AN EXPERIMENTAL CUSTOMER SATISFACTION INDEX TO EVALUATE THE PERFORMANCE OF CITY LOGISTICS SERVICES

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Abstract. Freight transport in urban areas entails benefits (i.e. free access to goods when needed), but also negative externalities (environmental, social and transportation impacts). In response to these problems the concept of city logistics emerged, for the purpose of planning, organizing, coordinating and controlling physical and information flows in order to find a compromise between efficient freight distribution in urban areas and protection of the environment. A typical city logistics initiative is the Urban Freight Consolidation Centre (UFCC), the benefits of which are significant. Its financial issues though represent a huge problem for public administrations. However, a large customer network, comprising retailers participating in the initiative, could make the UFCC a self-financing scheme. The key to expanding the scheme is closely linked with marketing campaigns and customer care. Therefore, customer care analysis represents an important tool in developing UFCC schemes.

In this paper a new Customer Satisfaction Index (CSI) is proposed for evaluating UFCC service quality. The new index, named CSI_{mod}, is a modified version of the traditional CSI, but places greater emphasis on customer dissatisfaction, so as to analyse the most critical areas of the service with a view to improving them. The index has been tested using experimental data collected within the Civitas Renaissance Project, in which the Bristol and Bath Freight Consolidation Centre (BBFCC) scheme was evaluated. The evaluation was done from a user perspective, i.e. the participating retailers. The CSI_{mod} places more importance on the most dissatisfied customers making it possible to understand why they are dissatisfied and with what. Thus, it is possible to intervene with the aim of improving those areas of the service that are perceived as the worst. In spite of the high level of satisfaction with the overall service provided by the BBFCC, thanks to the CSI_{mod} the analysis pointed out that some retailers are dissatisfied with the delivery time arrangements and also with deliveries that were getting wet, issues about which the BBFCC manager was totally unaware. The CSI_{mod} could be used by UFCC operators to extend the network of the retailers involved and could therefore provide an implicit solution for making the scheme self-financing.

Keywords: Transport policy; Freight scheme evaluation; Urban Freight Consolidation Centre (UFCC); Customer Satisfaction; Customer Satisfaction Index (CSI); Modified Customer Satisfaction Index (CSI_{mod}); (Alt + Ctrl +K)

Introduction

National and international economies are giving ever more importance to transport in terms of improving mobility and providing benefits to individuals and businesses; however it is worth noting its main role in producing negative impacts towards the environment also due to the consumption of non-renewable energy (Islam *et al*. 2013). These negative externalities are obviously more important in urban areas, due to the people presence. Measures to reduce the impacts of freight transport in urban areas in order to achieve a more sustainable urban mobility have to be implemented; models and tools for transport planning rarely include or take into account freight transport in the urban area (Lindholm 2013). The necessity to find solutions in order to reduce the effects of negative externalities on urban areas is of growing interest in studies in the field of urban freight transport (Russo, Comi 2011). To this purpose, Urban Freight Consolidation Centres (UFCCs) are introduced.

An Urban Freight Consolidation Centre (UFCC) is a logistics facility that is located close to the urban area. Deliveries can be made from the UFCC using environmentally friendly vehicles to a city centre, an entire town or a specific site such as a shopping centre, airport, hospital or major construction site (Browne *et al.* 2005). Initial funding from central or local government is necessary for feasibility studies and trials when the UFCC project starts (Browne *et al.* 2007). However a substantial number of UFCC trials have been abandoned. So, potential users need to be persuaded as to the convenience and efficiency of UFCCs so as to provide revenue thereby reducing or removing the need for public subsidies such that the UFCC can become financially self-supporting. In this sense, dedicated customer care planning represents an essential tool for UFCC managers because communication between a company and its customers plays a key role in the success of the company. The aims of communication are:

- Organizational responsibility, as through information flows it is possible to connect strategy and structure, decision areas and functional areas;
- Internal cohesion, which facilitates the development of the relationship value, thereby promoting a sense of belonging and integration.

Thus, it is necessary to create a communication network in order to obtain a wide range of information using user satisfaction as a tool for analysing service quality. Of major importance in this sense is the constant monitoring and comparison of results as well as feedback, configuring communication as a two-way process.

According to Reichheld and Schefter (2000), *"…building superior customer loyalty is no longer just one of many ways to boost profits. Today it is essential to survive...*". The success of a business depends on customer satisfaction. However, often attracting new customers and (or) marketing strategies prevail over the quality of the service offered to existing customers.

No studies on customer satisfaction with city logistics and/or UFCC schemes have yet been conducted. Most of the customer satisfaction analyses carried out in the transportation sector concern satisfaction with transit passenger services (above all bus services). Users who have a good experience with transit services will probably use them again, while those who do not are likely not to use them the next time. For this reason, improving service quality is important for retaining habitual and for attracting new users (Eboli, Mazzulla 2009).

Based on this statement, it could easily be generalized that satisfied customers buy more often, generate a higher value of orders and can procure new customers. A businessman should understand the quality experience of his customers to be successful and he is able to do this by listening to his customers.

