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Intelligent Energy Europe

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1. Introduction

In recent years numerous diverse bike sharing schemes (BSS) have been implemented in European cities. Starting with free low-tech offers by few enthusiasts, the schemes went through a two-fold development: high-tech systems with thousands of bikes and major funding requirements, and smaller, less expensive systems with lower usage rates. However, bike sharing is a recent development and little information regarding suitability of different models is available.

The main objective of OBIS is to capture, collate and correlate existing experience in order to understand what might be transferable between cities. For this purpose, 48 cities comprising 51 BSS from ten European countries were studied in OBIS. Fifteen partners from nine countries were involved in the data collection based on available literature, surveys and interviews with city representatives and operators.

The research reveals the following findings:

- Large cities (>500,000 inhabitants) tend to implement high-tech BSS with high costs for both implementation and running phase.
- Schemes in large cities mainly offer twenty-four-seven services whereas schemes in smaller cities often terminate operation at night. The availability throughout the year depends on the climate: BSS in cities with low temperature in winter do not operate during colder months due to low demand.
- The first 30 minutes of use are not charged for by BSS in large cities. Smaller cities often offer more time free of charge to encourage use.
- The average number of bicycles and stations per inhabitant seems to be similar in all city-size categories.
- The number of rents per bicycle is higher in large cities.

In order to illustrate the transferability of BSS, these results are to be applied to potential BSS cities of Czech Republic and Poland. The bicycle and station rate per inhabitant and the rental rate per bicycle of existing BSS are to be used to estimate the total number of bikes, stations and rents of the cities.

2. Typology of cities

In order to analyze the influence of the city-size on the cases studied, the 48 cities were classified by the number of inhabitants as follows.

- **Large cities:** more than 500,000 inhabitants
- **Medium cities:** between 100,000 and 500,000 inhabitants
- **Small cities:** less than 100,000 inhabitants

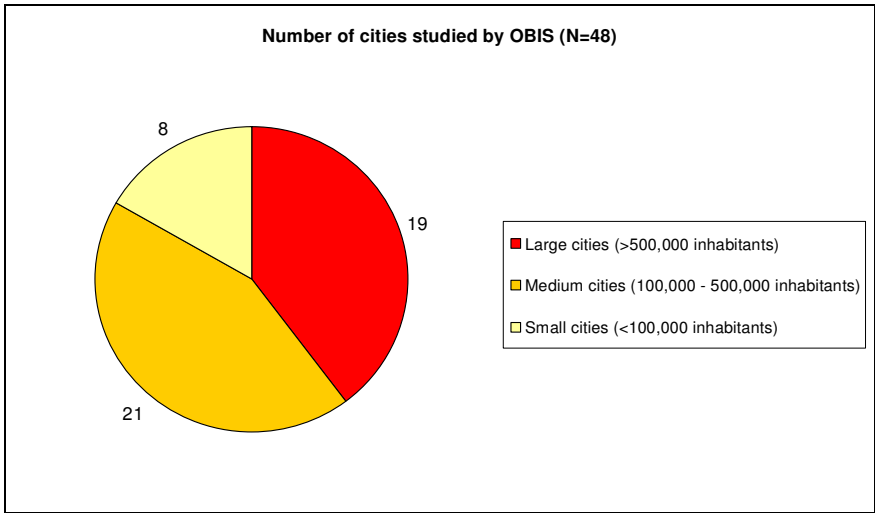

Figure 2-1: Number of cities studied sorted by the number of inhabitants

The average of the following variables reveals some common features in the cities depending on their city-size:

- The **population density** is substantially higher in large cities than in medium and small ones.
- Small cities have a higher share of population **60 year and over**
- The average of the variable "**income per employee**" is slightly lower in large cities.

	Large cities				Medium cities				Small cities			
	Average	Max	Min	N	**Average**	Max	**Min**	N	**Average**	Max	Min	N
Pop. Density	**4,777**	20,648	394	19	**1,914**	4,566	342	21	**1,111**	3,292	79	8
>60 years old	**22.3%**	28.0%	16.4%	16	**22.8%**	32.4%	16.4%	19	**25.6%**	36.1%	15.3%	8
Income	**€ 22,271**	€ 35,155	€ 13,284	14	**€ 23,386**	€ 32,014	€ 14,949	14	**€ 26,549**	€ 34,644	€ 19,540	6

Table 2-1: Average, maximum and minimum of population density (inhabitants/km²), share of population over 60 years old and net annual income per employee. N = number of cases analyzed.

