The impact of tender specifications and evaluation model of the waste collection procurement on the waste collection fees

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***Abstract*—**The current paper analyses the impact of the tender specifications and evaluation model of the waste collection public procurement on quality and waste collection fees of the organised waste collection service in Harju County municipalities. The tender specifications, including service quality requirements, and tender evaluation model are the two key factors which influence the final service quality and price. Since the organised waste collection is a public utility which is organised by local authority and executed by private enterprise, the service quality and price must be fair and reasoned. In the current research a new formula for the formation of the municipal waste collection fees within the organised waste collection scheme (OWCS) is introduced, and the impact of tender specifications on the OWC service is analysed. The OWCS enables the municipality to take more control over the formation of the waste collection service prices, and make the waste collection fees more transparent. Through the optimisation of waste collection routes within OWCS the environmental impact and economical costs of municipal waste transportation can be reduced remarkably. However most of the Estonian municipalities have not occupied this administrative tool effectively. The municipal waste collection fees in most of the municipalities are obscure, unequal, and unreasonable in terms of price-quality ratio of the waste collection service. This is the result of weak evaluation criteria of the waste collection public procurements. The current research gives the municipalities arguments to take more control over the municipal waste collection service.

***Keywords*—**administrative efficiency, municipal waste management, polluter pays principle, public procurement, tender evaluation model

I. Introduction

THE main principles of waste management, such as the waste management hierarchy, polluter pays principle, principles of self-sufficiency and proximity, and producers responsibility are set in the EU waste framework directive [EC, 2008]. Local authorities (LAs) constitute worldwide the main providers of municipal solid waste (MSW) management services, either directly or indirectly through subcontracting part or all of these services [Chalkias and Lasaridi, 2009]. Also in Europe, the municipalities are usually responsible for municipal waste management and its administration, either procuring services or providing services through municipal enterprises. In Estonia, since 2005 the municipalities are obliged to take more control over (= organise and procure) the municipal waste collection service, and since 2010 the National Waste act gives the municipalities the possibility to provide the service administration by themselves [EP, 2004, § 66-1 and §66-1[1]]. The waste companies have been against this kind of reorganisation accounting for and indicating to the potential inefficiency of the municipal enterprise.

Recent empirical research has confirmed that, contrary to common assumptions, there are no significant differences in efficiency between public and private waste operators (empirical studies also find the same result in respect of water, electricity and other sectors). A Spanish-American team analysed all econometric empirical studies of efficiency and privatisation in waste management and in water, and found "no systematic support for lower costs with private production…we do not find a genuine empirical effect of cost savings resulting from private production". Two of the authors carried out a further empirical study on waste management in rural areas, finding that inter-municipal arrangements reduce costs but outsourcing does not: "small towns that cooperate incur lower costs for their waste collection service. Cooperation also raises collection frequency and improves the quality of the service in small towns. By contrast, the form of production, whether it is public or private, does not result in systematic differences in costs." [Hall, 2010, p. 10]

As defined in the national Waste Act, the organised waste collection (OWC) is collection, and transportation of the municipal waste from the predetermined waste collection district to the predetermined waste treatment facility by a waste company selected by the local authority. The local authority holds a concession of services procurement to select the waste collection service provider, and determines the waste treatment facility. As the result of the public procurement, a waste collection service provider enter into contractual relationship with the local authority up to five years. All households are required to join the waste collection system. The size of the waste collection district should assure the fill up of a waste truck in one collection route but may comprise generally no more than 30,000 inhabitants. The OWCS involves the mixed municipal waste, and the source sorted waste. The local authority must define the principles of pricing the waste collection service in the local waste regulation [EP, 2004].

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The advanced OWCS allows municipality(ies) or a non-profit organisation authorised by the municipality(ies) to take over the customer database so that all the waste holders become clients of the waste management centre (WMC), which would then be the only client of the waste collection company, and fully responsible for the waste collection service as an administrative body. In the advanced OWCS the municipality holds separate public procurements for waste collection, and waste treatment services. The municipality bills the waste holders, and pays for the waste collection service to the waste collection company, and for the waste treatment service to the waste treatment company, thus acting as the customer service, and accounting centre. The redirection cash flow from "waste holder → waste company" to "waste holder → WMC → waste collection company, and waste treatment company" enables to integrate some waste management costs (e.g. waste holders register, domestic hazardous waste collection, advising, and awareness raising activities) into waste collection fee as the administrative costs, which disencumbers the municipality's budget from those expenses. The two main differences of the advanced OWCS compared to the regular OWCS are the redirection of the cash flow, and separation of the waste collection, and waste treatment services [Kivimägi and Loigu, 2013].

The principles of waste collection service pricing set in the local waste regulation, and tenders evaluation model of the waste collection service concession procurement are the key factors which create the base for the fair, and transparent formation of the waste collection fees. Another key factor is the qualification criteria which limit the circle of tenderers, and in association with the other requirements and conditions of the concession contract assure the quality of the waste collection service. Beside the mixed municipal waste, source sorted paper waste, and bio-waste can be involved to, and centrally collected within the OWCS. Thus, the OWCS, especially the advanced format of it, has given a set of administrative tools to a local authority to organise the environmentally sound, and economically fair municipal waste management on its territory.

