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Capacity Needs Assessment in Transport Innovation Living Labs: The Case of an Innovative E-Mobility Project

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Cities around the globe are implementing innovative transport solutions as part of measures to address pertinent socio-economic and environmental challenges in urban areas and help drive the transition to low carbon development. Planning and implementing such solutions require an effective and collective approach that includes the needs and aspirations of all relevant stakeholders. In the planning and implementation of urban transport projects, capacity building components have assumed great significance but seem to be the most eluded activity for project implementers. The Living Lab concept, which allows for co-creation in innovation development, presents the opportunity to adopt innovative participatory approach in capacity building activities in transport projects; and is largely seen as a potential catalyst for rapid transformation to low carbon and sustainability transitions in cities. To this end, this paper highlights the usefulness of the Living Lab approach and provides some perspectives on how key elements of the approach are adapted in the process of assessing the capacity needs of nine (9) cities in planning and implementing e-mobility innovations. The cities are participating in an innovation research project. In the case studied, the project's capacity needs assessment process was analyzed using an assessment framework built on four (4) key elements of the Living Lab approach, namely: extent of real-life contextualization, level of participation, diversity of stakeholders, and the time span of engagement. Insights from the assessment suggest that relevant project partners and city representatives with diverse expertise were actively involved from the onset and throughout the first 5 months of the project in defining and refining the capacity needs of partner cities based on local e-mobility conditions. This co-creative process helped determine priority areas where the need for capacity building mostly lied. Designing and operationalizing capacity building interventions tailored to the identified needs, as realized in the project, could therefore help build the necessary capacity and complement other measures aimed at developing e-mobility in the project's partner cities.

Keywords: capacity needs assessment, living labs approach, urban transport, e-mobility, project implementation

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INTRODUCTION

Urban mobility planning and implementation has become an important area of endeavour for cities around the world. This is undoubtedly grounded in the increasing realization that promoting sustainable transport mobility in cities is crucial to achieving climate objectives at the local, regional, and global levels. One of the most important elements in the planning and implementation of urban mobility projects is capacity building. In a 2013 report which evaluated the institutional capability and financial viability to sustain transport, it was remarked that nearly all World Bank transport projects embedded sector management and capacity building measures (IEG, 2013). However, in some cases, implementation focused on completion of physical works to the neglect of capacity building assistance components. It is revealed in the report that such neglect contributed in many instances to low implementation; whilst in places where capacity building measures were successfully implemented, the capabilities of transport institutions to effectively deliver transport mandates were enhanced and sustained (IEG, 2013). Particularly, in urban transport projects where new institutions are established owing to the novelties brought about by mobility innovations (for example, e-mobility), Kumar and Agarwal (2013) opine that building the capacity of lead institutions and relevant stakeholders is crucial to project success and in attracting the necessary public support and interest in the project.

From the foregoing, it is evident that the significance of capacity building in transport or mobility projects cannot be over-emphasized. For novel transport innovations such as electric mobility, there is greater need for capacity building in key areas of the innovation process. One key approach that is gaining popularity in innovation creation and sustenance, and is touted as a potential catalyst for rapid transformation to low carbon and sustainability transitions is the "Living Lab" concept (Eriksson et al., 2006; Bergvall-Kåreborn et al., 2009). Cities are increasingly adopting the Living Lab approach as it is thought to trigger new techniques in local urban sustainability governance and provides the platform to initiate and test ideas through co-production and innovation (Voytenko et al., 2016). Indeed, there are several Living Lab projects being implemented around the world across sectors. For instance, the European Network of Living Labs (ENoLL) states that its global network of over 150 active Living Labs members provides co-creation, user engagement, test and experimentation facilities for innovations in energy, media, mobility, healthcare, agriculture, among others (ENoLL, 2020).

Applying the Living Lab approach in projects, especially in demonstration projects, is considered instrumental in obtaining maximum benefits especially for project beneficiaries or intended end users. Schuurman et al. (2016) having studied the importance of using the Living Lab approach in 27 small and medium-sized enterprises projects, opined that the Living Lab approach made it possible to generate higher contributions from users of the projects' innovations and also constituted to maximal values generated from the innovation process. The authors suggested that the Living Lab approach also represented a flawless set up that made it possible to test and validate the assumptions made under the projects. As a comparatively new and under-researched concept, literature suggests that there are several aspects of the concept which research can help enlighten (Veeckman et al., 2013).

Research Questions: Now, knowing that planning and implementation of transport mobility requires the creation and sustaining of solutions; and that adequate capacity building of users and stakeholders in transport innovations is crucial to project success, it is important that transport project planners and implementers make concerted efforts to tailor capacity building interventions to the needs of users and stakeholders, doing it in a participatory and inclusive way so as so sustain the innovations developed in such projects. So, the questions are: how do we define or assess the capacity needs of target groups in novel transport innovation projects? How do we keep this assessment process participatory and inclusive enough? And how do we sustain the targeted capacity building interventions? Addressing these questions, this paper draws on the case of an EU-funded e-mobility innovation project which is adopting the Living Lab approach in its implementation strategy. More specifically, this paper answers the following questions: How did the case project assess the capacity needs of cities and stakeholders involved in the project? Which elements of the Living lab concept were embedded in the capacity needs assessment process? Did the process followed help tailor the capacity building interventions to the needs identified?

Main research objectives: This paper seeks to contribute to the body of knowledge on Living Lab concept and its application in project implementation particularly regarding capacity building processes in transport innovation projects. Drawing on the case studied, the paper seeks to provide insights on the usefulness of the Living Lab approach in assessing the capacity needs in an innovative e-mobility project. Key findings from this paper could be valuable to planners and implementers of transport mobility projects that incorporate capacity development components intended to sustain project actions and ensure project success.

