A practical guide for the systemic design of WEEE management policies in developing countries

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EXECUTIVE SUMMARY

With each passing day, more Waste Electrical and Electronical Equipment (WEEE) is generated. The appropriate integrated management of WEEE may offer economic opportunities insofar as this waste contains profitable materials such as precious metals. Yet, in countries with developing economies, improper management turns WEEE into a source of environmental contamination and a public-health concern. Only some of these countries have advanced in the creation of legislative and regulatory bases to address this problem through the lens of Extended Producer Responsibility (EPR). Adopting this approach is crucial because it ensures high-level coordination, cooperation, and involvement by all pertinent actors to implement a long-term planning vision from a more systems-oriented approach, as opposed to isolated and short-term decision-making.

The overarching purpose of this guide is to propose a methodology that facilitates the holistic conception of problems for which systemic design can be applied to develop sustainable solutions. A systems approach entails a profound understanding of the situation to be improved, and this understanding, in turn, requires the collaboration of all relevant actors. Thus, the methodology proposed herein includes participatory tools that encourage these actors to design the problem, identifying not only the associated causes and effects but also investigating which structural reasons underlie these causes and effects. The following steps rely on a high degree of participation to support the creation of strategies and elements that are integral to the designed policy's action plan. Applying the proposed methodology leads to tangible (quantitative) products—such as the policy itself, reports, or records of meetings/agreements—and intangible products—such as the actors' learning processes or enhanced knowledge of the system.

The different methods and design recommendations discussed in this guide are based on the methodological support provided during the design of national policy for WEEE management in Colombia as well as the design team's wealth of experiences. Therefore, this document describes the design process in the Andean nation in the style of an example of use and offers guidance regarding how to facilitate similar processes in other contexts with an eye towards strengthening WEEE management systems through the systemic design of policy.

CONTENT

0. Introduction

0.1. Managing Waste Electrical and Electronic Equipment (WEEE) in developing countries

Waste electrical and electronic equipment (WEEE) is defined as any device that requires an electric current or electromagnetic field to function and has lost the capacity to offer users a given service or satisfy users' needs. This equipment and/or its parts contain toxic substances, which can be released if not handled in accordance with minimum technical, occupational, and environmental standards. However, this equipment also contains metals that are potentially recoverable and profitable, so WEEE can also be said to offer a source of economic opportunity, notably in countries with emerging and developing economies (CEDEs).

Industrialised countries have implemented management systems based on the principle of Extended Producer Responsibility (EPR). Within the EPR framework, the producer, importer, or seller is responsible for the appropriate handling of the equipment from its production to its disposal by the consumer. Due to the implementation of the EPR model as well as appropriate incentives, there have been annual increases in the rate of WEEE treated in formal systems following proper processes and practices. In CEDEs, regulations and public policies explicitly aimed at WEEE are a recent phenomenon. In Latin America, according to GSMA Latin America (2015), some CEDEs currently have a national-scale law that addresses aspects of the integrated management of WEEE under the principle of EPR, including some iterations that employ the concept of shared responsibility. As detailed in the GSMA's 2015 report, the CEDEs with a general law related to WEEE in Latin America are: Brazil (2010), Colombia (2013), Costa Rica (2010), Ecuador (2011), México (last reform in 2015), Peru (2012), and, most recently, Chile (2016). Other non-industrialised countries with a national-scale law regarding WEEE include Taiwan (1998; EPA, 2012), China (2006; Step, 2013), and India (2011; Government of India, 2016), among others. That said, over the last 5 years, some of these countries have enacted sector understandings or official regulations that instrumentalise the specific nature of WEEE management not made explicit in each country's respective laws.

A common phenomenon in CEDEs, given the economic value of the recoverable materials in WEEE, is for thousands of families living in extreme levels of poverty to turn to the collection and treatment of WEEE as a means of subsistence. In China alone, for example, between 3.3 and 5.6 million people are involved in informal recycling activities related to urban solid waste (Linzner and Salhofer, 2014), which generally includes metals (Fei et al., 2016). In some parts of Latin America, up to 95% of WEEE collection is performed by members of this vulnerable sector of the population; however, most of this collection is conducted under poor technical,

environmental, and infrastructure conditions (GSMA TM, 2015). This issue has traditionally been referred to as *informal recycling*, though this generalisation should be revised in light of the differences signalled in the *Guidance Principles for the Sustainable Management of Secondary Metals* (ISO IWA:19, 2017). Per this document, informal recycling is categorised as *(i)* economic subsistence activities or *(ii)* unofficial economic activities. The former category includes recyclers who subsist thanks to their recycling activities, while the latter category includes those who have profitable or even lucrative businesses that deliberately evade compliance with pertinent regulations (see Section 0.6 for definitions of these terms).

Despite the advances with regard to developing programmes and infrastructure in the urban centres of some CEDEs, it is clear that enormous challenges remain, given the deficiency of the solutions for the growing quantities of WEEE generated. The level of cooperation and coordination required between the principal actors is, in general, weak, which makes it difficult to design and implement programmes for collection or treatment. This situation is evinced by the low rates of collection and inadequate final disposal of WEEE (e.g. tossed onto public roadways, public spaces, landfills, or the banks of riverfronts and gullies).

Figure 0.1. Images capturing the current context of WEEE management in some countries with emerging and developing economies.

Additionally, in many CEDEs, communication among relevant actors in WEEE management is ineffective, especially with respect to the dissemination of information to EEE consumers. These consumers, in the majority of cases, do not know how to dispose of their WEEE in spite of their responsibility to guarantee its adequate management. In the same vein, consumers are generally unaware of the toxic materials contained in the equipment that they store for prolonged periods or throw out along with regular waste. To this profile of the irresponsible consumer, we can add the uncontrolled spike in the acquisition of EEE, catalysed by its function in terms of social status and fashion, the low prices fuelled by contraband activities, overall low quality of some devices, and ever-shorter lifespan (i.e. planned

obsolescence). Taken together, the aforementioned aspects underscore the need for public-education programmes that raise awareness and guide the population towards more sustainable consumption.

Finally, although the enactment of laws and regulations for the specific management of WEEE has been significant, there is room to improve. In broad terms, the level of participation in policy design by different actors benefitting from and/or affected by improper WEEE management as well as the inclusion of the various aspects of the issue could be enhanced. Similarly, the legal requirements and objectives created to curb WEEE generation and improper disposal, on many occasions, are defined in terms of criteria that are either economic or purely technical, thereby failing to integrate other important aspects, such as social, cultural, technical, institutional, or environmental aspects, among others. In making decisions this way, governments and institutions can fall into the elaboration of non-holistic solutions that are far removed from a vision accounting for the possible future effects of these decisions on the entire WEEE management system. It is precisely on this point that design tools based on the systems approach take on relevance for decision makers.

0.2. The systems approach and policy design

The systems approach entails conceiving of phenomena (situations or objects) as integral parts of a *whole* instead of conceiving of them in isolation. Through this lens, when we refer to a *system*, we address the ensemble that comprises it as well as the interactions between the parts of this ensemble. An example would be the human body. The body not only has clearly identifiable parts but also has myriad interactions between these parts; these interactions enable the body's functioning as a system. Additionally, the body of a person forms part of even bigger systems, such as social ones. Thus, we can say that every system an observer defines consists of subsystems, which, in turn, are comprised of other, smaller subsystems and so on, as far as the nature of the phenomenon under study permits. In terms of systems thinking, systems can be conceived of and studied from 3 main foci:

- The soft systems approach addresses social systems consisting of activities and human relations and in which problems are hard to design. Its primary proponent is Peter Checkland.
- The hard systems approach identifies purely technical, predictable, and optimisable systems. Its primary proponents are Ludwig von Bertalanffy, W. Ross Ashby, Stafford Beer, Jay W. Forrester, and Doug Hall.
- The critical systems approach coordinates the 2 aforementioned approaches under its definition of sociotechnical systems. Its primary proponent is Werner Ulrich.

The systems approach imparted herein considers the integrated management of WEEE to be a sociotechnical system constituted by the interaction between human factors—e.g. decision-making, interests, and habits or customs—and technical elements—e.g. waste as waste, treatment technologies, and infrastructure. Systemic design thus implies a profound understanding of the complexity of the problem to address, for which it is not sufficient to merely identify its most conspicuous effects. Using the analogy of the iceberg (see Figure 0.2), what we normally identify as a *problem* or *problematic situation* is typically an effect of the *real problem*, or a problem that runs deeper, is bigger, or can only be understood on a structural level. The *real problem* is not easily recognised at first blush. Hence, to investigate the *real problem*, it is important to first articulate *problematic situations*. These situations can be used to investigate and understand the *real problem*. That said, readers should note that some situations may have 1 *real problem* but multiple *problematic situations* (Figure 0.2 – part b).

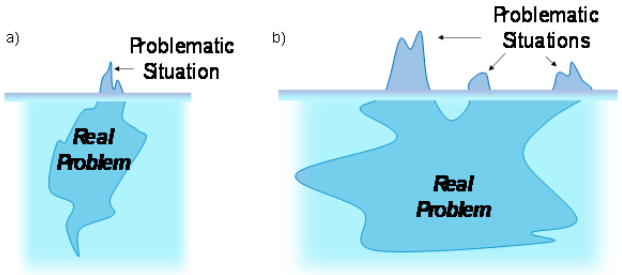


Figure 0.2. The iceberg analogy for problem identification.

This is part of what this guide calls the *design of the real problem*, a concept crucial to the first phase of the process of designing systemic policies. For the sake of clarity, the *design of the real problem* is similar to the commonly referenced *assessment of the current situation*. The *design of the real problem* includes identifying the most conspicuous effects determining the *real problem's* causes and secondary effects. It also entails prioritising which causes to address and delineating *structural causes*. Yet, there is a key distinction between assessment and design in the context of systems thinking: the *real problem* is *designed* through a collaborative effort by primary and secondary actors (institutional or otherwise) and reveals not only *problematic situations* but also their underlying *structural causes.* For practical purposes, the present guide focusses on identifying *problematic situations* that will be used to orient the *design of the real problem* to eventually create policy that changes the situation on a *structural* level.

The concept of idealised design (Ackoff, 2002), which also forms part of the conceptual framework of the systems approach, facilitates prospection or planning

towards desirable situations. With more in-depth knowledge of the *real problem* to solve, the systems-oriented designer has the basis for comparing the system under study to other systems or better/ideal systems as well as for identifying the characteristics that distinguish these systems or their disparities; so, efforts to design the solution would be focussed on replicating these successful characteristics and learning from the identified causes of disparity.

Systemic policy design as solution to the real problem

When evaluating the complexity of problems that perpetuate the improper management of WEEE and the challenges still facing CEDEs, the existence of a national policy is of heightened significance. What is required is the design of solutions planned for the short, medium, and long terms. These solutions should be integrated to enable the harmonisation of contexts, regulations, actors, and dynamics of the systems, which can be promoted by means of a systemically designed policy. The methodology proposed herein is primarily based on the critical systems methodology, in which the aim is to gain in-depth and detailed knowledge of the problem to tackle, and, simultaneously, to propose practical solutions to be implemented in the short, medium, and long terms. Thus, the proposed systemic design has 2 principal components related to the tangible (i.e. quantitative) results and the intangible (i.e. social or non-material qualitative) results. The 2 components are as follows.

- A process component with an integrated vision allows decision makers or policy designers to involve, from the conception stage of the problem to address, the needs and interests of different actors, waste-management processes, and multiple aspects of the problematic situation as part of the real problem. All of this is done within the framework of a cause-and-effect and temporal logic. The latter, temporal logic, specifically refers to using lessons gleaned from past experiences (or from previous actions) and visualising possible future effects of current decisions in the short, medium, and long terms.
- A capacity-building component goes beyond the mere identification of the problem by requiring the design of the problematic situation. In the actors involved, this component engenders learning and conceptual adjustments that may lead to a change in the current reality of the system. Systemic design, then, becomes a paradigm change that brings about the modification of the system from the outset of the solution design, rather than solely modifying the system once the solution has been designed and is ready for implementation.

0.3. Objectives of this guide

The general objective of this guide is to present a methodology for the systemic design of policies, particularly policies aimed at developing sustainable WEEE management in CEDEs.

In line with the concept of systemic design explained in the preceding section, this guide proposes the following specific objectives:

- ✓ **Offer methods and tools** that facilitate both the design of the problematic situation that leads to the real problem, and a policy to address it, taking into account various actors' needs and interests, waste-management processes, and multiple aspects of the problematic situation; these specific objectives require users of this guide to follow a causal and temporal logic.
- ✓ **Share results and lessons** from the experience employing systemic design in Colombia.

0.4. Note for countries using this guide

The systemic-design methodology contained in the present guide facilitates governments' strengthening of integrated WEEE management systems, stimulating actors' participation and assumption of ownership by dint of the design process.

The application of this methodology is also suitable for the design of strategies in cities, municipalities, or groups of cities or municipalities, provided that the required conditions for actor participation are met (see Chapter 1, 'Considerations for the application of this guide').

0.5. Layout of this guide

Figure 0.3 illustrates the structure of this guide. Chapter 1 describes the minimum requirements for application. In Chapters 2 through 6, the proposed systemic-design methodology is developed; this methodology is based on systems concepts, such as the differing vision each observer may have when approaching a phenomenon, and the framing of the problem based on the design of the associated problematic situation and its structural causes (laid out in Section 0.2). Designing a policy to create a more sustainable management system is expounded in Chapter 7. In the following chapter (Chapter 8), a practical application of these methods is described based on the experience in Colombia. To close, recommendations drawn from the learning process in the Andean nation are shared for the benefit of countries seeking to improve their own WEEE management systems (Chapter 9).

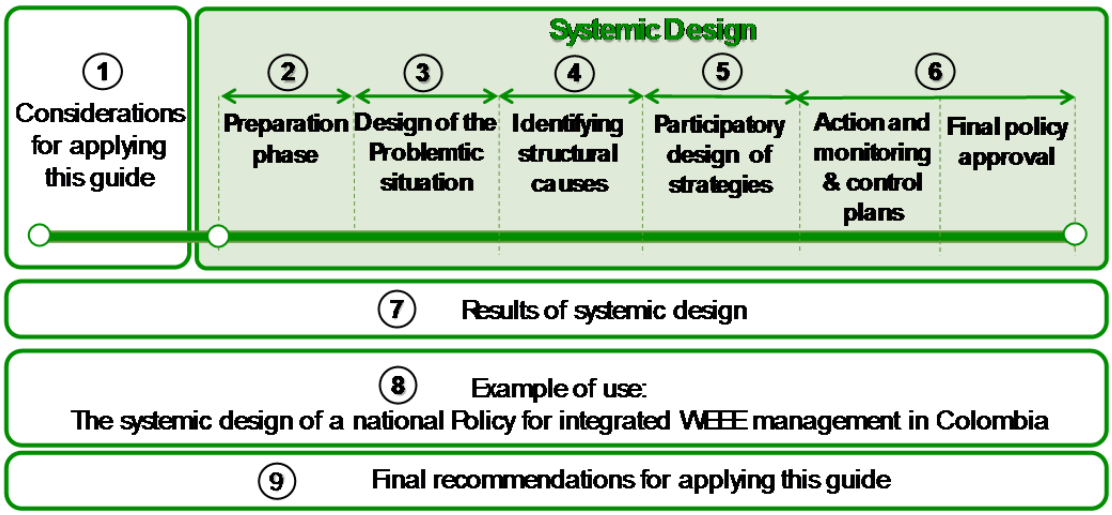


Figure 0.3. Structure of the document 'A practical guide for the systemic design of WEEE management policies in developing countries'

It is important to stress here that the systems approach demands an in-depth knowledge of the relevant context, which is constructed via collaboration between the relevant actors. With this knowledge, the actors can design possible solutions that address *structural causes* of the *real problem*. To this end, Chapters 2 and 3 provide an account of what is traditionally known as an *assessment*, while Chapters 4, 5, and 6 address the process of designing solutions.

0.6. Definitions and key concepts

EEE (Electrical and Electronic Equipment): A European Union Directive defines EEE as all devices whose proper function requires an electric current or electromagnetic field as well as devices needed to generate, transmit, and measure these currents and fields and which are intended for use with a normal voltage no greater than 1000 volts in alternating current and 1500 volts in direct current (The European Parliament and The Council on Waste Electrical and Electronic Equipment, 2012).

EEE consumer: All natural persons or legal entities acquiring, utilising, or enjoying a good or offer of a given service involving EEE (MADS, 2017).

EEE retailer: Seller of EEE goods or services directly to consumers (*adapted from* ISO IWA:19, 2017).

Extended Producer Responsibility (EPR): EPR is an approach to policy that places significant responsibility on producers—financial and/or physical—to treat or eliminate their products post-consumption. Assigning this responsibility serves, in principle, to offer incentives to avoid waste generation at the source, promote the environmentally-conscious design of products, and support meeting public targets of recycling and materials management (Lindhqvist, 2000).

The Organisation for Economic Co-operation and Development (OECD) defines EPR as an approach to environmental policy in which the responsibility of a producer—financial and/or physical—extends beyond its consumption and entails its end-of-life management. There are 2 characteristics of EPR: *(i)* the shift in responsibility (financial and/or physical, total or partial) upstream to the producer and away from municipalities and *(ii)* the incentivisation for producers to incorporate environmental considerations into the design of their products.

The broader focus in legislation on producer responsibility is a fundamental factor in the push to stimulate remanufacture initiatives insofar as it focusses on 'the end-of-use treatment of consumer products and has the primary aim to increase the amount and degree of product recovery and to minimize the environmental impact of waste materials' (Johnson M. and McCarty I., 2014).

Formal recycling: See the entry for 'Official business activities.'

Informal recycling: See the entry for 'Unofficial business activities' and 'Subsistence activities.'

Integrated sustainable management of WEEE: The integrated handling or management of waste refers to an ensemble of activities related to products' life cycles in combination with strategies to prevent or reduce waste generation. Figure 0.4 shows the main processes of the integrated management of WEEE in CEDEs.

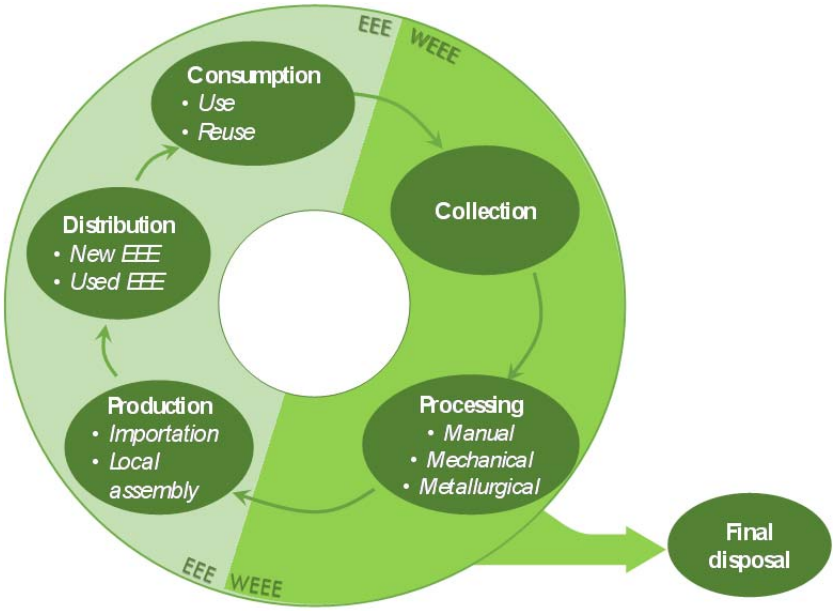


Figure 0.4. Main processes within the integrated management of WEEE in countries with emerging or developing economies (*adapted from* ISO IWA 19:2017).

However, in this document, integrated sustainable management refers to the integration of the 3 aspects of sustainable development (economic, environmental,

social) in WEEE management. Per the United Nations, the concept of Integrated Sustainable Solid Waste Management includes 3 other characteristics: inclusivity, financial sustainability, foundation of solid institutions and proactive policies (UN-HABITAT, 2010).

Official business activities: Economic activities carried out by economic operators registered as legal entities with an operating licence which obliges them to pay taxes; these operators are subject to regulation and governmental oversight (a*dapted from* ISO IWA 19:2017).

Policy: Set of decisions becoming actions, strategically selected within an ensemble of alternatives, in line with the interested parties' hierarchy of values and preferences (BID and David Rockefeller Center for LA Studies, 2006).

Producer: The manufacturer, importer, or local assembler of new or used EEE to be placed on the national market for sale or donation. Producers can be natural persons or legal entities and shall be lawfully registered in the country of production, that is, of manufacture or importation (*adapted from* Step, 2016).

Producer Responsibility Organisation (PRO): Organisation that brings together producers into partnership to facilitate the logistics of collecting and treating WEEE related to their products to comply with national regulations.

Subsistence activities: Business activities, registered or not, carried out by economic operators (primarily natural persons or families) earning wages which are barely enough to survive and which are below the minimum established subsistence level (ISO IWA:19, 2017).

