Chapter 11
How to Put Soundscape into Practice

André Fiebig and Brigitte Schulte-Fortkamp

Abstract Over the years soundscape planning has clearly gained significance; however, it is still the case that soundscape projects and soundscape-based urban noise planning are not fully established in the fields of noise control applications and noise policy. Worldwide, numerous soundscape interventions have been implemented, indicating the value of the soundscape approach and soundscape planning that includes input from local experts. Nevertheless, there are some reservations among policy makers and planners about applying human-centered approaches and developing participatory processes with a local community for sustainable soundscape design. There are no well-established procedures for soundscape design and planning. The introduction of standardized methodology endeavors to overcome the lack of defined systematic approaches for the identification of interventions. Utilizing soundscape standards will make the decision process transparent and comprehensible and thus more acceptable for authorities and policy makers. Moreover, activities to set-up databases to document soundscape interventions and their evaluation might lead to the recognition of frequently recurring design strategies and the derivation of best practices. Therefore, an increased interest in and more frequent application of the soundscape approach in urban sound planning can be expected in the future.

Keywords Soundscape design · Soundscape intervention · Soundscape planning · Urban planning

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11.1 Introduction

In urban planning and development, visual planning plays a major role while sound is often not considered from the beginning as a relevant point of concern to be managed. Frequently, at the end of the planning stage, sound is considered as a nuisance that has to be mitigated using technical measures and interventions (de Coensel et al. 2010). Consequently, the most common approach by far to noise control is remediation after noise conflicts are identified and, most likely, the remediation focuses on reducing the sound pressure level of noise. Over time with the growing awareness that sound is an integral part of an urban environment and the recognition that innovative, site-specific solutions are best determined by participatory processes, the soundscape approach has become more and more popular. Over the decades, soundscape researchers have encouraged the integration of sound considerations at the earliest stages of urban design rather than waiting for noise problems to arise (cf., Steele et al. 2019b). The availability of international soundscape standards for data collection and analyses facilitates the integration of the soundscape approach into standard noise management and planning processes.

Soundscape approaches have been recognized by governmental organizations and national funding bodies in Europe and worldwide (cf., Kang et al. 2016). Joint efforts of an international research network to determine validated translations of the established soundscape measurement protocols into various languages have allowed worldwide national adoption of questionnaires for soundscape characterization (Aletta et al. 2020).

In the context of urban planning, it is not a matter of choosing either a method of noise control or the soundscape approach but rather choosing noise control that is complemented by soundscape planning (Brown 2012). Soundscape planning addresses aspects of quality of life and accounts for the perceptions of local citizens (Steele et al. 2019b). Such a paradigm shift toward a perception-oriented design of acoustic environments can also be observed for indoor environments. Consequently, Altomonte et al. (2020) state that indoor and outdoor environments must promote restoration, offer variation, and advance the introduction of positive stimuli for better quality of life. Merely limiting building performance standards to avoid negative sound impacts on humans, like disease or discomfort, is not sufficient anymore. Built environments must be designed to enhance positive outcomes (Altomonte et al. 2020).

11.1.1 Soundscape in Urban Planning

Integrating soundscape in urban planning will continue to be a major challenge, especially when transferring the soundscape concept, with its inherent demand for a holistic approach and its interdisciplinary foundation, for real-world applications. In that sense, soundscape is sometimes perceived as an academic tool used by

numerous soundscape research studies that are working on indicators and descriptors, technologies, and frameworks. This may impede the application of a soundscape approach by urban planners who must deliver sound planning schemes and implement measures and interventions.

Moreover, urban planners and soundscape planners need to have basic planning skills, to be able to conduct fieldwork, and to have sufficient knowledge of the soundscape (Xiao et al. 2018). However, considering soundscape aspects at early stages in the planning process makes it possible to evaluate sound as a resource and not just as a nuisance to be managed afterward, as Schafer (1977) recommended in the 1970s. In this sense, significant progress has been made and a large body of experiences is now available to facilitate implementation of the soundscape approach.

