Testing collaborative accessibility-based engagement tools: Santiago de Chile Case

By

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Abstract

The population of metropolitan areas in developing countries has been rapidly growing and transport externalities – such as congestion, pollution and traffic fatalities – have followed, in most cases, the same trend. Latin American metropolitan areas, where generally public transit is still predominant, has important challenges in continuing their economic development without severe increases in transport externalities. At least partly in response, citizens are raising their voices for more reliable and people-oriented solutions. Transportation planning, thus, plays an important role and within transportation planning, increasing public participation in decision-making has emerged as key to providing better transport solutions. As part of a transport planning engagement process, new technologies and new forms of measuring benefits are emerging in practice. Accessibility-based metrics and web-based map visualizations could improve the engagement process with easy-to-read results and analysis, decreasing the complexity of traditional transit project appraisal. CoAXs, short for Collaborative Accessibility-based Stakeholder Engagement System, has been tested in several simulated instances of public participation in the U.S., showing interesting results including potential for co-creation and mutual understanding. This thesis presents an application of CoAXs in a developing country context, specifically in Santiago de Chile. The Santiago experience will attempt to answer questions regarding CoAXs' potential for improving the engagement process and its performance for encouraging higher-scale (metropolitan) conversations, among Decision Makers and Stakeholders. By analyzing the results of the tool application, this research argues that CoAXs use in public settings is capable to promote project impact understanding and project learning among participants, which might improve the engagement process in transportation planning. Additionally, CoAXs Santiago version seems to represent better high scale (metropolitan) project impacts, which provide an initial indication of CoAXs' encouragement for metropolitan level discussions.

Thesis Advisor: Associate Professor, P. Christopher Zegras

Thesis Reader: Professor of the Practice, Ceasar McDowell

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Chapter 1: Overview

The population of metropolitan areas in developing countries has been rapidly growing and transport externalities – such as congestion, pollution and traffic fatalities – have followed, in most cases, the same trend. Latin American metropolitan areas, where generally public transit is still predominant, has important challenges in continuing their economic development without severe increases in transport externalities. At least partly in response, citizens are raising their voices for more reliable and people-oriented solutions. Transportation planning, thus, plays an important role and within transportation planning, increasing public participation in decision-making has emerged as key to providing better transport solutions. As part of a transport planning engagement process, new technologies and new forms of measuring benefits are emerging in practice. Accessibility-based metrics and web-based map visualizations could improve the engagement process with easy-to-read results and analysis, decreasing the complexity of traditional transit project appraisal. CoAXs, short for Collaborative Accessibility-based Stakeholder Engagement System, has been tested in several simulated instances of public participation in the U.S., showing interesting results including potential for co-creation and mutual understanding. This thesis presents an application of CoAXs in a developing country context, specifically in Santiago de Chile. The Santiago experience will attempt to answer questions regarding CoAXs' potential for improving the engagement process and its performance in encouraging higher-scale (metropolitan) conversations, among Decision Makers and Stakeholders.

1.1. Research Questions

The principal questions for this thesis, emerging from the discussion above are:

- What possibilities might Accessibility Based Visualization Tools (ABVT) have to improve engagement processes and advance a more effective transportation planning?
- Might ABVT tools assist in encouraging wider metropolitan (rather than local) discussions in a transport planning engagement process?
- What differences exist in how different types of users evaluate the usefulness and performance of ABVT in Santiago de Chile, and what might this imply for transportation planning engagement processes?

1.2. Main Objectives

The following main objectives emerges from the research questions:

- Based on current CoAXs development and experiences, develop and adapt a CoAXs version for Santiago de Chile, including transit project selection.
- Design and develop a simulated participatory experience in Santiago for two different testing groups: Stakeholders and Decision Makers, to understand CoAXs' impact on the engagement process and CoAXs' encouragement of Metropolitan level transportation discussions.
- Develop recommendations for additional CoAXs testing experiences and further research.

1.3. Thesis organization

This thesis is organized in the following structure:

- Chapter 2 develops the literature review for the thesis, focusing on engagement processes in transportation planning and metropolitanism.
- Chapter 3 refers to the tool development needs for the Santiago experiment and describes the different required tasks and activities for CoAXs Santiago deployment.
- Chapter 4 describes the experimental design for testing CoAXs in Santiago the Chile based on previous CoAXs testing experiences.
- Chapter 5 describes the results of the testing experience.
- Chapter 6 develops conclusions of Santiago's CoAXs testing and presents further research recommendations.

Chapter 2: Literature Review

2.1. Characteristics of public participation in transportation planning

Public participation in transportation planning has often been characterized as an example of poor participation, with relatively little attention given to stakeholder engagement in planning and designing transportation systems, which has widened the gap between the social and technical determinants of the planning process (Cascetta, Cartenì, Pagliara, & Montanino, 2015). At the core of this weakness has been what some scholars and practitioners refer to as the 'Decide, Announce and Defend' or DAD approach. Under this approach, the agency in charge of transportation planning decides the course of action then announces it to the public and consequently moves into defending its intervention from the public's criticism. (Cascetta & Pagliara, 2013). DAD is a fundamental contradiction to a participatory process because alternatives are already decided, such that participants at public forums will naturally react negatively to presentations made by consultants and planners (Bailey & Grossardt, 2006). According to Stewart (2014), DAD is a mere evolution from the Predict and Provide approach that dominated

transportation planning since the mid twentieth century and does not advance a more inclusive and participatory planning process.

The traditional transportation planning paradigm provides little opportunity for stakeholders to meaningfully question the project itself (Bickerstaff, Tolley, & Walker, 2002) and implies that planners are only assistants to decision-makers for achieving self-evident goals; this limits planners activity to a technocratic role for designing, analyzing and evaluating alternative means (Willson, 2001). The consequences of this practice are twofold: on one hand, there is a clear division between decision-making and the planning process itself; one the other hand, the gap between the technical and social aspects of transportation is widened.

Public Dialogue and discussions under traditional transportation planning approaches typically focus on a specific project or solution (Wilson, 2001), which implies that policies or other important underlying aspects remain out of consideration, restraining the action of participants. Without reference information about projects and with limited knowledge about transport project evaluation, non-experts remain excluded from a meaningful participatory experience (Bickerstaff et al., 2002). Moreover, the use of sophisticated and technical language poses a barrier for the public, impeding deliberation and effective participation. In his proposal for a *communicative* approach to transportation planning, Willson (2001) states that the way transportation planners use language ultimately shapes knowledge, public participation, and the outcomes of planning processes. For Wilson (2001), the traditional transportation planning approach, or orthodox type of planning, is built upon the basis of instrumental rationality and objectivity. Under such a scope, the language used by planners and the range of discussions in participatory processes follow the same logic, ultimately being constrained to the "rationality" of a means-to-ends planning process.

Data visualization has been considered as an enabler for increased public understanding of transportation projects and for reaching consensus (Keister & Moreno, 2002). However, the development of transport-related visualization tools has focused mostly on assisting planners and engineers in visualizing and easily reading complex transport data, rather than attempting to include non-expert users in the process. Hughes (2004) argued that most of visualizations are used to present final designs or solutions for public approval, rather than as a base for public engagement. The lack of transport planning visualization tools for non-expert audiences has contributed to sustaining the "orthodox" approach to public participation in transportation planning, by supporting fixed and pre-analyzed transport alternatives or scenarios (Wigan, 2012). Moreover, traditional transport project evaluation-metrics, usually utilized in public settings, describe projects impacts as a whole, limiting the possibilities for local- and personal-impact representations. Nevertheless, recent research suggests that new tools, such as interactive software and digital open data, could theoretically improve public engagement in transport planning (A. F. Stewart &

Zegras, 2016); Goodspeed, 2013). The effectiveness of using these new tools will, however, remain closely related to the communication concepts and application methods of public engagement (Hughes, 2004)

2.2. Consequences – Impact

The use of traditional transportation approaches such as Predict and Provide and DAD has generated consequences that include a generalized mistrust from the public, the emergence of NIMBYism (short for Not-in-my-back-yard opposition), the lack of collaboration among administrations, and lack of buy-in from the public in engagement processes. Combined, these have undermined the transportation planner's capacity to advance a more comprehensive planning practice and have deteriorated relationships with the public.

2.2.1. Public Mistrust

Willson (2001) analyzes the drivers behind transportation planning and supports the argument that, under traditional transportation planning approaches, the public is absent from relevant discussions, which are mainly then driven by planning and politics. This author states that, "rather than adopt rational criteria (planning paradigm), such as cost effectiveness, political systems seek flexibility and projects in which the benefits are focused and the costs are dispersed" (p.7), the public is "rarely engaged in a substantive dialogue about transportation. Instead, their input is usually sought after the problem has been defined" (p.8).

This "outsider" type of public participation in the transportation planning process results in an unresolved tension between politics and traditional planning that leads to poor planning and generalized public mistrust. Stewart (2017) argues that the exceptional challenges faced by public participation for public transportation, are based on "the indirect incidence of many (public) transport impacts, [which] may encourage public mistrust and conflict" (p.2). Petts (2008) notes that any public engagement process reasonably generates tensions between the public and planners and, that given the complexities of the planning process and the high level of expectations of the public, trust is unlikely to arise. More generally, Innes & Booher (2004) find evident failure in the methods used in the US for public participation, which remain based in the DAD planning approach. These participation methods, legally structured in public planning agencies, counterproductively produce public anger and mistrust.

2.2.2. NIMBY Opposition

The NIMBY phenomenon is characterized by a local opposition to a facility, construction or change in land use. For O'Hare (2001), the definition of NIMBYism is a "political conflict associated with something

people generally want, but few want near them" (O' Hare, 2001, p. 2). NIMBYism's most important consequence is that building something positively evaluated for society at large becomes nearly impossible because of the political impossibility to build at any single place. This phenomenon is easy to find in transportation planning, where even if a project promises city-wide benefits, those people who are directly affected by a transportation facility location stand to lose. NIMBYism is not, however, always a "bad thing," especially when meaningful participatory processes are otherwise absent. Consider, for example, the "Costanera Norte Urban Highway" project in Santiago de Chile, which was planned as the first project of an ambitious plan of Urban Highways in Santiago. The Costanera Norte was designed as 34-kilometer long, 6-lane, two-directional highway serving 10 (of 34) *comunas* in Santiago (Sagaris, 2013). The project encountered early opposition by one community, which successfully drew attention of other affected communities, which then led to the emergence of the coalition "Coordinadora no a la Costanera Norte (CNCN)" (Sagaris, 2014). Due to the opposition of CNCN, the project was delayed and substantial changes to the original route placement were made, reducing several expropriations. The new route was placed in a tunnel under the Mapocho River, which avoided the demolition of several heritage and conservation buildings and ensured sustaining important green areas at the cost of increasing the highway construction cost, which suggests an increased total social benefit of the final project.

This particular experience showed how an original NIMBY phenomena escalated further to a larger and more robust public opposition. The planning process for the Urban Highways Plan was developed by the Ministry of Public Works, following a "predict and provide" approach which was the mainstream governmental planning approach followed by public institutions in Chile until late 1990s. Zegras and Gakenheimer (2000) recognized the inexistence of public participation in transport planning during these days with an example from the Transport Planning Secretariat (SECTRA[1]): "…since SECTRA plan was developed with no public participation, many of its final results have met with stiff opposition – represented, for example, by community opposition to a major busway proposed for Gran Avenida…"(p.81). Sagaris (2013) agreed, adding that CNCN opened a debate which changed public participation in transport planning "from nuisance status to a deeply felt public demand, which ultimately found its way into new planning processes…" (Introduction, p.12). The Costanera Norte project exemplifies and emphasizes the relation between weak planning processes and potential consequences such as NIMBYism, illustrating how the lack of participation could encourage opposition to projects.

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[1] Transport Planning Secretariat, www.sectra.cl

2.2.3. Lack of project Buy-in

Traditional planning approaches basically constrain public participation to presenting pre-developed alternatives or solutions. This anachronistic approach contributes to participant anger and mistrust (as mentioned in 2.2.2), and strengthens the public's 'sense of outsider' that generates a lack of buy-in and support for transportation projects. The feeling of "not being a part of the process" could thus produce the perception, real or not, that the participation process itself and/or the proposed policy or solution does not produce any benefits. Project buy-in is defined as the commitment of the public to a certain policy or project, which generates a sense of ownership. Traditional transport planning approaches potentially generate a lack of public buy-in. For Wagner (2012), the importance of peoples' buy-in is that the participatory process will more likely be collaborative and will possibly generate consent.

2.2.4. Lack of Collaboration between administrations – across scales

Traditional Transport Planning may not only widen the gap between agencies and the public, it could also contribute to disconnection, a lack of cooperation and isolated dynamics at planning agencies. Hull (2008) argued that the UK's new planning structures, which differ from traditional planning approaches, are more rhetoric than reality. Basing the argument on the analysis of broader planning objectives such as sustainable transport policies or reduction of CO2 emissions, she concluded that collaboration between agencies has depended mostly on the cooperative skills of public officials or practitioners and agencies, rather than inter-organizational (legal or not) new collaborative instructions or commitments. In the case of Santiago de Chile, the transport and land use decision-making processes depend on many agencies and actors, which is often indicated as a barrier for implementing metropolitan plans or projects. This fragmented governance structure; without a higher metropolitan planning institution, has led Santiago to well-recognized institutional competition and a lack of integration between different sectoral planning institutions (Zegras and Gakenheimer, 2000). These two examples (UK and Santiago) highlight the fact that metropolitan areas are potentially affected by poor collaboration between planning actors, which could lead to poor planning results. Collaborative metropolitan advantages for transportation planning are discussed in the following section (2.3).

2.3. The Collaborative advantage of metropolitan transportation planning

Metropolitan-scale transportation planning has been referred to in the literature as a means for yielding better public transport service (Cascetta & Pagliara, 2008), as an enabler of more coordinated transport policy (Hull, 2008), a vehicle for advancing sustainable urban development, and as a requirement for

sustainable mobility (Næss, Næss, & Strand, 2011). However, significant institutional, cultural, and political barriers often hinder inter-municipal collaboration.

The traditional approaches to transportation planning mentioned before have also obstructed metropolitan-level collaborative processes and can be considered inhibitors of policy integration, a widespread objective in transportation planning as suggested by, e.g., Stead and Meijers (2009), and Hull (2008). Huxham's (1996) definition of collaboration is instrumental in better understanding the importance of the metropolitan scale in transportation planning: "The concept of collaboration can be described as a form of working in association with other organizations for some form of mutual benefit" (p.7). The result of a collaborative endeavor, indicated by Stead and Meijers (2009), is also what legitimizes the association.

This "collaborative advantage" is critical in metropolitan transportation planning, especially in places where numerous relatively autonomous municipalities make up the metropolitan area but where transportation infrastructures and services extend well beyond any single municipal border. In such places, municipalities often must overcome rigid institutional frameworks and political and policy legacies, and higher-level governments often exert a powerful role.

Despite significant progress in developing collaborative approaches and the documentation of successful cases such as the Regional Metro System (RMS) in Naples and Campania, Italy (Cascetta & Pagliara, 2008), the limitations to inter-municipal collaboration are still large. The lack of clear communication between agencies at the local, regional, and national scales is often referenced as the starting point of a widening divide. Communication, which is considered to be essential for policy integration, can also generate buy-in from different stakeholders and establish channels for inter-sectorial policy making (Stead & Meijers, 2009).

Since transportation planning must often be elevated to the metropolitan scale, this larger geographical and political scope might make it more difficult to design and implement public engagement processes that can generate the "collaborative advantage" that Huxham (1996) defined. In the USA, the emergence of metropolitan planning organizations (MPOs) was a "forced" response (required by the national government) to this collaborative challenge which have brought together governmental and nongovernmental organizations representing the various transportation modalities in the planning process (Wolf & Farquhar, 2005). However, Lewis and Sprague (1997) argued that it becomes difficult to involve a broader cross-section of the population in metropolitan transport planning because citizen tend to become involved in public participation when the "policy issue" affects them directly. In this sense, they considered that advocacy groups and professional associations with economic incentives are likely to become involved, rather than minority groups.

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Introduced in the Federal Highway Act of 1962 in recognition of the need for Metropolitan instances for transportation planning, MPOs have evolved over time through subsequent legislation. Wolf and Farquhar (2005) assessed this evolution and analyzed MPOs' changing roles in transportation planning at a metropolitan scale. Over time, new partners, including other regional planning groups and nongovernmental organizations, have become more involved in the planning process. Apparently inter-agency collaboration has accelerated and opened opportunities for policy integration (Wolf & Farquhar, 2005) and MPOs have extended their involvement in program areas outside of traditional transportation planning (Edner & McDowell, 2002). Goetz et al (2002) identify three explanations for MPOs success after assessing planning effectiveness in large, fast-growing metropolitan regions. First, their research results suggest that there is a correlation between the shared funding received from the state and the level of satisfaction in meeting regional needs. Second, the level of complexity and severity of the problems each region faces directly affects the effectiveness of MPOs in dealing with them. Third, as the rate of growth in metro regions increases, it introduces a sense of urgency that seems to be antithetical to the purpose and functions of MPOs.

However, despite some advances, major challenges remain in advancing effective transportation planning at the metropolitan and regional scale. Zegras (2017) argues that barriers include political and economic competition among local jurisdictions and lack of incentives for accounting for the benefits of metropolitan transportation planning. Facing the ongoing challenges that inter-municipal collaboration poses for transportation planning, many agencies have decidedly moved forward with improving upon their traditional practice of deciding, announcing and defending their flagship projects. This provides an emerging opportunity for employing Accessibility-based visualization tools (ABVT) to bridge the communicative gap across scales, decision makers, and stakeholders in a metropolitan region. The potential cooperation generated by enabling a more common understanding about the impacts in a multi-scalar, multi-stakeholder way can be leveraged for increasing the legitimacy of the planning process itself.

Chapter 3: Tool Development

This chapter describes the adaptations to CoAXs for the Santiago experiment. Primarily, a chronological description of previous CoAXs developments is presented, to help understand the different available capabilities of the tool. Secondly, the selected features and projects for testing are shown, based on the Santiago planning context and proposed transportation projects in the city. The third stage corresponds to the tool deployment, which systematically presents the development of CoAXs for the Santiago testing experience.

3.1. Previous CoAXs Versions and Tool Capabilities

CoAXs is primarily a user interaction interface and visualization tool, which can be adapted to different scenarios for testing their potentials in different cities and planning environments. CoAXs can show accessibility metrics based on GTFS feeds, Open Street Maps, and available land use and activity data. (Stewart and Zegras, 2016). The following points briefly summarize the chronological development of the tool and its capabilities.

3.1.1. Early beginnings

In an exploratory research setting, Stewart (2014) developed a first application denominated "Accessibility Visualization Toolkit" originally tested in focus group settings with planning officials and stakeholders. The original objectives included developing stronger links between personal and regional lenses on accessibility, fostering mutual learning between participants, and enabling the comparison of benefits of different projects. Based on Open Trip Planner (OTP)[2] –an open web-mapping multimodal trip planning software— Stewart tested a customized accessibility version in Santiago de Chile and Boston, including two feature modules of OTP: Journey Planner and Analyst. Journey Planner returns the best routes, based on travel time optimization, when a user selects two points on a web base map; Analyst can easily calculate isochrones (Marciuska & Gamper, 2010) from a single point selection. The application of this toolkit showed that accessibility visualization, based on the Journey Planner and Analyst modules, makes accessibility metrics easily understandable and could enable constructive dialogue between planning officials and community advocates (Stewart, 2014). Stewart (2014) also argued that "The toolkit and participation process developed around it form a framework within which the accessibility benefits of different projects could be compared, not only in the aggregate but also for specific populations of concern." … "Instead of evaluating project benefits on the basis of travel time savings, transportation projects could be compared on the basis of access gains for low-income families" (p. 133). This early version was later named CoAXs version 1 (Stewart and Zegras 2016).

3.1.2. Focus Groups for Testing CoAXs Interface

Stewart & Zegras (2016), building on Stewart (2014)'s early accessibility toolkit work, argued that public transport agencies should pursue co-creative planning (Gebauer et al, 2010; Bailey & Grossardt, 2010), which will require new evaluation tools for enriching planners' and stakeholders' communications and Mutual Learning (Innes and Booher, 2004). As a result, CoAXs –short for Collaborative Accessibility-based Stake-holder Engagement System– was developed as "an online (web browser-based) tool that allows on-the-fly modifications of transport scenarios, with a user interface simple enough for use by groups of non-experts" (Stewart & Zegras, 2016; p. 426). This new toolkit version or CoAXs version 2 (Stewart, 2017), used the example of the MBTA[3] in Boston including the proposal of four new BRT corridors. Regarding functionality, version 2 was the first web-based version which included two main modules and two windows interfaces, supported by Conveyal's backend open source software package (Stewart &

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[2] Multimodal trip planning & analysis, http://www.opentripplanner.org/

[3] The Boston region public transit agency, Massachusetts Bay Transport Authority: http://mbta.com

Zegras, 2016). The accessibility module consists of a map-based accessibility visualization for examining access to opportunities by isochrones. The second module allows users to modify parameters –including frequency and dwell time– of selected public transport routes for creating new scenarios.

Figure 1: Example of CoAXs Interface. Accessibility and Corridor Editor Module.
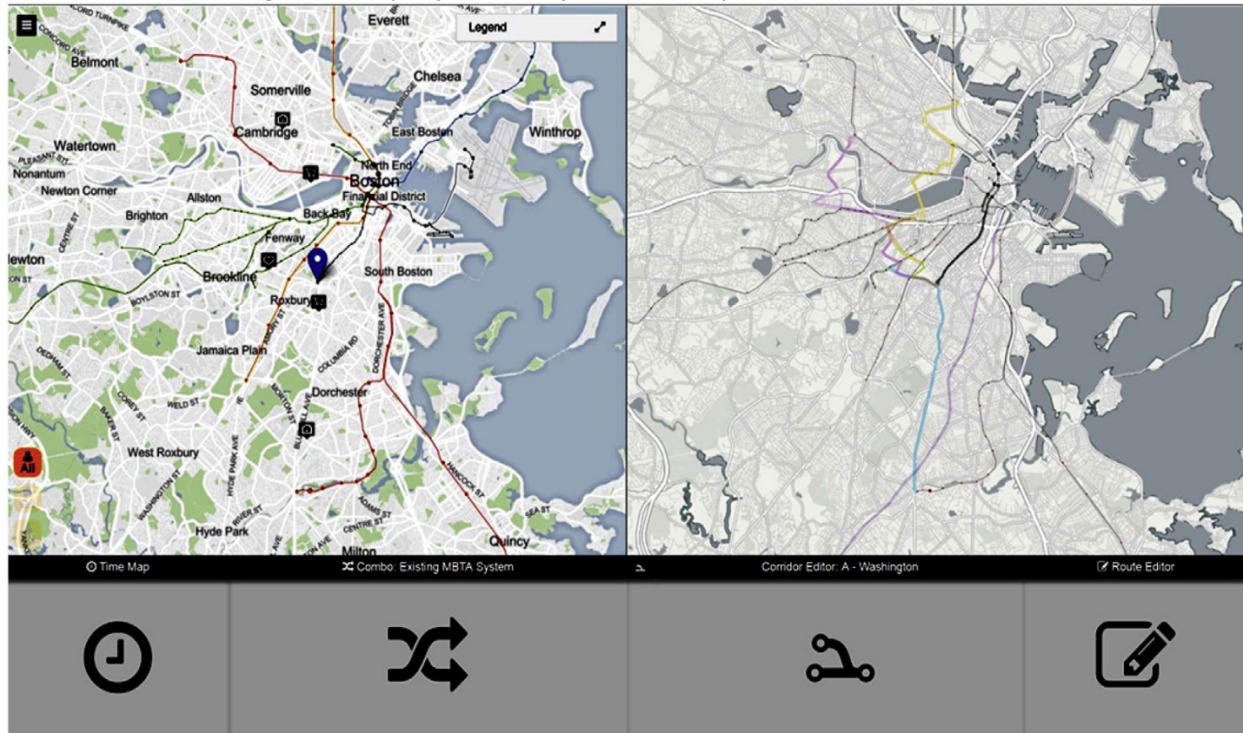
Source: Stewart & Zegras (2016)

Both modules were tested for feedback in a focus group experience during June of 2015. "Much of the participants' feedback centered on ways to expand CoAXs functionality –linking the maps and accessibility indices with various common travel patterns people deem important" (Stewart & Zegras, 2016; p. 431). This version of CoAXs and the focus group testing experiences held the door wide open for the future development of CoAXs features and functionalities.

