Operationalisation of service quality in household waste collection

Nico Alexander Schulte [a,*], Klaus Gellenbeck [b], Michael Nelles [a,c]

[a] University of Rostock, Faculty of Agricultural and Environmental Sciences, Department of Waste Management, Justus-von-Liebig-Weg 6, 18059 Rostock, Germany
[b] University of Applied Sciences Münster, Department Facility Management, Corrensstraße 25, 48149 Münster, Germany
[c] Deutsches Biomasseforschungszentrum (DBFZ), German Biomass Research Centre, Torgauer Straße 116, 04347 Leipzig, Germany

ABSTRACT

Since 2007, there has been intensive discussion at European and national levels concerning the standardisation of services including those in the sector of waste management. The drafts of the European standard prEN 16250 and the German preliminary standard DIN SPEC 1108 are intended to establish a uniform definition of corresponding services and their (minimum) service levels. Their binding application in practice requires that systematic inspections be provided to ascertain to what degree a service has been carried out as agreed upon. However, both standardisation projects give only a few examples of potential quality characteristics and offer no concrete information concerning methods of measurement. Because intersectoral or cross-service quality inspections do not exist, there is a need for the development of specific quality inspections.

The study introduced in this article examines the question of how the service quality of door-to-door waste collection can be systematically measured. To this end, the quality concept applied to the process of waste collection was first concretised and then operationalised using indicators. Based upon this, the methods of the quality inspections were developed and subjected to a trial of their applicability in a German waste management company. The methods for measuring and evaluating take into account, in addition to the different boundary conditions of collection, also the possible customer influence on the collection process and consequently on the service performed by the collection crew. In order to avoid time- and therefore cost-intensive exhaustive surveys, a multilevel random-controlled selection of survey units was developed, too. Based on the analysis of the measurement data, it was possible to determine specific time requirement values for the regular performance of the data surveys, as well as minimum sample sizes as a function of the number of container locations of the waste collection tours. On the basis of this information, it has been possible to make initial statements concerning the personnel requirement for quality inspections. Moreover, it is possible to make recommendations concerning the daily working-time schedule for a quality manager in order to achieve the most efficient performance of quality inspections possible.

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1. Introduction

Since 2007, there has been intensive discussion at European and national levels regarding the standardisation of selected services in the public sector. The drafts of the European standard prEN 16250 "Levels of performance and acceptance for street cleaning and municipal waste management services" and the German preliminary standard DIN SPEC 1108 "Services for waste and recycling logistics, road cleaning, winter maintenance and sewage systems" pursue the goal of providing a Europe-wide uniform definition of street-cleaning and waste-management services with reference to service levels (CEN, 2012a, 2013; DIN, 2009). This is intended to provide a uniform understanding regarding the service contents and possibly differing service levels among all parties involved. Obviously, the stipulations alone will not be sufficient in practice. Rather, a systematic inspection of the degree to which a service has been performed as agreed upon is required (CEN, 2009). In the area of quality management, these inspections are called "quality inspections".[1]

Against the background of the variety of services in the sector described above, a clear definition of the scope of the investigation

* Corresponding author.
  E-mail address: nico.schulte@mail.de (N.A. Schulte).

[1] The term *quality* is defined as the "degree to which a set of inherent characteristics fulfils requirements". Accordingly, quality is not a property of a service, but rather the result of a comparison between the actually achieved and the required property (ISO, 2015).

allows a differentiated approach to the study. The study introduced in this article focuses on the collection process as an essential procedural step in waste management.