11.1.2 Soundscape Action Plan, Interventions, and Stakeholders

In general, a large group of participating stakeholders is necessary to realize the soundscape perspective and to bring it successfully into practice. Planning and administration authorities are as important as the soundscape investigation experts and the local experts (see Sect. 11.3.1 for definition) in the communities under scrutiny (ISO 12913-2 2018). Although the soundscape approach with its interdisciplinary foundation is not yet established in urban noise projects, the increase in standards and technical specifications along with the rising number of implemented soundscape interventions are evidence of a significant change.

Related successes include the soundscape action plan (Welsh Government 2018) and the WHO guidelines for environmental noise (see Brown and van Kamp 2017) to exploit all intervention types to achieve substantially healthier acoustic environments. In Montreal, a cross-sector partnership called *Sounds in the City* was formed by university soundscape researchers, acoustic consultants, and the City of Montreal several years ago with the aim of connecting research and practice to make cities sound better (Steele et al. 2019b). Based on this collaboration, among other outcomes, a sound map of Montreal was successfully developed as a web-based soundscape project (https://www.montrealsoundmap.com) that empowered local people to make their personal soundscapes tangible and also compiled a shared database (MSM 2022). These developments are evidence of the increased attention being directed toward soundscape methods and practices. In this context, innovative interventions that are based on sound-conscious designs that go beyond conventional noise control approaches are needed to exploit all opportunities to significantly decrease the negative impact of noise, provide environmental improvements for public health, and promote individual well-being.

As Fig. 11.1 illustrates, successful urban sound planning must consider interventions at various levels to preserve and/or to improve a soundscape by following the

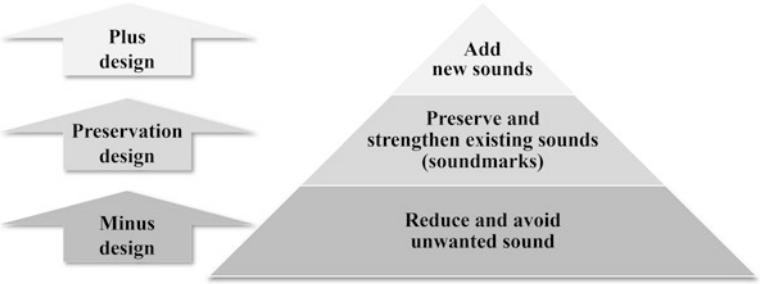

Fig. 11.1 From minus to plus design: typical fundamental approach for soundscape design. *Minus design* refers to noise abatement measures where unwanted noise is reduced. This can be understood as the conventional way of dealing with noise in noise control. The *preservation design* step refers to the identification and preservation of sound sources that contribute to the existing acoustic environment in a positive way. This is particularly relevant for sounds that are unique for a site and allow for identification of the place by listening. Those specific sounds are often called soundmarks (Schafer 1977). The *plus design* as the final step in the design pyramid intends to improve a soundscape by deliberately introducing new sound elements to an existing acoustic environment. Schafer (1977) described this design step as "… carefully redesigning the soundscape by adding sounds that will harmonize with the environment and with each other" (Schafer 2012, p.8). For more information see Siebein and Siebein, Chap. 5

Intervention Type/Level	Source	Path/ Infrastructure	Design	Local expert
Examples of measures	traffic flow road surface traffic composition	barriers tunnels greenery dwelling insulation traffic management	green areas sound quality noise masking quiet façade side soundmarks	communication education participation co-creation behavior

Fig. 11.2 Intervention framework adapted from van Kamp et al. (2019) and extended to soundscape. Interventions can be directed at sound sources or to transmission paths. Beyond those conventional measures, interventions can be implemented on a larger scale by which further aspects of the surrounding (e.g., easy access to quiet areas) or the living environment (e.g., flats with rooms facing the quiet façade side) are addressed that have an impact on well-being without directly reducing the noise exposure. Moreover, interventions can also be related to the involvement of the local experts to jointly work on solutions based on co-creation for a better soundscape. Soundscape design considers and exploits all intervention types with special emphasis on the local expert to develop a site-specific soundscape design