MATERIALS AND METHODS

This paper employed the Case Study research strategy which deals with a single or multiple cases in a real-life phenomenon where a considerable amount of usually qualitative data is collected on the case(s) in order to give an in-depth understanding of a situation (Thiel, 2014). Here, the paper focuses on a single case–capacity needs assessment in an innovative e-mobility Living Lab project. As a first step, the authors build an assessment framework based on literature review from secondary sources on Living Lab characteristics and elements. The framework spells out key elements of the Living Lab based on literature and a corresponding set of indicators, which were operationalized in the context of the case study. The second step was to outline the capacity building process followed in the project including a summary overview of the assessment results covering the capacity need areas worth considering in e-mobility projects. The project's capacity needs assessment results as highlighted in this paper need to be cautiously generalized since the geographic and situational contexts in the project cities may vary from other settings. Detailing of the capacity needs assessment process was facilitated through content analysis of project documents and outputs including among others the project's Capacity Building Plan, Survey instruments, Interview summaries, and project deliverables of public dissemination level. In the third step, the authors, based on the framework indicators analyzed the capacity needs assessment process allowing for qualitative inferences and findings to be drawn on how Living Lab elements are embedded in the process. Qualitative inferences allow researchers to make linkages, identify new instances of a case, put fairly similar things together to create categories and themes, and ultimately link concepts to create theory and apply research results (Morse, 2006). Moreover, the authors conducted an online key informant survey in July 2021 with project participants, the results of which allowed for validation of inferences and findings made. A total of 19 key informants responded to the survey. The analysis of the key informant survey also facilitated discussions on whether the project's capacity building program suitably or otherwise addressed the capacity needs identified.

The scope of this paper covers the processes followed in assessing the capacity needs of cities/stakeholders involved in the implementation of electric mobility innovations in an EU-funded project. The project establishes demonstration actions in cities as Living Labs to enable the testing of innovative e-mobility technologies and business models; and complements the demonstration actions with a comprehensive toolbox, capacity development and replication activities. The project is working on the adaptation and integration of different solutions in the following three key areas of urban mobility–vehicles, operations, integration. This paper provides insights on the project's assessment of nine (9) partner cities' capacity to plan, design, and implement e-mobility solutions. The nine (9) partner cities spread across different regions of the globe namely: Africa (Kigali, Dar es Salaam), Asia (Hanoi, Kathmandu, Pasig), Europe (Hamburg, Madrid) and Latin America (Montevideo, Quito). All these cities face in one way or the other the following challenges with regard to the transition towards electric mobility deployment: inadequate intersectoral coordination (between transport, energy and planning) and associated complexity in governance; inadequate collaboration between public and private sector; inadequate political will; inadequate enabling policy and regulatory framework; inadequate suitable technologies; inadequate private actor initiated projects; limited knowledge on business cases; reluctance of transport operators (due to fear of job loss and lack of knowledge); public authorities reluctance on decreasing fuel tax revenues; reticence from local companies; cumbersome maintenance (and spare part availability); difficulties in the supply chain of batteries and battery materials and limited maturity of technology (SOLUTIONSplus Consortium, 2020a). To help address the aforementioned challenges, these cities are implementing demonstration actions with key principles of co-producing e-mobility solutions with the active engagement of relevant stakeholders including local authorities, transport operators and local businesses.

Assessment framework: The authors adapt the literature summary as presented in the results section and builds this into the following assessment framework in **Table 1** to examine the capacity building process followed in the case study.

Four key elements of the Living Lab concept are reflected in the assessment framework and are developed into indicators and further operationalized to show how the elements are conceived in the scope of this paper. The assessment framework provides a guideline allowing the authors to identify aspects of the capacity needs assessment process that can be related to the key elements of the Living lab concept. This procedure, though subjective, proved useful in examining the process and drawing findings. To improve validity of the results and findings, the authors triangulated interpretations with findings from the survey conducted with key informants in the project under study. The analysis conducted in this paper was largely qualitative and described the process and resultant outcomes in more detail. **Figure 1** below describes the research methodology deployed by the authors.

RESULTS

Key Elements in Living Labs Approach–A Literature Summary

The Living Lab approach, which according to literature, emerged in the late 1990s, has been described as a relatively new approach and has evolved in its definition and application particularly within the scientific fields. Reflecting on the origin of the Living labs approach, literature suggests that the concept originates from the MIT Professor William Mitchell, MediaLab and School of Architecture and City Planning where it was used to observe people's usage of emerging technologies in a real home setting (deemed as smart or future home) over time (Eriksson et al., 2006; Bergvall-Kåreborn et al., 2009; Herselman et al., 2010). Since then, the Living Lab approach has been widely used to demonstrate how innovative solutions could be adopted to address socio-economic challenges facing communities and people in different parts of the world. Its wide application has been evidenced in several development projects and researches carried out in some socio-economic fields across the globe. Though there have been several attempts to reconceive the Living Lab approach, some key characteristics remained–its use in real life settings and the central role of users and their engagement in the innovation process (Veeckman et al., 2013). As there exist numerous definitions of Living Labs and its application cuts across several domains, it is essential to figure out the key elements of the concept to provide at least a guiding notion for those who apply it. From literature, this paper summarizes the following:

- Living labs depict a real-life scenario: Literature largely shows that Living labs are set up as a real environment or space for testing new or future scenarios (which could be technologies, products, services, and the like). Some researchers compare Living labs to 'Vacation on Campus' which serves as a normal home where residents participate in experimenting on new kinds of technologies. This kind of set-up allows for

TABLE 1 | Assessment framework.

Key elements of living labs	Literature/source	Assessment indicator and operationalization
Living labs depict a real-life scenario	Markopoulos and Rauterberg, (2000)	L1. Extent of real-life contextualization • Set-ups/platforms where capacity needs are defined or assessed
Living Labs allow active user-participation	Schuurman et al. (2016)	L2. Level of participation • Involvement of relevant stakeholders and participation of mobility end users in assessing the capacity needs
Living Labs involve multiple stakeholders	Ogonowski et al. (2013), Veeckman et al. (2013)	L3. Diversity of stakeholders involved • Variety of relevant stakeholders involved in the capacity needs assessment and corresponding fields relevant to urban mobility development
Living Labs span a time-period (Short, Medium, Long term)	Veeckman et al. (2013), Sarjanen. (2010), Franz et al. (2015)	L4. Time span of engagement • Length of time involved in defining capacity needs
Outcomes of activity/process (Capacity needs assessment) • Refined capacity needs reflecting collective decision • Sustained interest of stakeholders in the activity/process • Well-tailored capacity building measures/interventions		

Source: Authors' construct based on Living Lab literature.