3.1.3. Barr Foundation Development

Building on the past experiences, six workshops, which included CoAXs, were held at a municipal building in Boston's Roxbury neighborhood, supported by Barr Foundation.[4] The objectives were to: examine the possibilities for implementing bus rapid transit (BRT) in Boston as well as to test CoAXs as a way to promote social learning among participants with different level of expertise (Stewart, 2017; Stewart et al., 2017). This new testing experience, which include 36 individual who completed the whole test (pre-and

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[4] https://www.barrfoundation.org

post-workshop surveys), entailed a more systematic and robust experiment, including surveys and video recording, while maintaining the same CoAXs version 2 capabilities with a slightly modified interface. Using mixed methods to analyze the workshops, Stewart (2017) finds evidence supporting the expectation that alignment and imagination correlate positively with social learning. He also found that specific interactions with the accessibility-based features of CoAXs correlate positively with alignment and imagination, for both individuals and groups.

Figure 2: Roxbury Workshop Experience.

Source: Stewart (2017)

3.1.4. Transit Center development

With the support of Transit Center,[5] CoAXs improvements and testing were undertaken for an example case of Bus priority projects in Greater Boston, with the same software backend structure described in 3.1.3. The experience aimed to answer two main questions: 1) Can CoAXs help foster participatory transit planning and advocacy? And, 2) does it matter how benefits are measured and presented to users? To answer these questions some new features and interface improvements were needed. First, two versions of the tool were explicitly separated: an accessibility version and a point-to-point (travel time) version. Similar to prior uses, the accessibility version shows isochrone maps and presents benefits in terms of changes in potential jobs reached in a baseline-project comparison graph. The point-to-point version presents the best public transit route for user-selected origin and destination points, showing benefits based on travel time savings

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[5] Transit Center, http://transitcenter.org

in a baseline-project comparison graph. In both versions, users could modify and evaluate specific characteristics of corridor projects or scenarios, including corridor speed, frequency, and dwell time.

Figure 3: Point to Point and Accessibility Version.
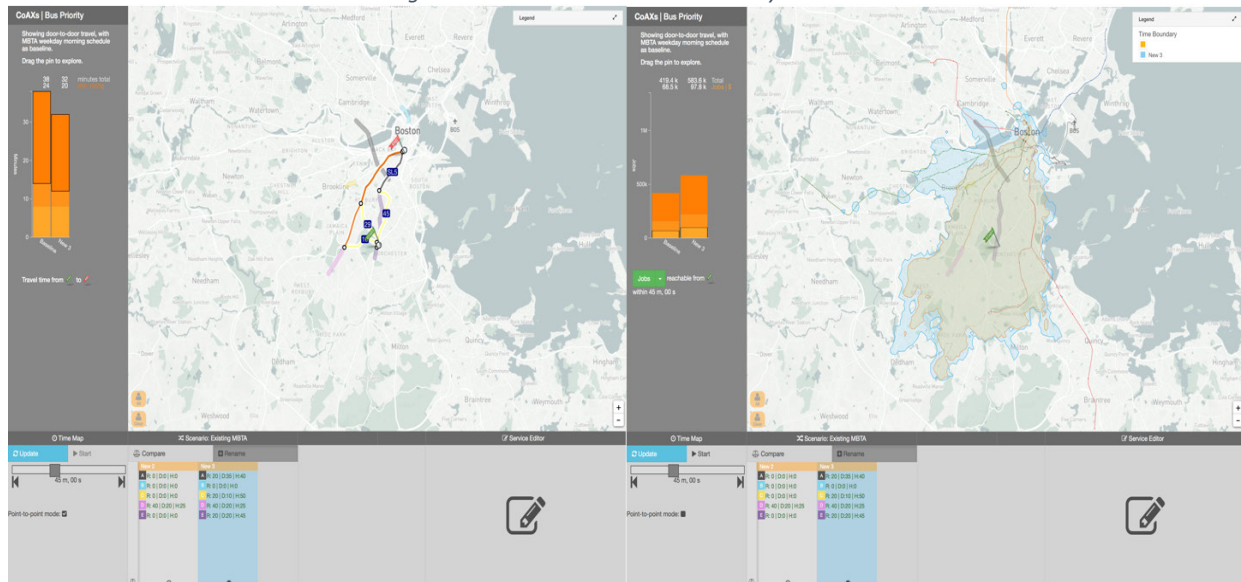
Source: Own elaboration based on CoAXs-Boston demo, http://coaxs-boston.herokuapp.com
Left: Point to point version, Right: Accessibility version.

During October-November of 2016, four new workshops were conducted for testing both the accessibility and point-to-point versions, in partnership with the LivableStreets Alliance[6] advocacy group. Early results of this experience showed a slight preference from participants for benefits as represented in the point-to-point version (the results of this experiment are still being finalized at the time of this writing). Then, to examine the potential for expanding the applicability of the new tool interface and for extending the testing experience to a broader audience, "Stand Alone" (SA) versions were developed for remote testing, keeping both the accessibility and point-to-point versions. Three new cities were selected for developing SA versions: Atlanta, San Francisco and New Orleans. This new testing experience differed considerably from previous experiments, challenging the development of CoAXs. First, the SA version hinges upon a different experimental environment, changing from a collaborative and open deliberative space to a completely personal (web-based browser) experience. Second, this new setting imposed an important challenge to the tool: be self-explanatory. For addressing this special challenge, a new front-end version was developed and then pre-tested with MIT Students, without previous CoAXs experience. This experiment dramatically changed and simplified the CoAXs front-end interface. *Figure 4* presents those differences.

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[6] LivableStreets Alliance, http://www.livablestreets.info

Figure 4: Differences between CoAXs Stand Alone and Collaborative versions
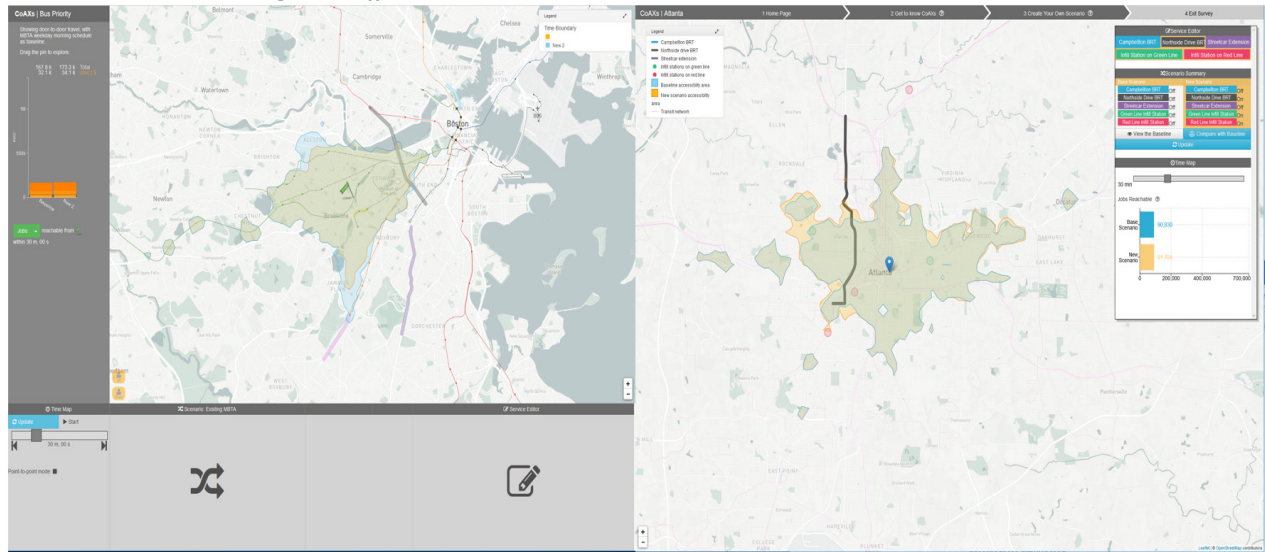
Source: Own elaboration based on CoAXs demos, http://coaxs-boston.herokuapp.com,
http://coaxs.herokuapp.com/main/atl/accessibility
Left: Boston Collaborative Version, Right: Atlanta Stand Alone version.

In order to test the SA version, several videos were developed for each city testing experience. These videos were designed to serve as an online, step-by-step instruction manual for using CoAXs. Pre- and post-use surveys were also posted for users to complete as part of the SA version testing. The final report and complete results of the Transit Center CoAXs experience were not available at the time of writing this thesis. The report should be available online by September 1, 2017.[7]

3.2. CoAXs Santiago deployment

Testing CoAXs in Santiago de Chile required a selection of tool capabilities and project scenarios in order to develop a thoughtful experiment. For tool capabilities, these were developed and deployed based on a selection of existing and new features deemed relevant for the local context of Santiago. Project scenarios were chosen based on transit plans and projects for Greater Santiago. The following points summarize the features and projects selected for the Santiago CoAXs development.

3.2.1. Capabilities Selection for Santiago Experiment

Based on the previous versions of CoAXs, various capabilities and features were selected. First, the Stand Alone (SA) interface was selected because of its self-explanatory characteristics and potential ease of use by a non-expert audience. The Accessibility Version was chosen based on its capability to represent potential opportunities, such as jobs accessibility, using isochrones, which characterize travel areas

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[7] Please visit: https://mfc.mit.edu/

reachable rather than just times between selected origins and destinations. The selection of the Accessibility Version is speculative, in the sense that it may potentially provide a better platform for understanding impacts at a higher-level scale (i.e., metropolitan). The scenario modification capabilities for the Santiago case were especially challenging due to the time requirements and the lack of detailed project descriptions and characteristics. The possibility of having only one workshop experience per testing group – which constrained the total time available – also contributed to the selection of an easy-to-use version. A less complicated tool increases the time available for users to test the tool rather than learning how to use it. Considering all these factors and previous CoAXs testing experiences, a capability to select from among multiple, but pre-fixed projects was chosen for the testing experience. This capability provides the user with the opportunity of selecting a combination of different projects to create a scenario, but without allowing the modification of these projects' characteristics (such as frequencies or dwell times).

3.2.2. New features development

Based especially on some of the comments at the LivableStreets workshops (October, 2016) and having decided to use the Accessibility Version, the idea of developing measures of accessibility to different opportunities emerged. Accessibility to education centers, health providers or green areas were some of the ideas taken from LivableStreet workshop participants. Ultimately, accessibilities to health and education opportunities were selected for the Santiago experiment mainly due to information availability. Regarding education, primary and secondary schools data were available and provided a real opportunity for accessibility testing. Moreover, the database included a quality index to characterize education providers. Education accessibility opportunities could, thus, not only provide a measure of the total magnitude (e.g. number of education providers within a certain travel time), but could also deliver a measure of the quality of the opportunity. Somewhat similarly, the health care opportunities were also available by categories, as described further below.

3.2.3. Projects and testing scenarios

As mentioned above, the possibility for testing a combination of projects was selected for the experiment. That meant a need for several projects to be included in the tool. As part of this research, proposed transit projects and their characteristics in Santiago were reviewed. Through this project review, several transit projects were identified and studied in order to select them for the experiment. The project selection was mainly based on two variables: magnitude and feasibility. The projects can be characterized as short-, medium- and long-term possibilities, as described below (see, also, *Figure 5* and *Table 1*).

Figure 5: Selected Transit Projects MAP
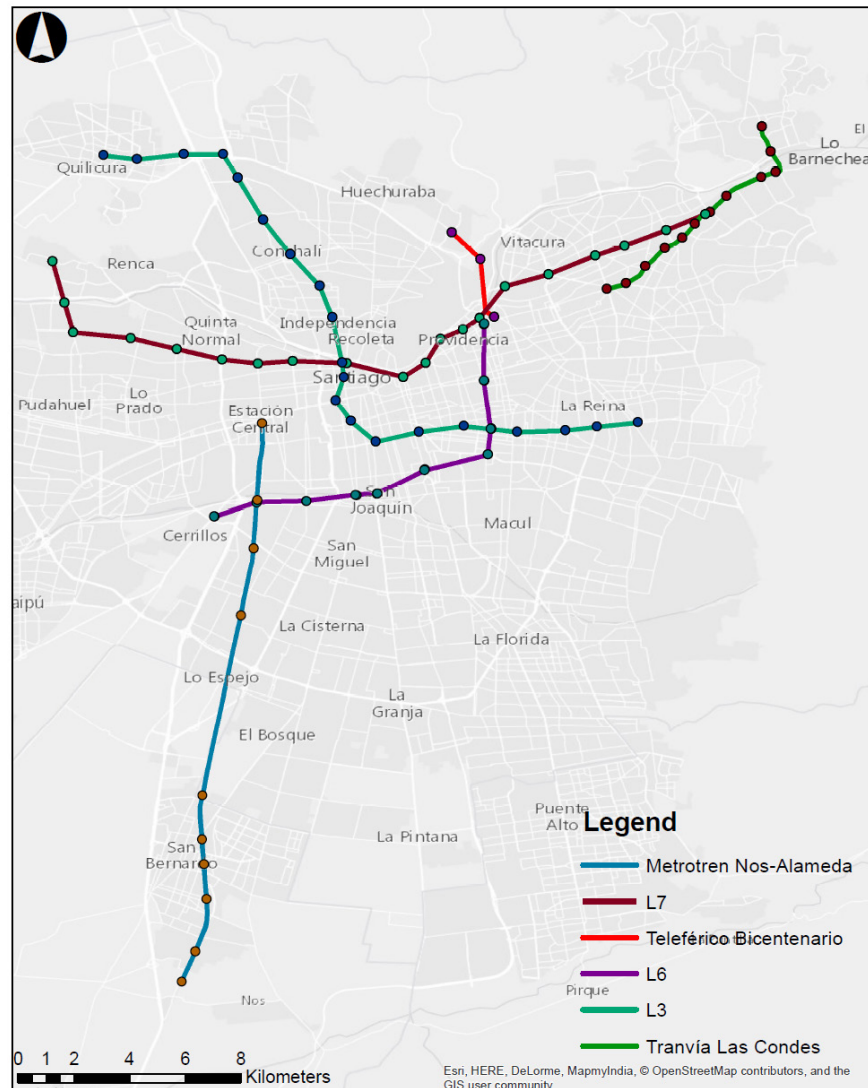
Legend
- Metrotren Nos-Alameda
- L7
- Teleférico Bicentenario
- L6
- L3
- Tranvía Las Condes

Source: Own elaboration based on MTT (2017); Metro (2017); Las Condes (2017); MOP (2017) and Tren Central, (2017).

- Short Term

Several interesting high capacity public transit projects were in final stages of development in Santiago during the experiment. Two new Metro (urban heavy rail) lines were soon to start operations –L3 and L6– and a suburban rail –Tren Nos-Alameda– was already operating in a trial period. Additionally, the contracts of Transantiago's trunk bus services will end in mid-2018, for which a new schema for a new bidding process has been designed. This new schema includes important changes for Transantiago's bus routes, considering new routes and route modifications for adjusting and improving current services. The new routes and modifications will change roughly 20% of the total system routes.

- Mid Term

Two public transit projects were studied for the Mid Term. First, the Chilean Ministry of Public Works developed (by Public Private Partnership at the Concessions Coordination[8]) the project called Teleferico Bicentenario, which consists of an elevated cable car system – running over the San Cristobal Hill and connecting the comunas of Providencia and Huechuraba. The Teleferico Bicentenario contract will be open for bid during 2017 and should open for operations during 2022. The second project selected for the mid-term considered an urban tram in the northeast area of Santiago. The so-called Tranvia Las Condes will connect the "La Dehesa" mall area with the "Manquehue" Metro line 1 station.

- Long Term

One month before the CoAXs testing experience for Santiago, Chilean president Michel Bachelet announced the government commitment for the construction of a new Metro line. The new line 7 will connect the Vitacura and La Renca comunas as a parallel route of the crowded line 1, which will imply a reduction of passengers and an increase in the level of service for the most packed line of the Santiago Metro. This line should be operational by 2025 and will complete a total Metro network of 174 km, serving 31 of 34 total metropolitan area comunas.

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[8] http://www.concesiones.cl

Table 1: Project description of CoAXs selected projects

Time Frame	Operative Year	Name	Mode	Origin - Destination (comuna)	Characteristics: Operative Information
Short Term	2018	Line 3	Metro	La Reina - Quilicura	Frequency: 2 min. Am peak, Travel time: 30 min, Long: 22 km
	2018	Line 6	Metro	Providencia - Cerrillos	Frequency: 2 min. Am peak, Travel time: 20 min, Long: 15 km
	2018	Tren "Nos-Alameda"	Suburban Railway	Nos - Santiago	Frequency: 6 min. Am peak, Speed: 58 km/h, Travel time: 24 min, Stations: 9
	2018	New Transantiago	Bus service	N/A	Represent 20% of changes in total network, 19 new bus routes services, and 17 modifications
Mid Term	2022	Teleferico Bicentenario	Elevated cable car	Providencia - Huechuraba	Frequency: 6 sec. Am peak, Max. Speed: 20 km/h, Travel time: 15 min, Stations: 3
	2022	Tranvia Las Condes	Tram	Lo Barnechea - Las Condes	Frequency: 4 min Am peak, Speed: 27 km/h, Travel time: 20 min. Stations: 12
Long Term	2025	Line 7	Metro	Vitacura - Renca	Frequency: 2 minutes, Speed: 40 km/h, Stations: 20

Source: Own elaboration based on MTT (2017); Metro (2017); Las Condes (2017); MOP (2017) and Tren Central, (2017).

3.2.4. Santiago CoAXs adaptation

For adapting CoAXs for testing in Santiago, several information sources were needed, such as GTFS feeds, public transport project information, open street maps and socioeconomic georeferenced data. The following points describe the development of CoAXs Santiago in different stages.

3.2.5. Stage 1: Data Base Requirements

As mentioned at point 3.1, CoAXs requires basic data. For backend calculation in the Accessibility Version, three main types of data are needed: the General Transit Feed Specification (GTFS), Open Street Map (OSM) network, and georeferenced information of opportunities. GTFS information for Santiago is constantly updated by the Transantiago Agency, which includes the feed information for the bus and Metro networks. Transantiago (buses) and the Metro are the main integrated transit modes in Santiago responsible for almost 90% (SECTRA, 2014) of the total public transport trips. For the purposes of the experiment, the GTFS feed version utilized corresponds to May 2017,[9] and represents the base scenario for the experiment. Regarding information on the street network, Open Street Maps (OSM) provides an open source network readable by the Conveyal package (Stewart & Zegras, 2016), which runs CoAXs' backend calculations. OSM is available for Greater Santiago and the version utilized for the Santiago test corresponds to year 2016. Regarding opportunities information, jobs, public health, primary and secondary education centers shapefiles were needed in order to quantify accessibility metrics with CoAXs. The following points will detail the procedures for georeferencing and linking data for CoAXs use.

3.2.5.1. Jobs Shapefile

Jobs data presented an important challenge for the research because of the inexistence of georeferenced jobs data in Chile. Several surveys about employment are regularly performed in Chile, however there is not a systematic method to measure jobs availability by location. For this specific challenge, the research approach was to obtain a proxy of the number and location of jobs based on the number of trips reported in the Origin – Destination Travel Survey 2012 (ODTS) (SECTRA, 2014). The estimation of the total number of jobs by location was calculated considering reported "to work" weekly travel purposes and the georeferenced destinations of the surveyed trips. It is important to mention that this first estimation represents a sample, which need to be expanded by "expansion factors" especially calculated by the ODTS, based on demographic information. The expansion factors of the ODTS 2012, were especially controversial because of Santiago's lack of updated demographic information, which is a factor to take into account for

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[9] https://www.dtpm.cl/index.php/gtfs-vigente

the precision of the final jobs number calculation. After expanding the sample, a total number of roughly 1.6 million job location points was estimated. Because these travel destination points are mainly dedicated to understand traveling patterns, the location of destination points may not be accurate. To reduce this possible source of error, the points were aggregated to the Transport Analysis Zones (TAZ) of Santiago. The choropleth map in *Figure 6* shows the number of jobs estimated with the described procedure (jobs by TAZ).

Figure 6: Santiago Jobs Choropleth Map
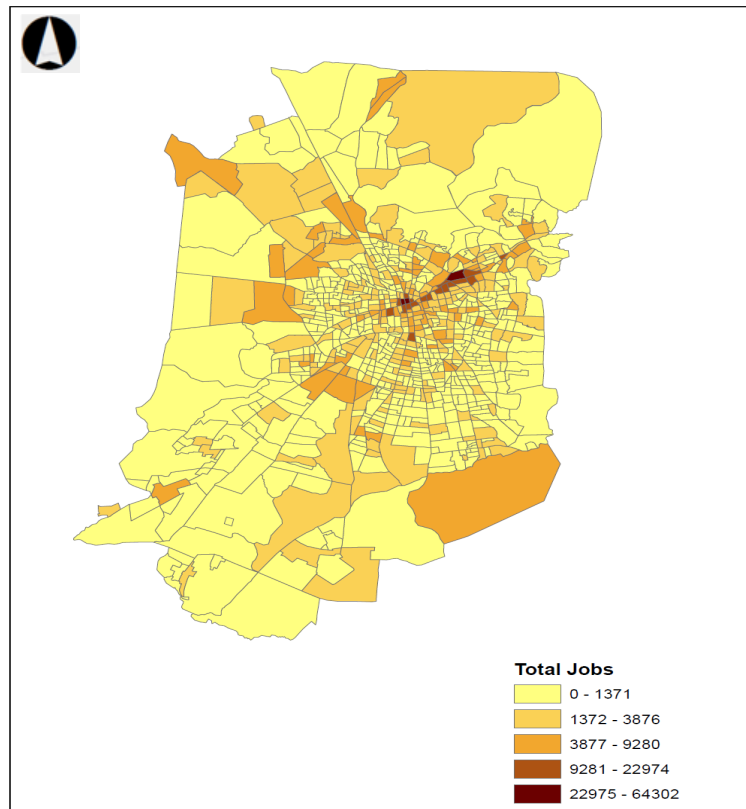
Source: Own elaboration based on SECTRA (2014)10

3.2.5.2.   Health Shapefile

Georeferenced Public Health Services were available for Santiago from the CEDEUS data Observatory.[11] The information corresponded to a database updated as of 2015, which was georeferenced by CEDEUS. A total of 422 health centers, categorized by type of service, were located for accessibility analysis. The type of service was divided into three categories: Primary Services, which correspond to primary care and

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[10] Some TAZ areas were eliminated in order clarify the result of the map

[11] http://datos.cedeus.cl/layers/geonode:_3_estab_salud_10_07

urgency public centers; Secondary Services, which are related to specialty health services such as mental health; and Tertiary Services, which correspond to hospitals.

