Exploring determinants of public satisfaction with urban solid waste collection services quality

Julio César Puche-Regaliza[1*], Santiago Porras-Alfonso[1], Alfredo Jiménez[2], Santiago Aparicio-Castillo[1], Pablo Arranz-Val[1]

[1] Department of Applied Economics. University of Burgos. Infanta Doña Elena Square, s/n. 09001 Burgos (Spain). {jcpuche, sporras, saparicio, parranz}@ubu.es

[2] Department of Management. Kedge Business School. 680, cours de la Libération. 33405 Talence (France). alfredo.jimenez@kedgebs.com

Acknowledgements

This work was supported by the City Council of Burgos and the SEMAT S. A. services company.

*Corresponding author (+34 947 259 389)

Exploring determinants of public satisfaction with urban solid waste collection service quality

Abstract

This work explores determinants of public satisfaction with urban solid waste collection service quality of the city of Burgos (Spain). A Structural Equation Modelling is conducted based on the indicators of the service quality offered by the SEMAT S.A. company and the dimensions offered by SERVQUAL service quality model. The findings show that Assurance and Responsiveness have a positive and significant effect on public satisfaction. However, Reliability, Empathy, and Tangible have no significant effect. Regarding Assurance, cleanliness of pavements and cleanliness of walkways are the indicators that provide a significant influence on this dimension. Otherwise, daily collection of organic waste and daily collection of selective waste are the indicators that provide a significant effect on the Responsiveness dimension. We can emphasize that increasing public satisfaction can be achieved by increasing the frequency of pavements and walkways cleanliness and the frequency of organic and selective waste collection, and that this has a clear relationship with the increase in costs and pollution impact. Find a balance between frequency of collection and cost and pollution is necessary. Despite this, the significance of these indicators is strong enough to motivate decision-makers to address their efforts and investments in improving them, enabling thus an effective and efficient service at the required level of quality and adjusting their strategies to increase public satisfaction. Moreover, the study highlights that 84.37% of citizens are satisfied with the service. In addition to this practical validation at the management level, we also discuss environmental and sustainability repercussions.

Keywords: Citizens' Satisfaction; Public Services; PLS-SEM; Waste Management; SERVQUAL Model; Environment and Sustainability.

Acknowledgments

This work was supported by the City Council of Burgos and the SEMAT S. A. services company.

Declarations

Funding

Not applicable.

Conflicts of interest/Competing interests

Not applicable.

Availability of data and material

Not applicable.

Code availability

Not applicable.

Authors' contributions (optional)

Not applicable.

1 Introduction

Public services are an important part in the economy of a country, region or municipality. Their main goal is to facilitate the daily life of citizens by establishing priorities, metting regulations, allocating public resources, and all doing so economically (Ovretveit 2005). Moreover, public services play a significant role in fighting poverty, to promote the equality of citizens and to combat the inequality (Graa et al. 2017). Due to the current importance of the environment and sustainability, urban solid waste collection service (USWCS) is one of the public services especially important today. This service can be carried out by the administration itself, by public corporations, or by outsourcing the services, and usually, are funded through government expenditure financed by taxes, government borrowing and grants (Graa et al. 2017).

How to measure USWCS performance and evaluate its quality according to certain standars and criteria is a frecuent research topic. For example, Guimaraes et al. (2010) present a Balanced Scorecard tool, based on objective indicators, to increase the quality of the USWCS in Portugal. In the same line, Mendes et al. (2012) propose and implement a management tool suited for the needs of the public administration (urban hygiene and solid waste division) in the south of Portugal. Wilson et al. (2012) carry out a comparative analysis of solid waste management on 20 cities in six continents. Lohri et al. (2014) examine the costs and revenues of a private waste company in Ethiopia, engaged in waste collection and transport. Teixeira et al. (2014) focus on the relevance of regular system monitoring as a service assessment tool in Portugal. They select and test a core-set of USWCS performance indicators that highlights USWCS system strengths and weaknesses and supports pro-active management decision-making. Guerrini et al. (2015) study the determinants of economic efficiency on waste collection observing 40 municipalities in Italy. Rodrigues et al. (2016) develop 12 indicators to characterize the technological aspect of 22 waste collection systems divided into three groups: container design, container capacity, and operation. Schulte et al. (2017) examine the question of how the service quality door-to-door waste collection can by systematically measured in a German company. Bertanza et al. (2018) suggest a set of indicators to evaluate the USWCS in four towns in Northern Italy, taking into account both the characteristics of collected waste and the operational-economic performance. Fernández-Aracil et al. (2018) analyze the factors that determine solid waste collection costs using a cross-sectional dataset of municipalities in Spain. Rada et al. (2018) propose a selective collection quality index including collection efficiency, method of collection, quality of the collected materials, presence of the punctual tariff, and tourism incidence in Italy. Rodrigues et al. (2018) develop criteria for performance assessment in municipal solid waste management. Finally, Tsai et al. (2020) explore the solid waste management hierarchical interrelationships using a sustainable balance scorecard approach in Vietnam.

From a more subjective point of view, public satisfaction is also important. A large volume of studies support the statement that service quality is the precursor of public satisfaction (Brady and Robertson 2001; Sureshchandar et al. 2011). In general, the service quality is conceptualized as the comparision between public expectations towards the service provided and the perception of the service received (Roch and Poister 2006; Munusamy et al. 2010), i.e., if the service has been provided exactly to the citizen as he wished, then the citizen will be satisfied with the service received. Therefore, a subjective way to evaluate the quality of the service is through measures of the public satisfaction.

Despite the extant literature concerning the multi-dimensional nature of USWCS quality and its influence on public satisfaction (Raje et al. 2001; Obirih-Opareh and Post 2002; Bel and Miralles 2003; Post et al. 2003; James 2007; Abassi et al. 2009; Purcell and Magette 2010; Chandra-Majumder and Razaul-Karim 2012; Akaateba and Yakubu 2013; Kawai and Osako 2013; Tilaye and van Dijk 2014; Cheng and Urpelainen 2015; Khanom et al. 2015; Ma and Hipel 2016; Shriwas et al. 2018), we believe that this topic has not yet received all the necessary attention. In theses studies, certain differences are also detected depending on the country, region or municipality in which they have been carried out. This is due to differences in the socio-cultural, legislative, and regulatory environments within which USWCS is undertaken, and therefore, their conclusions may not be easily extrapolable to other locations. For this reason, we think that exploring determinants of public satisfaction with the USWCS quality in the city of Burgos (Spain) can be a novel job that fills the existing gap in this particular municipality, in favor of an increase in public satisfaction with the USWCS quality and, as a consequence, supporting the environment and the sustainability. Additionally, the findings found can also help decision-makers in USWCS to keep monitoring performance and improving quality service. Moreover, no notable research or other initiatives had been started in Burgos until the commencement of this scoping study.

To achieve this aim, this study was undertaken with the following objectives: (1) identify the USWCS quality indicators of city of Burgos and (2) develop a Structural Equation Model (PLS-SEM) to quantify the relationship between USWCS quality indicators and public satisfaction in the city of Burgos. The remainer of this paper is structured as follows. The next section presents the materials and methods used in the study. In the third section, the results and a brief discussion describe an interpretation of the research. The last section discusses the implications of the study, its limitations, its practical validation, as well as offers concluding remarks.

2 Materials and Methods

To provide an empirical assessment of the proposed research, this study adopts a quantitative technique using a cross-sectional data collection approach. For this reason, three stages have been defined: (1) identification of the indicators of service quality and public satisfaction, (2) specification of statistical techniques and the hypotheses of the study and (3), data collection.

2.1 Identification of indicators

Currently, the city of Burgos (146,923 inhabitants in 2016) has privatized the USWCS in SEMAT S.A. company, which has been the promoter of the study. Table 1 provides a brief description of the USWCS in the city of Burgos in the context of investment, infrastructure, facilities and volume of waste collected.

