The Future of Car Usage: Quality Analysis and Assessment Method for Carsharing

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1. Introduction

The growing mobility needs in urban passenger transportation can be managed by exploiting the existing infrastructure and promoting public travel modes. The development of infocommunication technology provides significant support for the modern modes of travel. At the same time, traffic patterns are also changing, and this change may also be subserved. For example, among young people between the ages of 18 and 29 it can be observed that the motorized individual transportation mode share is decreasing, while the public transportation and non-motorized individual transportation mode share is growing [1]. The carsharing service fits the change in travel behaviour, combining the individual and public benefits of motorized transportation. The passenger car capacity utilization can be increased in two ways, as displayed in Figure 1:

- increasing time utilization (carsharing),

- increasing the number of passengers simultaneously delivered (carpooling).

Examples of the combination of the two modes are rare.

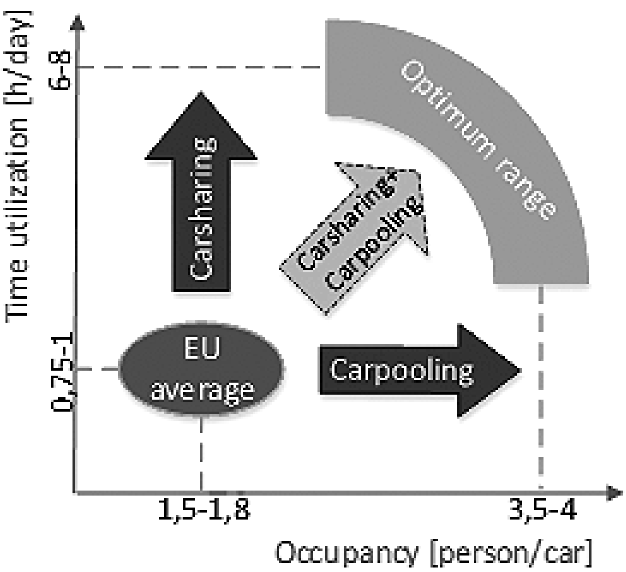


Figure 1. Ways of increasing passenger car capacity utilization (source: own research)

Carsharing is an element of the „mobility supply"; with the other transportation modes it forms a system that allows the preservation of current forms of activity and the efficient management of resources in addition the minimization of the environmental impact. Installation requirements: a high quality service meeting the user (traveller) expectations at reasonable charge.

Results of an article dealing with impact of carsharing on household vehicle holdings are given in Table 1. It is generally observed that the higher the level of carsharing service, the lower the number of motor vehicles per household [2]. 9-13 owned cars can be replaced by one individual car [3], so the volume of stationary traffic is reduced.

Several articles deal with the traditional public transportation quality issues ([4], [5]); however the methods have not been adapted to assess car sharing yet. On the other hand several studies have already examined the conditions of success of carsharing systems [6], [7], [8], [9]. In [10] a fuzzy classification has been devised to derive a service model that provides the highest income for service providers and the best service for customers according to performance indicators. The discrete event simulation presented in [11] also assists the decision makers by exploring areas for improvement and offering solutions. In [12] several practices are proposed which help to increase the acceptance and success of the carsharing system regardless of the service types. In another publication the number of potential carsharing users is determined on the basis of residence attributes, which helps to select the appropriate operation area [13]. In [14] demand structure is uncovered and motivation patterns are identified regarding carsharing. We built knowledge identified during the literature review into our assessment method.

There are numerous types and operational models of carsharing systems, and their application depends on the size of the settlement and the population characteristics. Installation of a new system (or extension of an existing one) can be established of scientific standard with the following modeling and method development steps:

- travel demand model (choice modeling),

- installation area choice method (stages of extension),

- vehicle fleet determining method,

- service characteristics determining method,

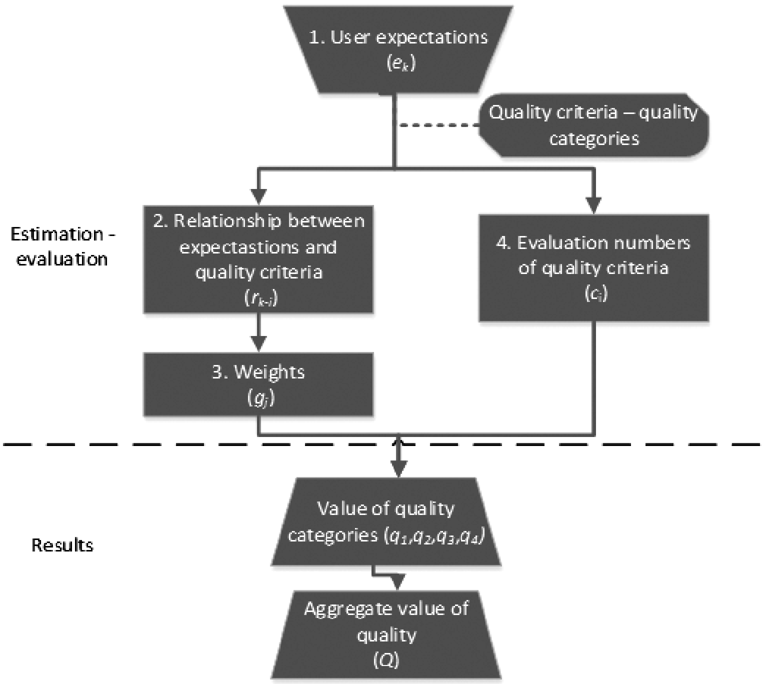
- business model.

