UNIVERSITY OF PARDUBICE
FACULTY OF TRANSPORT ENGINEERING

THE USE OF ENVIRONMENTAL MANAGEMENT ACCOUNTING IN MUNICIPALITY WASTE MANAGEMENT

DOCTORAL THESIS PRECIS

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CONTENT

1 INTRODUCTION

Sustainability is a very recent topic within many sectors and contexts. The public sector should also use this concept and set such procedural rules that are sustainable in the long term. It is understandable that waste management influences the environment. Improper waste treatment can unfavourably influence the land, water or the air. Waste is transported on a daily basis, therefore transport plays a significant role in the whole system.

There is a common legislation for all European Union countries concerning circular economic, green economics or bioeconomics. Nevertheless, the level of waste management in particular European Union countries is very different because of the varied process of developing in the sector. The aim of the doctoral thesis is not to compare different approaches to waste management in the European Union countries or regions, but to offer the municipality managements the functional system that respects the local conditions.

Waste reduction, waste separation, recycling, finding the best possible pick up routes and especially available and clear information about the system of waste management in the municipality can answer the questions of the municipality waste management. Municipalities should set up such system that is sustainable in all aspects. This is not possible without understanding the issue of waste management, or without the specific and clear data and information. Environmental management accounting can be a suitable tool for decision-making on strategic issues of waste management so that the municipality meets the requirements of the state by monitoring, collecting, recording and comparing and evaluating economic and environmental data and information.

As a part of the doctoral thesis a literature review of scientific resources will be processed in the field of environmental management accounting,

Balanced Scorecard and waste management in the public sector. Then the aim of the doctoral thesis will be determined and the scientific methods for the processing of the doctoral thesis will be defined. After that the own solution will be proposed and its results will be evaluated and discussed.

2 CURRENT STATE OF THE ART

In the second part of the thesis the basic concepts are defined and an overview of current knowledge in the field of the topics of the thesis is given.

2.1 Basic concepts in the topics of the doctoral thesis

According to the Waste Act, municipalities are the producers of municipal waste. It becomes so at the moment the residents deliver waste in a place designated for that purpose. It is the duty of the municipality to provide places for the disposal of all municipal waste produced by its residents. It is the duty of these persons to sort and dispose the waste separately in designated places.

In addition to legal obligations, it is necessary for local governments to monitor the development in the field of **waste management** in a broader context, esp. in the context of cooperation within the European Union. At present, it is necessary to focus our attention on topics that result in understanding and application of sustainable development, so the concept connecting environmental, economic and social pillars. The EU has responded to the concepts by circular economy, green economy and bio economy. The basic idea of all these concepts is the sustainable use of natural resources.

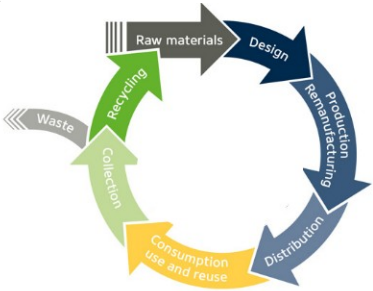

Figure 1 Circular economy concept (Nordic Ecolabel, 2018)

According to Remtová (2006) **environmental management accounting** (EMA) does not have a single definition. It is a voluntary environmental information tool that records the current situation, is not standardized and can be used universally. There are several procedures for its implementation, but none is considered as the official one.

EMA can be defined as a part of management that deals with the identification, collection, estimation, analysis, reporting and providing information about material and energy flows, information on environmental costs and other value-based information, which are the basis for decision-making within the company (Remtová, 2006; Farský, Ritschelová and Sidorov, 2006). The purpose of environmental accounting is to find out how activities related to environmental issues are reflected in the financial flows of a company.

According to Jasch (2003), the most important purpose of using EMA is to make sure that all relevant significant costs are taken into account in decision-making process. Environmental costs are a subset of larger cost items. They are part of the integrated system of material and financial flows of the company.