Table 1. Description of SEMAT S.A. USWCS (2016)

Investment (taxes included) (€)		15,618,295.95
Number of employees		256
Service points (islands)		518
Number of organic containers		1,845
Number of selective containers	**Paper/Paperboard**	518
	Glass	555
	Packaging	518
	Total	1,591
Total number of containers		3,436[1]
Organic waste volume (tons)		47,881
Selective waste volume (tons)	**Paper/Paperboard**	4,872
	Glass	3,437
	Packaging	2,656
	Total	10,965

Total waste volume (tons)	58,846[2]
Collection / cleaning frequency	The frequency of collection of organic and selective waste containers is daily for 80% of the containers and on alternate days for the remaining 20% of the containers. The frequency of cleaning off paint marks and graffiti, of snow and collection and capture of animals is done on demand. The collection of furniture and domestic appliances is done once a week, on Wednesday nights, although it is also collected if waste of this type is found deposited next to the containers and in the suburbs any day of the year. The collection and transport of sanitary waste is done every 15 days. The collection of batteries is done once a week, business establishments leave a notice in the office and they are collected on Thursday. The cleanliness of pavements, roadways and walkways are carried out every day of the year, divided into three work shifts. Cleanliness of riverbeds, riverbanks and beaches is done depending on the time of year. In winter one day a week, two days a week in autumn and spring and four days a week in summer.

[1] Containers capacity = 2900 litres. Container proximity = 150–200 metres.

[2] Kilograms per inhabitant per day (total waste volume/total population)/365 = 1.09.

The USWCS offered by SEMAT S.A. combines the collection of organic waste, the collection of selective waste, and the collection of other waste and other services. The indicators considered to measure the quality of collection of organic waste are: frequency of collections, capacity of containers, proximity of containers and appearance of containers. The same indicators are considered for the quality of collection of selective waste. The indicators take into account to measure the quality of the collection of other waste and other services are: collection and capture of animals, collection and transport of sanitary waste, collection of furniture, and domestic appliances, collection of batteries, cleaning off paint marks and graffiti, cleanliness of riverbeds and riverbanks, cleanliness of beaches, and the clearing of snow. Finally, the cleanliness of pavements, roadways and walkways are also considered.

To assure consistency with the aim of the study, the indicators identified, reflecting the know-how of the company, have been associated with the service quality dimensions offered by the SERVQUAL model (Parasuraman et al., 1998). Measuring service quality through of the SERVQUAL model has received broad attention from various service sectors (Chakraborty and Sengupta 2014; Chatzoglou et al. 2014; Graa et al. 2017; Durdyev et al. 2018), including waste management sector (Tabernero et al. 2016; Mohd-Zikry 2017). The indicators under consideration and SERVQUAL service quality dimensions associated are summarized in Table 2, so this table depicts quality indicators within the USWCS, which therefore provides a basis for achievement of the first objective of the study.

Table 2. SERVQUAL service quality dimensions and indicators associated

SERVQUAL service quality dimension	Indicator	
Reliability	**CPMG**	Cleaning off Paint Marks and Graffiti
	CLRR	CLeanliness of Riverbeds and Riverbanks

	CLBE	CLeanliness of BEaches
	CLSN	CLearing of SNow
Responsiveness	**DCOW**	Daily Collection of Organic Waste
	DCSW	Daily Collection of Selective Waste
Assurance	**CLPA**	CLeanliness of PAvements
	CLRW	CLeanliness of RoadWays
	CLWW	CLeanliness of WalkWays
Empathy	**COCA**	COllection and Capture of Animals
	CTSW	Collection and Transport of Sanitary Waste
	CFDA	Collection of Furniture and Domestic Appliances
	COBA	COllection of BAtteries
Tangibles	**COWC**	Capacity of Organic Waste Containers
	POWC	Proximity of Organic Waste Containers
	AOWC	Appearance of the Organic Waste Containers
	CSWC	Capacity of Selective Waste Containers
	PSWC	Proximity of Selective Waste Containers
	ASWC	Appearance of the Selective Waste Containers

The reliability dimension represents the ability to perform the service in a careful and reliable way. The responsiveness dimension represents the readiness and willingness to help citizens and provide fast service. The assurance dimension represents the knowledge and attention shown by the employees and their abilities to arouse credibility and confidence. The empathy dimension represents the personalized attention that the company dispenses to the citizens. The tangibles dimension represents the appearance of physical facilities, equipment, personnel and communication material. Additionally, the measure of General Cleanliness or Public Satisfaction (GCPS) is adopted based on the opinion of citizens regarding the USWCS. Consequently, 20 indicators have been identified, 19 of them to identify the USWCS quality and one to identify the level of public satisfaction.

2.2 Techniques and hypotheses

The study employs Structural Equation Modelling (SEM) to test the public satisfaction with USWCS in the city of Burgos. SEM is a second-generation multivariate data analysis method that can test theoretically supported linear and additive causal models.

SEM is an appropriate statistical analysis technique to assess simultaneously constructs of the model and the hypothesized structural relations through structural model, and constructs with their respective indicators through measurement model. There are two SEM approaches, namely the component-based approach (PLS-SEM) and the co-variance-based approach (CB-SEM). On the one hand, PLS-SEM does not require a large sample size and normal distribution. PLS-SEM can also be utilized for the models that comprises both reflective and formative nature simultaneously. PLS-SEM uses non-parametric test oriented to exploratory-predictive tests. On the other hand, CB-SEM is extremely sensitive to data normality, inter-dependence of observation, large sample size, and uniformity of variable metrics. Problematic explanation of co-variance of all indicators is an important reason for CB-SEM being an inappropriate technique for formative models. CB-SEM uses parametric test oriented to confirmatory-explanatory test (Hair et al. 2017).

We employed the PLS-SEM approach in this study mainly for two different reasons. First, the modelling of the USWCS is at an early stage, so we seek to build and assess a model that aims to predict new or future observations or scenarios instead of confirming an already defined theory (Shmueli and Koppius 2011; Henseler et al. 2016). Second, the model nature is formative. Two types of linkage between constructs and indicators are know: (1) reflective, where the indicators are reflections of the theoretical construct and (2) formative, where the indicators form the theoretical construct. The first case gives rise to the reflective models (effects) and the second to formative models (cause) (Diamantopoulos and Siguaw 2006; Simoteo 2012). In this work, the five quality dimensions of the SERVQUAL model are the combination of a set of services offered by SEMAT S.A.. Therefore, the quality dimensions do not exist independently of the services that the company develops, but are the result of them.

The SERVQUAL service quality dimensions are represented by exogenuos constructs, while public satisfaction is represented by endogenuos construct. Each of the defined constructs, is measured by the indicators identified in the previous section. The model allows therefore the quantification of the relationship between USWCS and public satisfaction (Wong 2013). Consequently, we propose the following hypotheses:

H1: Reliability has a positive and significant influence on public satisfaction.

H2: Responsiveness has a positive and significant influence on public satisfaction.

H3: Assurance has a positive and significant influence on public satisfaction.

H4: Empathy has a positive and significant influence on public satisfaction.

H5: Tangible has a positive and significant influence on public satisfaction.

2.3 Data collection

The necessary information to achieve the second objective that has been proposed was gathered using a questionnaire survey methodology. Thus, a questionnaire was designed to collect quantitative data. The questionnaire comprised two sections. The first one allows for further quantification of the relationship between USWCS quality and public satisfaction, and the second one investigates the demographic background of the respondents. The questionnaire[1] was administred by 20 students[2] from the University of Burgos in person-to-person (minimizing the missing value treatment) interviews. Table 3 shows the statistical technical file. The questionnaire covers all the indicators indicated in the section 2.1 (Table 2).

