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Foster the application of ISO standards on climate change adaptation in cities

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Abstract: A set of ISO standards on climate change adaptation exist that are relevant for the application by cities. However, the knowledge of these is limited among the target groups as well as support is needed to foster their application at city level. The CitISOsCA research project addressed these aspects by different engagement activities using mainly surveys and workshops. The main outcomes of this research are seven verified elements to support applying a standard at city level, and aspects to consider when start the application of a CCA standard in a city. The research fills the gap in literature, which lacks on information on how the application of standards can be fostered.

Keywords: ISO standards, climate change adaptation, application of standards, ISO/TS 14092

Highlights:

1. There are a number of standards that support cities in their efforts to adapt to climate change.
2. CCA city stakeholders have significantly more knowledge of general ISO standards than of CCA-relevant ISO standards.
3. Seven elements to support the application of standards at city level
4. Aspects to take into account when start the application of a standard in a city.

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1 Introduction

The topic of climate change adaptation (CCA) has become an important focus in standardization, and ISO has published several standards and further publications on CCA in the last four to five years. Hereby, they worked with global players on this topic like UNFCCC the United Nations Framework Convention on Climate Change or the World Bank (ISO, 2018). In order to support the understanding of CCA, it is necessary to define the concept of adaptation and distinguish it from the climate change concept and actions related to mitigation, for example. For UNFCCC adaptation refers to “adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects

or impacts. It refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change" (UNFCCC, 2023).

Although these standardization activities exist, there is no comprehensive information on the awareness and use of the standards by the different CCA actors. Cities are key actors in this regard, as they increasingly face climate related hazards such as heat waves or flooding and are highly relevant for achieving the Sustainable Development Goal (SDG) 13 'Climate Action' (UN, 2023). However, cities struggle to work intensively on CCA and to apply related standards. The project CitISOsCA ("Cities as focal points to foster the uptake of ISO standards on Climate change Adaptation") addressed these aspects by raising awareness on CCA-related ISO standards at city level and by providing support for their application.

1.1 About the CitISOsCA project

The CitISOsCA project was a research project led by Tecnun School of Engineering, University of Navarra (Spain) and conducted between October 2022 and August 2023 (CitISOsCA, 2023). It investigated the application of ISO standards on CCA at city level, identified the need for additional standards on CCA, and developed supporting elements for cities to apply the relevant ISO standards, which is the main objective of this paper. The target groups of the project were cities and communities from Europe and Latin America. It was funded by ISO and supported by ICLEI Europe Local Governments for Sustainability, the Spanish standardization organization UNE, and Instituto Ciudades del Futuro, a member of the Argentinian standardization organization IRAM. The main project activities were:

- A desktop research analyzing how research projects or international initiatives with focus on CCA have considered standardization, and to review the relevance of CCA ISO standards for cities (see section 1.2);
- An online survey to gather the cities' knowledge of standardization and of ISO standards on CCA, as well as to identify cities' challenges related to CCA (see section 2.2);
- Two cities workshops to discuss the CCA challenges and the difficulty of applying standards at city level;
- A Delphi survey to complete and verify the supporting elements for standards application;
- A workshop in Valencia, Spain, to confirm the supporting elements for standards application and to go through a practical example of applying an ISO standard on CCA.

In total 186 participations were achieved in the surveys and workshops, of which 129 were from European CCA stakeholders and 57 from Latin American ones. The results presented in this paper focus on the project outcomes related to the application of ISO standards.

1.2 ISO standards on climate change adaptation with city relevance

A search in the Online Browsing Platform of ISO using the keywords climate change adaptation and city or synonyms resulted in January 2023 in the identification of 197 standards (ISO, 2023). After assessing initially, the results for their focus on climate change

adaptation, the list of standards decreased to 24 items, of which one was a draft standard under development. These standards were developed by eight different ISO Technical Committees, which shows the diversity and complexity of the CCA topic and its relation to cities. Each standard identified was analyzed for its relevance to cities, with the relevance level selected based on the frequency of keywords used and the direct reference to cities and CCA. In total, nine identified standards had a low relevance, eight a medium relevance and seven a high relevance. The highly relevant standards are listed in Table 1.