• **Mobile phone** access is similar in all types of cities, while **Internet** and **bank cards** seem to be more available in larger cities.

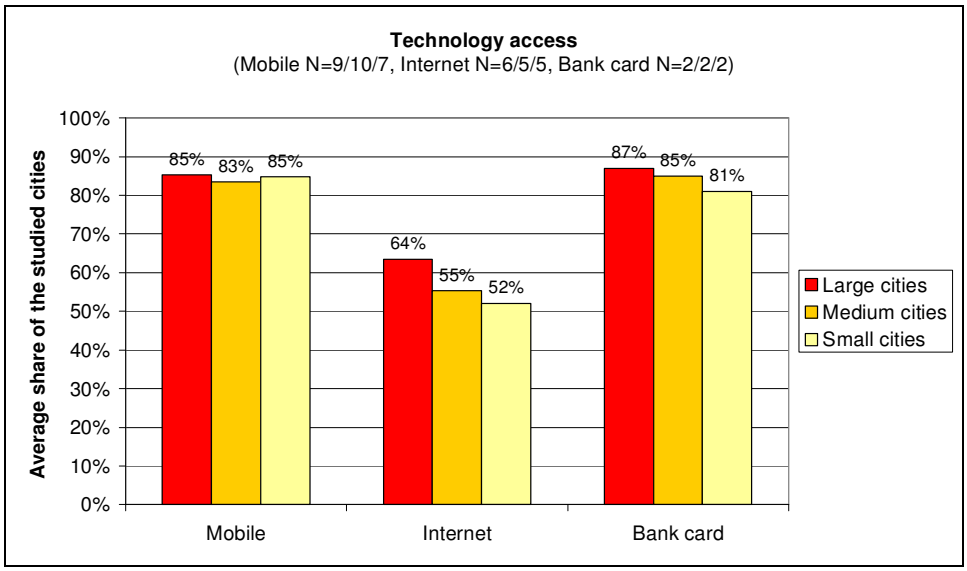

Figure 2-2: Average share of mobile phone, Internet and bank card access. N = number of cases analyzed.

• The smaller the city, the higher the **car** modal share and the lower the **public transport** modal share**. Cycling** is slightly more popular in small cities than in big ones.

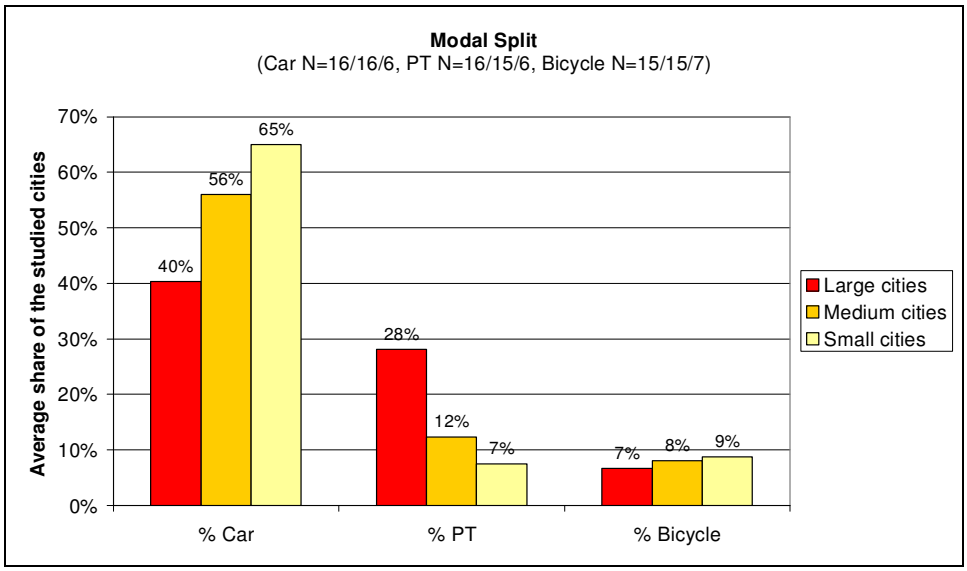

Figure 2-3: Average modal share of car (included all motorized individual vehicles), public transport and bicycle. N = number of cases analyzed.