Table 3. Statistical technical file

Date of realization	May, 16-22, 2016
Methodology	Personal interview through questionnaire prepared for this purpose
Information collection instrument	Questionnaire elaborated according to the proposed objectives, agreed with SEMAT, S.A. company, application of scales from 1 to 10, being 1 = very dissatisfied and 10 = very satisfied and previous application of pilot questionnaire (60 pilot questionnaires were passed – results not included in the definitive sample)
Interviewers	20 students of the university of Burgos, of the last university course, scholarships and trained for this purpose
Universe	Population of Burgos over 18 years old – the peripheral neighborhoods are included
Sample size	1,113 interviews
Type of sampling	Random, stratified and proportional afijation Random (20 urban routes according to population density) Stratified by quotas of geographical zones: Zone 1: Districts 1, 2, 4 Zone 2: Districts 3, 8

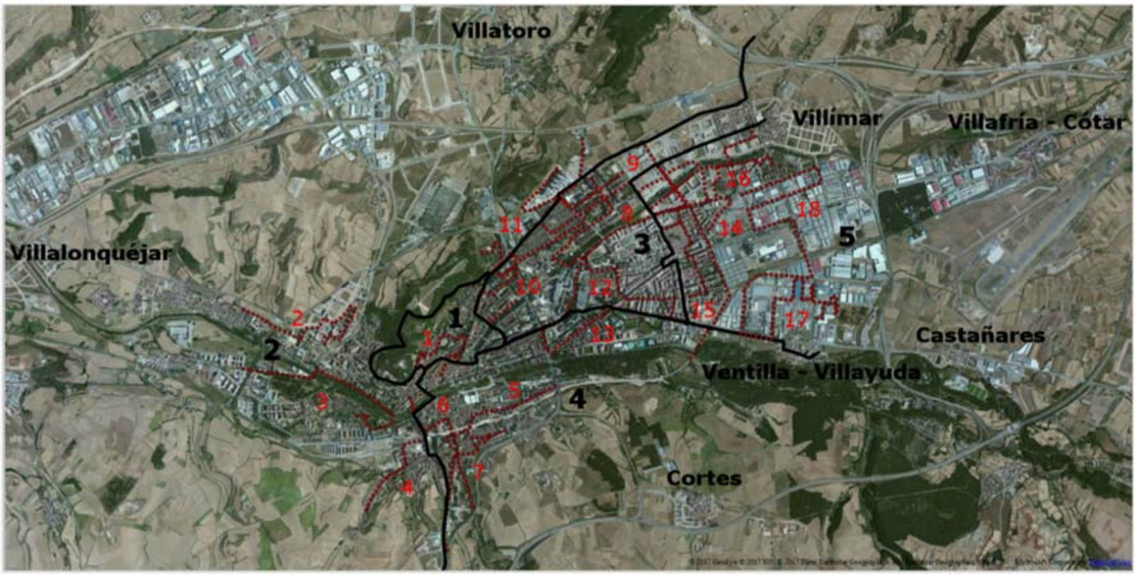
[1] Application of the scales from 1 to 10, where 1= very unsatisfied and 10 = very satisfied. The questionnaire is available on request from the authors. In additon to the variables used for this study, the questionnaire was completed with other categorization variables and open variables to collect the subjective opinion of the public. The open variables will allow us to gather ideas for improvement and to conduct an evaluation for the improvement of service provision in future works.

[2] Prior to the data-collection stage, the students followed a training course on aspects to be taken into account in the completion of the field work, after which they were given the questionnaires and allocated zones.

	Zone 3: District 5 Zone 4: Districts 6, 7 Zone 5: District 9 Zone 6: Peripheral neighborhoods (Castañares, Cortes, Cótar-Villafría, Villalonquéjar, Villatoro, Villayuda-La Ventilla, Villamar)
Confidence level	Greater than 95%
Error margin	Lower than ± 2.94%
Reliability	Cronbach Alfa: 0.910

Afterward, on the basis of the main urban solid waste collection routes established by the SEMAT S.A. company, i.e. the collection trucks routes with largest volume of waste collected per year, the 20 routes to carry out the surveys was defined (18 inner Burgos and 2 outer Bugos). These routes were also prepared in accordance with the density of the population and the confluence of the public (Figure 1, dotted lines).

Figure 1. Map of Burgos. Zones and routes



Then, considering the defined routes and the 9 electoral districts in which the city of Burgos is divided (plus its peripheral neighborhoods or outer Burgos), 6 geographical zones were defined (Figure 1, continuous lines). Zone 1 (centre): districts 1, 2 and 4; Zone 2 (west): districts 3 and 8; Zone 3 (north): district 5; Zone 4 (south): districts 6 and 7; Zone 5 (east): district 9; Zone 6 (outer Burgos): Castañares, Cortes, Cótar-Villafría, Villalonquéjar, Villatoro, Villayuda-La Ventilla, Villímar.

Having defined the 6 geographical zones, the distribution of the population and the distribution of the sample was done. With regard to the distribution of the population, the population under study was considered to be Burgos inhabitants older than 18 years old. According to the data from the Population Census of Burgos City Council, in April 2016, the city of Burgos had 146,923 inhabitants. The data of the Population Census of the I.N.E. (National Institute of Statistics), in 2015, indicated that the outer city (zone 6) had 5,268 inhabitants. With regard to the distribution of the sample, a stratified random sample, with proportional fixation was designed in order to obtain sufficient representativeness for each zone[3] (minimizing the non-response bias). Stratification is based on the geographical zone, considering the same proportions that the total population has regarding each zone (4.76% for zone 1; 15.18% for zone 2; 28.21% for zone 3; 12.13% for zone 4; 24.26% for zone 5; and, 15.45% for zone 6). The confidence level was higher than 95% with an error margin of less than [-2.94%, +2.94%] and a reliability of 0.910 (Cronbach's Alpha[4]). The distribution of the sample is defined in Table 4.

Table 4. Distribution of the simple in the different zones of Burgos

Zone	Total sample	Zone 6 (Outer Burgos)	Total sample
1	53	**Castañares**	9
2	169	**Cortes**	27
3	314	**Ventilla - Villayuda**	24
4	135	**Villafría - Cótar**	31
5	270	**Villalonquéjar**	6
6	172	**Villatoro**	40
Total	1.113	**Villímar**	35
		Total	172

Finally, the 1,113 questionnaires were administered to the public in the 6 zones allocated in accordance with the plan. While the sample size for the SEM-PLS methodology should be sufficiently large, there is a lack of clear consensus on required sample size. Hoyle (1995) recommends a sample size of 100 to 200 to maximize the results of the model. Marcoulides and Saunders (2006) advise a minimum of 70 observations when the structural model contains 5 relationships. Reinartz et al. (2009) indicate that al least 100 observations may be sufficient to reach

[3] Given the relatively small population and the greater dispersion in zone 6 (outer Burgos), that zone was oversampled, raising it to 172 cases. Subsequently, the corresponding weightings were attached for data analysis purposes.
[4] A minimum value of 0.7 was considered.

acceptable levels of statistical power, given a certain quality in the measurement model. For any of these cases, we think that 1,113 observations are a sufficient sample size. In addition, considering that the larger the sample size, the more accurate the model predictions are (Hair et al. 2017), we can consider that the results will be robust. Next, the processing and analysis of the data were performed and the results were obtained as shown below.

3 Results and Discussion

This research uses Structural Equation Modelling (SEM) and Partial Least Squares (PLS) approach to analyze the conceptual model proposed. In this sense, the current study aims at assessing the impact of the perceived quality of the USWCS on the public satisfaction by using the five dimensions of SERVQUAL model. First, the linkages between constructs and indicators are examined to distinguish the existence of formative or reflective constructs, being that the validation procedures are different. Later, it is advisable to evaluate the measurement model first and the structural model then. In addition, the model fit is analyzed (Kwong and Wong 2013; Hair et al. 2017). SmartPLS software 3.0 was employed to obtain all the results.