Morfoulaki *et al*. (2010) terms customer satisfaction as "*…the overall level of attainment of a customer's expectations…" adding that "…it is measured as the percentage of customer expectations which has actually been fulfilled".*

Nevertheless, it is often difficult to understand and especially recognize how to code customer satisfaction for improving the service. Hence, collecting data is not enough if one does not know how to use them.

This paper addresses the following key questions:

- How should the service provided by UFCCs be evaluated?
- How could customer feedback be used to improve the service in UFCC schemes?

Quality could be measured by means of "indicators" or "indices" which make it possible to perform an unbiased evaluation of the collected data, so as to be able to take the best business decisions. The quality evaluation targets are:

- Improve customer satisfaction;
- Reduce costs;
- Make organization performance visible and recognizable by everybody at an objective level (employees, customers, etc.);
- Compare performance over time.

The main indicator used to evaluate customer satisfaction is the Customer Satisfaction Index (CSI).

In this paper the authors propose a new CSI formula, which incorporates the weights of responses, with the aim of bringing to light those areas in which even only a small proportion of customers is not satisfied. Thus it is possible to improve services for all customers' needs, without neglecting the weakest (i.e. customers representing a minority).

This study considered the problem of UFCCs system performance assessment using CSI. The new CSI version is intended to improve the service provided by the UFCC aiming to recruit more retailers to the consolidation scheme thereby making it self-financing.

Bristol was involved in three projects funded by EU that provided for the use of a Consolidation Centre. The first project was the CIVITAS VIVALDI (2002-2006); the BBFCC served retailers that joined the project and that

were located in Broadmead shopping area (Bristol city centre). In 2007 started the second project, START(2007-2008); 70 retailers from Bristol city centre (Broadmead and Cabot Circus commercial areas) joined the scheme. The third project was CIVITAS-RENAISSANCE; this project involved the city of Bath, very closed to Bristol, but due to the excellent results of the two previous projects, the Bristol City Council, in partnership with Bath & North East Somerset Council, decided to provide the founding to finance the BBFCC, so as that the retailers could follow using it. The BBFCC is the first urban freight consolidation centre in UK serving two city centres: Bristol (83 retailers) and Bath (21 retailers). It is managed by DHL and deliveries are made by electric vans, reducing so the polluting emissions.

All the previously mentioned projects considered a first trial phase, during which retailers did not pay to join the scheme and to benefit from the services provided by the BBFCC. After the trial phase, retailers started paying for their deliveries, but local authorities (Bristol City Council and Bath & North East Somerset Council) continue to subside the scheme, because it otherwise cannot be economically independent, due to the low number of retailers involved and the high operational costs. Its self-financing is a big challenge.

Nobody left the scheme as a result of the fee being applied, indicating that they realized they were benefitting from using the BBFCC.

The BBFCC provides additional services for free (i.e. storage, pre-retailing, crisis stock management, drip feed of stock, recycling of cardboard and shrink wrap). However, only a minority of the survey participants received additional services and the most frequently mentioned benefit was delivery to stock room. In fact, thanks to the BBFCC, retailers can reduce their warehouse space needs and they can convert it into space for sale. The outlets belong to bigger commercial organizations or multinational corporations, so the deliveries are arranged by the head office of these corporations, which also provide for payment of the BBFCC service. The survey discovered that store managers are often unable to know how/what orders and deliveries are made (head office decision) and a few store managers were unaware of DHL and the BBFCC.

For all these reasons, those interviewed were not able to give their opinions about the added value and value for money related to the BBFCC. Of course, the BBFCC represents an important advantage in terms of vehicle-km reduction for the suppliers, and in this sense is an important means of cutting costs (e.g. vehicles, drivers, storage spaces, etc.). In the opinion of the manager of the BBFCC, the retailers that are not participating in the project do not engage because they perceive it as an additional cost or an extra link in the supply chain.

1. State of art

1.1. Customer Satisfaction Analysis for city logistics models

UFCCs are one of the possible city logistics initiatives and are becoming increasingly popular in sustainable urban freight mobility schemes. While they can offer considerable societal benefits, many commercial organizations remain highly sceptical, particularly larger businesses, and wide differences in opinion exist within individual sectors (Chalker, 2011). There are no studies of UFCC service quality in the literature, and few studies in which the service provided by the UFCC is evaluated by its customers: the retailers.

With customer satisfaction it is possible to:

- Devise new approaches to service delivery and/or actions to improve existing ones, tailoring specifications to the actual needs of citizens and businesses;
- Encourage user involvement and participation in the early stages of access to, use and evaluation of the service, in order to build and maintain trust between business and customer.