3. Characteristics of bike sharing schemes

A total of 51 BSS were analyzed by OBIS.

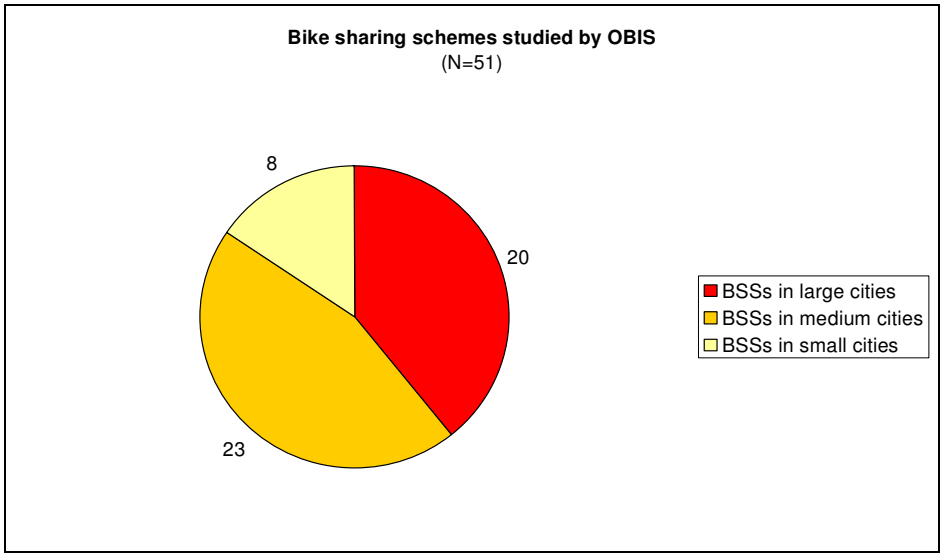

Figure 3-1: Number of bike sharing schemes analyzed, sorted by city size.

The study shows several findings about the characteristics of the BSS:

- 75% of BSS located in large cities offer **twenty-four seven** services in contrast to the 38% of BSS in small cities.

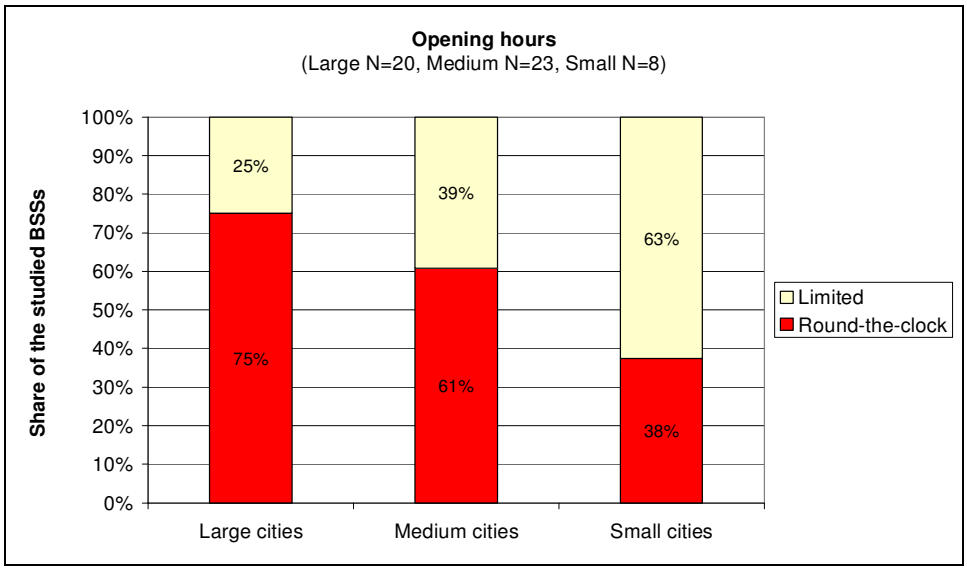

Figure 3-2: Limit of opening hours sorted by city-size. N = number of cases analyzed.

• The limitation of opening hours is affected by the **technology** of the bike sharing station. 85% of BSS in large cities are equipped with electronic devices at the station and they usually operate twenty-four seven. However only 38% of BSS in small cities are high-tech systems and 25% require staff for hiring a bike, thus they often terminate operation during the night.