3.1 Linkage between constructs and indicators

We performed a Confirmatory Tetrad Analysis (CTA) to corroborate the appropriate choice of the nature of the model. For the assessment, the significance of each tetrad is the relevant value. The results show the significance test for the non-redundant tetrads (Table 5). In a reflective model, the tetrads should be non-significant, so the p-values should be higher than 0.05. If p-values are lower than 0.05, the tetrads are significant and as a consequence, the model is formative. A model can be considered as formative if it includes at least one significant tetrad. In any case, if there are significant and non-significant tetrads, the choice must be made from a content point of view (Bollen and Ting 2000). The results of Table 5 justify the selection of the formative nature of the model, presenting 63.13% of tetrads significant.

Table 5. Confirmatory Tetrad Analysis (CTA)

Construct	Tetrad	P-value
Assurance	1: AOWC,CLPA,CLRW,CLWW	0.127

	2: AOWC,CLPA,CLWW,CLRW	0.955
Empathy	1: COCA,CFDA,COBA,CTSW	0.285
	2: COCA,CFDA,CTSW,COBA	0.051
Public Satisfaction	1: CLPA,CLRW,GCPS,CLWW	0.571
	2: CLPA,CLRW,CLWW,GCPS	0.000
Reliability	1: CLRR,CLSN,CPMG,CLBE	0.011
	2: CLRR, CLSN,CLBE,CPMG	0.546
Responsiveness	1: AOWC,ASWC,DCOW,DCSW	0.000
	2: AOWC,ASWC,DCSW,DCOW	0.000
Tangible	1: AOWC,ASWC,COWC,CSWC	0.000
	2: AOWC,ASWC,CSWC,COWC	0.000
	4: AOWC,ASWC,COWC,POWC	0.000
	6: AOWC,COWC,POWC,ASWC	0.581
	7: AOWC,ASWC,COWC,PSWC	0.006
	10: AOWC,ASWC,CSWC,POWC	0.000
	16: AOWC,ASWC,POWC,PSWC	0.000
	22: AOWC,COWC,CSWC,PSWC	0.036
	26: AOWC,COWC,PSWC,POWC	0.000

To complete the CTA process it is compulsory that each construct has at least four indicators. For constructs with less than four, indicators borrowed from other constructs were used. The choice of theses indicators is based on choosing the endogenous construct with the highest correlation and subsequently, the necessary indicators with highest loading are selected. If there is no endogenous construct, the predecessor construct with the highest correlation is selected and, consequently, its indicators with the highest loading. Either way, it should be the indicators of a successor or predecessor with the highest correlation scores with the construct that needs additional indicators. For this purpose, we have used the Fornell-Larcker criterion to select the construct with the highest correlation and the cross loadings to select the indicators with the highest loading in the discriminant validity results table (Gudergan et al. 2008). For Assurance, the construct with the highest correlation is Tangible, and the necessary indicator with the highest loading is AOWC. For Responsiveness, the construct with the highest correlation is also Tangible, and the necessary indicators with the highest loading are AOWC and ASWC. Finally, for Public Satisfaction, the construct with the highest correlation is Assurance, and the necessary indicators with the highest loading are CLPA, CLRW and CLWW.

3.2 Measurement model

For the evaluation of the measurement model with a formative nature, it is advisable to carry out the following statistical tests (quality criteria): convergent validity, collinearity between indicators and significance and relevance of the weights (Hair et al. 2017).

Convergent validity is the degree to which the indicators represent the construct, that is, whether it measures what it purports to measure. The convergent validity of formative measurement models is evaluated by determining to what degree an indicator correlates positively with another reflective indicator of the same construct. That is, it is necessary to create a formative construct as an exogenous construct (predictor) and link it to an endogenous construct with one reflective indicator. This reflective indicator must encompass all the indicators of the construct (this new indicator is called global indicator). This global indicator contains the essence of the exogenous construct to take its place. With theses indications, we proceed to build a new model, and subsequently, to run the PLS algorithm, for each construct. The path coefficient between the constructs of the new models must have a recommended value of at least 0.70 (Hair et al. 2017). Table 6 shows the path coefficient of each of the new models.

Table 6. Convergent validity

Construct	Path coefficient
Assurance	0.940
Empathy	0.769
Reliability	0.799
Responsiveness	0.940
Tangible	0.861

The most usual test to evaluate the level of collinearity between indicators is the variance inflation factor (VIF). Diamantopoulos and Siguaw (2006) consider that high collinearity exists when the VIF is greater than 3.3. Kleinbaum et al. (2013) and Hair et al. (2017) raise this value up to 5 and Belsley (1991) admit values of up to 10. Moreover, if all VIFs are equal or lower than 3.3, the model can be consdiered free of common method bias (Kock 2015). Table 7 shows the outer VIFs values.

Table 7. Collinearity between indicators

Indicator	VIF
AOWC	3.059
ASWC	3.203
COWC	1.894
CSWC	1.966
CLPA	3.610
CLRW	3.971
CLRR	1.601
GCPS	1.000
CLSN	1.241
CLWW	2.740
CPMG	1.161
CLBE	1.584
POWC	2.244
PSWC	2.269
COCA	1.099
DCOW	1.860
DCSW	1.860
CFDA	1.202
COBA	1.134
CTSW	1.153

To evaluate the significance and relevance of the weights, it is necessary to execute a bootstrapping process to verify that the weights of the model are significantly different from zero. To consider the weights of the indicators significant, the values of the t-statistic should be greater than 1.96 with p-value < 0.05 or greater than 1.645 with p-value < 0.1. If the weight of an indicator is not significant, it can be eliminated, although if its load is relatively high (> 0.5), the indicator must be maintained (Hair et al. 2017). If both the weight and the load are not significant, there is no empirical support to retain the indicator and it should be removed from the model. In any case, when eliminating a formative indicator, it is necessary to verify that the meaning of the construct is not lost, so Roberts and Thatcher (2009) and Hair et al. (2017) suggest a flexible position recommending the inclusion of indicators in the model. Table 8 shows the values of the outer weights and the outer loadings of the model.

Table 8. Significance and relevance of the weights

	Outer weights			Outer loadings		
	Value	**T-statistics**	**P-value**	**Value**	**T-statistics**	**P-value**
AOWC -> Tangible	0.486	4.596	0.000	0.899	34.570	0.000
ASWC -> Tangible	0.222	1.958	0.051	0.856	28.401	0.000
COWC -> Tangible	0.180	2.212	0.027	0.710	16.189	0.000
CSWC -> Tangible	0.305	3.929	0.000	0.767	20.685	0.000
CLPA -> Assurance	0.642	11.143	0.000	0.970	116.648	0.000
CLRW -> Assurance	0.100	1.732	0.084	0.889	51.153	0.000
CLRR -> Reliability	0.465	6.051	0.000	0.761	17.133	0.000
GCPS -> Public Satisfaction	1.000			1.000		
CLSN -> Reliability	0.670	10.723	0.000	0.869	23.749	0.000
CLWW -> Assurance	0.327	5.870	0.000	0.885	42.585	0.000
CPMG -> Reliability	0.143	1.991	0.047	0.443	6.635	0.000
CLBE -> Reliability	0.000	0.001	0.999	0.574	9.372	0.000
POWC -> Tangible	0.015	0.165	0.869	0.477	8.456	0.000
PSWC -> Tangible	0.009	0.097	0.923	0.481	8.136	0.000
COCA -> Empathy	0.148	1.110	0.268	0.362	2.851	0.005
DCOW -> Responsiveness	0.660	8.170	0.000	0.950	47.170	0.000
DCSW -> Responsiveness	0.426	4.997	0.000	0.875	23.868	0.000
CFDA -> Empathy	0.437	3.541	0.000	0.704	7.521	0.000
COBA -> Empathy	0.710	6.782	0.000	0.881	14.536	0.000
CTSW -> Empathy	0.038	0.331	0.740	0.332	2.860	0.004

According the results of the statistical test performed, the measurement model presents adequate values for the quality criteria used. Finally, to complete the assessment of the structural model we have decided to keep all the indicators of the model, although not all are relevant. In addition to the reason explained above, another motive to make this decision is that when the PLS algorithm is used for estimation, maintaning non-significant indicators in the model does not affect the estimation of those that are significant. Standard errors increase only if there is collinearity between indicators, and the previous analysis has shown that collinearity between indicators is not a problem in this case. Furthermore, as long as the estimated coefficients are not affected, a subsequent re-estimation of colinearity is not necessary (Chin 1998).