The concept of environmental accounting has become an integral part of the management of companies that are interested in participating in environmental protection, and also want to reduce their costs (Hyršlová and Vaněček, 2003). According to Schaltegger, Hahn and Burritt (2001), the United Nations expert group agreed that no differentiation will be made between the private and public sectors as potential EMA users. Local authorities can also be considered as EMA users as they take care of the management of local environmental situations and the local impact on the environment.

A little attention was paid to management accounting in the literature at the turn of the century (Qian, Burritt and Monroe, 2011). According to these

authors, much less attention is paid to environmental management accounting in the public sector. There are only unique studies on these topics from the UK (Ball, 2005) and Australia (Burritt and Welch, 1997; Frost, 1998 - as reported by Qian, Burritt and Monroe, 2008). Only Qian, Burritt and Monroe (2008, 2011) and Emery et al. (2006) deal with municipality waste management within the EMA system which identifies the economic and environmental impacts of different types of waste disposal.

Case studies by Qian, Burritt and Monroe (2011) focused on EMA practices and the motivation for its application. **EMA information** in waste management were recorded thanks to the interviews, data collection and analysis in 12 local Australian governments of various size. Physical and monetary information as well as hidden costs, costs related to externalities, and the accounting impact were recorded. Qian, Burritt and Monroe then expect that environmental strategies and government regulation will be developed and EMA system will be prepared for local authorities to use the EMA information to support sustainable waste management in the future.

The **Balanced Scorecard** (BSC) is a strategic management tool that enables organizations of all types to clarify visions and strategies and make them easier to implement. Based on its success in the business sector, BSC reached the public sector very quickly too.

According to Grasseová, Dubec and Řehák (2012) critics of the BSC point out that the four perspectives for the public sector are not complete. It ignores stakeholders (suppliers, regulation bodies), environmental perspectives and competitors. The four basic perspectives are not a dogma, only a model, and organizations can widen the perspectives, or add or rename them.

With regard to sustainable development the BSC method can be extended to the **Sustainability Balanced Scorecard** (SBSC), sometimes named the Eco-Blanced Scorecard (Sidiropoulos et al., 2004) or Sustainability Scorecard or Responsive Business Scorecard (Hansen and Schaltegger, 2016).

According to Mendes et al. (2012), BSC can contribute significantly to improve the **quality of waste management services** and help in management, technical, environmental, economic, social or operational activities of the organization. It delivers real-time results, makes better strategic and budget planning through a culture of communication, connectivity, integrated systems, learning and feedback.

Tsai et al. (2020) say that there are only a few studies reviewing the integrated waste management system in the context of SBSC. Appropriate implementation methods remain an unresolved issue. The authors have compiled 24 criteria in 8 levels, sorted according to 6 main aspects, which represent areas that can improve the performance of the integrated waste management system.

2.2 Critical evaluation of existing knowledge in the field of doctoral thesis

According to Soukopová (2016) the municipality should have a constant overview of its own financial flows within waste management as well as the ability to predict these flows in time.

EMA application in the public sector is so far only unique. But municipalities manage a huge amount of waste, where collection, transport, recycling, disposing into landfill or incineration are economically and environmentally demanding processes. Different views on the municipality system of waste management can stir emotions.

Information on environmental costs and significant impacts on the environment should lead the municipality, similarly as the private sector, to effective solution to waste management by identifying, collecting, estimating, analysing, reporting and distributing the environmental information.

The tables show the way the scientific resources describe the topics of EMA, BSC, SBSC and waste management in the private and public sector.

Table 1 Scientific resources describing EMA information within BSC and SBSC in waste management in the private and public sector

topics/ sector	private sector	public sector
EMA (in waste management)	yes	yes
BSC	yes	yes
SBSC	yes	yes
municipality waste management + BSC	not relevant	yes
municipality waste management + SBSC	not relevant	yes

Source: author

The particular situation in municipality waste management is described in table 2.

Table 2 Scientific resources describing EMA information within BSC and SBSC in municipality waste management

municipality waste management				
EMA	**BSC**	**SBSC**	**EMA + BSC**	**EMA + SBSC**
yes[1]	yes	yes[2]	no	no

[1] – no BSC, [2] – metrics are not EMAinformations
Source: author

The use of EMA information to support decision-making processes is well known in the private sector. Its use in the public sector can help mayors and other public budget administrators to set up a system that identifies, collects,

estimates, analyses, reports and distributes information to support decision-making processes in municipality waste management.