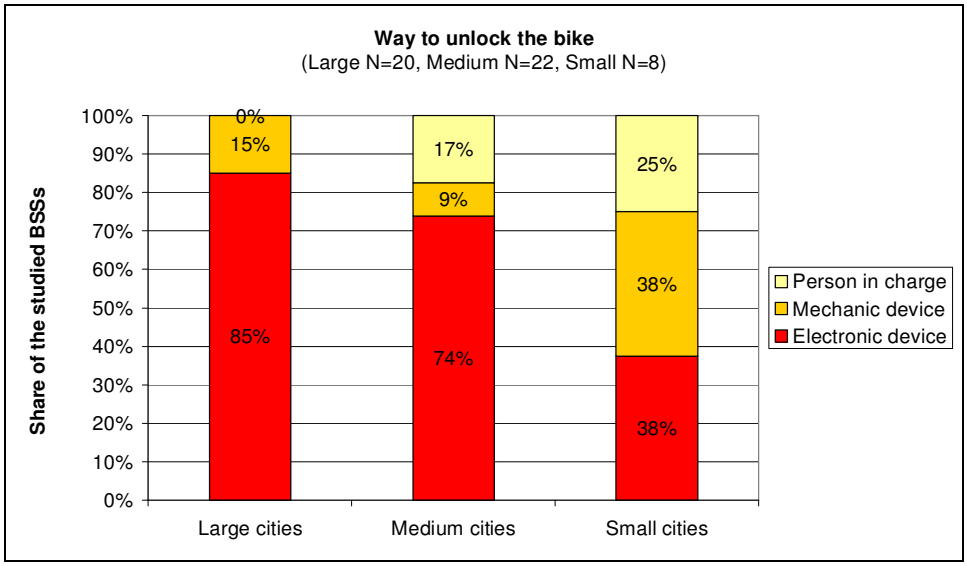

Figure 3-3: Technology of unlock sorted by city-size. N = number of cases analyzed.

• The **availability through-out the year** of the BSS is not affected by the city-size, but by the climate. 93% of BSS located in "warm cities" (over 11°C of average annual temperature) operate all the year round, whereas only 45% of BSS in cold cities (below 11°C) do it.

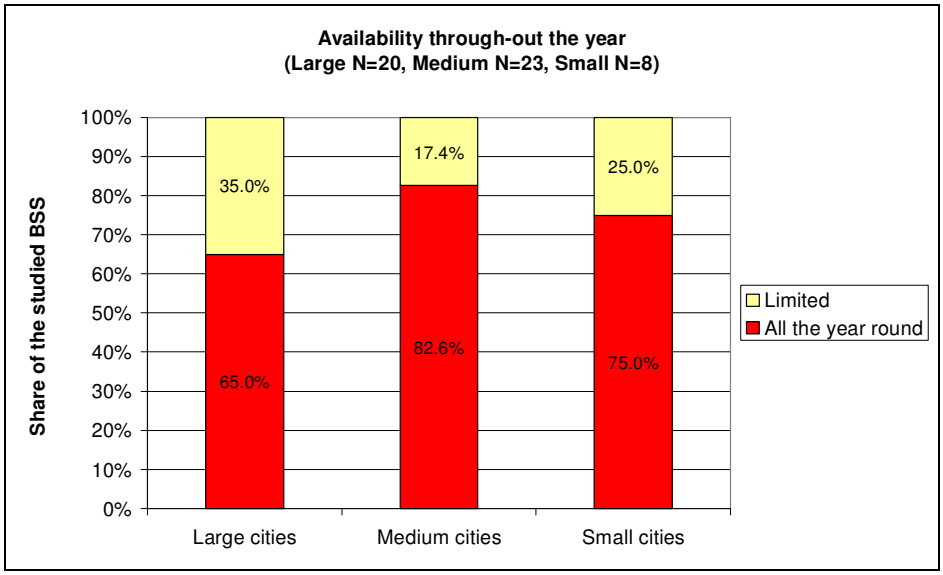

Figure 3-4: Availability through-out the year sorted by city-size. N = number of cases analyzed.