3.3 Structural model

Once a satisfactory assessment of the measurement model has been achieved, it is possible to further evaluate the structural model. Specifically, the following statistical tests have been analyzed (quality criteria): collinearity evaluation, coefficient of determination (R^2), predictive relevance (Q^2), sign, size and significance of the path coefficients, and effect sizes (f^2) and (q^2) (Hair et al. 2017).

Regarding the collinearity evaluation, just like in the measurement model, values below 3.3 for VIF discards the existence of collinearity. Table 9 shows the VIF values for all the different constructs.

Table 9. Collinearity evaluation

Construct	VIF
Assurance	1.652
Empathy	1.204
Reliability	1.525
Responsiveness	1.518
Tangible	1.752

The coefficient of determinantion (R^2) indicates the amount of variance of an endogenous construct that is explained by the predictor indicators of the exogenous constructs. Moreover, it is a measure of the predictive power of the exogenous constructs. Its value oscillates between zero and one. The higher the value of R^2, the more predictive the model offers (Chin 2010; Henseler and Sarstedt 2013). To achieve a required level of explanatory power, Chin (1998) classified the R^2 values as substantial, moderate and weak for 0.67, 0.33 and 0.19, respectively. Hair et al. (2017) recommend the values of 0.75, 0.50 and 0.25 for the same classification. The value obtained for R^2 is 0.656, so the model (exogenous constructs) explains 65.6% of the public satisfaction variance, which indicates a moderate (close to substantial) level of explanatory power. Therefore, the relationships formulated as hypotheses in relation to the endogenous construct have a high moderate predictive level.

In addition to R^2 as a predictive criterion, Hair et al. (2017) recommend examining Q^2 to assess the predictive relevance of the structural model. Blindfolding technique allows calculating Stone-Geisser's Q^2 value. Chin (1998) indicates that the predictive relevance of the constructs must be positive. Hair et al. (2017) establish values of 0.02 as small values, values of 0.15 as mean values and values of 0.35 as large values to consider validated the predictive relevance of the model. The endogenous construct of the study presents a strong prediction, because the crossvalidated redundancy (Q^2) offers a value of 0.644 for public satisfaction.

Regarding to sign, size and significance of the path coefficients, these are interpreted as standardized regression coefficients (β) that measure the strength of the relationship between constructs. In the explanation of the results, it is necessary to take into account the level of probability, for which the coefficient is significant, as well as its size ant the sign (Chin 1998). The level of significance of the path coefficients has been determined from the value of the t-statistics derived from re-sampling of bootstrapping process. T-statistics values larger than 1.96 and p-values smaller than 0.05 implies a significant path coefficient (Chin 1998). The results show that four path coefficients are positive (i.e. in the hypothesized direction) and half of them statistically significant. Therefore, the value of the estimated path coefficients confirms two of the five hypotheses announced in the hypothetical model. The model reveals a positive and significative relationship between the construct assuance and the construct public satisfaction ($\beta = 0.690$; $p < 0.05$) and a positive and significative relationship between the construct responsiveness and the construct public satisfaction ($\beta = 0.159$; $p < 0.05$). Empathy and tangible constructs has a positive but weak effect to be significant ($\beta = 0.024$; $p > 0.05$, $\beta = 0.053$; $p > 0.05$ respectively). Reliability construct has a negative relationship and very weak effect to be significant ($\beta = -0.002$; $p > 0.05$).

Thus, H2 and H3 were accepted and H1, H4 and H5 were rejected. Path coefficients, t-statistics, p-values and decision on hypothetical relationships in the studied model are presented in Table 10.

Table 10. Sign, size and significance of the path coefficients and decision on hypotheses

Hypothetical relationships	Path coefficent (β)	T-statistics (Boostrapping)	P-value	Decision
H1: Reliability -> Public satisfaction	-0.002	0.101	0.920	Rejected
H2: Responsiveness -> Public satisfaction	0.159	5.696	0.000	Accepted
H3: Assurance -> Public satisfaction	0.690	27.928	0.000	Accepted
H4: Empathy -> public satisfaction	0.024	1.166	0.244	Rejected

H5: Tangible -> Public satisfaction	0.053	1.799	0.073	Rejected

Besides evaluating the R^2 value of all endogenous constructs, it is necessary to know the change in R^2 when a certain exogenous construct is omitted from the model; that is, the value of f^2 can be used to evaluate whether the omitted construct has a substantive impact on endogenous constructs. Cohen (1998) specifies the following values to evaluate the f^2: 0.02 is a small effect, 0.15 is a middle effect, and 0.35 is a large effect. As can be seen in Table 11, assurance has a large effect with the public satisfaction and responsiveness have a small effect with the public satisfaction. However, we can consider that reliability, empathy, and tangible have no effect on public satisfaction.

Table 11. f^2 and q^2 effects

Exogenous construcs	Endogenous constructs	
	Public satisfaction	
	f^2 effect	q^2 effect
Reliability	0.000	-0.006*
Responsiveness	0.048	0.042
Assurance	0.838	0.820
Empathy	0.001	-0.006*
Tangible	0.005	0.000
* Negative values could mean that the model is overfitting to the data and thus it has a better predictive relevance without this predictor.		

The size of the effect (q^2) allows us to evaluate the contribution of an exogenous construct on an endogenous construct. In the same way as f^2, small (0.02), middle (0.15) or large (0.35) values are considered (Cohen 1998). Its calculation is performed manually because the SmartPLS 3.0 software does not provide it. To accomplish this, the expression $q^2 = (Q^2_{included} - Q^2_{excluded}) / (1 - Q^2_{included})$ is used, where $Q^2_{included}$ is the value obtained for Q^2 with the five constructs and $Q^2_{excluded}$ is the value obtained for Q^2 eliminating each of the exogenous constructs (Hair et al. 2017). In a very similar way to the f^2 values, Table 11 shows that the greatest effect q^2 on public satisfaction is due to assurance (0.820), responsiveness have a small effect (0.042) and reliability, empathy and tangible have virtually no effect.

3.4 Model fit

Henseler et al. (2016) consider that the resutls of the model can be evaluated globally (general model) and locally (measurement and structural models). The most common criterion for evaluating the adjustment of the global model is the standardised root mean square residual (SRMR). Values of zero for SRMR would indicate a perfect fit. By convention, a model has good fit when SRMR is less than 0.08 (Hu and Bentler 1998; 1999). However, some researchers use the more lenient cutoff of less than 0.1 (Henseler et al. 2014). The value obtained of 0.037 for SRMR indicates a very good fit of the model (Table 12).

Table 12. Model fit

	Saturated Model	Estimated Model
SRMR	0.037	0.037
d_ULS	0.286	0.286
d_G	0.077	0.077
Chi-Square	439.986	439.986
NFI	0.959	0.959

This study reveals interesting outcomes. Fistly, it is tested and confirmed the positive influence of assurance and responsiveness dimensions of USWCS quality on public satisfaction, i.e., assurance, followed by responsiveness, are the most important factors in the prediction of public satisfaction. In this regard, Mohd-Zikry (2017) examined the differences between expectation of consumers of the domestic waste collection services and the actual perception of consumers after receiving the service from the appointed domestic waste collection services cotractors in Malaysia. The results showed that only assurance and empathy do have a difference before and after consumers received the services.