Multicriteria analysis and comparison of the current operating systems (best practices) serve the establishment of the steps above. In this paper a compensated multicriteria method developed in our research is reviewed, which can determine the level of quality of carsharing systems. The multicriteria method takes a large amount of data into consideration [15], furthermore the impacts described by exact values as well as hardly or non-quantifiable factors can both be evaluated [16]. It is suitable for both retro- (ex post) and prospective (ex ante) use [17], and takes the individual criteria into consideration with different weights because of the compensation. However there are also limiting factors. The result significantly depends on the structure and amount of available information, and the preference of the evaluators [15]. Due to the properties, the method becomes increasingly popular in ratings pertaining to transportation [18], [19], [20].

2. Analysis and assessment method

During the development of the method we focused on the users' (travellers') personal expectations and demands. Figure 2 summarizes the operation, the steps are the following:

Figure 2. Application of the analysis and assessment method



(source: own research)

- Importance of user expectations on the basis of the characteristics of the users is determined.

- The relationship between expectations and quality criteria is considered to ascertain the degree to which the expectations are fulfilled by the criteria.

- Weights are determined on the basis of importance of expectations as well as the relationship between expectations and quality criteria.

- Evaluation numbers are calculated on the basis of the carsharing system's parameters and user expectations.

The results are weighted mean values based on the weights and evaluation numbers. They can be calculated for each quality category. Quality categories are specific groups created from the criteria. The total quality of the carsharing system can be calculated as an aggregation of values of the quality categories.

Our quality analysis multicriteria method can be applied in two ways:

- in a general way: without knowing the users' priorities and only for certain areas of the city (with house number accuracy),

- in a personalized way: incorporating the users' priorities and places into A.

3. Quality criteria – quality categories

The determination of the carsharing service quality number is based on quality criteria. These may be either constant or spatially and/or temporally variable. Table 1 summarizes the quality criteria and their evaluation numbers. In public transportation there are widely accepted norms that allow transforming subjective parameters into objective ones. We have applied these norms only with slight modifications for carsharing systems.

We applied the compensated multicriteria method instead of alternative methods, since the weighted mean value allows consideration of the criteria with different levels of importance. For the sake of uniform scoring, we applied a 1-to-5 rating scale, where 1 is the worst and 5 is the best value. Our purpose during the development of the assessment method was to assess the utmost parameters from the user's perspective.

Figure 3 displays the grouping of spatially and/or temporally variable carsharing criteria. The other criteria are assumed to be constant.

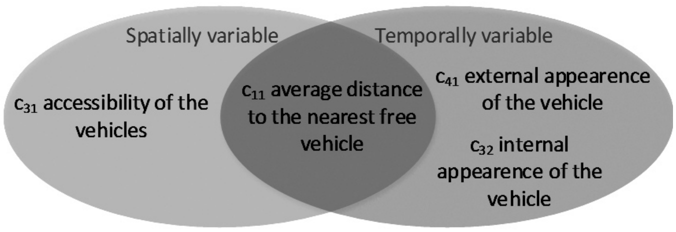


Figure 3. Variable quality criteria (source: own research)