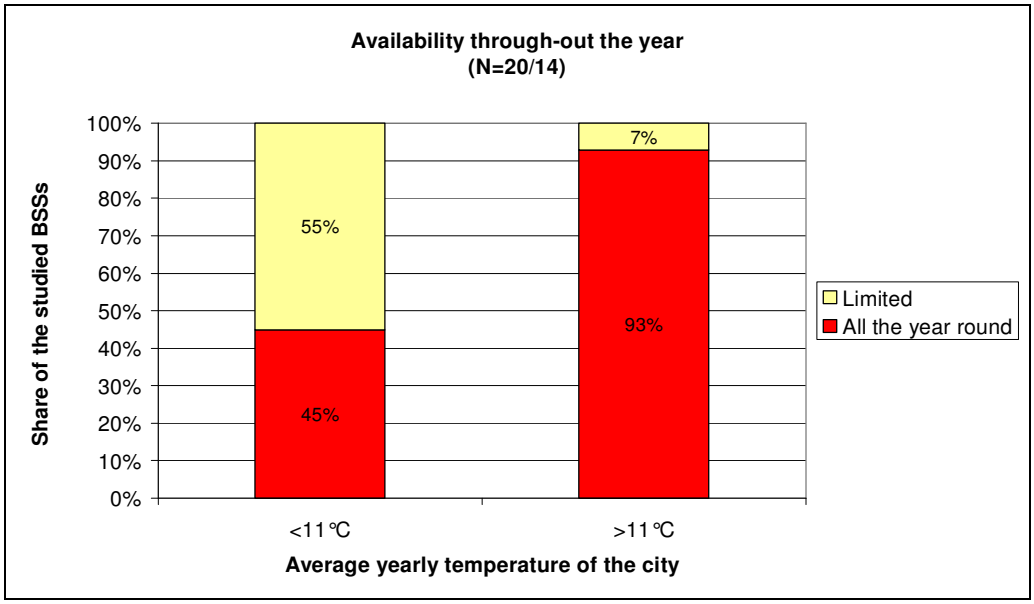

Figure 3-5: Availability through-out the year sorted by average yearly temperature. N = number of cases analyzed.

• 55% of BSS implemented in "cold cities" do not operate in winter due to low **demand**. However, the operators of these BSS manage a peak of usage in summer. BSS in "warm cities" have more constant demand through-out the year.

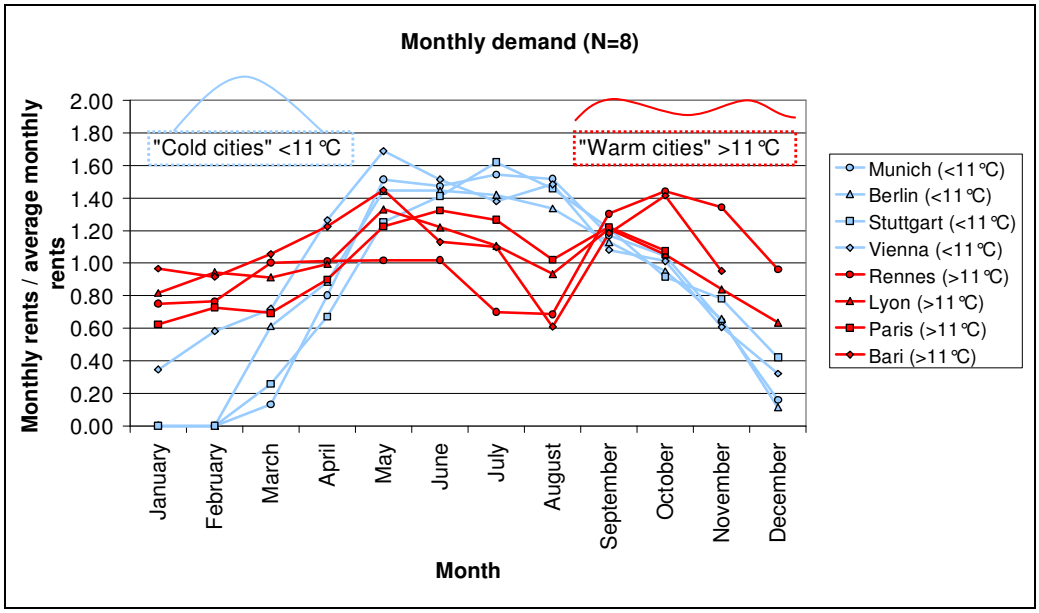

Figure 3-6: Monthly demand sorted by temperature. N = number of cases analyzed.