A new model for a fair, and transparent formation of the municipal waste collection fees, including the tender evaluation model of the OWC procurement is introduced in the current paper. Also the main tender specifications, and qualification criteria of the OWC procurements which would improve the quality of the OWC service are briefly overviewed, and reasoned. Since the OWC is a public communal service, the main principles of the public procurement including fair competition, contribution to the environmental sustainability, transparency of the evaluation criteria etc., must be applied to the OWC public procurements.

The analysed data involves the databases of the waste holders' registers of the Harju County municipalities, the tender evaluation models of the last OWC procurements [Kivimägi, 2011], and waste collection fees in those municipalities [Kivimägi, 2012]. In addition, the results of the OWC procurements in some municipalities which have applied the introduced formula were used as examples.

There are several researches aiming to improve the administrative and economic cost-efficiency, and to reduce the environmental impact of the municipal waste management applying different info-technological tools and models. These researches involve GIS (Geographic Information System), DSS (Decision Support System), IWMM (Integrated Waste Management Model), NPV (Net Present Value), LCA (Life Cycle Assessment), PAYT (Pay As You Through). GIS was used to improve the efficiency of waste collection and transport in the Municipality of Nikea (MoN), Athens, Greece via the reallocation of waste collection bins, the introduction of new vehicle routing and new vehicle time [Chalkias and Lasaridi, 2009]. Xiangyun *et al.* 2007 presented the development of DSS, which elaborates on the construction of databases, the evaluation model using NPV, and the development of system to assess effectiveness and profitability of any technological process and to find a cost effective model solution in municipal solid waste management [Xiangyun et al, 2007]. Hrebicek and Soukopova, 2010 applied environmental modelling, particularly modelling of Integrated Municipal Solid Waste Management Systems (IWMM) at the Czech Republic to simulate the different scenarios of prescribed waste landfill fees, an inclusion or an exclusion of certain facilities of energy recovery / mechanical-biological treatment of waste with prescribed annual capacity in selected locations [Hrebicek and Soukopova, 2010]. The economical feasibility of the reorganisation of municipal waste collection service in Harju County was assessed by calculating NPV and expanded financial NPV of the different waste management scenarios [Kivimägi and Loigu, 2013], [Järve, 2011]. Moora, 2009 applied LCA to evaluate the environmental impacts of different waste management scenarios regarding the municipal treatment options [Moora, 2009]. The PAYT system applicability in Estonia was analysed by Voronova in her PhD thesis [Voronova, 2013]. All the works conclude in common statement: municipal waste management is a field of activity which comprises a remarkable environmental impact and economic expenses which can be reduced by optimisation of the waste collection and treatment system.

Based on the work experience at the Environmental Department of Tallinn City Government, the author confirms that the implementation of the OWCS (organising public procurements and managing the concession contracts, keeping waste holders register, advising waste holders, supervisory on waste holders) in a municipality comprising nearly 420,000 inhabitants needs a full-time work load of six chief officers, and 0.5 part-time work load (management, coordination) of the head of the waste division in the Environmental Department and one officer (dealing with the exemptions, advising and supervisory) in each city district (8), estimatedly total 14.3 full-time work ($6 + 0.5 \cdot (1 + 8) = 10.5$) loads which makes 0.025 workloads per 1,000 inhabitants. Thus the administrative efficiency per capita is 4.4 times lower in Harju County compared to Tallinn City [Põldnurk, 2014]. In the current research, the options for improving the administrative efficiency through the conjoined transboundary waste collection procurements are also observed.

II. The practice of the OWCS in Estonia

Since 2004 when the local authorities in Estonia started to change over from the free market model to the OWCS, the waste collection service public procurements have been continuously accompanied by trials, contentions, and complaints. It has been a common practice that as soon as a public procurement in any local authority has been announced, one or another waste company, a potential tenderer sues the municipality. Over 150 adjudications regarding the OWCS can be found in the Database of the Court Decisions, most of them solving cases the waste company versus municipality [Court Decisions, 2014]. The concealed reason for this kind of counteract is to maintain the market share, and delay the implementation of the OWCS. The counteraction on re-municipalisation and municipal interaction on the waste collection market has been practised by the waste companies also elsewhere in Europe.

The town of Lodeve, near Montpellier, decided to terminate the street-cleaning contract of Nicollin and re-municipalise the service from the end of 2009. The company's workers went on strike, protesting that they would lose their jobs and their pay would be reduced; but returned to work after a meeting with the mayor. The city council estimated that the re-municipalisation would save €202,000 Euros in 2010 and €153,000 Euros in 2012 ("cette reprise en régie devrait se traduire pour l'année 2010 (avec trois CAE) par une économie de 202,000 euros et pour 2012 (après titularisation des CAE) par une économie de 153,000 euros."). In 2008 the city of Paris also decided in favour of direct labour for effuse collection, by cancelling plans to contract out two of the districts of Paris (IX e et XVI e arondissements). The city of Marseilles nearly did the same thing. The service in the centre of the city has been operated by a Veolia affiliate, Bronzo. The city council decided that their contract would be terminated, and drew up tender documents to invite bids from other companies, with Veolia debarred from bidding. In reaction to this, Veolia employees went on strike, in protest at the company being excluded, and demanding to be transferred with full protection for their pay. After a week of the strike, the council first cancelled the call for tenders, and then proposed to simply re-municipalise the service – not only in this area, but in all other areas of the city operated by contractors. In November 2009 the socialist president of Marseille council proposed re-municipalising refuse collection in all areas of the city, but in early 2010 the council voted narrowly to continue to contract-out the service, as there was not sufficient time to set up a regime before the current private contracts expire [Hall, 2010, p. 10].