1.1. Literature review

Numerous studies have already dealt with the collection process. Most of these emphasised the performance-related and economic viewpoints. As a rule, different collection systems/procedures are compared taking into account local boundary conditions in order to make possible the formulation of efficiency-oriented recommendations for decision-makers. In this way, key figures such as

- the collection time per unit of waste collected,
- the distance travelled by the collection vehicle per unit of waste collected,
- the average waste-collection crew size and
- the unit cost of waste collection (cost per ton)

occupied the foreground (e.g. Dornbusch, 2006; Huang et al., 2011; Bolaane and Isaac, 2015; Das and Bhattacharyya, 2015; Bing et al., 2016). Some studies were devoted especially to environmental protection aspects with the aid of key figures such as

- fuel consumption per unit of waste collected and
- pollutant emissions per year (e.g. carbon oxide, CO_2, NO_x)

(Larsen et al., 2009; Abdelli et al., 2016). With a few exceptions (Schulte et al., 2013, 2014, 2015), a holistic and systematic quality-oriented focus on the collection process against the background of the application of different service levels as conceived in the above-mentioned standardisation projects has received very little consideration in the literature.[2]

1.2. Problem statement and aims

Both standardisation projects name only a few exemplary potential quality aspects[3] and offer no specific information concerning their methods of measurement. Because no intersectoral or cross-service quality inspections exist, there is a need for the development of specific quality inspections for the above-mentioned fields of activity (Schröter, 2011).

The aim of the study presented here is to develop methods of standardised quality inspections for the door-to-door kerbside waste collection. Moreover, recommendations are to be made for performing the quality inspections as efficiently as possible.

1.3. Fundamental cases for the application of quality inspections

Quality inspections can be divided into two fundamental application cases. On the one hand, there are in-house quality inspections (case A), and on the other hand there are quality inspections contractually agreed upon in the client-contractor relationship (case B). In case A, the quality manager of the company inspects the services provided, as a rule in order to obtain data concerning quality control, to be able to support the Continuous Improvement Process and in order to enhance the quality awareness within the company. It is also conceivable for the work force to receive a quality-oriented remuneration. Case B is concerned with determining whether the contractor has adhered to the

agreed upon standards, for example in conjunction with an output-oriented incentive system. It would be advisable to already provide for these inspections in the invitation to tender for a service and in the contract formulation between the client and the contractor.

2. Methodology

Against the background of international quality management's understanding of quality (see Footnote 1), the study focuses on the following four guiding research questions:

1. How can service quality applied to the collection process be concretised?
2. How can service quality be measured systematically and as far as possible independently of personal assessments?
3. What options can be provided for minimising the time required for the survey during the quality inspections?
4. How can the data collected be evaluated as a statement of quality?

In order to answer these questions, the study was divided into three research modules. These will be presented in the following. Here, the manufacturing-based quality understanding is taken as the basis (Garvin, 1984; Crosby, 1979), rather than the subjective quality perception of the customer (e.g. the user of a waste container or the provider of bulky waste).

2.1. Conceptualisation module

The conceptualisation module is concerned with answering the first guiding research question. Accordingly, the task is the context-specific clarification of what is to be understood by the term "service quality". To this end, the following six model scenarios reflecting the common combinations of different collection systems, container systems, container transport services and vehicle types used in the collection of wastes from households as found in Germany were derived on the basis of a literature research and the evaluation of the authors' own experience.

1. mobile waste and recycling containers (wheeled bins e.g. compliant with CEN, 2012b) | partial service | rear loaded vehicle
2. mobile waste and recycling containers | partial service | side loaded vehicle
3. mobile waste and recycling containers | full service | rear loaded vehicle
4. refuse sacks (one-way system) | partial service | rear loaded vehicle
5. systemless collection (bulky waste) | rear loaded vehicle
6. systemless collection (e-waste) | flatbed or box truck

In the next step, a scenario-specific process detailing was done according to the top-down-method for the purpose of complexity reduction, in order to be able to take into account the possible influence of the different boundary conditions on the collection process at the level of individual activities while developing the quality inspections. Fundamentally, it is possible to apply requirements to each individual activity.[4] Here, in addition to organisational, technical and container-location-specific aspects, possible customer influences (container users and/or providers of waste) on the performance of services were identified.

Since service quality is a multi-dimensional construct, a hierarchical dimensioning of the quality of the collection process was carried out. This was done on three levels (see Fig. 1).

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[2] General standards for quality management, such as the ISO 9000 series, are not focused upon here.

[3] Included here are, e.g. the relation of the number of waste containers actually emptied to the number of containers which are supposed to be emptied, as well as service punctuality (CEN, 2012a).

[4] For the meaning of the term *requirement* see Footnote 1.