🏆 *reviewed paper*

Bringing Research on City Resilience to Relevant Stakeholders – Combining Co-creation and Standardization in the ARCH project

René Lindner, Daniel Lückerath, Josune Hernantes, Carmen Jaca, Vasileios Latinos, Katherine Peinhardt

(René Lindner, DIN e. V., rene.lindner@din.de)
(Dr. Daniel Lückerath, Fraunhofer IAIS, daniel.lueckerath@iais.fraunhofer.de)
(Dr. Josune Hernantes, TECNUN, jhernantes@tecnun.es)
(Dr. Carmen Jaca, TECNUN, cjaca@tecnun.es)
(Vasileios Latinos, ICLEI Europe, vasileios.latinos@iclei.org)
(Katherine Peinhardt, ICLEI Europe, katherine.peinhardt@iclei.org)

1 ABSTRACT

City resilience has gained increased recognition due to the COVID-19 pandemic situation and thus the topic has become one of great research interest, with several research projects focusing on city resilience within the last few years. However, in order for the project results to have an impact, meaningful stakeholder involvement needs to be centered. Acknowledgement of this need has lead to the use of different approaches in research, such as the use of co-creation activities and standardization, which aim to integrate city resilience stakeholders in the development processes of different tools and methods. This paper assesses the approaches of two city resilience-related research projects (Smart Mature Resilience or 'SMR,' and Climate Resilient Cities and Infrastructures or 'RESIN') and suggests an enhanced approach for combining co-creation and standardization – in a model called a Mutual Learning Framework – that is being used in an ongoing project called Advancing Resilience of Historic Areas Against Climate-related and Other Hazards, or 'ARCH.' The outcomes of this research will support the development of robust stakeholder engagement within city resilience, particularly in tool development and validation processes; ensured by a mix of co-creation and standardization methods.

Keywords: stakeholder engagement, city resilience, standardization, co-creation, research projects

2 INTRODUCTION

The topic of resilient cities is not new (Rockefeller Foundation and ARUP, 2014). However, the COVID-19 pandemic has put city resilience in the spotlight, more than ever (e.g. McCartney et al., 2021). This applies also for all city stakeholders and especially citizens, who also see the urgency of (climate) resilience. But involving all relevant stakeholders in research activities for the development of resilience-enhancing tools has not been simple thus far. The European Commission identified this issue a few years ago and requires the integration of research relevant stakeholders and end-users in the dissemination and exploitation of research projects: As noted by the Commission, intended audiences of research and tool development often includes groups such as city representatives (European Commission, 2015). One approach to bridge this gap, proposed by the European Commission within European Framework Programmes (FP) such as Horizon 2020 and Horizon Europe, is the tool of standardization, which can be used to actively support the exploitation and dissemination of FP projects (European Union, 2013; European Commission, 2018).

However, when reviewing FP projects, dissemination and exploitation activities during the implementation phase remain shallow and seldom reach affected stakeholders in a meaningful or actionable way. Only a few research projects have made specific progress on this topic and successfully integrated relevant stakeholders to enhance city resilience tools. The integration of cities within FP projects is key if the goal is to involve relevant stakeholders in achieving the common goal of becoming resilient cities in the future. This is primarily because a city cannot be resilient without the resilience of its critical infrastructures, citizens and network of cities to which it is connected in various ways. However, successfully involving the stakeholders and cities into projects depends very much on the approaches chosen, and depends heavily on the ways used to bring the theory of research into practical future uptake by cities. Different approaches are available, such as co-creation or standardization, but these approaches remain under-examined.

Therefore, the aim of this paper is to propose an approach for combining the methods of standardization and co-creation in research projects. To achieve this, the two EU-H2020 projects SMR 'Smart Mature Resilience' and RESIN 'Climate Resilient Cities and Infrastructures' on city resilience were assessed, with special focus on the success and impact of co-creation and standardization activities. The results of this assessment are used within the EU-H2020 project ARCH 'Advancing Resilience of Historic Areas Against

Climate-related and Other Hazards' to develop a methodology for enhanced stakeholder engagement by co-creation and standardization.

