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# OCCUPIER'S SATISFACTION WITH TECHNICAL STANDARDS OF MODERN INDUSTRIAL PROPERTIES IN THE CZECH REPUBLIC

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Jaroslav Kaizr graduated from the University of Economics in Prague in 2003 and joined Cushman & Wakefield in the same year. Jaroslav graduated from Sheffield Hallam University, Faculty of Development and Society in 2009 and became the Member of Royal Institution of Chartered Surveyors in 2010. Barry is a Chartered Surveyor through the academic route of the Royal Institution of Chartered Surveyors (RICS). He has been at Sheffield Hallam University for fourteen years where he teaches on both undergraduate and postgraduate programmes. Barry area of specialism is Corporate Real Estate. Barry has a research interest in new ways of working and office evaluation. An area of specific interest is the affects the office environment has on occupiers' productivity. David Parsons is a Chartered Surveyor and Town Planner. He began his career working for the public sector finally specialising in economic regeneration. He then became Director of a consultancy advising private companies on development projects. For the last twelve years he has been a Senior Lecturer at Sheffield Hallam University where he teaches on the Real Estate courses and addresses international conferences on research projects into social and economic issues associated with cities and the built environment.

Modern industrial facilities tend to use a similar set of technical specifications though they accommodate tenants in a wide range of businesses. This paper presents the results of an empirical study of occupiers of leased modern industrial property in the Czech Republic which assesses the extent to which these specifications meet their expectations and satisfy their requirements. This research analyses the results of a survey sent out to 179 occupiers of modern industrial facilities in the Czech Republic. Altogether 43 managers responded to the questionnaire, 29 in electronic version and 14 by interviews using the same questionnaire. Structural technical specifications (clear height, floor and column grid) are studied in detail from three perspectives: the satisfaction of occupiers, the importance for occupiers and the adequacy. Six other non-structural technical specifications are studied from the perspective of adequacy and importance. Non-parametric (the chi-square) test is used to test the hypotheses of occupiers' satisfaction regarding rental levels, and the quality of the accommodation in the light of their expectations. The research identifies the key characteristics of the specification of industrial properties concerning occupiers and concludes that they are generally satisfied with their premises. However some suggestions have emerged for areas where design flexibility could be introduced to improve levels of satisfaction. These differ for manufacturing and logistics businesses. Rental levels are found not to have a significant effect on satisfaction while the prior expectations of occupiers affect their perceptions. The implications for the provision of new premises are considered in the conclusions.

Keywords: industrial property, logistics, manufacturing, satisfaction, technical specifications.

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## **INTRODUCTION**

Industrial property is, according to Holmes (1948), a property which is used for the conversion of materials into finished manufactured products including warehouses and minor processing plants. Industrial property is one of the factors that support economy and its growth. Ambrose (1990, p356) defines industrial property as light manufacturing and warehouse space containing varying amounts of office space, usually concentrated along major transportation routes and confined to light industrial/commercial complexes.

## **WHAT IS INDUSTRIAL PROPERTY?**

### **Czech industrial property market**

Based in the heart of Europe, the Czech Republic is considered together with other CE countries to be a good location with strong prospects for both logistics and manufacturing (Thompson, 2005). Cushman & Wakefield's most recent European Distribution Report (2008) ranked the location of the Czech Republic as the 4th best out of 25 European countries.

As a result of 40 years long communist reign in the Czech Republic most of the existing industrial properties built in the early 90's has become obsolete and unsuitable for modern use. The earliest modern industrial buildings were developed in the second half of the 90s as owner occupier facilities for foreign companies entering the new open economy in Central Europe. The first modern facilities for lease were developed in 1998 in the Prague region. Since that time, the industrial market has expanded beyond the borders of the capital and today, modern industrial buildings for lease are available in all major regions.

### **Czech industrial property stock**

The Czech Republic has experienced steady growth of modern industrial space in recent years, as seen in Figure 1. By the first quarter of 2009, there over 3.178.000sqm of modern industrial facilities was built in the Czech Republic, Figure 1, of which over 1.569.000sqm is located in the greater Prague area. From 2006 till the end of 2008 the growth of warehouse stock was driven by speculatively built facilities. The vacancy rate on the Czech industrial property market grew and the rate is at present at the level of 15.5%, according to the latest industrial real estate market report from Cushman & Wakefield (Q1/2009). This translates to about 492,000sqm of vacant industrial space and about 2,686,000sqm of occupied industrial space. In recent months developers stopped speculative construction as the take up on the market slowed down, vacancy has grown and financing of industrial developments became difficult to be obtained without a pre-lease.

There are 6 major developers of facilities with units larger than approx. 1,000sqm on the Czech industrial real estate market: CTP, ProLogis, VGP, SEGRO, Panattoni and Pinnacle. Together they have about 80% share of the market and use similar technical specifications (Figure 2).

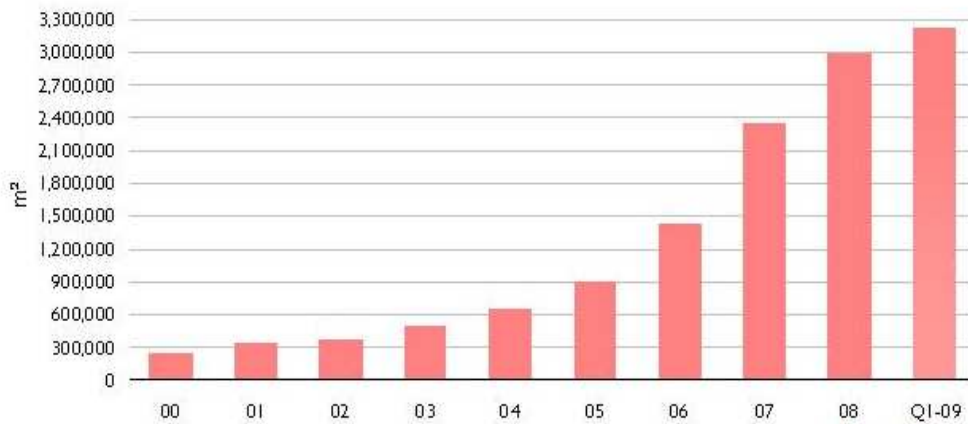
### **The technical standards of industrial facilities**

Ambrose (1990, p367) concludes that the most important technical aspects determining the property asking price are:

- Building size and layout
- Loading docks and drive ins
- Sprinklers and fire prevention installations
- Office and sanitary content (size and built-to-suit)
- Rail siding

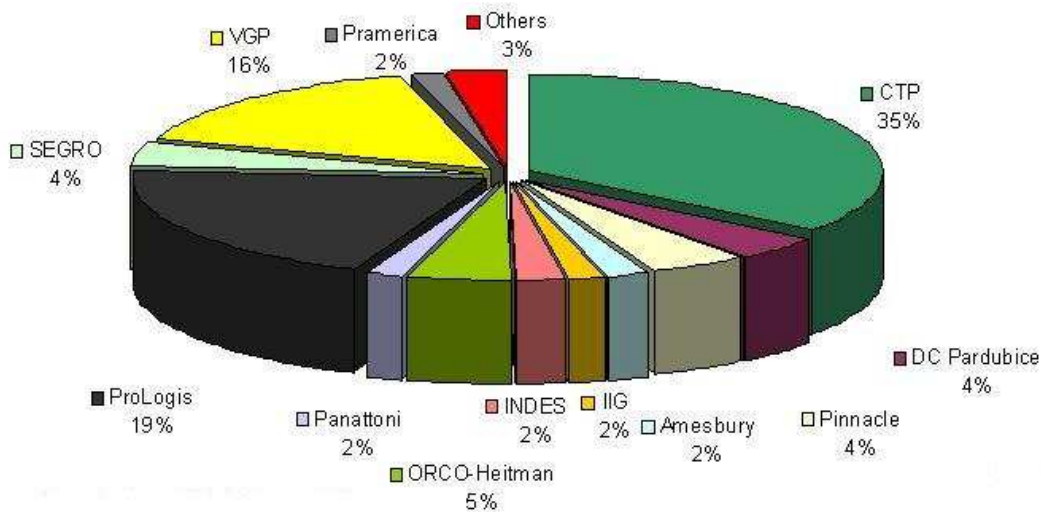
According to Ambrose (1990, p367) the presence of a sprinkler system, the building's age and ceiling height does not appear to have an impact on the property value. Fehribach et al. (1993, p375) believe that industrial property values are effected by building size, age, office content, ceiling height and number of dock doors. Tsolacos et al. (2005) in accordance with the above statements concludes that physical factors are among the key factors of industrial property value.

