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Developing a Participatory Approach to Support Decision-Making in Waste Management

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Introduction

Despite ambitious policies and tightening recycling targets, waste management in Europe continues to face big challenges in a move towards a more resource-efficient and circular economy. In 2018, 37.9% of all waste streams that were treated in Europe were recycled, and 45.4% were either disposed of in landfills, incinerated without energy recovery, or disposed of otherwise (Eurostat, 2021). Although the share of treated and recycled waste has increased, and the amount of waste sent to landfills has decreased, the total amount of waste generated in Europe has not decreased. This increases the importance of waste collection. A collection network is essential for obtaining waste that is clean enough for recycling purposes (Laaksonen et al., 2018). Although waste collection has a limited ability to solve the waste problem as a whole, efficient collection enables resource savings and is necessary for achieving the recycling

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targets set out within the European Action Plan for Circular Economy (Tallentire & Steubing, 2020).

The waste management value chain is a multi-stakeholder network that consists of municipalities and other authorities (such as different city departments), policy makers at European, national and local levels, public and private waste management companies, transport companies and waste producers (companies, citizens), producer responsibility organisations, recyclers and users of recycled raw materials. Most of these actors are driven by the shared goal of achieving European waste recycling targets. As waste management and recycling value chains consist of several interlinked processes, co-operation between actors is necessary.

In a multi-stakeholder network, business and governmental institutions come together to find a common approach to an issue that affects them all (Roloff, 2008). According to Roloff (2008), actors of the network can work iteratively towards solving issues through deliberation. During deliberation, various interpretations and dimensions of the issues are discussed, and the stakeholders position themselves to learn the same language and, most importantly, form a shared understanding of the common goal of the network. Furthermore, alternative options to address the issue are defined, and decisions towards action are made during the deliberation phase (Roloff, 2008). Effective methods to manage stakeholder interaction during the deliberation phase are therefore needed.

This chapter presents an experimental testing of group-based multi-criteria decision-making (MCDM) method within the European waste management value chain. MCDM methods are structured, analytical methods that can be used to solve complex decision problems (Kiker et al., 2005). We propose and empirically test MCDM as a stakeholder engagement tool that could be used to facilitate the deliberation phase, which is essential for issue-based network building and management. The study is structured around two research questions:

1. What kind of needs related to stakeholder engagement exist in the studied multi-stakeholder waste management networks?
2. How can the methods of MCDM support the analysed multi-stakeholder network in facilitating the deliberation process?

We base our analysis on empirical data obtained from two workshops that were participated by 31 experts who worked with waste collection at the local or regional level and in producer responsibility organisations (PROs) around Europe. PROs take care of organising the mandatory collection and recycling of waste on behalf of product manufacturers. The motivation for the workshops was to create experience-based recommendations on how to solve persistent problems that cause poor performance in waste collection and recycling.

The first research question is addressed by analysing the findings from a decision-mapping workshop where the experts discussed typical processes, challenges, and actors involved in initiatives aiming to improve waste management at the local level. The second research question is addressed by applying the evaluation criteria proposed by Edelenbos and Klijn (2006) to the quality of discussions and the outcomes of a MCDM workshop.

The empirical findings from this study highlight that co-operation between actors in the waste management chain is considered important and necessary to improve recycling rates. Previous studies have shown how a lack of information, co-operation and knowledge exchange within the value chain is one of the bottlenecks currently hindering the move towards a more efficient recycling and circular economy (Bachér et al., 2018; de Jesus & Mendonça, 2018). However, waste management experts who participated in the study acknowledged co-operation as a challenging topic. The need for contributions from a wide group of actors calls for better ways to manage the interaction of the stakeholder process (Soltani et al., 2015) in the waste management network. Actually, how a stakeholder dialogue is managed or facilitated in a decision-making situation can have the most influence on whether the outcome of the discourse is reasonable or has an impact (Edelenbos & Klijn, 2006). Practical tools for managing stakeholder engagement during the decision-making process are required (Kujala & Sachs, 2019).

In the following sections, we start by presenting the theoretical framework of the MCDM methods and multi-stakeholder network processes and position our study in relation to stakeholder engagement. In the next section, the workshops and the applied participatory MCDM method are described. After that, the findings are presented in two distinct

subsections addressing the two research questions and the two workshop settings. The discussion and conclusions are presented in the two final sections of the chapter.