The aim of ARCH is to make areas of cultural and historic value more resilient against climate-related and natural hazards and risks (ARCH, 2021). To this end, the ARCH team will develop a suite of tools to: (1) collect existing and new information about hazards and vulnerabilities; (2) assess risks and resilience of historic areas under different scenarios; and (3) identify effective pathways and action plans to increase resilience. These solutions are developed using a co-creation method combining mutual learning activities, co-creation workshops and standardization activities. The city-focused project includes partners from the cities of Bratislava, Camerino, Hamburg and Valencia, who will co-create project tools in efforts of helping their respective cities and others to protect their historic areas from the effects of climate change. From the outset of the project, the co-creation method included different principles such as equality, openness, transparency, flexibility, inclusiveness and reflexive/iterative learning, as well as trust, accountability and credibility (ARCH, 2020). Based on the co-creation activity, a Mutual Learning Framework has been set up to foster direct knowledge exchange and experiences among the partners of the four initial project cities, which are also called the Foundation Cities, and a larger group of European cities called the Keystone Cities who aim to increase the resilience of their historical areas.

The paper is structured as follows: the topic of city resilience is further introduced and some approaches for using co-creation and standardization are presented in Section 2. Section 3 describes the methodology used for this research, and Section 4 includes the results of the assessment of the two projects to support the methodology used in the ARCH project. Finally, Section 5 summarizes the research and provides an outlook for further research.

3 CITY RESILIENCE WITH SUPPORT OF CO-CREATION & STANDARDIZATION

Research done in EU-funded projects has intensified over the last decade and has shown that while negative impacts of climate-related hazards (such as heavy rainfall, heat waves and earthquakes) and human-induced ones (such as industrial pollution, radiation, toxic waste or transport accidents) on urban areas are widely discussed their impacts and cascading effects are not yet understood to their full extent. All of this, in addition to the layered impacts of the COVID-19 pandemic, remain a gap in our shared understanding.

In existing literature, several frameworks have been developed to describe city resilience, tools have been suggested for the enhancement of city resilience, and the importance of stakeholder engagement and interaction for city resilience has been identified (e. g. Kontokosta & Malik, 2018; Hernantes et al., 2019; Mourshed et al., 2016).

The need to transform our societies towards climate protection and sustainability has become more urgent due to climate change and the overuse of natural resources. The global COVID-19 pandemic has caused an economic crisis and made long-standing social inequalities within and between our societies more visible (e. g. Blundell et al., 2020). By working on resilience, cities may ensure that a functioning local and regional economy and a just urban society respect planetary resource boundaries, while remaining driven by solidarity and cooperation. Work on city resilience seems therefore not only urgent, but inevitable. Moreover, increased attention and efforts in the area of resilience lead to sustainable development in cities, towns and municipalities. To do this, cities need to safeguard and protect their critical infrastructure and assets (e.g. historic areas), often while simultaneously dealing with pressing chronic social and economic stresses.

To further understand and work with the topic of city resilience, a common definition is needed. Derived from the SMR project, city resilience can be defined as: the ability of a city or region to resist, absorb, adapt to and recover from acute shocks and chronic stresses to keep critical services functioning, and to monitor and learn from on-going processes through city and cross-regional collaboration, to increase adaptive abilities and strengthen preparedness by anticipating and appropriately responding to future challenges (Maraña et al., 2019).

In order to achieve city resilience, standardization is one approach for transferring outcomes of research projects into practice; especially attractive as an option because it follows a transparent and open process. In this regard, it has to be noted that standardization can be conducted twofold: The first and most common process for standardization is formal standardization within technical committees. In these committees, experts of all relevant fields are part of developing different kinds of standards for the benefit of everyone

(ISO, 2021). However, these committees address many different subjects, so not all possible relevant research and innovation activities can be easily integrated and adopted in this technical committee system. As a result, a second route has been developed for standardization deliverables, such as Workshop Agreements. This method provides an additional tool for bringing research and innovation outputs into standardization (Poustourli, 2016). On the European level, CEN Workshop Agreements (CWA) can be used for research projects (CEN, 2021). Figure 1 shows the different steps of initiating and conducting a CEN Workshop to develop a CWA.

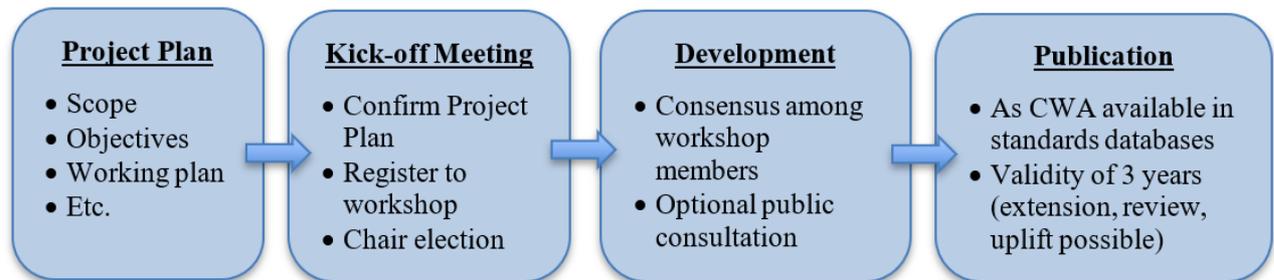| **Project Plan**	**Kick-off Meeting**	**Development**	**Publication**
• Scope • Objectives • Working plan • Etc.	• Confirm Project Plan • Register to workshop • Chair election	• Consensus among workshop members • Optional public consultation	• As CWA available in standards databases • Validity of 3 years (extension, review, uplift possible)