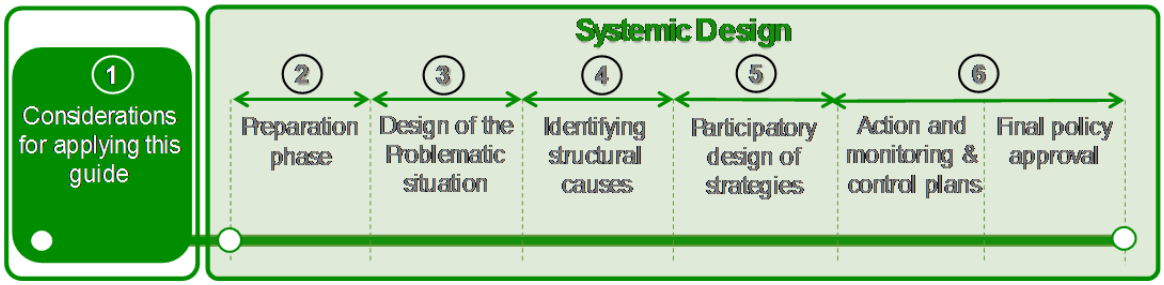
Systemic design of policies: For the present guide, the systemic design of policies refers to the participatory process in which relevant actors of the system assume the role of designers and include the following elements in their decisions (Méndez-Fajardo, 2016):

i) Understanding the various aspects of the real problem, including social, technical, environmental, economic, legislative, and other aspects.
ii) Involving different actors and taking their points of view and interests into account.
iii) Including different system processes from the perspective of the life cycle (such as the production, retail, and consumption of EEE and the collection, treatment, utilisation, and final disposal of WEEE) to design the solution.
iv) Devising solutions based on a causal and temporal logic, i.e. analysing causes and effects as well as learning from past experiences and visualising possible future effects of present decisions.

Unofficial business activities: Economic activities carried out by economic operators not registered as legal entities (i.e. without an operating licence) with income greater than the legal minimum wage as well as above the subsistence-level minimum; these operators deliberately evade compliance with local or national regulations (a*dapted from* ISO IWA 19:2017).

Waste Electrical and Electronic Equipment (WEEE): Directive 2012/19/EU of the European Union defines WEEE as all EEE that becomes waste (The European Parliament and The Council on Waste Electrical and Electronic Equipment, 2012). However, per Step, WEEE covers 'all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use' (Step and UNU-IAS, 2014).

WEEE economic operator: Natural person, business, association, cooperative or organisation involved in activities of collection, manual or mechanical processing, metallurgical processing, transportation, sale, storage, or final disposal of WEEE or its parts stemming from subsistence activities, unofficial business activities, or official business activities (*adapted from* ISO IWA 19:2017).



1. Considerations for the application of this guide

1.1. Context for applying the systemic-design methodology to policymaking

The present guidelines were created for use in CEDEs in which integrated WEEE management systems are insufficient, inefficient, non-existent, or in the process of creation.

Given that this guide serves to help systemically design a policy for more sustainable waste management, it is important to determine from the beginning if there is already a relevant national policy in the country of application and to analyse (in conjunction with the corresponding authority) the need to design a new one or update and strengthen the existing one. Note that the latter process may also be accomplished following the guidelines set out herein.

The tools proposed in this methodology require high-level involvement by several public and private actors, for which it is important to ascertain, from early on, the governance structure of the country of application. In so doing, the tools in this guide can be adapted to fit the decision-making hierarchy of each country.

1.2. The systemic-design team for policy

We suggest establishing a team to develop the systemic design; at a minimum, this team should include:

- An institutional leader, such as the national authority most directly involved in WEEE management (generally the environmental authority). This role is responsible for supervising the alignment of the policy to be designed with other standards, regulations, and related policies in the country of interest.
- A technical–logistical leader whose primary function is to provide conceptual and technical support. At the operational level, this leader helps resolve differences that may arise between different actors involved in the design process. Therefore, this leader can support the institutional leader in the processes of bringing together different parties, organising participatory activities, and holding meetings as well as centralising information and

engaging in general documentation of the design. It is important that the technical–logistical leader also take part in reviewing alignment with other regulations, including international provisions.

- A **methodological leader**, preferably from an academic institution, who has experience investigating and developing projects related to the management of waste, sustainability, and systems orientation. This leader's main role is to identify and adapt tools, such as those offered in this guide, and to facilitate participatory activities. This leader would also provide technical support to the rest of the design team, especially with respect to global scientific trends.

1.3. Actors to engage in the systemic design of policies

In light of the fact that each country may have a different institutional make-up, in what follows, we specify the primary considerations for each generic actor of the system.

National Government

It is essential for an entity representing the national government to lead the entire design process, with the technical and methodological support of a national or international adviser and, ideally, a member (or members) of academia. In some countries, this representation is generally headed by the national environmental authority, but there may be cases in which topics of WEEE management are directed by, say, the national authority for industry and commerce.

Regardless of which entity is in charge, the 2 aforementioned authorities should be engaged in the design process proposed in this guide. Moreover, if the country of interest has an authority in charge of formally passing/implementing policies, regulations, and strategies aimed at fostering the use of information and communication technologies, such as the Internet, cell phones, computers, or other such devices in schools, then this authority should also be brought into the process provided that this authority can help boost responsible consumption.

An authority related to the creation of national public-health initiatives should also form part of the entire design process given the potential impact of insufficient (or non-existent) integrated WEEE management on health. Likewise, if the country of interest has a national authority responsible for mining operations potentially linked to EEE production or the recovery of elements from WEEE, then this authority should also be called upon to participate in the design process, at least moderately so.

Lastly, in the search for solutions to the complex problematic situations of inadequate WEEE management, the human factor cannot be ignored. Education,

then, enables learning processes and helps raise awareness of responsible consumption practices as well as the potential danger of EEE and its parts. Each of these facets can stimulate active participation in the respective waste management programmes by society at large. It is in this sense that education takes on added importance; naturally, then, an educational authority in the country of application should be involved in the policy design.

Producers and retailers

In some countries, EEE producers, whether manufacturers, importers, or local assemblers, form organisations that offer them national-scale representation. In such cases, the respective representatives should be engaged as part of the policy design, for the policy would serve as the regulatory framework with which EEE producers would have to comply (under the EPR model). If there is no such association or other similar representative body, we recommend identifying and engaging original equipment manufacturers (OEM) with a presence in the country of application.

Nevertheless, the distributors and retailers of this equipment, new and used, should be involved in the design. EEE retailers play a relevant role in the value chain, for they are a bridge between producers and consumers as well as between producers and collection/treatment organisations.

WEEE collection and treatment organisations

It is worth mentioning that is not necessary for WEEE collection, pretreatment, or treatment systems to already be in place to use this guide. That said, if such systems are in place, their representatives should be contacted and included in the policy design. This includes producer responsibility organisations (PRO) as well as formal collection and treatment organisations (or those registered in accordance with each country's practices).

To achieve a systems approach and social sustainability, we also recommend including the informal recycling sector (those performing subsistence activities and/or unofficial business activities). In some countries, there may be organisations that represent this sector; however, in the absence of such organisations, and despite the complexity of engaging this population, it is imperative to identify how to include this sector. If the sector's participation is feasible, we suggest providing a baseline training in the fundamental concepts of systemic design to avoid conflict points arising from misunderstandings.

Technical advisers

A technical adviser refers to the institution and its representative(s) that will support the entire systemic-design process as technical–logistical leader, contributing pertinent technical knowledge and expertise in the application of methodologies to the environmental authority leading the design, i.e. the institutional leader. We suggest having a national technical adviser, who is also the technical–logistical adviser, and an international technical adviser who provides support.

Ideally, the national adviser would have recognised experience in topics of environmental sustainability and waste management systems (preferably WEEE), as in the case of Colombia's National Centre for Cleaner Production (CNPML). The important thing is for this adviser to have a comprehensive understanding of the national situation, solid knowledge of the international context, recognition of the role and context of each actor, and credibility among the actors.

With respect to the international technical adviser, knowledge transfer from industrialised countries, which have advanced for decades in the implementation of WEEE management systems and EPR, markedly enriches the systemic-design process.

Likewise, involving academia as a methodological leader also offers the advantage of support for the comprehensive systemisation of the process and its partial results. Additionally, this independent actor can facilitate dialogue, participation, and resolution of possible conflicts during the process.

Other actors

Given that one of the principal effects of improper WEEE management is the low rate of EEE collection through formal systems, it is important to involve unions, groups, or associations of consumers (should they exist).

Moreover, involving financial entities may create opportunities to explore financial-support options that complement or support the strategies that producers or other actors put forth for the creation and operation of programmes for the collection and integrated management of WEEE. Note that each country will have specific market and legal frameworks affecting private financial support of WEEE management systems.

Finally, civil society should be represented by non-profit or non-governmental organisations (NGOs) that convey and defend the interests of groups possibly affected by the implementation and operation of the WEEE management system, whether in terms of health or in terms of socio-economic exclusion.

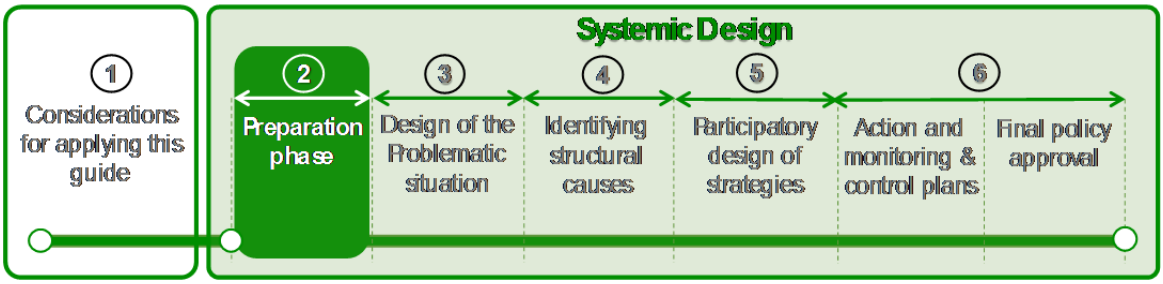
1.4. Other considerations

We suggest that, from the outset and throughout the entire process, the technical–logistical leader, hand in hand with the methodological leader, validates the instruments and methods as well as the partial results of each phase with the institutional leader, which is the authority. The institutional leader will ensure the alignment of the policy with already-established standards, regulations, or relevant guidelines. Part of this process, naturally, may be modified in accordance with the methodologies of policy design in effect in the country applying this guide.

Also paramount is the dissemination of the partial results with all actors involved, whether by sharing executive reports with each actor, by providing concrete presentations at in- person or virtual meetings conducted routinely by the institutions (or the national WEEE committee, should one exist), or by including them as in the inputs for each activity in each phase.

With a view to avoiding a multiplicity of interpretations that could divert the search for proposed objectives, we believe it is best to present key concepts—such as *systems approach, sustainability*, and *EPR*—as part of each participatory activity.

To review more details potentially related to the necessary conditions for developing systemic policy design, we recommend consulting Chapter 9, 'Final recommendations for applying this guide'.



2. Preparation phase

2.1. Information gathering

Accurate preparation for the systemic design of a policy entails procuring the following inputs:

Aspect	Description	Possible sources
Actors in the current system	Identify and categorise the main actors (see Table 2.2).	Direct consultation with the system actors, identification and analysis of assessments conducted by national or international experts, master's theses or university-led research, official national and international documents, reports by collection and recycling service providers, scientific papers, national statistics (readers are directed to Toolbox 2.1 for more detail on possible sources)
Characterisation (composition and quantity) of WEEE generated	Document the data regarding the composition of equipment and waste generated bearing in mind internationally-adopted categories as well as annually-reported quantities.	
Processes and milestones in the history of the current system	Identify the processes—based on the concept of integrated management—that are currently conducted in the country, have been conducted, or are slated to be conducted. Equipment or material flows are suggested if the necessary information is available. It is also important to identify the problematic situation(s) associated with each process.	
Relevant legislation in effect	Identify and analyse laws, ordinances, decrees, regulations, standards, and other relevant legislation.	Websites or libraries of relevant authorities
Methodologies of policy design	Identify, should they exist, the methodologies that each country may have adopted previously for the design of its public policies.	National authorities

Table 2.1. Basic information for the preparation phase.

2.2. Actors in the current system

The constellation of actors with potential for active involvement throughout the design process are shown in Table 2.2. We suggest classifying the level of

involvement for each actor as follows: high (*active participation throughout the design process*) or moderate (*participation in some of the critical phases*). Further, it is *indispensable* to call on actors tasked with directly safeguarding the implementation and monitoring of the policy designed in the medium and long terms.

Generic actor	Specific actors (representatives)	Involvement			
		Essential		Ideal	
		High	Med	High	Med
National government	Environmental authority	√			
	Authority for industry, trade, and commerce (importation and exportation of goods and services)		√		
	Public-health authority		√		
	Authority in charge of information and communications technology (ICT)	√			
	Authority in charge of mining operations			√	
	Educational authority			√	
Producers and retailers	Associations and strategic alliances of EEE producers or direct representatives of OEM	√			
	Associations and strategic alliances of retailers or direct representatives of the supply chain/distribution channels	√			
WEEE collection organisations and treatment operators	PRO	√			
	Actors carrying out unofficial business activities	√			
	Actors engaged in either subsistence or official business activities	√			
Technical advisers	Technical advisers (national and international)	√			
	Academia			√	
Other actors	Consumer groups				√
	Finance companies				√
	Civil society			√	

Table 2.2. Actors to engage in the systemic-design process.

The main product will be the list of actors to engage in the design process; they should be categorised based on the following distinctions:

- *Generic* or *specific*: Generic actors refer to institutions or organisations, whereas specific actors refer, above all, to people (e.g. national experts).
- *Primary* or *secondary*: Primary actors are essential (Table 2.2) for articulating a systemic vision of policy design, enhancing the implementation and monitoring of the policy designed, and reducing the likelihood of potential (future) conflicts. Auxiliary actors would ideally be involved throughout the process, but their absence (partial or total) does not have a major impact on policy design.

In this phase, the design team would consist of: the corresponding environmental authority in charge of setting up and monitoring the participatory process, the national technical adviser serving in the capacity of technical–logistical leader, and the methodological leader (see Section 1.2).

The next step is to plan the initial contact with other relevant actors. If the country already has a national committee or advisory committee for WEEE management, which may be required by national law, we suggest that the systemic-design team make first contact within the context of a meeting of relevant groups. Once there, the team can lay out the objectives of the process to be inaugurated, answer any questions posed by the attending actors, and introduce the methodological agenda to be followed. If no such committee exists, we suggest making contact with each actor individually according to the need for each actor's involvement (see Table 2.2).

The proposal of a schedule of activities or initial work plan is one of the main products of this phase; this work plan should include design phases, activities, products, dates, and resources. Note also that it can be adapted to fit the dynamics of the design process as it unfolds.

2.3. Characterisation and composition of WEEE and relevant legislation

To ensure sufficient inputs to design the problematic situation from a technical standpoint, it is important to determine the annual quantity of WEEE generated or figures reflecting the potential generation of WEEE in CEDEs (as evidenced by documents with statistics and assessments). These figures should be presented, for example, in tonnes/year or per capita (kg/person/day or kg/person/year).

As part of the composition, it is necessary to identify the primary streams of WEEE generated within the categories defined by the European Union (2012) and, in addition, to determine which collection and treatment strategies have already been implemented in the country of interest. If such programmes already exist (e.g. post-consumption programmes), it is important to document the collection figures that have been reported to the corresponding authority, for this reporting is how producers adduce regulatory compliance if there are such regulations.

It is also important to identify all existing regulations and standards related to WEEE management in terms of national/regional and governmental scales in the country of application for this guide as well as at an international level.

Toolbox 2.1

Sources of statistics regarding WEEE management

Below are links to examples of documents with statistics regarding WEEE management. This list focusses first on a global scale before moving to the context of CEDEs:

- Baldé, C.P., Wang, F., Kuehr, R., Huisman, J. (2015), The global e-waste monitor – 2014, United Nations University, IAS – SCYCLE, Bonn, Germany. Available at: https://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf
- GSMA TM, UNU-IAS, 2015. eWaste in Latin America. Statistical analysis and policy recommendations. Available at: https://www.gsma.com/latinamerica/wp-content/uploads/2015/11/gsma-unu-ewaste2015-eng.pdf
- UIT et. Al., 2016. Gestión sostenible de residuos de aparatos eléctricos y electrónicos en América Latina [The management of electrical and electronic equipment in Latin America]. Available at: https://www.itu.int/dms_pub/itu-t/oth/0b/11/T0B110000273301PDFS.pdf
- Unesco, RELAC, 2010. Los residuos electrónicos, un desafío para la sociedad del conocimiento en América Latina y el Caribe [Electronic waste, a challenge for the knowledge society in Latin America and the Caribbean]. Available at: http://unesdoc.unesco.org/images/0019/001900/190020s.pdf

Additional sources include the following

- Eurostat: http://ec.europa.eu/eurostat/web/waste/recycling-rate-of-e-waste
- The e-Waste Guide: http://ewasteguide.info
- StEp Initiative: www.step-initiative.org
- Plataforma RELAC: http://www.residuoselectronicos.net/

2.4. Processes and milestones in the history of the current system

The integrated management of WEEE includes the general processes of products' life cycle, that is, from the manufacture, distribution, use, and reuse of EEE to the generation, collection, manual/mechanical/metallurgical processing, and final disposal of WEEE (see Figure 0.3).

Based on an initial review of the possible sources, the following questions should be answered of the assessment:

- What processes and subprocesses have been implemented in the country? On what dates? If there are no prior relevant experiences, why is that the case?
- Who has participated and in what milestones?
- What has the design and implementation process been like? Have there been oversights/errors? If so, what are they? What led to these oversights/errors? On the flip side, which aspects have proved successful?
- What are the main effects that enable an assessment of the current system's functioning, whether as efficient, effective, or sufficient or as inefficient, ineffective, or insufficient?

The main products of this preparation activity are twofold. First, it allows for the creation of a map of integrated management processes, which should include the processes developed in the country and those related to activities in other countries according to the current knowledge of the system (Figure 2.1 displays 2 examples).

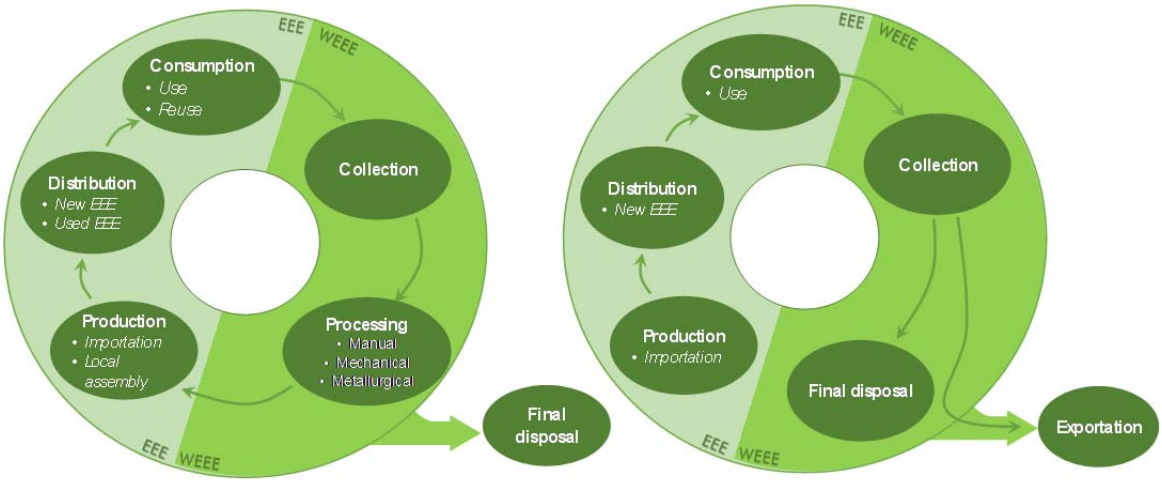


Figure 2.1. Examples of a preliminary map of the WEEE management processes in the country using this guide.

Second, it allows for the creation of a preliminary timeline (see Figure 2.2) that includes milestones in the history of WEEE management in the country; as this timeline is preliminary, it is subject to modification during the subsequent design phases.

Figure 2.2. Timeline and milestones identified in the history of WEEE management.

It is important to link the participation of actors to each milestone preliminarily identified by the design team, including, where possible, the role played by each actor in the history of the WEEE management system or relevant processes. To give one example associated with the implementation of a selective-collection programme or one related to the launch of a relevant regulation, we suggest specifying, on a preliminary basis and using secondary documentation, each actor's participation (e.g. did this actor coordinate, catalyse, promote, manage, advise, finance, implement, or approve a given event?).

2.5. Methodologies adopted for the design of national policies

In recognition of the fact that the preparation phase of systemic design includes methodological planning, the leadership team, headed by the methodological leader, determines the methodologies already adopted for policy design in the country's institutions. If such methodologies already exist, the challenge of this activity lies in proposing a complement that allows for implementing the systems approach proposed in this guide (see the case study in Chapter 8).

Lastly, an additional result of the preparation phase will be the compendium of concepts and terms adapted for the integrated management of WEEE in the country of interest; the information in this compendium should encompass tangible (instruments, interviews, workshops, meetings) and intangible material (discourse development and changes) throughout all phases of systemic design.