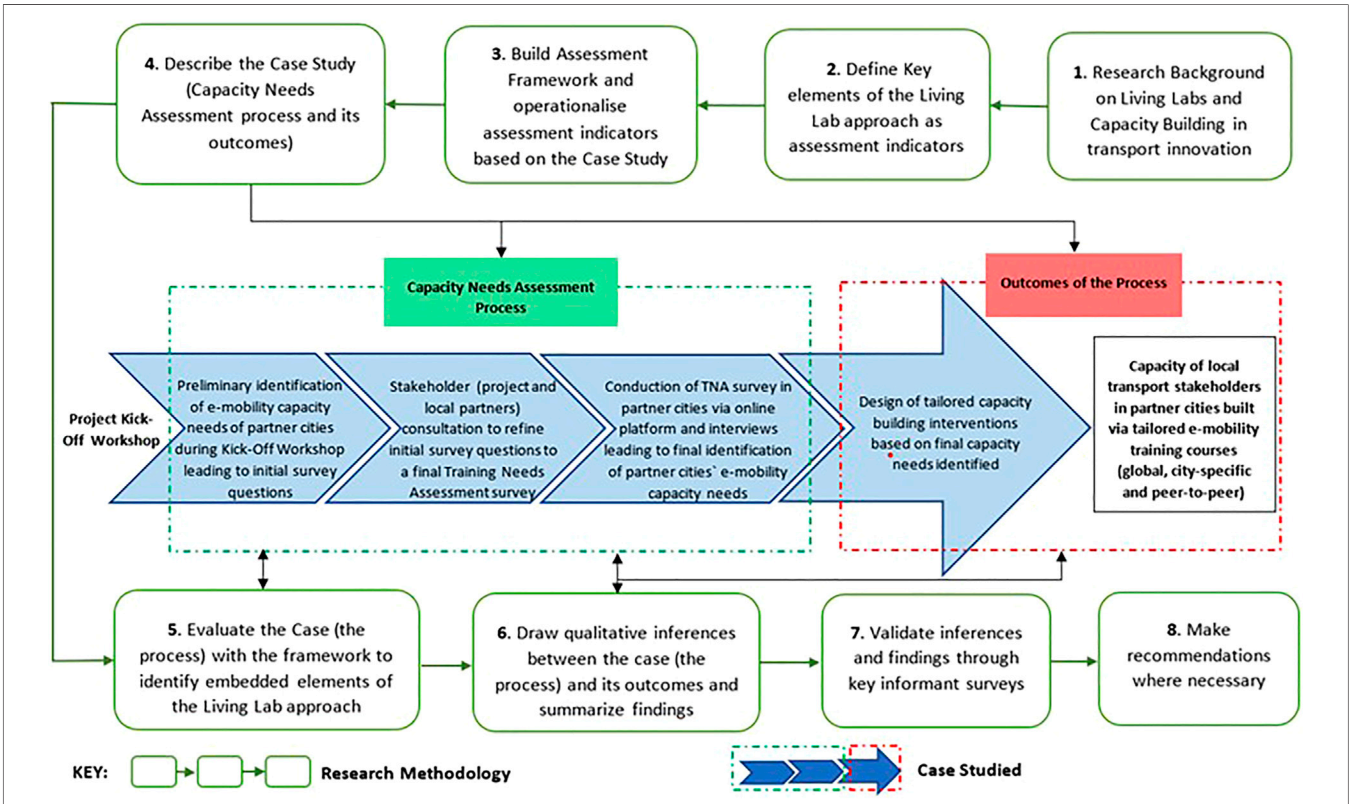

FIGURE 1 | Research methodology.

observations to be made over-time leading to the derivation of findings or results (Markopoulos and Rauterberg, 2000)

- Living Labs allow active user-participation: It is important to allow for vigorous involvement of users in a typical Living lab set up. For instance, in testing technologies, users could be invited to fully participate through surveys, workshops or co-creation sessions to experience hand-on skills or practice about the technologies (Schuurman et al., 2016)
- Living Labs involve multiple stakeholders: To ensure that varying perspectives are collected during the innovation process, Living Labs often engage several different stakeholders to enrich the pool of ideas. It is useful to combine different typologies of users including lead

users, non-experienced users and users who do not necessarily have any personal interest in the innovation usage but are only willing to offer personal expertise in the Living Lab set up (Ogonowski et al., 2013). Such a multi-stakeholder approach in Living labs usually generates valuable contributions from diverse stakeholder backgrounds which result in well-refined innovative solutions.

- Living Labs explore, experiment, or evaluate innovations: Living Labs approach can be deployed at different stages of innovation development. Schuurman et al. (2016) reconstructed from the work of Jespersen (2008) three (3) categories of projects in which the Living Labs approach could be used. **Figure 1** below depicts these categories which are mapped against the different stages of new product development. According to Schuurman et al. (2016), Living Labs can be designed to explore new knowledge for innovation development, experiment with an innovation at the prototype stage or evaluate an innovation at the pre-launch or later stage.
- Living Labs span a time-period (Short, Medium, Long term): Depending on the type of innovation under consideration, Living Labs are typically set up to span a certain period. Veeckman et al. (2013) suggested that a short-time could be up to a 6-month period, a medium-term (6 months–1 year) whilst a long term could span a period of 1–2 years. Opinions about how long Living Labs should take differ across stakeholder interests. For instance, Sarjanen (2010) mentioned that the academic community believes that the longer a research process takes the better the results; whilst businesses are concerned about the cost involved in the research process hence would prefer that results from researches are obtained within the shortest possible time to minimize costs. Nonetheless, it is generally understood that Living Lab set-ups should span more than a few months but should certainly not last indefinitely.

The Role of Capacities in the Transformative Change Towards Net-Zero Mobility

For a truly transformative change, the approach to decarbonising transport needs to go well beyond the vehicle and even the sector. All available options are required to bring the transport sector on a net-zero pathway and provide access to sustainable mobility for all. As the uptake of low-carbon mobility solutions has been lagging behind its potential, an integrated multi-modal, multi-level sustainable transport package should tackle all aspects of the mobility system and seek alignment and complementarity between national and local policies as well as between public and private sector actions.