soundscape approach. This extended intervention framework goes beyond the established three-step soundscape design approach: (1) to reduce, buffer, or mitigate noise elements that are unwanted; (2) to determine, preserve, and enhance those sound elements that are desired; and (3) to create new sound elements that enhance the overall soundscape, as illustrated in Fig. 11.2 (see Brooks, Chap. 4; Siebein and Siebein, Chap. 5; Siebein et al. 2006). All intervention types must be equally considered simultaneously to achieve high soundscape quality. This even concerns

communication, behavior, and co-creation as well as the exploitation of non-acoustical factors to modulate perception (cf., Kang et al. 2016, see Fig. 11.1). This notion corresponds to the holistic concept for urban sound planning based on the soundscape approach. For example, the specific function of the space must be determined to ensure acoustic compatibility of any future soundscape design within the site (Cerwén et al. 2017), the specific needs and requirements of the local population must be assessed (Schulte-Fortkamp and Jordan 2016), and their local culture and history must be considered (Kang et al. 2016) in addition to the (physical) impact of the acoustic environment on the residents.

The soundscape approach uses all information available on the key components of *people*, *acoustic environment,* and *context* to investigate an existing area (ISO 12913-1 2014) and to identify the interventions and actions required to preserve or improve a soundscape as much as possible (ISO/PWI TS 12913-4 2020). Focusing simply on the characteristics of sound sources and paths as the primary objective of conventional noise control studies is not sufficient to significantly improve soundscapes in a sustainable manner. Moreover, consideration of the context is important because non-acoustic factors are as important as acoustic ones in shaping the soundscape of a space (Taghipour et al. 2022).

To consider the voice of the users and local experts in the space under scrutiny, standardized soundscape data collection tools and methods (ISO/TS 12913-2 2018) are frequently applied in an acoustic consulting environment (Mitchel 2021). On the one hand, this development leads to more practical experiences with which to integrate soundscape methods and former conventional procedures and, on the other hand, facilitates discussion of the practicality of addressing issues (Heggie et al. 2019).

11.2 Soundscape Design and Interventions

11.2.1 From Soundscape Design to Soundscape Intervention

Soundscape design indicates the plan to specifically change an existing acoustic environment or to plan a new area. A soundscape intervention is the implementation of the design plan to preserve or improve an existing soundscape. In other words, the soundscape intervention is more than just the intention to preserve or improve soundscape: it is the factual realization of the intention (i.e., the design plan). The implementation of soundscape designs, which are usually derived from soundscape investigations that determine site-specific needs, is becoming increasingly popular. At present, collections of successful soundscape design interventions are quite scarce, and practical guidelines to implement soundscape design are rarely available in landscape or urban planning and design literature. Therefore, current initiatives and projects must overcome the relative lack of documented examples of interventions and soundscape design (Moshona et al. 2022).

Platforms and websites like *Catalogue of Soundscape Intervention* (CSI 2022), *Soundscape Design* (SD 2022), or *Urban Identity* (UI 2022) list several implemented soundscape interventions and soundscape projects. Lavia et al. (2016) gave a broad range of soundscape design and intervention examples with a comprehensive discussion of the applied methods and outcomes with the effects on citizens at the heart of the work. These developments indicate the growing interest in soundscape design in urban development and also indicate the increase in requests by authorities and urban planners to learn more about soundscape projects. The availability of databases showing successful soundscape interventions allows recognition of recurring strategies that probably can be collated into design toolkits (Moshona et al. 2022). However, as the soundscape concept relates to the perceptions of a specific location and emphasizes the specific context, the determination of universal interventions and implementation strategies might not be possible.

11.2.2 Examples of Soundscape Interventions

Soundscape interventions range from conventional noise mitigation combined with new approaches (e.g., installing loudspeakers or introducing natural sound features for additional masking) to sound installations and art. Examples include a dynamic system of water fountains in a public square (Kang and Hao 2013), natural organs played by sea waves (Oberman et al. 2020), the combination of a noise barrier with loudspeakers playing back natural sounds (Cerwén 2016), and the installation of audio islands as seating furniture with integrated loudspeakers for informational masking purposes (Schulte-Fortkamp and Jordan 2016).