It is obvious that the waste collection public procurements result in the tight pricing competition between the tenderers, and the municipality's control over the waste collection fees. In many cases the subject of the claim are tender specifications which are referred as stipulations limiting the circle of the tenderers, and the evaluation model which make the result of procurements. The most common evaluation criteria in the OWC procurements is 100% price criterion, meaning the lowest price offer wins the procurement. Since the waste collection service involves a set of fees for different types of containers with different numbers of emptying, all the evaluation models which do not consider the whole cost of the waste collection service, in other words the sum of money collected from the waste holders, can be qualified as inadequate type of tender evaluation model for this kind of service because they only reflect the pricelist of the different parts of the service not the whole cost.

A research on procurement outcomes for waste collection systems in the UK market in the period of April 2008 to February 2012 was carried out by 4R Environmental Ltd. This work examines the results of tenders over the mentioned four years to throw light on the actual, rather than theoretical, results when systems are tested in open competition situations. The research looked at the type of procurement: restricted or dialogue; whether there was a prescribed system in the process or whether alternative systems were sought or could be bid; what the outcome was; and who won what, where and when. In total, 65 procurements are included. In more than half, the system outcomes were largely predetermined by the procurement itself. In 29 cases there was a genuine opportunity for alternative options to be explored and a contract award resulted. The outcome of these should be of most interest to local authorities contemplating their procurement options. Most procurement seeks the most advantageous economic outcomes, and whilst cost is not the only determinant, it is most likely that as a whole the winning systems generally proved to be the most financially competitive. Many of the Council reports reviewed indicate that this was indeed the case. Restricting competition has always been a feature in avoiding outcomes that might not suit perceived interests [4R Environmental, 2012].

The OWC service procured by the Estonian municipalities involves both the collection and treatment (either recovery or disposal operations) of mixed municipal waste, and in many cases collection and treatment (recovery operations) of source sorted paper and cardboard and/or bio-waste. The two different services – waste collection and treatment – which require essentially different equipment and competence are mingled into one service. Within 9 years and two or three rounds of the OWCS procurements practice this has delivered to the situation where instead of 13 tenderers (the first OWC procurement in Tallinn, authors practical work experience, 2005) only 3 competitors have left on the municipal waste collection market who are capable for fulfilling the qualification criteria of the OWC procurements. Two out of these three companies (Ragn-Sells and Eesti Keskkonnateenused (EKT, former Veolia Group enterprise) possess the recycling, recovery and/or disposal facilities, which gives them the opportunity for cross-subsiding between transportation and treatment services. These two companies have stocked up the rest of the smaller waste collection companies. The cross-subsiding between transportation and treatment of municipal waste is not directly restricted, however it is against the requirement of the Waste Act § 66 art. 5 according to which the waste collection fee must be sufficient to cover the costs of establishment, operation, close-

down and after-care of the waste treatment facility, and also the costs of preparation the transportation (administration, customer service, accounting, etc.) and transportation costs.

Swedish legislation places the responsibility for dealing with solid household waste on municipalities, but leaves it up to the municipalities to decide how to execute this responsibility and organise the management of waste. Three out of four Swedish municipalities contract the collection of household waste to external actors; however, most municipalities process waste internally, either through municipal waste management departments or municipal waste management companies that are fully-owned by a single municipality or a collection of municipalities. The consequence of the Swedish legislation on waste is that municipal waste management companies enjoy a monopoly on household waste within the jurisdiction of the municipalities that own them. Municipal waste management companies are subjected to strict pricing practices, even if only a few fully respect the existing legislation that the confederation of Swedish enterprise demands. Municipal companies have to follow the so-called prime cost price and may not levy charges exceeding the cost of the services or utilities that they provide (SFS, 1991:900); neither are the companies allowed to engage in activities in competition with other companies at a loss. Practices of cross subsiding competitive activities with resources from regulated activities are therefore strictly forbidden, and something that is carefully monitored by municipal owners, competitors and competition authorities alike [Corvellec et al, 2011].

The most common evaluation model practiced in the Estonian OWC procurements is the merit-point system (MPS), in which different values are given to different types of containers, thus affecting the tenderers' pricing strategy. For example, if more merit points are attached to the smaller containers (e.g. 80 to 240 litres) compared to the bigger containers (e.g. 600 to 800 litres) then naturally the pressure is on the collection fees of the smaller containers. This may result in the situation where the collection fees of those containers are lower than their net value, and the collection fees of bigger containers which earned less merit points are remarkably higher than they would be in the free market. Then the whole pricing policy bases on the cross-subsiding between small, and big containers, meaning the users of the big containers will pay for the waste collection of users of the small containers. In a settlement of high population density the whole scheme works in opposite way: higher merit points are attributed to the bigger containers, and lower weighs to smaller containers. The most drastic examples of the MPS practice are cases where the collection fee of a smaller container is higher than that of a bigger container (e.g. 2.70 € for a 240 litres container versus 1.94 € for a 600 litres container) [Kivimägi, 2014]. The whole scheme is at variance with the polluter pays principle, and gives enough ground for suing the procurements. Therefore a strong need for an adequate evaluation model which enables a fair, and transparent pricing policy has been present already for few years.