To achieve this, a move to a "safe system" approach for sustainable, decarbonised mobility may be required. This can build on years of experiences from the road safety realm, beginning from the first adoption of "vision zero" in Sweden in 1997 which has revolutionised the approach to improving road safety (Wegman, 2017). There are now plenty of technological and operational options readily available which can drastically reduce CO_2 emissions and improve local air quality (Sims et al., 2014; Lah, 2017; IEA, 2021). If we provide more sustainable choices to transport users and signal a clear preference—for example, through pricing or regulation—we can nudge consumers towards more sustainable choices.

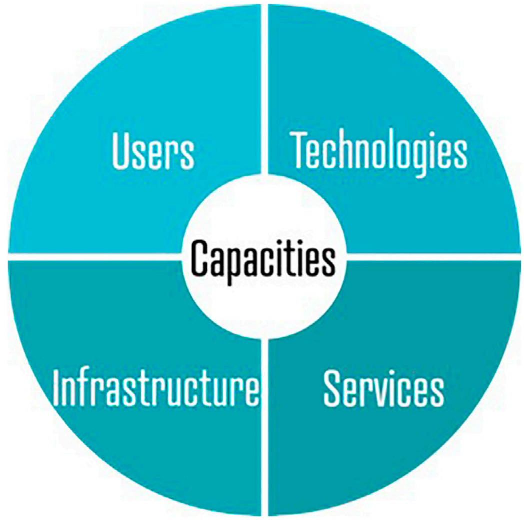

FIGURE 2 | Safe system approach for net-zero mobility.

Individual projects and technologies can contribute to the change, but only an integrated and systemic change across the whole sector and beyond—including the energy and resource dimensions—will enable a shift towards a net-zero transport system. For this, a societal perspective is needed to identify appropriate solutions. This is also vital to leverage on the potential for cost savings of a sustainable mobility system. A "safe system" approach for a transport sector that moves us towards net-zero emissions and that enables access to sustainable mobility for all needs to focus on four inter-connected pillars as depicted in **Figure 2**: users, vehicles, services and infrastructure.

Minimising the carbon content in vehicle technologies is a key systemic change that is required in the mobility transition. Hence, the shift to electric mobility has a vital role to play in decarbonising the sector. But the overall contribution of electric mobility to climate change mitigation and sustainable development depends critically on the integration with the other pillars of the system. Electric vehicles need to be fit-for-purpose—this means that they need to be resource and energy efficient; well-integrated with other mobility services and infrastructure; and designed for mobility as a service, which provides access for all.

To adopt a "safe system" approach, improved capacities and a better understanding of the needs and opportunities for key players in the sector is important, including: local and national authorities, vehicles manufacturers and other technology developers; mobility service providers and infrastructure developers. These are essential building blocks for the transition to sustainable mobility.

This transition has the potential to unlock trillions of dollars in cost savings, at least from a whole-society perspective, by 2050 a low-carbon mobility system could cut transport related annual costs by over 5 Trillion USD globally (Fulton, 2018). But the resulting impacts can also shift value generation and distribution. However, more sustainable travel patterns can generate substantial complementary benefits that could help in transforming cities into more liveable and economically-efficient centres. Policy interventions to foster the electrification of the sector can help towards achieving a range of objectives, for example, air quality improvements and reductions of greenhouse gas emissions. But addressing all key objectives—such as access to safe roads and liveable cities for all—requires a much broader package of measures. Linking and packaging policies is also a key tool to generate synergies between different measures and to align different players.

Integrating Electric Mobility Within a Wider System Approach

Capacity building on sustainable mobility needs to convey the need for an overarching approach that consists of several levels of intervention that shape not just vehicle technology, but also mobility patterns and urban form. Such a capacity building approach includes:

- **Technologies:** For electric vehicles there should be a clear focus on drastically downsizing vehicle size and power, fosters resource and energy efficiency and boosts cost-effectiveness. This is countering the trend of the last few decades towards bigger, faster and more powerful cars, which has eradicated almost all efficiency gains in powertrain technologies. Only then will the electrification of the entire vehicle fleet be viable and resource efficient as well as affordable. In addition, electric vehicle concepts, should be designed for shared use-cases, which will further foster access and affordability. Other technological innovations, such as automation, should focus on complementarity with public transport systems, and should avoid competition with non-motorised transport. This is vital to the viability of public transport services, and also encourages healthy and active mobility. Automation may play an important role in the provision of on-demand mobility services in rural areas where traditional public transport options are not viable.
- **Infrastructures**: Providing access for all to high-quality public transport services, walking and cycling infrastructures, is a vital part of a safe system for sustainable mobility. To enable this, compact city development can help with mixed use, poly-centric structures and short travel distances. To enable the shift to electric vehicles a comprehensive network of charging solutions and reliable availability of charging points is a vital element for a systemic change.
- **Services:** Access to mobility services such as shared and ride hailing services is another critical element for a safe system for sustainable mobility. Services should be harmonised across available mobility services to encourage the use of the most efficient option.
- **Users:** Should have access to transparent information about the cost, time, safety and other relevant aspects of different available mobility solutions and vehicles. To further guide consumer choices differentiated pricing should favour efficient modes and vehicles. Regulation of vehicle standards and technologies further ensures that consumers have sufficient access to safe and efficient vehicles.

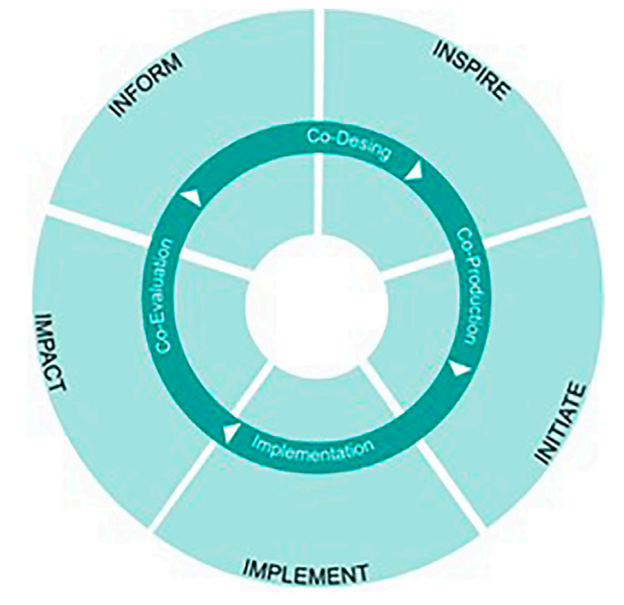

FIGURE 3 | Pillars for innovation co-development.