Theoretical Framework

We analyse our empirical MCDM approach against a theoretical framework that consists of the MCDM approach and selected frameworks from stakeholder engagement and multi-stakeholder networks literatures. This allows us to highlight similarities between the approaches and conceptualise the waste management value chain as an issue-based multi-stakeholder network. Furthermore, we aim to assess how well the tested MCDM method could support the analysed multi-stakeholder network in defining its goals and approaches and selecting appropriate action for increasing recycling rates.

Multi-Criteria Decision-Making (MCDM)

Developed since the 1970s, MCDM is a family of methods from the field of operations research designed to solve multifaceted and complex problems by decomposing them to manageable pieces and establishing the overall value, ranking, or trade-offs between alternative actions (Dyer & Sarin, 1979; Keeney & Raiffa, 1994; Köksalan et al., 2011). The methods commonly incorporate a definition of a goal, alternatives to choose from, and a set of evaluation criteria, which can be considered pre-requisites for informed decision-making (Fig. 6.1). Using MCDM, different dimensions, such as environmental and economic impacts that are important for the decision-making context, may be considered and evaluated one at a time. Applying the methods in group decision-making situations, opinions from several decision makers who possibly have different values and preferences can be collected and included in the decision. A widely used and perhaps best-known MCDM method is the analytical hierarchy process (AHP) presented by Saaty (1980).

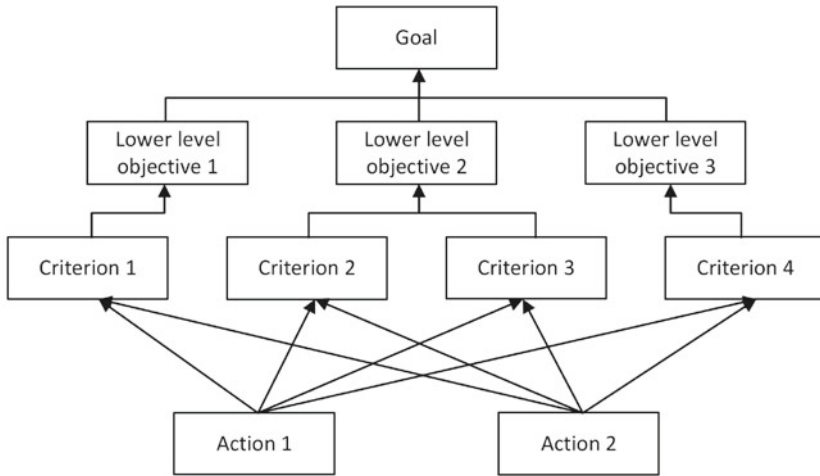


Fig. 6.1 An illustration of a decision problem in the form of a decision tree

The development and use of different kinds of decision support tools and modelling frameworks for the purposes of waste management have been a popular research topic in recent decades. In their review of available waste management models, Morrissey and Browne (2004) indicated that the first modelling studies date back to the 1970s. Whereas these optimisation studies considered issues such as vehicle route optimisation, recent studies aim at holistically evaluating the sustainability of alternative waste management strategies and cover different aspects of sustainability, sometimes also addressing stakeholder needs (Achillas et al., 2013; Morrissey & Browne, 2004).

The first actual MCDM studies related to the management of municipal solid waste were published in 1991 (Achillas et al., 2013). Recent reviews highlight how the use of MCDM methods in the context of waste management is becoming more popular, and the number of studies published in scientific journals is increasing (Achillas et al., 2013; Goulart Coelho et al., 2017; Soltani et al., 2015). This is most likely due to increasing interest in the sustainability of waste management, introduction of the circular economy concept, and the tightening regulatory demands related to recycling.

Although the development of quantitative models has been central to MCDM, mutual benefits from the inclusion of stakeholder management within MCDM approaches have been highlighted before (Banville et al., 1998). In their conceptual paper, Banville and colleagues (1998) proposed that both MCDM and stakeholder management aim at allowing the consideration of multiple points of view, and could thus significantly complement each other. Stakeholders can be involved in many ways within a MCDM approach. Although most studies somehow acknowledge the role of stakeholders in the MCDM process, it has not been very common to use stakeholders as active participants in the MCDM process but rather in a narrower role as input providers (Soltani et al., 2015).