The available literature supports SBSC as a tool to meet the objectives of municipalities in the field of waste management. Missing connection of municipality waste management with EMA and SBSC is an opportunity to fulfil the goal of this doctoral thesis, which is to **propose a system of environmental management accounting to support decision-making processes in municipality waste management**. SBSC seems to be a suitable implementation tool, as it clearly maps the context and enables monitoring of the environmental management accounting system.

3 AIMS OF THE DOCTORAL THESIS

The aim of the doctoral thesis can be defined on the basis of a processed literature review of scientific resources. The aim of the doctoral thesis is to **propose a system of environmental management accounting to support decision-making processes in municipality waste management.** SBSC seems to be a suitable implementation tool, as it clearly maps the context and enables monitoring of the environmental management accounting system.

The main aim consists of the following partial aims:

- waste management data collection (collection and analysis of publicly available data and information),
- identification of EMA information in municipality waste management (based on the personal interviews with the mayors in the given micro region), the EMA information will be used as metrics in SBSC,
- set of financial and non-financial EMA information in municipality waste management as a result of the personal interviews with the mayors,
- proposal of the environmental management accounting system to support decision-making processes in municipality waste management,
- application of the environmental management accounting system in the particular municipality,
- identification of strengths and weaknesses of the EMA system and its critical evaluation.

The proposed EMA system to support decision-making processes in municipality waste management should be easily applicable to municipality waste management system in the municipality with 200 – 4 200 inhabitants.

4 PROCESSING METHODS

The scientific methods theoretically defined in this chapter are used in the processing the doctoral thesis.

4.1 Sustainable Balanced Scorecard

SBSC tries to link the traditional perspectives (financial, customer, internal processes, learning and growth) with non-market perspectives. These should represent strategically important environmental and social issues not covered in the previous four perspectives (Špaček, Souček and Hyršlová, 2016).

The universality of the use of BSC also consists of the transformation of the identified performance indicators of individual perspectives into the 3E methodology - effectiveness, efficiency, economy (Šašek, Vacík, 2011).

4.2 The use of other processing methods

General theoretical explanatory methods are used throughout the entire doctoral thesis processing. The method of literature review serves to obtain the current state of knowledge in the field of the topics of the doctoral thesis. The expert panel method is used to obtain EMA information, then the electronic questionnaire survey is used to obtain the information from residents regarding the level of waste management service within the application of the proposed EMA system. An overview of the processing methods is as follows:

- Sustainable Balanced Scorecard,
- interview survey – expert panel method,
- interview survey – electronic among residents,,
- case study method – proposed EMA system application

- method of literature review,
- method of analysis and synthesis,
- method of induction and deduction,
- method of analogy,
- method of comparison,
- data collection,
- information sorting and processing,
- brainstorming,
- description.

5 RESULTS

The link to the goal of the doctoral thesis based on the analysis of the current state of the art in the second chapter is an extensive set of information leading to fulfilment of the goal. After the EMA system proposal, its application to a particular municipality will follow.

5.1 Proposal of the system of environmental management accounting in municipality waste management

Information of the legislative framework relevant for the area of waste management, evaluation of financial indicators and understanding the elements and links in the field of municipality waste management are the first step in **data collection**. As the specific waste management systems differ in particular municipalities, it is appropriate to identify the EMA information in more municipalities. On the basis of the questionnaire a personal interviews with the mayors follow. It is necessary to focus on the individual system of waste management, cooperation in the field of waste management, on the goals that the municipality wants to achieve, and aspects of the sustainability of municipality waste management system.

The Bystřička micro region (MRB) was chosen for data collection and subsequent identification of EMA information. All municipalities in the Czech Republic are governed by the same legislation and are required by law to report on the amount of municipal waste in the Report on Annual Production and Waste Management to Municipalities into the ISPOP system of the Ministry of the Environment of the Czech Republic, and Questionnaire on Municipal Waste Management in the Municipality, focusing on separate collection, for the

authorized company EKO-KOM. In addition to these common features the municipalities work with their own waste management systems.