The manner in which a survey is conducted can produce different, often even conflicting, outputs. Customer satisfaction can be an important tool in prioritizing choices and in assessing company performance. According to Woxenius (2012), "*The usual objectives of performance management are to decrease cost and to improve efficiency and effectiveness. An issue that arises is whether an item, a consignment, a unit load, a vehicle or vessel, a full transport system or even a logistics or supply chain is the best level of analysis*". There are no fixed rules for measuring an organization's performance: there are different ways of measuring quality and for obtaining an objective idea of that performance. When conducting a customer satisfaction analysis, it is very important to compare the data collected using statistical indices, which provide a better understanding of those parameters that have a greater impact on user satisfaction.

The construction of a model for assessing the overall satisfaction index allows one to identify those aspects of the service that affect user satisfaction to a greater extent (Castillo, Benitez 2012). In addition, the model quantifies this importance and the information provided can be used by transit service operators to focus improvements on those aspects considered by users to be the most important. Business and service companies can use the CSI for measuring customer satisfaction and monitoring service performance.

Quality assurance is essential to check if services provided by an organization are responsive with respect to customers' needs. In this sense, customer satisfaction analysis becomes a focal tool for quality assurance assessment and management. In a wider vision of a quality assurance system, customer satisfaction analysis can be imagined as the part related to the customer communication and management, without which a business may collapse: satisfied customers are necessary for the health of a business. Customer satisfaction analysis provides feedback that reflects the quality of the service as it is perceived by the customers.

1.2. Measuring customer satisfaction: a brief review

Quantifying customer satisfaction of products and services

is gaining increasing importance (Farris *et al.* 2010). The CSI is, in addition to financial indices, one of the most comprehensive results of the efforts of quality professionals (Poliaková, 2010).

An indicator for measuring customer satisfaction was introduced for the first time in marketing and it could provide a quantitative measure of "the number of customers or percentage of total customers, whose reported experience with a firm, its products, or its services (ratings) exceeds specified satisfaction goals" (Farris *et al.* 2010).

In 2002 Parasuraman *et al*. proposed the ServQual method with which they introduced a new customer satisfaction concept. They differentiate between customer expectations and customer perceptions and found that customer satisfaction depends on what customers expect from and what they perceive of the service. ServQual is the most widely used method for measuring customer satisfaction and consists in determining an index calculated through the difference between perception and expectation rates expressed for five generic dimensions or service factors (Tangibles, Reliability, Responsiveness, Assurance and Empathy); 22 statements measure the performance across these five service factors; the method uses a seven point Likert scale (from "strongly disagree" to "strongly agree") measuring both customer expectations and perceptions (Gabbie and O'Neill, 1996).This method was studied and modified by Cronin and Taylor in 1994; they introduced the ServPerf method, and Teas in 1993 proposed a model named Normed Quality (NQ).

However, the first ServQual method proposed by Parasuraman e*t al.* (2002) is still the most commonly used for calculating the customer satisfaction index. In 1989 the Swedish Customer Satisfaction Barometer (SCSB), was developed for assessing the service of domestically purchased and consumed products and services (Fornell, 1992); 1994 saw the advent of the American Customer Satisfaction Index (ACSI) (Fornell *et al*. 1996), while two years later, in 1996 the Norwegian Customer Satisfaction Barometer, the NCSB, was created: (Andreassen, Lindestad 1998); in 2000 the European Customer Satisfaction Index, the ECSI, was developed (Eklof 2000).

These indices, developed using highly complex models and calibration procedures, are not easily workable. The "Customer Satisfaction Index" (CSI) (Hill *et al.* 2003) on the other hand is simpler to use. Bhave (2002) defined the CSI as follows: "the Customer Satisfaction Index represents the overall satisfaction level of a customer as one number, usually as a percentage. Plotting this Satisfaction Index of the customer against a time scale shows exactly how well the supplier is accomplishing the task of customer satisfaction over a period of time". According to Chakrapani (1998), the CSI *"…is simply an average of all attributes that are believed to contribute to customer satisfaction. Since different attributes can contribute differently to the overall customer satisfaction, the individual attributes are weighted to reflect this reality. This is the essence of a customer satisfaction index…*".

With the CSI, it is possible to obtain a direct measure of the quality of service perceived by customers, with a view to evaluating overall service quality. The analyst can choose the factors considered the most important for developing the business quality analysis and users can assign different satisfaction scores to each of them. CSI is calculated on the basis of these users' perceptions. Customers are also asked to report any complaints they would like to make and offer suggestions as to how the organization could handle them. CSI ranges from 0 to 100; high values (80-100) mean a high quality level of the overall service; whereas low values (0-30) denote poor quality. The CSI procedure is simple to implement and can be easily calculated by UFCC operators.

2. Methodology

The methodology proposed is based on the CSI and more specifically on the formula proposed by Bhave (2002). The survey involved the managers of the retail stores participating in the Bristol and Bath Freight Consolidation Centre (BBFCC) scheme. Although the population of the retailers involved in the BBFCC scheme in Bristol is made up of 81 retailers, the sample is composed only by the retailers that use the BBFCC more frequently for their deliveries. For this reason, the sample is composed by 21 retailers. The survey was conducted by means of a questionnaire administered by means of face-to-face interviews. The questionnaire comprised two parts: the first part concerned information about the stores, the products sold, frequency and times of the deliveries made by the UFCC and kind of transport used. The second part concerned the satisfaction of the retailers with the delivery service; the questionnaire ended with claims/suggestions section.