Stakeholder Engagement in Multi-Stakeholder Networks

In this chapter, we define stakeholders as “those who are both affected by and affecting the problem, and are, at the same time, participating in the process of formulating and solving it,” according to a definition proposed by Banville et al. (1998, p. 18). This definition is close to the one proposed by R. Edward Freeman, who defined stakeholders from the point of view of an organisation as “any group or individual who can affect or is affected by the achievement of the organization’s objectives” (Freeman, 2010, p. 46). Our focus is especially on stakeholders who participate in the process of waste management, address related problems and have a clear role in solving them. Our study was conducted in a multi-stakeholder setting using a problem-based approach, as defined by Rühli et al. (2017), based on the works by Hemmati (2002) and Gray and Stites (2013). From the point of view of stakeholder engagement literature, the focus of the study is on integrative stakeholder engagement (Kujala & Sachs, 2019), taking a problem focus rather than the point of view of individual organisations. The study had a strong pragmatic aim in promoting collaborative activities within the waste management value chain and thus promoting societal change (see Kujala et al., 2022). Both the research approach and the findings from the study are characterised

by context-dependent problem-solving and decision-making, which are typical for the pragmatic stakeholder engagement, as described by Kujala et al. (2022).

In this study, we experimentally tested and evaluated the use of MCDM workshops to support the deliberation phase in an issue-based multi-stakeholder network in the context of waste management. Previously, Heikkinen (2017) used the lifecycle of an issue-based network to analyse stakeholder co-operation and engagement in the context of climate change mitigation. Roloff (2008) described the lifecycle of an issue-based multi-stakeholder network in four phases: (1) initiation, (2) deliberation, (3) action and (4) institutionalisation or extinction, which are further described in Table 6.1.

Combining the Two Approaches

The generic process of applying MCDM for problem definition and evaluation seems highly compatible with the deliberation phase, including its purpose and challenges considering the dialogue, creation of mutual trust and establishing the legitimacy of the eventual decisions. The outline of the deliberation process is compared side by side with a participatory MCDM process in Table 6.1. As Roloff (2008) did not propose a method to facilitate deliberation, it is interesting to assess whether the interaction of the stakeholders could be efficiently structured and facilitated using MCDM methods.

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Using MCDM for stakeholder engagement to discuss, compare and generate solutions to a shared problem has many similarities with

Table 6.1 Positioning a participatory MCDM process in line with the main phases of an issue-based multi-stakeholder network by Roloff (2008)

1. Initiation of multi-stakeholder network: The network is formed around an issue that requires attention. There are initial discussions around the issue or a problem	
2. Deliberation Deliberation process in issue-based multi-stakeholder networks: Acquaintance phase: Stakeholders discuss their views and positions, learn common language and interpret the problem	<p>A participatory MCDM process in the context of multi-stakeholder networks: Problem definition stage: The stakeholders form a shared understanding of the situation, including the roles and positions of the stakeholders and the state of the target issue. The group negotiates and agrees the structure of the problem:</p> <ul style="list-style-type: none"> • Definition of the overall objective • Definition of lower-level objectives that describe different dimensions of the goal • Defining criteria that describe performance within each lower-level objective
First agreement phase: Agreement on the problem definition, including goal definition	<p>Data collection stage: The stakeholders agree either based on external assessment or as ad-lib judgement the:</p> <ul style="list-style-type: none"> • Set and definitions of the alternative actions • Performances of the actions in each criterion

Second agreement phase: Comparison of alternatives to select the approach for implementation

Decision-making stage: According to the applied MCDM method and facilitation, the stakeholders state and discuss their preferences affecting the results of the assessment. The main steps are:

- Selection of MCDM method
- Elicitation of stakeholders' preferences according to the selected MCDM method(s)
- Ranking the alternatives according to the MCDM method.
- Agreement on the best action(s)

3. Action: After implementation, the network may consolidate, reform or expand and return to deliberation of further actions

4. Institutionalisation or extinction of the network

the interactive decision-making as described by Edelenbos and Klijin (2006), who used network theory to conceptualise stakeholder management in interactive decision-making processes. Edelenbos and Klijin (2006) described interactive decision-making as an open procedure that attempts to incorporate the values and wishes of the participants in the solutions that are developed during the interactive process. From the network theory perspective, the interactive process includes the participation of actors who are tied to each other by dependency relations. The outcomes of the interaction are shaped by the management of the process and the complex games of influence and interaction between the actors. Based on our empirical experience, this description is applicable to the context of waste management, in which our experimental testing was conducted.