3.2.5.3.   Education Shapefile

Education information was available from the Chilean Ministry of Education Center of Studies (MECS).[12] The center provided information on both primary and secondary education centers of the whole country. Particularly, a database from the Metropolitan Region was extracted from MECS including the school address and an aggregate quality index for Education Centers in 2016. Using the corresponding address, each education center was geo-referenced in order to locate each center as a point in a Santiago map. 3185 points were successfully georeferenced, which represents more than 80% of the total schools. The Quality Index is built from six different metrics –effectiveness, overcoming, lead, improvement, integration, and equality— and was available for more than 68% of the total georeferenced schools.

Figure 7 shows the georeferenced location of Health and Education Centers in Santiago.

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[12] http://centroestudios.mineduc.cl

Figure 7: Santiago Health and Education Centers

Legend

• Health Centers 2015
• Education Centers 2015

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
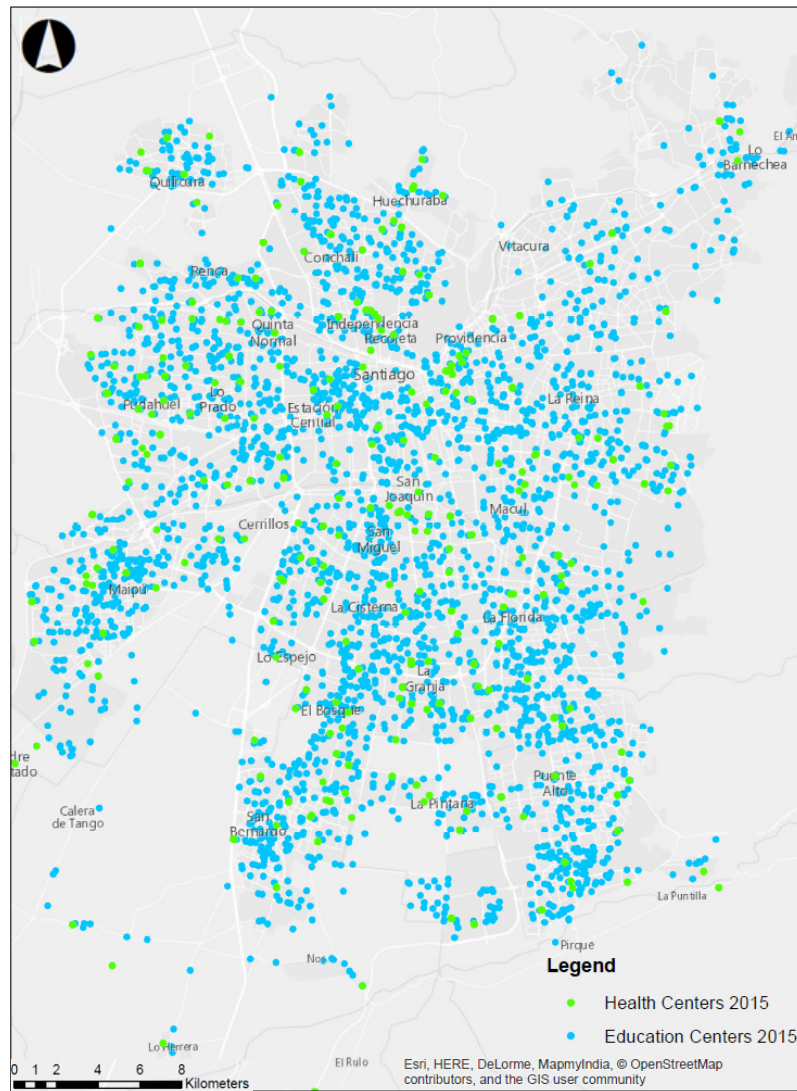
Source: Own elaboration based on CEDEUS and MECS (2015)

3.2.6. Stage 2: Project coding and Back-End development

All the selected projects requires GTFS project coding for CoAXs representation. Based on the Conveyal package (Stewart & Zegras, 2016), the GTFS Editor facilitates the process of new project creation into GTFS feeds. Using the operational information of *Table 1* all the projects were created as individual GTFS files. Especially challenging was the new Transantiago project, because it involved the codification of new 19 bus routes, and the modification of another 17 existing routes. A speed assumption of 18 km/hr was made in order to characterize the new and modified routes (Muñoz et al, 2014).

All of the individual GTFS and the base scenario GTFS were uploaded to Conveyal Analyst, the open software from Conveyal responsible for backend accessibility metric calculations. Finally, a scenario

creation development is needed in order to associate the different projects to scenarios. Scenario Editor (SE) is also an open software from Conveyal, which is capable of performing the scenario creations with several tools. Using SE, a combination of several scenarios was created and associated with the different projects. *Table 2* summarizes the scenarios for the CoAXs experiment.

Table 2: CoAXs Scenarios

Scenario	Projects	Scenario Name in CoAXs
1	Line 3 Line 6 Tren "Nos-Alameda" New Transantiago	2018
2	Teleferico Bicentenario	TBI
3	Tranvia Las Condes	TLC
4	Line 7	L7

Source: Own elaboration

3.2.7. Stage 3: Front End Development

The front end here refers to all the visualizing capabilities of CoAXs, with which the user directly interacts. For the Santiago tests, three main visualization areas of the tool were specifically developed. The map area shows the traces of the different projects and presents the isochrones from the different calculations. The service editor area summarizes the different selections of projects and the created scenarios. Finally, the time map and opportunity area represents, by graph, the number of opportunities reachable in a certain amount of time (modifiable by a time bar) by public transport. Is important to mention that due to time restrictions, it was not possible to adapt the tool to Spanish speakers, by translating the front end of CoAXs to Spanish language. This situation should be noted as a weakness of the present development. *Table 8* illustrates the different parts and functionalities of the CoAXs Front End.

Figure 8: CoAXs Front End Parts and tools

Source: Own elaboration based on CEDEUS and MECS (2015)
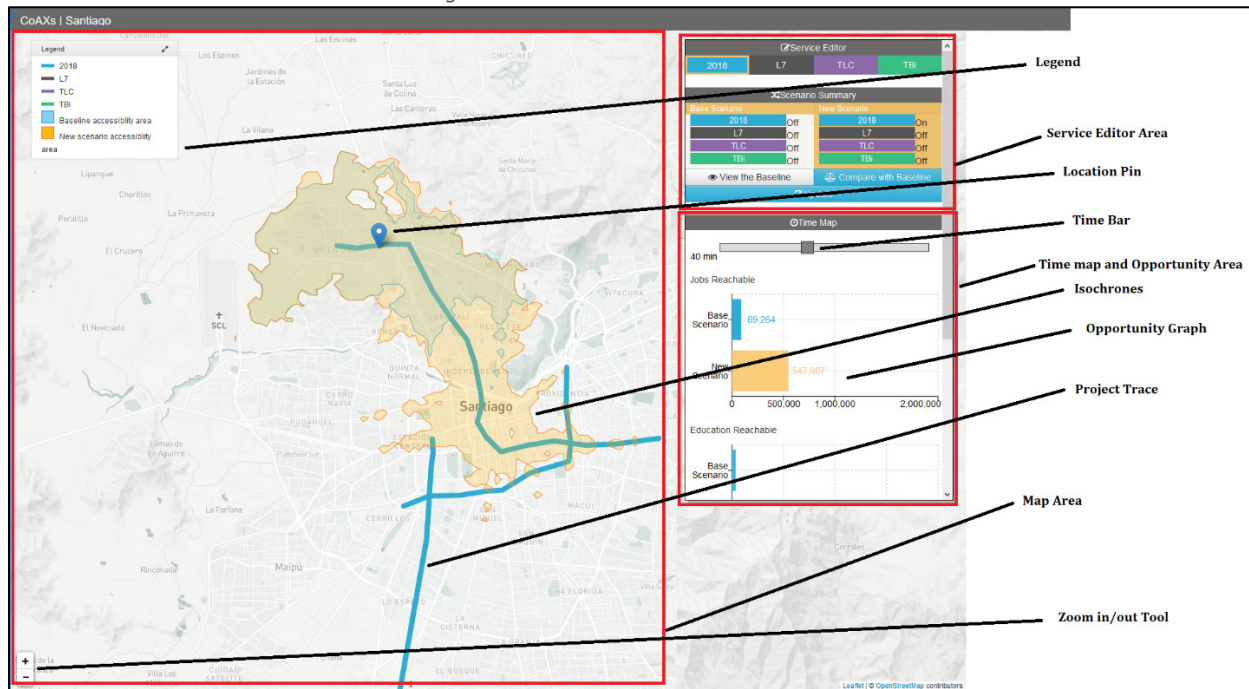
3.3. Preliminary Results

To illustrate the capabilities of CoAXs Santiago an example is presented. The example consists of testing accessibility measures from the Quilicura comuna, which is located in the Northwest area of Santiago. The example will compare the baseline and the 2018 scenario with the exact pin location in the middle of the Quilicura comuna.
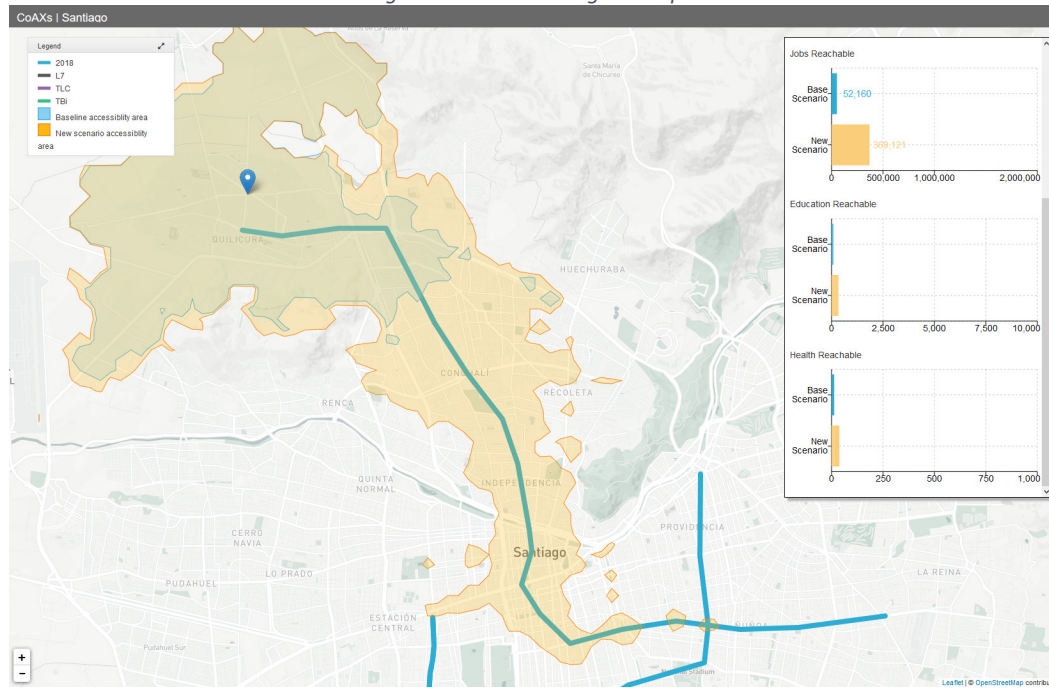
Source: Own elaboration based CoAXs Santiago Results

Figure 9 presents the results of the example. As can be seen, the results indicate a large increase in accessibility by travel time for Quilicura, comparing the baseline with the 2018 scenario. This result is mainly explained by the new Metro line (Line 3) project, which dramatically extends the area reachable from Quilicura. The base situation (blue isochrone) shows that in 40 minutes, people traveling by public transport from the center of Quilicura would only be able to reach the adjacent comunas. However, with the new 2018 scenario, the reachable area (orange isochrones) greatly increased, reaching the Santiago city center. In terms of opportunities, the example delivers large differences. In terms of jobs, within 40 minutes under the base scenario, only 50 thousand jobs could be reached, compared to almost 370 thousand under the 2018 scenario. While only 19 well-ranked education centers were reachable under the base scenario within 40 minutes, 55 were accessible with the 2018 scenario. Finally, regarding health accessibility, no hospitals were accessible within 40 minutes in the base scenario, while under the 2018 scenario, seven hospitals could be reached by public transport in the same amount of time.

3.4. Conclusions

The CoAXs development for the Santiago experiment addresses several challenges for adapting the tool to a new context. First, several improvements were made in order to simplify the tool for use by non-experts, based on the Stand Alone developments made by the CoAXs team for US deployments. Moreover,

information from projects was collected and GTFS coding was performed to code these projects and create scenarios for CoAXs representation. New capabilities were designed in order to incorporate new features to the tool. The main new feature of the Santiago version of CoAXs is the ability to incorporate different accessibility metrics, including to health, jobs, and education opportunities at the same time. This new capability increase the spectrum of accessibility opportunities represented, which provides a more complete accessibility analysis. Finally, the lack of front-end translation to Spanish is highlighted as a weakness of the present version.

Chapter 4: Experimental Design

This Chapter presents the experimental design and recommendations for CoAXs testing in Santiago. The main objective of this chapter is to systematize and adapt the previous experiences of using CoAXs in workshops in the USA (e.g., Stewart et al., 2017), considering the new context and characteristics of Santiago de Chile.

4.1 Design of the participatory framework

The workshops were designed to emulate a real participatory experience in the Chilean context. Due to time and cost restrictions, only two workshops were conducted in Chile for CoAXs testing among two different transport Planning groups: Decision Makers and Stakeholders. Considering the previous experiences of CoAXs testing (e.g., Stewart et al, 2017), I identified five important design factors: location and scheduling, participants, facilitators, staff, and room design.

4.1.1 Location and Scheduling

Location is crucial for scheduling workshops. A less accessible location will affect the scheduling in terms of a participant's ability to participate. In this sense, a central location with good public transport connections is recommended. Previous CoAXs experiences (e.g., Stewart et al, 2017) used a weekday evening schedule in order to avoid working hours, but still be available for participants and for workshop staff. Based on Santiago's office hours, the recommended starting time for the workshops was 6 pm or later.

4.1.2 Participants

The design decisions for the workshops were aimed to best understand participants' behavior while testing CoAXs. As mentioned at the beginning of this chapter, two different groups of participants were identified to test CoAXs; each group was tested in a singular and dedicated workshop. Based on the space availability, technical resources, and the previous experiences with CoAXs (e.g., Stewart et al, 2017), the maximum number of participants per workshop was determined to be 12 individuals.

The first group of participants was denominated the Decision Makers Group (DM), defined to be comprised of high-level officials from Municipalities and the Central Government[13], with a certain level of responsibility in the area of transport, mobility and urban development. *Table 3* shows the list of candidate participants identified for the DM workshop.

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[13] A summary explanation of the General Political Structure of Chile can be found at the Organization of American States website, https://www.oas.org/juridico/mla/en/chl/

Table 3: Potential Decision Makers Group

N	Title	Role	Level
1	Transantiago Director	Bus System Director	Metropolitan
2	Intendente, Metropolitan Region	Mayor (Appointed)	Regional
3	Regional Secretary of Transportation	Transport Policy Regulation	Regional
4	Undersecretary of Transportation	Transport Policy Regulation	National
5	Mayor, Recoleta	Mayor (elected)	Municipal
6	Mayor, Cerro Navia	Mayor (elected)	Municipal
7	Mayor, Estación Central	Mayor (elected)	Municipal
8	Mayor, Providencia	Mayor (elected)	Municipal
9	Mayor, Santiago	Mayor (elected)	Municipal
10	Mayor, Maipú	Mayor (elected)	Municipal
11	Director of Transurbano	Representative of private bus operators	Metropolitan
12	Councilor, La Reina	Commune Councilor (elected)	Municipal
13	Councilor, Providencia	Commune Councilor (elected)	Municipal
14	Metro Director	Metropolitan Subway System Director	Metropolitan

Source: own elaboration

The DM group presented a special challenge for guaranteeing the participation of high-level officials. This required setting up the meetings well in advance, designing formal letters of invitation and keeping constant contact with the potential list of participants.

The second group, the Stakeholders (SH) Group, was designed to consist basically of members of different advocacy groups related to city mobility and urban development. Similar to the DM group, early connection, formal letters of invitation, and ongoing contact is recommended to guarantee the SH groparticipation. *Table 4* presents the potential organizations identified for contacting candidates.

Table 4: Potential Stakeholder Group

N	Organization[14]	Role	Level
1	Comunidad de Usuarios y Trabajadores de Transantiago	Transantiago workers asociation	Metropolitan
2	Mujeres arriba de la cleta	Advocacy: Mobility and gender	Metropolitan
3	Juntas de Vecinos de Santiago	Official neighborhood councils	Neighborhood
4	Transporte Justo	Advocacy: Mobility	Municipal & Metropolitan
5	Consejos de la Sociedad Civil	Official civil society councils	Municipal
6	Casa de la Paz	Advocacy: Urban development	Municipal & Metropolitan
7	Ciudad Viva	Advocacy Urban development and mobility	Municipal & Metropolitan
8	Bicicultura	Advocacy: Cycling and Public Transport	Municipal & Metropolitan
9	Laboratorio Cambio Social	Advocacy: Equity, social justice and sustainability	Metropolitan
10	Bicivilizate	Advocacy: Cycling and Public Transport	Municipal & Metropolitan

Source: own elaboration

4.1.3 Facilitators

Another important design aspect is workshop facilitation. For this purpose, three Chilean urban planners-transportation professionals were contacted to facilitate the workshops (Facilitators Team). The selection of the facilitators was based both on their background experience and previous participatory framework involvement. Regarding their background experience, the idea was to emphasize different areas of specialization in order to have broad knowledge represented in the facilitator's team. *Table 5* summarizes their background experience and level of involvement in prior public participatory processes.

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[14]Organizations names were presented in Spanish to facilitate web searching

Facilitator	Title	Main Background Experience	Participatory Process Experience
Facilitator 1	Engineer	Street Design	Project Community Presentations
Facilitator 2	Civil Engineer	Demand Forecasting	Project Community Presentations
Facilitator 3	Architect, MSc. Urban Development	Urban Development	Plans, programs and projects Community Presentations

Source: Own elaboration

4.1.4   Workshop Staff

Based on previous experiences, at least four persons were needed in order to run the workshops smoothly. *Table 6* identifies the different tasks and support required from the staff.

Table 6: Staff requirements and tasks

Staff	Main Task	Support 1	Support 2
Staff 1	Data Collection	Receptionist	Room Set Up
Staff 2	CoAXs Technical Set Up	Data Collection	Room Set Up
Staff 3	Room Set Up	Technical Support	Food Coordinator
Staff 4	General Coordinator	Room Set Up	Technical Support

Source: Own elaboration

4.1.5   Room Design

For hosting the two workshops, the room design, informed by previous CoAXs workshop experiences, needed to generate an adequate and interactive space for the participants. Three main areas in the room were developed with different objectives.

4.1.5.1 Reception Area

The purpose of the reception area is to receive the participants and distribute the workshop materials. Several activities were designed to happen in this area such as: inscribing participants in attendance list, providing the workshop folder materials, providing identification tags, and delivering other general information.

4.1.5.2 Food Area

The food area was designed to provide a space for food and beverages during the workshops breaks. For the Santiago experience, a Coffee Break was provided. The recommendation for the Coffee break area is to have enough space to keep participant's interactions.

4.1.5.3 Tool Testing Area

The tool testing area should be designed to provide a space where participants can easily interact with each other while using CoAXs. The design of this area should encourage people to participate and collaborate, providing enough space for visualizing and interacting with the tool.

4.1.5.4 Room Dimensions and Basic Layout.

Based on previous experiences, the recommended room dimensions for the workshops were defined between 600 and 800 square feet, which means at least 30 square feet per person, considering an average of 20 people per workshop, including participants and staff. *Figure 10* presents the space recommendations by area for a 20 person tool-testing workshop.

4.2 Technology for CoAXs Testing

The selection of technology for tool testing was central for the workshop's design development. Some background research has demonstrated the advantages of touchscreen technology over other devices (Billinghurst and Vu, 2016). Touchscreen technology allows users to easily point to elements on a screen and allows for better hand-eye coordination than other devices such as keyboards and mice (Shneiderman, 1991). Holzinger (2013) suggested that touchscreen technology is the most intuitive pointing device for new applications that children and elderly can easily learn how to use it. Based on touchscreen technology advantages and the previous CoAXs testing experiences (e.g., Stewart, 2016 and Stewart et al., 2017), a touchscreen was also adopted for the Santiago experiment. Specifically, with the support of the BRT Center of Excellence and the Catholic University of Chile, a 75-inch touchscreen monitor, consistent with previous CoAXs experiments, was reserved for the workshops. The previous CoAXs experiences utilized large touchscreens of at least 55 inches.

4.3 Workshop Activities Definition

The required workshop activities were systematized for CoAXs testing. Basically, the tool testing workshops were divided in four main activities: Preparation and introduction, CoAXs capabilities and basic use, CoAXs testing, and CoAXs evaluation.

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4.3.1 Preparation and Introduction

This first stage of the workshop provided basic information to the participants including objectives, the tool testing background, the general capabilities of CoAXs and the characteristics of the projects to be used in the Santiago testing. It also involved registration of the participants, materials delivery, signing of the consent form, and the filling the Pre-workshop survey[15]. This part was conducted by face-to-face interaction with Staff. As the General Coordinator, I delivered a presentation.

4.3.2 Basic Use and Coax Capabilities

In this part, participants followed a basic introduction of CoAXs use with the touchscreen. The brief explanation covered CoAXs' components, features and assumptions. With the aim of reducing participants' possible pre-existing attitudes (biases) about the Santiago projects, this part of the workshop used a different instance of CoAXs. In this case, I used the version of CoAXs developed for Atlanta, based on the similarities of the Atlanta version with the Santiago version. As it was mentioned in the Chapter 3: Tool Development, Santiago version was inspired by CoAXs Atlanta development, which allows users to select fix preloaded projects to create own scenarios for the testing experience. Facilitators conducted this part of the experiment with the support of the General Coordinator.

4.3.3 CoAXs Testing

CoAXs testing is defined as the stage when participants test the Santiago version of the tool. First, participants tested the baseline scenario, based on their own travel experiences. The idea here is to challenge the participants to examine the tool with their previous knowledge of Santiago's public transit performance. The objective of this part is to generate participants' trust in the tool. Secondly, participants had the chance to test the different public transit projects previously uploaded in CoAXs. The objective of this part is to challenge the participants to understand the impacts or benefits of those projects. Similar to point 4.3.2, CoAXs testing was led by the facilitators with the support of the General Coordinator.

4.3.4 CoAXs Evaluation

After testing, the evaluation stage aimed to gather participant's reflections and conclusions. During this stage, two activities were undertaken: the Post-workshop survey and a focus group debrief. During the

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[15] Pre-workshop survey and Post-workshop survey will be explained at point (4.4) Data Collection.

debrief stage, the main idea was to open a discussion about the performance of the tool and its ability to provide a broader understanding of the impacts of projects. This second part aimed to complement some of the questions of the Post-workshop survey. The general coordinator and facilitators conducted this last activity.

4.4 Data Collection

In order to collect information from the participants during the workshop activities, two different data collection methods were developed and designed. First, Pre- and Post-workshop surveys were implemented following the instructions and procedures of MIT's Committee on the Use of Humans as Experimental Subjects (COUHES),[16] and based on previous CoAXs experiments. The questionnaires, to be completed by all participants, were developed help gauge:

- General usefulness of CoAXs in planning or advocacy activities.
- CoAXs' usefulness for measuring transit project impacts.
- Changes in participants' perceptions about transit project impacts.
- Changes in participants' perceptions about the beneficiaries of transit projects.
- Changes in participants' understanding of transit projects.