**TOTAL STOCK Q1/2009**  
**3 178 783 sqm**



**Figure 1 Total stock of industrial space for lease in the Czech Republic (Cushman & Wakefield, May 2009)**

**Developers market share by Take Up 2008**  
**TOTAL 574 015 sqm**



**Figure 2 Developers' market share in the Czech Republic by take up in 2008 (Cushman and Wakefield, May 2009)**

The Czech industrial market is young but the technical standards and the business terms institutionalized over time are designed to allow maximum value in respect of flexibility of the space for occupiers.

## THE SPECULATIVE CONSTRUCTION

Logistics and distribution companies do not have overly specific accommodation requirements (Henneberry, 1991a, p213). Henneberry (1991a, p214) postulates that speculatively built facilities are not necessarily designed to minimum standards and are built to a perceived average to achieve flexibility of use. New construction techniques allow for the development of adaptable, inexpensive, single storey light industrial buildings and shorter construction periods permit more flexible adjustments (Henneberry 1991a, p213). These techniques allowed the developers to build on speculative basis without having pre-lets from tenants.

### The database of occupiers in the Czech Republic

By the first quarter of 2009 there were 280 occupiers of units bigger than 1,000sqm in 46 existing parks bigger than approx. 5,000sqm throughout the Czech Republic. Figure 3 shows a map of the Czech Republic with locations of modern industrial parks for lease.

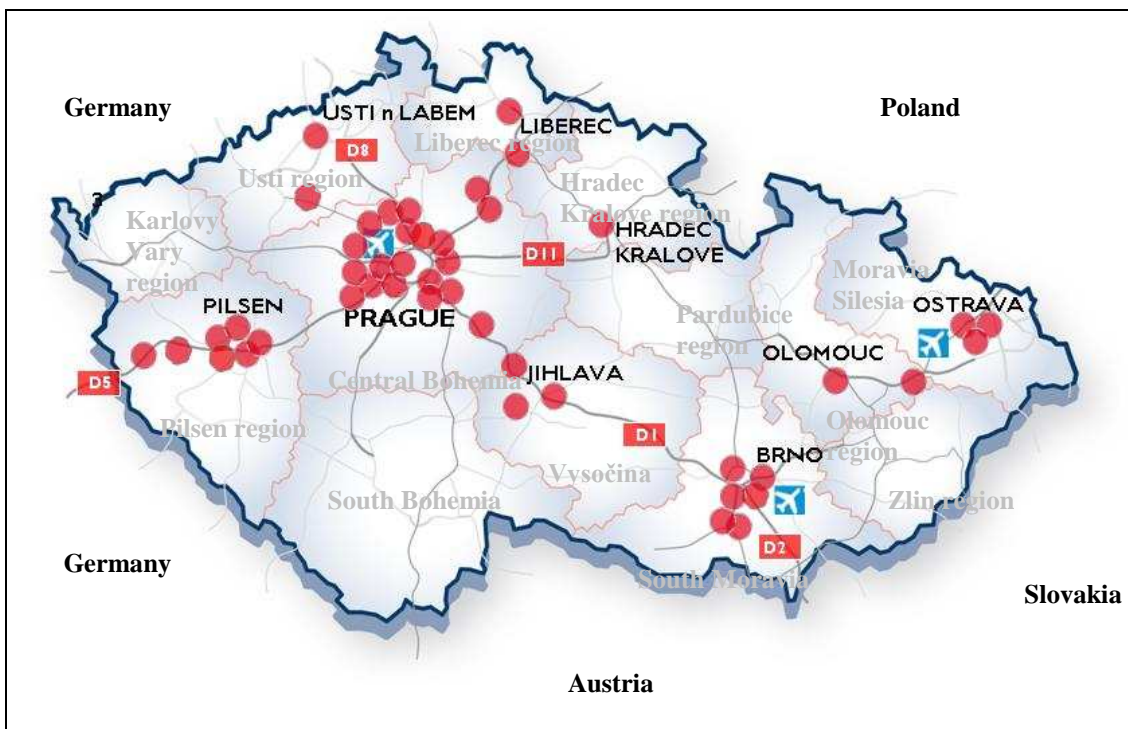
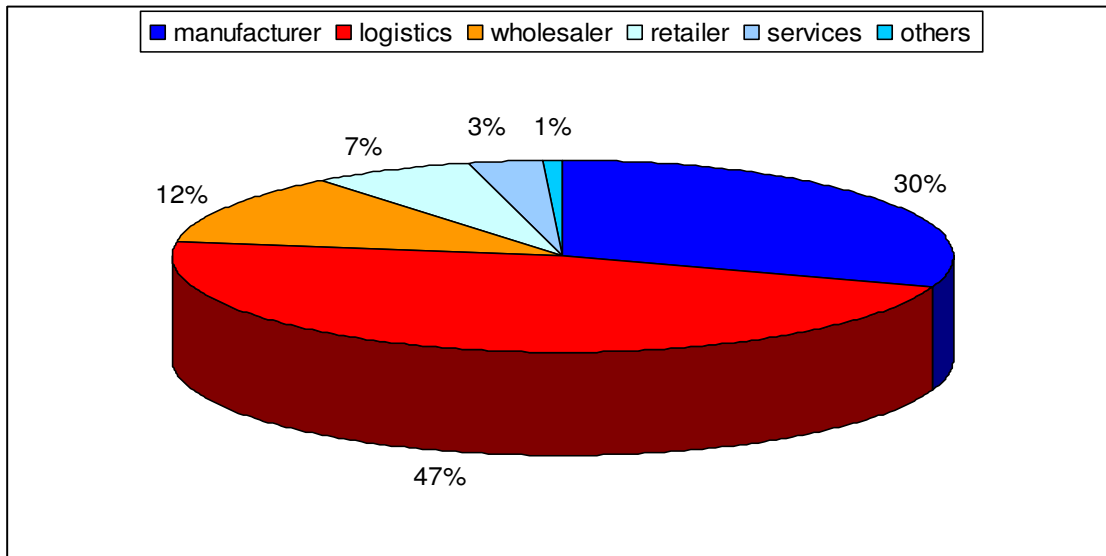


Figure 3 : Map of the Czech Republic with industrial parks (Cushman and Wakefield, May 2009)

The majority of the industrial space is occupied by logistics companies (47%) followed by manufacturers (33%), wholesalers (12%) and retailers (7%). The rest of the space is occupied mainly by other service providers and repair centres (Figure 4). Sixty seven percent of the occupiers use their premises for warehousing purposes, 33% of the occupiers use their leased premises for manufacturing related purposes (Figure 6).

### Main factors influencing occupier's satisfaction

Services provided by the landlord, business terms, quality of the facility, fulfilled expectations, location and other factors influence the satisfaction but in the end it is about the rent that the occupiers are willing to pay for the space. Tsolacos et al. (2005, p312) identified that occupiers are willing and afford to pay the rent subject to the profitability of their business and the standard technical specification must be in accordance with the net operating costs the occupiers will be able to achieve in the premises.



**Figure 4: Industrial space in the Czech Republic by occupier's business type (Cushman and Wakefield, May 2009)**

## LITERATURE REVIEW

While broader work on satisfaction and on technical specifications has been done there is a need to look in more detail at the relationship between the two to assess which aspects of the design is particularly significant for the occupier.