Quality criteria			Evaluation number	
group	**c_j**	**name**	**range**	**pt.**
flexibility	C_0	type of service	round-trip	1
			one-way	4
			free-floating	5
availability	C_{11}	average distance to the nearest free vehicle*	d ≥ 800 m	1
			d ≤ 250 m	5
	C_{12}	minimum and maximum period of usage*	**UT=MIN+MAX**	
			MIN≥ 1 hour	1
			MIN≤ 0,5 hour	3,5
			MAX≤ 4 hours	0
			MAX≥ 10 hours	1,5
			MIN, MAX: lower and upper limit of usage.	
	C_{13}	operating time*	**OT=0,7x+6,7y+2z**	1-5
			OT≤60	1
			OT=100	5
			Operating time [hour]	
			between 0 and 7	*x*
			between 7 and 20	*y*
			between 20 and 24	*z*
reliability	C_{21}	booking	**R=F+1/m**	1-5
			no booking	*F=1*
			booking required	*F=3*
			optional booking	*F=4*
			m: Continuous range. As many hours the booking can be modified before the start of the trip.	
comfort	C_{31}	accessibility of the vehicles	**A=1+0,5B+1,5T+4U**	1-5
			Number of connection points less than 250 m away: B: bus, trolley, T: tram, train U: underground.	
	C_{32}	internal appearance of the vehicle	by users' questioning	1-5
	C_{33}	driving behaviour	by users' questioning	1-5
	C_{34}	capacity – round-trip	P <4, L <400 l	1
			P=4, L <400 l	2
			P=5, L <400 l	3
			P=5, L> 400 l	4
			P> 5	5
		capacity – one-way, free-floating	P=2	3
			P=3 or 4	4
			P≥ 5	5
			P: seats [person], L: volume of luggage-rack [l]	
comfort	C_{35}	conditions of refuelling*	S<25%,	1
			S≥75%	4
			performed by operator	5
			S: petrol stations can be used close to the service area [%].	
	C_{36}	conditions of parking	$P=1+B+Ph_d/n°_v$, $P \in [1..5]$	
			parking place booking possible	B=1,5
			parking place booking not possible	B=0
			Ph_d: N° of dedicated parking places $n°_v$: N° of vehicles	
	C_{37}	other necessary activities	by users' questioning	1-5
other parameters of the vehicle	C_{41}	external appearance of the vehicle	by users' questioning	1-5
	C_{42}	vehicle length *	l > 4800 mm	1
			l ≤ 2965 mm	5
	C_{43}	vehicle safety	According to EuroNCAP results: 1 star 1 point.	
	C_{44}	CO_2 emission*	$Ex_{pr} \leq Ex_{cs}$	1
			Ex_{pr}, Ex_{cs}: average CO_2 emission of private and carsharing vehicles [g/ km].	
			Ex_{cs}= 0	5
	C_{51}	acceptability of the system	by users' questioning	1-5
	C_{61}	information system	by users' questioning	1-5

*: Continuous range. Evaluation by linear interpolation between the two limits.

Table 1. Quality criteria and their evaluation numbers (source: own research)

The quality of the carsharing service is a spatially and temporally variable dynamic parameter, as the average distance to the nearest vehicle (c_{11}) is not constant, since the demand rate is different in each term [21]. Fluctuations in demand are the basis of the dynamic characteristic. Furthermore accessibility of the vehicles (c_{31}) is also spatially variable due to the quality of public transportation depends on the location. Internal (c_{32}) and external appearance (c_{41}) of the vehicle are temporally variable due to the use.

We omitted the users/population number per vehicle quality criterion from the assessment method, since this rate and the quality of service are not clearly related. This is proved also by observation, as the users/population number per vehicle varies widely [22]. The evaluation of criterion c_{11} (average distance to the nearest free vehicle) for systems before installation is not obvious. It is necessary to determine a utilization rate for each term and to estimate the expected spatial distribution of vehicles for one-way and free-floating systems. A simple estimation can be applied: the expected number of free cars is distributed among the zones on the basis of population and density. The latter two indicators are related to the number of users. In our simple calculation, 50% of the vehicles are distributed on the basis of number as well as the other 50% on the basis of the density of population in each zone. In both cases the zone attributes are compared to the aggregate attribute of all zones.

The acceptability of the system (c_{51}) depends on the following:

- the clarity of the network and tariff system,

- the circumstances of registration and payment,

- the circumstances of vehicle booking,

- the manageability of the on board unit.

The quality of the information system (c_{61}) is influenced by:

- information about the vehicles,

- information about road traffic and parking,

- information about public transportation.

We have created four categories from the quality criteria in reference to the carsharing system on the basis of the standardized quality approach for public transportation that is used in the European Union:

- quality of service,

- quality of travel,

- manageability,

- environmental impact.

Figures 6-9. display the categorization of quality criteria.

4. Assessment

4.1. User expectations

Since the user characteristics are individual, the weights and the perceived quality of service are different for each person. The user preference is primarily influenced by the mobility patterns. The density of residence [23] and the number of household vehicles significantly affect a person's traffic patterns. The user expectations are given in Table 2. We applied a 1-to-5 scale for rating the importance of user expectations by their responses to the questionnaire. Accordingly, values between 1 and 5, where 5 marks the most important, can be found in the range of the expectation variables (e_1-e_9). Although reasonable cost is an important user expectation, we did not address it since the quality of the service is independent of the cost. In the case that the individual user preferences are unknown and the 'A' type of assessment method is applied, average preference values may be determined on the basis of local knowledge.

