack systems are installed when the height of racking systems exceeds that which can be protected by roof sprinklers only (Mc Cafferty, 2006).

## 4.2. Current activities in the distribution centre

The warehouse can focus its activities on a certain product, product group or industry sector. Examples of industry sectors that typically use dedicated warehouses are automotive, chemicals, consumer goods, electronics, food, mechanical engineering, pharmaceutical, retail, etc.

The products that are stored can be defined by their type, value density and weight, unit of handling, shelf-life and the number of stock keeping units (SKUs) that are held at the warehouse.

- Different types of goods are raw materials, semi-finished goods and finished goods, and spare parts.
- Value density is described as the value to cost ratio ( $[\text{Product value (€)}] / [\text{Chargeable weight (kg)}]$ ). Some examples of value density are 0,02 for coal and 18.000 for gold (Lovell, 2005).
- The units of handling can be a container, a pallet and bulk, and goods can be stored on pallets, racks, the floor (inside or outside) or in a tank or silo.
- The shelf-life of the products is important as products with a short shelf-life require fast rotation. Shelf-life is the time that perishable items are given before they are considered unsuitable for sale or consumption.

The volume of the current activities in the distribution centre can be measured by the flow of goods (measured in number of tons, number of pallets or inventory rotation), the turnover (in €) and the number of employees (white/blue collar, management and interim) that are working in the warehouse.

The geographical scope of the warehouse can be defined by the number of countries from where the products are sourced and to which the goods are being delivered. Depending on the number of countries from where the products are sourced we can talk about national, continental and global sourcing. Similarly, warehouses can be classified according to the geographical markets they serve, thus distinguishing between national, continental and global distribution.

Based on the markets that are served, the warehouses can also be divided into business-to-business (B2B) and business-to-customer (B2C) warehouses. A B2C distribution centre gives the end users the possibility to come and collect the products themselves, all other distribution centres are B2B distribution centres. If the warehouse is in a B2B environment, it is interesting to know what the position of the distribution centre in the total supply chain is (first tier, second tier, third tier, etc.), whether it plays a central role in the supply chain and whether it delivers goods to companies that are owned by the same group or not.

Different transport modes can be used to bring the goods towards the warehouse and to deliver them to the customers: air cargo (air), international or inland navigation (water) or truck or pipelines (land).

Distribution centres also differ in terms of the activities carried out by the operator. The activities can be divided in four categories:

- Order management refers to the administrative office in the warehouse that takes care of order intake, forecasting, supplier selection and invoicing.
- Transportation (inbound and outbound) can be planned and executed by the warehouse or alternatively by other parties in the supply chain.
- Warehousing activities that can be executed in the distribution centre are storage, sorting, consolidation, order picking and inventory management.
- Value-added logistics (VAL) can be described as the combination of logistic and simple industrial actions that take place before the final distribution of the products. Low-end VAL activities add little value to the goods; this is for example adding parts or manuals, making the products country- and customer specific, ticketing and testing of the goods. Final assembly and product repair are typically high-end VAL activities (Notteboom, 2004). The main advantages of VAL are the increased flexibility in order to satisfy unique customer demands and the elimination of excess inventories of similar products.

The inventory can be managed by the vendor. As the name implies, vendor managed inventory (VMI) is an arrangement under which the supplier, not the customer, decides how and when to replenish the customer's inventory (Cooke, 1998). In general, the warehouse owns the goods in its inventory, except in the case of consignment stock. This is stock that is held at the site of the purchaser, who only buys the goods and becomes the owner at the moment of putting them into use (Huyghebaert, 2006).

The operations in a distribution centre can be executed by the owner or by a third party. There can be several reasons for outsourcing the distribution activities to a third party: the ability to focus on core competencies, improved management, increased flexibility, on-time deliveries, reduced lead times, reduction of operating or fixed costs, shared risks and access to global markets, communication technologies and logistic skills (Vlerick Leuven Gent Management School in cooperation with S&V Management Consultants, 2001).