Fig. 1: Process of a CEN Workshop to establish CWAs

Due to the different process steps to develop a CWA, several possibilities to involve relevant stakeholders for the topic of the standard can be exploited and fostered. For example, as the CWA project plan is made publicly available for at least 30 days, interested stakeholders (even from outside of the project) can join and give input during the process. Also during the development phase of the CWA, relevant stakeholders can be easily and quickly integrated (CEN, 2021). However, the later that the stakeholder integration takes place, the more difficult it becomes to reach consensus among the workshop members. As standardization activities generally rely on developed tools and methods of a specific research project, the CEN Workshop process can also be used for co-creating the envisaged project outcomes.

Several references on co-creation methodologies for research and innovation projects in general, as well as on resilience exist. For example, Weichselgartner and Kasperson (2010) assessed successes and failures in collaborative knowledge production within the domain of resilience, based on 20 scientific assessments. With regard to research projects, the action research method of co-creation is of major interest. Here, the consideration of co-creation of the inputs and outputs of the research translates into practical outcomes, such as an example of a study with the public and governments (Cook et al., 2013). The benefits of participatory research approaches, in which we include co-creation, are that these bring the scientific process closer to decision-makers, enhance the perception of research outcomes and facilitate interaction among relevant stakeholders (e.g. Cvitanovic et al., 2019). Furthermore, existing literature on general co-creation activities refers to the objectives of the co-creation method itself and the influence factors and the outcomes of co-creation; whereas the discourse in this literature is limited as it relates to the eventual outcomes of the co-creation processes (Voorberg et al., 2015).

Standardization processes can adopt a co-creation approach. For example, in the practice of creating standards for city resilience, city officials and other experts come together to share their views and input in co-developing standards. Standardization around city resilience tools and processes can add to the co-creation process, as detailed input is requested from experts and stakeholders in a guided and facilitated way, where each workshop builds on the work that is done in the previous ones. This does not mean that the process is not flexible, but rather the opposite; one in which all voices have the opportunity to be heard and ideas the chance to be addressed. However, existing literature is lacking information on how co-creation and standardization activities can be combined successfully.

The presented research overcomes this gap and provides details on how both approaches can be successfully used within research projects to transfer theory to practice; and with regard to city resilience, to provide the cities with resilience-enhancing tools - ones that are especially easy to identify with, understand and adopt thanks to the fact that they co-developed them. Furthermore, as the inclusion of standardization in research projects is currently not addressed in the state of the art research, the link to standardization as a supportive tool for co-creation activities has not been well investigated. Therefore, it is important to review projects having successfully implemented standardization in the context of co-creation activities.

4 METHODOLOGY

This research was conducted by using the action research methodology. Chein et al. (1948) suggested the four dimensions of action research: diagnostic; empirical; participatory and experimental. Thus, they define participatory action research as a method in which researchers and practitioners actively participate in all stages of research. Furthermore, participatory action research has been verified as a method to make scientific findings useful for practitioners (Ottosson, 2003).

The information flow between research and practice, and vice versa, is crucial. This is especially true when it comes to achieving applicable resilience-enhancing tools for cities. Thus, this method can be a win-win relationship: firstly, for the researchers, as their tools will be directly brought into practice and be applied to the research projects assessed in this paper; and also for the practitioners, like city representatives who gain access to tools for which they provided essential input. In this way, action research has previously been used in other research projects.

In the framework of this action research, the RESIN and SMR projects have been assessed through the direct participation of the researchers in these projects. RESIN was an interdisciplinary, practice-based research project, funded under Horizon 2020, investigating climate resilience in European cities. The project was completed with direct co-creation activities involving the cities of Bratislava (Slovakia), Bilbao (Spain), Greater Manchester (United Kingdom), and Paris (France) and knowledge brokerage with 17 additional European municipalities. The project developed practical and applicable tools to support cities in designing and implementing climate adaptation strategies appropriate for their local contexts. RESIN also compared and evaluated methods that can be used to plan for climate adaptation to move towards formal standardization of adaptation strategies.