There is limited information about the Czech industrial property market generally and only one study organized by ATOZ Publishing (publisher of logistics magazine "Systemy Logistiky") in cooperation with real estate consultancy firm Cushman & Wakefield and statistics advisory firm STEM/MARK has been prepared regarding satisfaction of occupiers with industrial parks. The survey was based on questionnaire delivered to occupiers in 6 pre-selected parks (these parks were nominated by landlords). The main aim of this survey was to assess the overall satisfaction with pre-selected parks. The study concluded that occupiers are satisfied with overall technical standards of the pre-selected parks, but are not satisfied with level of services provided and generally with the parks. It did not provide in depth analysis of key factors of satisfaction.

In contrary the occupier satisfaction index (OSI) which is measured and presented in the UK annually by the Property Industry Alliance and Corenet Global UK is based on broader sample of properties. The UK OSI in 2009 was for the industrial property market at the level of 54 points where 100 points mean excellent, 80 points mean good and 60 points average. The index measures satisfaction of occupiers with performance of industrial parks and not satisfaction with technical specifications. There are 13 questions in the survey and none of them is related to technical specification.

Drury's (1977) classification of the types of production leads Henneberry (1991a, p216) to the conclusion that the higher the production plant intensity, the more frequent production plant change rate and the greater mechanical handling and services intensity, the more likely that the industrial facility will not be able to meet occupier's requirements. Based on the behavioural analysis Henneberry (1991a, p217) suggests that the managers opinion of the suitability will vary according to changes in factory's function, changes in firm's product or success/failure on firm's market or because of the technical changes in methods of production, changes in design of product, and changes in demand for product. Overall the longer the lease term the greater the need for change throughout the period of occupation. The life-cycle theory of product leads Henneberry (1991a, p218) to

conclude that the industrial property is likely to accommodate only first two stages of the product lifetime.

In 1988 Henneberry (1991b) surveyed 600 occupiers in Yorkshire and Humberside and analysed their responses. Two tests were made relating to the “fit” and “adequacy” of the unit. Henneberry defined “fit” as relation of the tenant to the amount of floor space required to pursue their business adequate concluding that bad fit tends to result from growth of the tenant’s business. In contrary “adequacy” was the function of the technical specification. Henneberry identified the supply side of the market as the main source of inadequacy. On the other hand the study did not provide information about what are the adequate technical specifications.

The above studies of Henneberry are focused on manufacturing companies. Thomson (2005) provided implications of further EU economic growth and regulation on specification of warehouses:

- connectivity (large amounts of data transferred and need for faster information flow);
- cross-docking (saves time and cost for warehousing);
- super flat floors (due to usage of automated warehousing systems);
- clear height (standard 10-12, trend to be 12m);
- span (30m span to be preferred in the future);
- security and fire protection: sprinklers, smoke detectors and fire doors becoming standard due to insurer led costs.

	CTP Log/Flexi	ProLogis	VGP	SEGRO	Panattoni	Pinnacle
Clear Height (m)	10/7	10	10	10.8	10	10
Floor load (t/m <sup>2</sup> )	5/5	5	5	5	5	5
Column grid	12m x 24m	11m x 22m	12m x.24m	11m x 22m	12m x 25m	12m x 25m
Direct access (sqm/1 DA)	4000/1500	5000	4000	4000	5000	5000
Docks with hydraulic ramps (sqm/1 HR)	700-1000	700-1000	400-1000	400-1000	400-1000	700-1000
Electricity	No standard	No standard	No standard	No standard	No standard	No standard
Skylights (%)	Min 4/8	Min 2	Min 2	Min 2	Min 2	Min 2
Lighting (lux)	300	200	300	200	200	200
Heating system	No standard	No standard	No standard	No standard	No standard	No standard
ESFR sprinklers	Yes/No	Yes	Yes	No	Yes	Yes

**Table 1 Comparison of technical specifications of major developers on the Czech industrial real estate market (Web sites and technical specification of respective developers including CTP, ProLogis, Pinnacle, Segro, Panattoni and VGP)**

Table 1 compares key technical specifications of main industrial developers in the Czech Republic. It is apparent from Table 1 that the basic technical specifications are similar. CTP has two different concepts of industrial design: logistics and so called flexi for manufacturers. ProLogis, Pinnacle and SEGRO develop standard warehouses and are less flexible to adjust the units to suit production

purposes. Panattoni and VGP built rather standard logistics facilities and are ready to change specifications to meet specific requirements of tenants.

In conclusion, the literature review shows that only limited research has been done on the subject of occupier's satisfaction with technical specification of industrial facilities and this research does not provide suggestions for newly constructed developments.

## SURVEY APPROACH

Since occupier's opinions on satisfaction with technical specifications have not been studied in previous research this project needed to be based on new primary empirical data. The opinions of the occupiers were the subject of the study so a qualitative attitudinal survey was used. The aim was to draw broad conclusion about the whole of the stock in the Czech Republic so it was necessary to include as wide a sample as possible. The number of potential respondents ruled out the use of interviews as the process would have been beyond the resources of the study and the diversity of response would have been difficult to analyse (Naoum, 2007, p117). A structured questionnaire based upon the key aspects identified in the literature review, informed by the authors experience and discussions with occupiers has therefore been used to gather the data. The questionnaire structure devised by the Author is shown in Table 2.

Section	Category	Type of questions
Structural technical specifications	- clear height - floor loading capacity - column grid	- factual question (checklist or open ended)  - importance (Likert scale)  - satisfaction (Likert scale)
Operational technical specifications	- direct access - docks with levellers - day light intensity - artificial lighting intensity - electricity capacity - heating system	- factual question (checklist or open ended)  - importance (Likert scale)
Questions on satisfaction	- in relation to the rent  - in relation to the experience with the facility  - in relation to expectations before start of the lease	Likert scale
Basic factual questions	- region - type of facility - size of unit	Checklist or open ended

**Table 2 Questionnaire design**



## Database of occupiers

There are 280 industrial units for lease bigger than approx. 1,000sqm in 46 locations/parks in the Czech Republic. Ninety one occupiers are manufacturing companies (32.5%), the rest (189) use their premises for logistics purposes (67.5%). Industrial units in the database can be split to following categories (see also Figure 5):

- 55 units from 1,000 to 2,000 m<sup>2</sup> (20%)
- 103 units from 2,001 to 5,000 m<sup>2</sup> (36%)
- 95 units from 5,001 to 15,000 m<sup>2</sup> (34%)
- 27 unit bigger than 15,001 m<sup>2</sup> (10%)

These 280 units are occupied by 225 different companies as some companies occupy more than one unit.

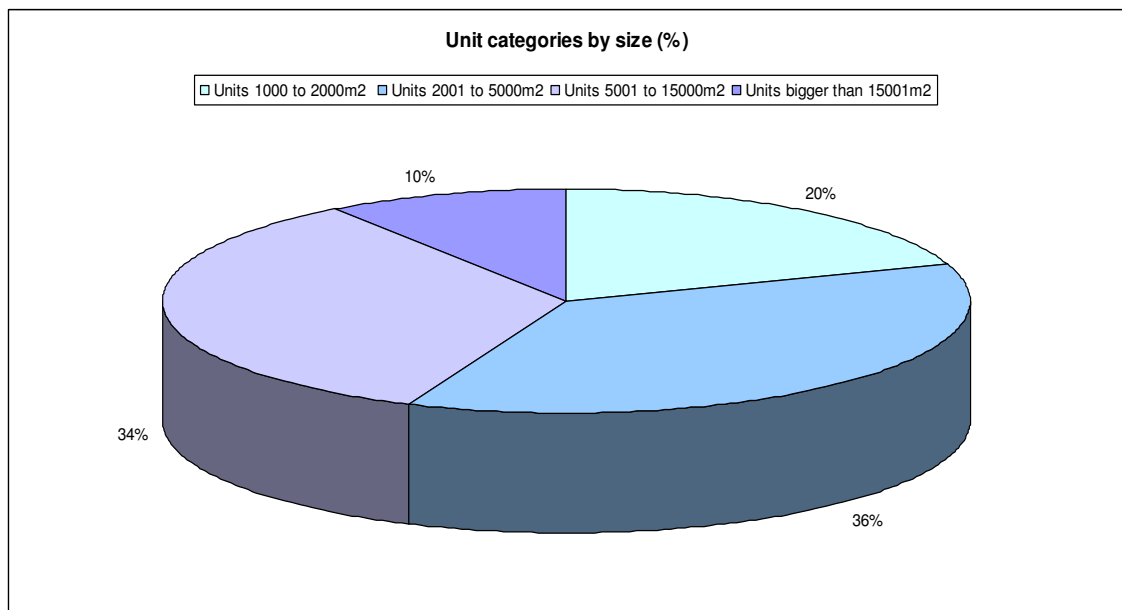


Figure 5 Distribution of the units in the database by size (Cushman and Wakefield, May 2009, N=280)