Research Design

The empirical data discussed and assessed in this chapter were collected from two expert workshops organised in 2019. During both workshops, the majority of time (of the two-hour sessions) was allotted for discussion and for collecting the views and arguments of the participants. Thus, the participants had a chance to learn from the responses of others, and exchange ideas of good practices. The authors of this chapter acted as facilitators in both workshops, and thus were actively involved in the analysed exercises. The research approach, applied methods and participants of the two workshops are presented in the next section and in Table 6.2. A description of collected and analysed data is also given in Table 6.2.

Workshop I: Mapping Decision-Making Processes for Developing Waste Management

The workshop I was organised in Thessaloniki and it focused on decision-making challenges in the context of waste management. Ten experts representing nine different European countries and regions

Table 6.2 Organised expert workshops, applied methods and collected data

Workshop date and place	Discussed waste streams	Applied methods	Aim of the workshop	Attendees
21.11.2019 Brussels	WEEE	MCDM: Pairwise comparisons using AHP and SWING weighing	Proposing and prioritising means & criteria for improving WEEE collection in two regions	21 WEEE Forum members from 10 countries
10.12.2019 Thessaloniki	PPW, CDW & WEEE	Decision-mapping + group discussions	Discussing typical decision-making processes, challenges and involved stakeholders in improvement initiatives	10 waste collection experts from 9 countries

(Belgium, Norway, the UK, Romania, Portugal, Spain, Italy, Greece, and Poland) participated in the workshop, and eight decision-making processes were presented and discussed.

The workshop included a decision-mapping exercise in which the participants drew maps about a decision-making process with which they were familiar. The presented decision-making processes included (for example):

- Reorganising the collection of municipal solid waste (MSW) and paper and packaging waste (PPW) and agreeing on the division of costs between the actors.
- Organising locations for urban composting to separate biowaste.
- Reorganising PPW collection to increase recycling rates.
- Introducing a new fee for collection and treatment of municipal waste.
- Establishing a new civic amenity site and organising the necessary infrastructure for waste collection, sorting and treatment.

The participants were asked to describe the main phases related to this decision process and to name the actors involved in each phase. They were also asked to describe the main challenges related to the process.

The results were gathered based on a mixed method that included the participants' observations, the drawings prepared by the participants and the discussion held during the workshop. The main findings from this workshop are discussed in the first subsection of the findings.

Workshop II: A Participatory MCDM Exercise

A participatory MCDM approach based on the analytic hierarchy process (AHP) (Saaty, 1980) was tested in a workshop in which experts discussed their ideas of actions to improve the collection of waste electrical and electronic equipment (WEEE). The workshop was organised in Brussels together with WEEE Forum, an international association representing 40 producer responsibility organisations. Participants in the workshop consisted of 21 WEEE Forum members from ten countries (France, Romania, UK, Portugal, Greece, Czech Republic, Malta, Norway, Luxembourg and Belgium).

There are large differences among existing collection systems and the amounts of WEEE currently collected for recycling in different regions. To create a meaningful discussion, two parallel groups were organised, and the participants were asked to take part in a group in which the local context seemed most familiar to them. The first group considered potential means for improving WEEE collection in a small city located in a rural area. The second group proposed options for improving WEEE collection in a large, densely populated city. Both regions had low collection rates in relation to average collection rates across the EU. Case descriptions were formulated based on information available in a public database describing over 200 existing European waste collection systems. No information other than the case region descriptions was available for the experts. Therefore, the proposed actions, evaluations and priorities were solely based on their individual expertise, judgement and interaction.

Both groups had two hours to complete the exercise. We recognised that the use of pairwise comparisons in the selected MCDM method would restrict the number of improvement options that could be discussed during the workshop, due to the amount of time that would be

needed for the comparisons (prioritising each option in relation to each criterion). Therefore, we planned that the participants would define 3–4 actions that they considered had the most potential to improve collection rates in their case region. Further, the participants defined a similar number of criteria that could be used to evaluate the importance and prioritise the proposed improvement actions.