SMR was also a Horizon 2020 project, the objective of which was to develop a European Resilience Management Guideline (ERMG) consisting of a set of resilience-enhancing tools such as a Maturity Model, Resilience Information Portal and Risk Systemicity Questionnaire. These were intended to support city decision makers in developing and implementing resilience measures. Therefore, the project used a co-creation method to involve further cities and stakeholders. Furthermore, SMR implemented within the co-creation process their tool development, validation and, finally, approval by city councils. In order to ensure the usefulness and reliability of the results, the SMR project involved the cities of Bristol (United Kingdom), Glasgow (United Kingdom), Kristiansand (Norway), Riga (Latvia), Rome (Italy), Donostia-San Sebastian (Spain) and Vejle (Denmark) in the project consortium and adopting a co-creation approach throughout the project to foster the integration of project-external cities in the tool development, verification and future application.

The lessons learned during the course of the co-creation and standardization activities conducted in these two projects have been gathered in this paper, setting a specific focus on the stakeholder involvement and the impact the conducted activities provided. The results of this assessment are being implemented, reflected upon and further enhanced in the ARCH project to successfully combine standardization and co-creation activities. Thus, the findings lead to the development of an improved approach in ARCH. The outcomes of this research will support the development of robust stakeholder engagement within tool development and validation processes, as ensured by a mix of a co-creation and standardization approach.

5 COMPARISON AND DISCUSSION OF COMBINED CO-CREATION AND STANDARDIZATION APPROACHES

This paper analyzes RESIN and SMR projects separately and provides information on how the standardization and co-creation activities were conducted. The lessons learned in these assessments are integrated in a comparison table. Table 1 outlines the general setup of each project, as related to co-creation and standardization, as well as post-project reflections on success factors, challenges and impacts.

5.1 RESIN project

Generally, the RESIN project employed multiple co-creation approaches tailored to the individuals and organizations involved in different tasks. This resulted in variations in conducted activities, timing of activities and depth of co-creation. Initially (i.e. during project design), RESIN planned a more traditional development process, with finite and separate stages for development, testing and user feedback, where each

stage would conclude in the 'handover' of a formal report containing relevant results. Separate stages were envisaged to be guided by close cooperation between technical partners and city partners. However, shortly after the start of the project in November 2015 this approach shifted to focus more on the co-creation of knowledge due to the needs of the city partners and advice from the project's external scientific advisory board. The aim was to align development activities even more closely with the ongoing issues at the local level in the partner cities. Subsequently, the more traditional development process shifted to a more agile process with more frequent and iterative testing and feedback loops between the technical partners and city partners.

The project design (prior to the shift mentioned above) envisaged that city partners' engagement with research partners in the development of tools would be guided through different activities, including: Process Management Workshops to foster an understanding for resilience building; development of a 'City assessment report' to communicate the state of local adaptation work in each city; and bi-monthly webinars between cities and tool developers to provide regular progress reports to one another. Additionally, different workshops, stakeholder dialogues and webinars were conducted in RESIN to integrate additional city practitioners into the project and to support co-creation of the resilience tools (RESIN, 2018a). Thus, the above activities provided a framework for co-creation of the tools. The co-creation processes between tool developers and city partners differed between the three different solutions developed by RESIN and based on the resources available in the cities. For example, while full risk analyses using the new method developed in RESIN were conducted with the cities of Bilbao and Bratislava, only a qualitative assessment was conducted for Greater Manchester, while the city of Paris followed the development processes more loosely. While standardization was originally envisaged as a cross-cutting exercise spanning all city cases, it was not consistently implemented in all the co-creation activities with city partners. Instead, standardization was often pursued from the viewpoint of technical partners developing tools and methods, with city partners being consulted infrequently (see RESIN, 2018a; RESIN, 2018b). For example:

- A survey on city viewpoints on standardization was conducted

- City partners were involved if dedicated standardization sessions were conducted during bi-annual project meetings

Instead, individual partners pursued standardization activities on international, European, and national levels (e.g. via memberships in ISO / CEN / national committees and working groups). An originally foreseen CEN Workshop Agreement was not pursued. Instead, RESIN produced recommendations for future standardization activities, based on the final project results (RESIN, 2018b).