Secondly, assurance is mainly characterized by CLPA (T-statistics = 11.143) followed by CLWW (T-statistics = 5.870), and responsiveness is mainly characterized by DCOW (T-statistics = 8.170) followed by DCSW (T-statistics = 4.997). The rest of the quality indicators that define theses dimensions do not have a significant effect on them. Therefore, considering the positive influence of these indicators on public satisfaction, SEMAT S.A. company should pay more attention to cleanliness of pavements and walkways and to daily collection of waste, both organic and selective. In this way, it will improve public satisfaction and as a consequence the USWCS quality in the city of Burgos.

These results are in line with those shown by Obirih-Opareh and Post (2002) who showed that the waste collection public system in Ghana suffered a number of weaknesses, notably the low frequency/irregularity of container pickup, and the lack of cleanliness. Furthermore, the number of containers and their location was severely limited and this incited people to reject the services. Also in Ghana, Akaateba and Yakubu (2013) suggested that the important factors for public satisfaction with the waste collection service were the neatness of waste collection crew, wearing of protective clothing, frequency of waste collection and vehicles and equipment used to collect and dispose waste. Alike, in India, Raje et al. (2001) detected a great importance to cleanliness of area, a medium importance to frequency of collection, and a small importance to location of dustbins. In India too, Virk et al. (2004) indicated that most annoying problem for the public was accumulated waste in the street. In Bangladesh, Chandra-Majumder and Razaul-Karim (2012) provided some recommendation for better solid waste management. Although different tangible factors were highlighted as very serious problems, they indicate as serious problem the frequency of service delivery.

To sum up, the results of the study reveal a percentage of public satisfaction with the USWCS quality of 84.37% (ratings greater than or equal to 5) and 37.65% (ratings greater than or equal to 8). These values have also been obtained for different segmentations of the sample based on gender, age, and type of respondent. In this sense, for the male gender we obtain 83.37% and 31.24%, while for the female gender we obtain 84.43% and 31.15%. Regarding age, 88.54% and 33.76% satisfaction is obtained for citizens between 18-20 years, 82.15% and 29.63% for the range of 30-44 years, 84.03% and 30.67% for citizens between 45-59 years and finally, for citizens over 60 years of age, a satisfaction percentage of 83.08% and 31.72% is obtained. In the questionnaire, information was also collected to segment the sample based on the type of respondent, either associated with a private home or associated with a commercial activity. Based on this last segmentation, satisfaction percentages of 84.97% and 31.50% have been obtained in homes and 76.35% and 31.08% for commercial activities, being possibly 76.35%, the most outstanding percentage due to its slight decrease. All these values are close to 86% of public satisfaction with the waste collection service in Malaysia (Fauziah et al. 2009) or 73% in a municipality of Ireland (Purell and Magette, 2010). Slightly lower values were shown by Abassi et al. (2009), with about 60% of public satisfaction in Jordan. Finally, Ali et al. (2014) offered lower public satisfaction percentages (40%) in Bangladesh, which may be reasonable due to the level of development in that country.

4 Conclusions

In the context of the urban solid waste collection service (USWCS), the research outcomes have enriched knowledge about the relationship between service quality and public satisfaction in different countries, regions and municipalities. The contribution of this study is to expand this knowledge by evaluating the USWCS quality in the city of Burgos. We believe that results obtained can provide guiadance for administrators at the forefront of the councils or companies to understand how citizens asses the quality level of USWCS, and how public and adminstrators meet their requirements, for example, combining satisfaction with the service for the former and a balanced budget for the latter. In addition, the study also makes a modest contribution in favor of environment and sustainability.

The results of the study offer a satisfactory general perception of the citizens of Burgos with the USWCS. 84.37% of citizens are satisfied with the service (ratings greater than or equal to 5). Moreover, the study highlights that assurance and responsiveness have a positive and significant effect on public satisfaction. However, reliability, empathy, and tangible have not significant effect on public satisfaction. Regarding assurance, cleanliness of pavements (CLPA) and cleanliness of walkways (CLWW) are the indicators that provide a significant effect on this dimension. Otherwise, daily collection of organic waste (DCOW) and daily collection of selective waste (DCSW) are the indicators that provide a significant effect on responsiveness dimension.

Obviously, it seems clear to think that improving CLPA, CLWW, DCOW, and DCSW implies improving public satisfaction. To further improve these four indicators, we could, for example, increase the frecuency of pavements and walkways cleanliness and the frecuency of organic and selective waste collection, but we must exercise caution as it is necessary to find a compromise between this frecuency and other factors such as costs, pollution, noise, smells, etc. At present, as indicated in Table 1, cleanliness of pavements and walkways is carried out every day, divided into 3 work shifts, while the frequency of collection of organic and selective waste containers is daily for 80% of the containers and on alternate days for the remaining 20% of the containers.

For the former (CLPA and CLWW), we could consider the associated costs per hour for manual cleaning, mechanical cleaning, checking and emptying of bins and cleaning of chewing gums, stains, etc. Table 13 shows these costs.

Table 13. Cleanliness of pavement and walkways costs

Type of cleaning	Costs (€/h)
Manual cleaning	12,88
Machanical cleaning	26,88
Checking and emptying of bins	12,78
Cleaning of chewings gums, stains, etc.	30,52

For the latter (DCOW and DCSW), the SEMAT S.A. company has provided us with the kilometers traveled for the collection trucks to accomplish the collection with the current frequency and the time used for it. The distribution by month can be seen in Table 14.

Table 14. Total kilometers traveled per month by collection trucks and time spent

Month	Kilometers	Hours
January	52,545.00	106.91
February	91,396.00	125.38
March	108,192.00	89.5
April	100,042.00	354.72
May	109,221.00	284.87
June	101,993.00	196.76
July	106,208.00	288.31
August	104,233.00	269.58
September	100,888.00	312.14
October	114,286.00	108.37
November	101,978.00	34.85
December	91,226.00	212
Total	1,182,208.00	2,383.39

In this line, we can consider a cost associated with each kilometer traveled by the collection trucks of 1.66 € (Table 15), a cost associated with each driver of 21.37 €/h and a cost associated with an assistant operator of 20.20 €/h. With these data, the total cost associate with the collection of organic and selective waste could be calculated.

Table 15. Costs associated with each kilometer traveled by collection trucks

Cost type		€/km
Direct costs	**In route**	1.031
	In load	1.212
	average	1.122
Amoritzation costs (5%)		0.056
Indirect costs		0.050
Direct+Amortization+Indirect Costs		1.228
Correction coefficient for lower transport performance (container collection cycles, maneuvers, etc.) of 35%		0.43
Total		1.66

All these costs are not the only ones that the SEMAT S.A. company incurs in the performance of its service. It should also take into account costs related to containers (amortization, maintenance, cleaning, etc.), the collection of other waste and other services (paint marks and graffiti, riverbeds and riverbanks, beaches, snow, sanitary waste, batteries, animals, and furniture and domestic appliances), recycling processes, personal, treatment and disposal of waste, etc. In any case, we have only focused this brief cost analysis on the indicators that have been shown to be significant in the study performed.

In addition to its influence on costs, an increase in the frequency of pavements and walkways cleanliness and the frequency of organic and selective waste collection, will also have an impact on pollution, noise and smells. Regarding the last two, we do not have information beyond the data obtained in the measurements that are made on the noise that drivers support through the hygienic evaluations in risk prevention, but this information does not affect public satisfaction. With respect to the pollution impact, the SEMAT S.A.[5] company has provided us with the CO_2 emissions that each of its activities generate over the course of a year (Table 16). It is clear that the activity that generates the most CO_2, by far, is the use of gasoil, so increasing the frequency of collection, that is, the kilometers traveled, will also generate a high increase in the generation of CO_2.