## Characteristics of respondents

Forty three responses were received, 29 responses via electronic questionnaire and 14 responses by managers filling in the questionnaire via interview. The response rate is 24% from the sample of 179 occupiers to which the questionnaire was sent and 17.7% among the total 225 occupiers in the Czech Republic. This is in line with response rate of other similar surveys (usually 19%-25%). With regards to the size of studied units, the respondents occupy approx. 318,000sqm of industrial space which means about 12% of all occupied space in the Czech Republic.

## Respondents by business type

Logistics companies form 46% of respondents and manufacturers 33% of the respondents. Retailers and wholesalers are the rest. This is in line with market situation.

## Respondents by unit use and building type

79% of the manufacturers who responded to the survey occupy standard units out of which 28% occupy units without extra installations. 21% of the manufacturers who responded occupy built to suit facilities. 65% of the logistics respondents occupy standard units out of which 62% occupy units without any extra installations. 35% of the logistics respondents occupy built to suit facilities. Logistic occupiers need less extra installations in the standard industrial units.

74% of the units used for logistics purposes are standard and 55% of these units are standard without any extra installations. 81% of units used for manufacturing purposes are standard out of which 69% are with extra installations. Based on the experience and on the interviews standard industrial units for lease rather fit to logistics purposes and can be used for manufacturing but must be adjusted. The overall majority of respondent occupiers are located in standard facilities (77%) out of which 55% are in standard units with extra installations.

### Respondents by unit size

Figure 6 shows division of the respondents by number in categories according to unit size. Most respondents are in the subgroup of units from 5,001 to 15,000sqm followed by respondents with units from 2,001 to 5000sqm. In comparison with Figure 5 this is in contrast to the other respondent subgroups (units from 1,000 to 2,000sqm and units bigger than 15,001sqm) are in line with the division of the whole database.

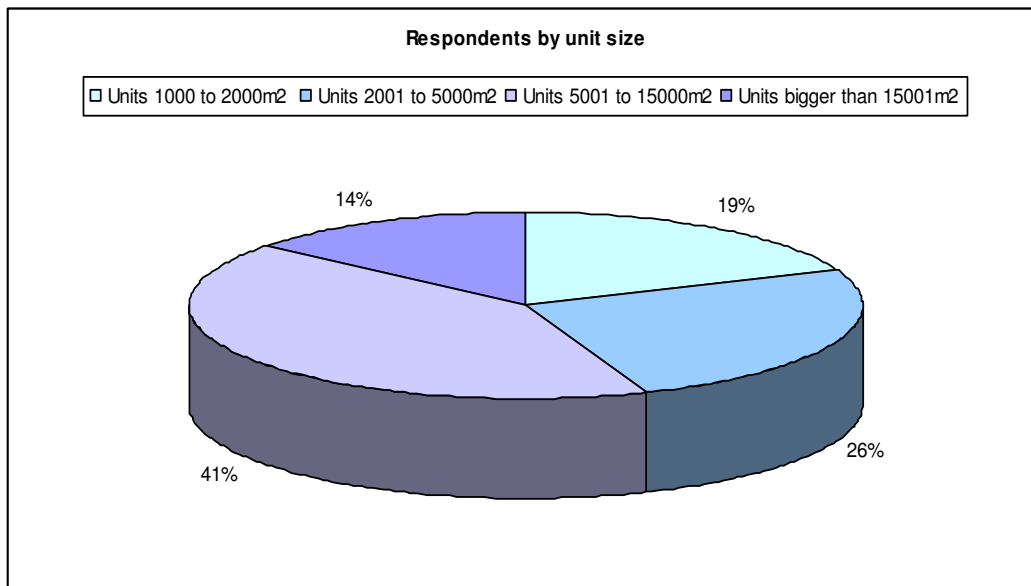


Figure 6 : Respondents by unit size N=43

Manufacturing units are mostly represented within the category 5,001 to 15,000sqm, logistics units are mostly represented within the category of 2,001 to 5,000sqm (Figure 7). Standard units with extras are mostly represented in the category of 5,001 to 15,000sqm which is mainly units for manufacturing use. Built to suits are mostly represented in the category of units bigger than 15,000sqm which are mainly units for logistics use.

### Analysis of the collected data

Satisfaction and importance for each technical specification is quantified as an average of received responses (points from 1 to 5 on the Likert scale representing scale from Dissatisfied to Very satisfied) and as a percentage of received points from the maximum points in total.

### Main hypotheses

The following main hypotheses are analysed:

"the type of unit use can have an effect on occupier's satisfaction with the key technical specifications of modern industrial facilities in consideration of the rental level."

The type of unit use can have an effect on occupier's satisfaction with the key technical specifications of modern industrial facilities in consideration of the expectations before start of the rent."

The type of unit use can have an effect on occupier's satisfaction with the key technical specifications of modern industrial facilities in consideration of the quality of the building."

“The satisfaction with basic technical specifications of modern industrial facilities in consideration of the quality of the building does not differ between occupiers with manufacturing operation and with warehousing operation.”

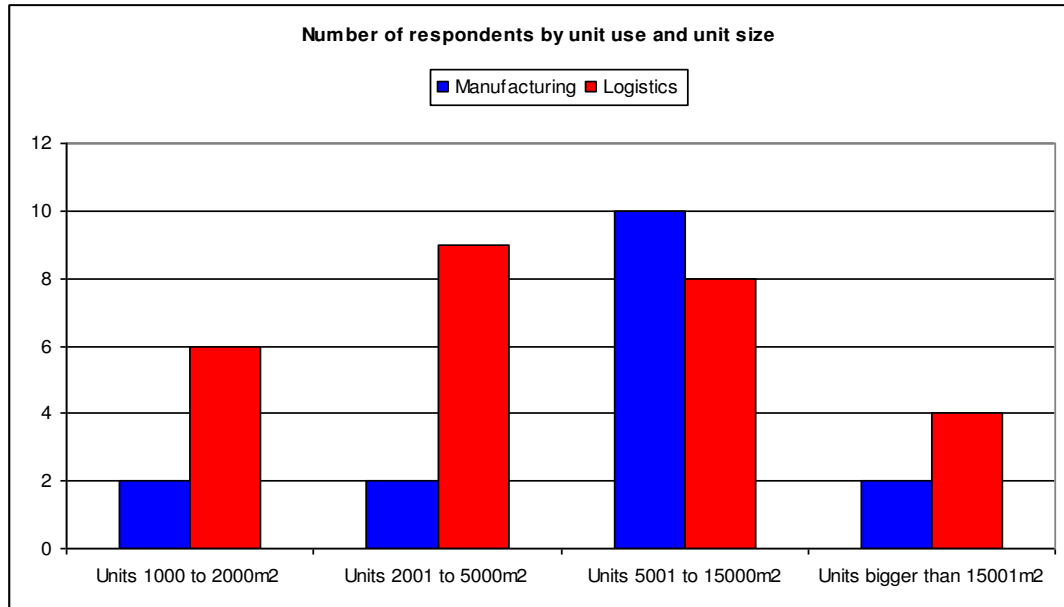


Figure 7: Respondents by unit use and unit size, N=43

Non-parametric (the Chi square) test is used to test the above hypotheses. Naoum (2007) suggests this test can be used in case the data is nominal, the research subjects (respondents) can be allocated into categories and the sample is large. The database of responses is in accordance to these criteria.