5.2 SMR project

The co-creation approach used in the SMR project ensured the active involvement and engagement of stakeholders in the production of knowledge. This included experts from local, regional and national governments, academic and scientific entities, and public and private companies. Several methodologies such as workshops, surveys, the Delphi method and semi-structured interviews were used to foster co-creation in the development of the five tools that support the ERMG. The standardization of the tools and ERMG was also undertaken as a co-creation process in a transversal way throughout the project. In fact, the standardization activities were envisaged from the very beginning, integrating sessions dedicated to standardization in the co-creation workshops for the development of tools. Once the tools and ERMG were developed, the SMR partners assessed the standardization potential of each solution, which resulted in the development of the CWA 17300 series on 'City Resilience Development' regarding the ERMG, Maturity Model and Information Portal (SMR, 2021). The development of these CWAs enabled further input from other project external stakeholders such as representatives from other cities or other resilience-focused research projects.

The SMR project defined a Circle of Sharing and Learning for the involvement of, and dissemination to cities. The three Tier 1 cities (Glasgow, Kristiansand and Donostia) were the earliest adopters, which implemented the ERMG and served as a testing ground for the pilot tools. Tier 2 included the other four partner cities (Riga, Bristol, Rome and Vejle), which acted as peer reviewers in the pilot implementations, providing advice. Tier 3 included the cities already considered active with regard to resilience, e.g. those who participate in the UNDRR resilient cities campaign or have been selected to participate in the 100

Resilient Cities of the World network pioneered by the Rockefeller Foundation. In the SMR project, the following cities were part of the Tier 3 group: Athens (Greece), Greater Amman Municipality (Jordan), Greater Manchester (United Kingdom), Malaga (Spain), Malmö (Sweden), Reykjavik (Iceland) and Thessaloniki (Greece). Finally, the Tier 4 level of cities is represented by those cities potentially interested in the project tools (SMR, 2021).
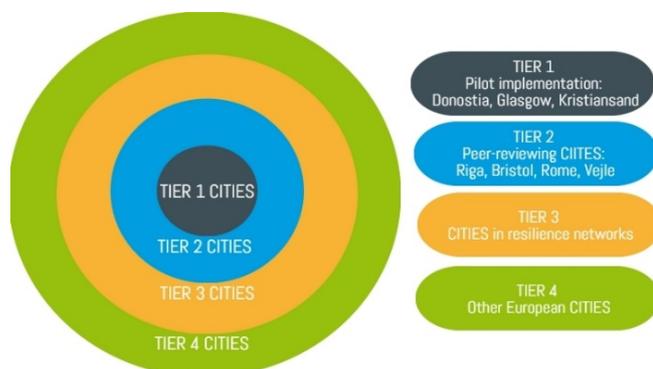

Fig. 2: The four different tiers of CITIES within the SMR project

During the co-creation activities and especially during the conducted stakeholder dialogues, all tiers of cities have been invited to participate in the standardization activities. However, due to the process of standardization, further cities and organizations interested in city resilience and the envisaged standards that are not related to the SMR project joined the standards development. Thus, the standardization activity increased the number of organizations and cities that validated the project's city-enhancing tools.

5.3 Comparison of RESIN and SMR projects

The results of this assessment of the RESIN and SMR project supports the development and enhancement of the co-creation and standardization activities within the ARCH project.

5.4 Combining the lessons learned in the ARCH project

Co-creation is at the heart of the ARCH project, and takes place in two contexts: within technical developments that are led by tool developers with the support of city partners; and in local activities that are spearheaded by city partners with the support of research partners. This twofold approach originated from the aim to make space within the project for not only research-driven developments, but also practical, "on the ground" development of solutions at the city scale. Accordingly, project partners worked to align tasks to ensure that technical developments and methods were appropriate or useful in confronting local challenges.

As an additional part of the co-creation aims of the ARCH project, the Mutual Learning Framework is an opportunity for exchange and sharing between the four cities that are part of ARCH's Consortium (Foundation cities) and a larger group of selected European cities, called the Keystone cities. These cities were selected because of their common interests in increasing the resilience of their historical areas. Both Foundation and Keystone are able to offer up and receive expertise during a series of four Mutual Learning Workshops (MLW), the main result of the Mutual Learning Framework. These interactive and dynamic workshops blend shared plenary discussions with more locally specific breakout sessions in city clusters that strategically match Foundation and Keystone cities with shared goals or challenges.

In addition to this co-creation approach, the ARCH project incorporates standardization, integrating it into nearly all of the other project tasks. To start, standardization-focused project partners have been included in tasks as "observers," and have led collaborative standardization activities during biannual project meetings and the activities of the Mutual Learning Framework, as mentioned above. To support the standardization activities in ARCH, the project will set up a liaison with relevant standardization committee(s) to ensure the uptake of the standardization outcomes of the project directly within the standardization system.