Table 16. CO_2 emmisions that each activity genetares in one year

Activity	Activity data	Emission factor	Kg CO_2	Tn CO_2
Gasoil (Litres)	615,425.35	2.47	1,520,716.04	1,520.72
Energy (Kwh)	184,447.00	0.12	22,133.64	22.13

[5] SEMAT S.A. company is certified in the Quality, Environment and Health and Safety Integral System (ISO14001:2015, ISO9001:2015, ISO 45001:2018). Carbon footprint registered in the Carbon Footprint Registry of the Ministry for Energy Transition and Demographic Challenge, with a scope 1 and 2 (emissions validated by Lloyd's Register company).

Water (M^3)	2,701.00	0.79	2,128.39	2.13
Paper (Kg)	2,625.00	3.00	7,875.00	7.88
Total			1,552,853.07	1,552.85

Considering all that has been said, we can emphasize that increasing public satisfaction can be achieved by increasing the frequency of pavements and walkways cleanliness and the frequency of organic and selective waste collection, and that this has a clear relationship with the increase in costs and pollution impact. Regardless of this conclusion, the study also has some limitations. The findings are influenced by the social, cultural context, etc. from the city of Burgos, so further research of similar cities can help reinforce the results obtained by increasing their generalizability. Moreover, the study certainly suffers from difficulties due to time and budget limits. Also, we wish to point out that due to the subjective nature of responses, as they are based on opinion surveys, the results are of an exploratory nature and have to be interpreted with caution. We present a series of possible lines of future investigation that will drive the evolution and improvement of the scientific progress commenced in this work, so as to reduce this caution.

First, to find a balance between frequency of collection and increasing cost and pollution, a possible line of research could be the realization of a mathematical model that considers these three objectives: minimization of costs, minimization of pollution impact and maximization of public satisfaction, considering also a limited budget and other series of restrictions. Once the model has been proposed, the use of multiobjective heuristics or metaheuristics can allow us to find the optimal solution to find that balance. Another possible line of investigation may be to consider the noise pollution generated with the collection of the containers, or the pollution caused by the smell when the frequency of cleanliness and collection decreases. On the other hand, we think that it may be interesting to carry out the study stratifying by the defined zones in the city of Burgos. It is possible that this new study offers different opinions in each zone about the relationship between public satisfaction and USWCS quality. Moreover, the exploration of additional factors affecting the public satisfaction could be interesting. For this, we propose to increase the stratification of the sample considering a categorization of variables such as age, gender, type of citizen (individual or commerce), if the citizen usually deposits the waste by him/herself, if the citizen recycles or if construction works and paint marks and graffiti are found to have an influence on the level of satisfaction with the general cleanliness. All these variables have already been convered in the survey. Even other external variables from the National Institute of Statistics and the World Bank might allow us to establish if circumstantial elements (rent, cultural level, etc.) can have an influence on both increasing and decreasing satisfaction level. In this regard, Khanom et al. (2015) show that factors such as age, education, occupation, income status, etc. have a significant positive correlation between quality of USWCS and public satisfaction. Finally, the survey also collects subjective open opinions on the most notable aspects and the aspects for improvements. The most detailed analysis of these three types of variables can lead to significant improvements in the USWCS quality as a consequence to an increase in public satisfaction levels with this service.

All these outcomes form a significant framework for the relationship between USWCS and public satisfaction in the city of Burgos. The significance of those four indicators is strong enough to motivate decision-makers to address their efforts and investments in improving them, enabling thus an effective and efficient service at the required level of quality and adjusting their strategies to achieve an adequate public satisfaction. In addition to this practical validation at the management level, also at environmental and sustainability level, consequences can be added. Despite these implications, the findings are not future-proof; therefore, rapid changes in needs of citizens or environmental and sustainability characteristics would necessitate re-definition of USWCS indicators and re-quantification of the influence of these indicators on public satisfaction.

References

Abassi, B.E., Khrisat, H., & Alnewashi, Q. (2009). Municipal solid waste management at Salt City in Jordan: Community perspective. *Journal of Food, Agriculture & Environment*, 7(2), 740-745.

Akaateba, M.A., & Yakubu, I. (2013). Householders' satisfaction towards solid waste collection services of Zoomlion Ghana LTD in WA, Ghana. *European Scientific Journal*, 9(32), 198-213.

Ali, K.M.B., Molla, M.H., & Faisal, M.M. (2014). Urban socio-economic and environmental condition of Hill Tracts Bangladesh: A case study in Bandarban Municipality. *IOSR Journal of Humanities and Social Science*, 19(4), 36-44.

Bel, G., & Miralles, A. (2003). Factors influencing the privatization of urban solid waste collection in Spain. *Urban Studies*, 40(7), 1323-1334.

Belsley, D.A. (1991). *Conditioning diagnostics, collinearity and weak data in regression*. New York: John Wiley & Sons, Inc.

Bertanza, G., Ziliani, E., & Menoni, L. (2018). Techno-economic performance indicators of municipal solid waste collection strategies. *Waste Management*, 74, 86-97.

Bollen, K.A., & Ting, K.F. (2000). A tetrad test for causal indicators. *Psychological Methods*, 5(1), 3-22.

Brady, M.K., & Robertson, C.J. (2001). Searching for a consensus on the antecedent role of service quality and satisfaction: An exploratory cross-national study. *Journal of Business Research*, 511, 53-60.

Chakraborty, S., & Sengupta, K. (2014). Structural equation modelling of determinants of customer satisfaction of mobile network providers: Case of Kolkata, India. *IIMB Management Review*, 26, 234-248.

Chandra-Majumder, S., & Razaul-Karim, M. (2012). Urban Solid Waste Management: A Study on Comilla City Corporation. *Journal of Economics and Susteainable Development*, 3(6), 53-61.

Chatzoglou, P., Chatzoudes, D., Vraimaki, E., & Leivaditou, E. (2014). Measuring citizen satisfaction using the SERVQUAL approach: the case of the ‘Hellenic post’. *Procedia Economics and Finance*, 9, 349-360.

Cheng, C., & Urpelainen, J. (2015). Who should take the garbage out? Public opinion on waste management in Dar es Salaam, Tanzania. *Habitat International*, 46, 111-118.

Chin, W.W. (1998). The partial least squares approach to structural modelling. In G.A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295-336). New Jersey: Lawrence Erlbaum Associates.

Chin, W.W. (2010). How to write up and report PLS analyses. In V. Esposito Vinzi, W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares* (pp- 655-690). Berlin: Springer Handbooks of Computational Statistics.

Cohen, J. (1998). *Statically power analysis for the behavioral sciences*. New York: Laurence Erlbaum Associates.

Diamantopoulos, A., & Siguaw, J.A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, 7(4), 263-282.

Durdyev, S., Ihtiyar, A., Banaitis, A., & Thurnell, D. (2018). The construction client satisfaction model: A PLS-SEM approach. *Journal of Civil Engineering and Management*, 24(1), 31-42.

Fauziah, S.H., Khairunnisa, A.K., Siti-Zubaidah, B., & Agamuthu, P. (2009). *Public perception on solid waste and public cleansing management bill 2007 towards sustainable waste management in Malaysia*. ISWA/APESB World Congress, 12-15 Oct 2009, Lisbon, Portugal.

Fernández-Aracil, P., Ortuño-Padilla, A., & Melgarejo-Moreno, J. (2018). Factors related to municipal costs of waste collection service in Spain. *Journal of Cleaner Production*, 175, 553-560.

Guerrini, A., Romano, G., & Leardini, C. (2015). Measuring performance of municipal solid waste collection services. Procedia Environmental Science, *Engineering and Management*, 2(1), 51-62.

Guimaraes, B., Simoes, P., & Marques, R.C. (2010). Does performance evaluation help public managers? A Balanced Scorecard approach in urban waste services. *Journal of Environmental Management*, 91, 2632-2638.

Graa, A., Labair, S., & Benyakhlef, K. (2017). Measuring Satisfaction of Algerian Social Insured: A PLS-SEM Approach. *Journal of Economics and Business Research*, XXIII(1), 43-58.