During CoAXs testing activities (point 4.3.3), and based on the previous CoAXs workshop experiences, staff also collected qualitative information via observation: essentially the number of different interactions with the touchscreen made by participants.

4.5 Conclusions

This chapter described the experimental setting for the CoAXs testing, based both on Santiago's participatory framework characteristics and on previous CoAXs test experiences. A systematic approach for workshop design was developed considering different parts for organization and the activities to be conducted. Recommendations for room dimensions and structure, contents for the workshops, and selection of technology for tool testing and methods for data collection were designed and described for the Santiago testing experience.

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[16] https://couhes.mit.edu/

Chapter 5: Experiment Results

5.1 Workshops General Information

Two CoAXs workshops were held in Santiago during June of 2017, for testing CoAXs with two different audiences. As mentioned in the Experimental Design Chapter, the first group tested was the "Decision Makers" group on Thursday June 22. A second workshop was conducted on Tuesday June 27 with the "Stakeholders" group. *Table 7* and *Table 8* summarize the final participant list for each workshop.

Table 7: Workshop 1, Decision Makers List of Participants

N	Name	Title
1	Martin Urrutia	Chief of Planning, Architecture Direction. Ministry of Public Works
2	Pablo Rivadeneira	Cabinet Principal Advisor, Mayor of Santiago
3	Catalina Rubio	Counclior, La Reina Municipality
4	Tomás Echiburú	Counclior, Providencia Municipality
5	Jorge Walters	Technology Manager, Metropolitan Directory of Transport (Transantiago)
6	Elkin Ruiz	Technology Management Department, Metropolitan Directory of Transport (Transantiago)

Source: Own elaboration

Table 8: Workshop 1, Stakeholders List of Participants

N	Name	Organization
1	Andrea Cortinez	MACLETA and La Frontera University Health advocate
2	Ivana Sicre	MACLETA
3	Cesar Barraza	Comunidad de Usuarios y Trabajadores de Transantiago.
4	Rodrigo Quijada	Transporte Justo
5	Nathalie Zamorano	Laboratorio Cambio Social
6	Maya Flores	Bicicultura
7	Lucio Alvarez	Laboratorio de Cambio Social
8	Rodrigo Alvarez	Laboratorio Cambio Social
9	Ivan Lopez	Ciclista Urbano

Source: Own elaboration

The number of confirmed participants of the Decision Makers group was ten, but only six participants show up, implying a 40% "no show" rate. On the other hand, ten Stakeholders confirmed and nine arrived to the workshop, meaning only 10% did not show up. This behavior is likely explained by the demanding agendas of Decisions Makers and possibly the relatively low importance that they give to academic or research activities in the Chilean context. It is important to note that this is a weakness of the experimental design, which entailed organizing a special testing experience rather than testing CoAXs for an actual planning activity. Both workshops were held at the Innovation Center[17] of the Catholic University, from 6:00 pm to 8:00 pm. *Table 9* shows the final scheduled activities for both workshops and *Figure 11* shows the final room layout.

Table 9: Workshop activities agenda

Start	Finish	Activities
6:00	6:10	Materials distribution and consent form
6:10	6:20	Initial presentation
6:20	6:30	Pre-workshop survey
6:30	6:50	Practical training and CoAXs use
6:50	7:05	Coffee Break
7:05	7:20	CoAXs Santiago, base situation
7:20	7:40	CoAXs Santiago, new projects
7:40	7:50	Final-Survey
7:50	8:00	Debrief: Reflections and remarks

Source: Own elaboration based on participants responses

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[17] http://centrodeinnovacion.uc.cl/?lang=en

Figure 11: Room layout.
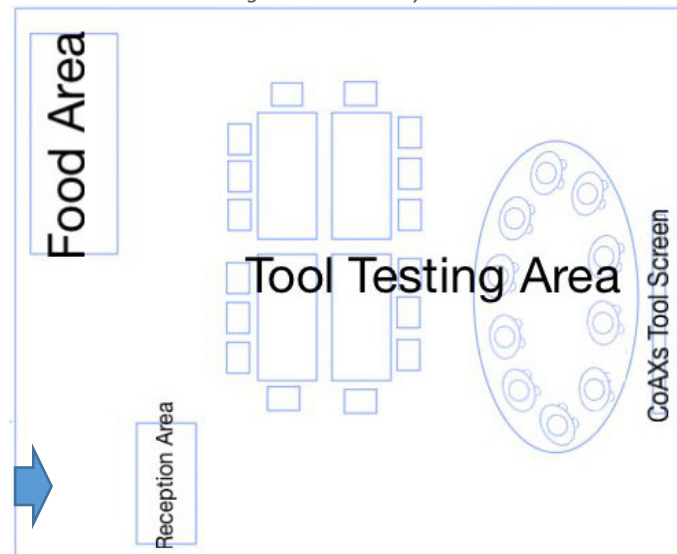
Source: Own elaboration based on participants responses

The workshops were developed according to the experimental design (chapter 4, page 38), without any special problems or circumstances. Both groups of participants followed the instructions and provided requested feedback in the different workshop stages, including completing the consent forms and the pre- and post-workshop surveys, and actively commenting during final remarks (debrief). Regarding the surveys, participants answered both parts with a high level of responses, with only few cases of empty answers. During the workshops, both groups participated actively and enthusiastically with a high level of empathy. The participant's positive behavior and the vigorous environment during the workshop augured for a successful experiment.

5.2 Decision Makers Group workshop

The following points present the results of the first workshop with decision makers group.

5.2.1 Pre-workshop Survey Results

The pre-workshop survey was designed to obtain initial attitudes of participants, before using CoAXs. Before this survey, and to contextualize the workshop and familiarize participants with the research topics, an introductory presentation was given. The presentation covered the motivations for the research, a brief explanation of the accessibility concept, and a summarized description of the projects used for the CoAXs testing. The following figures show the results of the pre-workshop survey, in stacked graphs.

Figure 12: Pre-workshop Survey Question 1.1. Initial Project Perceptions

After hearing the introduction and presentation, how do you think the transportation projects presented will impact each of the groups below?

Group	Significantly positive impact	Positive impact	No impact	Negative impact	Significantly negative impact
Yourself	40.00%	60.00%			
Your neighborhood	50.00%	33.33%	16.67%		
Your commune	33.33%	66.67%			
Santiago Metropolitan area	33.33%	66.67%			
People walking	16.67%	33.33%	50.00%		
People biking		66.67%	33.33%		
People driving		50.00%	16.67%	33.33%	
People riding public transport	100.00%				

Source: Own elaboration based on participants responses

This first stacked graph (*Figure 12*) is about the initial perceptions of the projects to be tested in CoAXs. As can be seen, participants' initial attitudes were positive regarding the expected impacts of the projects on most of groups. In terms of spatial groups: Neighborhood, commune, and Santiago Metropolitan Area, a highly positive impact is anticipated, with 80% of answers indicating at least a positive impact. On the other hand, responses on anticipated impacts on different transport modes –which include walking, biking, driving, and public transport— diverges based on mode. For example, 50% of participants expected no impact for people walking, but 66% expected a positive impact for biking. Moreover, the only expected negative impact was on drivers, with 33% expecting such an effect. Additionally and not surprisingly, all the participants agreed on expected a positive impact on public transport riders.

Figure 13: Pre-workshop Survey Question 1.2. Initial Ranking of opportunities

Regarding the concept of accessibility, what of the following variables do you think is more important? Rank your answer.
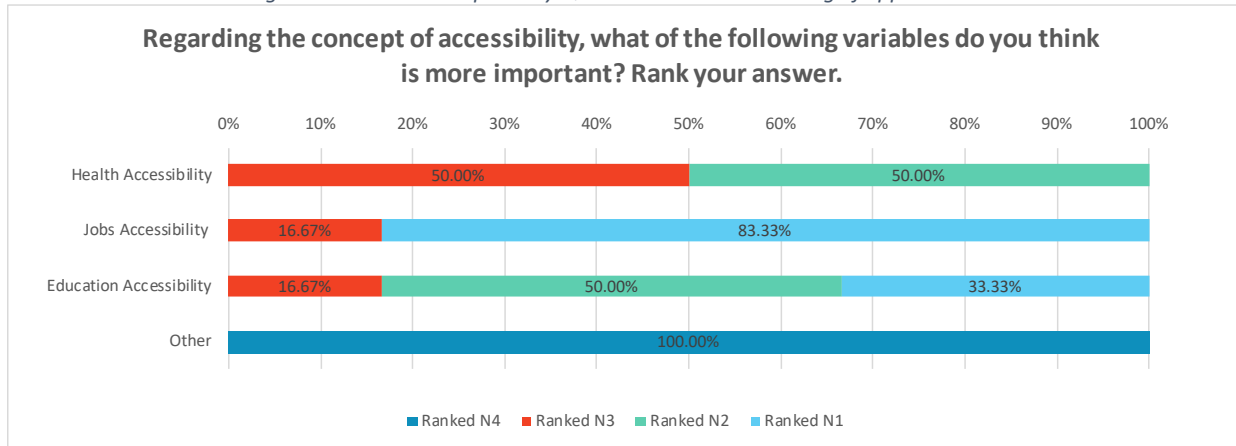
Source: Own elaboration based on participants responses.[18]

The second stacked Graph (*Figure 13*) shows how participants ranked the importance of accessibility to different types of opportunities. Interestingly, most of the Decision Maker participants agreed about the high importance of accessibility to jobs, with 83% of participants agreeing that job accessibility is the most important. In second place, participants emphasized education opportunities with 33% ranking it first and 50% ranking it second. Only 50% of participants (3 of 6), suggested other variables for the ranking, including retail, family, and leisure accessibility. In all cases (3 of 3), however, these were ranked fourth.

Figure 14: Pre-workshop Survey Question 1.3. Initial attitudes: Projects and Accessibility for Achieving Goals

To what extent do you disagree/agree with the following statements?
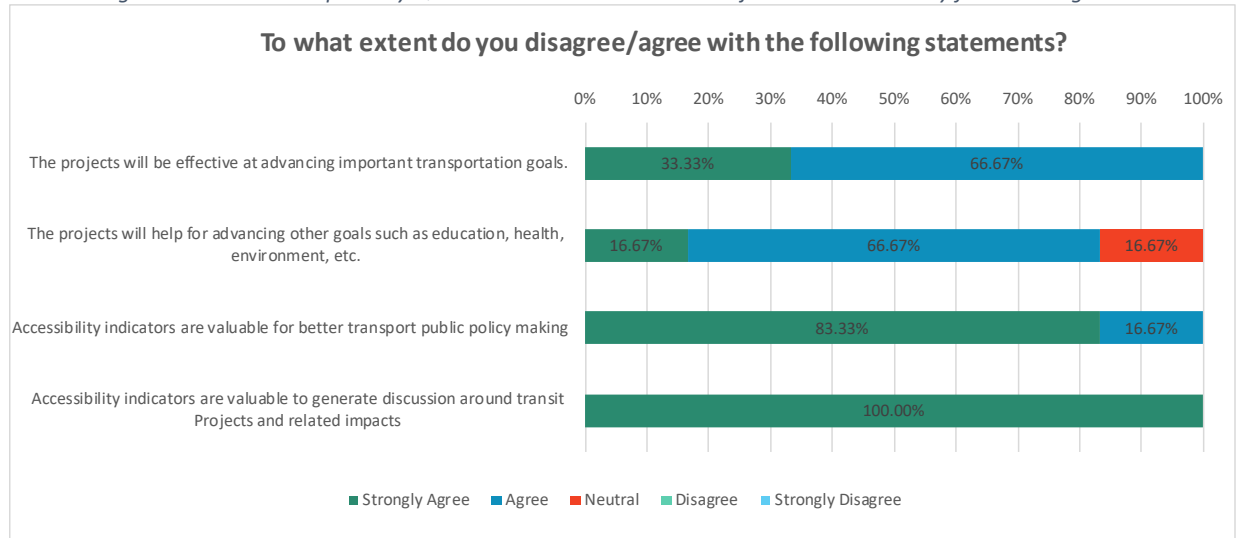
Source: Own elaboration based on participants responses

Figure 14 shows participants' attitudes about projects and accessibility metrics for achieving goals. Regarding project performance (the first two questions), participants predominantly agreed that the projects will help achieve transport and other goals. It is interesting to note that, regarding accessibility indicators,

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[18] Some participants ranked variables at the same ranking level.

participants strongly agreed about their importance for policy and planning goals. However, this strong commitment about accessibility indicators (83% and 100%) may be due to the lack of use of these indicators in the Chilean transport planning context. In this regard, this initial attitude could be biased by the fact that the experiment was run under the auspices of the Massachusetts Institute of Technology (MIT). In other words, if a world-renowned institution suggests accessibility indicators for a testing experience, this could imply that these indicators are highly valuable. Such perceptions could be amplified for a decision maker audience, which might prefer to not appear to be misinformed.

Figure 15: Pre-Workshop Survey Question 1.4. Initial project knowledge and impact description
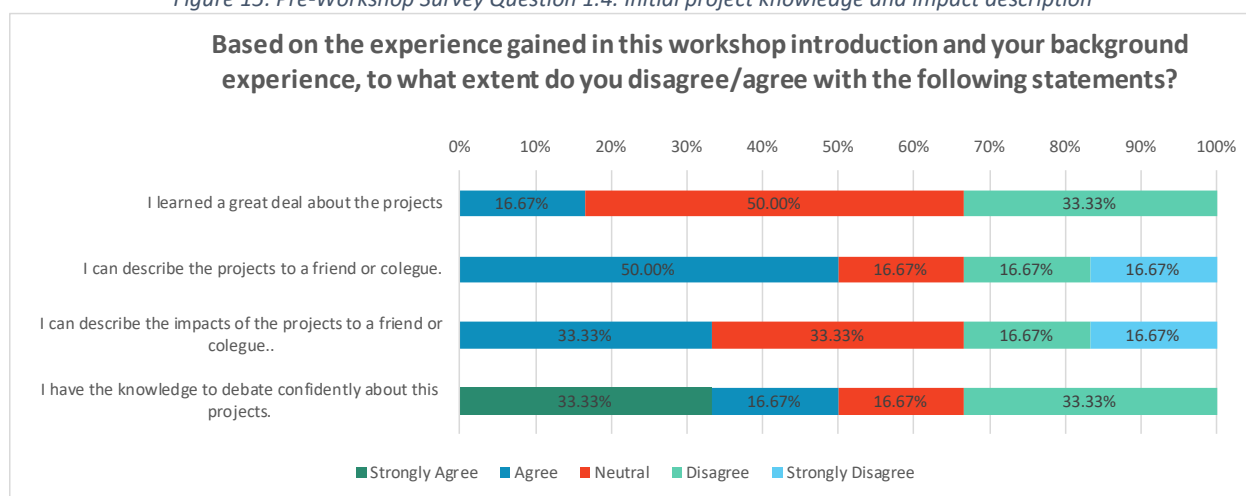
Source: Own elaboration based on participants responses

The last graph from the pre-workshop survey, *Figure 15*, presents participants' initial attitudes about the projects. As can be seen, responses vary. In general, the decision makers displayed mixed reactions, which is understandable given the little project descriptions provided. One interesting result relates to respondents' stated confidence to debate about the projects (50% agree), a higher number than those who indicated an ability to describe the project impacts. One possible explanation: perhaps decision makers simply feel comfortable debating.

5.2.2 Post-workshop survey results

The post-workshop survey was mainly designed to help understand changes in participants' attitudes after using the tool. In addition, two new fields of questions were added in order to measure participants' perceptions about CoAXs use.
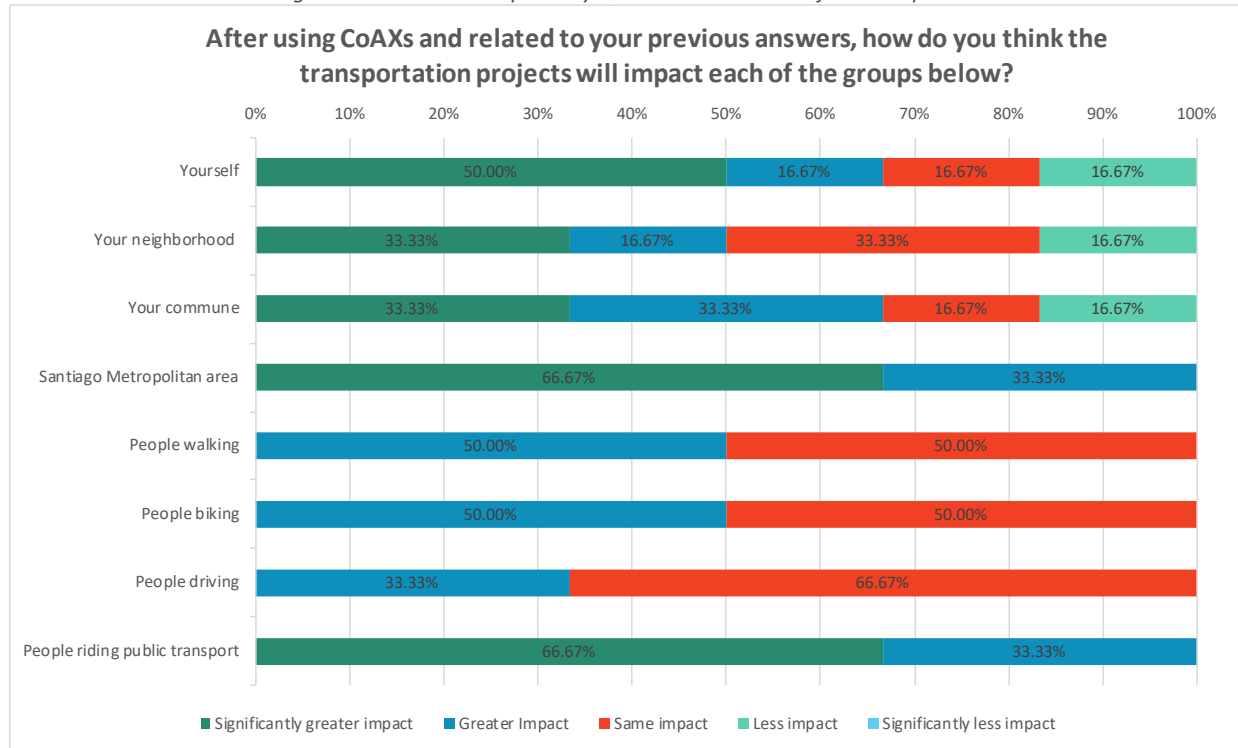
The graph in *Figure 16* is equivalent to the first pre-workshop survey graph, which summarizes responses about project impacts. As can be seen, using CoAXs apparently changed participant's perceptions about project impacts, in most cases, positively. Specifically, the expected impacts at the metropolitan scale (Santiago Metropolitan area) and for people riding public transport changed the most, with 67% of respondents indicating "Significantly Greater Impact." Somewhat interestingly, some evidence emerges that one person perceived the benefits that accrue to the metropolitan area and to transit users comes at some personal cost (negative perceived impacts on "yourself", "your neighborhood", and/or "your commune"). A wider analysis about changes in perceptions after using the tool comes at the end of this chapter.

Figure 17: Post-workshop Survey Question 2.2. Final ranking of opportunities

Regarding the concept of accessibility, what of the following variables do you think is more important? Rank your answer.

Health Accessibility	66.67% / 16.67% / 16.67%
Jobs Accessibility	100.00%
Education Accessibility	16.67% / 66.67% / 16.67%
Other	66.67% / 16.67%

Legend: ■ Ranked N4 ■ Ranked N3 ■ Ranked N2 ■ Ranked N1
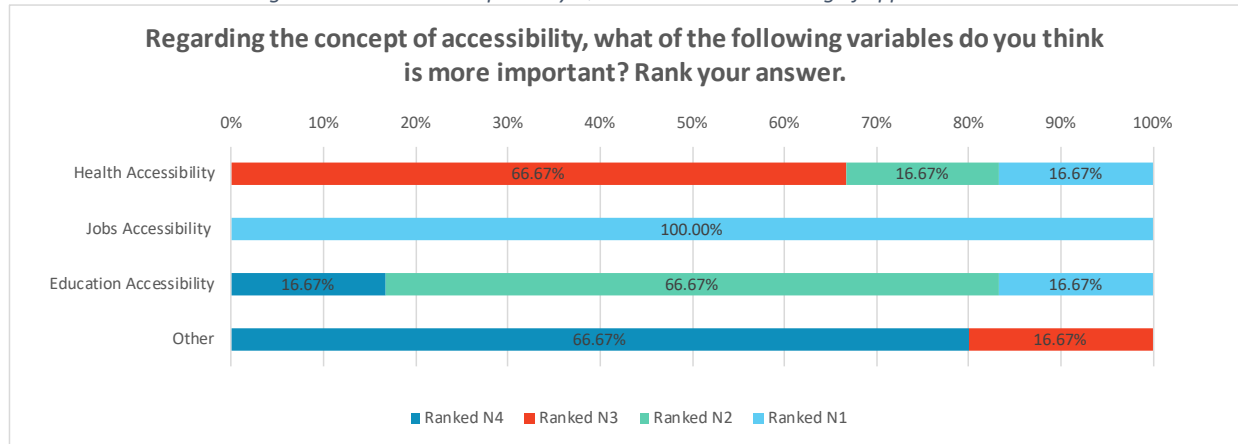
Source: Own elaboration based on participants responses

The graph in *Figure 17* presents the DM participants' ranking of the most important opportunities (for accessibility) after using CoAXs. Accessibility to jobs remained most highly ranked, as in the pre-Workshop survey, with an increase to all the participants ranking jobs as the most important opportunity. In comparison with the pre-Workshop responses, education increased in ranked importance relative to health.

Figure 18: Post-workshop survey Question 2.3. Final attitudes: Projects and Accessibility for Achieving Goals

After using the tool, to what extent do you disagree/agree with the following statements?

The projects will be effective at advancing important transportation goals.	50.00% / 50.00%
The projects will help for advancing other goals such as education, health, environment, etc.	33.33% / 16.67% / 50.00%
Accessibility indicators are valuable for better transport public policy making	83.33% / 16.67%
Accessibility indicators are valuable to generate discussion around transit Projects and related impacts	83.33% / 16.67%

Legend: ■ Strongly Agree ■ Agree ■ Neutral ■ Disagree ■ Strongly Disagree

Source: Own elaboration based on participants responses

Regarding perceived value of the projects and the use of accessibility metrics for achieving goals, *Figure 18* presents participants responses after using CoAXs. Answers show little changes compared to the pre-Workshop survey, with slightly more skepticism about possibilities for advancing other goals (second row question) (50%, 3 of 6, of participants answered neutral, compared to 17% before using CoAXs). One possible explanation for these responses could be that participants had greater expectations about the different projects' potential impacts on health and education accessibility, although this contrasts somewhat

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with the positive changes in project perceptions after using the tool (*Figure 16*). Alternatively, or additionally, perhaps participants, after using the tool, did not believe that increasing accessibility to education or health will "help for advancing in those goals." Despite some inconsistency in the trends between pre- and post-workshop surveys on this question, participants strongly agreed about the value of accessibility indicators for improving transport policy making and generating discussion around public transport projects (although one respondent became less strong in agreeing with the latter). The participants' relatively high evaluation about accessibility indicators both in pre and post survey, tend to validate their use. However, this behavior does not appear to be a response of CoAXs use.