We have determined the user expectations by questionnaires. The advantage of that is high data volumes can be collected at low input, though the validity of the information depends on the content of the questionnaire and the respondents' knowledge about the carsharing.

Symbol (e_i)	Name
e_1	Freedom, independence
e_2	Free parking place
e_3	Connection with public transportation
e_4	Reliability
e_5	Comfort, easy-to-use
e_6	Sustainability
e_7	Information about the service
e_8	Belonging to a community
e_9	Security

Table 2. The user expectations (source: own research)

There is no significant difference in mean values of importance of user expectations based on the answers of the respondents (Figure 4), and the standard deviation is rather high compared to the total range of value for every expectations: 2 or more in each case. Therefore the preferences are different for each user, and the quality level of service should be determined individually to each person. The values of importance of user expectations can be considered as constants, though it

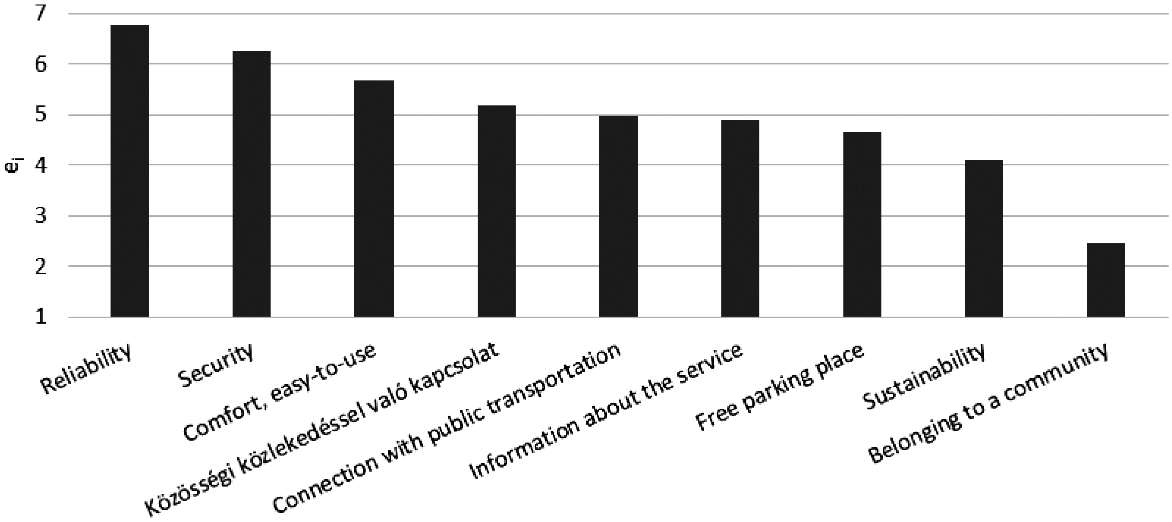


Figure 4. Mean values of importance of user expectations (ei) (source: own research)

is important to note that the importance of a free parking place depends on their actual number, which is different for each term. Thus the quality depends on the user characteristic, time and location.

Private car use				Public transportation	
Advantage	[%]*	Disadvantage	[%]*	Disadvantage	[%]*
Freedom, independence	84	Expensive	69	Crowded	47
Comfortable	53	Lack of free parking places	45	Unreliable	41
Reliable	30	Environmental impact	38	Uncomfortable	33
Fast	14	Slow	28	Poor condition of infrastructure	27
Safe	9	Unused capacities	13	Inflexible	27
Technical condition of the vehicle is known	8	Maintenance tasks	11	Slow	19
Fun	3	Unreliable	11	Dirty	14
*: prevalence of answers [%]		Stress	8		
		Not safe	6		

Table 3. Advantages and disadvantages of private car use, disadvantages of public transportation (source: own research)

The answers given to advantages and disadvantages of private car use, and disadvantages of public transportation (Table 3) are consistent with the results of previous foreign studies. The most often mentioned advantage of private car is freedom, independence. Aware of this it is unexpected that carsharing user expectation 'freedom, independence' the 5th most important. Another unexpected result that the security is the 2nd most important carsharing user expectation, but only 15% of the respondents mentioned safety as an advantage of private car use. The cost is the most frequently occurring drawback of private car use, but we not dealt with it.

Carsharing is a public transportation mode, therefore it is necessary to analyse the features of the public transportation. It is not a huge drawback that the carsharing does not offer full mobility, if we integrate the carsharing system into a well-functioning public transportation system.