Another issue regarding the OWCS in Estonia is the size of the waste collection districts. The restriction arising from the Waste Act on the number of inhabitants a waste collection district may involve is 30,000. There are only 5 cities out of total 215 local authorities which number of inhabitants exceeds 30,000 (Tallinn, Tartu, Narva, Pärnu, Kohtla-Järve) [KOP, 2013]. Most of the waste collection districts in Estonia are formed on the basis of the administrative territory, and 70% of municipalities have less than 4,000 inhabitants. Only in few regions the municipalities have cooperated to form conjoined waste collection districts which then comprise a reasonable number of inhabitants. There are 6 regional cooperation organisations (Central Estonian WMC, Eastern Estonian WMC, Rapla County WMC, Valga County Environmental Services Centre, Hiiumaa County Council, Communal Services Center of Harju County), which have successfully formed conjoined waste collection districts, and few other cooperation attempts between some municipalities to form transboundary waste collection districts, comprising altogether approximately 300,000 inhabitants in about 30 districts from about 100 municipalities [Kivimägi, 2014]. Thus, the average size of a conjoined waste collection district is 10,000 inhabitants, which is still far smaller than eligible. The bigger waste collection districts are obviously more attractive to the tenderers, and motivate to offer lower waste collection fees at the public procurements. The bigger collection districts also enable to optimise the waste collection logistics and thus decrease the environmental impact of the waste transportation.

The solid waste collection logistic costs play a major role in the total solid waste and disposal costs, which approval by many researches. Therefore, solid waste logistic costs model which consider most logistic activities as costs and environmental impact help to improve the solid waste supply chain and minimize the city budget for waste management activities. The model presents a reasonably effective way to predict the fuel consumption; distance travelled for waste collection in different area with different collection intervals within alternative network option. The results from those different models give a different investigation but all the result show that the vehicles and man power play a big role in the waste logistic costs [Rhoma et al, 2010].

III. Tender specifications, and the OWC contract conditions

The common practice in Estonia is that the conditions and requirements of the OWC contract to be signed between the municipality (or the authorised non-profit organisation), and the public procurement winner waste company are mostly described as the tender specifications. The usual qualification criteria involve fulfilling the tax duties, and absence of criminal or professional records. Commonly the possession of the waste collection/treatment licence, experience at the waste collection market (usually at least equal to the service volume of the waste collection district), and sometimes the certificate of the environmental quality management (ISO, EMAS or equal) are required.

In Romania the organisations that want to implement a waste management system should participate directly in the preservation, protection and improvement of environment by making decisions in accordance with the requirements of environmental protection; prevent pollution and damage towards the environment; maintaining and improving the environmental quality; establish a system for monitoring of environmental factors; sustainable use of resources and environment, and; creating of ecologically and informative program aimed at regional level. The main objective of implementing an environmental management system is to reduce the impact on the environment of activities, products and services of organisation. The most important are increasing profits by optimising the use of resources (raw materials, energy), by improving waste management and reduce costs of any environmental incidents [Dumitrascu and Nedelcu, 2012].

The conditions of the OWC contracts may vary at a large scale from municipality to municipality from detailed description of the waste collection service, and from strict technical requirements to a very general conditions such as that the municipal waste must be collected from households and treated somewhere [Kivimägi, 2014]. The conditions introduced, and reasoned below are suggested by WasteBrokers LLC. Those conditions may rise the waste collection fees but are necessary for the municipality in order to gain better control over the waste collection service. The following list of the conditions is not final, only the major conditions are disserted. Most of the requirements have arisen from the practical experience of the OWCS, step by step evolved from execution of one or another OWC contract.

A. Technical specifications

1) waste trucks must be passed through the technical inspections, and be technically in order;
2) waste trucks may not be older than e.g. 10 years, or must meet the EURO IV requirements;
3) waste trucks must be provided with the utilities/repellents to clean up any waste spilled during emptying containers or driving, also the absorbent to clean up any liquid waste;
4) waste trucks must be provided with the GPS-device, mobile phone, and camera, also the rechargers of the devices. GPS must register the emptying of the container and keep the record of the movements of the waste truck;
5) waste trucks must wear the label of the company, and the contact information, the drivers must wear the uniform;
6) waste containers hired out must meet the standards, be labelled, and in fine condition.

It is natural that only trucks which are legally, and technically in accord may participate the competition. In order to contribute to the sustainable development, and reduce the environmental impact of the waste transportation, the requirements on the exhaust gases are imposed. The equipment for spillage clean up mitigates the pollution risk. The GPS-device, mobile phone, and camera are necessary in case of conflicts between the waste holder and waste contractor, e.g. if the container contains improper waste, and is left unemptied, the contractor can immediately contact the client, and inform about the situation, and also record the situation with the camera. GPS-device enables to track the itinerary of the waste truck. The containers hired out by the contactor must meet the requirements of the local waste regulation, and be labelled with the requisites of the contractor.