Table 1: CCA ISO standards with high relevance for cities

No.	Title	Year	Relation to cities
ISO 14080	Greenhouse gas management and related activities — Framework and principles for methodologies on climate actions	2018	Communities are one characterization type in the standard; local governments as benefiting organizations of the framework in the standard
ISO 14090	Adaptation to climate change — Principles, requirements and guidelines	2019	Includes direct references to communities and local governments
ISO 14091	Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment	2021	As the scope is very broad, it has also relevance for cities
ISO/TS 14092	Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities	2020	Local governments and communities are the main focus of the standard
ISO 14093	Mechanism for financing local adaptation to climate change — Performance-based climate resilience grants — Requirements and guidelines	2022	Due to reference to subnational authorities and local communities, cities and urban areas are also included
ISO 37123	Sustainable cities and communities — Indicators for resilient cities	2019	Direct focus on cities; includes CCA indicators (in mapping with SDGs 11 & 13 in Annex D)
ISO/DIS 24566-1[2]	Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts — Part 1: Assessment principles	DIS	Direct relations to urban activities, e.g. in section 9.3 and Annex A.3

As most relevant standard, the ISO/TS 14092 (ISO/TS 14092, 2020) has been identified, which provides detailed information, among others, on roles and responsibilities towards adaptation within local governments and communities, the assessment of climate change impacts and opportunities, the formulation of an adaptation plan, as well as on its

[2] Published in November 2023 as ISO 24566-1

implementation, monitoring and evaluation, and reporting and communication. Furthermore, the annex of the document provides examples of tables of contents of local adaptation plans from cities of different sizes (e.g. Vancouver, Canada; and San Sebastian, Spain) and tools for these plans.

2 Status quo about the application of ISO standards at city level

2.1 Literature and initiatives on CCA with relation to ISO standards

The literature about the application of standards related to city resilience, which includes the topic of CCA, is rare. Two examples are Vakula et al. (2020) and Maraña et al. (2019). Vakula et al. (2020) analyzed the resilience-related international standards ISO 37101 'Sustainable development in communities – Management system for sustainable development – Requirements with guidance for use' and ISO 37120 'Sustainable cities and communities – Indicators for city services and quality of life' for their potential application in Moscow, Russia. It was pointed out that the possible lack of interest on the part of governors and mayors in discussing sustainability and resilience issues in general was originally attributed in part to the unsuccessful translation of the standards into Russian. Moreover, the authors have examined how the city of Moscow can benefit from the involvement of communities to sustainable development outcomes, thus responding to the requirements set in ISO 37101. In addition, Maraña et al. (2019) provided information on the European city resilience project SMR, which has developed and applied in their city cases the standards series CWA 17300 on 'City Resilience Development', of which the content derived from the resilience-enhancing project tools. Hereby, the key stages of the resilience management cycle described in the CWA 17300 'City Resilience Development - Operational Guidance' had influenced some indicators of the ISO 37123 'Indicators for resilient cities'. Moreover, the project partners have benefit from translating these project tools into practical and short guidance documents (SMR, 2018). For example, the CWA 17302 'City Resilience Development – Information Portal' supported the city of Kristiansand, Norway, in improving their communication with citizens and stakeholders. And the CWA 17301 'City Resilience Development – Maturity Model' enabled the City of Vejle, Denmark, to have a standard tool to measure in which level they are in making the city resilient, as well as identify areas that they need to focus on in the future.

In addition, there are some international initiatives referring to CCA-related ISO standards. For example, the World Council for City Data (WCCD), which have led the development and implementation of the ISO 37120 standards series on city data, including ISO 37120 'Indicators for sustainable cities', ISO 37122 'Indicators for smart cities', ISO 37123 'Indicators for resilient cities'. Moreover, they provide a certification scheme to these ISO standards (WCCD, 2023). Another initiative is the 'Guide to Climate Risks' developed by the Development Bank of Latin America. They refer to the ISO 14090 standards series, including a comprehensive description of their content and the use of their terminology (CAF, 2020). A Finally, the CCA activities of the EBRD - European Bank for Reconstruction and Development can be highlighted. They are promoting the participation in relevant standardization committees and the implementation of ISO 14090 standards series (EBRD, 2022).