Application of the Living Lab Approach in the Context of Sustainable Urban Mobility

The basic Living Lab concept has been widely used in application-oriented urban development projects. For example the EU-funded CIVITAS programme has supported a number of projects, which focused on the development and testing of innovative solutions for sustainable mobility. Since the inception of the CIVITAS programme in 2002, more than 800 measures have been implemented in over 80 cities through Living Lab projects (Kotler, 2021). As an international cooperation flagship project, SOLUTIONSplus was launched in 2020 adopting the Living Lab approach and applying it in nine Living Labs in Europe, Asia, Africa and Latin America.

The SOLUTIONSplus project, is supported by the a European Union and aims to boost sustainable electrification of transport in large urban areas in developing countries and emerging economies. The project seeks to establishing a global platform for shared, public, and commercial e-mobility solutions to kick-start the transition towards low-carbon urban mobility. Towards these objectives, the project is working to bring together highly committed cities, industry, research, implementing organizations and finance partners to carry out demonstration actions in partner cities to test innovative e-mobility technologies and business models (SOLUTIONSplus Consortium, 2020b). The demonstration cities, as Living Labs, act as incubators of e-mobility innovations which are guided by a comprehensive toolbox, impact assessments, capacity building on e-mobility, stakeholder dialogues and participatory processes.

The SOLUTIONSplus project adapted the Living Lab approach to a five-pillared co-development process that provides an overall structure to the project. The project aims to showcase interventions for sustainable and inclusive development, building on the New Urban Agenda and the Paris Agreement and utilise the urban Living Labs to link key sectors and actors as a step towards an integrated approach that helps decarbonizing urban systems and delivers liveable and accessible cities for all. The Co-development of solutions integrating research and innovation along five pillars as shown in **Figure 3**, include:

- Inform: Boost capabilities, provide tools to plan, assess and implement
- Inspire: Foster the take-up by inspiring through peer-to-peer exchange
- Initiate: Strengthen collaboration by initiating partnerships
- Implement: Create reference models by implementing demonstration actions
- Impact: Scale-up, replicate and transfer

The SOLUTIONSplus approach for testing innovative solutions in urban living labs is intended to be a steppingstone for the transfer and replication of learnings into scaled-up public or private sector actions, which is considered to be a vital next step towards transformative change (SOLUTIONSplus Consortium 2020a).

Capacity Needs Assessment in the Project Studied

A core element of the co-development process is the development of transformative capacities for public and private sector actors. In this section, the process is described for the assessment of project stakeholders' capacities to plan and implement e-mobility innovations. The capacity building approach in the project under study aims to strengthen the knowledge and the skills of transport stakeholders in participating partner cities and also ensure the transferability and applicability of the capacity building tools and methods (developed in the project) for use outside of the project. The main target groups in the project's capacity building plan are the city representatives from the project's nine (9) partner cities. In addition to this group, the capacity building activities aim to benefit government officials (at national, regional and local levels), transport operators and authorities, the private sector (industry, small and medium-sized enterprises, and start-ups), civil society (particularly Non-Governmental Organizations), research and innovation community (academia, research centres, etc.).

The capacity needs assessment process started during the project's Kick-off meeting in January 2020 in Berlin, Germany and ran through to May 2020. The Kick-off meeting was attended by about 72 participants made up of representatives from all 45 partner organizations and cities. During the meeting, discussions about how to develop the training needs assessment were held together with project partners and city representatives during a dedicated workshop session. As part of the workshop engagements, a Mentimeter session was conducted to obtain inputs and feedback from participants. Mentimeter is an online application for measuring and obtaining feedback from the audience (Mentimeter, 2021). **Figure 4** below shows sample results from the Mentimeter exercise conducted during the workshop session at the Kick-Off meeting.

Source: (SOLUTIONSplus Consortium, 2020a):

Subsequent to the Kick-off meeting and following up on the preliminary need definition, initial survey questions were developed by the partners leading the task on capacity building activities in the project. These questions were shared with the whole project consortium to solicit feedback leading to the formulation of a final Training Needs Assessment (TNA) survey. The TNA survey questionnaire was structured in the following categories: Education background and technical qualifications; Awareness and perception about electric mobility; Ability to plan and implement e-mobility projects; Areas of training that will help the cities to deliver project successfully; Preferred modality of training; Criteria for selecting partner cities learning exchange. The TNA survey was administered online and the questionnaires were shared with the partner cities via an online platform (NUA Campus, 2021). Also, in-depth interviews were conducted with local representatives using the survey questions. Here, the authors highlight the results of the TNA survey and interviews, though the analysis of these is not a focus in this paper. As mentioned earlier, the results of the TNA as conducted in the project under study need to be cautiously generalized considering that the geographic and situational contexts in the project's partner cities may vary from other settings. According to project documents as sighted by the authors, there were 18 respondents from all nine (9) partner cities. A majority representing 39% of respondents were from the private sector whilst 22 and 17% of the respondents work with local government and national government authorities, respectively. It is worth mentioning that 50% of respondents have expertise in engineering (transportation, civil or electrical). The respondents' period of time working in the transport sector varied: 17% have less than 5 years of experience, 44% have 5–9 years of experience, 28% have 10–14 years of experience and 11% have experience of 15 years and more. According to respondents, the three most important motivation for working on e-mobility in their respective cities include: moving forward climate change mitigation efforts, contributing to less fuel imports initiatives (Improvements to national energy security and independence) and making contributions to actions aimed at reducing air pollution (SOLUTIONSplus Consortium, 2020a).