In general, the introduction of natural elements (e.g., sounds from birds, vegetation, or water) in soundscape projects can frequently be observed as those interventions are related to higher psychological restoration (Payne 2013) but also might reduce stress, ultimately contributing positively to general health (Hägerhäll et al. 2017). Steele et al. (2019c) confirmed that naturalistic sounds increased calmness and lowered perceived sound levels; however, they also showed that these benefits extended similarly for sound art that uses added sounds with cultural themes consisting of music extracts, speech, and urban elements.

Masking techniques can play a prominent role in soundscape design to enhance or introduce preferred sounds that mask unwanted sound components or that divert attention to other more pleasant sounds (Kang et al. 2016). In the context of masking, Cerwén (2016) observed that the use of masking strategies was effective in his soundscape project in the city of Malmo, Sweden, at the given sound pressure level (i.e., 58 dB(A)). However, the implementation of adding sound designed to energetically or informationally mask unwanted noise might have limitations. Zhang and Kang (2007) estimated that additive sound design using the principle of masking might work until approximately 70 dB(A). For higher sound pressure levels, an increase of annoyance can be expected due to sensory overload that is independent from the valence level of the sound.

Kang (2010) suggests protecting the diversity of sounds in acoustic environments because they characterize a place and can be related to cultures and history (Schulte-Fortkamp and Jordan 2016). This often intersects with the attractiveness of a place with regard to tourism. Similarly, Fiebig et al. (2016) observed in a nationwide, citizen science project in Germany (initiated by the German Federal Ministry of Education and Research) that in addition to the general desire for quiet urban places, acoustically diverse and vibrant places were frequently mentioned by citizens as their favorite places in their urban environments. In this context, the term *soundmarks* became associated with specific community sounds that provide spatial and temporal orientation. Soundmarks, as defined by Schafer (1977), are unique community sounds with special qualities that are perceived by the people in that community and are associated with landmarks that are linked to a specific geographical area. In the citizen science project soundmarks like church bells or sounds from local city festivals achieved the highest number of likes (Fiebig et al. 2016).

11.2.3 The Social Dimension of Soundscape Interventions

Soundscape interventions are not intended to improve the acoustic environment by defining users as solely passive receivers. Interventions are also used to increase engagement with the environment, facilitate social interactions, and attract new user groups. For example, Steele et al. (2019a) observed those outcomes after providing an amenity that allowed for public music playing in a small pocket park in Montreal, Canada. This soundscape intervention, implemented as a democratic soundscape installation called Musikiosk, resulted in increased and diversified social interactions in the park while still ensuring a high level of restoration for visitors. This example illustrates how soundscape design can go beyond classical noise abatement to enrich the acoustic experience in an environment.

Soundscape design also considers the function of space, the person-environment interactions, and the support of social interactions. An in situ study on the effect of water features by Trudeau et al. (2020) suggested the value of including slightly audible misters in outdoor urban environments. Those misters support in space and design the user's activities which have a positive effect on the quality of the soundscape. Similarly, Cerwén et al. (2017) regards the location of specific functions within a place as a most important aspect of the overall planning. The location of functions should focus on the compatibility of new and existing functions, and planning should take into account how different functions affect the sound in space and time. Such considerations go beyond the aim of conventional noise control, which simply reduces the sound pressure level of unwanted noise. Urban sound must be evaluated and designed considering the specific place and contexts of use.

According to Lavia et al. (2016), typical soundscape interventions and sound management types include introducing sounds to a soundscape, utilizing sounds that already exist in a location, incorporating sonic art installations, employing noise control elements, and introducing design alterations, among other

possibilities specific to a location. As no well-established framework of soundscape interventions exists so far, research projects and initiatives are underway to overcome this deficit based on data collected with the specific intent of developing a comprehensive taxonomy (Moshona et al. 2022).

11.3 Implementing Soundscape into Practice

The soundscape approach demands consideration of key elements that include *people*, *acoustic environment*, and *context* (ISO/TS 12913-2 2018). Understanding the specific context, inclusion of all relevant stakeholders, and successful communication across research disciplines during soundscape investigations are complex and sometimes challenging requirements. This complexity can impede the application of a soundscape approach in practice and the value of guidelines, recommendations, and examples is clear. To address these needs, further standardization efforts are being made. For example, the ISO working group 54 "Perceptual assessment of soundscape quality" works on a part 4 within the ISO 12913 series to provide information about the determination of the need for soundscape interventions and guidance on how interventions should be implemented.