Distribution centres also differ in terms of their degree of collaboration with other units. Two types of collaboration can be distinguished: vertical and horizontal collaboration. Vertical collaboration is collaboration between subsequent parties in the same supply chain i.e. suppliers, manufacturers and customers. Horizontal collaboration is collaboration between companies in the same market. They form alliances, partnerships and virtual organizations in order to collaborate in some markets and reduce the number of competitors. The main advantages of collaborative networks are optimization of capacity and assets utilization, cost savings and improvement of the margins of logistic carriers (Van Breedam, 2007 and Ragusa, 2007). Collaboration is often supported by ICT. The main purpose of the ICT collaboration is to give a transparent overview of the flows of goods in the logistic network. (Van Breedam, 2007). Unfortunately this assignment is easier defined than implemented due to a lack of standardization, diversity of applications and necessity of interconnectivity (Rome, 2004).

### **4.3. Future potential of the distribution centre**

We have discussed the current size of the distribution centre as one of the design characteristics. Closely related to this design characteristic is the area that is available for the potential future expansion of the distribution centre.

A warehouse can also have extra potential due to the high skill level of its employees. The skill level of the employees in the distribution centre is an indicator of the future potential of the distribution centre. For example, technically skilled people are required in case VAL-activities are to be developed (Van Breedam, 2007).

Distribution centres will need certifications in order to obtain permission to carry out certain activities. As such, they can be crucial for the current activities on the site. They can also be seen as a source of competitive advantage, since they can offer the potential to attract new business into the distribution centre. Some of the most common certifications are:

- The environmental licence is the combination of an exploitation licence with all other environmentally related licences. Vlarem I lists all activities for which a licence is needed; who needs to request the licence and to which government you should address yourself to request the licence. Each company that practices activities listed in Vlarem I is obliged to fulfil several conditions. The conditions are bundled in the Vlarem II norm (Argusmilieu).

- HACCP are guidelines in order to develop, implement and maintain a food safety program (Stier, 2005). All food manufacturers, caterers and food distributors in the European Union are obliged to meet the EU regulations regarding HACCP systems (Szeitzne, 2004).
- The International Standards Organization (ISO) writes down which conditions need to be fulfilled by an organization in order to receive ISO certificates. The ISO 9000 certificate for Quality Management and the ISO 14000 certificate for Environmental Management are not obliged, but some organizations only work with companies that are ISO-certified.
- European Hygienic Engineering and Design Group (EHEDG) writes, from the industry, the norms to which the machines used in the food sector should comply in order to admit hygienic production. The purpose of these guidelines is to create a cooperative relationship between the food companies, the machine building company, the government and the research organizations in order to promote hygiene during the processing and packaging of food.
- All companies that hold a manufacturing authorization for medicinal products for human use, will be obliged to use active pharmaceutical ingredients (APIs) manufactured following Good Manufacturing Practice (GMP) guidelines. The definition of manufacturers includes in this case also the "partial manufacturers" such as agents, importers, repackers and relabellers.
- The ISO/TC 92/SC4 guideline concerns the basic elements of fire safety design in a chemical warehouse: construction design (separated compartments, escape routes, smoke ventilation and fire fighting water), model fires and fire simulation, storage layout and packaging, preventive and protective systems, building location and safety distances (Hietaniemi, 1997).
- ADR (Accord européen relatif au transport international des marchandises Dangereuses par Route) is the title of a European pact that describes rules for the international transport of dangerous products across roads. The products that require an ADR-licence are listed and can be found at the website of the Belgian federal government for mobility and transportation (FGOV, 2006).

## 5. List of the characteristics of the distribution centre

**Table 1: Design characteristics of the distribution centre**

<b>Characteristic</b>	<b>Characterizing variable</b>	<b>Options</b>
Identity	Location Age Owner Country of origin VAT number	
Location advantage	Reason for exploiting the DC in the region  Cost of land (€/m <sup>2</sup> ) Building cost (€) Accessibility  Other investments in same region	Low cost input factors Proximity to suppliers Proximity to market Labour availability Availability of skills and knowhow Socio-political advantage Proximity to competition  Access to airport, seaport Dense network of roads Pipelines Traffic bottlenecks Before/after the establishment of the DC
Scale	Surface area (m <sup>2</sup> ) Warehouse volume (m <sup>3</sup> )	
Infrastructure	Number of docks Super flat floor Floor loading capacity Atmosphere control Temperature control Secured	
Technology	Material handling  Tracking and tracing  ICT Safety	Conventional/automated Racking system (characteristics) Barcodes/RFID/RTLS/GPS Voice-pick Pick-to-light  Fire protection