• Rental periods without charge have become a common attribute of BSS. The duration of this period varies depending on the city-size. 45% of schemes located in large cities offer 30 minutes **free of charge,** while rent time free of charge is usually unlimited in smaller cities.

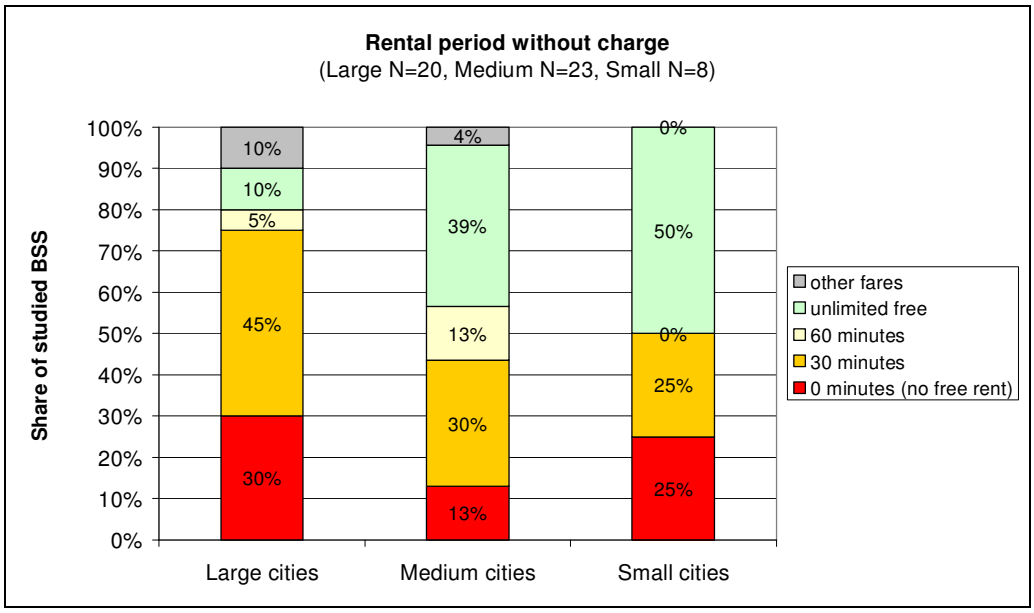

Figure 3-7: Rental period without charge sorted by city-size. N = number of cases analyzed.

• The number of **bicycles** varies within a wide range. Nevertheless these values are on average similar in all city-sizes: 14 to 16 bicycles per 10,000 inhabitants. BSS offer from 1.3 to 1.8 **stations** per 10,000 inhabitants and from 1.2 to 1.8 **docking points** per bike in order to guarantee the return of the bicycle.

	Large cities				Medium cities				Small cities			
	Average	Max	Min	N	**Average**	Max	Min	N	**Average**	Max	Min	N
Bicycles per 10,000 inhabitant	**15.6**	95.0	0.1	19	**14.4**	105.8	0.2	20	**14.0**	26.0	1.7	8
Stations per 10,000 inhabitants	**1.5**	6.7	0.1	15	**1.3**	6.7	0.1	22	**1.8**	5.2	0.1	8
Docking points per bicycle	**1.8**	2.3	1.5	6	**1.8**	3.2	1.0	13	**1.2**	1.5	1.0	4

Table 3-1: Average, maximum and minimum of bicycles and stations per 10,000 inhabitants and docking points per bicycle. N = number of cases analyzed.[1]

• The number of **annual rents** depends on the number of bicycles offered by the BSS. In average, BSS located in large cities make 463 annual rents per bicycle, 378 in medium cities and 235 in small ones.

[1] The number of docking points per bicycle can be "1" because in some BSS, customers have to return the bicycle to the same docking point after the usage.

	Large cities				Medium cities				Small cities			
	Average	Max	Min	N	**Average**	Max	Min	N	**Average**	Max	Min	N
Annual rents per bicycle	**463**	1,702	20	10	**378**	1,422	35	9	**235**	529	63	4

Table 3-2: Average, maximum and minimum of density of stations, bicycles and docking points. N = number of cases analyzed.