To drive the transition to e-mobility in cities, respondents indicated that national government policies are the most important enablers coupled with the activities of Start-ups and local innovators, the presence of a local champion such as Mayors

FIGURE 4 | Initial results from the Mentimeter exercise during the project's Kick-Off workshop.

and sufficient demand for e-mobility services from end users or the citizenry. Also, the TNA results show the following as the main obstacles that could hinder a transition to e-mobility: insufficient personnel, limited knowledge, or skills on e-mobility, limited financial means; and high upfront investment cost. Such indications suggest that there is the need for skill development and technical advice on e-mobility in the partner cities, with focus on financial and fiscal measures. Again, respondents revealed that vehicle infrastructure development constitutes the area with the highest training needs for e-mobility development followed by business modelling, finance and fiscal schemes, and experience-sharing on examples of successful e-mobility project implementation. It is interesting to mention that respondents indicated that, though there are priority areas, there is a need for capacity building in all categories or areas of e-mobility development including Technology, Operations, Procurement and Financing, Infrastructure, Policies and Regulations, Businesses. **Table 2** below provides an expanded overview of how respondents rated the need areas for capacity building. Moreover, respondents' views were sought regarding the top three preferred forms of capacity building activities. Responses showed that the top three preferred forms include: face to face meeting, study tours or site visits, and city-to-city (peer to peer) exchange activities.

The results from the TNA survey and the interviews according to project documents are expected to provide a framework for capacity building in the project. Subsequent to the capacity needs

TABLE 2 | Categories of needs and corresponding ratings.

Area for capacity building	Rating				
	Highly necessary	Necessary	Average need	Little need	No need
Technology	–	–	–	–	–
Technology specifications	–	√	–	–	–
Batteries		√			
Difference between buses and providers	–	–	√	–	–
Operations	–	–	–	–	–
Electricity grids	–	–	√	–	–
E-mobility solutions for deployment	–	√	–	–	–
Maintenance of Electric Vehicles	–	√	–	–	–
Procurement and Financing	–	–	–	–	–
Terms of References development	–	√	–	–	–
Financing Options	–	√	–	–	–
Financing Requirements	–	√	–	–	–
Procurement and contractors	–	–	√	–	–
Infrastructure	–	–		–	–
EV charging	–	√	–	–	–
E-bus charging	–	√	–	–	–
Charging Standards	–	√	–	–	–
Charging Plans	–	√	–	–	–
Electricity Grid Needs	–	–	√	–	–
Policies and Regulations	–	–	–	–	–
Fiscal incentives	–	–	√	–	–
Other incentives (non-fiscal)	–	–	√	–	–
Cross-sectoral cooperation	–	–	√	–	–
Integration of e-mobility in SUMPs	–	√	–	–	–
Communication, advocacy, and promotion	–	–	√	–	–
Logistics plan and delivery	–	–	√	–	–
Mobility and integrated planning issues (Transit Oriented Development, urban design, land value capture, etc.)	–	√	–	–	–
Inter-modality	–	–	√	–	–
Businesses	–	–	–	–	–
Business Models	–	√	–	–	–
Attracting Start-ups	–	√	–	–	–
Developing frameworks that encourage private sector involvement	–	√	–	–	–

Source: (SOLUTIONSplus, Consortium, 2020a).

assessment, the project is developing series of learning activities to equip local and national policy makers, practitioners, entrepreneurs, and operators with the skills and knowledge required to effectively develop, implement and operate innovative urban electric mobility solutions. Ultimately, it is anticipated that the project would help establish and sustain the capacities and capabilities at all levels and for all key stakeholders to facilitate the transition to electric mobility in cities.

Capacity Building Interventions

Following up on the results of the TNA survey, the capacity building task leaders after several online meetings with relevant project stakeholders, designed training courses tailored to the needs identified in the TNA survey. The highest training need areas as revealed by the TNA survey results and sighted by the authors included Electric Vehicles Infrastructure (26% of respondents), Business Modelling (9% of respondents), Finance and Fiscal Schemes (9% of respondents), Examples of Successful Project Implementation (9% of respondents). Accordingly, global, regional, city-specific and on-demand peer-to-peer training courses are being designed by the project based on the capacity needs identified and also considering the expertise available in the project consortium. The first training course was a global e-learning course themed "Electric mobility–more than just electrifying cars". According to project documents, the course consists of four thematic units: the first unit contextualized e-mobility within transport systems decarbonization; the second unit provided an overview of e-mobility eco-system touching on stakeholder needs and operational requirements; the third unit made the link between e-mobility and integrated planning; and the four unit gave synopsis of how e-mobility is implemented in cities (SOLUTIONSplus Consortium, 2021). The course was also designed to provide good practice examples of policy measures and incentives that support the electrification of transport; and was designed for city and regional authorities though it also provided a compact knowledge foundation for any stakeholder involved in electric mobility. The global course was structured into video lectures and materials were provided for self-study. There was a kick-off webinar which gave key information and guidance about the learning program and the project as a whole. Virtual exchange sessions were held during the course to enable interactive discussions with and among participants. The course established a general framework that was built upon in designing subsequent learning activities (regional, city-specific and peer-to-peer training).

DISCUSSIONS

Extent of Real-Life Contextualization

Acting as Living Labs, the demonstration cities in the studied project constitute real-life environments for testing e-mobility innovations. As the innovations are to be developed and tested within local settings, the capacity needs assessment was also to be carried out within the framework of local conditions available in respective partner cities. Though physical engagements to assess capacity needs did not take place in individual cities, descriptions of the cities' local environment conveyed by the city representatives who participated in the project's Kick-off meeting provided to some extent a local contextualization and direct physical consultation on the capacity needs of the cities. In the instance of the dedicated workshop session held during the project's Kick off meeting, city representatives who doubled as intended users of planned innovations were presented with the physical platform to discuss their respective cities' e-mobility aspirations, challenges and need areas for capacity building. Providing such physical settings according to Markopoulos and Rauterberg, (2000) helps gather observations and make findings. In the case of the project, the workshop session facilitated the preliminary identification of capacity need areas which were later reviewed and validated by the whole project consortium and finalized into a survey instrument. Also, the approach, as used in the project, is congruent with the Living Lab concept which allows open participation in the innovation process through surveys or closed participation where users are involved in co-creation sessions (Schuurman et al., 2016). It can be said that the project used both the open and closed approaches by involving the key city representatives in closed workshop sessions during the project Kick-off and later opening the opportunity for other city stakeholders to respond to the surveys online. Corroborating this insight, the key informant survey conducted by the authors revealed that five (5) out of six (6) respondents who indicated having participated in the dedicated workshop agreed that the workshop provided city stakeholders who were present at the workshop the platform to actively exchange on their capacity needs (Key Informant survey, 2021). Also, there is general consensus among key informants that other instruments used in the project to assess the capacity needs of the cities such as the survey, interviews and email exchanges helped generate adequate feedback from city stakeholders.