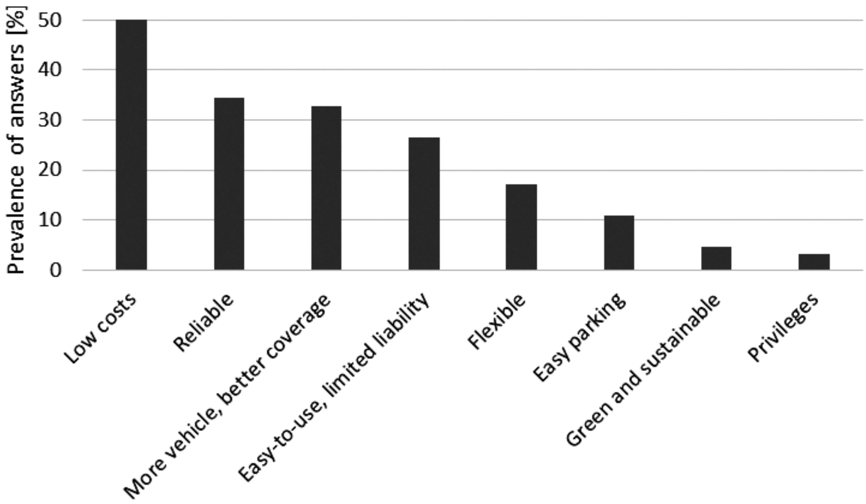


Figure 5. The conditions, under that the respondents would use carsharing (source: own research)

We examined under what conditions the respondents would use the carsharing service (Figure 5). 15% of the respondents mentioned the lack of free parking places as a disadvantage of private car use, but on the other hand only 10% of them mentioned easy parking as an accession criterion. 5% of respondents thought that carsharing and carpooling are the same. The rate is low, though the questionnaire was filled out at our university where carsharing is part of education. It can be assumed that this rate would be significantly higher over a representative sample. Inadequate knowledge and fear of the unknown can impede the success of a carsharing service.

In summary the carsharing service can be successful among the users on the basis of the result of the survey, if it is:

- significantly cheaper than the private car use, not much more expensive than the public transportation,

- reliable,

- easy-to-use,

- available close to the user.

4.2. Relations between expectations and quality criteria

The weights (gj) can be determined on the basis of the importance of user expectations and the strength of the relationship between expectations and quality criteria. The strength of a relationship (ri,j) indicates how the expectations (i) are fulfilled by a criterion (j). While user expectations are different for each person, the relationships between user expectations and quality criteria are not. Therefore these relationships determined by questionnaire are applicable for all users.

The respondents had to determine the presence and the strength of the relationships. The qualitative features are associated with values: 1 – strong relation, 2 – medium relation, 3 – weak relation. The connection matrix between user expectations and quality criteria is shown in Table 4.

The number of links of “other necessary activities” (c_{37}) did not exceed the minimum requirement value which is the 20% of the respondents; hence the number of connections is 0. According to feedback, the name of this quality criterion was not obvious.

$r_{i,j}$ [%]		User expectations (i)									Number of connections
		(e_1)	(e_2)	(e_3)	(e_4)	(e_5)	(e_6)	(e_7)	(e_8)	(e_9)	
Quality criteria (j)	c_0	18,8									1
	c_{11}	10,7		34,5	25,7	14,1					4
	c_{12}	24,7									1
	c_{13}	18,1			34,6						2
	c_{21}	27,7									1
	c_{31}			65,5		6,4					2
	c_{32}					17,8					1
	c_{33}				39,7	7,2				30,1	3
	c_{34}					15,4					1
	c_{35}					11,2					1
	c_{36}		100								1
	c_{37}										0
	c_{41}					5,1			100		2
	c_{42}					8,0					1
	c_{43}									69,9	1
	c_{44}						100				1
	c_{51}					14,9		31,1			2
	c_{61}							68,9			1
$\sum_j r_{i,j}$		100	100	100	100	100	100	100	100	100	-
Number of connections		5	1	2	3	9	1	2	1	2	26

Table 4. Connection matrix between user expectations and quality criteria (source: own research)

We plan to improve the reliability of the results by a new survey which will be more widely filled out. Each answer was different; hence the connection system is not independent of the person. Nevertheless it is not necessary to determine the connection system for each person, because:

- he assessment method must be easy-to-use,

- the quality level remains personalized because the individual user expectations have greater influence than the connection system.

Figures 6-9 summarize the relationship between quality criteria and user expectations by quality categories.