Following formula is used for the Chi square calculation:

$$\chi^2 = \sum (O - E)^2 / E$$

where,

- O...observed frequencies for each category;
  - E...expected frequencies for each category;
  - ∑...sum of the results calculated for each category.
- Discussion and analysis of the results

### Clear height

Clear height under the beam is one of the key technical specifications. Ten meter clear height allows stacking of pallets in 5 or more levels. Thomson (2005) concludes that 12m clear height is the trend in warehousing. On the other hand manufacturing or cross dock operations prefer a clear height lower than 10m as it might be cheaper on heating and easier to bring light to the shop floor.

More than 67% of respondents consider clear height as important factor for their operation (average 3.86 points). The most important is clear height for respondents in units from 2,001 to 5,000sqm (80% importance) and in units above 15,001sqm (80% importance). The least important is the clear height for respondents in small units from 1,000 to 2,000sqm (72% importance). Small units are primarily for local representation (buffer warehouse), cross docking or light manufacturing and not for warehousing.

Clear height is more important for logistics respondents (81% importance) than for manufacturing users (71% importance). Eighty six percent of respondents are satisfied with their existing clear height (average satisfaction 4.35 points), although 19 out of 43 respondents would prefer a different clear

height than the existing one. 10 of these 19 would rather prefer higher and 9 lower clear height than existing. The most satisfied with clear height are respondents in small units from 1,000sqm to 2,000sqm (95% satisfaction) followed by units bigger than 15,001sqm (93% satisfaction). The least satisfied are occupiers in units of 2,001 to 5,000sqm (78% satisfaction). Further analysis shows that occupiers of small units have mostly 10m clear height which is also their preferred clear height. Occupiers of units from 2,001 to 5,000sqm have mostly 10m clear height but they would rather prefer clear height around 12m.

Occupiers mostly prefer clear height around 10m (26% of respondents) which is also the most common clear height used in existing industrial facilities. Other preferred clear heights are around 12m (19% of respondents) and 6-7m (19% of respondents).

The difference in satisfaction between logistics users (87% satisfaction) and manufacturing users (86% satisfaction) is minor. In the sample the units with manufacturing use are more frequently with clear height around 7m and the units with logistics use are more frequently around 10m and this is the preference of occupiers by business use. Manufacturers rather prefer lower buildings (about 6m). For warehousing operations a clear height of 10m or 12m is preferred as it allows efficient storage of goods. However, some of the logistics companies prefer clear height at about 5m or 6m as they use the warehouse for cross-docking operations where the goods move mainly on the floor and it is more important to have more docks with ramps rather than a higher building. Across the unit size and building type categories clear height from 10m to 12m is the most preferred.

### Floor loading capacity and quality of the floor

Floor shall allow movement of forklifts, storage of pallets in several levels and installation of manufacturing technology. Floor loading capacity is one of the main floor characteristics, other characteristics are point load and flatness of the floor (important in case of racking system), net of dilatation joints, thickness of the floor and foundations.

Seventy two percent of respondents consider floor loading capacity as an important specification for their operation (average 4.12 points). The most important is floor loading capacity for respondents in units from 5,001 to 15,000sqm (88% importance) and in units from 2,001 to 5,000sqm (85% importance). The least important is the load for respondents in small units from 1,000 to 2,000sqm (65% importance). As already mentioned in the section about clear height small units are not meant for warehousing purposes but mainly for local representation, cross docking and light manufacturing. As such loading capacity of the floor is not as important.

Loading capacity of the floor is more important for manufacturing users (88% importance) than for logistics users (79% importance). Manufacturers have technology in their facilities which very often need special foundations.

Eighty one percent of the respondents are satisfied with the load capacity of the floor in their units (average 4.23 points). Sixty percent of the respondents consider the floor load capacity as adequate and 40% as inadequate out of which 94% would prefer a higher floor load. The most satisfied with the floor load are respondents in units bigger than 15,001sqm (87% satisfaction) but the occupiers in other unit size categories are satisfied on the similar level around 85%. There is a difference in satisfaction between logistics users (87% satisfaction) and manufacturing users (81% satisfaction). 75% of manufacturing respondents have 5t/sqm in their present units. Most manufacturing users consider 5t/sqm as adequate (50%) but about 40% respondents would prefer higher floor load. On the other hand logistics users mostly prefer 5t/sqm (63%) and only 28% would prefer higher floor load capacity. Production technology very often requires higher loading capacity of the floor which can be overcome by special foundations under the machinery.

The occupiers prefer the floor loading capacity of 5t/sqm (61% of respondents) which is the most common floor loading capacity in existing industrial facilities. Sixteen percent of the respondents would like to have 7t/sqm in their units.

Some of the respondents commented on the quality of the floor. Only 57% of respondents are satisfied with quality of their floor which means 3.76 points on average. The biggest problem is the crumbling of the dilatation joints and movement of the floor decks due to the forklift truck movement.

### Column grid

Column grid determines how the facility can be split to units because landlords prefer to split the facility to units by walls built in between the columns. Column grid determines the flexibility of size of the units and flexibility of the internal layout, be it manufacturing or warehousing operation.

Sixty five percent of the respondents consider column grid as important for their operation (average 3.76 points). The column grid is more important for managers of logistics operations (83%) than for managers of manufacturing operations (64%). Interviews provided the answer: column grid is more important for logistics operations due to optimization of racking system layout, i.e. for instance to optimize the layout columns should be in between the racks and isles should be as narrow as possible just to allow the forklifts to manoeuvre.

The lowest importance has the column grid for occupiers of small units (65%). This is again in line with the results for clear height and floor load as small units are not primarily meant for warehousing purposes.

Eighty four percent of the respondents are satisfied with their present column grid (average 4.09 points) and this satisfaction is similar in all unit categories (by size, by use, by building type) although 65% of the respondents consider column grid in the facility as inadequate. This is mainly due to the fact that 45% of the respondents answered that no columns would be preferred but they realize that this is not possible. Small units from 1,000sqm to 2,000sqm sometimes do not have columns at all. In general the wider the grid the better the diversity of the space as columns restrict flexibility of the space and are limiting flow of the goods and the facility layout. Most of the existing units have column grid 12m x 24m and this column grid is also preferred by 25% of the respondents

### Direct access

Direct access to the unit is used for forklift trucks to go in or out of the unit, for trucks to get into the building and to allow side loading and unloading. Standard size of overhead doors is 4.2m x 4.0m which allows the truck to enter the building.

Seventy nine percent of the respondents consider direct access to the facility as important (average 4.30 points). Direct access is more important for companies with logistics operation (88% importance) than for companies with manufacturing operation (82% importance). The highest importance of direct access is for respondents in units from 2,001 to 5,000sqm (94% importance) the lowest importance is for respondents in units bigger than 15,001sqm (77% importance) where mainly hydraulic ramps are used to load and unload trucks.

Thirty five percent of the respondents consider number of their access doors as inadequate out of which 73% would rather see more direct accesses.

Twenty six percent of the respondents prefer to have one and 37% two direct accesses. Number of direct accesses depends on the type of operation in the unit. It also depends on size of the unit. 1 direct access per 944sqm of is enough for units between 1,000 and 2,000sqm. Units from 2001 to 5000sqm should have 1 direct access per approx. 764sqm. Occupiers in larger units do not need as many direct accesses and in units bigger than 15,001sqm it is necessary to have only 1 direct access per approx. 5,370sqm.