Figure 19: Pre-workshop survey Question 2.4. Final project knowledge and impact description
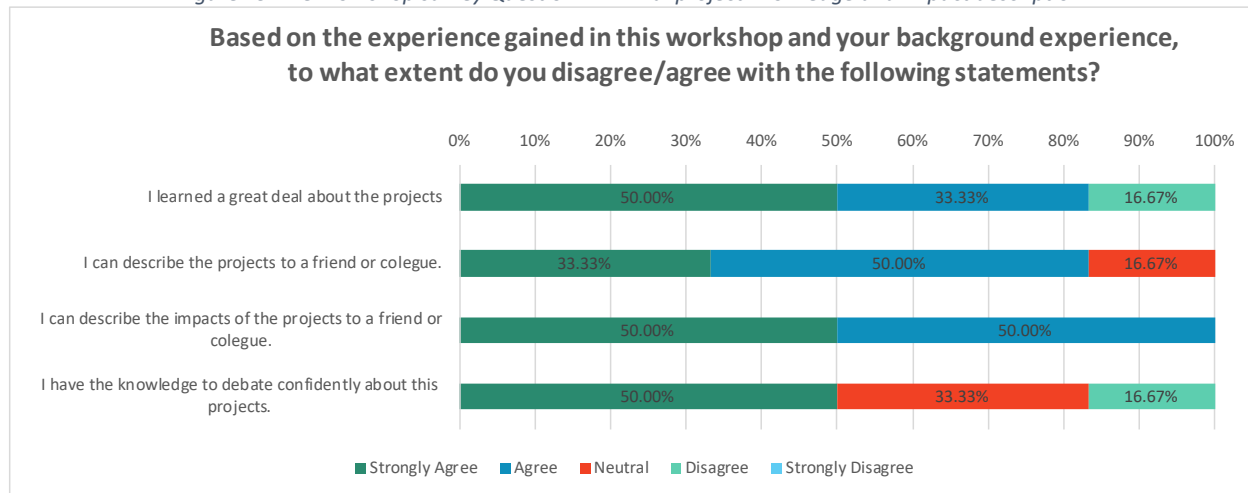
Source: Own elaboration based on participants responses

Figure 19 presents the final perceptions about project knowledge and impacts. As can be seen, most of the participants agreed or strongly agreed about gained project knowledge, supporting the usefulness of CoAXs. Particularly noteworthy are the responses regarding the possibility to "describe the impacts of the projects" (row 3), which suggest a dramatic change after using CoAXs and support CoAXs' value in helping to understand project impacts.

Figure 20: Post-workshop survey additional Question 2.4. General Workshop Experience
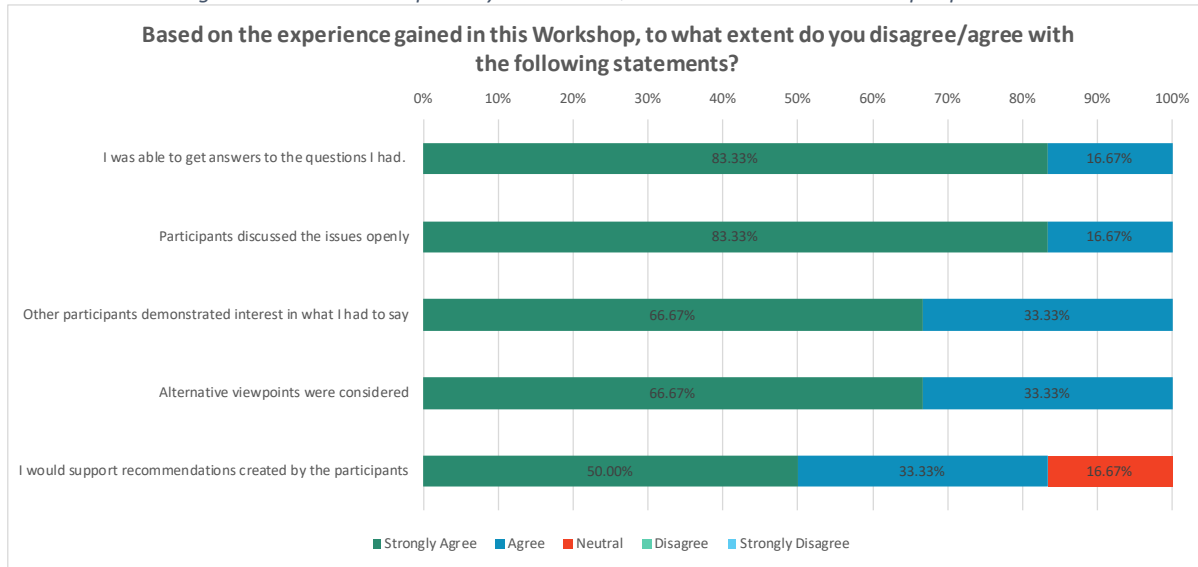
Source: Own elaboration based on participants responses

The graph presented in *Figure 20* shows Decision Makers' responses regarding the workshop general experience. As can be seen, almost 100% of participants positively agreed about the different fields of evaluation, suggesting a good setting for participants' interactions. Interestingly, despite the varied institutional and political backgrounds of the participants, 83% of the responses indicate that participants would support recommendations made by other participants (row 5). This result supports the public engagement capabilities of CoAXs.

Figure 21: Post-workshop survey Question 2.5. CoAXs Usefulness
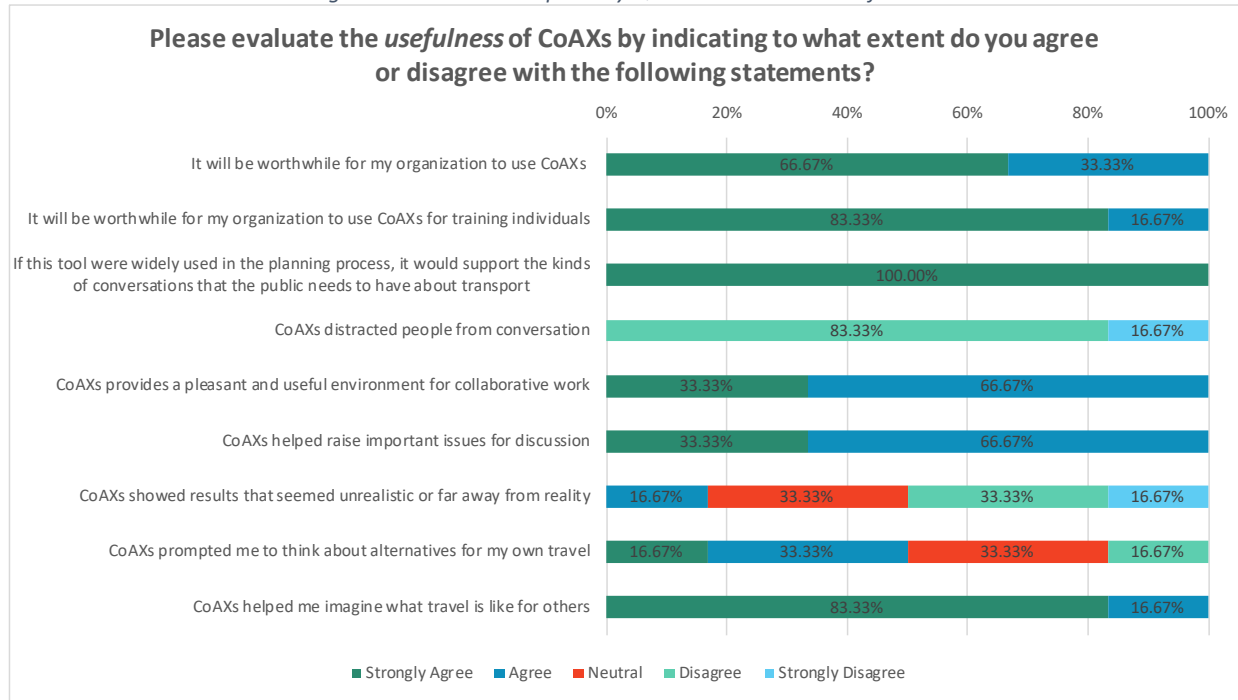
Source: Own elaboration based on participants responses

Figure 21 presents the post-workshop survey results about the usefulness of CoAXs. In general, most of the Decision Makers agreed about the usefulness of CoAXs and disagreed about potentially negative effects of using the tool. For example, participants positively evaluated the potential use of CoAXs in their organizations (in rows 1 and 2), both with 100% agreement. All participants agreed about the positive impact of using the tool in the transport planning process, which clearly supports the use of CoAXs in the Chilean Transport Planning context. Moreover, questions aimed at evaluating impacts of CoAXs in collaborative work (row 5), thoughtful discussions (row 6) and imagining "how travel is for others" (row 9) were positively evaluated, achieving a 100% rate of agreement. In contrast, Decision Makers were more skeptical (50% neutral or disagreeing) about CoAXs' impact on their own travel alternatives (row 8), which may be because the tool does not explicitly show traveling routes or modes. Importantly, participating decision makers expressed some concerns about unrealistic results from CoAXs. This perception could be based on GTFS assumptions (e.g., regular frequencies) and accuracy and the lack of reflecting service quality, such as capacity restrictions on subway and buses. Concerns about these particular assumptions were raised by participants during the workshop, which suggests their impacts on responses. Finally, Decision Makers strongly disagreed (100%) about conversation distractions produced by CoAXs.

Please evaluate the *usability* of CoAXs by indicating to what extent do you agree or disagree with the following statements
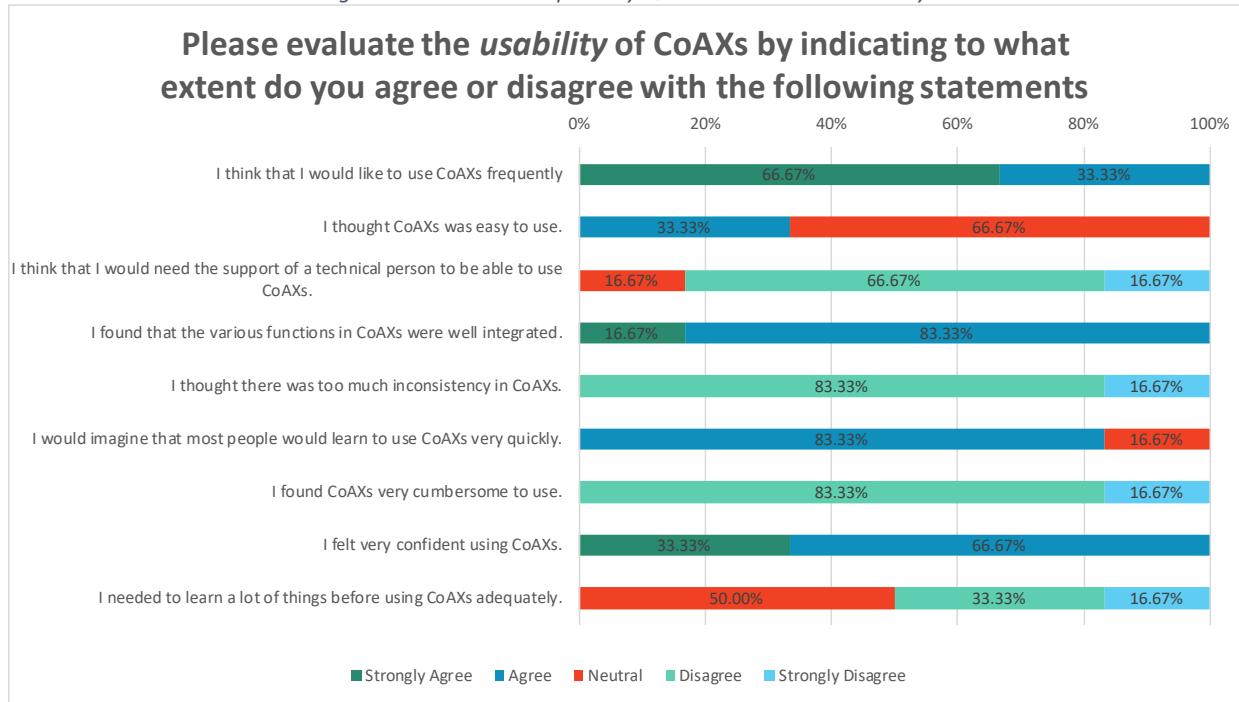
Source: Own elaboration based on participants responses

Regarding usability, the Graph presented in *Figure 22* shows Decision Makers' responses. As can be seen, over 80% of participants disagreed with negative sentences about CoAXs' "inconsistency" (row 5), being "cumbersome" (row 7), and requiring technical support (row 3). This supports the self-explanatory characteristics of this version. Although participants were mostly neutral about CoAXs' being easy-to-use (row 2), they also thought that people would learn CoAXs quickly (83% of agree), which emphasizes the fact that the tool is not complex to use. This is supported by the fact that most of the participants agreed about feeling very confident in using CoAXs.

5.3 Stakeholder Group workshop

The following sub-sections present the results from the workshop with the stakeholders group.

5.3.1 Pre-workshop Survey Results

Analogous to the Decision Makers workshop, an introductory presentation was given to the stakeholder group before they took the Pre-workshop survey. The presentation covered the motivations for the research, a brief explanation of the accessibility concept, and a summarized description of the projects presented in CoAXs. The following figures present the results of the stakeholders' Pre-workshop survey.

After hearing the introduction and presentation, how do you think the transportation projects presented will impact each of the groups below?

Group	Significantly positive impact	Positive impact	No impact	Negative impact	Significantly negative impact
Yourself	22.22%	55.56%	22.22%		
Your neighborhood	22.22%	33.33%	44.44%		
Your comuna	22.22%	55.56%	22.22%		
Santiago Metropolitan area	33.33%	66.67%			
People walking	11.11%	44.44%	33.33%	11.11%	
People biking		33.33%	66.67%		
People driving	11.11%	44.44%	33.33%	11.11%	
People riding public transport	55.56%	44.44%			

■ Significantly positive impact ■ Positive impact ■ No impact ■ Negative impact ■ Significantly negative impact

Source: Own elaboration based on participants responses

Figure 23 shows the respondents' initial perceptions about the projects in CoAXs. As can be seen in the graph, participants' initial attitudes were mostly positive regarding the expected impacts of the projects across the different potentially impacted groups. The "people biking" group emerged as the outlier, with just 33% of respondents suggesting a positive impact and 67% no impact. While expected impacts on drivers and walkers were mostly positive (50% positive and 33% no impact), they were the only groups with negative impacts mentioned (11%). Respondents expected positive impacts on themselves; interestingly, however, increasing in spatial scale from neighborhood, to comuna, and to metropolitan area was associated with higher expected positive impact, from 56%, to 77% and 100%, respectively. Finally and not surprisingly, all the participants agreed about a positive impact to public transport riders (56% "significantly positive" and 44% positive).

Regarding the concept of accessibility, what of the following variables do you think is more important? Rank your answer.

Health Accessibility	11.11% / 44.44% / 11.11% / 33.33%	
Jobs Accessibility	11.11% / 11.11% / 77.78%	
Education Accessibility	22.22% / 77.78%	
Other	77.78% / 22.22%	

■ Ranked N4 ■ Ranked N3 ■ Ranked N2 ■ Ranked N1

Figure 24: Pre-Workshop survey Question 1.2. Initial Ranking of opportunities
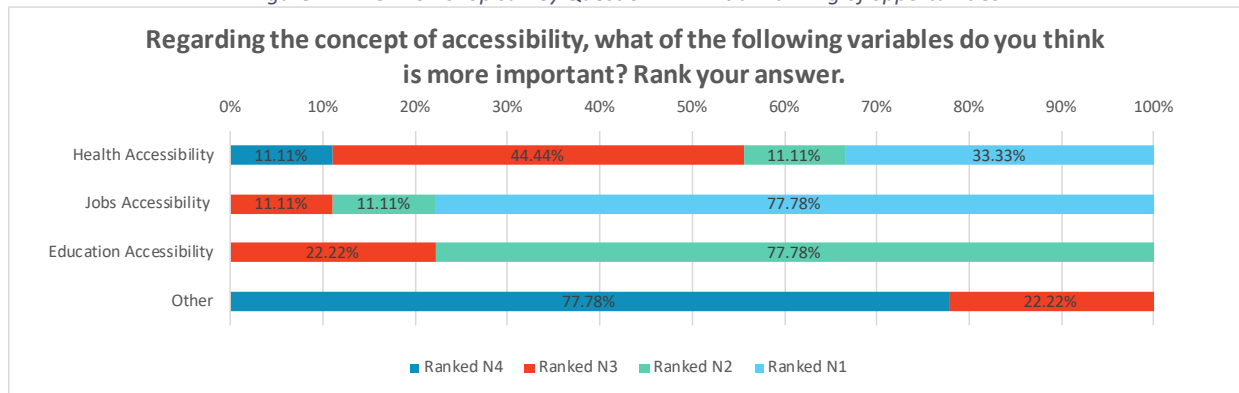
Source: Own elaboration based on participants responses.[19]

The second stacked Graph (*Figure 24*) presents stakeholder respondents' ranked importance of accessibility to different opportunities. Most of the stakeholders agreed about the high importance of accessibility to jobs with 77% ranking this first. Education was ranked second by 78% of respondents. Health was more mixed, with a third ranking it as most important. Six (of 9) participants, suggested other opportunities, with commercial activities mentioned three times and the other opportunities suggested being leisure, public transport, and services. However, 100% of the participants suggesting other opportunities ranked these in third or fourth position of importance.

Figure 25: Pre-workshop survey Question 1.3. Initial attitudes: Projects and Accessibility for Achieving Goals

To what extent do you disagree/agree with the following statements?

The projects will be effective at advancing important transportation goals.	33.33% / 66.67%
The projects will help for advancing other goals such as education, health, environment, etc.	44.44% / 44.44% / 11.11%
Accessibility indicators are valuable for better transport public policy making	77.78% / 22.22%
Accessibility indicators are valuable to generate discussion around transit Projects and related impacts	66.67% / 33.33%

■ Strongly Agree ■ Agree ■ Neutral ■ Disagree ■ Strongly Disagree

Source: Own elaboration based on participants responses

The graph in *Figure 25* shows participants' responses about the projects and the value of accessibility metrics. Regarding project performance (first two questions), participants predominantly agreed about their expected impacts on achieving transport and other goals (100% agreed about transportation Goals and 89%

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[19] Some participants ranked variables at the same ranking level.

agreed about other goals). Interestingly, regarding accessibility indicators, participants strongly agreed about their importance for reaching policy and planning goals, with 78% and 67% respectively. As discussed in the Decision Makers pre-workshop survey section (5.2.1), accessibility indicators are rarely presented or used in the Chilean planning context and this result could be influenced by, e.g., the project's association with MIT (see, also, section 5.2.1)

Figure 26: Pre-workshop survey Question 1.4. Initial project knowledge and impact description
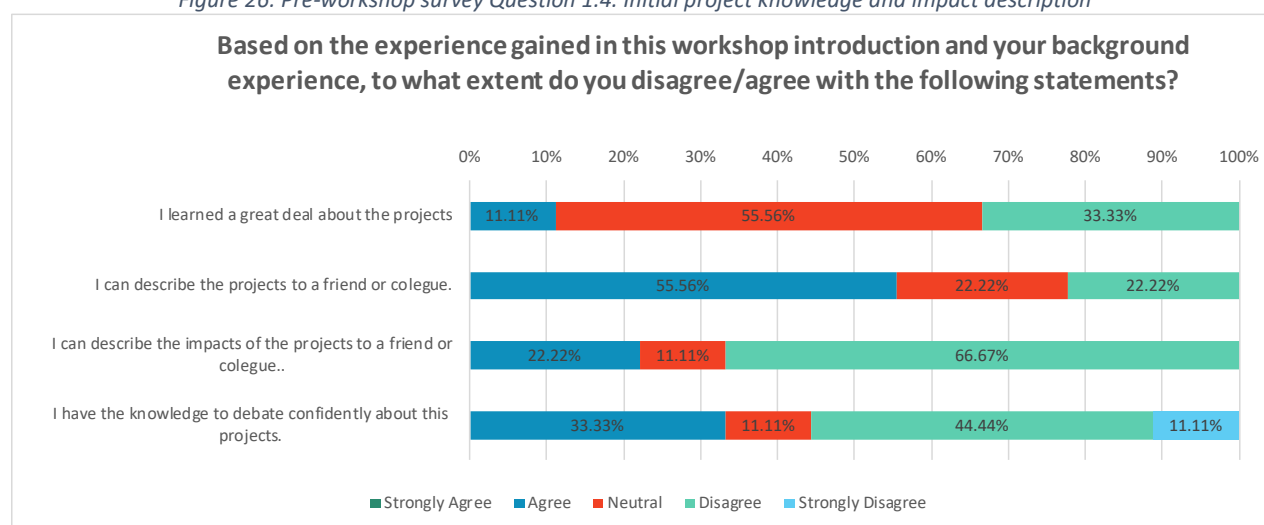
Source: Own elaboration based on participants responses

The last graph of the Pre-workshop survey (*Figure 26*) deals with the initial attitudes about project knowledge and impacts. As can be seen, responses vary. Regarding learning about projects, responses were mostly neutrals or disagreed (88%). Consistent with this, respondents primarily disagree with being able to describe project impacts and debate the projects, with 67% and 56% respectively. In contrast, stakeholders agreed with being able to describe the projects.

5.3.2 Post-workshop Survey Results

The following figures present the results from the Stakeholders post-Workshop survey.

After using the tool, how do you think the transportation projects presented will impact each of the groups below?

Legend: Significantly greater impact · Greater Impact · Same impact · Less impact · Significantly less impact
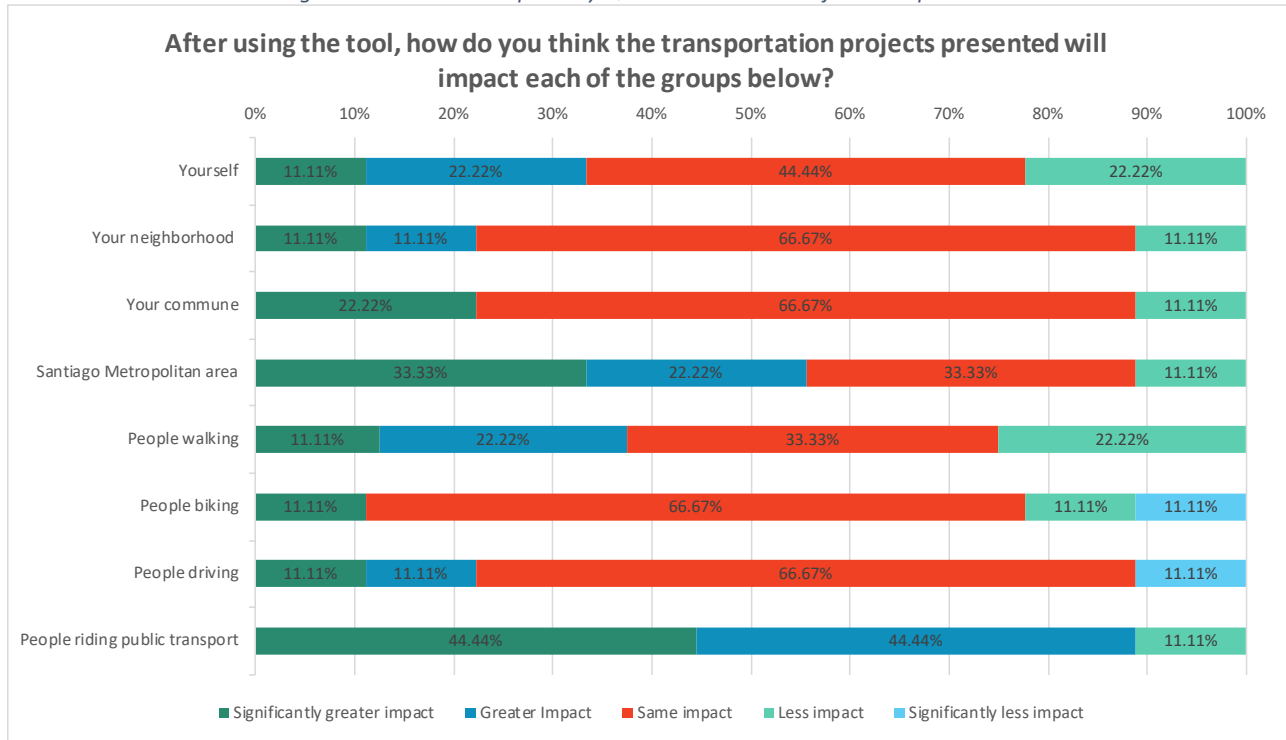
Source: Own elaboration based on participants responses

The graph in *Figure 27* summarizes self-reported changes in expectations about project impacts. As can be seen, introducing CoAXs changed participant's project perceptions. While some respondents slightly increased their expected impacts, others slightly decreased. Importantly, in most of the cases, a large share of respondents maintained the same level of expected impact reported in the Pre-workshop survey. This result is different from the decision makers group, denoting more moderated expected effects. Similar to the case for the Decision Makers, for the Stakeholders the greatest changes in expected impacts were for the Santiago Metropolitan area (33% expecting significantly greater impact) and Public Transport Riders (44% expecting significantly greater impact). The greater expected impact for the Santiago Metropolitan Area among both Decision Makers and Stakeholders, provides an interesting result for CoAXs' use, which seems to influence largely the perceptions at metropolitan level. Another interesting finding is related to the expected impacts reported for the Stakeholders themselves (i.e., "yourself"). While 33% of participants increased their perceived impacts on themselves, 22% decreased this expectation. This result emphasizes that for the majority of the participants (54%) the tool changed the project's personal impact perception. A wider analysis about changes in perceptions after using the tool is reported at the end of this chapter.