2.6. Preliminary idealised design

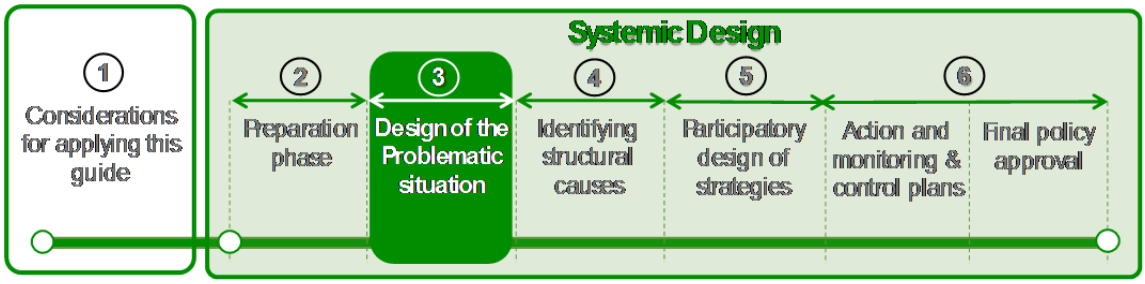
Part of systemic design, in addition to understanding the elements of the problematic situation that indicate the current *real problem*, includes projecting the desired future situation or idealised design (Ackoff, 2002).

Thus, armed with all the information compiled and analysed in this phase, the design team can build a *preliminary idealised design* of WEEE management, through which the team can seek to reduce or eliminate, in the future, the negative impact identified as resulting from improper practices and promote practices that will have a positive impact. To this end, elements of good practices deployed in industrialised countries, in countries similar to the one using the guide, and in theoretical models developed within academia should be utilised. We suggest evaluating their feasibility in the specific context of their intended application.

Several questions can help guide the preliminary idealised design:

- How *would* the ideal management of WEEE look from the point of view of processes?
- Which actors *would* be involved?
- Which aspects *would* be taken into account?
- Which strategy (or strategies) for achieving economic and financial sustainability
- *would* be considered?

This activity of systemic design, in conjunction with the elements of the following phases, serves as a base for delineating the designed policy's scope.



3. Design of the problematic situation

3.1. Phase objectives

The *design of the problematic situation* is an essential part of *design from a systems approach*, for, together with the *idealised design* or the most desirable situation, these aspects reveal the gap to be narrowed through the policy (Figure 3.1).

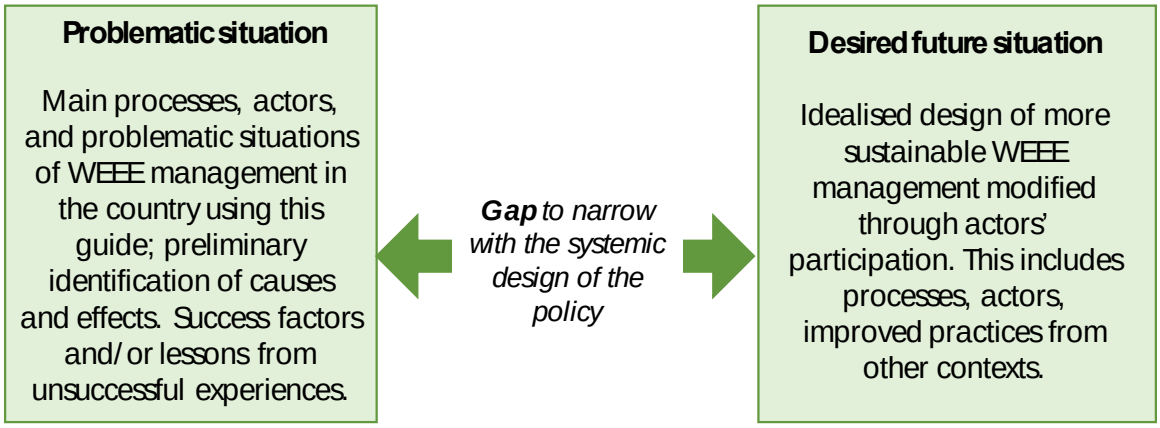


Figure 3.1. Elements for the design of the problematic situation.

The primary objective of this phase, then, is to identify which factors or situations may be barriers to achieving the ideal situation. Moreover, users can adjust the preliminary map of processes (see Figure 2.1), the preliminary timeline of WEEE management (see Figure 2.2), and the preliminary idealised design structured by the design team in the preparation phase (Chapter 2). The participation of all relevant actors is needed to obtain a general picture of the policy to be designed and to subsequently design it. These results shall align with the guidelines in place in the relevant context (in the form of existing laws and standards).

As part of the planning in the preparation phase, interviews should be conducted; these interviews should be structured as shown in Table 3.1. These interviews should be conducted with, at the very least, the primary or essential actors and experts—both national and international— who have been involved with some part of the history of WEEE management in the context of the country using this guide (in accordance with the preliminary timeline; see Figure 2.2). The first part of the interview should allow the design team to confirm each interviewee's relevance and

identify his or her motivation for participating in (and perhaps even becoming a more active part of) the whole design process.

Part 1	General interviewee information, including experience related to WEEE management.
Part 2	Identification of milestones in the history of WEEE management in the country applying this guide.
Part 3	Questions related to: The current state of WEEE management in the country. The identification of actors and the interviewee's interactions with each of them. Include each actor's weight (%) in terms of decision-making importance regarding WEEE management on a national scale. Ask how the WEEE management should look in the short, medium, and long terms.

Table 3.1. Structure of an interview with relevant actors.

The main result of the second part of the interview will be the modification of the preliminary timeline obtained in the previous design phase. We suggest including explicit questions regarding factors that explain the success of the previous phase, answering the question: What common interests or motivations unite the different actors?

Lastly, in the third part of the interview, the current situation is examined. In this case, the expected products are:

- A review of the current system and its main elements.
- A map of primary and secondary systems actors and possible relationships between them that accounts for cooperation, monitoring, and approval, among other aspects.
- The aggregate percentages of the weight of the opinion of relevant generic and specific actors that will ideally participate in the entire design process. These percentages will be kept in mind when designing the matrix of direct influences between causes (see Chapter 4).
- The systemisation of the expected development of the current management system in the short, medium, and long terms. For this purpose, interviewees may draw on their knowledge of the systems of other countries or pertinent literature to enhance the idealised design of the management system with the vision of each relevant actor.

3.2. Workshop on identifying causes and effects

The methodology most commonly applied to the design of public policies in Latin America is based on the construction of a cause-and-effect tree, as proposed by the Economic Commission for Latin America and the Caribbean (CEPAL) in its 'methodology for the analysis of management of social problems' (CEPAL et al.,

2005). To use this tree, part of the problematic situation, formulated as a focal problem to guide discussion, is articulated; then, the causes of this focal problem are used to represent the tree's roots (see Figure 3.2. – left). Its effects form part of the branches. One proceeds until establishing the objectives to be fulfilled as part of the solution to the focal problem, which would represent the tree's fruit.

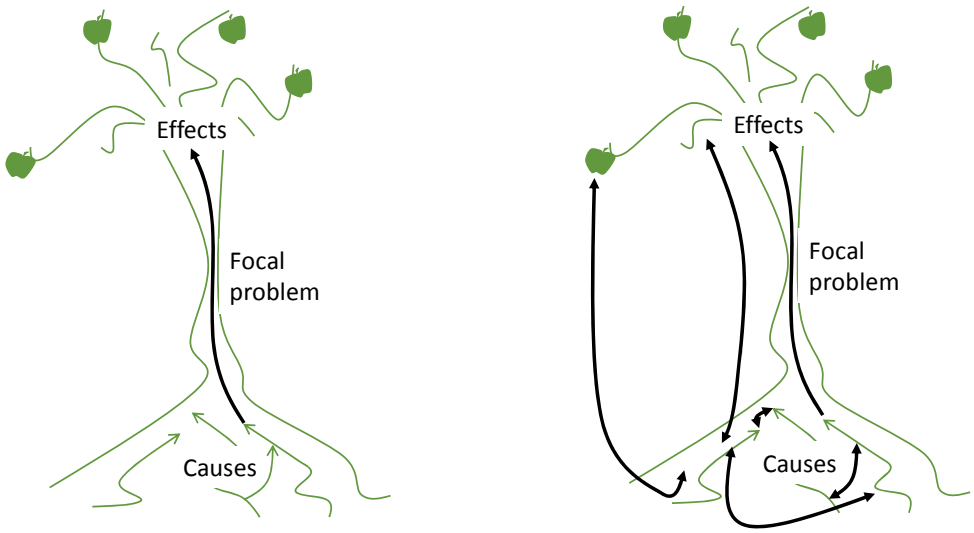


Figure 3.2. Cause-and-effect tree; left: linear causality; right: circular causality of a complex system.

Toolbox 3.1.

On subjectivity in complexity

As already recognised in other guidelines on policy design, there is a natural level of subjectivity when trying to define the limit between a cause and an effect. What for some is the cause of a problem may, for others, be its effect. This underscores the complexity of the system addressed, in this case WEEE management, for which one's mindset cannot be limited to linear causality. There must be room to accept that there are effects that can become causes of other problems, causes that can become relevant effects, and even objectives (solutions) that can become the cause reinforcing the real problem (partially represented by the focal problem in Figure 3.2. – right).

To strengthen the systems approach of this methodology, we suggest holding a workshop to identify the focal problem and its concomitant problems. For this workshop, the brainstorm method is recommended. To ensure that all participants are on the same page and to reduce possible sources of confusion, only the term '*cause*' should be used in the workshop. This also helps avoid entry into the thorny (subjective) discussion of whether a problem is a cause or an effect. This workshop also allows for all possibilities to be used in building a more comprehensive tree, one which will facilitate a later systemisation activity performed by the design team. Similarly, in recognition of potential subjective interpretations, we suggest

tentatively establishing a *focal problem* before the workshop. This *focal problem* will highlight an aspect or aspects of the *problematic situation* and help orient discussion. This *focal problem* should be modified in collaboration with participants.

One of the main objectives of this activity is to reinforce actors' participation and the concomitant process of ownership (i.e. actors feeling that they have a stake and voice in this process) among all actors. Another main objective is to achieve alignment of perceptions with respect to the *problematic situation* expressed as the focal problem in this activity, establishing consensus on (or validating) its formulation. To this end, the workshop should be carried out in a space that affords an unbiased and respectful ambience propitious for discussions (e.g. a room in an educational institution). However, depending on the context of the country using this guide, the location may be provided by the institution representing EEE producers to foster the logic of EPR.

This space should have a board with enough room to display the statement of the guiding *focal problem*, the names of the main aspects to include in the analysis, and the links between them and the identified causes (Figure 3.3). Each actor should also have the opportunity to identify the main relationships between problems and their different aspects. For example, see Figure 3.3, specifically the second problem of the social aspect, which is also associated with the technical and environmental aspects illustrated in the figure.

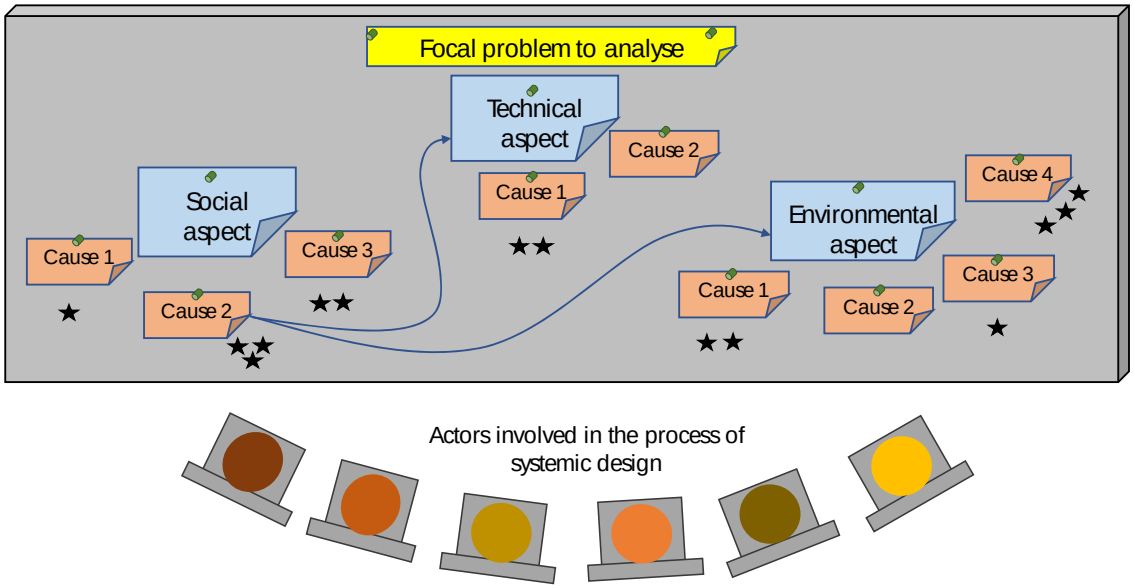


Figure 3.3. Image of a board showing the results of the collaborative (participatory) identification of problems related to the focal problem.

From there, attendees can rate the relevance of each identified cause, assigning a maximum number of points for each participant; in Figure 3.3, the ratings are represented by stars, revealing that the attendees considered the second problem of the social aspect and the fourth problem of the environmental aspect the 2 most

relevant problems. This activity will allow the design team to establish an initial understanding of the actors' perceptions of the importance of causes and effects. Using the information presented in Figure 3.3 as an example, we can deduce the importance of the second problem of the social aspect, not only because of the number of points assigned to it but also because of its relationship with the other aspects. It is important to mention that offering the chance to prioritise causes during the workshop promotes the logic of structural causes in each participant; these structural causes are significant and will ultimately be defined in the next phase of systemic design.

The workshop facilitator should be the methodological leader of the systemic-design team. This eases the process of creating trust with the actors involved, strengthens participation, and increases actors' sense of ownership. At a minimum, the workshop schedule should include:

- Introduction: presentation of the objectives of the workshop and main concepts (e.g. *what is a systems approach*). In this section, the time needed for the scheduled activities is also reported; for these times, there should be some degree of flexibility given the complexity of the exercise.
- Presentation and discussion of the focal problem to analyse: at this juncture, the methodological leader, playing an impartial role, will present the preliminary version of the focal problem related to the current WEEE management in the country, opening a space for discussion and modification proposals.
- Defining the minimum aspects to include in the analysis: environmental, technical, sociocultural, and economic aspects represent the minimum.
- Brainstorm in subgroups: depending on the number of attendees, subgroups consisting of 2 or 3 people should be formed, though care should be taken to avoid subgroups with representatives from the same institution or in the same role, thereby boosting the diversity of approaches. Each cause will be written on a card to be subsequently attached to the blackboard (Figure 3.3).
- Brainstorm as a group: each subgroup shares the results of its analysis with the other groups and offers a succinct explanation of all causes it identified. Doing this allows all attendees to obtain a clear picture of other parties' points of view, leading to a more robust result at the end of the session.
- Rating the relevance of the causes identified: to preliminarily prioritise causes, each participant should express which cause is, in his or her opinion, most important.

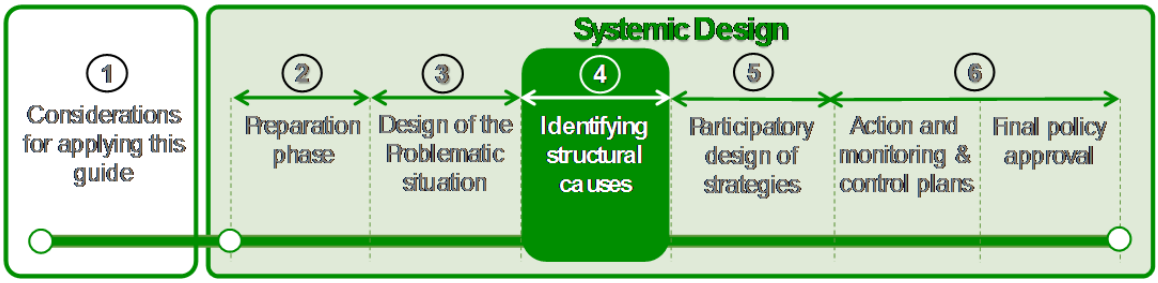
Arriving at consensus in this way may serve as the foundation for the next phase—identification of structural causes.

For the final elaboration of the product of this part of the design, we suggest validating with the institutional leader. This is to determine if any of the following should be added to the list of causes created in workshop: the *problematic situations* identified in previous studies, assessments.

Toolbox 3.2.

An alternative method: The ladder of abstraction

An alternative to the brainstorm approach and the rating of the relevance of causes presented in this chapter is the 'ladder of abstraction' method. This alternative can be used to generate pertinent definitions of a problem or challenge participants by means of engendering creative divergent thinking. For more details, readers are directed to: *http://www.creativeeducationfoundation.org/wp- content/uploads/2015/06/ToolsTechniques-Guide-FINAL-web-watermark.pdf*



4. Identifying structural causes

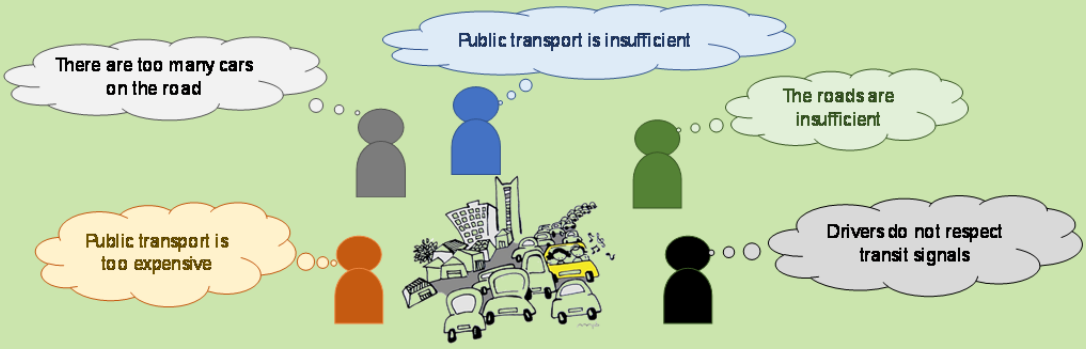
4.1. The logic of structural causality

The objective of this chapter is to identify the causes of the *real problem* based on the prioritisation of the causes of the observed *problematic situation* (see the iceberg analogy in Section 0.2) defined in the previous design phase. Prioritising causes is important because it reveals which are structural and which are not; in terms of planning interventions such as public policies, a crucial part of determining where primary efforts should be focussed consists of identifying *structural causes*. *Structural causes* are the source of many problems (also identified initially as the source of the *focal problem* used to guide discussion in the workshop outlined in Chapter 3). Consequently, prioritising will lead to solutions that resolve other problems, perhaps even ones not directly addressed.

Toolbox 4.1.

An example of the logic of structural causality

To address the complex *focal problem* (which is used to guide discussion of a problematic situation) of 'transport in this city is chaotic', the mayor invited experts and representatives from public and private institutions to proffer ideas regarding possible causes. The following causes were proposed:



¿ How should the mayor tackle the *focal problem* if he or she only has the resources to address only 2 of the 5 causes identified by advisers? Solving which of these 2 would lead to the indirect solution of other problems? For example, improving the public-transport system through ticket-price optimisation may incentivise its use and bring about an *indirect* drop in the number of cars on the road.

4.2. Matrix of Direct Influences as a Prioritisation Method

The matrix of direct influences (MDI) method developed by Godet (1993) within the methodology of scenario planning is one of the most utilised approaches for supporting the search for structural causes behind a *problematic situation*. To this end, an MDI is constructed with the causes determined in phase 3 (Chapter 3) to determine the existence, or lack thereof, of a relationship of direct influence between each pair of causes. Using the example of chaotic transport in the city as the *focal problem* (see Toolbox 4.1), our MDI would have the structure shown in Figure 4.1.

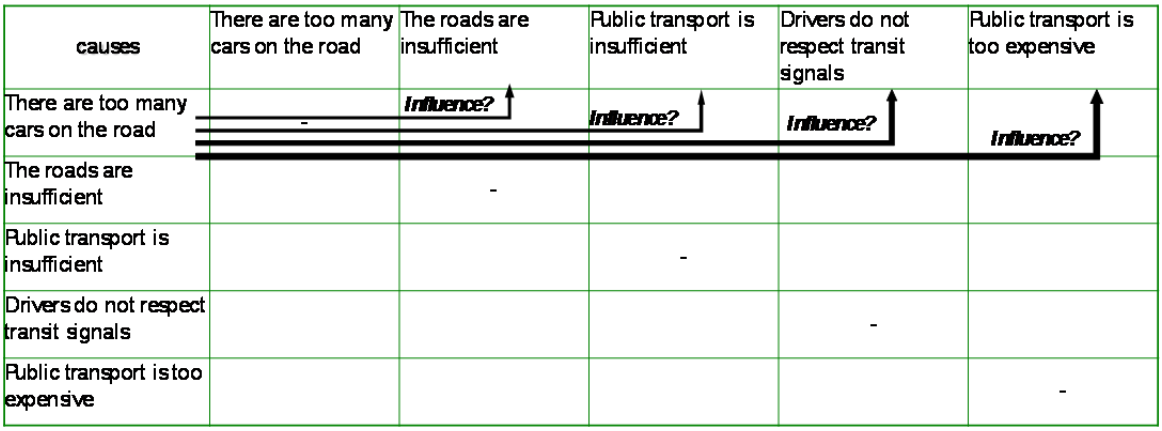
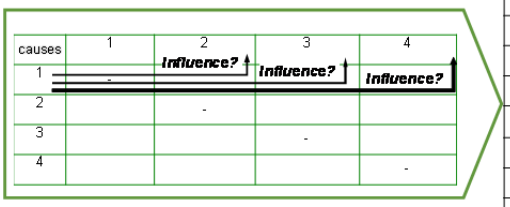


Figure 4.1. Matrix of direct influences between different causes of a problem.