4. Obstacles implementing bike sharing

- Cities with high bicycle ownership or high cycling modal share might have **low demand of bike sharing.** Most of regular cyclists prefer to ride their own bike. This problem was obvious in Lower Austria and in Brussels. Their BSS were transformed in order to offer new services.

- On the other hand, **underestimation of demand** might cause low availability of bicycles. To avoid this, BSS operators raise the number of stations and bicycles. The registration fee might also be increased, like in Barcelona, in order to control unexpected demand. Excess demand seems to be more common in the start phase of BSS located in large cities.

- BSS in tourist areas might **compete with traditional bike rental**. After the launch of Citybike Wien, shops started promoting new services like guided tours. Bicing, in Barcelona, do not offer daily or weekly registration and provide information about available bike rental shops in order to avoid this conflict.

- **Vandalism** has been a significant issue for BSS in cities that didn't previously have a cycling culture, i.e. cities with low cycling ownership or low cycling modal share. Cities like Paris, Seville or Brescia reported a large number of stolen bicycles which led to high maintenance costs.

- Where there is intensive use of the bicycles operated by a BSS (e.g. around 5 rents per bike and day in Paris), **breakdowns** can occur. This can be detrimental to the BSS' image and as the bicycle is out of service, the capacity of system decreases. To avoid this problem, operators have typically specified bicycles made of very durable components.

- When BSS stations are empty, users cannot rent a bicycle and when they are full, bicycles cannot be returned. In both cases users have to move on to the next station. This causes the user to waste time and, potentially, causes them to loose trust in the system. BSS operators, e.g., in Barcelona and Lyon, fight against this problem by **redistributing bicycles** in order to restore the balance. The unequal distribution of bicycles can be caused by two factors: topography – with downhill journeys being popular and uphill journeys unpopular – bicycles will tend to concentrate at the lower stations; commuter journey patterns and timings.

- Registration and rental fees are not enough to fund BSS. External revenues from advertising contracts or public authority subsidies are required. **Short-term and insufficient funding** compromise viability of the BSS.

- Public space is normally limited in city centres. Therefore a study of **public space availability** for fixed BSS stations is required before implementation. Sidewalks and car parking spaces might be occupied by BSS stations.

Problem	Background	Consequence	Solutions
Low demand	High bicycle ownership and cycling modal share	Uneconomical BSS	Attractive and complementary offers
High demand	Large cities	Empty stations and bad image	Increase the number of bicycles, stations
Traditional bike rental	Tourist cities	Competition	Traditional bike rental offer new services. BSS do not offer daily or weekly registration
Vandalism	Low bicycle ownership and cycling modal share	Reduction of bicycles in service. Poor system image. High maintenance costs	Specification of durable bicycles
Breakdowns	Low ratio bicycle/rents	Reduction of bicycles in service. Poor system image. High maintenance costs	Specification of durable bicycles
Redistribution	Topography or irregular demand	Unavailability of bicycles or parking spaces at docking stations. Poor system image	Avoid elevated areas for placement of stations
Insufficient funding	Bad financial planning	Closing of the BSS	Inexpensive maintenance of the BSS and reliable funding
Lack of public space for docking stations	Bad planning	Residents and businesses adjacent to proposed sites	Study of space availability

Table 4-1: Summary of the obstacles implementing a new BSS.

5. Show cases

In recent years numerous BSS have been implemented in Europe with different results in different types of countries:

- **"Established cyclists":** The use of BSS was moderate in countries with good cycling infrastructure and moderate increase of modal split.
- **"Cycling newcomers":** BSS have become very popular in countries like France, Italy or Spain, despite there was no previous cycling culture related to commuting and every day journeys.
- **"New EU partners":** Very few BSS are currently operating in central and east Europe. Therefore experience is crucial for implementing new BSS.

This factsheet is directed at this last group of countries in order to illustrate the transferability of the lessons learnt elsewhere in Europe. If any of the following cities in the Czech Republic or Poland decide to implement a new BSS, we suggest the following predictions could be made.