Figure 28: Post-workshop survey Question 2.2. Final ranking of opportunities

After using the tool, what of the following variables do you think is more important? Rank your answer.
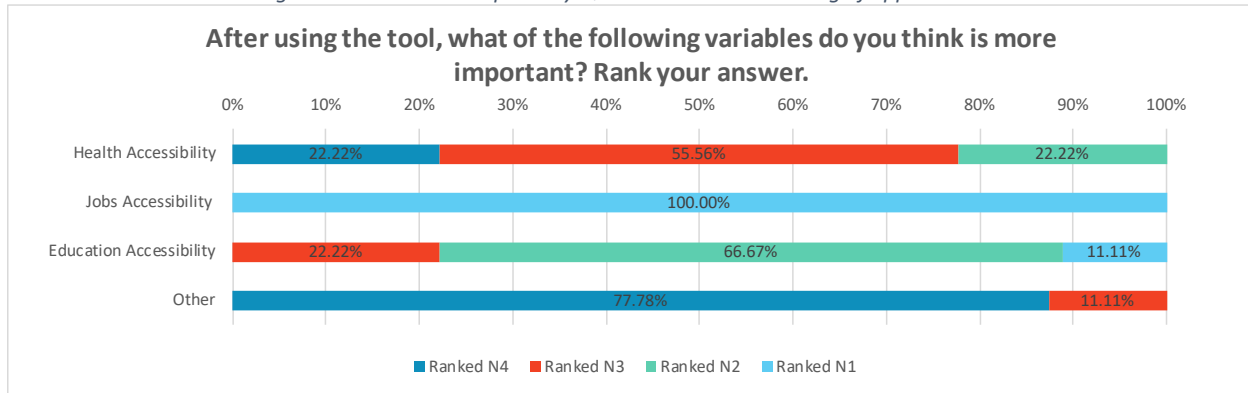
Source: Own elaboration based on participants responses

Figure 28 presents Stakeholders' responses about ranked importance of accessibility to different opportunities, after using CoAXs. All participants ranked jobs as the most important accessibility variable after using the tool, which follows the same pattern reported by the Decision Makers group. It is interesting to note that Education slightly decreased in importance (from 77% ranking it second to 67%), while Health increased mentions for the third place (from 44% to 55%). "Other" opportunities maintained their responses in fourth place. The trends for the two groups (Decision Makers and Stakeholders) interestingly concurred, even with the same ranking positions. This result tends to validate the relative weight given to each opportunity, supporting the following (decreasing) order: jobs, education, health, and others.

Figure 29: Post-workshop survey Question 2.3. Final attitudes: Projects and Accessibility for Achieving Goals

After using the tool, to what extent do you disagree/agree with the following statements?
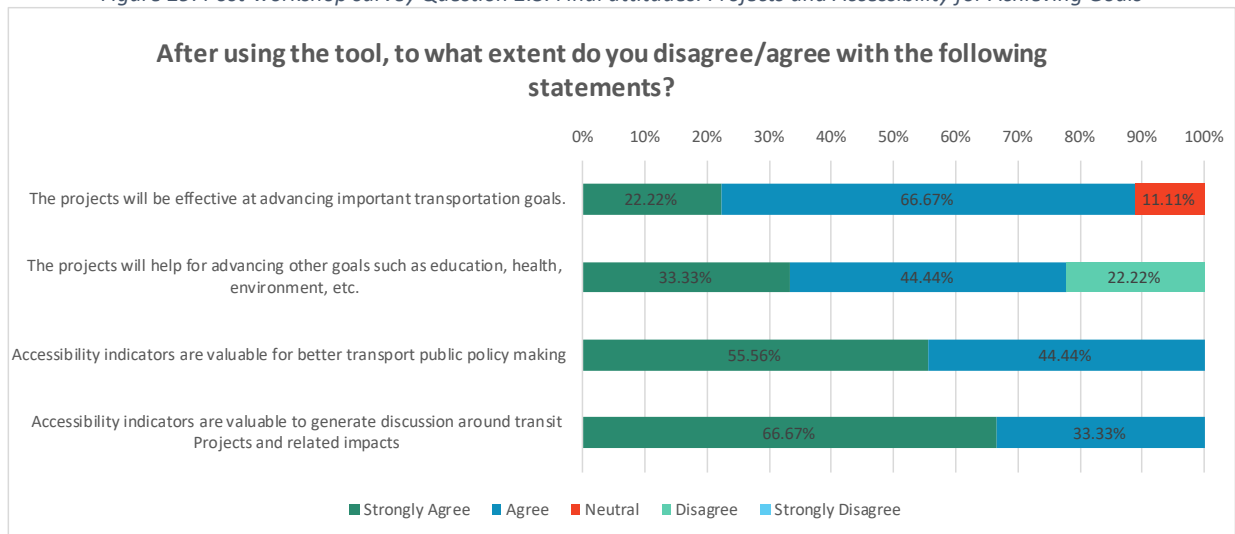
Source: Own elaboration based on participants responses

Figure 29 presents participants' responses regarding the role of the projects and accessibility metrics for achieving goals, after using CoAXs. As can be seen, and following the same trend as for the Decision Makers Group, answers slightly decrease in agreement compared with Pre-workshop survey. Regarding the second statement, 22% (2 from 9) of participants now disagree with effectively advancing goals, but most

of the participants (78%) still agreed, which differed from Decision Makers group. Despite the fact that respondents decreased in the number that "strongly agree" after using the tool, accessibility indicators were positively evaluated for generating discussion and improving transport policy making.

Figure 30: Pre-workshop survey Question 2.4. Final project knowledge and impact description
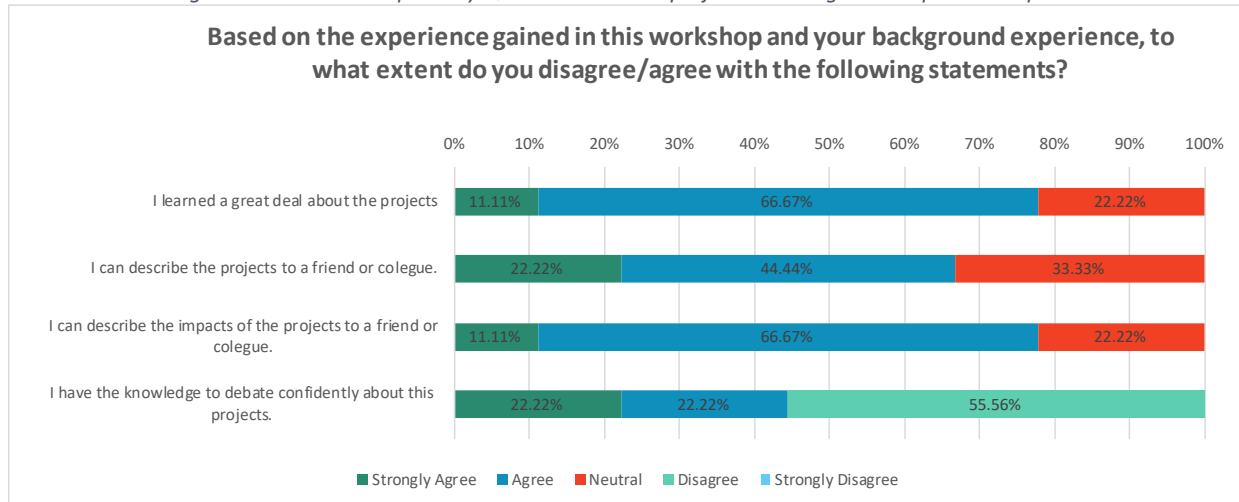
Source: Own elaboration based on participants responses

Figure 30 presents the Stakeholder group's perceptions about project knowledge and impacts. As can be seen, participants mostly agree with the first three statements (higher than 60%). Comparing these results with the initial attitudes, it is possible to appreciate important changes towards learning about the projects. For example the third statement ("I can describe the impacts of the projects to a friend or colleague") changed from 67 % disagreeing to 78% agreeing. These changes in perceptions suggest an important impact of CoAXs in project learning, which positively emphasizes the tool's utility. Additionally, comparing both testing groups (i.e., Decision Makers and Stakeholders), the most significant difference lies in the fourth statement. Stakeholders still felt unable to confidently debate about the projects (55% disagreeing), while Decision Makers responses suggest strong agreement about abilities to debate projects (50% strongly agreed).

Figure 31: Post-workshop survey additional Question 2.4. General Workshop Experience

Based on the experience gained in this Workshop, to what extent do you disagree/agree with the following statements?
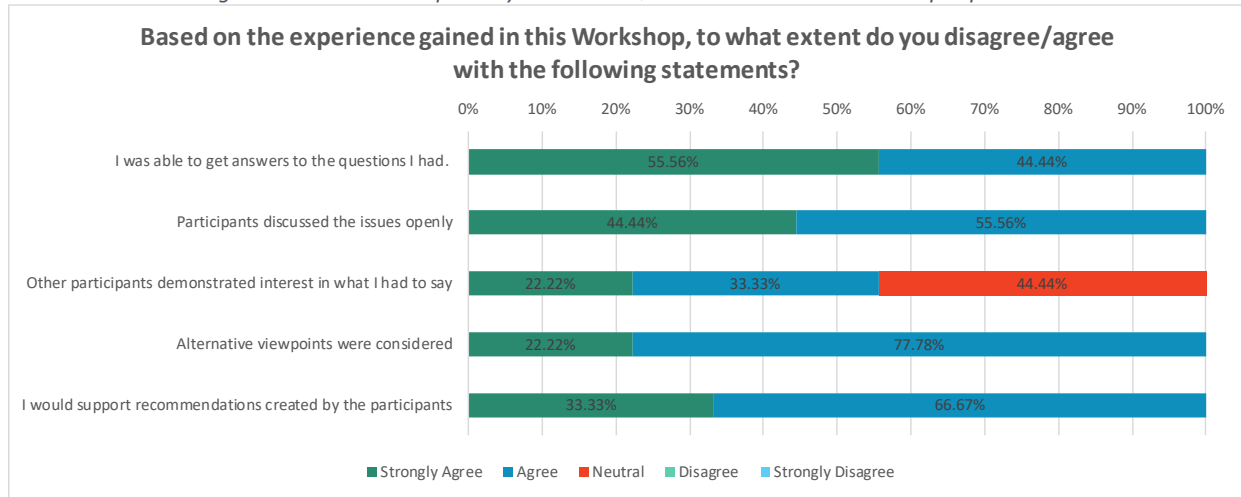
Source: Own elaboration based on participants responses

The graph presented in *Figure 31* shows stakeholder answers regarding the general workshop experience. As can be seen, almost all participants positively agreed about the different statements in evaluation, which highlights a good experimental setting for participants' interactions and suggests that CoAXs is helpful in supporting public engagement. It is interesting to mention that both groups (Decision Makers and Stakeholders) quite positively evaluated their general workshop experience, which again emphasizes the tool's potential utility in public engagement.

Please evaluate the *usefulness* of CoAXs by indicating to what extent do you agree or disagree with the following statements?
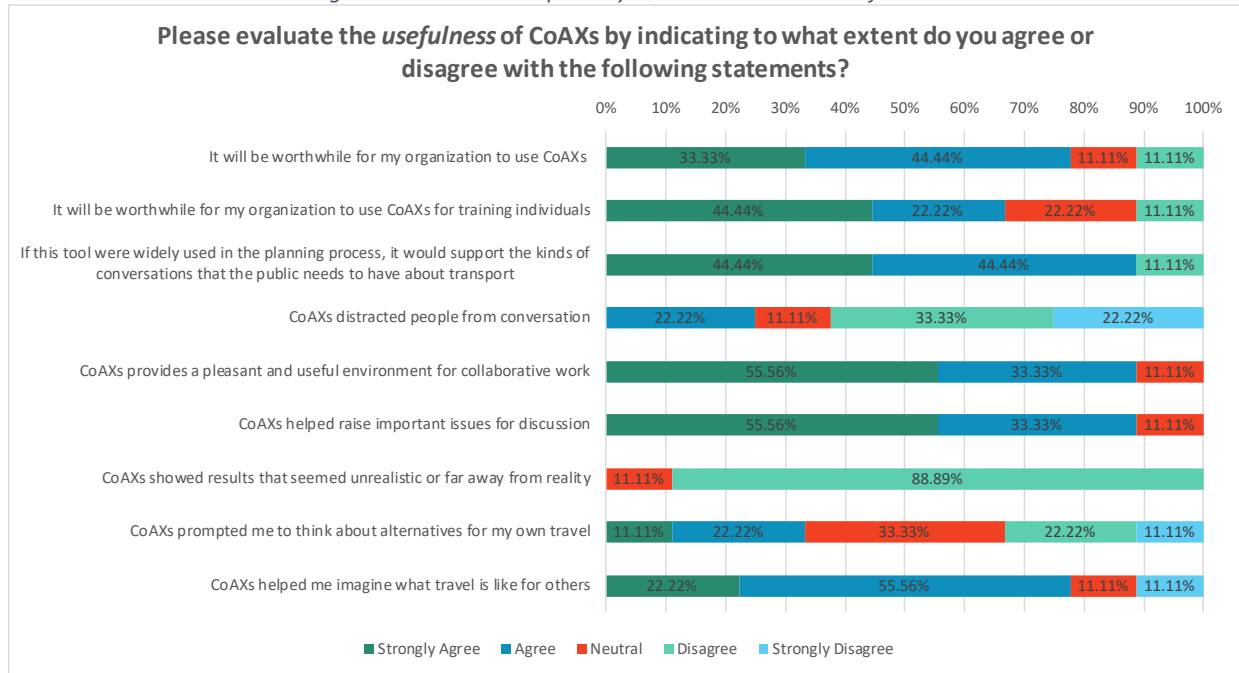
Source: Own elaboration based on participants responses

The *Figure 32* presents the post-workshop survey results about the usefulness of CoAXs. As can be seen, most stakeholders agree about the usefulness of CoAXs, and disagree with the negative statements, such as distractions (55% of disagree) and unrealistic results (89% of disagree). Not surprisingly, stakeholders support the use of CoAXs in their organizations (77% agree), and for training individuals (66% agree). More interestingly, Stakeholders support the wide use of CoAXs for facilitating conversations that the public needs to have about transport (89% agree), for providing a useful environment for collaborative work (89% agree) and for raising important issues for discussion (89% agree). Regarding personal travel experiences, stakeholder did not support CoAXs for facilitating thinking about travel alternatives (66% neutral or disagree), which is reasonable because the tool do not explicitly shows travel alternatives. In contrast, Stakeholders significantly support CoAXs for helping to imagine the travel of others (78% agree). Comparing the results with the Decision Makers group, both support CoAXs in several areas including using CoAXs in their organizations, for public engagements, and for imagining "others" travels. However, they disagree about the potentially unrealistic results of CoAXs. On one hand, some Decision Makers respondents were skeptical about the results of CoAXs . On the other hand, Stakeholders highly disagree about CoAXs' potentially unrealistic results.
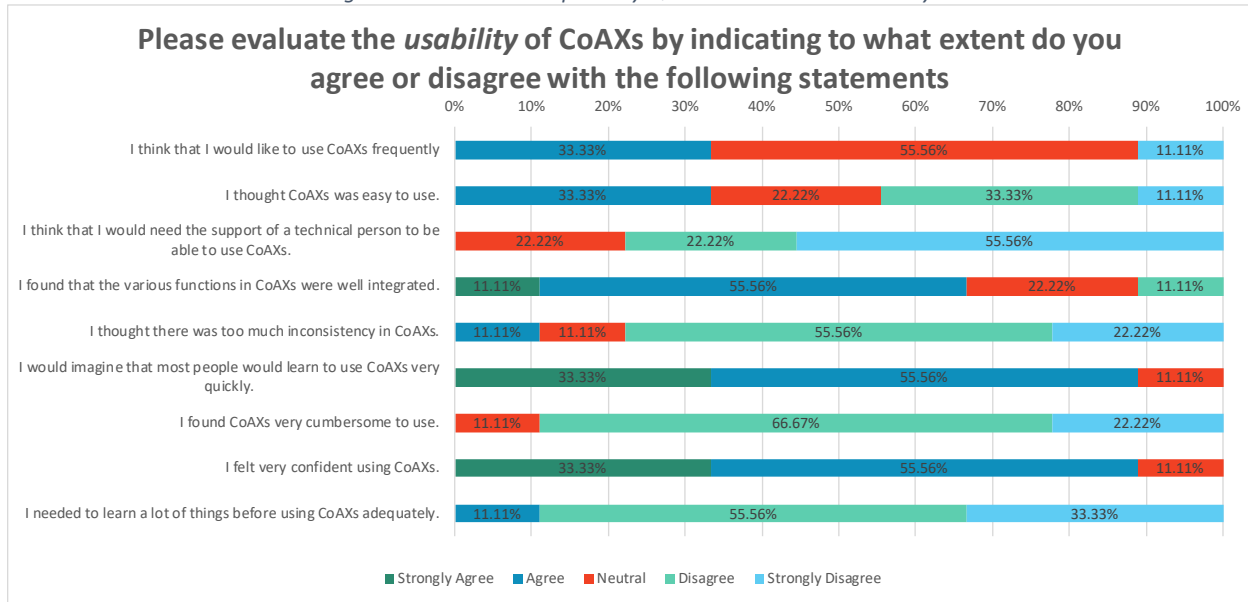
Please evaluate the *usability* of CoAXs by indicating to what extent do you agree or disagree with the following statements

Figure 33 shows Stakeholders responses about CoAXs' Usability. As can be seen, Stakeholders disagree with the need for technical support (78%), about tool inconsistencies (78%), it being cumbersome to use (89%), and the need to learn a lot before using CoAXs adequately (89%). Moreover, stakeholders supported the well-integrated functions of CoAXs (66% agree), the ability to quickly learn to use CoAXs (89% agree), and the confidence in using CoAXs (89% agree). Stakeholders did not express a strong willingness to use CoAXs frequently (Statement 1, more than 50% neutral, 11 % not agreeing) and did not think that CoAXs was easy to use (statement 2, almost 50% did not agree with this statement). Based on the answers provided by both groups (i.e., Stakeholders and Decision Makers), it seems that CoAXs is not easy to use, but would be easy to learn how to use it. Both groups agreed about their confidence in using CoAXs and disagreed about need for technical help, it being cumbersome and inconsistent. Despite the fact that 50% of Decision Makers were neutral about the need for previous learning, both groups positively evaluated the usability of CoAXs, which emphasize the performance of the tool for public and non-technical users.

5.4 Survey comparisons

As mentioned at the beginning of this chapter, the Pre- and Post-workshop surveys were mainly designed for tracking changes in participant's attitudes after using CoAXs. Quantifying those changes provides some understanding about the impacts of CoAXs on participant's engagement and its significance in fostering broader metropolitan conversations. This section deepens the analysis, contrasting pre- and post-workshop between the two groups (i.e., Decision Makers and Stakeholders). This analysis focuses on three pre- and post-workshop questions, which consider the following topics: Project impacts, project learning, and

expectations for the projects and accessibility measures for achieving goals. Contingency tables, Slopegraphs (Wheeler, 2014) and pie charts are used for presenting these results.

5.4.1 Expected Project Impacts

Table 10 shows the pre and post attitudes regarding the "project impact question" of the survey. As can be seen, both groups' attitudes move towards expecting greater impacts after using the tool. However, for Decision Makers the increase is greater. For both for Decision Makers and for Stakeholders, the greatest change in expected impacts (significantly greater impact) was for the Santiago Metropolitan Area and Public Transport Riders.

Table 10: Decision Makers and Stakeholders. Project impacts comparison: How do you think the transportation projects presented will impact each of the groups?

Decision Makers	Pre survey					Post Survey				
	Significantly negative impact	Negative impact	No impact	Positive impact	Significantly positive impact	Significantly less impact	Less impact	Same impact	Greater Impact	Significantly greater impact
Yourself	0.0%	0.0%	0.0%	60.0%	40.0%	0.0%	16.7%	16.7%	16.7%	50.0%
Your neighborhood	0.0%	0.0%	16.7%	33.3%	50.0%	0.0%	16.7%	33.3%	16.7%	33.3%
Your commune	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	16.7%	16.7%	33.3%	33.3%
Santiago Metropolitan area	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	0.0%	0.0%	33.3%	66.7%
People walking	0.0%	0.0%	50.0%	33.3%	16.7%	0.0%	0.0%	50.0%	50.0%	0.0%
People biking	0.0%	0.0%	33.3%	66.7%	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%
People driving	0.0%	33.3%	16.7%	50.0%	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%
People riding public transport	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	33.3%	66.7%

Stakeholders	Pre survey					Post Survey				
	Significantly negative impact	Negative impact	No impact	Positive impact	Significantly positive impact	Significantly less impact	Less impact	Same impact	Greater Impact	Significantly greater impact
Yourself	0.0%	0.0%	22.2%	55.6%	22.2%	0.0%	22.2%	44.4%	22.2%	11.1%
Your neighborhood	0.0%	0.0%	44.4%	33.3%	22.2%	0.0%	11.1%	66.7%	11.1%	11.1%
Your commune	0.0%	0.0%	22.2%	55.6%	22.2%	0.0%	11.1%	66.7%	0.0%	22.2%
Santiago Metropolitan area	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	11.1%	33.3%	22.2%	33.3%
People walking	0.0%	11.1%	33.3%	44.4%	11.1%	0.0%	25.0%	37.5%	25.0%	12.5%
People biking	0.0%	0.0%	66.7%	33.3%	0.0%	11.1%	11.1%	66.7%	0.0%	11.1%
People driving	0.0%	11.1%	33.3%	44.4%	11.1%	11.1%	0.0%	66.7%	11.1%	11.1%
People riding public transport	0.0%	0.0%	0.0%	44.4%	55.6%	0.0%	11.1%	0.0%	44.4%	44.4%

Source: Own elaboration based on participants responses

Figure 34 presents the slopegraphs of Decision Makers' changes between pre-workshop survey question 1.1 and post-workshop survey question 2.1.[20] A slope different from zero denotes change in expectations after using the tool. Interestingly, most of the slopegraphs' slopes are positive, which means that, on average, CoAXs' use tended to increase the participants' perception about impacts. Among drivers, bikers and walkers groups, Decision Makers responses seems to diverge including some zero slope responses, however the average slope is still positive. Interestingly, Metropolitan Area and Transit Riders have the highest slopes between groups and seems to have similar behavior among participants.