In addition to identifying if there is relationship of direct influence between 2 causes, it is also important to attach a weight to the level of influence of such relationships. For this purpose, the design team can define different scales according to the degree of participation expected, the number of causes to prioritise, and the allotted time frame for an activity. For example, if the number of causes exceeds 20 and a 5-point weighting scale is proposed—0 (*no relationship of influence*), 1 (*weak*), 2 (*moderate*), 3 (*high*), and 4 (*very high*)—then each actor responding to questions for the MDI will spend more time reflecting on the answers and deciding which value to assign each relationship of influence. However, if there are 10 or less causes to prioritise and a 3-point valuation scheme (i.e. 0 – *non-existent*, 1 – *weak*, and 2 – *strong*) is employed, the time spent by each participant will be shorter.

Consistent with the objective of systemic policy design, it is fundamental to fill in this matrix with the point of view of each actor involved in the process. That said, it is likely that, upon working directly with the matrix, each person may have a different interpretation of the guiding questions when filling in the MDI's cells. One such example would be the following dual interpretation: Does Cause 1 *exert a direct influence* on Cause 3 or is Cause 1 *influenced by* Cause 3? To reduce the risk of this divergence, we suggest formulating specific questions in the form of a checklist instead of a matrix (Figure 4.2). Doing so allows each actor (i.e. organisation

represented) to share its perception with the process leaders; these leaders, in turn, translate the checklist responses back into a single or aggregate matrix.



CHECKLIST QUESTION	Strong	Weak	Null
To what extent does cause 1 influence cause 2?			
To what extent does cause 1 influence cause 3?			
...			
To what extent does cause 1 influence cause *n*?			
To what extent does cause *n* influence cause 1?			
...			
To what extent does cause *n* influence *n-1*?			

Figure 4.2. Translation of the matrix of direct influence into a checklist.

As in any process that aspires to transform various individuals' opinions into a consensus, and especially in cases of decision-making pertaining to public policy, hierarchies and power relationships should be taken into account. That is, in practical terms, the formulation of consensus should not ignore the differently weighted importance of each individual (vis-à- vis institution or role). To achieve this weighting, there are 3 recommended paths:

- The systemic-design team assigns weights;
- The topic is broached in structured interviews in the design phase of the *problematic situation* (Chapter 3 of this guide); or
- Equal weighting is granted to all actors' opinions.

With regard to weights, let us turn to the second path, the example of structured interviews. Say that for interviewees, the opinion of the environmental authority is given a weight of 60% for decisions related to WEEE management, while that of the producers is given a weight of 40%. Consequently, each cell in the aggregate MDI should be weighted appropriately to correspond to these percentages until the matrix is filled.

In the previous example of the *focal problem* formulated as 'transport in this city is chaotic' (Toolbox 4.1), once obtaining the aggregate MDI, the sum of the rows and the sum of the columns are calculated (Figure 4.3). The rows will yield the level of influence between causes, while the column total will indicate the level of influence of each cause with respect to others or each cause's potential to be influenced by other causes (or its dependency).

	Causes	There are too many cars on the road each day	The roads are insufficient	Public transport is insufficient	Drivers do not respect transit signals	Public transport is too expensive	Influence Σ	Influence %
	There are too many cars on the road each	-	0	0	1	0	**1**	**9**
	The roads are insufficient	2	-	1	1	0	**4**	**36**
	Public transport is insufficient	2	0	-	0	1	**3**	*27*
	Drivers do not respect transit signals	0	0	0	-	0	**0**	*0*
	Public transport is too expensive	2	0	1	0	-	**3**	*27*
Dependency	∑	**6**	**0**	**2**	**2**	**1**		
	%	*55*	*0*	*18*	*18*	*9*		

Figure 4.3. Matrix of direct influences of multiple causes of the focal problem.

In the example in Figure 4.4, the most dependent (i.e. influenceable) cause is revealed to be 'too many cars on the road each day', while the most influential cause is revealed to be 'roads are insufficient'. This can be appreciated more easily by looking at the plot of direct influences, which is shown in Figure 4.4.

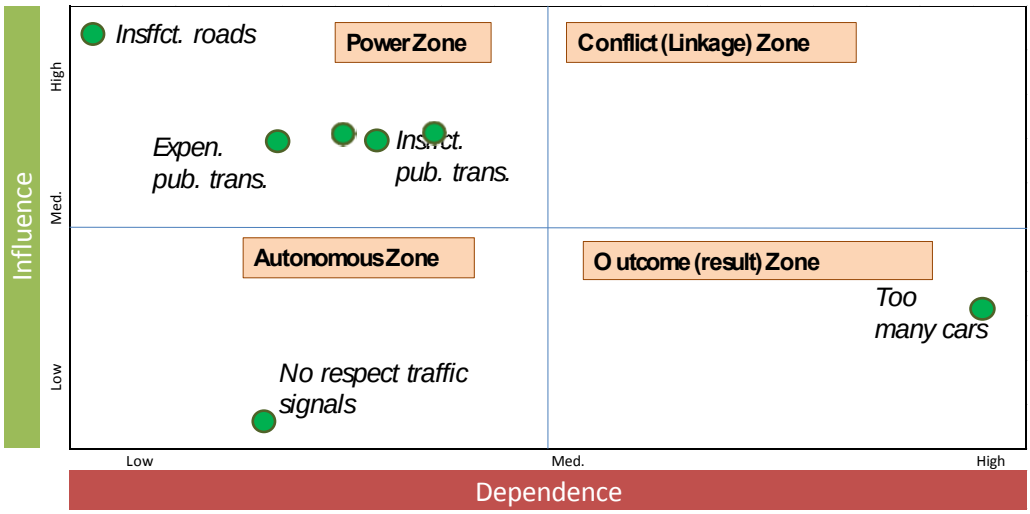


Figure 4.4. Plot of the causes analysed in the matrix of direct influences.

Toolbox 4.2.

A technological tool

To facilitate the analysis of results, one suggested tool is the open-source software Micmac, which stands for Impact Matrix Cross-Reference Multiplication Applied to a Classification (Micmac is an abbreviation of the software's original name in French; Godet, 1993).

A detailed description of, as well as link to download, Micmac can be found at: http://en.laprospective.fr/methods-of-prospective/softwares/59-micmac.html

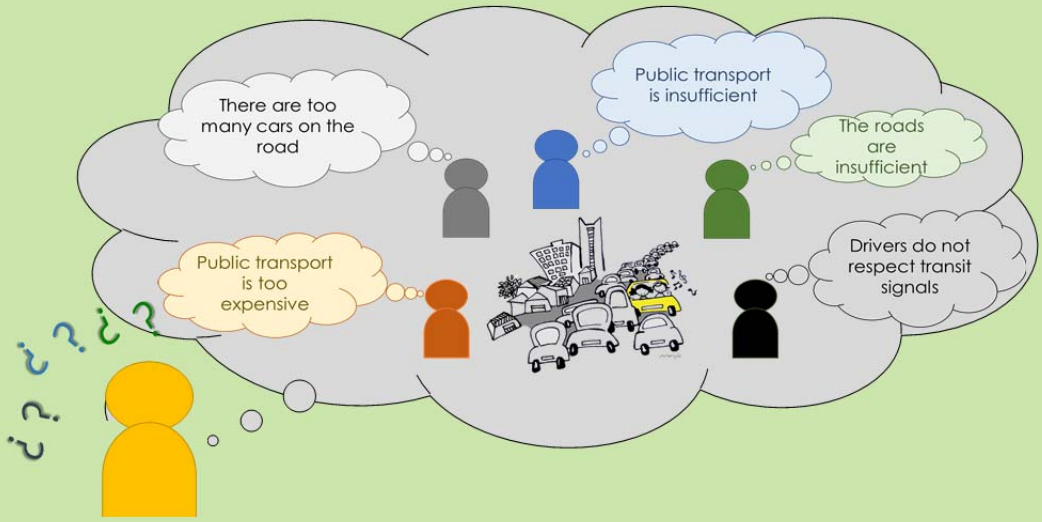
With this software, the plots of direct influences as well as the visualisation of the relations of influence and dependence between causes can be generated (see Chapter 8).

Figure 4.4 displays the 4 zones in which the different causes may be located as a function of their relationships of influence and dependence.

- **Power zone**: structural causes are found in this zone. These causes are those that most heavily influence other causes. Thus, they have the least dependence on the others.
- **Conflict (linkage) zone**: this zone includes causes that are both dependent *and* influence others.
- **Autonomous zone**: causes that are slightly dependent and slightly influential fall into this zone. Hence, these causes should be addressed directly, despite the fact that resolving them will not significantly impact other causes.
- **Outcome (result) zone**: the most dependent causes and those with the least influence on others, but which are, in turn, influenced by several causes (or are at least highly influenceable) are found in this zone. These causes can be solved by tackling other causes (i.e. they can be solved as a 'side effect' of addressing other causes). As a result, causes in this zone do not need to be explicitly included in the strategic objectives of the policy design.

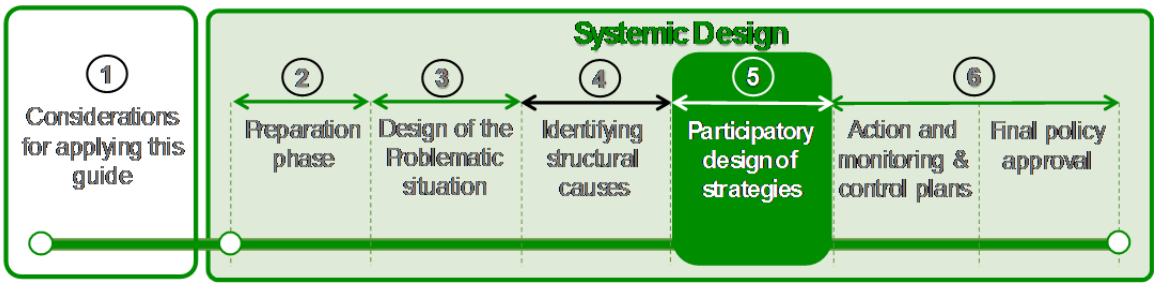
Toolbox 4.3.

Advice for the mayor



After the exercise on identifying structural causes (including the MDI), we are prepared to answer the questions posed in **Toolbox 4.1.** The mayor should design solutions focussed on improving the city's road network and public-transport system. Doing so would indirectly solve the excessive number of cars, for this number depends directly on the public-transport system. Yet, the mayor could also consider investing additional resources in education to enhance drivers' respect for transit signals, despite the analysis has demonstrated that this cause is automonus (see Figure 4.4).

For the final activity of the identification of structural causes, we suggest that the systemic- design team draft an initial version of the possible objectives to be included in the policy. This will facilitate the design of specific strategies to help ensure policy fulfilment (Chapter 5). To this end, it is important to ensure that these objectives are aligned with all relevant laws or policies in effect (should any exist).



5. Participatory design of strategies

With the strategic objectives defined in the previous phase, a workshop on participatory design of strategies can be carried out. In this chapter, the various methods for this workshop and how to adapt it to the country using this guide are discussed. Part of the methodology offered in this guide on systemic design includes presentation of a modified version of the *round-robin* method (Figure 5.1). This method's name reflects how an idea evolves as it is passed from one person to another (LUMA Institute, 2012). This method allows for the creation of a preliminary drafting of strategies that may serve as the basis for the final strategies in the policy design.

Caja de Herramientas 5.1.

Other methods for designing participatory strategies

(*adapted from* Miklos T & Tello M.E., 2007)

- ✓ Affinity diagram (or TKJ method); created by Shunpei Kobayashi in 2009. It consists of 3 phases: definition of the problems based on facts, development of solution proposals, and definition of committments to action.
- ✓ Search conference; created by Emery and Trist in 1997. It is ideal for organisations between 30 and 60 people strong, all with the same hierarchical level. Several meetings are held, and an initial meeting serves to reflect on the past and present contexts and to develop an idealised design of the future. A second meeting serves to engage in participatory planning.
- ✓ Force-field analysis; created by Robert Abramson and Walter Halsey in 1983. It is ideal for organisations that can or want to measure/improve their performance.

The first step of this phase entails conducting a workshop with the actors hitherto involved. As part of this workshop, the facilitator (or methodological leader) presents the objectives of the activity and the inputs needed to carry it out before inviting participants to form subgroups. Note that no subgroup should have more than 1 representative from the same institution or actor in the same role within integrated management in order to spur a more interdisciplinary discussion. The number of subgroups depends on the number of preliminary strategic objectives resulting from the previous design phase, 'identifying structural causes'.

In the example in Chapter 4 (Toolboxes 4.1 and 4.3), the main inputs would be 3 strategic objectives: *(i)* improve the road network, *(ii)* strengthen public transportation, and *(iii)* increase education regarding the importance of respecting transit signals. In this case, there would be 3 subgroups, as shown in Figure 5.1.

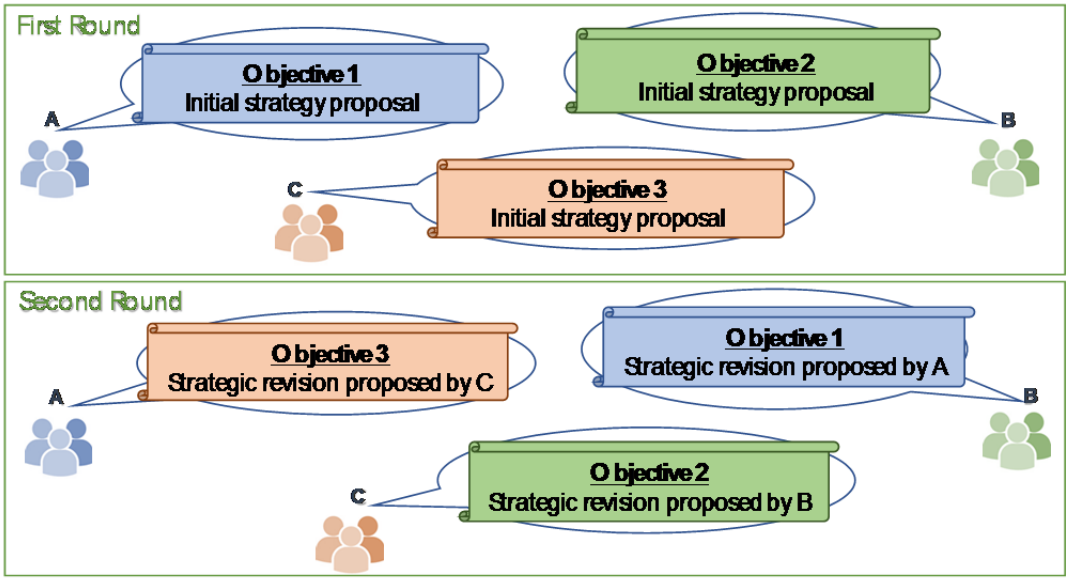


Figure 5.1. Description of the *round-robin* approach with 2 rounds.

As can be seen in Figure 5.1, each subgroup receives, in a first round of discussion, a form with a strategic objective written on it and with the information shown in Figure 5.2. In our example, there would be 2 rounds for each group to develop a strategy for each objective (Figure 5.2 shows only 2 of the 3 objectives in the example).

Strategic Objective 1	Strategic Objective 2
ROUND 1	ROUND 1
List the possible ways to achieve objective 1 (Round 1, Group A)	List the possible ways to achieve objective 2 (Round 1, Group B)
Draft the strategy to meet objective 1, accounting for the ways to achieve it (Round 1, Group A)	Draft the strategy to meet objective 2, accounting for the ways to achieve it (Round 1, Group B)
Identify responsibilities of the public, private, and civil sectors (Round 1, Group A)	Identify responsibilities of the public, private, and civil sectors (Round 1, Group B)
ROUND 2	ROUND 2
Identify elements that would make the strategy for Strategic Objective 1 infeasible(Round 2, Group B)	Identify elements that would make the strategy for Strategic Objective 2 infeasible (Round 2, Group C)
Improved draft of the strategy for achieving Strategic Objective 1 (Round 2, Group B)	Improved draft of the strategy for achieving Strategic Objective 2 (Round 2, Group C)

Figure 5.2. Detailed view of the structure of the instrument for the participatory drafting of strategies. This figure displays 2 of the 3 specific objectives in the example shown in Figure 5.1.

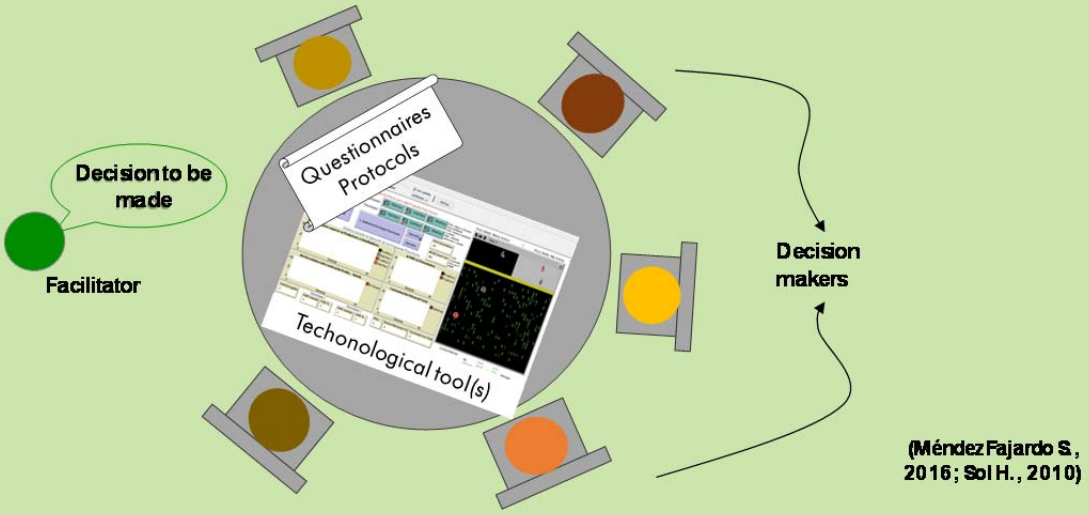
We suggest that elements considered viable for the second round (Figure 5.2) take into account, in line with country-specific contexts and needs, different aspects:

environmental, economic, logistical/operational, institutional, legal, technical, and sociocultural aspects, among others. It is important to include aspects capable of sparking conflicts of interest among actors to clearly reveal potential barriers to the implementation of the proposed strategy.

Toolbox 5.2.

Decision-Enhancement *Studios* (DES)

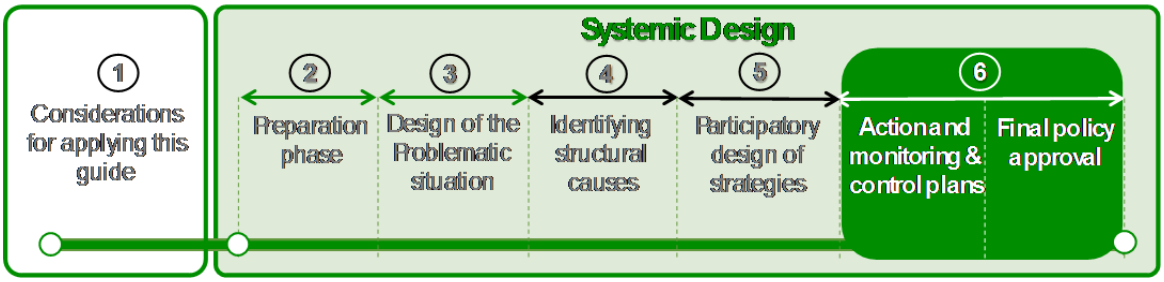
To reinforce the ownership needed for system sustainability, we suggest implementing DES as a systemic-design process with the use of technological tools. This approach will allow for the inclusion of actors not actively represented in the policy-design process



Upon finishing the activity, depending on the number of objectives to analyse and possible rounds in the time allotted for the workshop, the design team will be equipped with the first draft of the strategic lines analysed in the participatory workshops. It is important to point out that we do not recommend attempting to analyse all strategic objectives or addressing all possible strategies in this workshop; any attempt to do so in a participatory session would convert the exercise into a fruitless one given the time and resource constraints. Additionally, as myriad studies have demonstrated, absolute consensus and the total satisfaction of interests of all parties involved in a participatory process is impossible. Thus, for this workshop (4hours, minimum), it is enough to present the main objectives of the systems methodology and foment the systems-approach logic in the actors involved as well as a sense of ownership with respect to the WEEE management system and the resulting policy.