11.3.1 Co-creation

A further challenge concerns the participation of local communities in the development of solutions through co-creation. There is a broad consensus that the knowledge of the local experts is indispensable. Accordingly, Foth (2017) demanded that the role of the city government and the citizen must change: authorities must grow from a simple administrator role to a collaborator involved in forging a positive relationship between cities and the people living in those cities. Moreover, citizens must move from the passive role of residents to active participants and enthusiastic co-creators in an increasingly collaborative approach to city making (see Botteldooren, De Coensel, Aletta, and Kang, Chap. 8).

In the past, the creation of new urban environments used to be the responsibility of architects, urban designers, and local authorities; however, the role of the citizen has changed over time to a partner in the co-creation process (Winne et al. 2020). This kind of collaboration requires that information and participation tools are provided to the people involved, those we call the local experts. Local experts, as defined in the ISO/TS 12913-2 (2018), are persons familiar with the area under scrutiny, either living in the area or having daily activities there, who can provide valuable information about what they consider to be necessary measures (see Schulte-Fortkamp and Jordan, Chap. 3). The users of a space are the primary experts in any environment, and their feedback enables creative and responsive solutions for the acoustic design (Schulte-Fortkamp and Fiebig 2006; Lavia et al. 2016). Their

participation sharply focuses the subsequent analyses of any soundscape data, as the information provided enhances the sensitivity of the research team to the particularities of the examined areas (Schulte-Fortkamp and Jordan 2016).

Accordingly, Schulte-Fortkamp (2017) states it is essential to provide advice to local participants and stakeholders on how to use the given resources as sustainable solutions, considering future generations as well. Overall, a comprehensive consideration of all socio-cultural, aesthetic, and economic effects is necessary. Moreover, a platform must be available for communication that allows all stakeholders to participate. In this regard, a variety of sources of electronic communication, such as social networks, social media, and smartphone applications, are readily available for much of the population (see Brambilla and Fiebig, Chap. 7). Those platforms provide the public with the opportunity to generate data, to provide recommendations, and to pinpoint noise conflicts. The public is empowered to report on pleasant, restorative soundscapes that should be protected (Radicchi 2019a) or to document noise conflicts (NA 2022) that should be addressed by local authorities. Residents also are encouraged to support the generation of participatory noise maps (D'Hondt et al. 2013). Thus, Radicchi et al. (2018) point out that smart digital technologies are expected to play an important role for acousticians, city planners, and policy makers in the future.

Radicchi (2019b) observed an increase in the development of mobile applications that have been deployed as environmental noise and soundscape evaluation tools to allow everyone to contribute to addressing open questions in the field of environmental noise and soundscape research. At the time of the review, she found over 20 smart applications were available that allow for the collection of mixed data, such as noise levels, audio recordings, and the collection of user feedback. Figure 11.3 displays important aspects of successful electronic participation that are needed to encourage the public to take part.

Co-creation opens a wealth of opportunities to improve public spaces and their use but, of course, a few critical pitfalls must be avoided. For example, local experts are less familiar with technical terms which challenge the communication between stakeholders (Botteldooren et al. 2020). As discussed by Brooks (Chap. 4), introducing the concept of soundscape into the urban master-plan process early is vitally important to ensure that soundscape considerations are integrated into any comprehensive plan and are part of a publicly available, visionary document. The key is to inspire proactive planning versus reactive measures regarding sound resources, their benefits, and impacts.

11.3.2 Training in Participation

Sometimes the lack of technical expertise among residents limits their ability to estimate the (perceivable) impact of noise control measures as they are less familiar with the technical terms, as Botteldooren et al. (2018) observed. Therefore, training sessions are proposed for the people who are participating in the co-creation

Fig. 11.3 Elements of successful electronic participation of the public in the context of urban sound. According to Fiebig et al. (2016), electronic participation opportunities can only have their intended effects if several requirements are met. The opportunity alone to participate electronically in a project does not automatically lead to a large turnout. Therefore, designers of electronic participatory projects need to carefully consider the conditions (as shown in the figure) to meet the desired public resonance

process. Technical terms, such as the averaged equivalent sound levels, can be explained and made more understandable. The result will be a more effective co-creation process with informed input from the residents.