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[20] For creating slopegraphs, Question 1.1 of the Pre-workshop survey was valued as following: Significantly positive impact (+5), positive impact (+4), no impact (3), negative Impact (2) and significantly negative impact (1). For Question 2.1 of the post-survey: Significantly greater impact (+2), greater impact (+1), same Impact (0), less Impact (-1) and significantly less impact (-2)

Figure 34: Slopegraphs Project Impacts – Decision Makers:
How do you think the transportation projects presented will impact each of the groups?
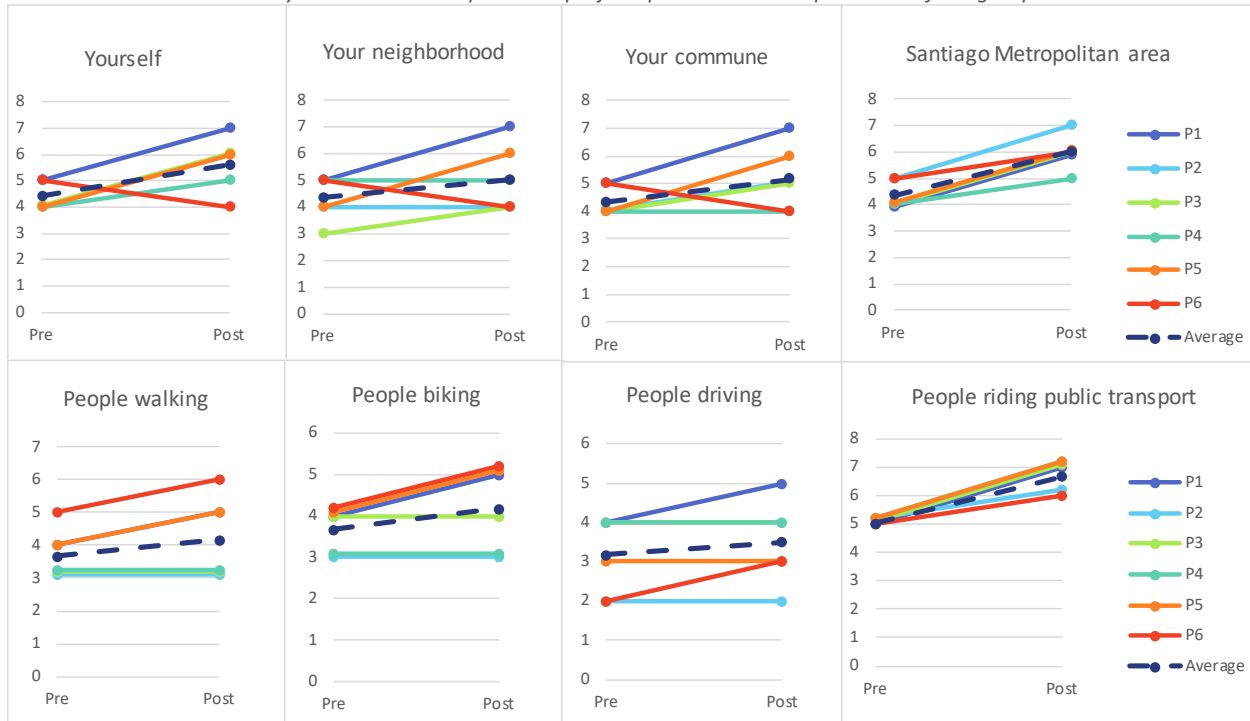
Source: Own elaboration based on participants responses. "P" represents participants.

Similarly, *Figure 35* presents the slopegraphs of Stakeholders' changes in expected impacts. In contrast to the case of the decision makers, the Stakeholders' slopegraphs show more lines with zero or negative slope. Following the same trend as Decision Makers, both Santiago Metropolitan area and the Transit Riders groups present the most positive slopes, suggesting that the tool use generated an important increase of perceptions about projects' impacts on these groups. This result somewhat supports the hypothesis that CoAXs tends to emphasize project impacts at broader scales, potentially promoting Metropolitanism.

Figure 35: Slopegraph Project Impacts – Stakeholders:
How do you think the transportation projects presented will impact each of the groups?
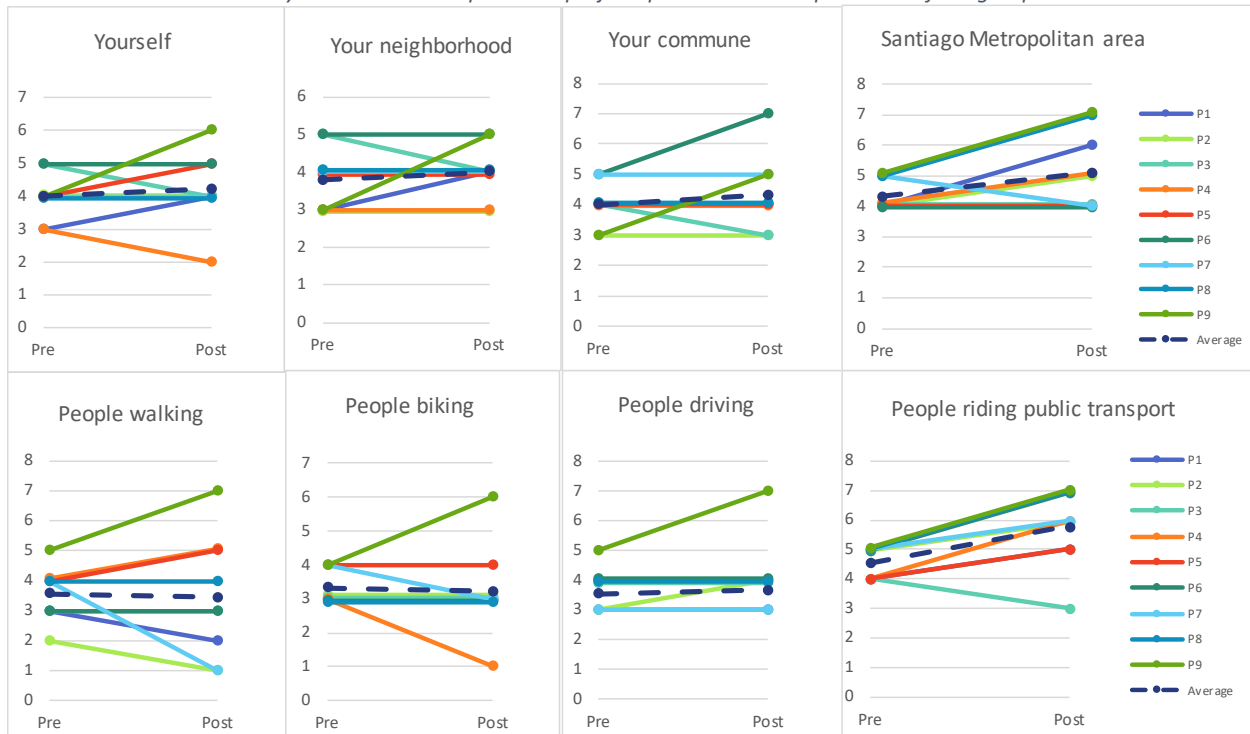
Source: Own elaboration based on participants responses. "P" represents participants.

The pie charts[21] in *Figure 36* present the aggregate individual changes (questions 1.1 and 2.1 from surveys) of each workshop. As can be seen, 71% of Decision Makers and 53% of Stakeholders changed their initial expectations about projects impacts, which demonstrates that predominantly perceptions among Decision Makers and Stakeholders changed after using the tool. This predominant change among participants may be related with CoAXs ability to create a broader understanding of project impacts, which encourages changes in participants' perceptions after using the tool.

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[21] The Pie Charts describe the changes between pre workshop and post workshop surveys, aggregated by groups (i.e., people biking, people walking, yourself, etc.) and participants (i.e., P1, P2, P3, etc.). First, each participant's behavior change after using the tool was calculated. A positive change means an increase in impact after using the tool, a neutral means that the participant maintained the same expected impact, and a negative change means a decrease in expected impact. Finally, all participants' changes were aggregated and classified by type of change (negative, neutral, positive) to create the pie charts.

Figure 36: Aggregated Individual Changes in Project Impacts

Changes in Project Impacts Perceptions Decision Makers workshop

6%
29%
65%

■ Negative Change
■ Neutral
■ Positive Change

Changes in Project Impacts Perceptions Stakeholders workshop

17%
36%
47%

■ Negative Change
■ Neutral
■ Positive Change
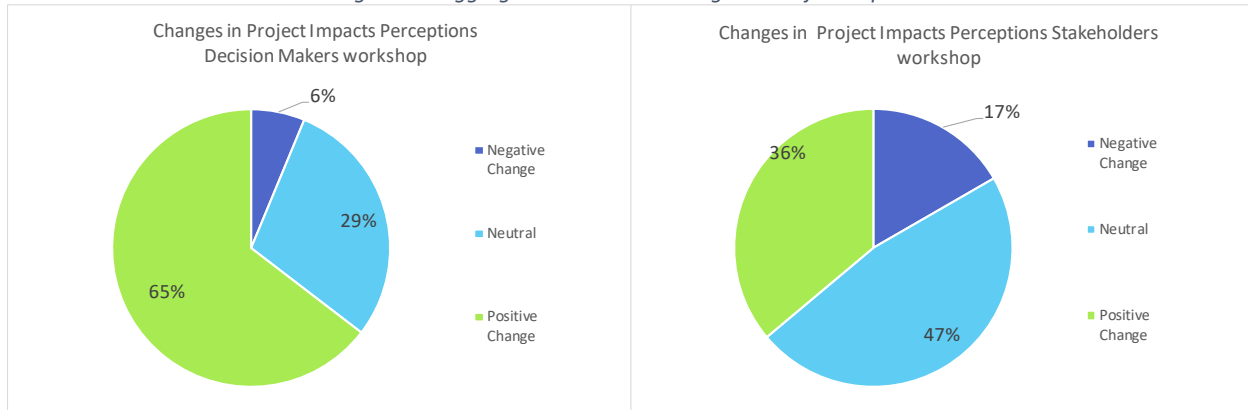
Source: Own elaboration based on participants responses

5.4.2 Project Learning

Table 11 shows the Pre-workshop and Post-workshop survey responses on learning about the projects. In general, the table shows a great deal of post survey agreement; participants reported learning after using CoAXs. As can be seen, the most important difference between groups is about project debating. While stakeholders mostly disagreed about having knowledge for project debating after using the tool, only a 17% of Decision makers followed that trend.

Table 11: Decision Makers and Stakeholders. Project learning comparison: To what extent do you disagree/agree with the following statements?

Decision Makers	Pre survey					Post Survey				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I learned a great deal about the projects	0.0%	33.3%	50.0%	16.7%	0.0%	0.0%	16.7%	0.0%	33.3%	50.0%
I can describe the projects to a friend or colegue.	16.7%	16.7%	16.7%	50.0%	0.0%	0.0%	0.0%	16.7%	50.0%	33.3%
I can describe the *impacts* of the projects to a friend or colegue.	16.7%	16.7%	33.3%	33.3%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%
I have the knowledge to debate confidently about these projects.	0.0%	33.3%	16.7%	16.7%	33.3%	0.0%	16.7%	33.3%	0.0%	50.0%

Stakeholders	Pre survey					Post Survey				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I learned a great deal about the projects	0.0%	33.3%	55.6%	11.1%	0.0%	0.0%	0.0%	22.2%	66.7%	11.1%
I can describe the projects to a friend or colegue.	0.0%	22.2%	22.2%	55.6%	0.0%	0.0%	0.0%	33.3%	44.4%	22.2%
I can describe the *impacts* of the projects to a friend or colegue..	0.0%	66.7%	11.1%	22.2%	0.0%	0.0%	0.0%	22.2%	66.7%	11.1%
I have the knowledge to debate confidently about this projects.	11.1%	44.4%	11.1%	33.3%	0.0%	0.0%	55.6%	0.0%	22.2%	22.2%

Source: Own elaboration based on participants responses

Figure 37 present the slopegraphs of Decision Makers' changes between Pre-workshop question 1.4 and Post-workshop survey question 2.4[22]. As can be seen, most lines show a positive slope, which indicates an average positive change among participants after using CoAXs. Specifically, this result suggests that the

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[22] For creating slopegraphs, Question 1.4 and 2.4 of the Pre-workshop and Post-workshop survey were valued as following: Strongly Agree (+5), Agree (+4),Neutral (+3), Disagree (2) and Strongly Disagree (+1).

use of CoAXs produces advances in project learning. Interestingly, the most important change is produced in a respondents' claim about being able to describe project impacts (statement 3).

Figure 37: Slopegraphs Project Learning – Decision Makers:
To what extent do you disagree/agree with the following statements?
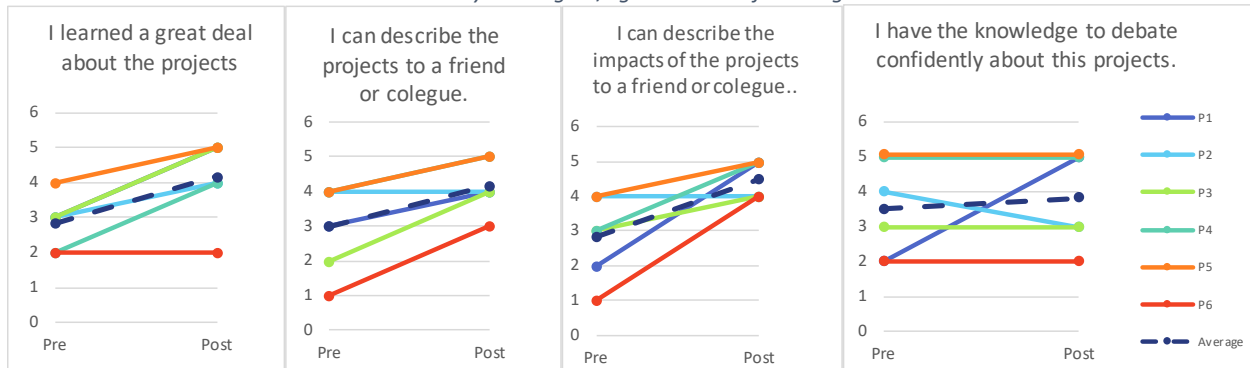
Source: Own elaboration based on participants responses. "P" represents participants.

Figure 38 shows the slopegraphs of Stakeholders' changes in reported learning. Similar to the Decision Makers group, most of the chart lines presents positive slopes, however, Stakeholders reveal more neutral responses. Interestingly, the highest reported changes for both Decision Makers and Stakeholders groups concur: for statement three regarding the ability to describe project impacts. In contrast, the ability to debate about projects seems to be neutral after using the tool. The mostly positive slopes among groups (i.e., Stakeholders and Decision Makers) suggest that CoAXs' use tended to increase the participants' project learning.

Figure 38: Slopegraph N2, Project Learning – Stakeholders:
To what extent do you disagree/agree with the following statements?
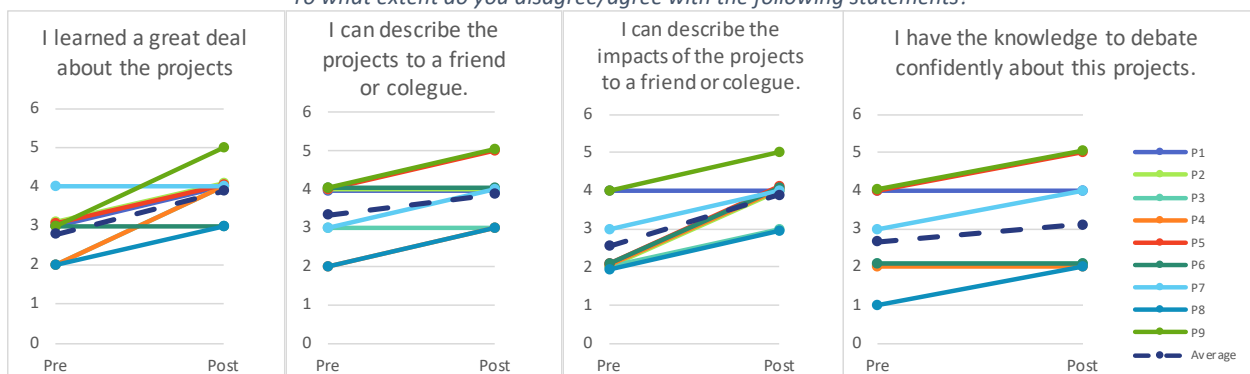
Source: Own elaboration based on participants responses. "P" represents participants.

Pie charts in *Figure 39* show that both Decision Makers and Stakeholders achieved a 67% positive change, which confirms that most of the participants positively changed their perspective on project learning after using the tool. This result interestingly suggests that CoAXs use could increase project learning.

Figure 39: Aggregated Individual Changes in Project Learning
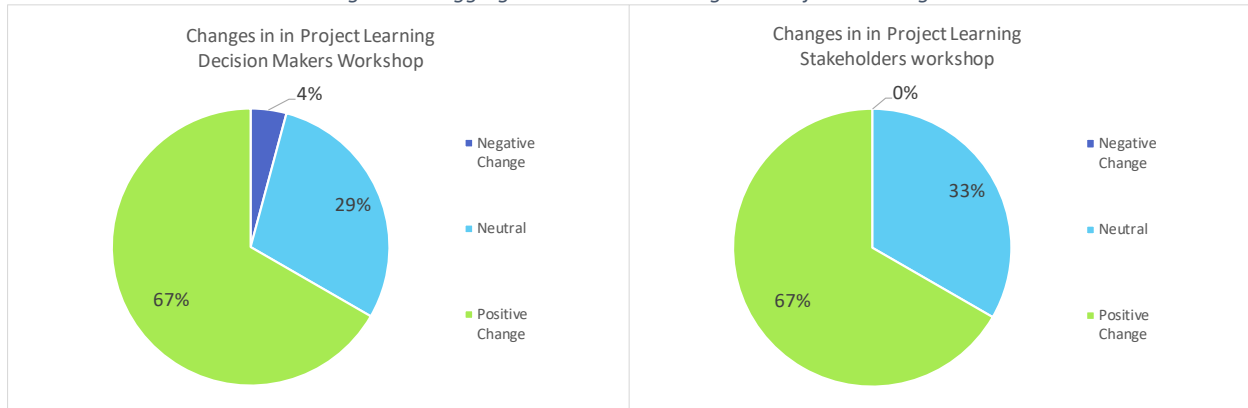
Source: Own elaboration based on participants responses

5.4.3 Projects and accessibility measures for achieving goals

Table 12 presents the changes among both groups in their responses regarding expected impacts of projects in achieving goals and value of accessibility as a metric. As can be seen, both groups mostly agreed with the different statements in the pre-workshop surveys. However, after using CoAXs only slightly changes are observed. Interestingly, 50% of the Decision makers, after using the tool, were neutral about statement 2 (Projects … advancing other goals such as education, health, environment, etc), while Stakeholders mostly agreed with this statement.

Table 12: Decision Makers and Stakeholders. Projects and accessibility measures for achieving goals: To what extent do you disagree/agree with the following statements?

Decision Makers	Pre survey					Post Survey				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Projects...effective at advancing important transportation goals.	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	0.0%	0.0%	50.0%	50.0%
Projects … advancing other goals such as education, health, environment, etc.	0.0%	0.0%	16.7%	66.7%	16.7%	0.0%	0.0%	50.0%	16.7%	33.3%
Accessibility ... for better transport public policy making	0.0%	0.0%	0.0%	16.7%	83.3%	0.0%	0.0%	0.0%	16.7%	83.3%
Accessibility …. encourage discussion about transport project impacts	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	16.7%	83.3%

| Stakeholders	Pre survey					Post Survey				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Projects...effective at advancing important transportation goals.	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	0.0%	11.1%	66.7%	22.2%
Projects … advancing other goals such as education, health, environment, etc.	0.0%	0.0%	11.1%	44.4%	44.4%	0.0%	22.2%	0.0%	44.4%	33.3%
Accessibility ... for better transport public policy making	0.0%	0.0%	0.0%	22.2%	77.8%	0.0%	0.0%	0.0%	44.4%	55.6%
Accessibility …. encourage discussion about transport project impacts	0.0%	0.0%	0.0%	33.3%	66.7%	0.0%	0.0%	0.0%	33.3%	66.7%

Source: Own elaboration based on participants responses

Figure 40 presents the slopegraphs of Decision Makers expectations about project impacts on goals and value of accessibility (changes between Pre-workshop survey question 1.3 and Post-workshop survey

question 2.3)[23]. As can be seen, an important number of participants registered no change and no trend can be seen among the different statements, which could suggest that no relationship exists between using CoAXs and the participants' perspectives on the projects and accessibility metrics.

Figure 40: Slopegraph Projects and accessibility measures for achieving goals – Decision Makers: To what extent do you disagree/agree with the following statements?

Source: Own elaboration based on participants responses. "P" represents participants.

Figure 41 shows the slopegraphs for the Stakeholders group. Following the same behavior of the Decision Makers group, the results among Stakeholder participants varies and it is difficult to observe any trend. Despite this fact, the charts interestingly show a great deal of neutral responses. This result seems to reflect that in the case of "Projects and accessibility measures for achieving goals", CoAXs is not making participants change their perceptions.