Lastly, the definitive formulation of the strategies as inputs for the action plan (Chapter 6) will be carried out by the design team. The team will consider all results of the participatory phases, the idealised design, relevant legal regulations, and the pertinent actors' first-hand knowledge of the system. The institutional leader,

fulfilling its role of enacting and monitoring national legal regulations and ensuring alignment with international ones, heads this part of the design with the assistance of the technical–logistical leader and, possibly, the methodological leader, who can contribute knowledge of national and regional WEEE management systems.



6. Designing the action and monitoring-and-control plans; final policy approval

6.1. Elements of an action plan

The action plan will serve as the road map for implementing the policy and meeting all proposed objectives insofar as this plan's elements enable the development of the strategies designed. Each strategic objective should answer the following questions:

- What strategies and actions will be used to achieve this strategic objective?
- Who will carry this strategic objective out?
- When should it be carried out and for how long?
- How will the results be measured or confirmed?

The last question entails the creation of indicators that allow for the measurement of progress towards a proposed goal. Such indicators may identify possible problems or deviations from the ends sought.

Indicators are classified in terms of what they measure. For example, to measure the sustainability of urban projects (Guerrero and Erbiti, 2004), for which the idea is to link social, environmental, and economic aspects, *cause-effect* indicators are used. These indicators reflect the relationships between the 3 aspects. Similarly, the use of *prospective* indicators allows for future-oriented classification based on projections, facilitating the identification of future policy plans. To give an example, in the case of an action plan that includes the construction of a landfill for the disposal of urban solid waste, one type of indicator could be depreciated land value near the landfill caused by its construction and measured during its operation. Conversely, another type of indicator type could be the landfill's potential for contaminating aquifers or soils. Other types of indicators can be used to measure impact or results. We suggest that indicators be measurable and clearly described. Despite the fact that their name should be concise and specific (e.g. 'job creation'), it is important, in most cases, to include a short explanation or description to avoid ambiguity (e.g. 'job creation for informal WEEE recyclers'). In the same vein, if the information used to measure the

indicator is not yet available, strategies for how to obtain it should also be proposed.

Toolbox 6.1.

Some indicators of sustainability

Based on 2 Global Sustainable Development Goals
(https://unstats.un.org/sdgs/indicators/indicators-list/)

Goal 11.6. **By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.**

Indicators

11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated by cities.

11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted).

Goal 12.4 **By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.**

Indicators

12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement.

12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment.

Goal 12.5 **By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.**

Indicator: **National recycling rate, tons of material recycled.**

Another important element of an action plan is the time frame for meeting its proposed objectives. A complex system such as WEEE management involves human factors (e.g. decision-making) and other types of factors (e.g. technical, economic, political, organisational, legal, etc.); hence, it is all but given that obstacles or unforeseen phenomena will arise. Thus, we suggest mid-range time frames for evaluation. If, for example, 30 years are allotted for implementation, establishing 5-year evaluation periods is recommended to allow for adaptation to changing system contexts and circumstances. Such mid-range periods facilitate the reformulation, modification, or redesign of the strategies and actions needed to achieve sustainability as well as to enable the definition of objectives in the short, medium, and long terms.

An initial version of the action plan should include the results of the participatory activities (Chapters 3, 4, and 5), the information analysed in the preparation phase of the systemic design (Chapter 2), and relevant legal regulations. Thus, the next step is to define the strategies, lines of action, goals, indicators, primary actors, and secondary actors for each strategic objective formulated.

6.2. Monitoring-and-control plan

As part of the final policy document, a monitoring-and-control plan for the goals and indicators proposed within the action plan should be designed and included to support implementation and ensure fulfilment of the objectives proposed. We also suggest explicitly defining the periods in which the monitoring activities should be made explicit in the short, medium, and long terms in line with country-specific dynamics.

Looking at the example in Toolbox 6.1, to verify Goal 12.5—'substantially reduce waste generation by 2030'—the related policy should measure tonnes of material recycled on a national scale, an indicator proposed as part of the Global Sustainable Development Goals (see Toolbox 5.1). This measurement could be planned for 2 years after strategy implementation (short term), 5 years after (medium term), and 15 years after (long term). Further, it could be subdivided into municipal measurements that, when added together, provide the national value. Also, these measurements could be categorised according to the types of WEEE defined in the corresponding European Union Directive. The more detailed the indicators, the more they are adapted to the dynamics of country using this guide, the more reliable the monitoring-and-control process will be and the more opportune the identification of adjustments in the strategies will be. However, the design team should strike a balance between, on one hand, all-encompassing indicators that do not allow for timely response when faced with changes and, on the other, very specific indicators that are highly complex in terms of measurement and management.

6.3. Final approval processes of the policy designed and its enactment

Within the systems approach, actors' participation would ideally span the entire design process. By this point, the involvement of all parties should already have been achieved in previous phases, establishing an important level of ownership and social capital in addition to allowing for the creation of a robust model for the management system (both current and expected). Thus, depending on the context of the country following this guide for systemic design, the final phase of designing the action plan is the sole responsibility of the design team, headed by the institutional leader and in consultation with other actors as dictated by the processes of design, approval, and proclamation (i.e., dissemination of the enacted policy) of public policies.

With the complete policy document, including the action plan and the monitoring-and- control plan, the design team can support a review process, while the institutional leader approves and enacts the final policy. This process may include, for example, the development of activities that are legally required and adopted in

light of the review of the policy document by committees or departments of the related institutions or the governmental body responsible for the approval of public policies in the specific context of WEEE management. One example of this is the work done by some institutions' internal legal departments; such departments review laws to avoid incongruence with the pertinent legal framework, which may include laws, regulations, orders, mandates, etc., that cover issues related to the environment, public sanitation, domestic and foreign WEEE-related commerce, cleaner production, or working conditions relevant to the management of WEEE.

Lastly, some countries have specific requirements for the approval of public policies that mandate public consultation, in which civil-society actors and anyone interested can access the policy's content in advance of its passage. Thus, these actors have a forum for sharing questions or suggestions regarding this policy. In this way, the policy will enjoy ownership not only among the actors who participated throughout the process of systemic design but also among other parties who, in these final steps, come to feel a sense of belonging in this policy process.

7. Results of systemic design

Design processes generally yield a combination of tangible and intangible results; however, systemic design emphasises the latter, such as: learning processes in the actors, whether individuals or organisations, changes in the conception of the system addressed, or high levels of ownership regarding the design product (in this case, the policy).

7.1. Tangible results

The main tangible result achieved by the methodology proposed in the present guide is the final policy document. Following the systems analogy of the cause-and-effect tree, a shift in focus is proposed to underscore a new way of thinking. Namely, there is a shift from thinking about 'causes of problems and their effects' to 'causes of solutions and their effects' (Figure 7.1). That is, this tree's roots are the inputs that facilitate systemic design, and its branches and leaves emerge as systemic bases that bear fruits, i.e. the policy and its elements. Thus, in Figure 7.1, we suggest some elements to include in the policy design; however, in line with each country's processes for creating public policies, new elements should be added or proposed ones modified.

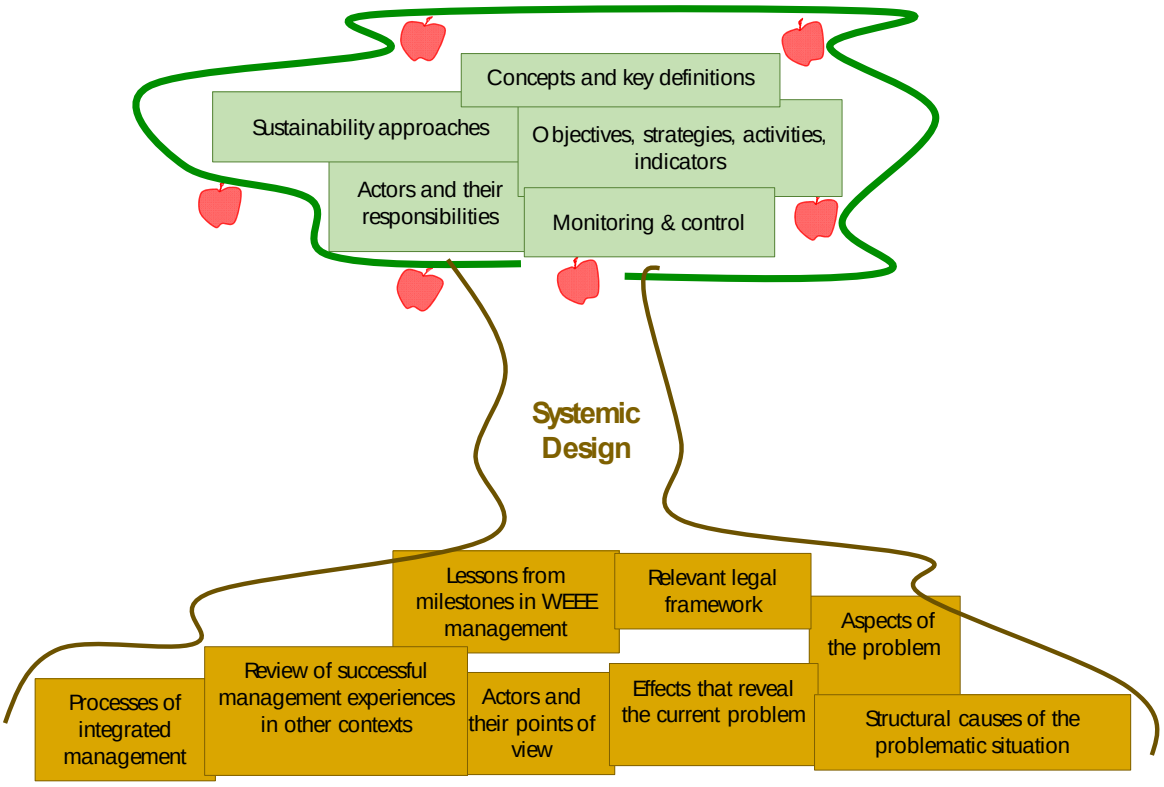


Figure 7.1. Elements suggested for the final policy document resulting from systemic design.

As shown in Figure 7.1, each constituent element of the *tree roots* forms part of the stages of design. To this end, the *real problem* is studied in depth, an idealised design is constructed to show an ideal future situation, and the gaps between both extremes (i.e. current versus future) are identified. In so doing, it is possible to articulate the elements needed to make suitable decisions regarding the actions to be planned. Moreover, all these pieces are interrelated, so they are all relevant to ensuring that the tree has a strong foundation and that the *branches* and *fruits* (i.e. effects) are sustainable.

The structure of the document should follow this same logic. In the case of this document, the opening chapters expressed the elements of the *roots*; then, moving up the *trunk*, we discussed methodological processes. These processes enable growth in the final part, namely a description of the results as captured in the components of the action plan, objectives, strategies, actions, indicators, and corresponding monitoring-and-control plan (leaves and branches).

Anyone with access to the document—whether for educational purposes, research, or use as a base for designing projects or creating businesses—should understand the fundamental concepts contained within. Therefore, we suggest explicitly incorporating the concepts, key definitions, and sustainability-oriented approaches into any such venture (see the top part of Figure 7.1 – the crown of the tree). Examples include the systems approach, EPR, integrated sustainable management, eco-design, product life cycle, cleaner production, circular economy, sustainable consumption, and Global Sustainable Development Goals.

Another tangible result is that the country of application can redesign its methodologies for public-policy design to include successful instruments vis-à-vis the attainment of more significant and more active participation by the actors involved, thereby reinforcing the dynamics of interinstitutional cooperation and coordination necessary for sustainable natural-resource management. Such results can be considered tangible as long as the new methodologies are documented to facilitate their application in future processes for designing public policies.

7.2. Intangible results

Intangible results refer to the processes involving experiences, primarily learning experiences, among which we can include familiarity with new concepts, understanding of the way others perceive the world, or shifts in one's own world view. Turning back to the example in Figure 7.1, these intangible results could be understood as the tree's *fruits*.

A first intangible result is that the actors involved in the systemic design will enjoy a greater sense of ownership of the objectives, strategies, and action plan included in

the policy, which will, in turn, enhance the potential sustainability of the system. By considering more sustainable management of WEEE from a systems perspective, each actor learns to consider the possible effects of decisions taken in his or her role within the system writ large. This factor increases the sustainability of the programmes to be designed and implemented.

An enhanced sense of ownership engenders increased commitment by each actor. This raises the likelihood of success in the monitoring of the implementation of the strategies. The same can be said of the adjustments in the medium and long terms in response to ongoing evaluation (hence the importance of indicators). Moreover, the deeper trust established by this constructive process will facilitate the collaboration and cooperation necessary during policy implementation.

By considering the other actors' points of view, each participant in the process will gain a more complete understanding of the complexity of the real problem (partially evidenced by problematic situations) to address; therefore, each participant will learn a holistic approach that produces structural-level solutions. This also results in more detailed and nuanced knowledge of the system, an added bonus that facilitates more effective actions within each organisation. That is, the methodological logic modelled throughout this process can be reproduced within each participating institution to make its specific decisions more systemic.

Lastly, the lessons related to good practices and successful tactics, as well as not-so-successful tactics and the reason underlying their lack of success, facilitate the development of systemic design in the country applying this guide. Thus, the country of application is further invited to systemise, document, and share its experiences with this process to strengthen sustainable WEEE management systems in the region and across the globe.

8. Example of use: the systemic design of a national policy for integrated WEEE management in Colombia

For the sake of improving the potential impact of this guide, we have included an example of use (i.e. a practical application) of the methodology of systemic design. In this chapter, experiences related to supporting the design of a national policy on integrated WEEE management in Colombia are described.

As previously mentioned, the Andean nation has positioned itself as one of the leaders in Latin America in this field. It was the first country in the region to implement post-consumption programmes and a national WEEE policy in line with the principle of EPR. Moreover, Colombia has made great strides in enacting and adopting regulations and laws related to WEEE management. Therefore, countries beginning to undertake similar processes can model their approach on the lessons learned from Colombia's experiences. To that end, what is described herein may help enhance the success of other countries' strategies and programmes for more sustainable management of EEE and its parts.

8.1. Background and Colombian regulatory development of WEEE management

Legislative processes broadly related to the management of WEEE in Colombia began more than a decade ago. Yet, the processes most directly related to WEEE management, as shown in Figure 8.1, can be traced to the year 2010. In the subsequent years, particularly 2014 and 2015, the proposed methodology of systemic design was applied

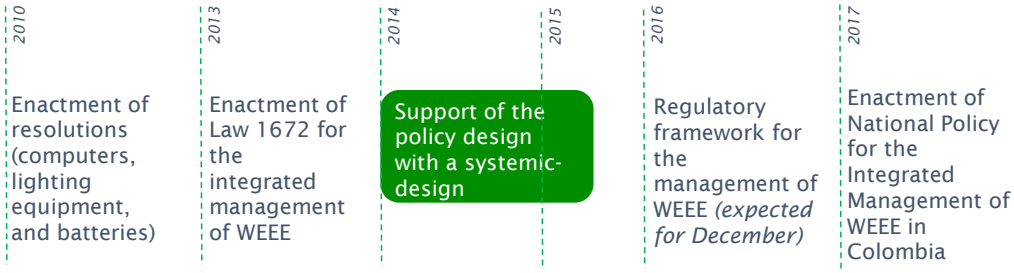


Figure 8.1. Milestones in the legislative and regulatory development of integrated WEEE management in Colombia

Two milestones indirectly related to WEEE merit highlight. With regard to the first, in December 2005, the National Environmental Policy for the Management of Waste or Hazardous Materials was passed (MAVDT, 2005). This was partially ratified in the same month by Order 4741 of 2005. As for the second, the National Policy on Sustainable Production and Consumption was passed in the year 2010 (MAVDT, 2010), and partially enforced by Order 1369 of 2014. In these 2 cases, enforcement came after the corresponding policy was passed. However, for the specific case of

WEEE management, Colombia followed a different process (see Figure 8.1). First, in 2010, the Ministry of the Environment and Sustainable Development (MADS) issued 3 regulations for some WEEE streams (Resolution 1512 for computing equipment, Resolution 1511 for lighting equipment, and Resolution 1297 for batteries). Then, in 2013, Law 1672 was enacted, establishing a national-scale law for the integrated management of WEEE (Congreso de la República de Colombia, 2013) and, recently, in June 2017, a national policy for the integrated management of WEEE was enacted. This most recent law was supported—as part of the design process—with the methodology that subsequently materialised as part of this guide on systemic design.

Another factor that distinguishes Colombia's regulatory development is international support, which has played an important role in its advances towards integrated sustainable WEEE management. Of note is the bilateral cooperation between Colombia and Switzerland, specifically the programme *E-Waste Recycling Latin America,* implemented by the Swiss institution Empa[1] with phase I of the assessment (beginning in 2007 and running through 2008). The years 2009 and 2012 saw the implementation phase executed. In this phase, one line of action was the development of a legal framework to serve as a basis for the design, creation, and operation of an integrated WEEE management system. As part of this second phase, a national technical committee comprised of public and private actors was formed; this committee was created to discuss technical topics and standards to determine the country's course with respect to WEEE management. It also provided support for the elaboration of the first draft of the law on the integrated management of WEEE, which reaffirmed EPR as a guiding principle. Likewise, training activities for the most relevant actors were led by this committee.

During the same period (2009–2012), specifically in 2012, the first 3 programmes for collecting and managing WEEE in Colombia were created. They were called *post-consumption programmes* and driven by the 3 waste streams regulated at the time: the programme *EcoCómputo* for computers; the programme *Lumina* for lighting equipment; and the programme *Pilas con the Ambiente* for batteries.

Upon finalising the implementation of the programme *E-Waste Recycling Latin America*, the following were identified as the main challenges remaining:

- Finish and enact the law working its way through the Colombian Congress.
- Support the development of already-implemented post-consumption programmes.

[1] The Swiss Federal Laboratories for Materials Science and Technology (Empa) was commissioned by the State Secretariat for Economic Affairs (SECO) to lead the programme *E-Waste Recycling Latin America*, which was implemented in Colombia to support the MADS; this programme received technical and logistical support from the CNPML

- Cultivate ownership and commitment in the actors involved in the management of WEEE
- Integrate the 'informal recycling' sector, i.e. the actors carrying out unofficial business activities at the time.

To ensure continuity of the process initiated with the programme *E-Waste Recycling Latin America* in Colombia, the programme *Sustainable Recycling Industries* (SRI) was launched in 2013. The SRI was implemented by the World Resources Forum (WRF) under the full responsibility of Empa and in cooperation with the CNPML. Its activities focussed on the main challenges identified: the development and implementation of the legal and regulatory framework, the technical and operational consolidation of the post-consumption programmes, the creation and reinforcement of Colombian actors' capabilities, and the integration and sound management of the formal recycling sector. Within this context, the design of a national policy for the integrated management of WEEE was developed. The following sections present the process of this development.

8.2. Application of systemic design

As previously mentioned, the design of the policy for the management of WEEE in Colombia officially commenced with the enactment of Law 1672 of 2013. The descriptions that follow are based on the support that, within this process, was provided, demonstrating the practical implementation of the methodology referred to in this guide as *systemic design* (Figure 8.2). This support specifically corresponds to the systemisation of activities mainly conducted in the years 2014 and 2015. It should be pointed out that a verification phase for the pertinent considerations (phase 1 in Figure 8.2) only applies to countries seeking to begin this process from the ground up. In light of the groundwork laid in Colombia and the Swiss–Colombian cooperation, this phase was not necessary and is thus not described in this chapter. That said, it should be applied by the countries using this guide.

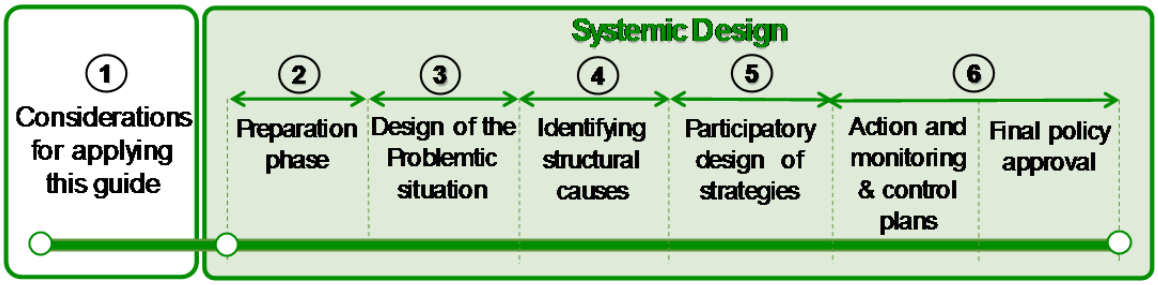


Figure 8.2. Phases of the methodology for systemic policy design for sustainable WEEE management.