Most of those criteria rise the quality standard of the waste collection service, which may result also in higher waste collection fees. For example, a GPS-device, phone, and camera are not essential for the waste collection service, but facilitate solving any communication problems increasing the satisfaction of the clients. The environmental requirements which are stricter than set in national or EU legislation serve mostly the objectives of sustainable development.

B. Service quality

1) customer service must be available by phone, e-mail or counter service;
2) reaction to the complaints, orders or subscriptions may not take longer than e.g. 3 working days;
3) contractor must inform the client about any circumstances which make the waste collection impossible, such as absence of access to the waste container (the container or gate is locked, the gateway is impassable), improper waste in the container like bio-waste in the paper container, broken container etc.;
4) contractor must provide the waste holder with the necessary number, and types of waste containers for each waste classes, and adjust the container emptying frequency according to the waste generation of the particular waste holder;
5) contractor must clean up any spillage caused during emptying the waste container or waste transportation.

The service quality stands mostly on the conditions set on the OWC contract. Since the waste company gains the monopoly for the period of the OWC contract, there is no pressure of competition like it was at the free market conditions, and the exclusive position may result in a loose quality of the service. In the very first OWC contracts, merely any requirements were set on the customer service, and communication. For example the implementation of the OWCS in Tallinn pilot districts was accompanied by extensive displeasure of the waste holders caused by the miscommunication, and poor quality of the customer service. Although the containers are not involved to the OWCS, in the case of need the contractor must be capable of providing the waste holders with the containers. It is also natural, that after waste collection the area is still clean and free of any spillage caused by the emptying waste containers or transportation of the waste.

C. Reporting

1) contractor must keep minimum for three months all the recordings, files, e-mails, and photos regarding the communication with the clients, including tracks of any

conflicts appeared during providing the service;

2) contractor must periodically (monthly/quarterly/annually) fill a detailed report about the waste collection service performance which presents the volume and weigh of the waste collected and treated, mileage of the waste trucks, number of emptyings per each type of containers, overview of the complaints from the waste holders etc.;
3) contractor must keep the waste holders register, and periodically update the database. The register comprises the following data: addresses, and names of the waste holders; status of the waste holders (incorporated to the OWCS, exempted from the OWCS); number, and types of the containers for each waste classes; emptying frequency of the containers; overdues, and indebtnesses; other records;
4) contractor must inform the municipality about any violation of the local waste regulation requirements which the contractor finds out.

The demand for maintaining the records for a certain period helps to solve any conflicts or misunderstandings between the contractor and municipality or waste holder. The detailed reporting about the waste collection service in particular waste collection district give the municipality not only overview about the waste collection service but also a good input data for the next public procurement. The more precise input data about the service is given in the tender specification, the more fair is the competition, and the more judicious tenders will be made. The waste holders register is a good virtual tool for supervisory and statistics if the data is periodically updated.

D. Additional conditions

The prices of those services which are not involved to the OWCS but are inseparable for the regular waste collection such as the rental of the waste containers, unlocking the containers or gates with the waste holder's key, manual transportation of the containers from a certain distance (10 or more metres) to the closest possible stop of a waste truck, washing the containers etc., are fixed.

Many local authorities have demanded the bank deposit or accreditation letter from a bank to warranty the accomplishment of the contract conditions. However none of the municipalities have ever tried to put this type of warranty into practice. Thus it may be a pretty much useless condition which only rises the price offer because it is costy to the tenderer.

The contractor may not rise the waste collection fees without the permission of the municipality. The waste collection fees will be risen only if the direct expenses (such as the price of fuel, gate fee of the waste treatment facility) of the waste collection service have increased. This condition can be implemented only if the components of the waste collection fee are clearly defined or separable. Otherwise the condition is not objective. Another option practiced widely is the fixed pricing for the whole contract period without any possibility to rise the collection fees.

The collected waste must be delivered to the waste treatment facility determined by the municipality. This condition is taken from the Waste Act literally, but interpreted arbitrarily by both the municipalities, and waste companies, and has been one of the reasons for prosecutions. As the waste companies have declared, this condition is limiting the freedom of entrepreneurship. The municipalities who have not appointed a particular waste treatment facility but outlined the condition generally cannot gain any control about the recycling or recovery of the municipal waste later during the concession period neither.

By the end of the contract the contractor must give over the upgraded database of the waste holders register, and not counteract to the next contractor overtake the waste collection district. The contractor has to update the data of the waste holders register, and give it over to the municipality.

In order to improve the waste collection efficiency in the detached houses areas, the municipality obliges or suggests the waste holders to place the waste bins along the street on the day of waste collection. This eases the manual transportation of the bin from its location to the waste truck, and thus fastens up the waste collection speed rate. The time of the stops of the waste trucks are shortened, the exhaust gas emissions are cut and the environmental impact arising from the transportation is also decreased.