The Bystřička micro region was chosen for this work for several reasons. It is a relatively homogeneous region with 12 municipalities in size from 212 to 4 246 inhabitants. According to the Czech Statistical Office there are 70.5% of municipalities of this size in the Czech Republic. Another reason is the knowledge of local actors in the field of waste management. In particular, there is a deeper awareness of the waste management system in general, waste disposal sites, waste collection for energy use, regional plans and other entities dealing with waste management issues, waste collection companies and so on. Another reason is the availability of information and the possibility of repeated contact with the mayors and officers of municipality waste management system.

Figure 2 shows the waste collection companies serving the municipalities. Twelve municipalities of MRB are served by 5 different waste collection companies (June 2019).

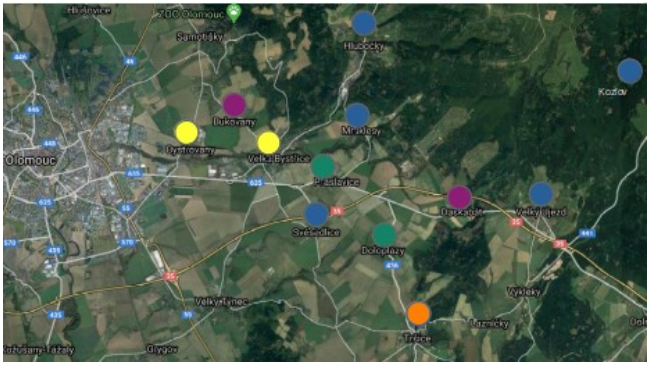

Figure 2 Waste collection companies in MRB (author, based on the map)

The proposed EMA system to support decision-making processes within municipality waste management brings a new approach to waste management based on the SBSC method. As described, the literature promotes the SBSC method as a tool for strategic management in municipalities.

The partial goal of the thesis is a **set of financial and non-financial EMA information** in the field of municipality waste management. The proposed EMA system will support decision-making processes within municipality waste management using the SBSC method. The new approach of municipality waste management on the basis of SBSC using EMA information consists of 8 consecutive steps (Figure 3).

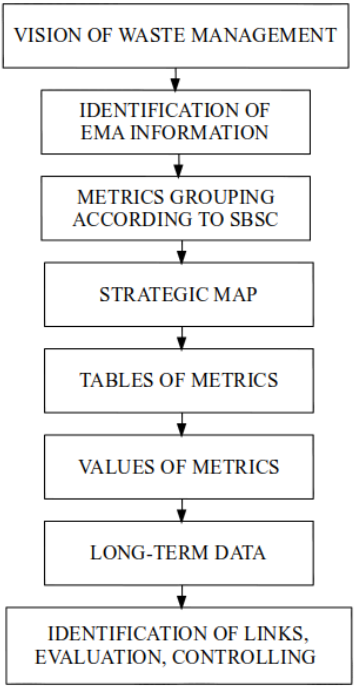

Figure 3 Scheme of the proposed EMA system (author)

The SBSC **strategic map** for municipality waste management reflects the sustainability of this system, i. e. the economic, environmental and social aspects thanks to the identified EMA information. To complete the strategic map and perspectives within the SBSC an integration approach was chosen.

EMA information are then used as metrics in SBSC. Each metric is designed to provide all methodological information. A source of information is included too. In addition to the name of the perspective, strategic area and metrics itself, the individual tables also contain the data as shown in the example of the table metric in table 3.

Table 3 Example of the table of metric

PERSPECTIVE	… fill the perspective ...		
STRATEGIC AREA	… fill the strategic area ...		
METRIC	… fill the metric name ...		
measurement	**form**	**frequency of effectiveness evaluation**	**source of information**
data in 2018	**data in 2019**	**plan 2020**	**goal**
Metric description:			
Methodic:			
Metric administrator:			

Source: author

5.2 Application of the system of environmental management accounting in municipality waste management

The proposed system of environmental management accounting to support decision-making processes within municipality waste management will be applied to a specific municipality, the town of Velký Újezd.