8.3. Preparation phase (January – February 2014)

First, the design team was formed (referred to in this guide as the *systemic-design team*); in the Colombian context, the institutional leader (the MADS) had already

performed said role during the 2 milestones identified in Figure 8.1. Similarly, the technical–logistical leader (the CNPML) had also already advised the MADS and, in addition, coordinated cooperation with Switzerland. The team was complemented by the addition of a methodological leader, namely a researcher from a university in Colombia, the Pontificia Universidad Javeriana de Bogotá (PUJ).

Given the experience of the members of the systemic-design team, the documents related to WEEE management in Colombia were gathered in a relatively short period. As Table 8.1 demonstrates, these documents primarily included assessments, master's theses, technical reports, and official national and international documents. This list of authors (included in Table 8.1 in chronological order) reinforces the importance of international cooperation in strengthening WEEE management.

MAVDT, 2005. Política Ambiental para el Manejo Integral de Residuos o Desechos Peligrosos [Environmental Policy for the Integrated Management of Solid Waste and Hazardous Waste].
Marthaler, Christian, 2008. Computers for Schools: Sustainability Assessment of Supply Strategies in Developing Countries: A Case Study in Colombia – Master's Thesis, Department of Environmental Science Swiss Federal Institute of Technology of Zurich (ETH); Empa, Switzerland.
Ott, D., 2008. Manejo de Residuos Electrónicos en Colombia: Diagnóstico de computadores y teléfonos [Management of Electronic Waste in Colombia: Assessment of Computers and Phones]. Empa, CNPML.
Blaser F., 2009. Manejo de Residuos Electronicos en Colombia, Diagnostico de Electrodomésticos y de Aparatos Electronicos de Consumo [Management of Electronic Waste in Colombia, Assessmetn of Electrical Appliances and Electrical Consumer Devices]. Empa, CNPML, ANDI.
Uribe L.M., Wolfensberger M., Ott D., 2009. Manejo de los WEEE a través del sector informal en Medellin [Management of WEEE in the Informal Sector in Medellin]. Empa, CNPML.
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Leon, J., 2010. Análisis de flujos de residuos de computadores en el sector formal e informal en Colombia (resumen ejecutivo) [Analysis of Waste Flows of Computers in the Formal and Informal Sectors in Colombia: Executive Summary]. Swiss Federal Institute of Technology (EPFL) / Empa. Switzerland.
Ministerio de Ambiente y Desarrollo Sustainable, 2010. Lineamientos técnicos para el manejo de residuos de aparatos eléctricos y electrónicos [Technical Guidelines for the Management of Waste Electrical and Electronic Equipment]. Colombia.
Unesco, RELAC, 2010. Los residuos electronicos, un desafio para la sociedad del conocimiento en LAC [Electronic Waste: A Challenge for the Society of Knowledge in LAC].
MAVDT, 2010. Resoluciones 1512 y 1297 [Resolutions 1512 and 1297]. Colombia.
MAVDT, 2010. Política Nacional de Produccion y Consumo. Hacia una cultura de consumo sustainable y transformación productiva [National Policy for Production and Consumption: Towards a Culture of Sustainable Consumption]. Colombia.
Programa Seco/Empa sobre the Management de WEEE en América Latina, 2010. Manejo de los WEEE a través del sector informal en Bogotá, Cali y Barranquilla [WEEE Management in the Informal Sector in Bogotá, Cali, and Barranquilla]. Bogotá: ewasteguide.info.
Congreso de the Republic de Colombia, 2013. Ley 1672 [Law 1672].
Hernández, C. A., 2013. Situación actual del manejo de WEEE en Colombia [Current Situation of WEEE Management in Colombia]. CNPML
MADS, 2015. Decreto 1076 de 2015 [Order 1076 of 2015]. Colombia.

Table 8.1. Principal documentation of WEEE management in Colombia at the beginning of systemic-design support (2014, preparation phase).

Processes and preliminary elements of the problematic situation

In reviewing this information, we identified the general WEEE management processes in place in Colombia. These included: the production, distribution, use and reuse of EEE; the generation, pretreatment (primarily manual), treatment, and exportation of WEEE. This line of processes abides by general standards of WEEE management in CEDEs. That said, the significance of reuse in the Colombian context merits highlight, for the repair, refurbishment, and reconditioning of devices is important in Colombia not only in terms of identified equipment flow but also in terms of the concomitant informality it frequently engenders, which is described in the assessment documents included in Table 8.1. The management processes included in the final policy can be found in Figure 8.8 (Section 8.2.2).

Similarly, as part of the systemisation of processes and problematic situations in the preparation phase, the main milestones were identified and placed on a preliminary timeline (Figure 8.3). This timeline was expected to be adjusted or have items added in the subsequent phases, particularly the *design of the problem situation* phase.

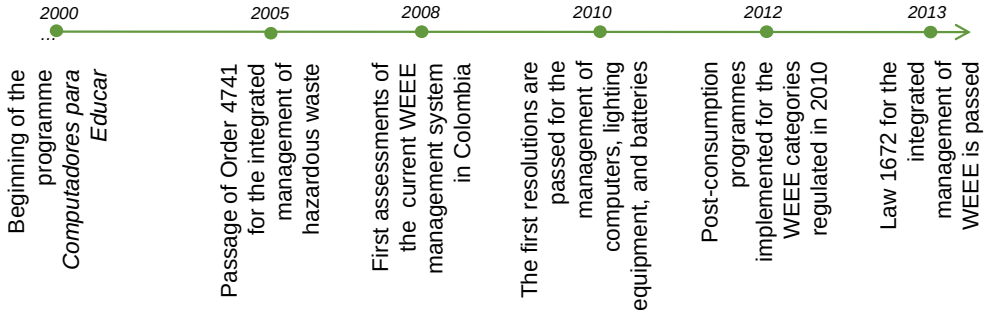


Figure 8.3. Preliminary timeline of milestones identified in the preparation phase.

The main problems identified as challenges in the assessments conducted from the years 2008 to 2011 stemmed from the lack of a formal management system that addressed all WEEE categories proposed by the corresponding European Union Directive as well as the lack of legislation to guide the development of programmes based on EPR.

To confirm the positive impact of leadership by the national environmental authority (MADS), the producers (represented by the National Association of Entrepreneurs [ANDI]), and other actors engaged in support activities led by Empa, the WRF, and the CNPML, one need look no further than the creation of the 3 aforementioned post-consumption programmes since 2012, which have become the main systems for the safe collection and management of WEEE in Colombia.

Characterisation and composition of WEEE[2]

A review of the Colombian context (see Table 8.1) revealed that the per capita generation of WEEE in Colombia for 2014 was approximately 2.6 kg/person/year; the estimated percent distribution is shown in Figure 8.4 (below).

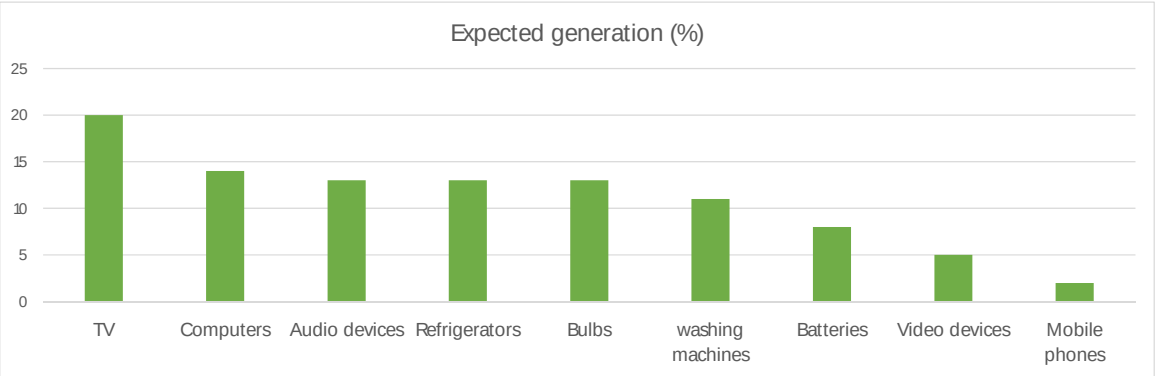


Figure 8.4. Estimated percentage distribution of WEEE by category for the year 2014. *Adopted from* (MADS, 2017).

In 2014, 34% of all WEEE generated (20% for televisions and 14% for computers) consisted of devices falling under Category 2 as outlined in the European Union Directive 2012/19/EU, which covers information and telecommunications devices with screens larger than 100 cm^2 [15.5 in^2].

As part of the quantification and characterisation of WEEE, the MADS also identified the number of regulated EEE importers participating in the WEEE collection and management systems as reported by the environmental licensing authority—ANLA per its name in Spanish—for the year 2015. The information revealed a total of 133 importers for computers, 66 for printers, 85 for lighting equipment, and 50 for batteries.

Lastly, between 2012 and 2014, the 3 regulated post-consumption programmes (for computers, lighting equipment, and batteries) collected a total of 2,126 tonnes of WEEE (MADS, 2017).

Actors in Colombia's WEEE management system

Analysis of the documents shown Table 8.1, in addition to the fact that WEEE management processes were already underway in the country, allowed for the rather quick preliminary identification of relevant actors to be involved in the

[2] For further information on WEEE characterisation, see the entire policy document at: http://www.minambiente.gov.co/index.php/asuntos-ambientales-sectorial-y-urbana/gestion-integral-de-residuos-de-aparatos-electricos-y-electronicos-raee#e-book

systemic design. At this juncture of the preparation for systemic design, then, it was evident which parties to engage from the outset (shown in Table 8.2). In this specific case, the actors already part of the national technical committee on WEEE, formed by order of Law 1672 of 2013 were also taken into account. In fact, this committee gave the green light for the formal commencement of the design process described in this chapter.

General actors	Specific actors (representatives)
National government	Ministory of the Environment and Sustainable Development (MADS)
	Ministry of Commerce, Industry, and Tourism (MCIT)
	Ministry of Health and Social Protection (MSPS)
	Ministry of Information and Communication Technologies (MTIC)
	Ministry of Mining and Energy (MME)
Producers and retailers	National Association of Entrepreneurs (ANDI)
	National Federation of Retailers (Fenalco)
Collectors and managers of WEEE	Post-consumption programmes (main WEEE collection strategy in the country)
	WEEE treatment operators
Technical advisers	National Centre for Cleaner Production (CNPML)
	Swiss Federal Laboratories for Materials Science and Technology (Empa)
	World Resources Forum (WRF)
	Pontificia Universidad Javeriana, Bogotá (PUJ)

Table 8.2. Preliminary identification of actors to involve in the systemic design of policy for the integrated management of WEEE in Colombia.

Per the systemic-design methodology, this preliminary list of actors is subject to change during the later phases, as may be required by the dynamics of the design process.

Preliminary idealised design

In the Colombian context, Law 1672 of 2013, which was already in effect upon beginning the methodological support of the systemic design, stipulated several elements that would form part of the idealised design of the system for WEEE management in the country. First, the principles that would constitute the policy's conceptual base were presented in the law, namely EPR, product life cycle, responsible production and consumption, gradual implementation, decentralisation, active participation, incentivisation, and prevention.

Second, the law defined responsibilities for all main actors (the national government, the producers, sellers, consumers, and treatment operators). In the same vein, the National WEEE Committee was established as an 'advisory body' for the MADS; this committee consisted of representatives from the MADS, MCIT,

MSPS, EEE production, and WEEE management as well as national and international experts (on behalf of their respective entities).

At this stage, the team analysed other countries' WEEE management systems, relevant literature, and the experience of the experts involved (Figure 8.5) to determine *i)* the actors to engage to ensure the policy design enjoys a high degree of ownership and *ii)* additional elements for the preliminary idealised design.

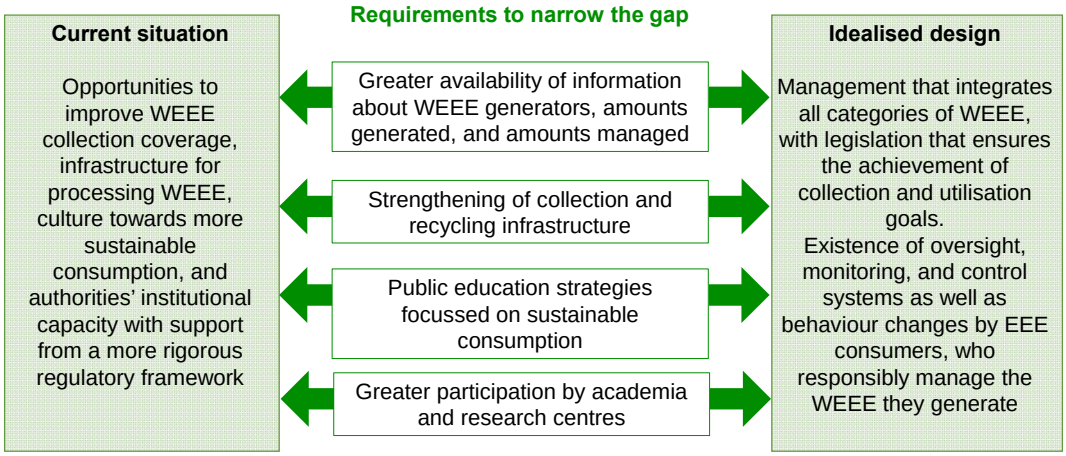
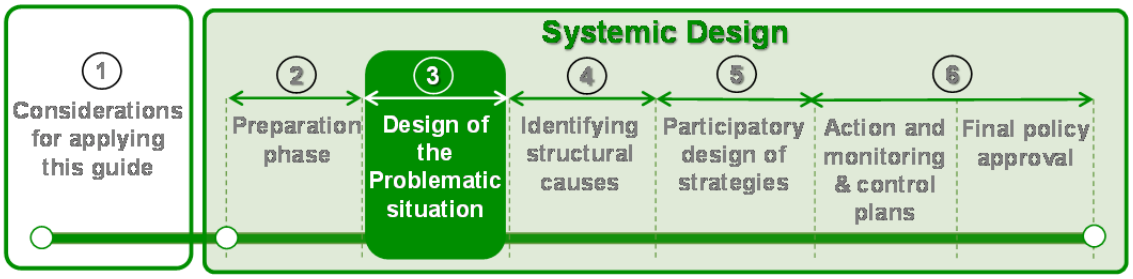


Figure 8.5. Main requirements for designing actions that narrow the gap between the current situation and the idealised design (more sustainable WEEE management).

8.4. Designing the problematic situation (February 2014 – January 2015)



The first step in designing the problematic situation and thereby coming to understand the *real problem*, as captured by the analogy of the iceberg,[3] consisted of structured interviews with representatives from the MADS (in its capacity as national environmental authority), ANDI (in its capacity as the professional association representing producers), and Fenalco (in its capacity as the professional association representing retailers). This was complemented by the vision of the representatives of the post-consumption programme *EcoCómputo* and that of the 4 main experts and technical advisers who supported the development of WEEE management in collaboration with Switzerland.

[3] As illustrated by the analogy of the iceberg, it is impossible to gauge the size of what lies beneath the surface simply by observing the protruding tip of the iceberg.

The interviewees' responses, in conjunction with the *preliminary idealised design* (Figure 8.5), helped determine the main needs identified as requirements to narrow the gap between the current and future situation.

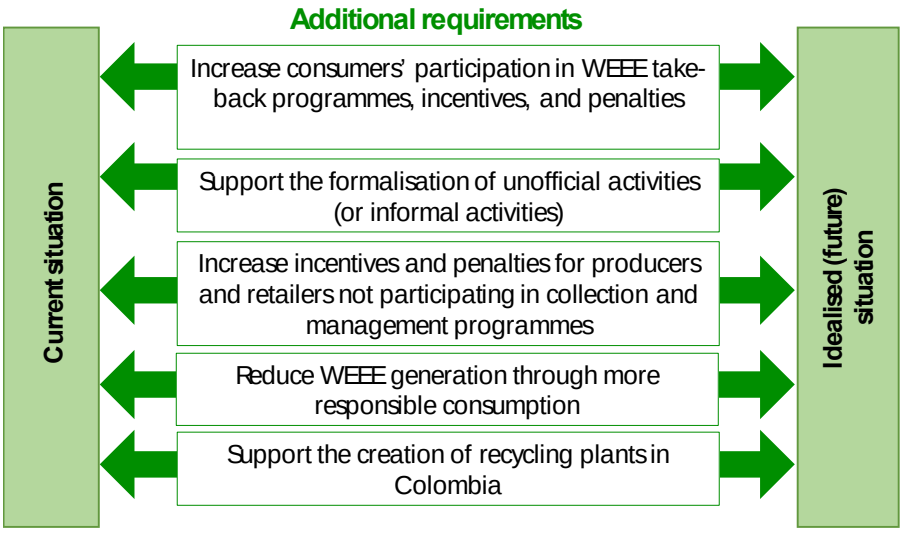


Figure 8.6. Additional requirements for closing the gap between the current and (future) idealised situation as identified in structured interviews.

In light of the interviews, we modified the timeline and milestones, as shown in Figure 8.7.

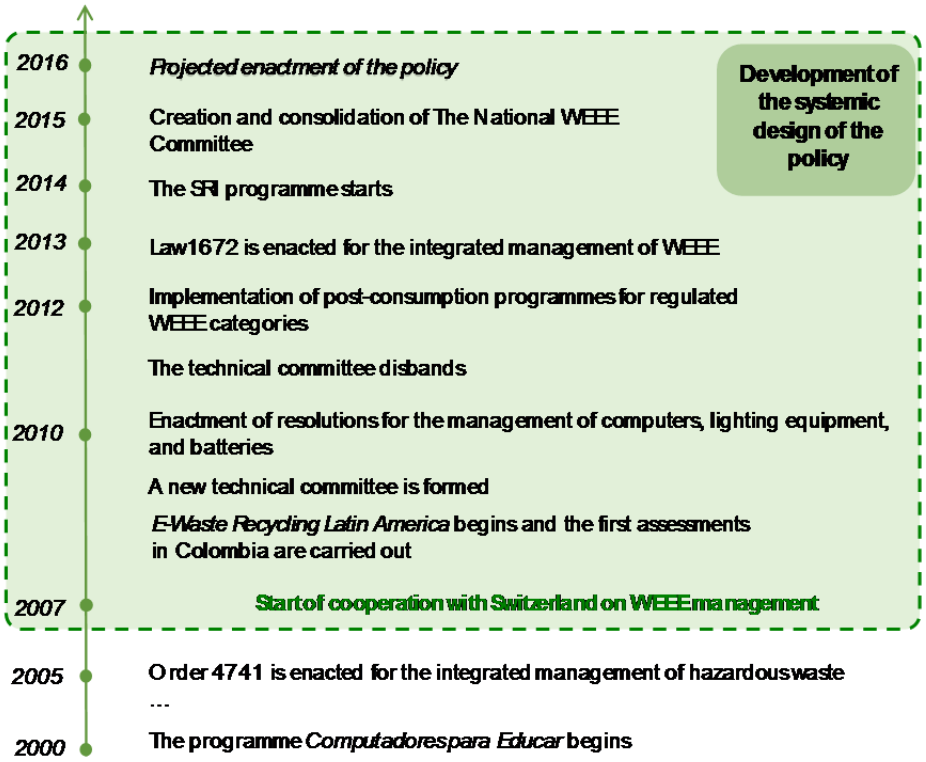


Figure 8.7. Modified preliminary timeline and milestones in the history of WEEE management in Colombia.

An important part of the problematic situation is understanding the process flows within WEEE management to complement the preliminary-level identification of these flows performed in the preparation phase. In this case, the institutional leader (MADS) and its team within the organisation adapted the Step initiative's[4] proposal (2014) to reflect each relevant actor's decision-making processes within the life cycle of EEE products (Figure 8.8).

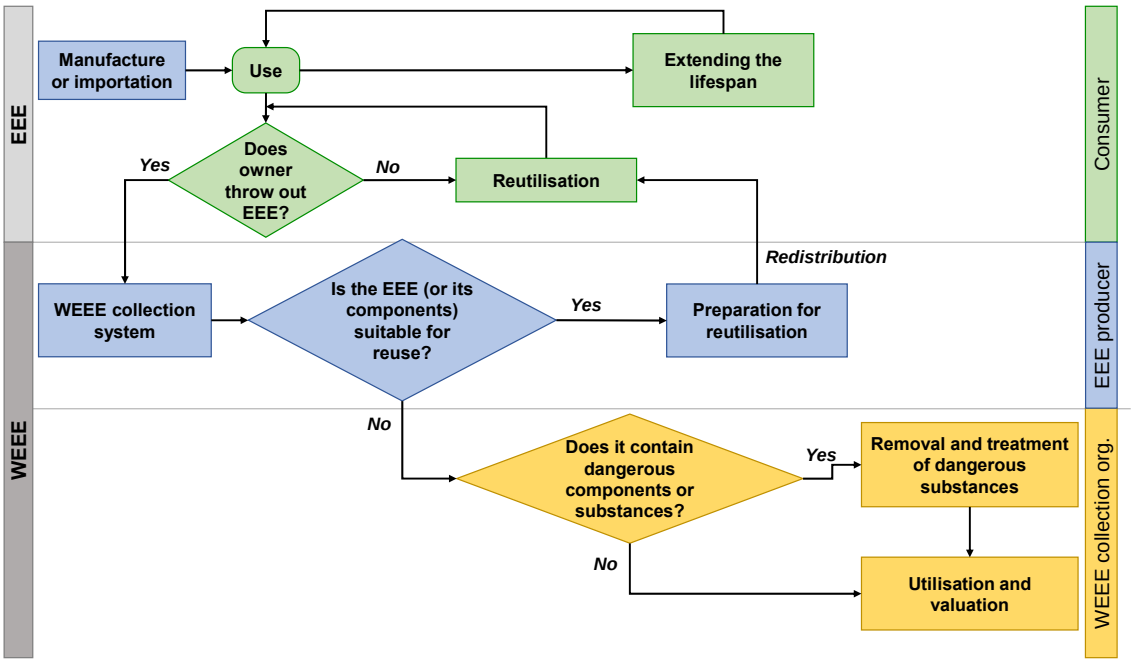


Figure 8.8. Flow chart of decisions and actors related to the management of waste electrical and electronic equipment (WEEE) in Colombia (*adapted from* MADS, 2017).