Manufacturing respondents need on average less direct accesses (1 per approx. 3,399sqm) than logistics respondents (1 per approx. 2,003sqm). In general logistics operations need better accessibility than manufacturing ones.

### Hydraulic ramps

Hydraulic ramps allow flexible adjustment of the entrance to the facility/truck in order to maintain good flow of goods in and out of the facility. The ramp is installed at the level of 120cm at the level of the floor of the unit and at the height of 120cm from the truck yard. Sectional doors are usually 3.0m by 3.0m.

Eighty one percent of the respondents consider hydraulic ramps as important for their operation (average 4.28 points). Hydraulic ramps are more important for companies with logistics operation (90% importance) than for companies with manufacturing operation (78% importance). Logistics operations in general require more accesses in order to allow easy flow of the goods.

The highest importance of hydraulic ramps is for respondents in units from 2,001 to 5,000sqm (91% importance) and for respondents in units from 5,001 to 15,000sqm (90% importance), the lowest importance is for respondents in small units from 1,000 to 2,000sqm (75% importance). This result is caused by the fact that in small units the flow of goods is not too fast and therefore number of access points is not that important.

Thirty percent of the respondents consider number of their hydraulic ramps as inadequate out of which 77% would rather see more hydraulic ramps.

Existing number of hydraulic ramps by unit size is in all 4 categories higher than the number actually required by occupiers. Manufacturers in general require less hydraulic ramps (1 per approx. 2,237sqm) than is provided on average in standard (1 per approx. 1,071sqm). This means that the standard number of hydraulic ramps is closer to the requirements of logistics companies who on average need 1 hydraulic ramp per approx. 802sqm.

Eighty one percent of the respondents consider day light as important for their operation (average 4.18 points). The differences in importance among the unit size categories are minor (+/- 2%). Day light is considered as more important by managers of manufacturing operations (88%) than by managers of logistics operations (81%). This was expected as manufacturing process needs more light in general.

Sixty percent of the respondents are satisfied with the intensity of day light in the unit. Average satisfaction is at 3.58 points, the most unsatisfied are occupiers of small units (52%).

Twenty six percent of the units have skylights with 2% to 4% coverage of the roof. Roof with 2% to 4% coverage of skylights is the standard for warehousing facilities for which hygienic regulations stipulate such intensity of day light. Twenty eight percent of units have skylights with 8-10% coverage of the roof. This is mainly used by CTP in their flexi space concept.

### Day light and artificial lighting

Day light on the shop floor is provided by sky lights or by windows on the façade. It is required by legal norms but also it saves electricity on artificial lighting. It is necessary to provide more day light in the space where workers spend most of their time, in warehouse this is in the inbound/outbound area in front of the docks, in a manufacturing unit at the working stations.

Artificial lighting is required by legal norms at permanent working stations and is necessary for operations with more than one shift per day. For some manufacturing operations it is important to equip the unit with specific lighting systems which prevent so called stroboscopic effect (CNC and other rotating machines). Another important factor is the allowance of the lighting to be switched on and off in sections.

Ninety three percent of the respondents consider artificial light as important for their operation (average 4.49 points). The highest importance of artificial lighting is for occupiers of small units. Artificial light is, similarly to day light, more important for manufacturing managers (94%) than for logistics managers (87%).

Thirty percent of the units have artificial lighting with an intensity between 100 and 200lux. This is the standard for warehousing facilities. Manufacturing units have higher intensity of the artificial light (400lux to 500lux) due to hygienic regulations.

Light is important in labour intensive operations. An interesting solution provided by the developer VGP is painting the interior in white to make the unit lighter. One of the respondents commented that it would be helpful to have lighting system which would be possible to flexibly move in order to fit to the different racking systems and isles.

Adequacy was not studied as the day light and artificial light must meet local and national regulations which are considered as minimum requirement. As mentioned above some companies adjust lighting in their units to meet higher requirements.

### Electricity capacity

Sufficient electricity capacity is important to maintain the operation at satisfactory level without interruptions. Some companies with continuous operations require back up generators.

Seventy seven percent of the respondents consider electricity as important for their operation (average 4.11 points). The most important is the electricity for managers of manufacturing operations (93%) and it is not that important for managers of logistics operations (76%). This result was expected as manufacturing operations consume more electricity than logistic ones. Ninety eight percent of the respondents consider installed electricity capacity as adequate. Higher capacity is installed in units with manufacturing use.

Almost 10% of logistics managers did not know the installed electricity capacity, in contrast 100% of manufacturing managers knew it. The parks have reserve electricity power in case of expansion or for the case that manufacturing company comes to the park.

## Heating system

Heating systems are required by law. There are minimum temperatures that the heating system must maintain, in warehousing operations the temperature can be lower (min. 15C) than in manufacturing operations with permanent working stations (min. 18C).

The heating system is important for 65% of respondents (3.86 points on average). It is more important for respondents who use the units for manufacturing purposes (82.5% importance) than for those with logistics operation (74% importance). The highest importance has the heating system for respondents in unit size category from 2,001 to 5,000sqm (85% importance). Respondents in other unit size categories view heating systems with a similar importance at the level of about 75%. The level of importance in respect of facility type is also similar for both built to suit and standard facilities.

Sixty seven percent of the respondents are satisfied with the heating system they have in the unit (3.56 points on average). The least satisfied are respondents in the unit size category from 2,001 to 5,000sqm (60% satisfaction). Respondents in other three unit size categories are satisfied in similar level of about 75%. Companies which are more satisfied are those with manufacturing operation (75%) as opposed to those with logistics operation (69%) in the unit. The reason is that developers must install better heating system in manufacturing units than in those for logistics purposes. Seventy percent of the units have gas heated blowers usually mounted on the walls and 63% of respondents are satisfied with this system. Gas heated infrared heaters are in 16% of the respondents' units and 71% respondents are satisfied with this system.

Ventilators are considered by some respondents as noisy especially when the vents run on the highest power. Other respondents commented that the regulation system should allow the occupier to fully control the environment in the unit.

## Sprinkler system

Sprinkler systems are part of the fire prevention of buildings. ESFR sprinkler systems are the most commonly used system in the Czech Republic. Some landlords and occupiers require sprinkler system because of their insurance policies. On the other hand some occupiers can not have sprinkler system for instance in the ADR storage (chemicals) or in case they store electronics or paper. In such case the sprinkler system should be able to be switched off in some sections.

Sprinkler systems are considered by 44% of the respondents as important for their operation (average 3.23 points). A sprinkler system is the least important for respondents in small units (only 53%). In contrast the highest importance of a sprinkler system for is occupiers of units bigger than 15,001sqm (93%).

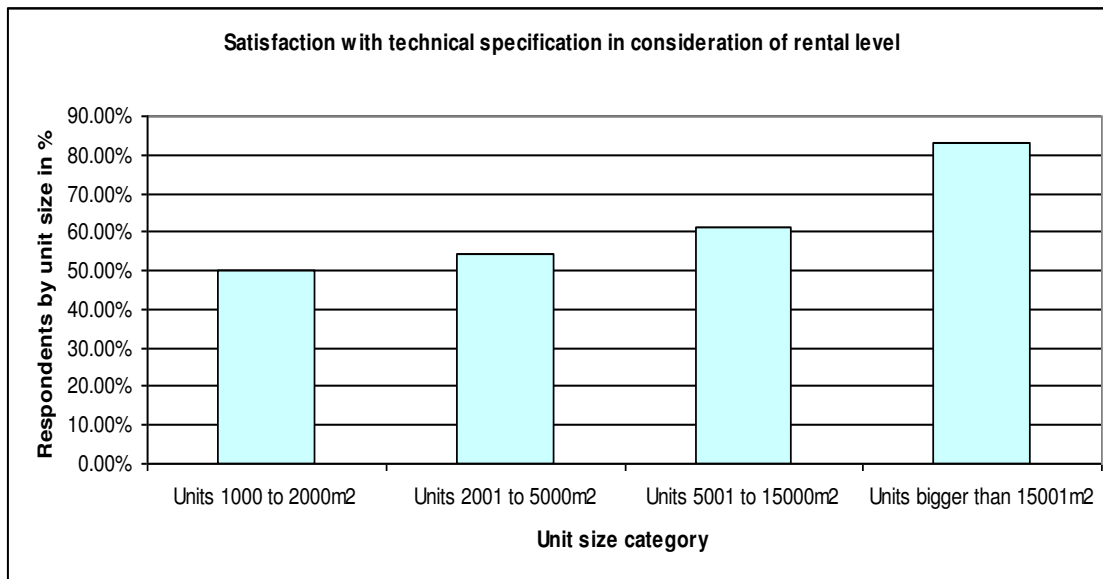
Sixty percent of the respondents answered that they have sprinkler system in their unit and only 17% of the respondents that do not have sprinkler system in their unit would like to have it.