Altogether, co-creation and standardization are central to the methods of the ARCH project. In fact, early on in the project, co-creation tasks were bundled into a dedicated Work Package to ensure ease of coordination. This varied and strategic approach has ensured ongoing cooperation in the work of ARCH partners, and helped project outcomes to stay true to the aforementioned project principles of equality, openness,

transparency, flexibility, inclusiveness and reflexive/iterative learning, trust, accountability and credibility (ARCH, 2020).

	RESIN project	SMR project
General		
How was standardization integrated in the project (resources, etc.)?	Standardization Work package Context: Only some technical partners (as well as ICLEI) and none of the involved cities had resources for standardization	Standardization Work package Context: All partners, including cities had resources for standardization Standardization addressed since project start, thus became more 'understandable' by all partners (despite their lack of previous experience)
How was the exchange with relevant (city) stakeholders organized?	Co-creation Work package with tasks focused on general process management, assessment reports, testing and documentation. Inclusion of stakeholders in standardization work only via (ad hoc) project meetings	Co-creation, pilot implementation and testing Work Package with tasks that focused on co-developing the tools having the input by all cities, development of manuals and handbooks to accompany the tools. Inclusion of external stakeholders through project meetings, training workshops and external events.
Reflection on conducted standardization and co-creation activities		
How successful was the stakeholder involvement approach (process)?	No explicit inclusion of (city) stakeholders in standardization processes. Where there was input, it was generally more indirect, coming in the form of results from the co-creation approach between researchers and city stakeholders, which then were transferred either to standardization work conducted by technical partners (e.g. inclusion of city perspective when commenting on the draft of a standard) or reported during project standardization meetings (i.e. meetings conducted for the standardization Work Package as part of other project meetings or as stand-alone meetings).	A number of cities and stakeholders were included in standardization activities, attended workshops and actively contributed to shaping three CWAs.
Which difficulties and challenges have been tackled?	Co-creation approach was not meant to be aligned with the standardization approach, as the standardization approach was more focused on technical partners (in part due to the initial project setup, wherein a less intensive co-creation approach was planned. Instead, a more traditional development and testing approach was planned. Identifying suitable results to standardize was difficult. Even when assigning personnel resources for standardization to city stakeholders, going the route of (individual) participation of organizations in standardization committees and transferring results this way was a challenge, as partners need to allocate time for these actions over a long period (potentially going beyond the project lifetime) which might conflict with their "business as usual."	Identifying which tools and processes would be standardized was a long process and demanded coordination with all partners. The CEN workshop participants made efforts to ensure the reliability and accuracy of the technical and non-technical content of all CWAs, but this does not guarantee the overall correctness of input, as it reflects their way of working and cooperating in their cities or organizations.
Impact of standardization outcomes		
How stakeholders benefit from the standardization activities, their results (impact of results)?	As some RESIN results were transferred to at least one international standard (although after the end of the project) applying these approaches makes sure that processes and methods in cities are aligned with other approaches, and also follow these aforementioned standards.	The SMR results were transferred into three CWAs on 'City Resilience Development' and then introduced to at least one international standard. More specifically, the indicators included in ISO 37123 'Indicators for Resilient Cities' were mapped along the five steps of the operational guidance cycle of CWA 17300.
Which are implications for the future?	Depending on what the desired outcome is (e.g. a "guideline" for a process vs. a more "technical" standard; a direct application in cities vs. a "blueprint" for methods or tools aimed at researchers), a direct alignment between standardization and co-creation would be desirable. This would include standardization tasks being specifically designed in a way to make use of co-creation. However, this can also require very coordinated timing of technical developments in the project, which might not be possible in an adaptive and agile co-creation process (e.g. in RESIN the focus switched from tool to method development).	With the publication of the CWA 17300 series, the topic of city resilience gained visibility. Due to the COVID-19 pandemic, this becomes even more timely. However, the SMR project has shown that, besides the classical research on existing standards and the development of research results out of standards, other benefits arise from the integration of standardization. Among these benefits is the standardization network of experts within the technical committee and the different options to support standardization work, which allows all relevant stakeholders to contribute to standards.