The research of Chalkias and Lasaridi, 2009 aimed to develop a methodology for the optimisation of the waste collection and transport system based on GIS technology. The methodology was applied to the Municipality of Nikea (MoN), Athens, Greece based on real field data. The strategy consisted of replacing and reallocating the waste collection bins as well as rescheduling the waste collection via GIS routing optimisation. The benefits of the proposed strategy were assessed in terms of minimising collection time, distance travelled and man-effort, and consequently financial and environmental costs of the collection system. In this study GIS technology was used for the optimisation of commingled municipal solid waste collection. The proposed method exploits various geographical data (road network, waste collection bins' position, land use etc) in combination with advanced GIS based spatial analysis. The implementation of the proposed method in MoN focused on the re-design of the waste collection bins system as well as on the investigation of an optimal collection routing scenario. The results demonstrate that the proposed scenario is significantly efficient in terms of collection time and distance covered (20% and 12.5% improvement, correspondingly) with consequent gas emissions and fuel consumption savings [Chalkias and Lasaridi, 2009].

IV. The Equations for Waste Collection, and Treatment Fees

The equation for OWC service fee, including formulas of waste collection fee, and waste treatment gate fee introduced below is worked out by WasteBrokers LLC basing on different common tenders evaluation models. The formulas are used for evaluation of the tenders at the OWC service public procurement. All the components of the waste collection, and treatment service (collection, and

administration, transportation, and treatment) are taken into account separately. This enables to change/recalculate them independently during the period of contract. The evaluation model for waste collection service has been practiced in some of Estonian municipalities [Põltsamaa, 2011], [HÜK, 2013], and has given clearly positive results in terms on transparency of the price formation, and comparison of the tenders. The whole set of equations (collection, and treatment service separately) has not been practiced yet, but the legislative prerequisites are created in the local waste regulations of few municipalities [Tartu, 2012], [Viljandi, 2011], and the evaluation model will be implemented in the next round of the public procurements which will be held before the current waste collection contracts end, perspectively within next couple of years.

Only the equations for mixed municipal waste fee is introduced below because the paper waste is usually collected free of charge if the waste collection company retains the possession of the paper waste, and the equations for the source sorted bio-waste are identical, ant the amounts of this waste are marginal.

A. The collection fees

The tender evaluation criteria at the public procurement of the OWC service concession is 100% price criteria. The tenderers offer the collection fees (€) for the different size groups, and types of waste containers indicating separately the calculated percentage of transportation costs within the collection district, and transportation from the collection district to the determined waste treatment facility. Then the annual waste collection fee is calculated for each group of containers multiplying the collection fee by the number of emptyings per year, and the annual cost of the collection service is calculated as follows:

$$K_A = (K_{M1} \cdot E_{M1}) + (K_{M2} \cdot E_{M2}) + (K_{M3} \cdot E_{M3}) + (K_{M4} \cdot E_{M4}) \quad (1)$$

where

K_A – total annual collection fee;

K – collection fee for particular type of container;

E – number of emptyings of particular type of container a year;

M1 – type of container, e.g waste bag with volume of 50...100 litres;

M2 – type of container, e.g small two wheels container with volume of 80...400 litres;

M3 – type of container, e.g four wheels container with volume of 600...1,100 litres;

M4 – type of container, e.g container without wheels, deepload containers etc. which need special mechanism for their emptying.

The best tender is the one which sum of the annual collection fee (K_A) is the smallest. The grouping of containers may differ in municipalities depending on what kind of containers are more or less used. The technical parameters such as age of the truck, service quality, reporting, customer service or other determined as the tender specifications, and qualification criteria are not subject of evaluation.

B. The treatment service fee

The evaluation criterion at the public procurement of the municipal waste treatment service is 100% price criterion. The tenderers offer the gate fees (€/t) for treatment (recycling, and recovery operations) of the mixed municipal waste, and indicate the location, and distance of the treatment facility from the collection district. Then the combined gate fee is calculated as follows:

$$CF = L + S \cdot T / w \quad (2)$$

where

CF – combined gate fee (€/t);

L – gate fee at the treatment facility (€/t);

S – the shortest distance for fully loaded waste trucks between the treatment facility, and collection district (kilometres);

T – transportation cost, constant 1 €/km;

w – weight of the load, constant 8 tons.

The best tender is the one which combined gate fee (CF) is the smallest. The technical parameters such as the rate of recycling or recovery, annual capacity, and other environmental requirements determined as the qualification criteria are not subject of evaluation. The combined gate fee enables to consider the transportation costs in the collection fee, and are used only for evaluation model. The contractor will receive only the offered gate fee for his service.