a sprinkler system is required by the fire regulations in case of larger units. The maximum size of unit without a sprinkler system is about 7,000sqm (depends on local regulations). The maximum size of unit with a sprinkler system could be up to 10,000 or even 12,000sqm. Therefore in concepts which focus on small units it is not necessary to have a sprinkler system. Only 38% of the small units from 1,000 to 2,000sqm have sprinkler systems on the other hand 100% of the units larger than 15,001sqm have sprinkler systems.

About 60% of both manufacturing and logistics units have sprinkler system. One of the respondents commented that it is good to have sprinkler system and even better is not to use it.

## Satisfaction with technical specifications in consideration of rental level

Sixty percent of respondents consider the technical specification in accordance with rental level of the modern industrial facilities. Eighty three percent of occupiers of units bigger than 15,001sqm are satisfied which is much higher number than in case of smaller units (please see Figure 8).



**Figure 8 Satisfaction with specification in consideration of rental level by unit size N=43**

More manufacturing respondents (69%) are satisfied with technical specification in consideration with rental level (Figure 8) than respondents who use the facilities for logistics operations (56%). Occupiers with manufacturing operations have their units adjusted and count with these extra installations in their project budgets. Logistics users take the space without many extra installations on shorter lease terms and their dissatisfaction is mainly driven by constant pressure from their clients to cut the costs.

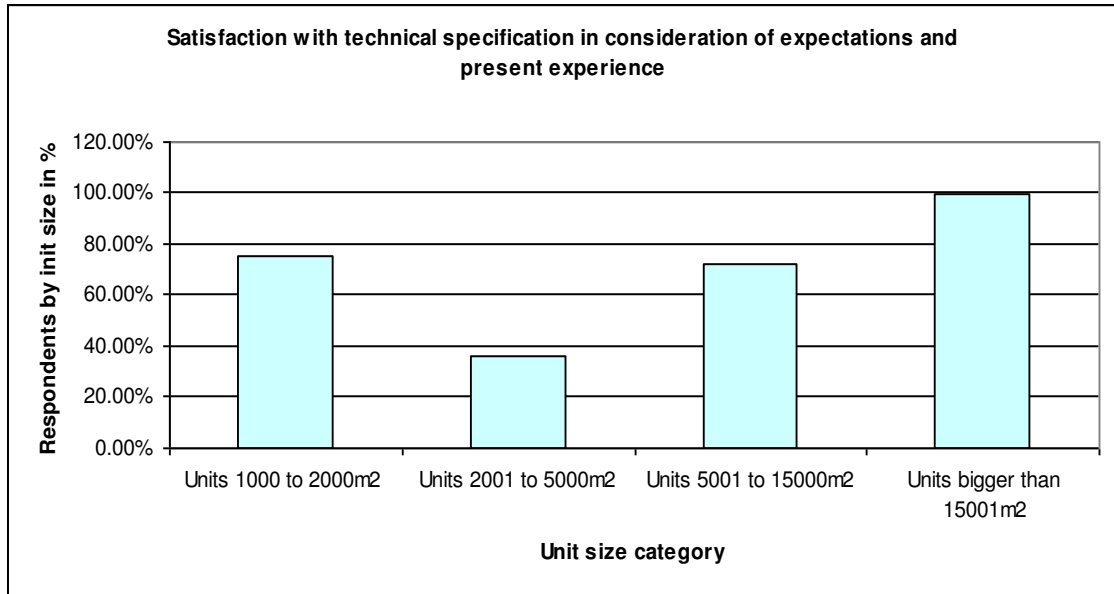
The result of the test of the hypothesis 1 is not significant at 5% or 10% probability level and the null hypothesis can not be rejected. The satisfaction with basic technical specifications of modern industrial facilities in consideration of rental level does not significantly differ between occupiers with manufacturing operation and with warehousing operation. Both manufacturing and logistics respondents mostly comment that the technical specification is in good standard but the rent is higher than they would expect for such standard.

### Satisfaction with technical specification in consideration of expectations and present experience

Sixty seven percent of respondents consider the technical specification in accordance with expectations before the start of the lease (Figure 9). The lowest satisfaction in this respect is in the category of units from 2,001 to 5,000sqm, the highest in the category of units more than 15,001sqm (100% respondents are satisfied in this respect)

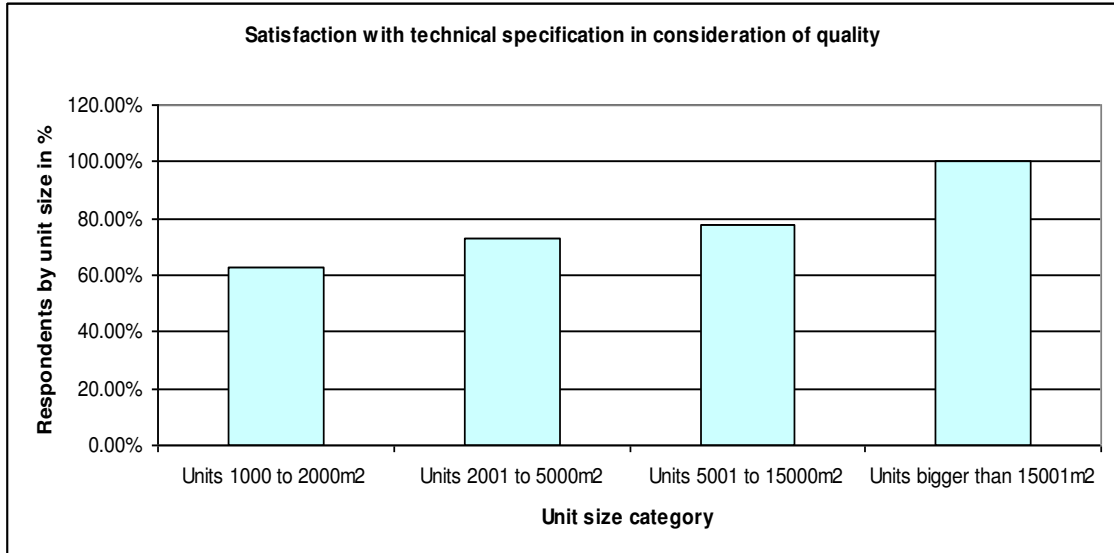
More manufacturing respondents (81%) are satisfied with technical specification in consideration of expectations than respondents who use the facilities for logistics operations (56%). From experience manufacturers spend more time on preparation of their new manufacturing project than logistics operators who sometime, when they win a logistics tender, need to take the space immediately without prior deep knowledge of the facility.





**Figure 9: Satisfaction with technical specification in consideration of expectations and present experience, N=43**

The result of the test of the hypothesis is not significant at 5% probability level but is significant on the probability level of 10% since the  $\chi^2$  value is higher than the critical value for  $P < 0.10$ . Thus the null hypothesis can be rejected on the 5% probability level but on the 10% probability level the results are significant. The unit use has an impact on the satisfaction of the occupier in regards to the expectations. This may be caused by the fact that manufacturers spend more time in the project preparation phase and they adjust the units to fit their operation.