Table 1: Comparison of RESIN and SMR project

6 CONCLUSION AND OUTLOOK

The research on city resilience can only be impactful when all relevant stakeholders are included throughout the development of tools or processes. In recent years, standardization has come to have a major role in many research projects (especially those in Europe), where it is employed to support the dissemination and exploitation of project results. However, the ways in which a project can best exploit standardization to foster the integration of all relevant stakeholders has not yet fully researched. This paper provides practical

examples of how co-creation and standardization can be conducted jointly, as reflected in the context of the ARCH project. The lessons learned of the RESIN and SMR projects were used via participatory action research to support the methodology of co-creation linked with standardization activities in ARCH – specifically within the ARCH Mutual Learning Framework. RESIN and SMR both have successfully integrated standardization in their respective project work, of which the SMR project was deemed by the European Commission as a success story for using standardization in an FP project (European Commission, 2019).
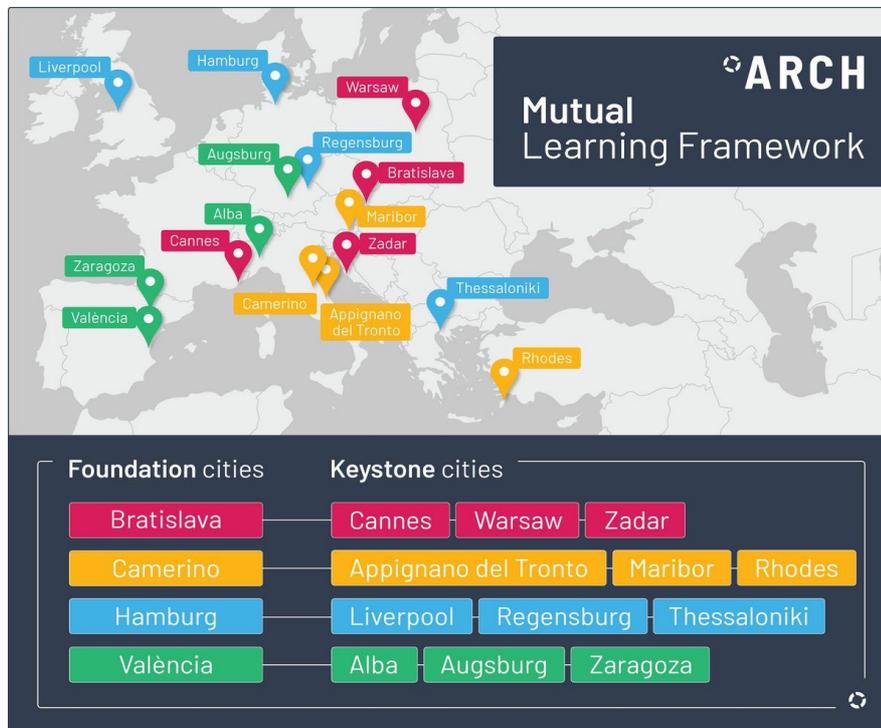
Fig. 3: Overview of cities involved in the ARCH Mutual Learning Framework (ARCH, 2021)

This research has some limitations, as few projects have thus far combined co-creation and standardization; and few among these with a focus on city resilience. The outcomes of this research will be important for the future activities to complement the CWA 17300 series on 'City Resilience Development,' with more resilience supporting standards. In this regard, the ARCH project is currently initiating further standard development within the frame of a CEN Workshop that is called 'City Resilience Development – Framework and guidance for implementation with a specific focus on historic areas' (ARCH, 2021).

The implications of this research should be part of future research on how to successfully integrate standardization in research projects, combining it with co-creation as well as on city resilience approaches in general.

7 ACKNOWLEDGEMENTS

8 REFERENCES

ARCH (2020). Deliverable 3.1 Guideline on ARCH co-creation approach. Available online:
    https://savingculturalheritage.eu/resources/deliverables#c715 (accessed 28 May 2021).
ARCH (2021). Project Website. Available online: https://savingculturalheritage.eu/ (accessed 28 March 2021).
Blundell, R., Costa Dias, M., Joyce, R. and Xu, X. (2020). COVID-19 and Inequalities. Fiscal Studies, Volume 41, Issue 2, pp. 291-
    319. https://doi.org/10.1111/1475-5890.12232.

CEN (2021). Website of CEN boss. Available online: https://boss.cen.eu/developingdeliverables/CWA/Pages/ (accessed 20 May 2021).

Chein, I., Cook, S. and Harding, J. (1948). The field of action research. American Psychologist, 3(2), 43–50. https://doi.org/10.1037/h0053515.

Cook, B., Atkinson, M., Chalmers, H., Comins, L., Cooksley, S., Deans, N., Fazey, I., Fenemor, A., Kesby, M., Litke, S., Marshall, D. and Spray, C. (2013). Interrogating participatory catchment organisations: cases from Canada, New Zealand, Scotland and the Scottish–English Borderlands. The Geographical Journal, 179 (3), 234-247. https://doi.org/10.1111/j.1475-4959.2012.00492.x.

Cvitanovic, C., Howden, M., Colvin, M., Norströmd, A., and Meadow, A. (2019). Maximising the benefits of participatory climate adaptation research by understanding and managing the associated challenges and risks. Environmental Science & Policy, 94, 20-31. https://doi.org/10.1016/j.envsci.2018.12.028.