Data were first analysed, by means of frequency distribution of the answers. Then a satisfaction analysis (in a post-process analysis) was performed, based on the responses given in the second part of the questionnaire.

Five questions were selected to carry out the satisfaction analysis and each of these questions was associated with a specific study area, called "TOPIC":

1. Q1. Delivery time: "On a scale from 1 to 5, how satisfied are you with your current delivery time arrangements?"

2. Q2. Delivery frequency: "On a scale from 1 to 5, how satisfied are you with the current frequency of your deliveries?"

3. Q3. Delivery punctuality perception: "How often does the Consolidation Centre team deliver on time?"

4. Q4. Safe delivery: "How often have you experienced damage/shortages with the deliveries made by the Consolidation Centre?"

5. Q5. Overall service: "Overall, how would you rate the service you receive from the Consolidation Centre (for example considering the service provided by your previous delivery experiences)?"

The satisfaction analysis proposed in this paper aims to obtain a quantitative indicator that places greater emphasis on the low scores of the responses' scale (scores that indicate user dissatisfaction). In this way it is possible to highlight those areas in the service provided by the UFCC that leave

room for improvement.

To achieve this aim, the authors decided to use the CSI calculated on basis of the CSI calculation proposed by Bhave (2002).

The authors propose to use a process from which has been deduced the following formula:

$$CSI = A*\frac{1}{q}*\frac{1}{n}*\sum_{j=1}^{q} \quad \sum_{i=1}^{n}[xij] * \frac{wj}{wj'} \qquad (1)$$

A= 10 (scale 1-10)

n= number of interviewees

q= number of parameters

xij= score given by the interviewee (i) to the parameter (j)

wj= weight assigned to the parameter (j)

wj'= average weight = ∑_(j=1)^q (wj/q)

3. Application

The methodology adopted in this paper is applied considering an experimental case study of deliveries made by DHL for the BBFCC to shopping areas in Bristol and Bath city centres, in the Southwest of England (Paddeu et al. 2014). 81 retailers in Bristol and 25 in Bath (106 outlets in total) joined the scheme. In addition to the delivery service, DHL provides additional free services, such as storage and recycling. The survey was limited to the city of Bristol and involved 21 retailers. The small sample size is due to the fact that the other retailers did not make frequent use of BBFCC. Thus the authors preferred to consider just those retailers who used the UFCC regularly, to ensure more reliable results. In fact, including all 81 retailers in the survey could distort the outcome. From a total of 21 different participating retailers, 38% of the sample is composed by entertainment and technology stores, 24% by clothing and footwear stores, 14% by cosmetic stores, 10% by food and drink stores, 10% by household goods stores and 5% by jewellers. All the goods delivered to the retailers surveyed can be considered as "same - exigent", because perishable goods are not delivered by the BBFCC.

The survey was carried out by means of a questionnaire proposed to the managers of the stores selected for the sample. As mentioned in the previous section, five TOPICs were examined: a specific question was related to each one. Retailers were asked to rate satisfaction on a scale of 1 to 5, 1 being the worst in terms of satisfaction and 5 the best.

To be able to use the formula (1), it was necessary to convert the response scale (1-5) into a 1 to 10 point scale (table 1).

The authors attributed a weight from 1 to 10 to each TOPIC denoted in the previous paragraph as Q1, Q2, Q3, Q4, Q5. The criterion for assigning weights was influenced by the importance attributed to each TOPIC. In brief, all variables (weights and answers) for each TOPIC were assigned a number from 1 to 10.

At first, a specific CSI for each customer was calculated and the overall CSI was calculated by averaging the sum of the specific indices. Starting from the questions and the corresponding answers used to calculate the CSI, the authors carried out a sensitivity analysis to test the effect of eliminating or adding different variables, changing the weights attributed to each TOPIC in order to find the best combination of indices for obtaining the highest CSI value and, conversely, the combination for obtaining the lowest CSI value. In this way it was possible to understand what areas needed to be strengthened. The whole sample of combinations is summarized below:

- Case 1: All the TOPICs have the same weight, thus only one iteration is considered. In fact, the weight associated with each TOPIC (Q1, Q2, Q3, Q4, Q5) is 10 and the CSI for case 1 is calculated on the average of the 5 CSI calculated for each TOPIC, thus just 1 output value is obtained.
- Case 2: One TOPIC has a value twice as high as the others. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 is 10 and the weights associated with the others are 5 and so on for the other iterations. The CSI values per iteration are calculated on the average of the 5 CSI values calculated for each TOPIC. Five output values are obtained, as there are 5 TOPICs.
- Case 3: One TOPIC has a value three times higher than the others. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 is 9 and the weights associated with the others are 3 and so on for the other iterations. The CSI values per iteration are calculated on the average of the 5 CSI values calculated for each TOPIC. Five output values are obtained, as there are 5 TOPICs.
- Case 4: One TOPIC has a value four times higher than the others. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 is 8 and the weights associated with the others are 2 and so on for the other iterations. The CSI values per iteration are calculated on the average of the 5 CSI values calculated for each TOPIC. Five output values are obtained, as there are 5 TOPICs.
- Case 5: Only one TOPIC per iteration is considered. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 is 10 and the weights associated with the others are 0 and so on for the other iterations. The CSI values per iteration are calculated on the average of the 5 CSI values calculated for each TOPIC. Five output values are obtained, as there are 5 TOPICs.
- Case 6: The TOPICs are analysed for couples. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 and to TOPIC Q2 is 5 and the weights associated with the others are 0 and so on for the other iterations. The CSI values per iteration are calculated on the average of the 5 CSI values calculated for each TOPIC. Ten iterations are produced, as there are 5 TOPICs and their combination in this case produces ten output values.
- Case 7: One TOPIC has a value clearly higher than the others. For example, in iteration 1 "I1", the weight associated with TOPIC Q1 is 6 and the weights associated with the others are 1 and so on for the other iterations. The CSI values per itera-

tion are calculated on the average of the 5 CSI values calculated for each TOPIC. Five output values are obtained, as there are 5 TOPICs.

Summing up, the number of output values is related to the number of possible combinations. For example, it is possible to analyse Case 2: "1 index has a value twice that of the others". For I1, the index "delivery time" has a value twice that of the others, and so on. Five different combinations are possible, thus 5 different output values can be obtained (the TOPICs studied are 5 for all the cases – table 2).

4. Results

The analysis has ascertained the following critical aspects:

- The highest CSI value found in the analysis is 90.48 for case 5 and I5, when all the importance is placed on TOPIC Q5, satisfaction with the overall service.
- The lowest CSI value corresponds to case 5, but is associated with I4 (damage/shortage experiences with the delivery).
- These results did not convince the authors because they conducted the survey via face to face interviews with the retailers who stated they were very satisfied with the delivery service. Furthermore, the few complaints received by retailers concerned delivery times (some of the retailers said they could not fix a definite delivery time which they needed to optimize organization of their daily work in the store).
- CSI indices calculated showed a distribution in which it was really difficult to highlight differences between the different cases and parameters, and thus to pinpoint those areas associated with the lowest CSIs (because the lowest was not so low compared with the others).

For this reason, after this first analysis, the authors attempted a second analysis suggesting a new CSI, the "CSI_{mod}" for the purpose of broadening the range of the results. The new index was calculated on a 200-point scale.

Using the CSI_{mod} the authors associated weights with the question areas (as in the first analysis) and also to the responses, in order to influence the CSI value, increasing it for the higher scores on the scale (6 to 10) and decreasing it for the lower ones (4 to 1), 5 being neutral. Particularly, the authors aimed to place more importance on determining the CSI on the upper and lower limits of the scale (1 and 10).

This could be achieved by associating a coefficient with the CSI formula. The process is described below.

In the first place, the authors wanted to identify a coefficient that should "substantially increase" the CSI when the score assigned to the question (index) is the highest (10); on the other hand, the coefficient should "substantially decrease" the CSI when the score assigned to the question is the lowest (1). Its form should also be proportional to the scores assigned to the question. Moreover, the lowest score has a much greater influence in determining the CSI value.

After several attempts, the following coefficient was chosen:

$$\alpha_{mod} = \frac{xij}{5} \quad (2)$$

xij = score assigned by the customer (retailer participating in the BBFCC scheme) to each question

with which the formula (1) shown in session 2, is converted to the following form:

$$CSI_{mod} = A*\frac{1}{q}*\frac{1}{n}*\sum_{j=1}^{q} \quad *\sum_{i=1}^{n}([xij] * \frac{wj}{wj'} * \alpha mod) \quad (3)$$

A= 10 (scale 1-10)
n= number of interviewees
q= number of parameters
xij= score given by the interviewee (i) to the parameter (j)
wj= weight assigned to the parameter (j)
wj'= average weight = ∑_(j=1)^q (wj/q)
αmod= response weighting coefficient

This form represented the best solution in that it better achieved the targets established. It is worth noting that:

- CSI_{mod} calculated for xij = 5 does not increase but neither does it decrease because the score of 5 represents a neutral judgment (αmod = 1). This therefore represents the boundary line between the increasing and decreasing CSI_{mod} processes.
- The extreme values of the scale are determinant in the increasing/decreasing process; in fact if the customer is very satisfied and gives a score of 10 to a specific TOPIC, this score has double the value in the CSI determination process: score =10 means double the CSI value (αmod = 2).
- If the customer is totally dissatisfied and rates a specific TOPIC as 1, this score converts the CSI value to one-fifth, thus drastically reducing the overall value. In this way CSI_{mod} makes it possible to highlight which areas are perceived as the worst, placing more emphasis thereon and thus making them immediately recognizable (αmod = 1/5).