**Figure 10: Satisfaction with technical specification in consideration of quality, N=43**

#### Satisfaction with technical specification in consideration of quality

Seventy seven percent of respondents consider the technical specification in accordance with quality of the facility. The lowest satisfaction in respect of quality is in the category of small units (Figure 10).

The result of the Chi square test for the hypothesis 3 is not significant at the 5% or 10% probability level and the null hypothesis can not be rejected. There is no difference between manufacturing and logistics operators in regards of satisfaction with quality of the industrial facilities which is also the result of interviews.

## CONCLUSIONS

This research confirmed that the technical specifications of modern industrial facilities currently provided are acceptable for the occupiers across all unit sizes and unit use categories (Table 3: Technical specifications preferred by occupiers by unit size. However there is some variation in the preferences of occupiers of different sized units and the requirements of logistics companies are different to those of manufacturing businesses for certain aspects of the specification. The key aspects of the specifications are set out below in the tables which also identify the differences in preferred specifications.

Technical specification	Unit size			
	1,000 - 2,000m <sup>2</sup>	2,001 - 5,000m <sup>2</sup>	> 15,000m <sup>2</sup>	Bigger than 15,000m <sup>2</sup>
Clear Height (m)	<10m	<11m	10m-12m	<12m
Floor load (t/m <sup>2</sup> )	>3t/m <sup>2</sup>	>5t/m <sup>2</sup>	>5t/m <sup>2</sup>	>5t/m <sup>2</sup>
Column grid	None	12m x 24m or none	12m x 24m or none	12m x 24m or none
Direct access	944m <sup>2</sup> / 1	764m <sup>2</sup> / 1	3,474m <sup>2</sup> / 1	5,370m <sup>2</sup> / 1
Docks with ramps	871m <sup>2</sup> / 1	672m <sup>2</sup> / 1	896m <sup>2</sup> / 1	1,506m <sup>2</sup> / 1
Skylights (%)	< 10%	< 10%	2% - 8%	2% - 10%
Lighting (lux)	100 - 500lux	100 - 500lux	100 - 500lux	100 - 400lux
Electricity	< 400kVA	>400kVA	> 400kVA	> 400kVA
Heating system	No preference	No preference	No preference	No preference
Sprinklers	Not necessary	Rather necessary	Rather necessary	Necessary

**Table 3: Technical specifications preferred by occupiers by unit size**

For manufacturing operations the most important specifications are lighting and electricity, which are necessary for the production process. For logistics operation number of direct accesses and number of hydraulic ramps are the key specifications. Clear height, floor load and column grid is not viewed by occupiers of small units from 1,000 to 2,001m<sup>2</sup> as important as light in the unit. For bigger units most important are ramps, direct accesses (not in unit bigger than 15,001m<sup>2</sup>) and light.

The research did not prove that there is a difference in satisfaction with technical specifications in respect of rental level and quality between manufacturing and logistics operation managers. Both view the quality of the facilities as good but both would expect lower rent for such a standard. The research concludes that there is a difference between manufacturers and logistics in satisfaction in relation to expectations. Manufacturers spend more time when preparing the project and extra installations. Those manufacturers are more satisfied with the rent as they do expect the budget to be higher due to extra installations.

Technical specification	Unit use	
	Manufacturing	Logistics
Clear Height (m)	>6m	>10m
Floor load (t/m <sup>2</sup> )	>5t/m <sup>2</sup>	>5t/m <sup>2</sup>
Column grid	12m x 24m or none	12m x 24m or none
Direct access	3,399m <sup>2</sup> / 1	2,003m <sup>2</sup> / 1
Docks with ramps	2,237m <sup>2</sup> / 1	802m <sup>2</sup> / 1
Skylights (%)	< 12%	< 10%
Lighting (lux)	< 500lux	< 400lux
Electricity	> 400kVA	< 400kVA
Heating system	No preference	No preference
Sprinklers	No preference	No preference

**Table 4: Technical specifications preferred by occupiers by unit use**

Technical specification	Importance					
	1,000 - 2,000m <sup>2</sup>	2,001 - 5,000m <sup>2</sup>	5,001 - 15,000m <sup>2</sup>	> 15,000m <sup>2</sup>	Manufacturing	Logistics
Clear Height (m)	72%	80%	77%	80%	71%	81%
Floor load (t/m <sup>2</sup> )	65%	85%	88%	83%	88%	79%
Column grid	65%	76%	77%	83%	64%	83%
Direct access	80%	94%	87%	77%	82%	88%
Docks with ramps	75%	91%	86%	90%	78%	90%
Skylights (%)	85%	84%	82%	87%	88%	82%
Lighting (lux)	95%	89%	87%	93%	94%	87%
Electricity	83%	82%	80%	90%	93%	76%
Heating system	72.5%	85%	74%	77%	82.5%	74%
Sprinklers	52.5%	58%	64%	93%	67.5%	63%

**Table 5: Importance of technical specifications by unit size and unit use**

## **RECOMMENDATIONS FOR FURTHER STUDIES AND PRACTICE**

This research answered many questions and also identified areas for further research:

- what other technical specifications are important to tenants and how satisfied are they with them?
  - what would be the existing and preferred specifications of small business units (unit smaller than 1,000m<sup>2</sup>)?
  - are there differences between the requirements for headquarter or local branches regarding technical specifications?
  - is there a link between location and technical specifications?
- are manufacturing firms better informed about technical specifications and do they therefore make better judgements about the suitability of the property they occupy?

## REFERENCES

- Ambrose, B.W. 1990. An Analysis of the Factors Affecting Light Industrial Property Valuation. *Journal of real estate valuation* Vol 5 No 3, pp 355-370
- Building Employers' Confederation 1985. *Building - The Nation's Needs: Spotlight on Industrial Building*. London.
- California State University 2008 TITLE NEEDED [online]. Last accessed 3rd March 2009 at:  
<http://business.fullerton.edu/Finance/Journal/papers/abstract/past/av08n03/v08n3a04.htmg>
- Centre for Advanced Land Use Studies (CALUS) 1979 *Building for Industry*. Reading, College of Estate Management.
- Cushman & Wakefield 2008. European distribution report. Cushman & Wakefield research publication
- Drury, J. 1980. *Handbook of factory design*. London: The architectural press
- Fehribach, F.A., Rutherford, R.C. & Eakin, M.E. 1993 An Analysis of the Determinants of Industrial Property Valuation. *Journal of real estate research*. Vol 8 No 3, pp 365-376
- Henneberry, J.M. 1984. Property for high technology industry. *Land Development studies*, 1(3)
- Henneberry, J.M. 1991a. Interrelationship between manufacturing firms and accommodation in the rented sector; theoretical perspectives. *Property Management*, Vol. 9 No. 3, pp 212 – 219
- Henneberry, J.M. 1991b. Occupier satisfaction with rented industrial property *Property Management*, Vol. 9 No. 4, pp 348 – 357
- Holmes, L.G. 1948. *The real estate handbook*. New York: Prentice-Hall
- McDonald J.F and Yurova, Y. 2007. Property taxation and selling prices of industrial real estate. *Emerald*, Vol. 6, pp 273-284
- Naoum, S.G. 2007. *Dissertation research and writing for construction students* (2nd Fothergill, S., Monks, S. and Perry, M. 1987. *Property and industrial development*. London, Hutchinson
- Tarcan, E and Varol. E. S. 2004 A qualitative study of facilities and their environmental performance *Emerald, Management of Environmental*. Vol. 15, pp 154-173
- Thompson, R. 1997 Industrial Employment Densities“, *Journal of real estate research*. Vol 14 No. 3, pp 309 – 319
- Thomson, B. 2005 Pan-European Industrial Property. *Journal of Property Investment & Finance*. Vol. 23 No. 4, pp 379-385
- Tsolacos, S., McGough, T. & Thompson, B. 2005. Affordability and performance in the industrial property market“, *Journal of Property Investment & Finance* Vol 23 No. 4, pp 311-328