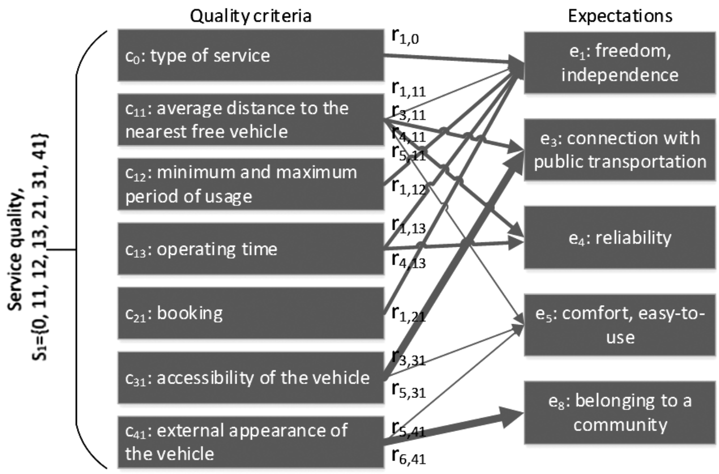


Figure 6. The effect of service quality criteria on expectations and the strength of relationships (source: own research)

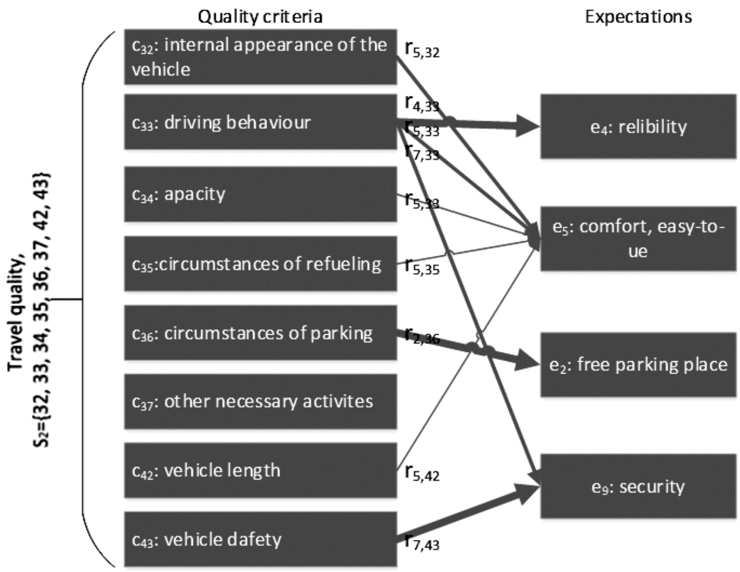


Figure 7. The effect of travel quality criteria on expectations and the strength of relationships (source: own research)

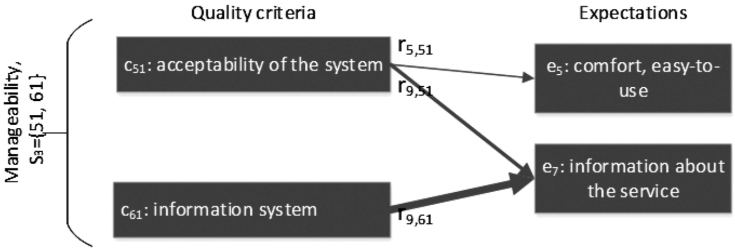


Figure 8. The effect of manageability criteria on expectations and the strength of relationships (source: own research)

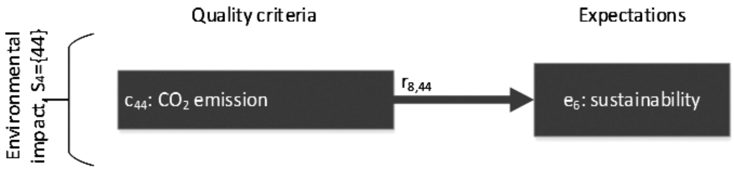


Figure 9. The effect of environmental impact criteria on expectations and the strength of relationships (source: own research)

For example $r_{1,13}$ indicates the strength of the relationship between expectation 1 (freedom, independence) and criteria 13 (operating time).

4.3. Calculation of weights

The weights are calculated in two steps on the basis of equation (1) and (2):

$$g_j = \sum_{i=1}^{9} g_{i,j} \quad (1)$$

$$g_{i,j} = r_{i,j} \cdot \frac{e_i}{\sum_i e_i} \quad (2)$$

Where:

j: the index number of quality criteria (0, 11, 12, 13, .., 61),

i: the index number of expectation (1..9).