With the new method proposed here, CSI_{mod} is determined on a 200-points scale instead of the 100- points scale used in the traditional method.

Scores given by the retailers to the TOPICs are thus converted into the 1 to 10 scale and then multiplied by the response weighting coefficient described above. Hence, CSI_{mod} is calculated with the same process used to calculate the classic CSI, but with the addition of the response weighting coefficient. CSI_{mod} values per case and relative iterations are shown in table 3.

As mentioned above, the number of output values is related to the number of possible combinations.

The highest CSI_{mod} is 166.48 and has been calculated for case 5, iteration 5 when the highest weight is attributed to TOPIC Q5 and thus when overall satisfaction is the most important variable. On the other hand, the lowest value has been calculated for case 2, iteration 1, when satisfaction with delivery time is the most significant variable (TOPIC Q1).

5. Discussion

The results achieved with the CSI_{mod} better reflect the qualitative observations collected during the face-to-face interviews. Actually, the few retailers who did complain were unhappy because they were not able to arrange delivery at a specific time.

In order to be able to compare the outcomes of the two analyses, the CSI with the CSI_{mod}, the authors converted the CSIs calculated on the 100-point scale (first analysis) into the new 200-points scale. To facilitate reading of the results shown below, the CSI calculated with the classic method and converted into the 200-point scale, is denoted "CSI_1".

The conversion comprised the following steps:

STEP 1

Calculate the average score (scores are 1 to 10; total number of scores is 105), as follows:

$S_{avg.} = (A1+A2+A3+A4+A5)/105 = 8.62$

STEP 2

Divide the average by 5 to obtain the converter coefficient:

$C_{conv.} = S_{avg.}/5 = [(A1+A2+A3+A4+A5)/105]/5 = 1.72$

STEP 3

Multiply C_{conv} for each of the CSI values calculated using the classic method to get so, CSI_1.

Comparison of CSI values (classic and new method) is shown in table 4. There are only three negative values of ΔCSI which correspond to CSI_{mod} values lower than CSI_1:

- ΔCSI= -10.03; associated with "case2, iteration1: Q1-delivery time- has double weight respect to other indicators". In fact, one retailer rated this TOPIC as 1 (RET_13; scores are shown in Table 1) and the CSI_{mod} value is influenced by this low score. Also, the average of all the scores given to TOPIC Q1 is the lowest compared to the average values calculated for the other TOPICs. This reveals the greater emphasis given by the CSI_{mod} to dissatisfied users.
- ΔCSI= -4.81; associated with "case5, iteration4: when Q4-safe delivery- is the only indicator considered". Actually, talking in terms of decreasing order, Q4 is the second TOPIC for which the average of the scores is the lowest compared with the average score calculated for the other TOPICs.
- ΔCSI=-1.75; associated with "case6, iteration8: when Q3-perception of punctuality- and Q4-safe delivery- are the only indicators considered". The second and third lowest values of the average score are for Q3 and Q4 respectively.

Also minimum and maximum values, mean and standard deviation are analysed and compared for both CSI_1 and CSI_{mod} (table 5).

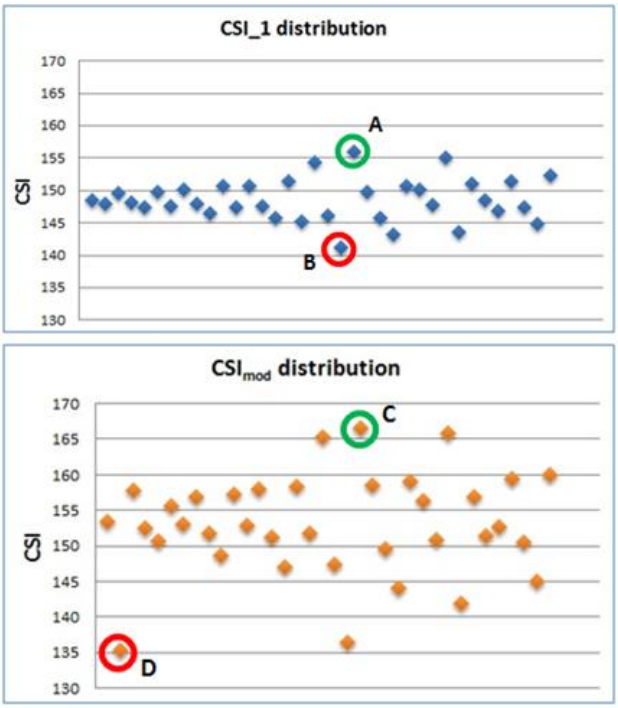

Fig. 1. CSI_1 and C_{mod} distribution (A_max CSI_1 value=155.96 with overall satisfaction; B_min CSI_1 value=141.19 with safe delivery; C_max C_{mod} value=166.48 with overall satisfaction; D_min C_{mod} value=135.26 with fixed delivery time).