**Table 2: Current activities in the distribution centre**

<b>Characteristic</b>	<b>Characterizing variable</b>	<b>Options</b>
Focus	Industry sector	Dedicated/mix
Products stored	# SKUs Type  Value density Weight (kg) Unit of handling/storage Shelf-life	Raw material, semi-finished, finished good Spare parts
Volume	Goods flow (ton, # pallets)  Turnover (€) Number of employees	Volume (ton, #pallets) Inventory rotation  White/blue collar Management Interim
Geographical scope in	National, continental or global sourcing	
Customers	National, continental or global distribution B2B/B2C Position in supply chain Same group/independent customers	Countries served  If B2B: Tier?
Transport mode out	Air, water or land	
Transport mode in	Air, water or land	
Activities	Order management  Transport  Warehousing  Value-added logistics	Order intake Forecasting Supplier selection Invoicing Transport execution Fleet management Transport planning Storage Sorting/consolidation Order picking Inventory management Final assembly or kitting Customization Labelling Quality inspection Testing/repair of products After sales support
Inventory management	VMI Consignment stock	
Operator	Owner or third party? Single/shared	If outsourced: to whom/why?
Collaboration	Vertical collaboration Horizontal collaboration	

**Table 3: Potential characteristics of the distribution centre**

<b>Characteristic</b>	<b>How to measure</b>
Potential for expansion	Available Greenfield (m <sup>2</sup> )
Skill level	Educational background employees
Certification	Vlarem HACCP ISO 9000 ISO 14000 GMP EHEDG ISO/TC 92/SC4 ADR Others

## 6. Strengths and weaknesses of Flanders

Healey & Baker (2001) identify four categories of characteristics that compare the attractiveness of regions for logistic activities: Costs, transportation system, accessibility of markets and supply of property. In what follows, we will discuss how Flanders scores on these four aspects.

- Rental costs are rather low in Flanders compared to other submarkets such as London and Stockholm. On the other hand, land prices and labour costs are among the highest of the European locations (Cushman & Wakefield, 2006).
- The transport system: Flanders is a top location concerning road and rail density, but needs to pay attention to the increase in road congestion. Thanks to the presence of the ports of Antwerp and Bruges and the airport of Zaventem near Brussels, Flanders ranks as a region with a prime transport system (Healey & Baker, 2001).
- The accessibility of the markets is characterized by the population density, access to the European core and access to Eastern Europe. Due to its central location in Western Europe, Flanders ranks first concerning the access to the European core (Healey & Baker, 2001). Within a radius of 750 kilometres around Belgium, 75% of the European GNP is created and 227 million consumers are living (FFIO, Eurostat, 2002). Thanks to this elevated population density and the high purchasing power that these people enjoy, distribution centres that are located in Flanders are situated in the heart of a huge market. For companies that want to distribute on Eastern European markets, however, Flanders' geographical position is less attractive.
- As the availability of Greenfields in Flanders is constantly decreasing, it becomes more difficult and expensive to find land and less newly built units are seen. Moreover, planning authorities in many Western European locations are increasingly loathe granting permission for distribution centres, based on the impression that this function increases traffic and does not create many jobs (Cushman & Wakefield, 2006).

Next to the above mentioned criteria, labour characteristics and the availability of know-how can also be taken into account. Flanders should be aware of the facts that nearby regions such as Ile de France and Saarland have a higher productivity per worker, and a higher availability of workers. In terms of the know-how, Flanders ranks first in Europe due to the knowledge of foreign languages and the presence of logistic trainings (Jacobs, 2004).

To conclude, we can state that Flanders retains its first position on the Cushman & Wakefield comparative ranking for distribution locations, thanks to its low rents and excellent accessibility. Nonetheless, Flanders also suffers from a lack of land in prime areas and a congested road system (Cushman & Wakefield, 2006).

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