However, also these activities and initiatives exist, there is no information provided that directly supports cities in their efforts of applying standards.

2.2 Current application of CCA ISO standards in Europe and Latin America

As described above, the CitISOsCA project assessed in the beginning the knowledge of standardization and (CCA-related) ISO standards in an online survey. In total 93 respondents, 66 of European CCA city stakeholders from 20 countries and 27 Latin American ones from 11 countries, could be gathered during February and March 2023. The survey was titled 'Supporting cities in Adapting to Climate Change through Standards', created in Microsoft Forms and made available in six different languages (English, Spanish, Italian, German, French, and Portuguese) to gather more responses from countries in Europe and Latin America. The resulting data of the survey was analyzed by using Microsoft Excel to compare, among others, the respondents' backgrounds and level of experience in CCA, and their knowledge with ISO standards and standardization. A content analysis was done to summarize the answers of the open questions related to reasons for (not) applying the provided CCA-related ISO standards, which were the ones displayed in Table 1 above.

The majority of the respondents (55%) were staff working for a city, public body or city association, followed by researchers (17%), businesses (13%), and representatives of local communities (7%) (see Figure 1). Moreover, about 70% of the respondents were from Europe or from a city. Most responses were in Europe from Spain (12), Italy (9), Germany (8) and UK (6); and in Latin America from Peru (6), Mexico (5) and Chile (4). With almost 50%, the majority of the respondents had more than 5 years extensive working experience with CCA.

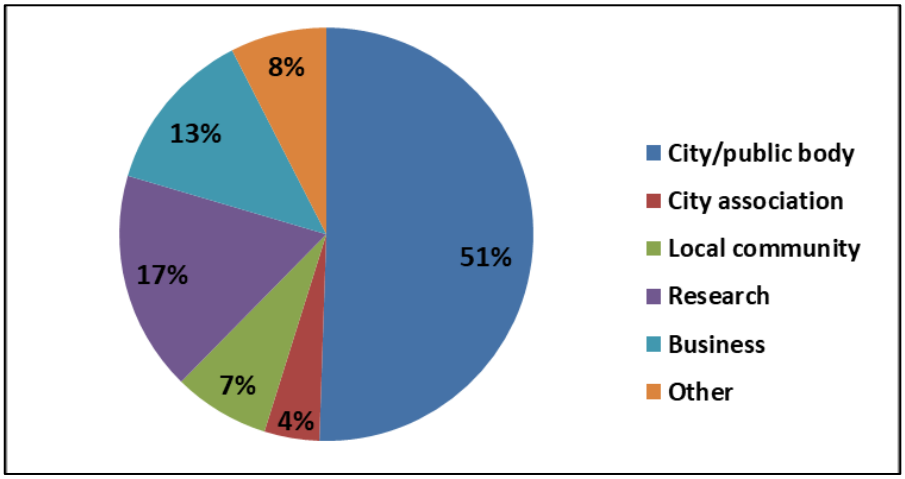

Figure 1: Type of organizations to which respondents belong

The questions related to the respondents' knowledge of standardization and ISO standards (e.g. ISO 9001) in general were answered with more than 80% each very positively. However, when asking about their knowledge of ISO standards related to CCA, at least half of the respondents do not know the ISO standards relevant for CCA. About 30% to 40% of the respondents were aware of these standards, but do not know if their organization or city applies them. And with only between 2% to 15%, very few respondents apply these standards (see Figure 2).