The results of the key informant survey also showed that the majority (68.4%) of respondents would recommend a physical workshop/platform in respective partner city as an ideal setting for relevant city stakeholders to engage on their capacity needs (Key Informant survey, 2021). Such finding is consistent with the view that Living Lab settings should depict real-life scenarios as much as possible in order to derive the full benefits of the approach. Considering that the Covid-19 emergence and accompanying restrictions happened around the period of capacity needs assessment (January to May 2020) in the case under study, having a typical Living Lab real-life physical setting such as physical engagements in respective cities seemed difficult for project implementers. A combination of measures including physically engaging participants during the Kick-off workshop and using feedback mechanisms and platforms therefore proved to be instrumental in ensuring that project participants and key beneficiaries and users were carried along the process, feeling that their respective locally-contextualized contributions were accounted for, in this case, in the capacity needs assessment process.

Level of Participation

In Living Lab projects that test technologies such as in the case studied here, Schuurman et al. (2016) opine that users' participation usually generates diverse perspectives which help to suitably adjust or modify the innovations to users' tastes or preferences thereby increasing the acceptance of the technologies. In this study, city stakeholders represented the user groups or to a large extent conveyed the needs of user groups in the respective cities. In the TNA survey, there was at least one (1) respondent from each city who by way of their position, profession and working experience, possessed adequate knowledge on the respective city, therefore allowing them to convey the transport challenges and capacity need areas worth addressing when transitioning to e-mobility. As the project's capacity building drive targets mainly the city representatives and transport stakeholders, and there is apparent difficulty to quantify the total number of representatives in all the nine cities, an average of 2 responses per city coupled with follow ups interviews as conducted by the project brought a fair representative sample to the target group surveyed. Also, through the key informant survey conducted by the authors, participation in the capacity needs assessment in the project was largely described by 18 out of 19 respondents as average to very high. Out of the 18 respondents, nine (9) reported the process as averagely participative, eight (8) indicated participation as high whilst one (1) agreed that the process was highly participative. Indeed, 18 respondents confirmed having participated in the capacity needs assessment process in one way or the other (Key Informant survey, 2021). The participation of relevant stakeholders which was largely through the physical workshop as discussed earlier as well as the planning and execution of primary data collection strategies - survey and interviews - facilitated the collection of responses in the form of observations, experiences, opinions (Hox and Boeije, 2005) directly related to the categorized needs parameters set out by all project partners. The workshop, survey, interviews as well as email exchanges allowed city stakeholders to directly contribute to the capacity needs definition right from the beginning of the project. According to the key informant survey findings, this level of participation in the capacity needs assessment process was partly contributory to the derivation of well-refined capacity needs areas (Key Informant survey, 2021). One would argue that adopting such participative approach as characteristic of Living Labs helped generate shared needs and acceptable capacity building interventions tailored to the e-mobility needs identified in the cities. Ensuring that project stakeholders, particularly city partners were involved actively throughout the process was thus a contributory factor to the outcomes realized.

Stakeholder Diversity

In deriving the needs of project partner cities, the project deployed a key principle of the Living lab approach which is to involve multiple stakeholders in co-defining problems and collectively identifying common objectives. As opined by Voytenko et al. (2016) the ability of Living Labs to contribute to urban sustainability and low carbon transitions depends on how they are designed and executed in practice. Such set-ups according to the authors usually consist of varied stakeholders who share common interests and values in the subject matter (for instance e-mobility transitions). Maintaining a high level of openness throughout the process is however crucial to obtaining the much-needed contributions from all stakeholders (Veeckman et al., 2013). In the project studied here, the assessment of the capacity needs of the project's partner cities which represent the living labs, followed a similar multi-stakeholder approach where several project partners with varied e-mobility expertise including city stakeholders who constituted innovation users were involved in defining the need areas for capacity building. There were experts with backgrounds in Transport Planning/Engineering, Urban planning/architecture, Environmental, Energy and Political sciences as well as experts in Information and Communication Technology (ICT), Finance and Administration. These experts belong to different stakeholder groups in the project including industry partners, network partners, research partners, international organizations as well as local implementing partners. This multi-stakeholder approach created a critical mass of contributions on various elements of e-mobility development such as electric vehicle development, operations, and integration into public transport systems. The approach, as opined by the authors and also confirmed in the key informant survey, helped refine capacity needs assessment questions in the TNA, offered different perspectives on e-mobility, provided understanding on indicated or identified needs and contributed to appropriately tailoring the project's capacity building interventions to the identified needs (Key Informant survey, 2021).

Time Span of Engagement

In Living Lab set-ups, the time period in engaging participants is equally important to success or otherwise (Sarjanen, 2010; Franz et al., 2015). In the project under study, the capacity needs assessment process elapsed a period of five (5) months (January to May 2020) followed by periods of engagements to tailor capacity building interventions to identified needs. Though the majority of project participants who responded to the key informant survey expressed that the five (5) months period was adequate to assess the cities/stakeholders' needs, they do not strongly associate the outcomes of the capacity needs assessment to the period taken (Key Informant survey, 2021). For those who indicated that the five (5) months period was not adequate, they propose a period of 6–9 months as a more appropriate duration for the capacity needs assessment process. Such perceptions could be related to the research nature of the project confirming Sarjanen (2010)'s assertion that living lab research projects allow for sufficient time to derive better findings unlike in commercial living lab setups where economic costs of the research discourage longer research durations. Allowing sufficient time to assess the needs of the partner cities could have therefore accounted partly for the successes drawn in the process. A summary of the project's adaptation to the Living Lab approach is provided in **Table 3** below.