AHP was chosen because the workshop was designed to act as a simulation of an early-stage assessment of improvement alternatives prior to the availability of comparable data on potential improvement options. In other words, the shared goal and best actions were intended to be created during the interaction. In addition to being among the most popular methods of multi-criteria decision-making, previous experience has shown how AHP was successful in promoting discussion between experts in the recycling value chain (Bachér et al., 2018). Upon agreeing on the set of improvement actions and the evaluation criteria, the groups were asked to make a round of pairwise comparisons using the AHP. In the pairwise comparisons, all the improvement actions were compared against each other, two at a time, in terms of how well they performed in each criterion. For example, option “Organising awareness raising campaigns” was compared against option “Increasing permanent bring-points,” considering how much they would improve collection rates (criterion). The comparisons were made using the fundamental scale of AHP (Saaty, 1980), with a range of 1 (the options perform equally well) to 9 (one option performs extremely better than the other).

The voting was open, and the experts were asked to contest their arguments within the group during the voting. We devised the elicitation procedure so that the experts had to present their scores on a paper sign for others to see and react to. By doing so, the group also better shared, through discussion, their linguistic interpretations of the evaluation scale.

After pairwise comparisons of alternatives, the criteria weights were elicited. The criteria weights indicate the importance of each evaluation criterion, and they were used as factors together with the AHP results to calculate the final scores of the WEEE collection improvement options. The criteria weights depended on the individual preferences of the group members, but were possibly also influenced by the perceived differences in the reliability of the pairwise comparisons under the criteria. This

was incited by eliciting the criteria weights after pairwise comparisons in AHP. The criteria weights were elicited using the SWING method, as time constraints did not allow for carrying out pairwise comparisons between the criteria, according to the AHP method. In the SWING weighting method (Zardari et al., 2015), the experts/decision makers assign a value of 100 points to the most important criterion. Then, they give the next most important criterion an importance of equal or smaller than 100 points, the third most important criterion an importance equal or smaller than the second criterion, etc. This continues until they arrive at the least important criterion, which is assigned an importance equal to or higher than zero.

Discussions held during the workshop were recorded and transcribed. All the answers were implemented in a spreadsheet tool during the exercise to display the results to the participants. After the workshop, the qualitative data was analysed, considering the interaction between participants during the exercise, how actively the participants were involved, and whether they seemed content with the actual outcome of the MCDM and how the exercise was conducted.

To reflect upon the outcomes of our decision-making experiment, we adopted the framework used by Edelenbos and Klijn (2006). In their framework, the evaluation is based on actor contentment and enrichment of ideas, including the variety of created ideas and the influence of the ideas on the eventual concrete outcome. The assessment of perceived actor contentment is based on our interpretation of the satisfaction of the decision makers at the end of the session. We take into consideration any direct feedback received after the session and critique on the scores and priorities of the evaluated actions resulting from the MCDM. We analyse the variety of ideas during the stakeholder dialogue in terms of activity in the debate, differing views and ideas and finally did the stakeholders come up with solutions that were not mentioned during the briefing on the current status of the two case regions. Finally, we assess the influence of ideas based on how successful the groups were in establishing a clear priority order for the actions. The main findings from the decision-making workshop are discussed in the second subsection of the next section.

Findings

Waste Management Value Chain as an Issue-Based Multi-Stakeholder Network

During the decision-mapping exercise (Workshop I), European recycling targets were frequently mentioned as important drivers for implementing changes in existing waste collection systems. Consequently, increasing collection or recycling rates was among the main targets of the discussed decision-making processes. However, in addition to European legislation, other drivers, such as new ideas originating from local waste management companies, the citizens, or other local actors, were highlighted. For example, it was mentioned that the increased interest of citizens in improving waste sorting sometimes initiated the process of change or speeded up the planned changes.

The described decision-making processes involved several actors: municipal actors (different city departments), public and private waste management companies, ministries, local policy makers, PROs, NGOs, transport companies and citizens. For example, when trying to find a location for a new civic amenity site or sorting centre (to improve sorting and reduce landfilling), there is a need to find a suitable location that would be accepted by the different departments of the city, and by the nearby residents and companies. Issues related to the availability of the service (transport and logistics) need to be considered, and permits related to environment, health and safety have to be acquired. The availability of necessary trucks and other equipment must be ensured by discussing and negotiating with potential service providers and contractors.