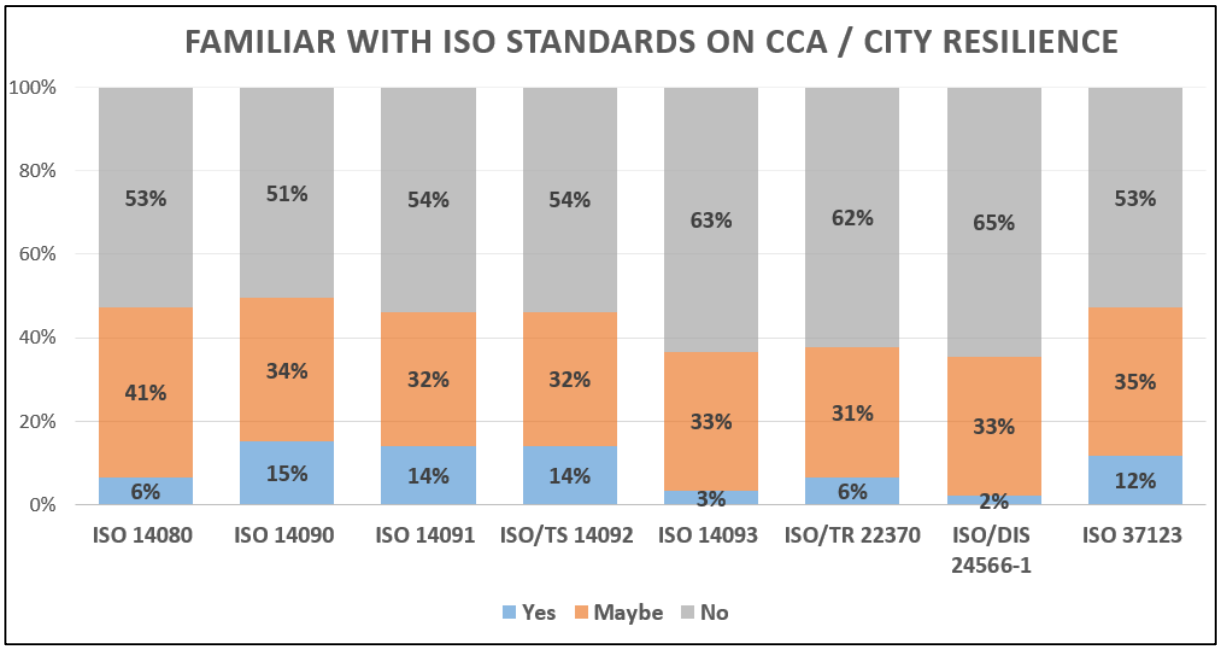

Figure 2: Respondents' familiarity with CCA-related ISO standards

The respondents mentioned as reasons for applying one of these standards that the standard, among others:

- supports compliance with national or regional regulations,
- supports benchmarking with others,
- improves their resilience strategy,
- strengthens stakeholder engagement, or
- improves policy making.

In comparison, the respondents indicated that they do not apply any of these standards as, for example, they:

- do not know these standards or if the city applies them,
- have insufficient staff capacity,
- have a knowledge gap,
- don’t have the costs of implementing them, or
- lack of management support.

In summary, it can be said from the survey that the knowledge of CCA ISO standards is quite low among CCA city stakeholders in Europe and Latin America and that there are several aspects that influence the application of these standards.

3 Method

To respond to the low level of knowledge and use of the CCA ISO standards at city level, supporting elements to the application of standards were searched for. Therefore, three activities were conducted in the CitISOsCA project to identify, improve and verify the support for the application of international standards at city level. At first, within the two cities workshops with CCA city stakeholders of Europe and Latin America the following question was discussed: 'What is needed to support the application of CCA standards at city level?'. To answer this question, the focus group technique was used. Within a focus group a certain topic is discussed among the participants with the support of a moderator or facilitator (Krueger and Casey, 2008). The results of these workshops were refined and completed in a subsequent Delphi survey. As third activity, a workshop in the city of Valencia, Spain, was conducted using again the focus group technique. Besides approving the results of the previously conducted cities workshop (see section 4), this event additionally consisted of an exercise on the implementation of a CCA- and city-related ISO standard (see section 5). Figure 3 summarizes the methodology of this research, followed by a detailed description.