C. The OWC service fee

The final OWC service fee of a mixed municipal waste container is calculated as follows:

$$T_m = K_m + k \cdot m \cdot L \; (\cdot J_m) \quad (3)$$

where

T_m – the fee (€) for collection, and treatment for waste contained in particular container (€);

K_m – the collection fee (€) for the waste contained in particular container which includes the costs of waste transportation from waste generation site to the waste treatment facility, costs of fuel, logistics, preparation of the waste collection, and other costs of waste collection company directly linked to the OWC service, except the costs of other additional services not involved to the OWCS such as rental of the container, unlocking the container or gate, transportation of the container from further than 10 metres, container wash etc.;

k – the coefficient of the volume weight of the mixed municipal waste (t/m^3) which is determined separately for each municipality, and procurement (usually in range of 0.13…0.17), and which the municipality has right to change if during the concession contract occurs that the real volume weight differs from the agreed one;

m – the volume of the container (m^3);

L – the gate fee for the mixed municipal waste (€/t) at the determined waste treatment facility;

J_m – administration fee coefficient which the WMC or municipality has right to apply in case of implementation of the advanced OWCS; it is a cost-based coefficient, which includes the municipality's/WMC/s expenses directly linked to the administration, and organisation of the OWC, such as salaries of the officers, keeping, and development of waste holders register, accountancy, and bookkeeping of the OWC,

including rescontra, and incasso, logistics, customer service, and call centre (either within WMC or procured).

V. Results and Discussion

As the result of application of above introduced formulas, the annual turnover within OWC service is calculated for each tenderer based on their price offers. Then the final numbers – the annual turnovers – are compared and the tender with the smallest annual turnover is announced as winner. This means that not any abstract pricelists are competing but the real (annual) cost of the whole service is calculated. This is an important difference between the introduced tender evaluation model and all the rest of the OWC tender evaluation models applied in Estonia theretofore. Another important property of this evaluation model is that it takes into account the collection and treatment costs separately, and the collection fees are proportional to the sizes of the containers.

Below the comparison between annual turnovers of the mixed municipal waste collection within previous and current OWC service is drawn by case of four municipalities in Harju County, which recently applied this tender evaluation model – Jõelähtme, Kiili, Raasiku and Rae parishes. The procurement was organised by the Communal Services Center of Harju County (Harjumaa Ühisteenuste Keskus, HÜK) which was established as the result of a project [Kivimägi and Loigu, 2013], [Põldnurk, 2014], and this procurement was its first attempt towards the advanced OWCS. In addition to applying the new tender evaluation model, the four municipalities formed a conjoined waste collection district for the new OWC procurement.

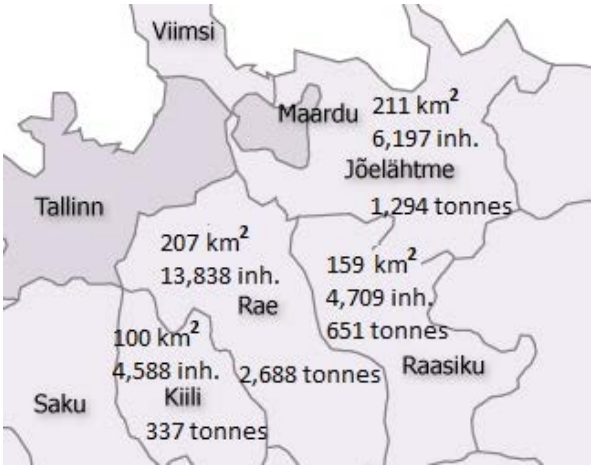

Fig. 1 The map of the four parishes [Kivimägi, 2012].

A. The input data

All the four parishes are neighbouring, they have prevailing rural areas scattered with settlements and village centres with higher population density. The number of inhabitants vary from 4,588 to 13,838, sizes of the territories from 100 to 211 km^2 [KOP, 2013] and mixed municipal waste (MMW, code 20 03 01 by List of Wastes [EC, 2000]) generation from 377 to 2,688 tons per year [EEIC, 2012] (Fig. 1). Thus their administrative-territorial profile is relatively similar.

Table 1. Number of MMW containers' emptyings in the four parishes and in the conjoined waste collection area [Kivimägi, 2011], [HÜK, 2013]

Container	Jõelähtme	Kiili	Raasiku	Rae	Conjoined
100 L*	117	5384	100	687	6288
80 L	4347	26	19	38	4430
140 L	3865	3265	1300	6001	14431
240 L	7046	13740	2556	17190	40532
370 L	958	939	440	2720	5057
600 L	2646	1393	3031	6205	13275
800 L	1990	1493	1827	5962	11272
1000 L	352	821		985	2158
2500 L	878	378	679	1845	3780
4500 L	365	52	286	798	1501
*waste bag					

Table 2. Pricelist (V.A.T. not included) of MMW collection service 2011 (4 parishes) and 2013 (conjoined) [Kivimägi, 2012], [EKT, 2013]

	Jõelähtme	Kiili	Raasiku	Rae	Conjoined
Container	Ragn-Sells	Ragn-Sells	Veolia	Adelan	EKT
100 L*	1,03 €	0,96 €	0,92 €	1,00 €	0,44 €
80 L	1,00 €	1,13 €	1,54 €	1,16 €	0,31 €
140 L	1,56 €	1,13 €	2,15 €	1,62 €	0,52 €
240 L	2,94 €	2,05 €	4,14 €	2,70 €	0,87 €
370 L	3,07 €	3,05 €	4,52 €	2,98 €	1,33 €
600 L	3,58 €	3,45 €	7,02 €	1,94 €	2,35 €
800 L	4,28 €	6,50 €	11,51 €	3,24 €	2,84 €
1000 L	5,35 €	8,13 €	n/a	4,05 €	3,88 €
2500 L	10,89 €	9,35 €	18,41 €	7,15 €	8,80 €
4500 L	17,90 €	16,45 €	32,21 €	12,78 €	15,82 €
*waste bag					