According to the experts, the main challenges related to the decision-making processes discussed were:

- Understanding and defining the problem: How the problem should be addressed, what kind of options are available, and where/how to find all necessary information.

- Coordinating activities: Reaching consensus and ‘speaking the same language’ with different actors (including different municipal actors/ authorities but also PROs, and private companies involved).
- Engaging with citizens and other actors related to the process.
- Implementing the decisions in practice and finding practical ways to monitor the performance.

Thus, many of the discussed challenges faced in the context of waste management were related to different phases of deliberation: the acquaintance phase and the first and second agreement phases. Although the goal of the network seemed to be common for many of the actors, the process was usually complicated by the fact that, in addition to the joint issue or problem, different actors have multiple other goals (such as optimising costs) that need to be negotiated during the process. There might also be conflicting regulations or unclear responsibilities between different city departments that could hinder the process.

The need for practical tools that could be used for facilitating and structuring different phases of the decision-making process and for engaging with stakeholders was highlighted during the workshop. Collecting feedback and reaching consensus between different actors were considered challenging and often laborious but important. The experts emphasised that a lot of time is spent getting the participants to speak the same language. This challenge is closely linked to the acquaintance or problem definition phase: how the different actors interpret the problem, what kind of changes would be required in the activities of each organisation, and who will need to pay the costs.

In a nutshell, the findings from the workshop illustrate in practice how an issue-based multi-stakeholder network should be formed when planning or implementing changes in waste collection. This is necessary, as proper functioning of the value chain and finding acceptable solutions require co-operation between several actors, including both public and private organisations and citizens. The length of the decision-making processes discussed during the workshop varied from months to years. Although the focus of the discussions was related to the deliberation phase, in most cases, the network should also continue its operation after the deliberation and action phases for the proper functioning of the

value chain and to achieve the original target of the network (reaching the European recycling targets). In an ideal case, the network would be institutionalised in one way or another for the purposes of monitoring the performance, and making further adjustments in order to ensure reaching the targets.

Structured MCDM Workshops as Practical Tools for Deliberation

Actor contentment. None of the participating experts expressed disagreeing opinions about the results of the decision-making exercise, that is, a priority order of ideas/actions to improve local WEEE collection. Such a level of consensus was not taken as granted, as there were contrasting views in the beginning when the set of alternative actions was proposed. For instance, one expert coming from a similar region as the small case city, who was very active in the discussion, criticised the inclusion of “awareness-raising campaigns” by stating such effort was outdated and inefficient use of funds, whereas other experts had a completely opposite view about the importance of such action. The debate continued when the action was pairwise compared with other actions regarding the criteria (i.e., the cost of WEEE collection, climate impacts, collection increase and increase in local employment and GDP).

The results eventually indicated that “awareness-raising campaigns” were among the four potential actions to improve the WEEE collection in the case region, but it had the lowest priority based on the criteria. This indicates that the applied approach can increase the legitimacy of the decision by allowing the stakeholders to present, discuss and contest individual viewpoints during the deliberation. This may indicate that the experts who believed in the impact of awareness-raising campaigns were sufficiently content that the action made it to the shortlist or that their estimate of the anticipated performance of such actions was lowered based on the negative feedback on the action. However, the expert who did not wish to shortlist such action may have been content that it was given the lowest priority in the end.

Other contrasting views were revealed during the pairwise comparisons of the actions, particularly concerning enforcement of better practices to avoid processing of WEEE through illegal channels. The experts presented opposite views when comparing an increase in permanent WEEE collection points against enforcement of better practices to avoid WEEE processing through illegal channels. Here the discussion revealed interdependencies between the actions, as enforcement of better practices might be inefficient without adequate number of WEEE collection points. When comparing the enforcement of better practices, which was interpreted as surveillance and required interventions by authorities, to “defined single channel regulated collection,” the experts debated if some of the responses were based on experiences from conditions too dissimilar to the case region.

In the reported situation, sufficient deliberation and facilitation fostered a dialogue in which the disagreements were already processed during the phases of the MCDM prior to the ranking of the alternative actions, that is, during problem definition, definition of the set of alternative actions and when the stakeholders’ preferences and judgement were elicited.