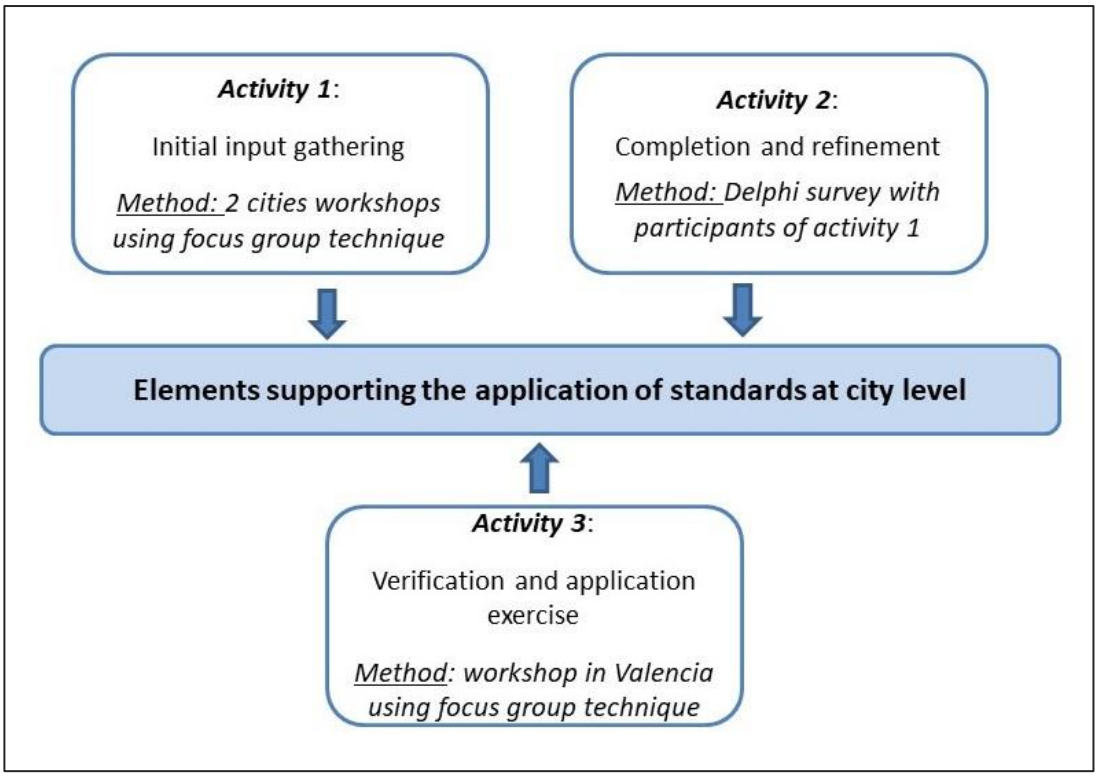

Figure 3: Methodology to develop elements supporting the application of standards

Activity 1: Within the two cities workshops, one each targeted to CCA city stakeholders in Europe or Latin America, in total 51 participants of 20 countries were participating. Finally, 30 participants contributed during the interactive session, which was divided into four sub-groups (i.e. focus groups) to allow gathering more input by the participants and to have more detailed discussions. With seven and six, the majority of the participants during the European workshop were from Spain and Germany, respectively, followed by three each from Italy and

Greece. In comparison within the Latin American workshop, most participants were with seven from Peru, followed by three from Mexico, and two each from Colombia and Argentina. As for the background, most of the participants were directly from a city/public body or a private organization working on CCA for a city (see Figure 4).