Technological developments of virtual and augmented reality might help in the future to preview urban design and architecture both off site and on site. Experiencing the relative effectiveness of potential measures, at least to some extent, can facilitate discussions between different stakeholders. The soundscape experts, whether residents, regular visitors, or concerned public stakeholders, can communicate and work on solutions using different formats, such as workshops, public discussions, soundwalks, public consultations, or presentation of creative seminars.

Brooks et al. (2014) presented a case study in which they focused on co-creation with people from the downtown area in Jamestown, Rhode Island. The issue was noise from a beer garden, and they used a variety of methods for community participation, including physical sound surveys and stakeholder workshops (see Brooks, Chap. 4). The outcome of this participatory procedure was the unexpected decision by the residents to oppose limitations of the sound emissions from the beer garden as the activity is important for community identity (Schulte-Fortkamp et al. 2007; Brooks et al. 2014).

Table 11.1 describes how different tools and methods can be applied to involve local experts successfully as co-creators. Steele et al. (2019b) support increasing the connections between soundscape evaluations and emerging models of participatory design and planning that will facilitate the dissemination of knowledge and, ultimately, make cities sound better. Local experts need to be empowered to take part in urban sound planning by approved participatory methods to represent their interests and needs.

Table 11.1 Forms of cooperation and communication in soundscape projects. Summary of different forms of co-creation

Measure of cooperation and communication	Description
Workshop	A group of local experts together with few other stakeholders develop soundscape design solutions by means of a collaborative process without addressing any technical requirements and boundary conditions. Outcomes of the workshops are evaluated with respect to criteria including feasibility, regulatory requirements, costs, and sustainability in subsequent steps
Public consultation	Process by which the public opinion about a project is collected and discussed. Sometimes the public consultation is also used to inform the public about potential measures and developments, which increases transparency and acceptance
Soundwalk	Site inspection to raise awareness of site-specific demands with soundscape project stakeholders and/or for data collection
Creative seminar	A group of local experts together with a few additional stakeholders develop creative soundscape design solutions for inspirational purposes. Ideas and proposals can be based on artistic approaches
Focus group discussion	Problems and objectives are identified through interactive and directed discussions with stakeholders and local people

Figure 11.4 illustrates a model of a flexible participatory, urban soundscape-planning process suggested by Xiao et al. (2018). Different participation and engagement methods are proposed for different urban scales: from street level, community level, and city level. Various methods are needed to successfully engage stakeholders at these different stages of soundscape planning and the design process. In this context, it is important to mention that at each planning phase, the strategies and design plans should be re-evaluated to allow maximum freedom in the next stages and to avoid missing opportunities to create the most pleasant and healthy living environments (van Renterghem et al. 2020).

Engaging the local experts is critical. Achieving a good understanding of soundscape concepts by the stakeholders is an essential step to be completed before conducting further work. Greater understanding among all participants guarantees due consideration of regulatory requirements and further aspects of the project.

11.3.3 Integrating the Virtual Experience

Several examples are available that illustrate how the soundscape approach can be extended by using virtual reality (VR) for non-existent or future environments (see Brambilla and Fiebig, Chap 7). Vorländer (2020) acknowledged that tools of acoustic virtual reality offer ground-breaking opportunities to advance sound assessment both in preliminary consulting and in actual practice.