In this flow chart, the process of 'extending the lifespan' includes subprocesses of maintenance and repair. Similarly, 'preparation for reutilisation' refers to the manufacture, recondition, repair, and/or update of products. 'Utilisation and valuation' encompasses recycling, recovery, exportation, or final-disposal processes.

Focal problem: causes and effects

After the interviews conducted by the methodological leader of the systemic-design team, it is important to identify the most propitious methods for cultivating the systems approach in the participatory design activities. Therefore, the next step consisted of planning and executing a workshop on causes and effects of the problematic situation (Figure 8.9). This session stemmed from a confluence of interests between the National WEEE Committee, the SRI programme, and the relevant actors in WEEE management in Colombia. Although this topic had been

[4] Step, which stands for 'solving the e-waste problem', is a collaborative initiative between 'manufacturers, recyclers, academics, governments and other organizations committed to solving the world's e-waste problem' that seeks to develop solutions for better e-waste management. (http://www.step-initiative.org/)

addressed for years, the workshop activity marked a milestone in terms of paving the way for open and respectful discussion, a fundamental ingredient in systems-oriented policymaking. The meeting took place at the ANDI's facilities and was supported by a pro-sustainability professional association of 'regional autonomous corporations' (ASOCARS), which served as facilitator.

Figure 8.9. Images from the workshop on identifying causes and effects.

The primary objective of the workshop on identifying causes and effects was to identify the problematic situation of WEEE management in Colombia from environmental, economic, social, technological, and policy perspectives. After introducing the concept of *systems approach*, which would be used to design the policy, guiding questions were created, such as: What problematic situations exist in the management of WEEE in Colombia? Which problematic situations are treated cross-sectorally (e.g. by the environmental authority and the public-health authority) and which are treated sectorally? Which are their causes? Discussing these questions allowed for the initial construction of a cause-and-effect tree (see Figure 8.10).

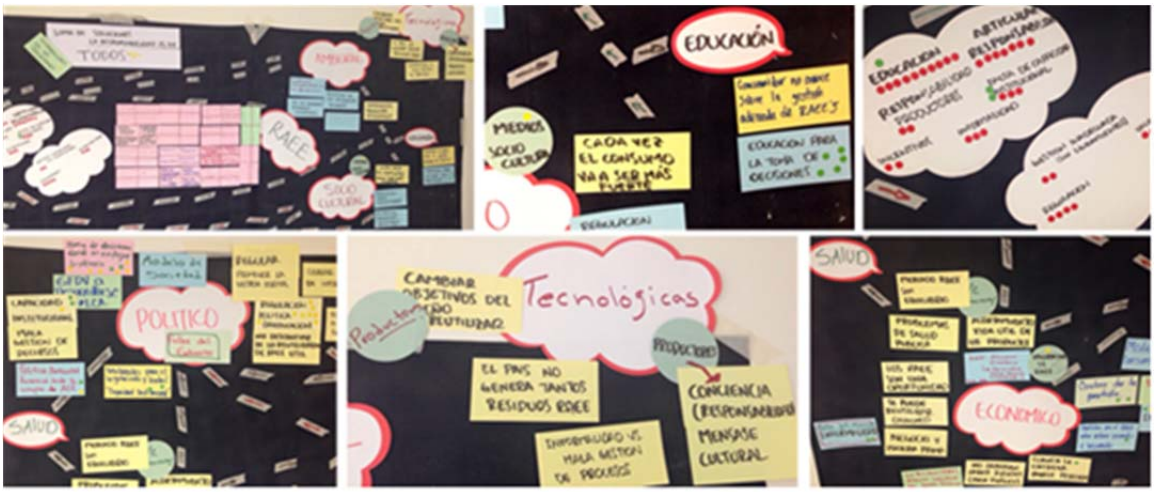


Figure 8.10. Workshop on identifying causes and effects in WEEE management in Colombia.

In other words, the attendees took part in identifying the possible causes of problematic situation in Colombia's WEEE management. They articulated 24 in total using the cause-and-effect tree and its logic as well as the point-weighting system (which was used to reflect the importance of each cause in actors' minds). This prioritisation did not quite reach the level of a formal definition of structural causes (see Section 8.2.3), but it did bring the process closer in line with the actors' understanding of the problematic situation, thus, of the real problem.

In this workshop, 3 causes of the focal problem were articulated:

- In first place was the consumption model in place at the time, which was not sustainable because, on one hand, the number of devices on the market was increasing quickly and, on the other, consumers were not taking back their old devices to the post-consumption programmes developed for that express purpose.
- In second place was a lack of systemic decisions behind the design of strategies; essentially, this was an indictment of the habit of devising urgent solutions that proved ineffective or were focussed on the short term, e.g. solutions based on purely economic or political criteria or solutions that disregard the interests of multiple parties affected.
- In third place was the lack of monitoring and control by the responsible authorities; this was identified as an important cause of phenomena such as contraband (illegal importation) of EEE, unlawful sales practices, and informality in WEEE collection and management, among others.

As part of the same activity of assigning weights and seeking a proactive vision with respect to the previously described causes, the participants also identified and prioritised solutions or actions that could engender a change in the state of affairs of WEEE management:

- The first measure proposed was the creation of education and awareness strategies aimed at the Colombian public. This was done based on the assumption that increased awareness among EEE users would lead to enhanced efficiency and sustainability in WEEE management.
- The second solution widely embraced by the attendees was the improvement of institutional capacity related to the management of WEEE. This was primarily premised on the idea that the causes related to the low level of interinstitutional coordination or generally deficient monitoring and control usually flowed from a lack of personnel in some departments, which meant that these departments could not meet large-scale demands like those addressed in this design exercise.

After the workshop, the systemic-design team analysed the 24 causes identified by the participants, refining them to 21; these 21 are found in Table 8.3 (the abbreviations assigned are related to the process of identifying structural causes discussed in Section 8.2.3).

Possible cause of the focal problem	Cod
Consumers' expectations of a reward for taking back WEEE	ExpEconC
Insufficient (public) interinstitutional coordination	Coor.Publ
Insufficient cooperation between public and private institutions	CoopPrPu
Insufficient information regarding differentiated management and consumers' obligation to take back WEEE	InfConGD
Insufficient mechanisms for selective collection	InfRetoma
Insufficient spread of information on the topic to consumers, i.e. not enough to strengthen WEEE collection and management systems	InfPrACon
Insufficient technical capacity and research	CapTeInn
Lack of an information system for monitoring and control	InfoVigi
Lack of complete enforcement of Law 1672 of 2013	NoReglamL
Lack of implementation of inverse logistics	NoLogInv
Lack of legislation regarding the alienation (i.e. transfer) or disposal of EEE and WEEE as public goods	EnajeBEs
Lack of permanent training for civil servants	CapaFunc
Lack of recognition of externalities to consumers, to stimulate sound WEEE management practices among consumers	ReconCons
Lack of standards for EEE	EstanEEE
Lack of technical standards for the management of WEEE	EstanRAE
Opportunites to earn direct income from unofficial business activities related to WEEE	OporIngr
Weak control of WEEE exportation	VigExpor
Weak customs-office monitoring of EEE	VigilEEE
Weak integration of the topic into national education programs	NoProgEd
Weak monitoring of EPR compliance for WEEE collection and management systems	VigilREP
Weak monitoring of formal and informal WEEE management	VigAuAmb
Weak relay of relevant information from producers to treatment operators, including information related to hazardous waste	InfPrGest

Table 8.3. Possible causes of the problematic situation (focus problem) linked to the management of WEEE in Colombia (listed in alphabetical order).

Using the results of the workshop experience as inputs, the systemic-design team formulated a second version of the statement of the focal problem that was used to guide discussion of the problematic situation. This, along with the causes identified, was validated in a subsequent activity developed in cooperation with the environmental authorities unable to send representatives to the workshop, such as the District Environmental Secretariat (environmental authority responsible for the

city of Bogotá, Colombia's capital with 8-million-plus inhabitants), the National Environmental Licensing Authority (ANLA per its name in Spanish), and officials from the MADS. The revised focal problem was formulated as 'insufficient and inadequate management of WEEE in Colombia' (see Figure 8.11).

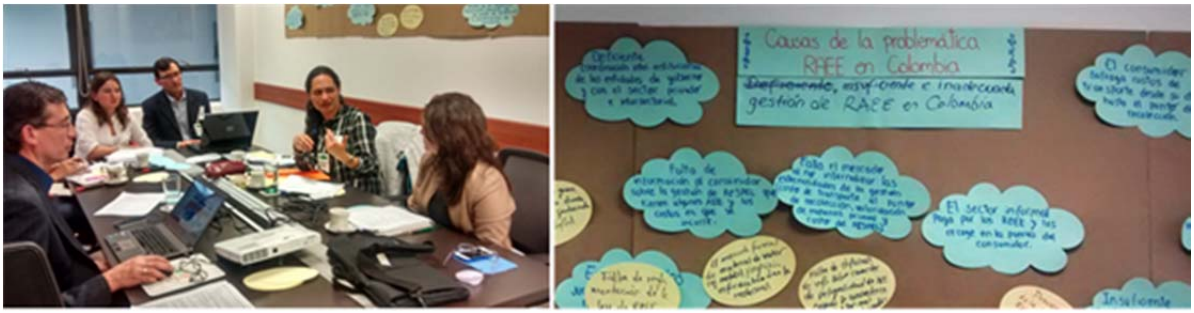
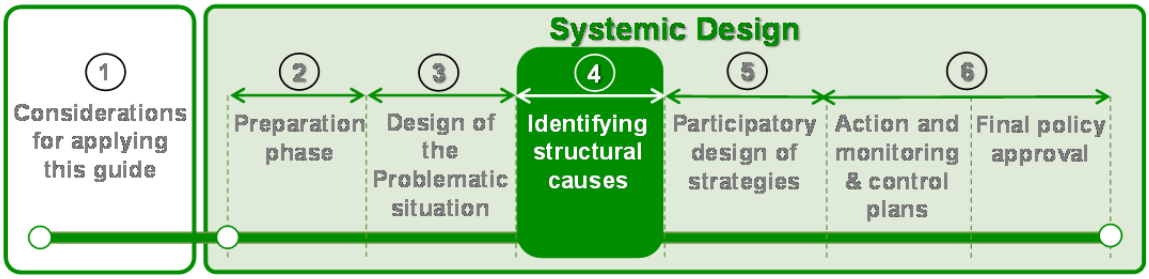


Figure 8.11. Validation of the workshop on identifying causes and effects and of the formulation of the (revised) focal problem.

8.2.3. Identifying structural causes (January – March 2015)



For this phase, the MADS called a meeting of the National WEEE Committee (note that members of this committee participated in the previous activities). Additionally, the MADS invited other actors who may not have been part of the national committee but who have contributed to the systemic-design process.

To explain the methodology for identifying structural causes, the final list of causes of the *focal problem* ('insufficient and inadequate management of WEEE in Colombia') was presented at the beginning of the meeting (Table 8.3). The methodological leader of the systemic-design team then went over the concepts that would be used: systems approach, structural causality, and the MDI. Next, each attendee was given a list of the causes as well as the forms shown in the example in Table 8.4. The methodological leader later filled in the MDI with this information (for more on the MDI, readers are referred to Chapter 4 of this guide).

That which	is influenced by…	Strng	Weak	Null
insufficient interinstitutional coordination between national, regional, and local public entities involved in WEEE management	insufficient cooperation and coordination for the implementation of selective collection and environmental management of WEEE between municipal authorities, environmental authorities, and the private sector (WEEE producers, retailers, associations, and collectors/collection organisations)			
	insufficient spread of information—by producers and their distribution chains—regarding selective collection and environmental management of WEEE and the respective take-back procedures aimed at consumers			
	lack of recognition of consumer incentives though there are parties willing to pay for consumers' WEEE			

Table 8.4. Example of the form on which each actor identified the direct influences between causes.

In recognition of the time needed to fill out the forms and to give each actor the opportunity to investigate within his/her own institution, a time frame of 2 weeks was established. In these 2 weeks, each institution had to assign a value between 0 (*no relationship between 2 causes*), 1 (*weak relationship*), and 2 (*strong relationship*) to all items on the form. Additionally, the systemic-design team, based on its analysis of hypothetical decision-making cases, determined that the weights of the opinions would be distributed as follows: 40% for the government (including the different authorities involved), 25% for producers and retailers, 15% for treatment operators, and 20% for technical advisers (national and international). By combining participants' evaluation of direct influences and by weighting opinions, the matrix shown in Table 8.5 was generated.

	Coor.Publ	CoopPrPu	InfPrACon	VigAuAmb	ReconCons	NoReglamL	InfPrGest	InfRetoma	VigilAEE	OporIngr	InfConGD	ExpEconC	VigilREP	CapTeInn	InfoVigi	NoLogInv	NoProgEd	EstanAEE	EnajeBEs	EstanRAE	VigExpor	CapaFunc
Coor.Publ	-	2	1	2	0	2	0	1	2	1	1	1	2	1	2	0	2	1	2	2	2	2
CoopPrPu	1	-	1	1	1	0	1	2	1	2	2	1	1	1	1	2	1	0	1	0	1	1
InfPrACon	0	1	-	0	1	0	0	1	0	1	2	2	0	1	0	1	1	0	1	1	0	0
VigAuAmb	1	1	1	-	1	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	1	1
ReconCons	0	0	0	0	-	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0
NoReglamL	2	2	1	1	1	-	2	1	2	1	1	1	2	1	1	1	1	2	1	2	2	1
InfPrGest	0	0	1	0	1	0	-	0	0	1	1	1	0	1	0	0	1	0	0	1	1	1
InfRetoma	0	1	1	0	1	0	0	-	0	1	1	0	0	0	0	1	0	0	0	0	0	0
VigilAEE	1	1	1	1	1	0	0	0	-	1	0	0	1	1	1	1	0	0	0	0	1	1
OporIngr	1	1	0	1	1	0	0	1	0	-	0	2	0	1	0	1	0	0	1	0	0	0
InfConGD	1	1	2	1	1	1	1	2	0	1	-	2	0	1	0	1	1	0	1	0	0	1
ExpEconC	0	1	1	1	1	0	1	1	0	2	0	-	0	1	0	1	0	0	0	0	0	0
VigilREP	1	1	1	1	1	0	1	1	1	1	2	0	-	1	1	1	0	0	0	0	1	1
CapTeInn	0	1	0	0	1	0	1	1	0	1	1	0	0	-	1	1	0	0	0	1	0	0
InfoVigi	1	1	0	2	0	0	1	0	2	1	1	0	2	1	-	1	1	0	1	1	2	1
NoLogInv	0	1	1	0	1	1	0	2	0	1	1	1	0	1	0	-	0	0	0	0	0	0
NoProgEd	1	1	1	1	2	1	1	1	1	1	2	2	1	2	0	1	-	0	1	0	0	1
EstanAEE	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1	1	0	-	0	1	0	0
EnajeBEs	1	1	1	1	0	1	0	0	0	1	1	1	0	0	0	1	0	0	-	0	0	0
EstanRAE	1	1	1	1	0	1	1	0	1	1	1	1	0	1	0	0	0	1	0	-	0	1
VigExpor	1	1	0	2	1	0	0	0	1	1	0	1	1	1	1	1	0	0	0	0	-	1
CapaFunc	1	1	1	1	1	0	1	1	2	2	1	1	2	1	2	1	1	0	1	1	1	-

Table 8.5. Matrix of direct influences resulting from consultation with the relevant actors (for more information on each abbreviation, see Table 8.3).

The information from the matrix (Table 8.5) was then plugged into Micmac, the open-source software (Godet, 1993). The result, Figure 8.12, was a graphic clearly illustrating the classification of causes (or problems) into 1 of the 4 zones explained in Section 4.2: the power zone, autonomous zone, conflict (linkage) zone, and outcome (dependent) zone. Zone classification, in this model, is based on each cause's level of influence and/or dependence on other causes.

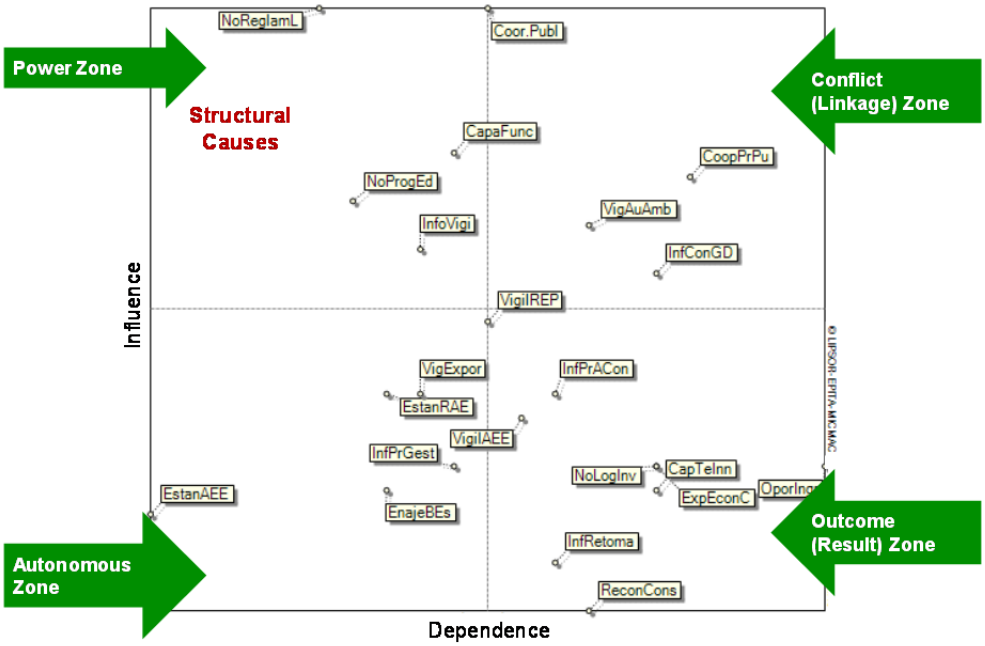


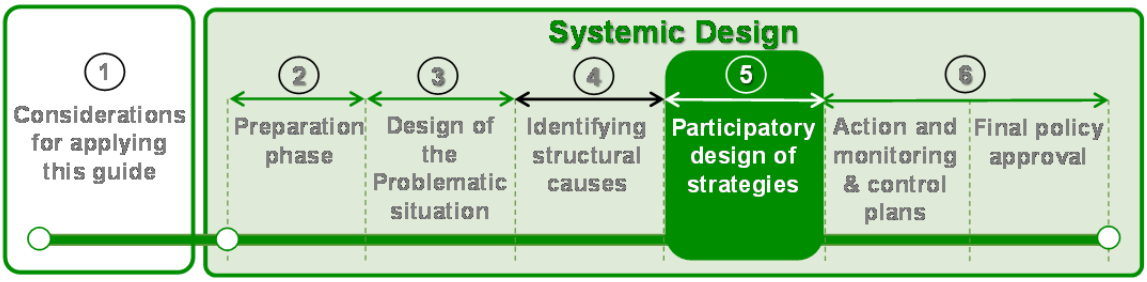
Figure 8.12. Map of the matrix of direct influences. Adapted from the graphic created with Micmac software.

As shown in the previous figure (Figure 8.12), the causes located in the power zone are: lack of complete enforcement of Law 1672 of 2013 (NoReglamL), lack of permanent training for civil servants (CapaFunc), weak integration of the topic into national education programs (NoProgEd), and lack of an information system for monitoring and control (InfoVigi). Taking into account that the conflict zone is also consequential when designing policy, the final list of prioritised causes, or structural causes, was defined as shown in Table 8.6 (below).

Structural causes of the focal (which constitute causes of the *real problem*)
Lack of complete enforcement of Law 1672 of 2013
Insufficient (public) interinstitutional coordination
Lack of permanent training of civil servants
Weak monitoring of formal and informal WEEE management
Insufficient cooperation between public and private institutions
Weak integration of the topic into national education programs
Insufficient information regarding differentiated management and consumers' obligation to take back WEEE
Weak monitoring of EPR compliance for WEEE collection and management systems

Table 8.6. Causes prioritised as structural causes of the focal problem (*see Table 8.3*).