The highest standard deviation was found for case 5. Actually, in case 5, the TOPICs were measured individually (w=10 was attributed to the TOPIC considered in the specific iteration and w=0 to the others), so it was easier to single out the most important variable in terms of decreasing/increasing CSI. Furthermore there was a substantial difference between the standard deviations calculated for CSI_1 and for CSI_{mod}, greater for CSI_1, which better represented the distance between the scores, providing a better tool for evaluating improvements to the service delivered by the BBFCC.

The analysis pointed out low satisfaction with delivery time. In fact, some retailers declared they were unable to choose the delivery time. This is related to the fact that, in the BBFCC case, the delivery time decision makers are the head offices of the retailers. Within an interview with the BBFCC manager, he explained that delivery times are established according to customers' (head offices') requirements. That is, if the head office has particular needs, it can choose a delivery time for its retailers by paying an additional fee rate for this service; otherwise, delivery times are established by BBFCC manager, depending on the daily delivery route. Retailers who took part in the survey were not aware of this and, probably for this reason, they showed dissatisfaction with the topic related to the delivery time arrangements (as proved by the CSI_{mod}'s values and highlighted by the standard deviation values).

The analysis also pointed out dissatisfaction with delivery safety. According to qualitative comments collected during the interviews undertaken as part of the survey, this concern related to some episodes of parcels being delivered

wet, but the authors believe this problem is not entirely resolvable in climates like that of the UK. Anyway, it is less important (in terms of frequency of the issue being raised) than delivery time.

The analysis also highlighted the low level of awareness of the existence of the BBFCC scheme and of city logistics measures in general. This is a very important factor, because if retailers do not know about the scheme, they cannot promote it to the other retailers, so it probably represents a constraint to the growth of the number of the participants in the scheme (the biggest constraint on the BBFCC's economic sustainability at the time of study).

The BBFCC represents an important successful example of existing UFCC scheme. However, its limits of economic sustainability could really depend on the lack of awareness.

The retailers assigned high scores, thus, in the case of the CSI_{mod} clearly high values were augmented and for this reason CSI_{mod} values were on average higher than for CSI_1.

The same findings were observed in the overall analysis (Q5): there was greater variability in the CSI_{mod} (more or less twice that of the standard deviation calculated for CSI_1) making it a very useful tool for improving service provision.

Conclusions

The highest CSI value found in the analysis was 90.48 and was associated with case 5 when all the emphasis was placed on satisfaction with the overall service (TOPIC Q5). The lowest CSI value corresponded to the same case, but with safe delivery (TOPIC Q4: damages/shortage experiences with the delivery).

For the purpose of broadening the range of the results, the authors proposed a modified version of the classic CSI, the CSI_{mod}, calculated on a 200-point scale in which a response weighting coefficient has been introduced. The indicator was corrected for the purposes of testing it empirically within a post-processing analysis using the collected data.

The highest CSI_{mod} was 166.48 and was calculated when the greatest weight was attributed to TOPIC Q5 and thus when overall satisfaction was the most important variable (case 5, iteration 5). On the other hand, the lowest value – 136.38 - was calculated when satisfaction with delivery time (TOPIC Q1) was the most important variable (case 2, iteration 1).

The results achieved with the CSI_{mod} reflected in a more exhaustive manner the qualitative data collected with face-to-face interviews.

The highest standard deviation value was obtained for case 5. Indeed, in case 1 the variable was measured individually (weights were only assigned to one variable per iteration), hence it was easier to identify the most important variable in terms of decreasing/increasing CSI_{mod}.

It is worth noting the substantial difference between standard deviations calculated with the classical method and with the modified version, higher for CSI_{mod} which better represents the distance between scores, providing a better tool for evaluating improvements to the service delivered by the BBFCC.

Also the same findings emerged for the overall analysis: there was greater variability in the CSI_{mod} (approximately twice that of the standard deviation calculated for CSI_1) Unfortunately, it proved complicated to single out which areas required improvement due to the high satisfaction level expressed by the retailers. Indeed, users perceived more or less all areas considered as almost perfect in terms of the service delivered by BBFCC.

The BBFCC manager was totally unaware of the dissatisfaction of some retailers with the delivery time arrangements and only came to realize this thanks to the CSI_{mod} that converted the likert scale evaluations of customer experience collected through the questionnaires into quantitative data.

In the quality assurance field, customer satisfaction should be an integral part of the process of quality monitoring and assessment. In this sense, CSI_{mod} can be introduced as a strategic tool able to analyze weakness areas perceived as bad quality areas, in order to improve these areas and ensure high quality services. It could help to broaden the application of city logistics measures, by investigating the satisfaction/dissatisfaction with the service, in order to provide to the decision makers (local authorities, UFCC managers, etc.) a tool for better understanding the service provided and for defining a strategic plan with economically sustainable measures to be implemented within the city logistics field. By means of this indicator, this kind of measure can be tailor-made according to the stakeholders needs.

Nevertheless, the CSI values obtained with both methods are very high for this specific case study, owing to the high satisfaction reported by the BBFCC users with the service provided. For this reason, the authors recommend applying this methodology to other case studies using samples with a greater proportion of dissatisfied users. Thus, CSI_{mod} could better single out those areas that leave room for improvement as it provides more meaningful outcomes.