The outcomes were formed as a result of intensive and goal-oriented exchange of views, which likely fostered a shared acceptance of the results, which we (for lack of a better measure) take as an indication of actor contentment. The direct feedback received from the experts included statements regarding the intensity or exhaustiveness of the exercise but also positive statements about its usefulness. One participating expert indicated an intent to transfer and use the method in another setting.

Enrichment of ideas. During the intensive two-hour workshop, the participants became familiar with some basic ideas of the MCDM methodology and backed their views by the experiences of their own countries and regions, thus creating knowledge sharing. Individual contributions varied among workshop participants, and some of the participants took on a more active role in leading the discussion and asking questions from others. In particular, those with experience in WEEE management in circumstances reminiscent of the case region actively proposed solutions and commented on others’ ideas. However,

as the method required each participant to give their answers to each question, everyone was given the opportunity to explain their choice. Arguments against and in support of the presented views were abundant. Further, there was a vivid discussion and exchange of experiences, turning the session into a dynamic learning activity for participants and facilitators. The topics of the discussions also revealed differences in the regional, legal and demographic contexts in which the experts were working.

The experts were very active in providing WEEE collection improvement ideas. The ideas were often based on the personal experiences of the experts, which although might indicate that the answers were biased towards solutions and perceptions that were most familiar to the experts and less applicable to the case region, promoted knowledge exchange as the experts were from various countries and had their work histories in different regional contexts. The experts even accused each other of such a bias during one pairwise comparison. The experts assessed the status quo of the case region's WEEE collection, including the number and type of bring points, and proposed adjustments. The additional three improvement ideas in both groups were related to actions that were not touched upon in the initial description of the case region and were therefore not incremental changes to the collection system but completely new types of initiatives.

The two parallel groups working on the two case regions were successful in generating a set of ideas (about applicable improvement actions) that were sufficiently accepted by the group of experts, agreeing on a set of evaluation criteria and finally creating a priority order for the actions. In both groups, the experts were able to differentiate the potential performance of the actions according to the evaluation criteria. The final results showed a clear priority order for the actions based on their expected overall value. In addition to having a say on the problem definition, the experts were able to influence the opinions of their peers through argumentation, and there was an active exchange of views on the responses given on the evaluation scale. Due to the two-hour limitation of the duration of the dialogue, however, many of the debates were left open and unfinished. To sum, we believe the experts perceived that their ideas had a direct influence on the results, increasing the legitimacy

of the outcome, as reflected in a high level of agreement regarding the results.

Overall judgement. In the designed workshop setting, the AHP functioned as a method for contesting the individual ideas and views of the decision makers. The structure of the approach, from the definition of alternatives and criteria to pairwise comparisons and criteria weighing, was applied in practice without problems. However, it took some time before the participants understood the logic of the exercises. One of the challenges was that no screen was available during the discussion, and thus the participants could not see the evaluation matrix, as it was only included within the laptop of the facilitator, who inserted the answers within the matrix. However, the participants could see the answers of other persons when sharing the results (scores from 1 to 9) on a post-it note. This provoked many questions and discussions, especially when the opinions were very much divided. This also highlighted how, due to varying regional circumstances, the participants sometimes came up with very different prioritisations, which were also accepted after each participant presented their argument.

The workshop was characterised by lively conversations and assessments of ideas, which stayed quite well within the context of the case region. Initial difficulties in carrying out the pairwise comparisons were experienced, which was alleviated by improving the definitions of the criteria and practising the procedure. The focus of the process management changed multiple times during the workshop. The focus was first on keeping track of the ideas and conversation, then on ensuring the functionality of the criteria, and finally on the execution of the MCDM methodology.

The duration of the workshop was limited to two hours, which necessarily narrowed down the scope of the assessment. Based on the workshop experiences, it is possible to perform a simple MCDM in a rather short time slot. However, perhaps half a day would be a more suitable duration, as it would allow for some iterations during the exercise.

The pairwise comparisons of the proposed actions were difficult to initiate. The accurate definition of performance parameters, such as cost

per tonne of WEEE collected, often needed to be brought to the attention of the decision makers. The decision makers commented on the challenge of incorporating local situations, such as the scale of collection, into their estimates of the performances. In the end, we do not know the extent to which the decision makers' answers were based on intuition affected by fundamentally different local situations. In the context of waste management, practical decision-making is often affected by a lack of measured data related to created, collected and recycled amounts of different waste fractions. This is a particular challenge, especially in the case of WEEE, since significant amounts of old equipment have unknown fates.