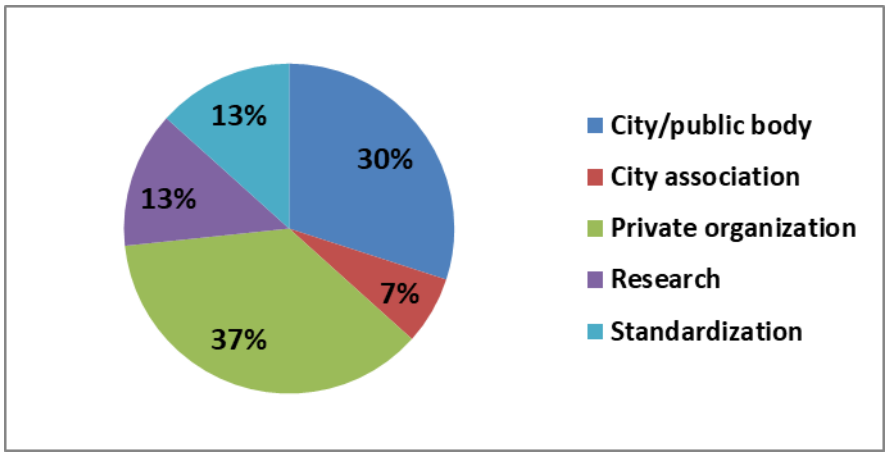

Figure 4: Background of participants in the cities workshops

Activity 2: The participants of the first activity were approached afterwards using a Delphi survey. A similar format has already been used in previous research related to standardization and cities (Ruess and Lindner, 2023; Muse et al., 2020). The input summarized from the cities workshops were refined, completed with responsible entity (city, supporting organization or standardization body), and rated for its relevance in a two-stage Delphi survey with in total 31 participations. In the first round of the Delphi survey, a total of 16 responses were gathered, equal to a participation rate of 31%. With 12 persons from six countries, most of the participants were from Europe, completed by four persons from four Latin American countries. The second round included 15 persons that responded in the first round (participation rate of 94%). The following figure provides information on the participants' background, which were with more than two-third from a city/public body.

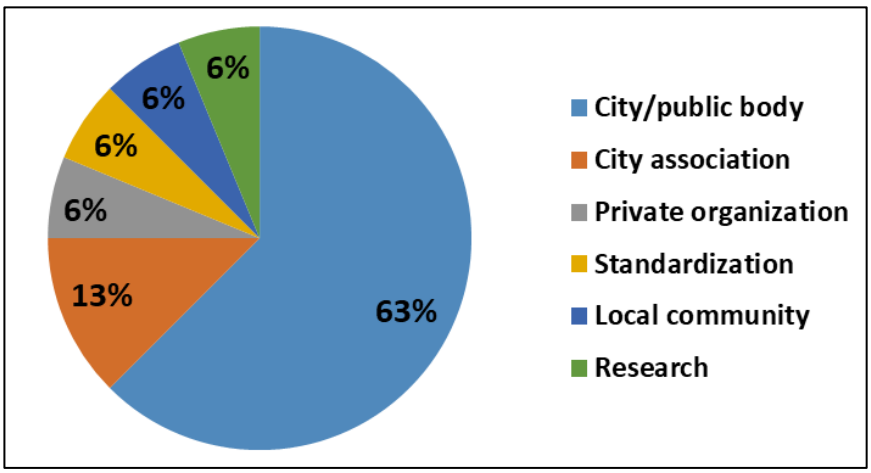

Figure 5: Background of participants in the Delphi survey

Activity 3: Within the city workshop in Valencia, Spain, in total nine persons participated to verify the results of the Delphi survey and to conduct an exercise on applying a CCA standard at city level. By using the focus group technique, the participants rated the relevance and allocated responsible entities to each of the elements supporting the application of standards. After this introduction, the main focus of this workshop was the application of the ISO/TS 14092 'Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities'. Therefore, the focus group was giving a copy of the standard to start thinking of its application. The group was completely free in its approach and the moderators were more passive reviewers of this exercise to gather relevant aspects to consider when start applying a standard in a city. With four persons, the majority of the participants were representatives of the city or municipality of Valencia, followed by three participants from private organizations supporting CCA activities in Valencia, and two researchers who participate in collaborative CCA projects with the city of Valencia (see Figure 6).