Recommendations for Project Planners and Implementers

A combination of factors including ensuring a blend of physical and non-physical settings, encouraging active stakeholder participation, maintaining a wide diversity of stakeholder involvement as well as keeping sufficient time for engaging participants in the capacity needs assessment accounted for the outcomes realized in the project studied in this paper. In this light, the authors would recommend the following:

- Transport project planners and implementers who deploy the living lab approach need to consider the inclusion of physical or tangible settings to provide the living lab participants a real-life feeling of the project's innovations. As revealed in this study, providing physical platforms in the respective partner cities to assess the capacity needs of stakeholders would have been a more desired approach and may have yielded better outcomes. Nevertheless, the physical workshop held at the project's Kick-off provided the city representatives at least a closer attachment to the process from the start of the project and partly accounted for the outcomes of the process.
- Ensuring active participation in living lab set ups particularly for intended innovation users is key to success. Transport project planners and implementers can ensure participation in such processes by establishing regular feedback mechanisms using tools such as workshops, surveys, interviews, email correspondences, among other online or physical platforms that allow interactive engagement amongst project stakeholders. As seen in this study, the inclusion of city representatives or stakeholders from the beginning of the capacity needs assessment and their subsequent continuous engagement in the process was instrumental in refining the cities' capacity needs in terms of e-mobility planning and implementation and in designing tailored capacity building interventions.
- There is the need for transport project planners and implementers to maintain a wide range of diversity of expertise in project set ups as this is important to generating multiple perspectives and deriving shared identity among project stakeholders. From the key informant survey conducted by the authors, respondents cited the multi-stakeholder approach taken in the process as the most indicative factor that accounted for the well-refined capacity needs derived in the TNA.
- Finally, though the time of engagement matters in Living lab set ups, in the case studied here, this factor was less associated

TABLE 3 | Summary of key elements of Living Labs in the project and in its Capacity Needs Assessment process.

Key living lab elements	Literature	Living lab elements in the project as a whole	Living labs elements in the project's capacity needs assessment process
Living labs depict a real-life scenario	Markopoulos and Rauterberg, (2000)	Partner cities as Living Labs providing real settings of local urban transport systems	The needs assessment process involved physical workshop sessions at the Kick-off meeting and online calls, setting the scene for local city representatives and transport industry players to define need areas taking into consideration local e-mobility contexts in partner cities
Living Labs allow active user-participation	Schuurman et al. (2016)	Innovations are to be developed together with local transport industry players including local SMEs, local authorities, transport operators and associations, and various transport service user groups	There was active participation in defining, refining, and elaborating needs areas with the involvement of local city representatives who doubled as innovation users, transport industry players and partners who exchanged ideas and provided direct feedback during the Kick-off physical workshop and via online platforms (Mentimeter, emails, survey, interviews)
Living Labs involve multiple stakeholders	Ogonowski et al. (2013), Veeckman et al. (2013)	Over 45 partners made up of transport industry players, businesses, academia, local, national authorities, and stakeholders. International experts in the field of transport and electric mobility development are involved in the project	The assessment process involved diverse transport stakeholders ranging from representatives of local authorities who also constituted end users, businesses, transport operators, among others
Living Labs span a time-period (Short, Medium, Long term)	Veeckman et al. (2013), Sarjanen. (2010), Franz et al. (2015)	The demonstrations are planned to last a period of 18 months, but other related activities are to continue running throughout the 4-years life span of the project. Long term replication activities are also expected depending on the outcomes of individual demonstration actions	The capacity needs assessment process lasted a period of 5 months starting from the project's Kick-Off meeting. Participants' interest through that period was sustained. Actual activities to build capacity (such as training courses, peer to peer learning) are to span through the city demonstration actions and even throughout the project lifetime

Source: Authors' construct, 2021.

with the positive outcomes realized. Yet, in a research project such as the one studied here; it is imperative to allow sufficient time to derive refined results acceptable to all stakeholders. The longer engagement period can engender participant fatigue; however, participants' interests can be sustained in the process through regular meetings amongst relevant partners who plan the process, constant follow ups and reporting from responsible team partners coupled with active participation of relevant stakeholders or innovation users.

The authors would like to mention that the main study subject in the paper is not the Training Needs Assessment and its results; hence we do not do an in-depth analysis of the TNA survey instruments and its results. The paper rather focuses on the entire process adopted in assessing the capacity of the cities which included the TNA survey. Our study sought to explain the extent to which this process followed the Living Lab approach and which element(s) of the approach were embedded in the process. Drawing on the usefulness of the Living Lab approach, the study also drew findings on how the adoption of the Living lab elements helped derive the eventual outcomes (tailored capacity building interventions for the cities involved). We carried out a key informant survey to validate these findings. For purposes of laying a methodological approach for others to follow, we have included in this paper, a flow chart in **Figure 1** to clearly express our research approach.

Having elaborated on how the elements of the living lab were embedded in the project studied, the authors opine that the Living lab approach remains a useful tool for project planners and implementers and could help achieve project objectives particularly in transport innovation projects which by nature involve a multiplicity of stakeholder interests which need to be harmonized. Future research could help develop weighting factors for each of the Living lab elements to determine their comparative importance and facilitate the assessment of how each of these elements individually or collectively affect project outcomes.

CONCLUSION

The need to build capacity in urban transport projects has long been recognized by project planners and implementers. However, evidence shows that much more conscious efforts are required to ensure that capacity building elements in projects are effectively executed to derive expected project benefits. The Living Lab approach presents an opportunity to make such efforts in defining and refining capacity needs together with project implementers and beneficiaries. As highlighted in this paper, the project seized that prospect and adapted elements of the Living lab approach in assessing the capacity of its partner cities in e-mobility development. This was reflected in how the project from its onset and for a period of five (5) months actively involved all relevant project partners and city representatives who provided insightful locally-tailored information and data on e-mobility policy environment and capacity building considerations in partner cities. By so doing, well-refined capacity needs assessment criteria were developed with inputs from diverse stakeholder perspectives–a benefit of the Living Lab approach which generates increased acceptance of solutions developed. In the case of the project, this would mean that the capacity building tools, methodologies and training activities implemented in the project would likely address the specific capacity needs of partner cities and would in addition to other measures help drive the transition to e-mobility.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the authors. The data are not publicly available due to confidentiality agreement with the key informants included in this study.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by SOLUTIONSplus Consortium. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Conceptualisation and Methodology, ET; Case Study Data and Interviews, ET; Writing Original Draft, ET; Capacity building approach, OL; Review and Editing, ET and OL; Supervision, funding acquisition, OL. All authors have read and agreed to the published version of the manuscript.

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