According to equation (1), if a quality criterion is in relation with several user expectations, the resultant weight (g_j) is the sum of partial weights of each expectation. The partial weight of one criterion and one expectation can be calculated on the basis of equation (2). The numerator of the first fraction is the strength of the relationship; the denominator is the sum of strengths of the relationships subject to the same expectation. The numerator of the second factor is the importance of the expectation; the denominator is the sum of the importance of every expectation. It is impossible to determine a weighting system that is uniformly valid everywhere since the preferences are different; however the expectations of real and potential users are the same. Furthermore the following two constraints must be met:

- $0 \le g_j \le 100, \forall g_j$
- $\sum g_j = 100$

The weighting system can be derived with consideration to either average or individual preferences of real and potential users. In the latter case, personalized quality level is determined, which provides significant support in decision-making.

4.4. Evaluation numbers of quality criteria - evaluation

During the determination of the evaluation numbers of the quality criteria the users' interests have been considered. Some examples: the distance that is accepted by a user to walk to a vehicle (c_{11}), the fluctuation of the demand within one day (c_{13}, weights), the travel demand characteristics of each service type (c_{34}), and the applied vehicle length for parking place design purposes (c_{42}). The quality criteria, that do not require user involvement, can be evaluated objectively. The evaluation method is given in Table 2.

There are three input sources of data required for the evaluation:

- user characteristics (c_{11}, c_{32}, c_{33}, c_{37}, c_{41}, c_{51}, c_{61}),

- properties of carsharing service (for each criterion),

- areal properties (c_{31}).

5. Calculation of results

By using the carsharing quality analysis method the service quality (q_1), travel quality (q_2), manageability (q_3) and environmental impact (q_4) can be calculated separately on the basis of equations (3-6). The aggregated result is a weighted mean value, which

$$q_1 = \frac{\sum_j g_j c_j}{\sum_j g_j}, \forall j \in S_1 \quad (3)$$

$$q_2 = \frac{\sum_j g_j c_j}{\sum_j g_j}, \forall j \in S_2 \quad (4)$$

$$q_3 = \frac{\sum_j g_j c_j}{\sum_j g_j}, \forall j \in S_3 \quad (5)$$

$$q_4 = \frac{\sum_j g_j c_j}{\sum_j g_j}, \forall j \in S_4 \quad (6)$$

$$Q = \frac{\sum_j g_j c_j}{100} \quad (7)$$

can be calculated on the basis of equation (7).

The values concerning the quality categories and the aggregated quality number can be beneficial for potential users in decision making. The carsharing systems are comparable by the calculated results.

Spatial representation of the service quality is appropriate for the identification of areas where the quality of service is low as a consequence of the high average distance to the nearest free vehicle. Patterns of use become visible by representing the temporally variable distribution of free vehicles on a dynamic map. The areas can be recognized where the number of vehicles is low. Furthermore the areas in need of development can be identified and the ranking of development options also can be determined on the basis of the results. To do this, the assumed conditions after the interventions can also be evaluated by our quality analysis method.

6. Application of the method in Wien

We applied the method with the knowledge of individual user preferences (type 'B') to estimate the autumn 2014 conditions of a fix-floating and free-floating carsharing system. As part of that:

- The weights have been calculated on the basis of two different user expectations.

- Evaluation numbers have been determined on the basis of service attributes.

- The results have been displayed on a dynamic map by an application.

Table 5 summarizes the evaluation numbers.

We determined the quality numbers for two different user preferences:

- the first one uses the carsharing service instead of private car,

- the second one mainly uses public transportation.

Evaluation numbers				
c_i	Fix-floating system		Free-floating system	
	attributes	value	attributes	value
c_0	Fix-floating	1	Free-floating	5
c_{11}	> 50 vehicles	spatially variable	700 vehicles	spatially variable
c_{12}	MIN= 1 hour, MAX>10 hours	2,5	MIN <0,5 hour, MAX>10 hours	5
c_{13}	Operation 0-24	5	Operation 0-24	5
c_{21}	Booking required	3	Booking not required	4
c_{31}	Depends on the location	spatially variable	Depends on the location	spatially variable
c_{32}	New, aesthetic	5	New, aesthetic	5
c_{33}	No information	-	No information	-
c_{34}	Depends on the vehicle	3-5	P=2 person	3
c_{35}	S>75%	4	Performed by operator	5
c_{36}	$Ph_d=n°_v$, booking not possible	2	Very small amount of dedicated parking places	1
c_{37}	Not important due to $g_{37}=0$	-	Not important due to $g_{37}=0$	-
c_{41}	Aesthetic	5	Aesthetic	5
c_{42}	Depends on the vehicle: 3546-4782 mm	1-3,7	l=2965 mm	5
c_{43}	Depends on the vehicle	2-5	4 stars	4
c_{44}	Estimation	1,5	Estimation	2
c_{51}	Clear, simple, easy to use, quick registration	5	Clear, simple, easy to use, quick registration	5
c_{61}	Appropriate amount of information	4	A lot of information	5

Table 6 summarizes the user preferences.