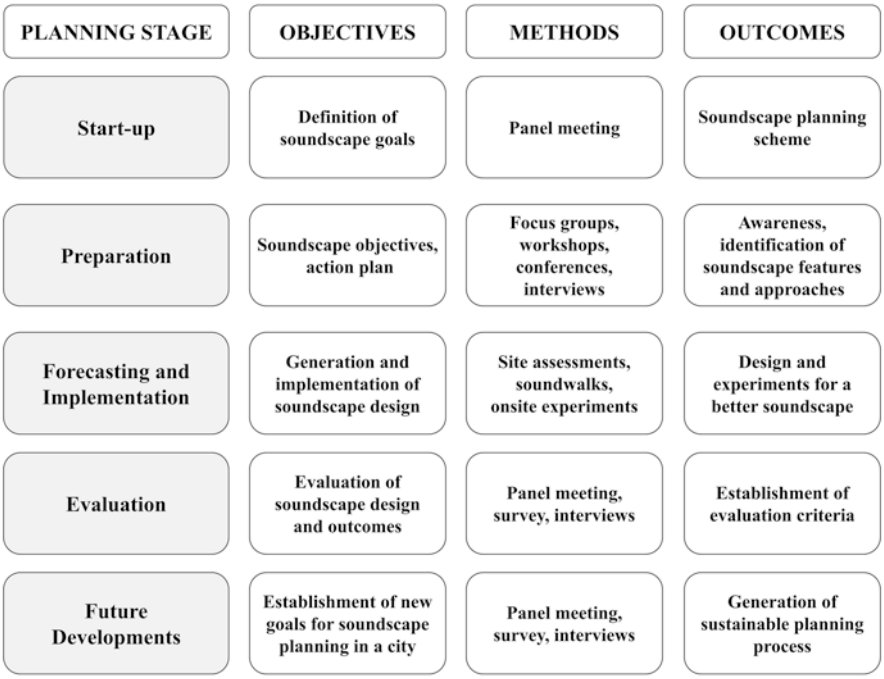

Fig. 11.4 Proposal of an agile participatory process for urban soundscape planning by Xiao et al. (2018) shown in a condensed version. The soundscape planning process is understood as an iterative, agile, and circular process to manage interactions with local experts as co-specifiers. The process is flexible: each stage can be referred back to the last stage and re-developed to meet the objectives. As shown in the figure, different methods like panel meetings, surveys, soundwalks, or interviews can be performed at different stages to achieve the respective objectives, to support the co-creation process, and to consider sufficiently location-specific aspects. (Adapted from Xiao et al. 2018)

A practical example is presented by Sajeev et al. (2022). They applied the soundscape approach for a co-housing development project in combination with a conventional noise impact assessment. They performed in situ soundwalks with future residents during daytime and night-time periods, covering locations with different sounds and different future uses. Beyond that, they created virtual soundwalks based on auralizations to provide an actual experience of the future soundscape. They concluded that their procedure helped the residents to recognize design improvements for the sound environment of their future homes, fostered inclusivity, and facilitated co-creation (Sajeev et al. 2022).

Oberman et al. (2020) used virtual techniques to investigate the value of soundscape interventions with musical features that were introduced to public spaces as permanent sound art. They used second-order ambisonics (a special surround sound format) that reproduced the three-dimensional spatial relationships of both static and dynamic sound sources and combined the ambisonics with panoramic photographs to determine the effect of sound installations at specific sites (see Brambilla

and Fiebig, Chap.7). They showed based on the virtual scenarios the potential which public sound art has when applied within urban design; adding sound art to a site can influence not only pleasantness but also appropriateness of the overall acoustic environment (Oberman et al. 2020).

Although a gap between on-site and virtual experiences of soundscape may still exist, studies suggest that there are similarities in sound source recognition and sound assessments under those different conditions (e.g., Hong et al. 2019). Once a certain level of immersivity is reached, soundscape evaluations obtained in VR-based experiences seem to be like those obtained directly at the same location, at least when analyzing the results from standard questionnaire surveys (Rajguru et al. 2020). Thus, the application of VR for experiencing non-existing acoustic environments appears basically conceivable.

Fraisse et al. (2022) applied a higher order ambisonics soundscape simulation tool to design a permanent sound installation in an urban public space in Paris. Lugten et al. (2018) used virtual reality experiments to evaluate the benefit of introduced water features in soundscapes affected by aircraft noise. They observed the reduction of the saliency of aircraft flyovers with the presence of moving water sound features, which clearly indicated that soundscape strategies can complement noise abatement in areas prone to aircraft noise. These examples show that simulation techniques allow perceptual assessments of various options for soundscape interventions before they are implemented, and modifications of less successful interventions as indicated by the virtual experiences.