Discussion

In this chapter, we have proposed and empirically tested a group-oriented MCDM approach to support interaction and deliberation in a multi-stakeholder network in the context of waste management. Our experimented approach bears resemblance to the proposed use of multi-criteria decision analysis for strategic decision-making by Montibeller and Franco (2010). Our findings highlight how decision-making in waste management value chains requires establishing an issue-based stakeholder network to reach consensus and find practical solutions for challenges related to both the collection and recycling of different waste fractions. This topic is particularly relevant in the context of waste management, as tackling the challenges related to waste prevention, collection and recycling is necessary for a move towards a circular economy and requires co-operation between various public and private stakeholders. Almost every region in Europe is currently facing these challenges.

We have further presented how the decision-making approach using MCDM has considerable similarity with the deliberation stage of an issue-based multi-stakeholder network, as described by Roloff (2008). Although Roloff (2008) provided an elaborated description of the stages and related challenges, practical solutions for managing and facilitating such processes were not proposed. Our work aims to complement the

literature on the management of such stakeholder processes by experimenting in practice on how MCDM workshops could provide structure to the deliberation stage, in which shared understanding should be created and best actions selected for implementation.

Edelenbos and Klijn (2006) showed how facilitation of a decision-making process may have significant impacts on the outcomes of the process. The terms “width” and “depth” of participation are used to describe how much actors are included and how much impact the actors are allowed to have on the decision-making process (Edelenbos & Klijn, 2006). In traditional MCDM studies, both the width and depth of participation may be limited to providing answers to pre-defined questions that are used for weighting the criteria and consequently for ranking the assessed alternatives in the order of preference. However, the participatory MCDM approach using the AHP method, as presented in this chapter, aims at increasing both the width and depth of participation while following a structure that ensures that the voice of each participant is included in the final decision.

Our findings support the idea that the structured and facilitated workshops promote both a shared understanding of the issue and a consensus on the appropriate actions to solve the issue. Moreover, they provide enrichment of ideas (Edelenbos & Klijn, 2006) by requiring all the attendees to participate in the dialogue. The process needs to be carefully designed and adapted to the case at hand to yield successful outcomes. The need for structured analysis may also feel burdensome for the participants. At worst, systematic pairwise comparisons can create a feeling of repetition and make the process look rigid. Although these problems were certainly encountered during our experiments, we were able to provide enrichment of ideas by flexible but reasonably formal (Edelenbos & Klijn, 2006) management of the expert dialogue.

There is room for further research and development of the methodologies, and there may be many adaptations of MCDM to support multi-stakeholder processes. Here, we have experimented with group-based MCDM in a single workshop (with two parallel groups) to demonstrate its potential to aid in the deliberation of goals and selection of appropriate actions. In reality, the approach might be adapted in sequences over the course of time or repeated iteratively in various stages of the deliberation.

Limitations of the Study

The experimental part of our study consists of discussions and interaction with European experts from the field of waste management. As an inherent quality of such research setting, the outcomes are case and context dependent. In addition, the composition of the group of participants affects the outcome. Our experiment did not yet include other stakeholders than those working with waste management. Conducting a similar exercise in a specific local context with a more heterogeneous group of stakeholders could reveal different kinds of challenges that might be related to conflicting interests of stakeholders, for example. More studies would be needed to understand better the potential challenges related to facilitating such a process.

Conclusions

Waste collection and recycling are essential processes in a move towards more circular use of resources. Necessary co-operation in waste management value chains can be enhanced by setting up an issue-based stakeholder network. Such a network can enable reaching consensus and finding practical solutions for challenges related to both the collection and recycling of different waste fractions. Based on the findings of our study, we conclude that participatory MCDM approach could be used as a tool for pragmatic stakeholder engagement, especially in situations when there is a need to prioritise actions or to reach consensus. Decision-making approach using MCDM has considerable similarity with the deliberation stage of an issue-based multi-stakeholder network. Structured and facilitated MCDM workshops can promote both a shared understanding of the issue and a consensus on the appropriate actions to solve the problem. Applying MCDM in practice requires careful planning and preparations, but the formal structure of MCDM ensures that the voice of each participant is included in the final decision.

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