Table 3. Annual turnovers (V.A.T. not included) of MMW collection service 2011 and 2013 (conjoined) [Kivimägi, 2012], [EKT, 2013]

Container	Turnover 2011	Turnover 2013
bag 100 L	5 380,97 €	2 766,72 €
80 L	4 405,56 €	1 373,30 €
140 L	22 232,87 €	7 504,12 €
240 L	105 877,08 €	35 262,84 €
370 L	15 901,17 €	6 725,81 €
600 L	47 593,85 €	31 196,25 €
800 L	58 563,70 €	32 012,48 €
1000 L	12 547,18 €	8 373,04 €
2500 L	38 786,50 €	33 264,00 €
4500 L	26 798,83 €	23 745,82 €
total turnover	338 087,71 €	182 224,38 €

To calculate the annual turnover of the previous OWC contracts the valid pricelists of 2011 [Kivimägi, 2012] and databases of the waste holders' registers [Kivimägi, 2011] were used. Only the Jõelähtme, Kiili and Rae parishes had the valid waste holders' databases which contained the number of waste containers and their emptying intervals. In order to create the missing data of containers and their emptying intervals of Raasiku parish, the data of the three other parishes was extrapolated on Raasiku parish taking into account the average number of inhabitants, population density and waste generation and the sum of emptyings for different types of containers of all the 4 parishes presented in the new OWC public procurement documentation. The results were double-checked by calculating the MMW amounts basing on the number of containers, their emptying intervals and expected mass weigh of 0.13 t/m^3 [HÜK, 2013]. In the table 1 the number of containers in each parish is presented and in the table 2 the pricelist of the previous OWC service is presented.

The pricelist of EKT presented in table 2 is the result of the new OWC procurement in the conjoined waste collection district. The formulas 1 and 3 were applied in order to calculate the best price offer and pricelist for each particular container. The annual turnover basing on the tables 1 and 2 was calculated for the years 2011 and 2013 (table 3). As it can be seen from the table 2 and table 3, cheaper collection fees were achieved in the new OWC procurement and the annual turnover drop nearly twice. This was the result of the remarkable drop of the collection fees whilst the treatment service made up the majority in the total annual turnover. The cost of treatment service was calculated basing on the expected annual waste generation of 5,408 tonnes multiplying it by the offered treatment facility gate fee 27 €/t. The total cost of treatment service was 146,016 euros [HÜK, 2013].

Recent data from the UK also shows that the average net total cost of waste collection is slightly lower (by about 3%) for municipalities which operate an in-house service. Municipalities which outsource appear to have lower current expenditure, but they:

- employ staff costing over 5% of the contract value, to monitor the service
- still pay for capital investments, with more than half of the capital costs of in-house services
- lose income worth more than 7% of the cost of the service.

These factors more than offset the apparent reduction in current expenditure. The apparent cheapness of contractors' operating costs is also frequently due to the low pay of private companies: in Germany in 2011, some contractors paid such poor pay and conditions that their workers claimed benefits. (The German employers and trade union Ver.di have now agreed a minimum wage for the sector that has been declared generally binding, to prevent such cut throat competition) [Hall and Nguyen, 2012].

Despite fiscal pressures, there are clear signs that municipalities are continuing to move towards re-municipalisation rather than privatisation, in a number of countries in Europe, including Germany, France and the UK. A study in 2011 by Leipzig University of over 100 German municipalities concluded that the trend is towards greater provision by the public sector. In his report, Hall, 2012 presents in table the main services and process of the re-municipalisation in different European countries. As to the waste management, the re-municipalisation has taken place in Germany, UK, France and elsewhere through in-house brought contracts, including inter-municipal incinerators involving factors such as cost of service, control, or contract expiry. German municipalities have also been bringing other services back in-house, such as waste management, housing management and public transport: In the history of privatization of local public transport, more often than not, the services provided were reduced dramatically and the prices saw steep increases. Pressure to make cuts still tends to lead to re-municipalisation: half of the municipalities with budget deficits plan some form of restructuring of municipal services, but while 41% of these are considering moving towards inter-municipal cooperation, and 36% towards re-municipalisation, less than 3% are considering privatisation. [Hall, 2012].

VI. Conclusions

The OWCS practice in Estonia theretofore has led to the decrease in number and competition between the waste collection companies, incomprehensible pricing, and sometimes also poor quality of the waste collection service. The cooperation between Estonian local authorities would improve the administrative efficiency and raise the level of competence in the waste management field. In Harju County, the waste management cooperation organisation HÜK has been established and already performed positive result in the OWC procurements.

The formation of the waste collection fees within the OWCS, especially within the advanced OWCS have to be transparent, and fair. A set of equations for the waste collection fees worked out by WasteBrokers LLC enable municipalities to implement the comprehensive tender evaluation model at the OWC public procurements, which creates the equal opportunities to the tenderers, and facilitates the tenders' evaluation process. The implementation of the formulas result in transparent waste collection fees, in which each component is clearly distinguishable, and economically justified. Strict requirements of the OWC contract assure the quality of the waste collection service, and municipality's control over the waste collection fees.

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