As shown by the projects and case studies presented here, using sound reproduction techniques facilitates co-creation and allows participatory approaches during project development (see Schulte-Fortkamp and Jordan, Chap. 3). Although some challenges remain for successfully producing virtual soundwalks that allow a future soundscape to be experienced, there are no real obstacles to providing a holistic approach and putting human perception in the center of soundscape considerations.

11.4 Summary

There is no doubt that there is increasing interest in the soundscape approach and application of soundscape techniques when dealing with environmental noise (Aletta and Xiao 2018); however, integration of the soundscape approach with standard community noise procedures is not mandatory at present. Nevertheless, there is evidence for an ongoing paradigm shift from noise control to soundscaping and soundscape approaches are increasingly applied in noise management projects and everyday practice (cf., Jiang et al. 2022).

Indeed, further research is required on soundscape design to reduce the gap between theory and practice (Carvalho et al. 2019). In particular, knowledge gained about best practices must be shared among academic researchers, urban planners, and designers (Aletta and Xiao 2018). The main issue is to bring the soundscape

approach successfully into practice for all kinds of environmental noise projects. Goals for the future of soundscaping can be summarized as follows:

- Raising awareness of all stakeholders for the need to integrate the soundscape approach in all stages of urban sound planning through public activities
- Promote education for students, professionals, and practitioners in soundscape methods to enable consistent and proper use of soundscape data collection and analysis methods according to national or international specifications (e.g., ISO/TS 12913-2 2018; ISO/TS 12913-3 2019)
- Integrate soundscape methods in legal frameworks to promote their regular use in everyday practice and to stimulate future developments based on the gained experiences in practice
- Improve virtual reality technologies to allow the perceptual assessment of non-existing environments in a multidimensional way with the help of local experts
- Provide more scientific evidence regarding the sustainable design of soundscapes and impacts on public health
- Disseminate current developments in conferences and workshops

While some challenges remain, inclusion of the soundscape approach in a variety of noise management and development projects is becoming more common. Increasingly, soundscape projects are overcoming imagined obstacles in noise management and development and providing successful temporary or permanent interventions (Oberman et al. 2020). In those projects, the expertise of locals was considered and acknowledged at each stage of the planning process, which produced effective outcomes and sustainable solutions.

The soundscape interventions that were implemented in various successful projects and studies have been documented and have demonstrated the benefit of the soundscape approach, validating these practical applications beyond academic interests. Understanding the performance of previous soundscape investigations leads to more established best practices that include the involvement of local experts in co-creative processes and the consideration of location-dependent particularities. In addition, ongoing research activities will provide further information about soundscape interventions and how to achieve the intended purpose, for example, the detailed design of waterfalls, fountains with upward jets, and the configuration of flowing streams to effectively promote peacefulness and relaxation in the presence of road traffic noise (e.g., Galbrun and Ali 2013; Calarco 2015) or the effect of various water features and vegetation on the perceived levels of aircraft noise (Lugten et al. 2018).

In general, soundscape planning could be successfully introduced to large urban (re)development projects and multi-stage development projects (van Renterghem et al. 2020) because the technical, economic, and organizational feasibility of integrating soundscape design actions has been demonstrated. Guidance on how to set-up a communication framework to bring all stakeholders successfully on board and how to implement innovative soundscape interventions will additionally increase the interest in, and applicability of, the soundscape approach in urban sound planning.

The ISO working group 54 (ISO/PWI TS 12913-4 2020) provided standardized guidance on how to design soundscapes to preserve or improve a soundscape. This guidance intends to encourage the further rise of the soundscape concept within urban planning processes and establish new ways of managing urban acoustic environments beyond noise regulations that focus on designating noise level limits.

Finally, the built environment should not be viewed as a monolithic construction. The history and current purpose of a place must be considered in urban planning, particularly with respect to comfort, engagement, and community connections. Over time, an acoustic environment is also constructed by the various people who use it and their interactions within the space. Thus, the strategies used to understand any particular location must be adapted to these singularities. Considering how to most effectively balance acoustic measurements, architectural planning, and input based on the expertise of local experts will lead to a new understanding of co-creation methods in urban planning.

Compliance with Ethics Requirements André Fiebig declares that he has no conflict of interest.

Brigitte Schulte-Fortkamp declares that she has no conflict of interest.

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