Gudergan, S.P., Wende, S., & Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. *Journal of Business Research*, 61(12), 1238-1249.

Hair, J.F., Hult, G.T.M., Ringle, C.M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM), 2º Edition*. California: Thousand Oaks, SAGE.

Henseler, J., & Sarstedt, M. (2013). Goodness-of-fit indices for partial least squares path modeling. *Computational Statistics*, 28(2), 565-580.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen, D.J., Hair, J.F., Hult, G.T.M., & Calantone, R.J. (2014). Common beliefs and reality about partial least squares: Comments on Rönkkö & Evermann (2013). *Organizational Research Methods*, 17(2), 182-209.

Henseler, J., Hubona, G., & Ray, P. (2016). Using PLS path modeling new technology research: updated guidelines. *Industrial Management & Data Systems*, 116(1), 2-20.

Hoyle, R. (1995). *Structural Equation Modeling*. California: Thousand Oaks, SAGE.

Hu, L., & Bentler, P. (1998). Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. *Psychological Methods*, 3(4), 424-453.

Hu, L., & Bentler, P. (1999). Cutoff criteria for fitindexes in covariance structure analysis: conventional criteria versus new alternative. *Structural Equation Modeling*, 6(1), 1-55.

James, O. (2007). Evaluating the expectations disconformation and expectations anchoring approaches to citizen satisfaction with local public services. *Journal of Public Administration Research and Theory*, 19, 107-123.

Kawai, K., & Osako, M. (2013). Advantages and disadvantages of a municipal solid waste collection service for citizens of Hanoi City, Vietnam. *Waste Management & Research*, 31(3), 327-332.

Khanom, T.F., Farjana, T., Manum, A.A., Hossain, A., & Baten, M.A. (2015). Household satisfaction on solid waste collection services conducted by NGOs in Mymensing Municipality, Bangladesh. *International Journal of Natural and Social Sciences*, 2(4), 14-22.

Kleinbaum, D.G., Kupper, L.L., Nizam, A., & Rosenberg, E.S. (2013). *Applied regression analysis and other multivariable methods, 5th Edition*. Boston, MA: Cengage Learning.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration*, 11(4), 1-10.

Kwong, K., & Wong, K. (2013). Partial Least Square Structural Equation Modeling (PLS-SEM). Techniques Using SmartPLS. *Marketing Bulletin*, 24, 1-32.

Lohri, C.R., Camenzind, E.J., & Zurbrügg, C. (2014). Financial sustainability in municipal solid waste management – Costs and revenues in Bahir Dar, Ethiopia. *Waste Management*, 34, 542-552.

Ma, J., & Hipel, K.W. (2016). Exploring social dimensions of municipal solid waste management around the globe – A systematic literature review. *Waste Management*, 56, 3-12.

Marcoulides, G., & Saunders, C. (2006). PLS: A silver bullet? *Management Information Systems Quarterly*, 30(2), 3-9.

Mendes, P., Santos, A.C., Perna, F., & Ribau-Teixeira, M. (2012). The balanced scorecard as an integrated model applied to the Portuguese public service: a case study in the waste sector. *Journal of Cleaner Production*, 24, 20-29.

Mohd-Zikry, Z. (2017). *Service quality of domestic waste collection services in Batu District, Selayang Municipal Council, Selangor: the SERVQUAL approach*. Master thesis, University Utara Malaysia.

Munusamy, J., Chelliah, S., & Mun, H.W. (2010). Service Quality Delivery and Its Impact on Customer Satisfaction in the Banking Sector in Malaysia. *International Journal of Innovation, Management and Technology*, 1(4), 398-404.

Obirih-Opareh, N., & Post, J. (2002). Quality assessment of public and private modes of solid waste collection in Accra, Ghana. *Habitat International*, 26, 95-112.

Ovretveit, J. (2005). Public service quality improvement. In E. Ferlie, L. Lynn, & C. Pollitt (Eds.), *The Oxford Handbook of Public Management* (pp. 537-562). Oxford: Oxford University Press, Oxford.

Parasuraman, A., Zeithaml, V.A., & Berry, L.L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12-40.

Post, J., Broekema, J., & Obirih-Opareh, N. (2003). Trial and error in privatisation: Experiences in urban solid waste collection in Accra (Ghana) and Hyderabad (India). *Urban Studies*, 40(4), 835-852.

Purell, M., & Magette, W.L. (2010). Attitudes and behavior towards waste management in Dublin, Ireland region. *Waste Management*, 30, 1997-2006.

Rada, E.C., Zatelli, C., Cioca, L.I., & Torretta, V. (2018). Selective collection quality index for municipal solid waste management. *Sustainability*, 10(1), 257-273.

Raje, D.V., Wakhare, P.D., Deshpande, A.W., & Bhide, A.D. (2001). An approach to assess level of satisfaction of the residents in relation to SWM system. *Waste Management & Research*, 19, 12-19.

Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparision of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing*, 26(4), 332-344.

Roberts, N., & Thatcher, J. (2009). Conceptualizing and testing formative constructs: Tutorial and a noted example. *The data Base for Advances in Information Systems*, 40(3), 9-39.

Roch, C.H., & Poister, T.H. (2006). Citizens, accountability and service satisfaction. The influence of expectarions. *Urban affairs review*, 41(3), 292-308.

Rodrigues, S., Martinho, G., & Pires, A. (2016). Waste collection systems. Part B: Benchmarking indicators. Benchmarking of the Great Lisbon Area, Portugal. *Journal of Cleaner Production*, 139, 230-241.

Rodrigues, A.P., Fernandes, M.L., Rodrigues, M.F.F., Bortoluzzi, S.C., Gouvea da Costa, S.E., & Pinheiro de Lima, E. (2018). Developing criteria for performance assessment in municipal solid waste management. *Journal of Cleaner Production*, 186, 748-757.

Schulte, N.A., Gellenbeck, K., & Nelles, M. (2017). Operationalisation of service quality in household waste collection. *Waste Management*, 62, 12-23.

Shmueli, G., & Koppius, O. (2011). Predictive analytics in information systems research. *MIS Quarterly*, 35(3), 553-572.

Shriwas, S., Rao, S.S., & Sharma, R. (2018). Public satisfaction towards solid waste management services in Chhattisgarh: A comparative study. *International Journal of Research in Advent Technology*, 6(12), 3567-3571.

Simoteo, A. (2012). Formative and reflective models: state of the art. *Electronic Journal of Applied Statistical Analysis*, 5(3), 452-457.

Sureshchandar, G.S., Rajendran, C., & Kamalanabhan, T.J. (2011). Customer perceptions of service quality: A critique. *Total Quality Management*, 121, 111-124.

Tabernero, C., Cuadrado, E., Luque, B., Signoria, E., & Prota, R. (2016). The importance of achieving a high customer satisfaction with recycling services in communities. *Environment, Development and Sustainability*, 18, 763-776.

Teixeira, C.A., Avelino, C., Ferreira, F., & Bentes, I. (2014). Statistical analysis in MSW collection performance assessment. *Waste Management*, 34, 1584-1594.

Tilaye, M., & van Dijk, M.P. (2014). Sustainable solid waste collection in Addis Ababa: the users' perspective. *International Journal of Waste Resources*, 4(3), 158-168.

Tsai, F.M., Bui, T.D., Tseng, M.L., Wu, K.J., & Chiu, A.S.F. (2020). A performance assessment approach for integrated solid waste management using a sustainable balanced scorecard approach. *Journal of Cleaner Production*, 251, 119740.

Virk, M.K., Singla, V., & Sandhu, P. (2004). Awareness among urban inhabitants about waste management and its impact on environment. *Journal of Human Ecology*, 15(2), 97-100.

Wilson, D.C., Rodic, L., Scheinberg, A., Velis, C., & Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste management & Research*, 30(3), 237-254.

Wong, K.K.K. (2013). Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing Bulletin*, 24(1), 1-32.