European Commission (2015). A new role for EU Research and Innovation in the benefit of citizens: Towards an open and transformative R&I policy. Matthias Weber, Dan Andrée, Patrick Llerena. Available online: https://ec.europa.eu/research/innovation-union/pdf/expert-groups/rise/weber-andree-llerena-new_rolo_research.pdf (accessed 20 May 2021).

European Commission (2018). 2018/0224 (COD) - Proposal for a Regulation of the European Parliament and of the Council - establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:0435:FIN (accessed 20 May 2021).

European Commission (2019). European Commission website. Success stories. Cities work together towards a more resilient future. http://ec.europa.eu/research/infocentre/article_en.cfm?artid=49852 (accessed 25 May 2021).

European Union (2013). Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013. Available online: https://publications.europa.eu/en/publication-detail/-/publication/3c645e51-6bff-11e3-9afb-01aa75ed71a1/language-en (accessed 20 May 2021).

Hernantes, J., Maraña, P., Gimenez, R., Sarriegi, J. and Labaka, L. (2019). Towards resilient cities: A maturity model for operationalizing resilience. Cities, 84, 96-103. https://doi.org/10.1016/j.cities.2018.07.010.

ISO (2021). ISO Website. Available online https://www.iso.org/who-develops-standards.html (accessed 20 May 2021).

Kontokosta, C. and Malik, A. (2018). The Resilience to Emergencies and Disasters Index: Applying big data to benchmark and validate neighborhood resilience capacity. Sustainable Cities and Society, 36, 272-285. https://doi.org/10.1016/j.scs.2017.10.025.

Maraña, P., Eden, C., Eriksson, H., Grimes, C., Hernantes, J., Howick, S., Labaka, L., Latinos, V., Lindner, R., Majchrzak, T. A., Pyrko, I., Radianti, J., Rankin, A., Sakurai, M., Sarriegi, J. M. and Serrano, N. (2019). Towards a resilience management guideline - Cities as a starting point for societal resilience. Sustainable Cities and Society, 48, 101531. https://doi.org/10.1016/j.scs.2019.101531.

McCartney, G., Pinto, J. and Matthew L. (2021). City resilience and recovery from COVID-19: The case of Macao, Cities, 112, May 2021. https://doi.org/10.1016/j.cities.2021.103130.

Mourshed, M., Bucchiarone, A. and Khandokar, F. (2016). SMART: A process-oriented methodology for resilient smart cities. IEEE International Smart Cities Conference. https://doi.org/10.1109/ISC2.2016.7580872.

Ottosson, S. (2003). Participation action research: A key to improved knowledge of management. Technovation, 23(2), 87-94. https://doi.org/10.1016/S0166-4972(01)00097-9.

Poustourli, A. (2016). European and International Workshop Agreements: A Brief Example in Security Research Areas. Available online: https://www.researchgate.net/publication/310242304_European_and_International_Workshop_Agreements_A_Brief_Example_in_Security_Research_Areas (accessed 21 May 2021).

RESIN (2018a). D4.2 Developing the RESIN tools, advancing local adaptation. Available online: https://resin-cities.eu/fileadmin/user_upload/Resources/RESIN-D4.2-Developing_the_RESIN_tools-advancing_local_adaptation.pdf (accessed 20 May 2021).

RESIN (2018b). RESIN Deliverable 5.1/2.2: Standardization in urban climate adaptation. Available online: https://resin-cities.eu/fileadmin/user_upload/Papers/RESIN-D5.1_Standardization_in_urban_climate_adaptation_NEN_30102018.pdf (accessed 20 Ma 2021).

Rockefeller Foundation and ARUP (2014). City Resilience Framework. Ove Arup & Partners International Limited. Available online: https://assets.rockefellerfoundation.org/app/uploads/20150530121930/City-Resilience-Framework1.pdf (accessed 19 May 2021).

SMR (2021). Project Website. Available online: https://smr-project.eu/ (accessed 21 May 2021).

Voorberg, W. H., Bekkers, V. J. and Tummers, L. G. (2015). A systematic review of co-creation and co-production: Embarking on the social innovation journey. Public Management Review, 17 (9), 1333–1357. https://doi.org/10.1080/14719037.2014.930505.

Weichselgartner, J. and Kasperson, R. (2010). Barriers in the science-policy-practice interface: toward a knowledge-action-system in global environmental change research. Global Environmental Change, 20(2), 266-277. https://doi.org/10.1016/j.gloenvcha.2009.11.006.