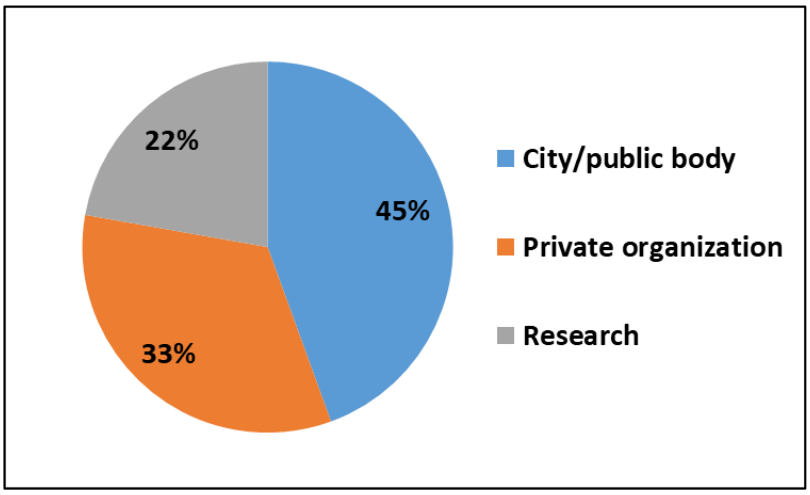

Figure 6: Background of participants in the workshop in Valencia

4 Elements supporting the application of standards at city level

During the focus groups in the cities workshops in total 28 inputs, of which 21 were from European CCA stakeholders and seven from Latin American ones, were gathered for the question on which support is needed for the application of CCA standards at city level. These inputs were summarized to seven elements and sent back to the participants of the workshops to refine the elements, to rate each one for its relevance based on a 5-likert scale (1 = not relevant to 5 = highly relevant) and to choose from the entities 'City', 'Supporting organization' and 'Standardization body' the most appropriate one for addressing this element. Table 2 summarizes the results.

Table 2: Seven elements to support the application of standards at city level

Element	Relevance*	Responsible entity**
1. Awareness of the standard: Knowledge of the standard and its developers among all city stakeholders concerned; recognition of the city stakeholders as target group of the standard; and the standards' role within a set of similar standards and for the (inter-)national context (e.g. to meet EU regulations/comply with the standards' subject)	High (4.7)	Supporting organization (87%); (Standardization body (73%); City (67%))
2. Awareness of the standardization process: Knowledge of the city stakeholders about the standardization process, the standardization system (National, European and International level), committees and deliverables (e.g. EN, ISO, CWA) and how to participate	Medium (3.3)	Standardization body (73%)
3. Resources for the application of the standard: Financial (e.g. funding from projects), technical and human resources (including the identification of responsibilities within the cities) as well as know-how on the subject and availability of the necessary data	High (4.4)	City (93%)
4. Organizational support: Projects, competence centres, binding institutions or similar organisations that directly support (mainstreaming) the application of the standard within the city/public organization	High (4.4)	Supporting organization (87%)
5. Content-related support: Guidance and training on the application of the standard as well as workshops or working tables (e.g. organized at national level) for cities and/or supporting organisations	Medium (3.9)	Standardization body (87%); (Supporting Organization (60%))
6. Experiences with implementation: Case studies on different city sizes and characteristics to show the replicability, issues and benefits of (not) applying the standard (i.e. content like a tool or process; also compared to methods other than those described in the standard) and who the users of the standard are in a city	Medium (3.4)	Supporting organization (80%)
7. Dissemination and visibility: Different dissemination methods (e.g. awareness raising webinars, translations) focusing on (parts of) the standards' context and use cases of cities that have	High (4.0)	Standardization body (80%); (Supporting organization (73%);

Element	Relevance*	Responsible entity**
implemented the standards; reference to the standard in regional/national planning mechanism/documents (e.g. CCA national plan, public procurement) to achieve a broad public debate on the standard		City (67%))

**Scale (1 = not relevant to 5 = highly relevant)*

***Entities: City/public body; Supporting organization such as consultancy, business or research; Standardization body (listed when more than 75% of the respondents mentioned it and listed in brackets when a bit less than 75% respondents mentioned it)*

The verification of the elements during the city workshop in Valencia confirmed in most cases the data compiled during the two Delphi survey rounds. Regarding the rating of the relevance of the seven elements, a total difference of approx. 5% less was noted. As only difference, Element 4 (Organization support) was rated with only 'Medium' instead of 'High'. The workshop participants had also chosen in six of seven elements the same entities to be responsible for this specific element. Only for Element 5 (Content-related support), 'Supporting organization' were favored instead of 'Standardization body'. However, as in the Delphi survey this entity was selected already by 60% of the participants, this shift does not change the overall results at all. Table 3 summarizes the verification of the data. Here, only the most selected responsible entity is listed.