Symbol (e_i)	Name	values of e_i	
		1. user	2. user
e_1	Freedom, independence	9	3
e_2	Free parking place	5	2
e_3	Connection with public transportation	6	7
e_4	Reliability	8	5
e_5	Comfort, easy-to-use	7	6
e_6	Sustainability	1	1
e_7	Information about the service	3	8
e_8	Belonging to a community	2	9
e_9	Security	4	4

Table 5. Evaluation of carsharing services in Wien (source: own research)

Table 6. User preferences of different users (source: own research)

users	Weights																	
	g_0	g_{11}	g_{12}	g_{13}	g_{21}	g_{31}	g_{32}	g_{33}	g_{34}	g_{35}	g_{36}	g_{37}	g_{41}	g_{42}	g_{43}	g_{44}	g_{51}	g_{61}
1.	3,8	13,5	4,9	9,8	5,5	9,7	2,8	10,2	2,4	1,7	11,1	0	3	1,2	4,7	4,4	5,1	6,1
2.	1,3	10,8	1,6	5	1,8	11	2,4	10,7	2,1	1,5	4,4	0	2,9	1,1	12,4	20	4,7	6,1

The weights calculated on the basis of different user expectations are shown in Table 7.

Table 7. Weights for different user expectations (source: own research)

	Quality	Fix-floating	Free-floating
1. user	q_1	3,2-4,2	3,8-4,9
	q_2	3,4	2,7
	q_3	4,5	5
	q_4	1,5	2
	Q	3,3-3,9	3,6-4,2
2. user	q_1	3,4-4,6	3,7-4,9
	q_2	4,2	3,6
	q_3	4,4	5
	q_4	1,5	2
	Q	3,3-3,8	3,4-3,9

Results calculated on the basis of values from the previous tables are shown in Table 8.

Table 8. Quality numbers by categories (source: own research)

The value of q1 is spatially variable due to quality criterion c11 and c31. Consequently the value of Q is also not spatially constant. The main differences between the two services are service (q1) and travel quality (q2). The free-floating service has a higher quality level of service due to its flexibility, while the fix-floating service's travel quality is better due to the more comfortable vehicles. In the case of the 2nd user the travel quality (q2) is significantly higher regarding both services. The reason of it the huge differences between g36 and g43 in the two cases. Figure 10 displays the spatial change of Q. In this analysis it was impossible to investigate the temporal change of quality due to the lack of information about usage.

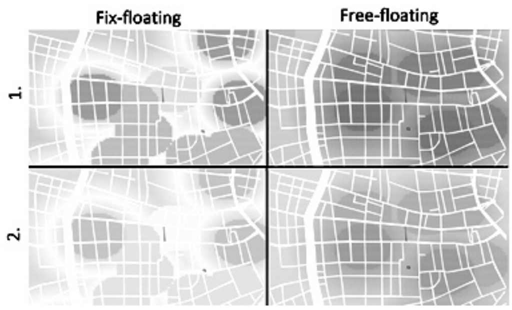


Figure 10. Spatial change of Q in Wien, Neubau (source: own research)

In this example, disregarding the average distance to the nearest free vehicle, the weak points of the fix-floating system are: type of service (c0, 1 point), CO2 emission (c46, 1,5 point) and conditions of parking (c54, 2 point). In the first case among these criteria the c54 has the largest weight; hence the most efficient way to increase the service quality is to establish dedicated parking places. In the second case the most efficient way to improve quality is to reduce the average CO2 emission of the vehicles.

The weak points of the free-floating system are: lack of dedicated parking places (c54, 1 point), CO2 emission (c46, 2 point) and capacity (c34, 3 point). Taking into account the weights, the most efficient ways to increase quality are the same: establish dedicated parking places and reduce CO2 emission. If there were vehicles with bigger capacity in the fleet, the quality would increase significantly.

7. Conclusion

High service quality and good value for money are the conditions for a successful carsharing service. By applying the carsharing system quality analysis method, the degree the service satisfies the expectations of the user can be determined in view of the individual user preferences and locations. Travel mode choice depends on three aspects: personal expectations, service quality and service charge, thus our assessment method can be built into the process of transportation related decision support applications concerning various terms.

The quality analysis method is appropriate for evaluation of the system before installation, during operation or after interventions that affect the quality. In addition the impacts of future development plans or completed interventions on quality can be evaluated by pro- or retrospective assessments. The development plans can be evaluated by cost-benefit (benefit: increasing quality) assessments and priorities can be determined on the basis of intervention costs.

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