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Appendix

Table 1 Scores assigned by retailers interviewed (scores converted to a 1-10 point scale)

	RET_01	RET_02	RET_03	RET_04	RET_05	RET_06	RET_07	RET_08	RET_09	RET_10	RET_11	RET_12	RET_13	RET_14	RET_15	RET_16	RET_17	RET_18	RET_19	RET_20	RET_21
Q1	10	10	8	6	10	10	8	10	6	10	8	10	1	10	6	8	8	10	10	8	10
Q2	10	10	8	6	10	10	6	10	10	10	6	10	6	10	10	8	8	10	10	10	10
Q3	10	10	6	8	8	10	8	6	8	6	10	10	10	8	8	8	8	10	8	10	8
Q4	8	10	6	8	8	8	8	8	8	8	8	8	10	8	6	8	8	10	10	8	8
Q5	10	8	10	8	10	10	6	8	8	8	10	10	10	8	10	10	8	10	8	10	10

Table 2 Summary of CSI values obtained for each iteration

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
Case 1					86.19					
Case 2	85.87	86.75	85.95	85.48	86.90			(just 5 outputs)		
Case 3	85.65	87.14	85.78	84.96	87.41			(just 5 outputs)		
Case 4	85.48	87.44	85.65	84.58	87.80			(just 5 outputs)		
Case 5	84.28	89.52	84.76	**81.90**	**90.48**			(just 5outputs)		
Case 6	86.90	84.52	83.09	87.38	87.14	85.71	90.00	83.33	87.62	86.19
Case 7	85.24	87.86	85.48	84.05	88.33			(just 5 outputs)		

Table 3 Summary of CSI_{mod} values obtained per iteration

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
Case 1					153.46					
Case 2	135.26	157.71	152.46	150.62	155.63			(just 5 outputs)		
Case 3	152.96	156.86	151.74	148.58	157.18			(just 5 outputs)		
Case 4	152.81	157.92	151.20	147.06	158.34			(just 5 outputs)		
Case 5	151.71	165.33	147.43	136.38	**166.48**			(just 5 outputs)		
Case 6	158.52	149.57	144.05	159.09	156.38	150.86	165.90	141.90	156.95	151.43
Case 7	152.59	159.4	150.45	144.92	159.97			(just 5 outputs)		

Table 4 Comparison of CSI values (classic and new method)

Case	Iteration	$CSI_{\_1}$	CSI_{mod}	ΔCSI (CSI_{mod}- $CSI_{\_1}$)
1		148.58	153.46	4.88
2	1	148.03	138.00	**-10.03***
	2	149.53	157.71	8.18
	3	148.16	152.46	4.29
	4	147.34	150.62	3.27
	5	149.81	155.63	5.83
3	1	147.64	152.96	5.33
	2	150.22	156.86	6.64
	3	147.87	151.74	3.87
	4	146.46	148.58	2.12
	5	150.69	157.18	6.50
4	1	147.34	152.81	5.46
	2	150.73	157.92	7.18
	3	147.65	151.20	3.55
	4	145.80	147.06	1.25
	5	151.35	158.34	6.99
5	1	145.29	151.71	6.42
	2	154.32	165.33	11.01
	3	146.11	147.43	1.31
	4	141.19	136.38	**-4.81***
	5	155.96	166.48	10.51
6	1	149.81	158.52	8.72

	2	145.70	149.57	3.87
	3	143.24	144.05	0.81
	4	150.63	159.09	8.47
	5	150.22	156.38	6.16
	6	147.75	150.86	3.10
	7	155.14	165.90	10.76
	8	143.65	141.90	**-1.75***
	9	151.04	156.95	5.91
	10	148.57	151.43	2.85
7	1	146.93	152.59	5.66
	2	151.45	159.40	7.95
	3	147.34	150.45	3.11
	4	144.88	144.92	0.04
	5	152.27	159.97	7.70

Table 5 Maximum, minimum, mean and standard deviation for both methods (Results are shown per iteration)

Case	**Maximum**		**Minimum**		**Mean (μ)**		**Standard Deviation (σ)**	
	$CSI_{\_1}$	**CSI_{mod}**	**$CSI_{\_1}$**	**CSI_{mod}**	**$CSI_{\_1}$**	**CSI_{mod}**	**$CSI_{\_1}$**	**CSI_{mod}**
1	148.58	153.46	148.58	153.46	148.58	153.46	-	-
2	149.81	157.71	147.34	138	148.57	150.88	1.05	7.71
3	150.69	157.18	146.46	148.58	148.57	153.47	1.80	3.62
4	151.35	158.34	145.80	147.06	148.57	153.46	2.36	4.75
5	155.96	166.48	141.19	136.38	148.57	153.46	6.30	**12.66**
6	155.14	165.90	143.24	141.90	148.57	153.46	3.64	7.31
7	152.27	159.97	144.88	144.92	148.57	153.46	3.15	6.33