Table 3: Verification of elements during the workshop in Valencia

Element	Relevance (Difference)*	Responsible entity (Difference)*
1. Awareness of the standard	High 4.6 (-0.1)	Supporting organization - 63% (-24%)
2. Awareness of the standardization process	Medium 2.9 (-0.4)	Standardization body - 71% (-2%)
3. Resources for the application of the standard	High 4.3 (-0.1)	City - 100% (+7%)
4. Organizational support	Medium 3.6 (-0.8)	Supporting organization - 100% (+13%)
5. Content-related support	Medium 3.3 (-0.6)	*Supporting organization - 88% (+28%)*
6. Experiences with implementation	Medium 3.5 (+0.1)	Supporting organization - 88% (+8%)
7. Dissemination and visibility	High 4.6 (+0.6)	Standardization body - 63% (-17%) City - 63% (-4%)

5 The application of a standard in a city

During the workshop in Valencia, Spain, the participants were asked to start applying the ISO/TS 14092 'Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities'. By using two hand-outs of this document to be used in the focus group session, the participants reviewed and discussed the content of the standard. Each section of the standard was shortly introduced by a moderator of the focus group. Afterwards, the participants independently had read the text of the standard and discussed its content for application in Valencia. Furthermore, they made recommendations for adjustments of the standard and identified difficulties in understanding parts of the standard.

The moderators observed the exercise and collected aspects to take into account when start the application of a standard in a city. These aspects were noted and in the end of the exercise confirmed by the participants.

General aspects:

- A short first meeting should have the goal to initially bring stakeholders of a specific topic together, to get aware of importance of the standard for the stakeholders and to acknowledge that the participants are the target group of the standard.
- A longer second meeting should be conducted to go into more detail of the standard and to in depth plan the application of it in the specific city case.
- The discussion on the content of the standard should take place in a team with different backgrounds and views on the specific topic.

Aspects related to the analysis of the standard:

- Before going into the content of the standard, it is recommended to get familiar with the structure of a standard, the scope it has, and which related (e.g. more management related) standards exist.
- The analysis of standard can be conducted by identifying and marking keywords in the text, understanding the different level of obligation and recommendations (e.g. shall/should), and to discuss the benefits each part has for the participants.
- The revision of the standard should foster the conduction of further activities related to the standard, which should be described in the definition of next steps and a discussion of whom else to involve in further meetings.

In summary, in addition to the elements identified in section 4 that support the application of standards at city level, the practical experience gained from the direct application of a CCA ISO standard provides information on how to start the discussion about a standard at city level and thus promote its application.

6 Conclusion

ISO has published in the last years a variety of standards related to CCA, which do have dedicated focus on urban areas. The experts within these bodies, who developed these

standards, are one element to foster the dissemination and application of the standards. However, usually the market and current political priorities decide which topic is more in the focus and visible.

ISO standards, such as ISO 9001 'Quality management systems – Requirements' or ISO 14001 'Environmental management systems – Requirements with guidance for use' are widely known among CCA city stakeholders. This research investigated that this is not the case for CCA-related standards. Thus, more awareness raising activities from standardization bodies and experts active in the relevant standardization committees are needed. In addition, best practices of cities and CCA stakeholders using the standards are needed to present the benefits of their application.

The seven elements defined to support the application of standards at city level provide were developed and verified during three different research activities with a total of 186 participations. Due to the number of relevant stakeholders of different countries involved, the data obtained from this research can be seen as representative for city CCA stakeholders in Europe and Latin America. However, due to the broad topic and worldwide relevance, the research results could be applied also outside these two regions.

The results obtained are bridging the gap in literature, which lacks research on the application of standards in general and on CCA in particular. Especially, the exercise to start applying a standard at a city can be a blueprint for similar future activities. With regard to research projects, it can support the awareness raising and implementation of standards, as state-of-the-art documents and as add-on to the analysis of existing standards (see Lindner et al., 2021). However, this research has also limitations with regard to the limited amount of CCA city stakeholders involved in comparison to the total number of cities in Europe and Latin America. Nevertheless, the raising awareness activities in this project were very well received by the CCA city stakeholders, who wish to have more support on CCA standards and standardization activities; an outcome that should be considered in future work of the standardization bodies and their experts.

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Conflict Of Interest (COI)

There is no conflict of interest.