8.2.4. Participatory design of strategies (March – July 2015)



The methodological path followed up to this point has been focussed on developing the 4 elements of systemic design stated in Section 0.6 of this guide: understanding the various aspects of the real problem, including social, technical, environmental, economic, legislative, and other aspects; involving different actors and taking their points of view and interests into account; including different system processes from the perspective of the life cycle; and conceiving of the solution based on a causal and temporal logic.

All these activities have indeed had an important degree of active participation; however, the discussions have primarily looked at the design of the problem. At this stage of the design, the aim shifts to opening a space for the joint construction of solutions within the main objective of creating dialogue and proactive discussion with a view to increasing the sense of ownership in the actors involved. Therefore, the inputs for the workshop on strategy design were 5 strategic objectives, which included the stipulations included in Law 1672 of 2013 as well as the main components of the structural causes identified in the previous phase (see Figure 8.13).

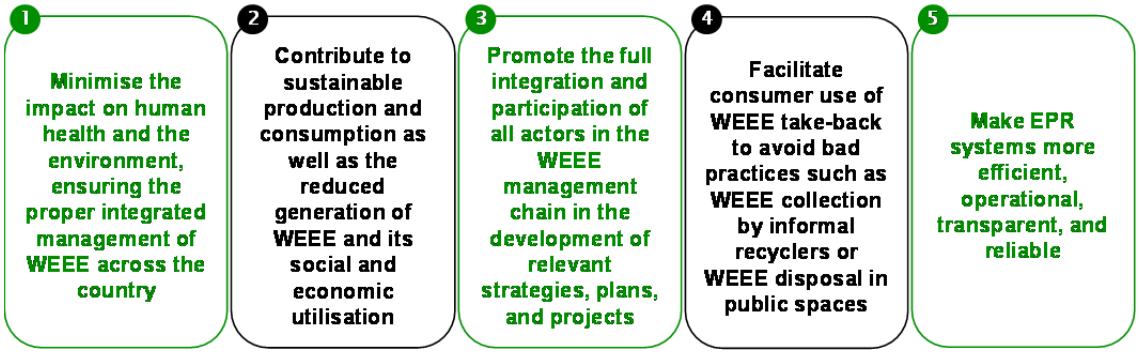


Figure 8.13. Strategic objectives used to guide discussion of participatory strategy design.

This workshop, led by the methodological leader and supported by the institutional leader and the technical–logistical leader, was conducted on the campus of the PUJ, and 27 representatives from various entities attended. Attendees represented the government (52%), producers (33%), treatment operators (11%), and academia (4%). Note that this last category encompassed members of Colombian academia as well as international technical advisers (primarily from Switzerland).

As explained in Chapter 5 of this guide, to develop the *round robin* methodology, 5 groups were formed, with multiple actors represented in each one. Figure 8.14 depicts a scene from the actual subgroup discussion tables.

Figure 8.14. Images of subgroup discussion tables with multisectoral representation for the participatory-design-of-strategies workshop.

Two rounds were carried out. In the first, each group recorded possible means to achieve the corresponding objective, drafted an initial version of a strategy, and identified the main responsibilities of the public sector, private sector, and civil society writ large. In the second, these written-down ideas were exchanged between groups, that is, each group evaluated another group's ideas as formulated in the first round. This step, which served as a de facto test of feasibility, was done with emphasis on economic, logistical-institutional, legal, and technical terms, with a space for 'other' considerations as deemed necessary by participants.

The final tangible result was the list of statements included in Figure 8.15 for each of the 5 strategic objectives proposed in the workshop. It should be pointed out that ideas involving education, cooperation, and monitoring and control stood out in the discussion.

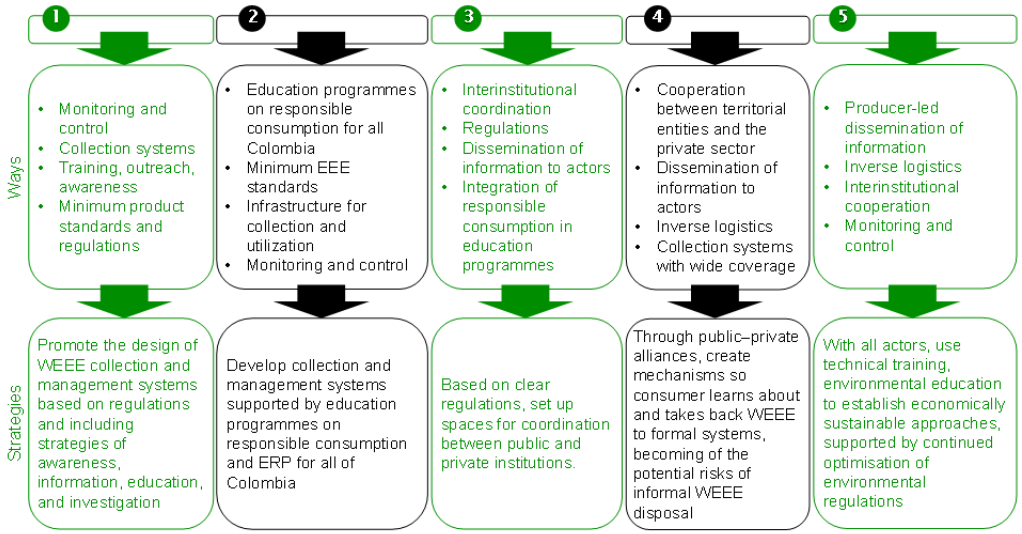


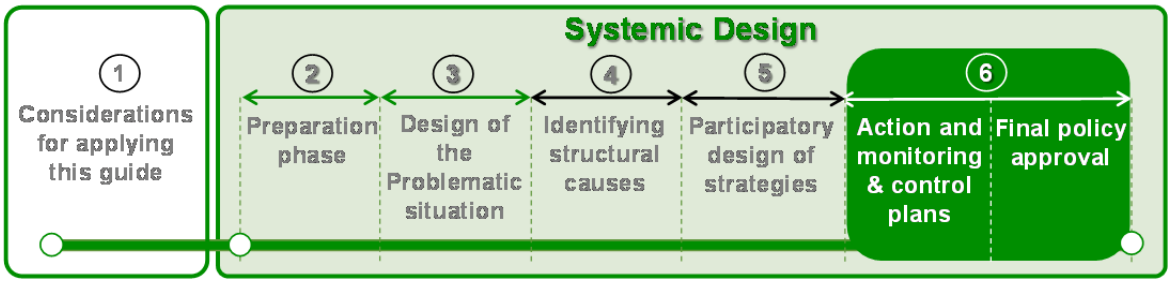
Figure 8.15. Summary of the main results of the participatory design of ways and strategies (Note: numbers 1 to 5 represent the strategic objectives described in Figure 8.13).

On an intangible level, the exchange of ideas took place in an atmosphere that was cordial, respectful, and open (see Figure 8.16), despite the nature of the WEEE management system to have actors whose interests may be in opposition. For example, if the objective of system sustainability includes minimising WEEE generation, actors who view WEEE as an economic opportunity can be said to have opposing interests with respect to the rest of the actors. The participatory spaces of the systemic-design process facilitate each individual's consideration of others' points of view, leading to the construction of a collaborative proposal for possible actions that seek to benefit all parties involved with a focus on sustainability—economic, social, and environmental.

Figure 8.16. Images of actors participating in the workshop on the participatory design of strategies.

Finally, the results of the activity were reported to the institutional leader, in this case the MADS. This institution's representatives then decided how to utilise or include the reported information in the final design of the policy while ensuring alignment with the relevant legal and regulatory framework and in light of the internal processes adopted for the design of public policies (the next section provides more detail on this aspect of the policy design process).

8.2.5. Defining the action plan and the monitoring-and-control plan; final policy approval (July 2015 – June 2017)



As mentioned in Chapter 6, during this systemic-design phase, we advise the use of participatory workshops; this, however, was not done in the Colombian experience at this phase because of the processes of public-policy design followed in Colombia. The detailed structure of the action plan and corresponding monitoring-and-control plan were developed within the final policy created by the MADS, the institutional leader of the systemic-design process (see Figure 8.17).

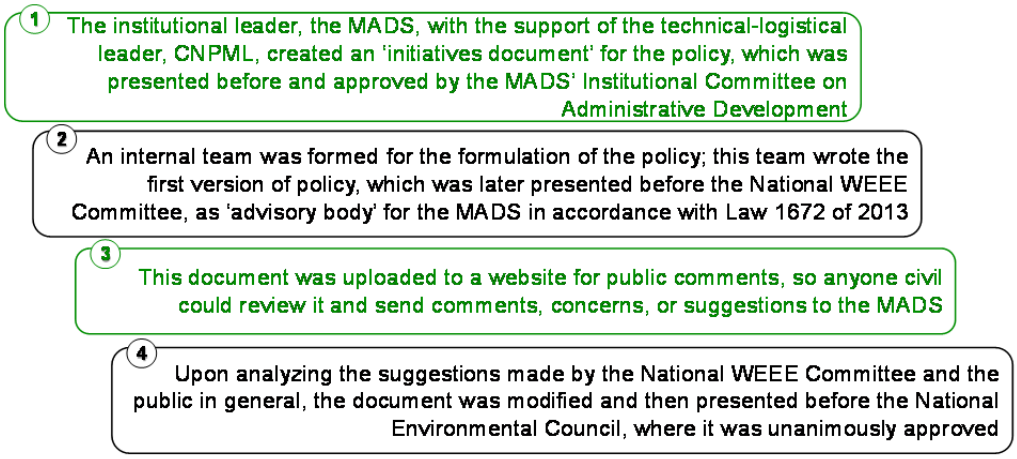


Figure 8.17. Steps for creating the final document, including a detailed action plan, and final policy approval in Colombia.

Participation in the review of the Colombian policy primarily took the form of individual consultation with the actors or discussion in committee meetings, as required by the legal framework for enacting public policies in the country.

The details of the action plan and monitoring indicators can be found in the following section, 'Resulting policy'.

8.3. Resulting policy

On June 6, 2017, the MADS launched the National Policy for the Integrated Management of WEEE in Colombia (Figure 8.18).

Figure 8.18. Images from the launch of the National Policy for the Integrated Management of WEEE in Colombia—Bogotá, June 2017.

As part of the National Policy National for the Integrated Management of WEEE in Colombia, the resulting strategic framework was focussed on meeting the general objective of 'promoting the integrated management of waste electrical and electronic equipment management (WEEE)'. To that end, 4 specific objectives were proposed, along with strategies, goals, indicators, and primary and secondary actors. In the spirit of sharing the most important elements, Figure 8.19 shows an example of the specific objectives and their respective strategies as well as some

proposed indicators. It should be noted that these objectives were included in the policy ultimately approved and enacted in Colombia; although there is overlap in terms of content—given that Law 1672 of 2013 was the basis for both—between these objectives and the objectives utilised in the workshop on the participatory design of strategies (Figure 8.13), there are some differences.

Specific objective	*Strategy*	*Types of indicators*
Prevent and minimise the generation of WEEE	Outreach/education aimed at sustainable production & consumption, reuse, and eco-design	% municipalities with programmes, campaigns, or strategies; number of Colombian technical norms or standards developed or updated; number of related documents and instruments developed
Promote the integrated management of WEEE	Development/establishment of instruments for integrated WEEE collection and management	Number of norms created and reports published; % de EEE imported or manufactured locally; registration of producers and retailers; number of campaigns; number of websites created; number of trainings offered
Incentivise the environmentally conscious utilisation of WEEE	Technology transfer and development of environmentally safe infrastructure	Number of related projects carried out; publication of a manual technical environmental guidelines; dissemination of terms for environmental licensing; number of regulations regarding labour competence enacted
Promote the full integration and participation of producers, retailers, users, and consumers of EEE	Joint work plans through private-public alliances	Number de meetings held/number de meetings scheduled; number of work groups or discussion boards formed; participatory strategy designed and executed (in progress)

Figure 8.19. Specific objectives of the National Policy for the Integrated Management of WEEE in Colombia and their respective strategies and proposed indicators.

Additionally, in different sections of the policy, the systems approach is explicitly mentioned, e.g. in the introduction, where it reads: 'to address the formulation of this policy, an assessment of the problematic situation of waste electrical and electronic equipment management in Colombia was conducted in accordance with available information, the environmental, social, and economic effects were examined, and the *structural causes* were identified and evaluated using a *systems approach*'.

The high-level participation during the process of systemic design in Colombia was, to some extent, shaped by years' worth of activities related to the management of WEEE, as described at the beginning of this chapter. However, this methodology fomented discursive change in participants who came to adopt the systems approach to WEEE management. Evidence of this result, as well as the level of ownership also enhanced through this methodology, was on clear display in meetings after the design of the policy: each actor referred to the policy as *mine*.

Chapter 9, the last chapter, provides explicit recommendations for countries that have begun a policy-design process or have recently begun executing actions related to the management of WEEE. As the case of Colombia demonstrates, effective results can be achieved by applying this guide.

9. Final recommendations for applying this guide

To recap the earlier chapters in this guide, there 4 fundamental aspects of the proposed systemic-design methodology. These aspects are shown in Figure 9.1.

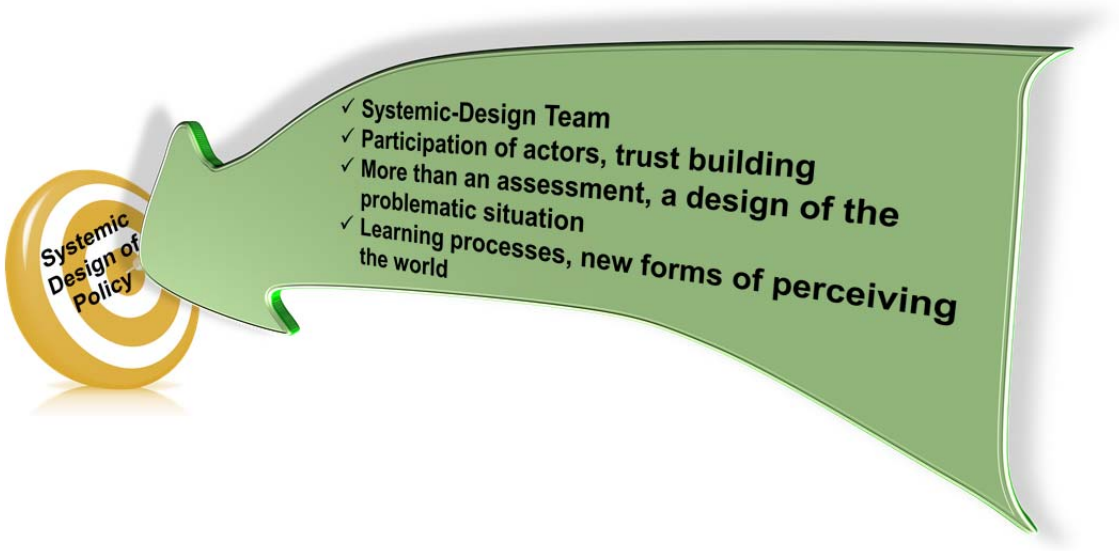


Figure 9.1. The 4 fundamental aspects of systemic policy design to achieve more sustainable WEEE management.

Systemic-design team

The systemic-design team should consist of an institutional leader, a technical–logistical leader, and a methodological leader. The institutional leader would lead, from the national government or the pertinent territorial government, issues linked to the management of WEEE. This role is generally performed by environmental authorities, but there are successful cases in which this role is performed by an internal and external trade authority given that it involves importation and exportation or industrial manufacturing.

The role of technical–logistical leader can be held by institutions that represent cleaner-production or environmental-preservation initiatives with specific experience in topics related to the management of WEEE. If the country of interest has already begun legislative processes or begun implementing certain WEEE-oriented programmes (e.g. collection), the technical support required to follow a systems approach may already be offered to the government by an organisation. In this case, the relevant organisation could fill this role on the systemic-design team. As revealed in Chapter 8, the CNPML assumed this role in Colombia because it had already served in a key role in the development of the WEEE management system.

Academia can provide an impartial actor with knowledge of design methods and tools as well as the elements of waste management. Hence, we suggest that the role of methodological leader be filled by a member of academia, whether from a university, research centre, or other educational institution. To this end, teachers and/or researchers or, alternatively, students working on theses, preferably doctoral- or master's-level theses, or other research projects could be brought on board. Note that postgraduate theses may be a valuable source for assessment-of-the-current-situation studies. In the Colombian context, for example, master's students working with Empa provided useful background research (see Table 8.1).

Participation of actors, trust building

Systemic design depends on high-level participation by the actors involved in the management of WEEE. Some CEDEs will already have undergone processes that established communication channels between all relevant parties involved in WEEE management, while others will not. Applying the tools included in this guide will streamline the strengthening or initiation of the trust building needed to establish open dialogue between parties, even those that may have opposing interests.

In the case of Colombia, the presence of strong professional associations, trade groups, and strategic alliances—such as those representing the industrial sector (e.g. ANDI), EEE producers, or EEE retailers (e.g. Fenalco)—facilitated these actors' participation in WEEE management. If a country aspires to engage in systemic design but lacks these types of organisations, it is important to establish an active link with at least one (preferably more) *original equipment manufacturers*, as well as representatives of e.g. large supply chains of EEE in the country.

Similarly, it is important that each country, in light of its own context, determine how to best engage and bring in WEEE collectors and collection organisations. We suggest direct participation by organisations of formal/official recyclers, though this process also provides an opportunity to explore the inclusion of the informal sector.

More than an assessment, a design of the problematic situation

In the design of public policies or the strategic management of waste, the term *assessment* is frequently invoked. However, from a methodological standpoint, an assessment means that an institution or person is tasked with taking a *snapshot* composed of technical information such as waste flows or equipment, existing processes, and identified or recognisable problematic situations as part of the real problem. The final product is thus a list of data interpreted by an *expert,* who also proposes and defines the areas in which solutions should be implemented.

In the case of the proposed methodology of systemic design of the policies, it is fundamental to establish the best possible understanding of the *real problem* to solve, in its entirety, or whatever brings the *systemic-design team* closest to an understanding of the *real problem*. Hence, we suggest designing the problematic situation to arrive at the *real problem* through collaboration with all actors who, to varying extents and in varying ways, are part of the *problematic situation* itself. Further, this participatory process engenders greater trust, which is necessary for achieving systemic objectives and sustainability. That said, even if there are already assessments for the country in question, working in a participatory fashion towards updating these statements following the logic and methods discussed herein can provide an equally powerful opportunity for trust building.

In this sense, if the country using this guide has no previous assessments, the technical data required for the preparation phase of the systemic design, e.g. statistics regarding WEEE generation or WEEE processes, can be obtained from studies such as those listed in Toolbox 2.1. The country in question can also complement these data with the gathering of country-specific data. Regardless, we suggest that the tools for the continuous measurement of WEEE flows are applied for categories of equipment—perhaps following those proposed by the corresponding European Union Directive [2012/19/EU] or those defined by the country applying this guide in line with country-specific factors. We also recommend including these tools in the strategies and indicators of the action plan and the monitoring-and-control plan eventually included in the policy designed.

A fundamental part of designing the problematic situation is the identification and comprehension of the legislation and regulations related to the management of WEEE. If the country of interest has pertinent laws, decrees, ordinances, regulations, or any other legal provisions, we suggest including their processes of design, approval, and enactment in the milestones to be studied within the systemic-design process in order to identify factors that drove their success as well as the underlying motivations, barriers, and conflicts (and how they were resolved). Moreover, any other element that could contribute to the success of the systemic-design process should be addressed. The same recommendation would apply to countries that do not have a relevant legal framework but do have background experiences in the creation of programmes for the collection and management of WEEE.

Learning processes, new forms of perceiving the world

An essential goal of systemic design is to generate or facilitate learning processes in the actors involved; they will gain a deeper understanding of the WEEE management system, its elements, its dynamics, and concepts such as that of systems approach. Together, these learning processes may spark a change in how actors perceive reality. That said, given the participatory and interactive nature of

systems process and the concomitant variety of possible interpretations, this experience may also entail some misunderstandings, conflicts, or deviations from the path towards fulfilling the design objectives. Therefore, on a methodological level, we recommend constantly discussing and reminding participants of the fundamental concepts of systemic design across all participatory activities such as workshops or meetings. This repetition facilitates smooth interactions. Within these concepts, for example, we suggest working on what is understood by *systemic design*, *objective*, *strategy, cause*, *effect*, and *problem*. It is also important to disseminate the partial results of the process to all actors involved, whether through executive reports, specific presentations in institutions' routine meetings (or at meetings of a national committee on WEEE, if one exists), or as part of the inputs for each activity in each phase.

It is important to bear in mind that the post-design activities, beginning the moment the policy is launched and disseminated after its approval, should be conducted with the participation of all parties, even the monitoring-and-control activities stipulated in the action plan. In fact, the systems approach entails addressing not only the design phase but also the policy's implementation, operation, and evaluation. Thus, throughout all these stages, we recommend not losing sight of the interests and points of views of the various parties involved, the different management processes, and the multiple aspects of the *real problem* identified through analysis of a *problematic situation*. On a final note, readers should remember that the entire systemic-design process and subsequent phases should be carried out with emphasis on cause-and-effect logic, which allows for the policy to be adapted to system's changing dynamics.

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