- **Large cities: Prague (CZ).** Prague, as a large city, might implement a high-tech BSS and operate twenty-four seven. The availability of the BSS throughout the year should be reviewed: it might be available for either limited period or available all the year round. For instance, in Vienna (10.1ºC) Citybike started with an operating period from March to December. However, demand was such that the winter break was removed in 2007. Since Prague is a tourist city with some hills and low cycling modal share, the main problems of a BSS might be vandalism, competition with traditional bike rental and redistribution. According to the Table 3-1, the number of bicycles required by the BSS can be estimated from the population. The Table 3-2 shows of the number of BSS bicycles can then be used to calculate the expected number of rents. Following this reasoning, on average around 180 stations and 2,000 bicycles might be required and around 890,000 annual rents might be expected.

	Population	Av. yearly temperature	Cycling share	Tourist city	Hard slopes
Prague (CZ)	1,233,211	11.1ºC	1.5%	Yes	West part

Table 5-1: Framework of the city of Prague.

	Bicycles			Stations			Annual Rents		
	Average	Max	Min	**Average**	Max	Min	**Average**	Max	Min
Prague (CZ)	**1,927**	11,718	18	**183**	825	8	**891,469**	5,421,519	8,154

Table 5-2: Estimation of the number of bicycles, stations and annual rents for the city of Prague.[2]

- **Medium cities: Gdansk (PL), Brno (CZ), Pilsen (CZ).** Technology access is lower in theses cites but high-tech BSS might be still the most suitable option and consequently they might operate twenty-four seven. Nevertheless, only Brno should consider the possibility of operating all the year round. Low temperatures indicate then need for winter breaks in Gdansk and Pilsen. In Gdansk redistribution might be required due to topography and competition with tourist bike rental might appear. Vandalism might be the main problem in Brno due to its low cycling modal share. The investment in infrastructure and the result might be more modest in these three cities than in Prague. On average from 250 to 650 bicycles and from 90,000 to 250,000 rents per year might be expected.

	Population	Av. yearly temperature	Cycling share	Tourist city	Hard slopes
Gdansk (PL)	455,717	7.3°C	NA	Yes	West part
Brno (CZ)	370,592	10.7°C	1.0%	No	Some hills
Pilsen (CZ)	169,273	8.7°C	6.0%	No	No

Table 5-3: Framework of the city of Gdansk, Brno and Pilsen.

	Bicycles			Stations			Annual Rents		
	Average	Max	Min	**Average**	Max	Min	**Average**	Max	Min
Gdansk (PL)	**655**	4,823	10	**61**	306	3	**247,314**	1,822,164	3,929
Brno (CZ)	**532**	3,922	8	**50**	249	2	**201,117**	1,481,795	3,195
Pilsen (CZ)	**243**	1,792	4	**23**	114	1	**91,863**	676,830	1,459

Table 5-4: Estimation of the number of bicycles, stations and annual rents for the city of Gdansk, Brno and Pilsen.[3]

- **Small cities: Tczew (PL), Sopot (PL), Kromeriz (CZ).** Low-tech BSS with limited operating hours and winter breaks might be recommended in Tczew, Sopot and Kromeriz. Competition with tourist bike rental might appear in Sopot and Kromeriz. On average from 40 to 85 bicycles and from 10,000 to 20,000 rents per year might be expected.

[2] The average, maximal and minimal number of BSS bicycles and stations were calculated by multiplying the average, maximal and minimal number of BSS bicycles per inhabitant (Table 3-1) by the population. The average, maximal and minimal number of annual rents was calculated by multiplying the average number of rents per bike (Table 3-2) by the average, maximal and minimal number of bicycles implemented.

[3] See footnote 2.

	Population	Av. yearly temperature	Cycling share	Tourist city	Hard slopes
Tczew (PL)	60,532	7.3°C	NA	No	No
Sopot (PL)	37,658	9.6°C	NA	Yes	No
Kromeniz (CZ)	29,225	8.4°C	13.8%	Yes	No

Table 5-5: Framework of the city of Tczew, Sopot and Kromeriz.

	Bicycles			Stations			Annual Rents		
	Average	Max	Min	**Average**	Max	Min	**Average**	Max	Min
Tczew (PL)	**85**	157	11	**11**	31	1	**19,945**	36,976	2,488
Sopot (PL)	**53**	98	7	**7**	20	0	**12,408**	23,003	1,548
Kromeniz (CZ)	**41**	76	5	**5**	15	0	**9,630**	17,852	1,201

Table 5-6: Estimation of the number of bicycles, stations and annual rents for the city of Tczew, Sopot and Kromeriz.[4]

[4] See footnote 2.