Velký Újezd was chosen for the application of the EMA system due to the knowledge of the environment, the knowledge of the actors in the field of waste management, the optimal size and availability of data and information.

Application of the particular steps of the proposed EMA system follows:

1. Vision - **Sustainable waste management system in Velký Újezd respecting the needs of the residents.**

2. Identification of EMA information – EMA information for Velký Újezd are based on the **set of 10 financial and 33 non-financial information** gained after the MRB mayors interviewing. Due to the widest possible concept and preparation of tables of all metrics for further use the application of the system in Velký Újezd will be based on all metrics.

3. Metrics grouping – according to the set of financial and non-financial information based on the MRB mayors interviewing.

4. Strategic map – strategic areas in the perspectives

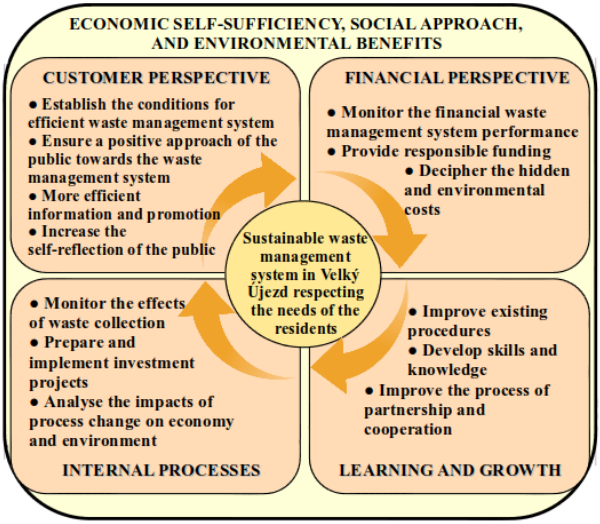

Figure 4 Strategic map (author)

5. Tables of metrics - metrics were prepared and completed for all **43 financial and non-financial EMA information** in the field of municipality waste management.

6. Values of the particular metrics - the actual values of the particular metrics were obtained from the reports and others documents, from the budget, or via consultations with employees of the municipality. Planned values for 2020 and target values were discussed with the management of the municipality, in case it is not the goal resulting from the legislation. Values concerning satisfaction and quality were obtained by the primary survey among the residents of Velký Újezd during March and April 2020. 105 residents of of Velký Újezd took part at the electronic questionnaire survey.

7. Long-term data in the particular metrics - regular and / or continuous competition of the data to the metrics. The nature and the goal of this thesis did not expect long-term monitoring of individual metrics. However, the proposed EMA system as a whole is a long-term issue.

8. Identification of metric links/ EMA information, evaluation and controlling - the system as a whole is a long-term issue. Identification of links, evaluation and controlling can be carried out after reaching the target values.

The proposed EMA system to support decision-making processes in municipality waste management is easily applicable in municipalities with 200 – 4 200 inhabitants. Each municipality has different priorities. Municipalities can modify the proposed EMA system according to their priorities and needs. Thanks to the strategic map, the system is clear, and each of the actors involved has clearly defined tasks. Strategies are transferred into the particular strategic areas, the metrics are linked and provide feedback.

To keep such EMA system supposes motivation of all involved subjects, regular data completion, regular evaluation and adjustment or addition of metrics according to current needs. Continuous monitoring of the metrics leads to the immediate elimination of any discrepancies.

6 EVALUATION OF RESULTS AND DISCUSSION

The doctoral thesis deals with the issue of **Environmental management accounting in municipality waste management**. The existing knowledge was defined using the method of literature review. Then the aim of the doctoral thesis was set. The aim was to **propose a system of environmental management accounting to support decision-making processes in municipality waste management.** The next chapter introduced the scientific methods used in the processing of the doctoral thesis. The solution and results followed.

6.1 Evaluation of results

Waste management is closely connected to the environment. The aspect of sustainability is a logical outcome of all activities of the municipality in the field of waste management. There are many unknowns in the system. The running system is an advantage for mayors, changes often cause problems and emotions. The presented system of environmental management accounting makes it possible to uncover the unknowns, to identify the problem areas and to decide how to handle all the information. At the same time, it offers an immediate long-term overview of both financial and non-financial data and information in the field of waste management.

The systems of waste management in Bystřička micro region were monitored and analysed in detail. Expert interviews on the topics of waste management were held, lectures and seminars were attended, and the whole issue was widely discussed. The aim of the thesis was to offer the leadership of municipalities, who deal with the issues of waste management, the tool offering immediate overview of waste management system in terms of sustainability. EMA is a voluntary tool providing an overview of information, costs and

benefits important for the environment. Grouping of information and using them within the SBSC will bring clear and well-arranged system discovering possible variances from its stability.

The following most important strengths and weaknesses are identified in the proposed EMA system:

Strengths:

- well-arranged strategic map,
- long-term vision thanks to the projects,
- immediate identification of discrepancies and variances,
- possibility of immediate correction,
- possibility to uncover and eliminate hidden costs,
- knowledge of real costs of waste management,
- balance between financial and non-financial metrics,
- possibility to use parts of the method / metrics.

Weaknesses:

- (apparent) extra work for the employees involved,
- the need for regular filling the data,
- long-term effect, there are no short-term goals for motivation,
- low sophistication of externalities,
- questionnaire survey - frequency (2020 values are an estimation)

6.2 Discussion

The proposed EMA system to support decision-making processes in municipality waste management is applicable in all municipalities in the Czech Republic. The larger the town is (see Velký Újezd), the greater the modification to the proposed system are expected.

The expected change in legislation will bring changes that need to be prepared for. It is not easy to change the existing system, convince people of the benefits, quantify the total costs associated with waste management, incl. hidden costs, motivate residents, or apply crucial changes to the waste management system. The current systems of waste management in municipalities differ from each other.

The limits of the thesis are in the application of the system in municipalities of size 200 – 4 200 inhabitants. The proposed system can be applied without any modifications or changes. For large municipalities and cities next studies of the EMA information are necessary due to the existence of a different infrastructure within waste management.

6.3 Benefits of the doctoral thesis

The doctoral thesis is focused on environmental management accounting, or more preciously on its use in municipality waste management. The system of environmental management accounting in public administration is not a common topics within researchers. The analysis of the literature referred to the connection of EMA and waste management, to the connection of SBSC and waste management, however, the municipality waste management or the application in the public sector is not usually dealt using the EMA information grouped according to the SBSC. This is the most important benefit of the thesis.

A significant benefit is on a practical level, too. The proposed EMA system to support decision-making processes in the municipal waste management maps the context of waste management and enables continuous monitoring of the system. The proposed EMA system is beneficial for representatives and management of municipalities for systematic and efficient

work in the field of municipality waste management. The analysis of theoretical knowledge together with the practical example can both be used for the study of the theory and then for the implementation into the praxis.

7 CONCLUSION

Progressive and responsible approach of municipal leadership in the issues of waste management together with the introduction of systematic measures can be the solution of many tasks in municipality waste management.

Environmental management accounting applied on municipality waste management can fill in the gap in optimizing the system and help to find hidden environmental costs and other benefits. Data from financial and management accounting in the municipality agenda can answer many questions. Waste management calls for the use of environmental management accounting, because economic and environmental issues are closely linked or even have joint agendas and overlaps.

The aim of the doctoral thesis was to propose a system of environmental management accounting to support decision-making processes in waste management of the municipality. The system identifies, collects, estimates, analyses, reports and distributes information to support decision-making processes in municipality waste management. Thanks to the Sustainable Balanced Scorecard management tool it is systematically arranged and understandable. The system can be applied under specific condition in all municipalities of the Czech Republic. The challenge for further research in the field of municipality waste management is the long-term monitoring, identification of links, evaluation and controlling. The proposed system was applied on the particular municipality. The results were discussed and the strengths and weaknesses were identified. With regard to the outputs of the doctoral thesis it can be stated that the aim of the thesis has been met.

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