Figure 41: Slopegraph Projects and accessibility measures for achieving goals – Stakeholders: To what extent do you disagree/agree with the following statements?
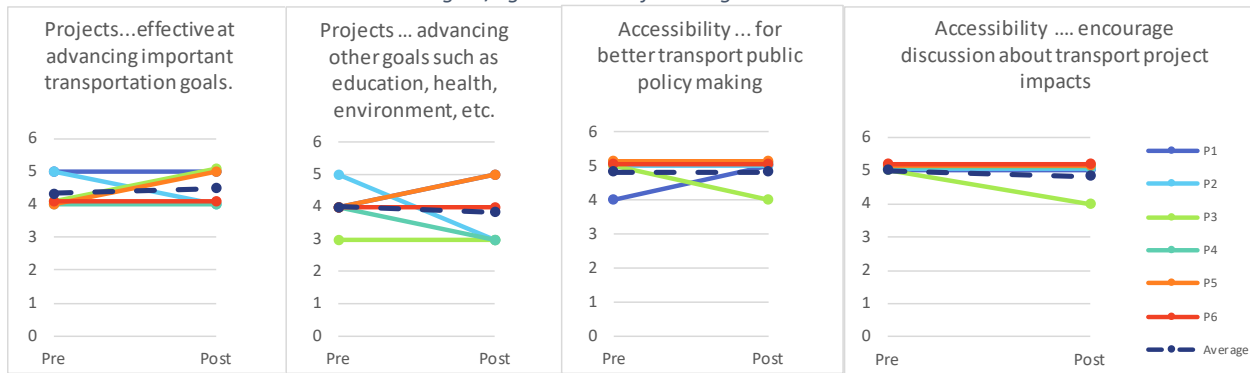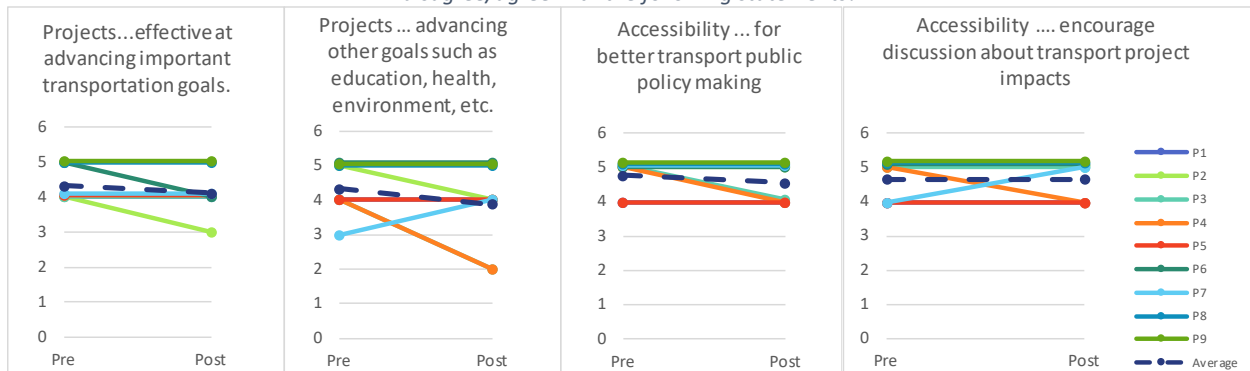

Source: Own elaboration based on participants responses. "P" represents participants.

The Pie Charts in *Figure 42* show that Decision Makers (58%) and Stakeholders (72%) predominantly did not change their initial perspectives regarding the value of these projects in fulfilling larger goals, or the usefulness of the accessibility metrics. Again, it is worth noting that individuals mostly indicate neutral responses after using the tool. This is a somewhat unexpected result, even more so when considering that

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[23] For creating slopegraphs, Question 1.3 and 2.3 of the Pre-workshop and Post-workshop survey were valued as following: Strongly Agree (+5), Agree (+4),Neutral (+3), Disagree (2) and Strongly Disagree (+1).

after using the tool respondents reported positive expected impacts of the projects and learning about the projects. At least two possible explanations for this behavior emerge. First, as mentioned in the survey description of Decision Makers (***Error! Reference source not found.***), participants may tend to agree about specific unknown measures or concepts, even more when the sponsorship of the research is a well-known foreign institution. Such attitudes could bias the initial perspectives toward the use of accessibility metrics, which in the context of Chile are mainly unused and unknown. A second explanation is based on the survey design. If a respondent initially strongly agreed (or disagreed) with a statement in the Pre-workshop survey, she is constrained from moving higher (lower) in the Post-workshop survey. This would trigger a neutral response. Responses to the pre-workshop survey question 1.3 for both Decision Makers and Stakeholders, show a high initial share of "strongly agree" answers (62% DM, 56% SH), meaning that more than a half of participants could not change perception in the same direction.

Figure 42: Aggregated Individual Changes in Projects and accessibility measures for achieving goals
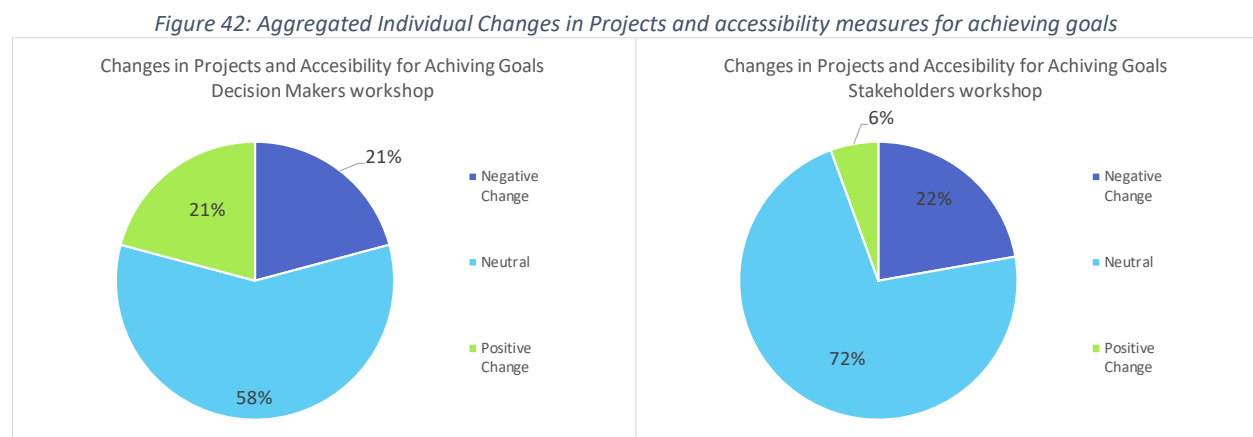
Source: Own elaboration based on participants responses

5.5 Workshops Staff Data Collection Analysis

As mentioned in the Experimental Design Chapter, data on participants interactions with the touchscreen were systematically collected as were participants' comments and suggestions.

5.5.1 Touchscreen interactions

Table 13 presents data on individual interactions with CoAXs, by group. In general, Stakeholders (SHs) tended to interact more with the tool compared with Decision Makers (DMs). Even though SH total time available for interaction was lower than for DMs[24], SHs had 99 total interaction with the tool, or 11

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[24] Total interaction time of SH group was little in comparison with DM group because SH asked several questions to facilitators before tool testing started, which shortened the total available time for tool testing.

interactions per participant. In contrast, DMs only interacted 37 times, or six (6) interactions per participant. SHs had almost twice the interactions per participant than DMs.

Table 13: Workshop's Tool Interactions, General Results

Variable	Decision Makers	Stakeholders
Total Participants	6	9
Total CoAXs Interactions	37	99
Total Interaction Time [min]	84	59
Interactions per Participant	6.17	11.00
Interactions per Minute [n/min]	0.44	1.68

Source: Own elaboration

Table 14 shows the number of interactions divided by type. Three different types of interaction were defined based on the relative level of complexity. Point, i.e. pointing at the touchscreen but not necessarily touching the screen, is the least complex and Click, Tap or Zoom are the highest-level interactions (more complex). In general DMs not only had little tool interactions, they also predominantly pointed (13) or moved the marker (13), which are less interactive touchscreen gestures. On the other hand, SHs mostly utilized Click/Tap/ Zoom (51), which implies a higher level of tool interaction.

Table 14: Workshop's Tool Interactions by Type

Workshop	Type of Interaction		
	Point	Move Marker	Click/Tap/Zoom
Decision Makers	13	13	11
Stakeholders	30	18	51

Source: Own elaboration

Table 15 presents the number of interactions according to CoAXs' interface part, the tool component with which participants' interacted. For example, a map interaction is a user interaction on CoAXs' map. SH and DM interactions were mostly made in the map area. Interestingly, the relation between number of map interactions and Control Panel interactions is similar between groups, with almost four (4) map interactions per one (1) Control Panel interaction.

Table 15: Workshop's Tool Interactions by interface part

Workshop	Interaction Interface	
	Map	Control Panel
Decision Makers	29	8
Stakeholders	79	20

Source: Own elaboration

5.5.2 Participants comments and suggestions

During the session and especially during the final reflections and debrief activity, participants commented about the experience of using CoAXs. Following tables summarize participant's comments and reflections, divided by suggestions for tool improvements (*Table 16*) and general comments or remarks (*Table 17*).

Table 16: Summarized Comments and Reflections: Tool Improvements.

Tool improvements and Suggestions	
Decision Makers	Stakeholders
Add milestones and more information to the tool map	Include number of Ambulances in health accessibility opportunities
Add BRT options for CoAXs	Consider multiple-origins for calculating accessibility (regional analysis)
Include Speed modifications	Provide a chance to modify the weight of the decision variables to filter unwanted travel modes (e.g., crowded metro)
Include the possibilities routes change	Add more information of the network, such as traffic lights
Include a more local scale for the analysis	
Include cost of the projects	Add off-peak period for comparison
Include a diagram of project type (cross-section) to help improve understanding impacts on accessibility	Include Jobs Category in accessibility opportunities
Prioritize benefits among opportunities (jobs, health, educations, etc)	Add landmarks and more information to the tool map
Include hospital beds available for health accessibility	Add stations and routes of existing transit services
For a city like Santiago, make the time bar larger, at least 120 minutes	Add travel time to specific places as a reference
Consider the possibility of eliminating the Metro for accessibility analysis (or other existing modes)	Include penalties for transfers with crowded buses
Include alternatives for tramway project (BRT or others)	Add a new bar for changing travel periods (peak, off peak)
Include quality of life indicators	Include bike as a stage for transit travel
Incorporate the "real GTFS'	Include existing projects such as Metro lines for visualizing
Test the impact of including turnstiles in buses	Add addresses to easily geo-reference origins points
Add information regarding number of transactions using Santiago's transport payment card	Use polygons as origins for aggregate analysis
Include how much you walk for each analysis	Include names of streets
Include beneficiaries using new census information	Add how many people benefits from projects
	Add population density

Source: Own elaboration

Table 17: Summarized Participants' Comments and Reflections: General Comments and Remarks

General Comments or Remarks	
Decision Makers	Stakeholders
Establish a global vision with one authority for the whole city	CoAXs does not include penalties for transfers
I didn't know that I could reach that place in 30 minutes	Tool is more generic, not so specific (good)
More tangible benefit with accessibility	Good for public debate
Plausible to understand for the "average Joe"	Analysis generally is point-to-point, better by areas such as CoAXs
CoAXs helps in different levels of decision (Neighborhood, commune and metropolitan)	Still technical for "average Joe"
In general the isochrone make sense	CoAXs mostly cares about projects impacts rather than project costs
Interesting to look at the isochrone rather than a specific place	Still need more data to be useful

Source: Own elaboration

As can be seen in *Table 16* and *Table 17*, participants widely commented about the workshop experience, and mostly regarding improvement possibilities for CoAXs. Participants from both groups provided a great deal of comments for tool improvements, which interestingly kept most participants' attention during final reflections and remark activities. Some comments among the groups referred to adding more information to the maps, for better understanding locations. One commented that "including existing projects in the map, such as subway lines or "TranSantiago" corridors, would facilitate the visualization and understanding of the accessibility results." Another participant added: "If the map incorporates travel time indications for some city landmarks, it would facilitate understanding accessibility."[25] In general, comments regarding map information suggested that non-experts would need more landmarks on maps to better understand locations and more easily visualize impact results. Interestingly no comments regarding interface language were made among participants, which suggest that the English language used in the tool components and titles were not an impediment for the tool testing experience by the selected participants. Regarding new capabilities, comments varied widely. Some interesting ideas included: adding penalties for transfers with crowded buses, enabling regional analysis rather than singular point of origin, and including cross-sectional diagrams to illustrate the types of transit solutions. Other interesting areas mentioned for improvement included: "increase the time bar, at least to 120 minutes for a city like Santiago", "real time GTFS for the analysis", and "consider the creation of a quality of life index from the accessibility metrics".

Regarding general comments and remarks, Decision Makers positively commented about the tool. In contrast, Stakeholders were more skeptical and made more claims for tool improvements. For example, while one Decision Maker said "the tool is plausible to understand for the average Joe", a Stakeholder said "the tool is still too technical for average Joe." Nonetheless, there was agreement about the greater value of using Isochrones: "Is interesting to look at the isochrone rather than a specific place," said one Decision

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[25] In Spanish: Visualizar el tiempo de viaje a ciertos hitos importantes de la ciudad facilitaría el entendimiento de la accesibilidad

Maker; "[most] Analysis is, in general, point to point; it's better by areas such as CoAXs does," added a Stakeholder.

The comments and suggestions provide important feedback regarding the original research questions. In terms of public engagement, stakeholders agreed about the usefulness of the tool for "public debate," and considered it a good trait that "the tool is more generic and not too specific." Nonetheless, as mentioned, some comments were made about the need for tool improvements in order to be suitable for broader non-technical audiences. Regarding the research question of promoting broader conversations around the metropolitan scale, Decision Makers noted the usefulness of the tool to "Establish a global vision with one authority for the whole city" and "for helping different levels in decision making", which provides a sense of encouragement for wider conversations. Direct comments around metropolitanism were lost for stakeholders, however some observations, such as "Analysis is in general point to point [travel time from an origin to a destination], better by areas [i.e., isochrones] such as CoAXs did" and "the tool is more generic and not too specific" support the idea of CoAXs' wider impacts capabilities, enhancing broader scale conversations.

5.6 Conclusions

The results analyzed in this chapter help to understand CoAXs' application implications in Santiago de Chile. In general, participants of both groups (i.e., Decision Makers and Stakeholders) agreed about the usefulness and usability of the tool. Additionally, participants also positively evaluated the general workshop experience, highlighting support for "recommendations created by participants," which suggests trust generated among participants. Regarding pre-workshop and Post-workshop surveys results, the analysis suggests that the use of CoAXs, in most cases, changed participant's attitudes regarding projects impacts among both Decision Makers and Stakeholders. In this sense, anticipated impacts on public transport riders and the Santiago Metropolitan Area displayed the largest changes. The latter result, regarding the Santiago Metropolitan Area suggests that CoAXs tends to emphasize project impacts at broader scales, promoting, for example, Metropolitanism.

Results from the slopegraphs and pie charts suggested a direct relation between CoAXs use and project learning among Decision Makers and Stakeholders. Participants of both groups consistently agreed about CoAXs' contribution to learning about the selected projects. If CoAXs use could encourage project learning, then CoAXs may potentially contribute to improved public engagement processes. Regarding expectations about the projects helping to achieve broader goals and the value of accessibility metrics, the slopegraphs and aggregated individual responses (Pie Charts), suggest a somewhat counterintuitive outcome. Two possible explanations for this outcome were identified: biased initial attitudes founded on

foreign research sponsorship and the survey design, which constrained movement (positive or negative) from extreme initial expectations.

Tool interaction analysis demonstrated higher tool interactions made by the Stakeholders group, which had almost double the number of interaction per participants than the Decision Makers group. Regarding interaction location, both groups mainly interacted on the map space with almost four (4) Map interactions per one (1) Control Panel interaction. In the debrief, both decision Makers and Stakeholders mainly discussed tool improvement possibilities, rather than general comments or remarks about the experiment. Some participants' comments were consistently aligned with survey results, such as regarding CoAXs' capabilities for illustrating project impacts at higher scales and for improving understanding for non-expert audiences.

Chapter 6: Conclusions and Future Research

In general, the research presented in this thesis fulfilled the initial objectives of designing, developing and applying a participatory experiment in Santiago de Chile for testing CoAXs. Based upon this entire process, several findings, recommendations and conclusion emerge, providing responses to the original research questions, additional feedback, and areas for future research.

This chapter is divided into three main sections: findings and recommendations, conclusions, and future research.

6.1. Findings and Recommendations

6.1.1. Experimental design for further testing

The Experimental Design Chapter (3) elaborated several recommendation for testing CoAXs in Santiago. These recommendations were based on previous CoAXs' testing experiences documented in several references (e.g, Stewart et al., 2017) and by the practical experience of the author in CoAXs-based workshops (with Livable Streets Alliance) conducted in Boston in October 2016. The experiment in Santiago somewhat validated the approach while suggesting areas for improvement for further testing

experiences. *Table 18* presents the final recommendations for developing a single workshop for CoAXs Testing.

Table 18: Single workshop recommendations

Variable	Recommendation
Touchscreen	1
Touchscreen size	Large, at least 55 inches
Maximum Number of Participants	12
Minimum Staff	4
Facilitators	2 or 3
Recommended Area for testing experience	600-800 [sqft]
Defined testing areas	Reception, food, tool testing area
Minimum size for each area	Food (180 sqft), tool testing area (360 sqft), reception area (60 sqft).
Workshop minimum activities	Introduction, basic use, tool testing and evaluation.
Data collection: qualitative method	Pre and Post surveys
Data collection: quantitative method	Participants number of tool interactions classified by type
Time for experiment	Late evening, avoid working hours
Minimum extension of experiment	2 hours
Room location	Transit accessible, parking availability.

Source: Own elaboration

6.1.2. CoAXs Santiago tool development

The development of CoAXs for the Santiago experiment provided an opportunity for improving tool capabilities and, at the same time, a challenge for selecting from among existing capabilities according to the needs of the Santiago experiment context. The following points summarize the final selected capabilities and new features of CoAXs Santiago:

Selected Features:

- A self-explanatory and more intuitive version for non-technical users;
- Accessibility version: Isochrones and accessibility to opportunities feature;

New Features:

- Additional opportunities (beyond the traditional accessibility to Jobs): Health and Education; and
- A project list and customizable scenario testing.

In general, the capabilities developed for CoAXs Santiago were actively used, but not explicitly tested in the workshops, where the main objective was to answer the research questions. However, the survey results, participants' comments, and practical experience support the CoAXs features chosen for the Santiago experiment.

Regarding CoAXs' self-explanatory characteristics, post-workshop survey results about usability of the tool suggested good performance among both the Stakeholders (SH) and Decision Makers (DM) groups. Most of participants disagreed with the idea that CoAXs was cumbersome to use (100% of DMs disagreed, 88% of SHs disagreed) or with the need for technical training to use it (83% of DMs disagreed, 78% of SHs disagreed). Furthermore, participants felt confident using the tool (100% of DMs agreed, 88% of SHs agreed). In contrast, during the debrief session a stakeholder comment suggested the need for improvements in CoAXs for non-technical audiences ("Still technical for average Joe"). Regardless of this isolated comment, the surveys results support the self-explanatory and more intuitive version of CoAXs, emphasizing the accomplishment in the Chilean testing context.

The surveys did not include specific questions regarding relative effects of utilizing the accessibility version, mainly because the experimental setting did not provide the chance to contrast its use with other versions of the tool (e.g., the point-to-point travel time version). However, some survey results provide indirect support for the use of the accessibility version. In term of usability, participants' survey responses mostly agreed about the good integration of CoAXs' functions (100% DM agree, 67% SH agree), which may support the accessibility version selection. Moreover, some comments from the debrief sessions specifically support the use of accessibility version. For example a SH noted that "In general the isochrone make sense" and a DM argued "Analyses are in general point to point, better by areas such as CoAXs."

Survey questions inquired about the types of opportunities that should be included in the accessibility measures. Specifically, participants were asked to rank the importance of potential types of opportunities (among Jobs, Health Care, and Education). The results indicate that, in general, participants highly ranked the opportunities included in the tool; while participants did mention other opportunities of potential interest, they tended to rank these as lower in importance compared to those in the tool. A general result of this analysis, comparing pre and post surveys, indicates that participants support in first place the need to represent Job opportunities, followed by Education opportunities, and then Health opportunities.

Regarding the public transport projects included in the tool, the surveys did not include questions for formally testing participants' preferences for projects included no comments were made in relation to including new projects or the existence of non-interesting ones. Nonetheless, pre- and post-workshop survey results strongly suggested project learning among participants, who enthusiastically tested scenarios and selected different projects according to their particular interests. Both survey results and participants' participation supported the project list and the scenario-creation tool feature.

6.1.3. Experiment Results

Participants' use of CoAXs was associated with changed perceptions, based on the results of pre- and post-workshop surveys. The following points support this finding:

- Pre-/post- results suggest a strong effect on reported self-learning about the projects among participants, supporting CoAXs' role in project learning;
- Similarly, pre-/post- results showed a relationship between using CoAXs and changes in participants' expected impacts of projects on different user groups and geographic scales; specifically, CoAXs was apparently capable of providing a better picture of potential impacts principally at the metropolitan scale and among public transport riders.
- Regarding the expectations of project impacts on overall goals and the value of accessibility metrics, counterintuitive results were obtained, with at least two explanations possible: ignorance about the concepts (accessibility) and/or poor survey design.

Post-workshop survey results suggested a strong agreement among participants regarding CoAXs Usability and Usefulness. The following points highlight some interesting results:

- Participants did not consider that CoAXs' results were unrealistic or inconsistent;
- Participants agreed with the user-friendliness of the tool
- Participants agreed with the idea of using CoAXs in their organizations and for training others; and,
- Participants were mostly confident using CoAXs.

Post-workshop survey results evidenced a direct relation between the use of CoAXs and potential value for public engagement. The following points highlight some interesting results:

- Participants agreed that CoAXs provides a useful environment for collaborative work;
- Participants agreed that CoAXs would support the kinds of conversations that the public needs to have about transport.

The research design and data collection (surveys, tool use assessment, and debrief comments) and analysis provide the opportunity to test the differences among the two groups. The following points describe some of the findings:

- The SH Group interacted more with CoAXs in comparison with the DM Group;
- In general, the DM Group more positively evaluated the use of CoAXs; and,
- Both groups focused primarily on tool improvements, rather than planning comments, in the discussion and suggestions.

6.2. Conclusions

The testing experience of CoAXs in Santiago contributed to broadening the understanding of how interactive visualization tools might improve the transportation planning process. More specifically, this thesis sought to answer two research questions, as presented in Chapter 1. The first question was about the implications of the use of CoAXs for improving public engagement and advancing to more effective transport planning. Several results from the testing experiment in Santiago suggest a relation in that direction. Representatives from the DM and SH groups, constant presences in the planning process in Chile, tested the tool and both positively evaluated its usefulness and usability in public settings. The majority of the participants of both groups highlighted the tool's ability to support conversations around transport planning issues, with high agreement. Likewise, participants mostly agreed about the capabilities of CoAXs to provide a "Common Ground" for collaborative work, which suggests that the interactive visualization generates a shared level of knowledge, encouraging collaborative work and helping to raise important issues for discussions. In addition to these capabilities, many participants also suggested that the tool greatly helped in imagining how travel is for others, which suggests some empathy created and which might encourage engagement with others. Survey questions also explored participant's attitudes around the testing experience itself. In this sense, both the DM and SH groups highly supported the environment created around CoAXs use; most participants agreed that CoAXs encourages open discussions, collaboration among participants, and creation of trust. All of these positive results associated with the use of CoAXs suggest hope for improving the public engagement process and advancing more effective transportation planning.

The second question in this thesis related to the possibilities for CoAXs to enhance metropolitan-scale discussions. Pre- and post-workshop survey results demonstrated that use of CoAXs by DM and SH participants in Santiago was associated with changes in relevant perceptions. Specifically, CoAXs use was associated with reported changes in expected effects of the included public transport projects, indicating a movement to a more "metropolitan-level" sense of impacts. This result was also corroborated by some comments during the debrief discussions. For example, a Decision Maker argued that CoAXs would be helpful to "Establish a global vision with one authority for the whole city". Nevertheless, the association between CoAXs and Metropolitanism is only an initial indication. First, the number of participants involved was quite small. In addition, the evidence of association does not indicate a cause-effect relationship (e.g., no control group). Future research is needed to provide more evidence to corroborate this result.

Finally, it is worth mentioning that the CoAXs Santiago application does demonstrate that good adaptation of the tool can enable the expansion of its use to different political and cultural environments, including in a developing country context.

6.3. Future Research

This research helps open the way for new research regarding the application of ABVT in Transport planning processes in a new context. In this regard, deepening the analysis into the relationships between CoAXs and perceived impacts on expanding the scales of planning discussions, such as at the metropolitan level, seems to be a natural next step. Ongoing efforts should center on adding new specific features to CoAXs with the objective of broadening the analysis scope. In this sense, developing features for regional analysis as part of the interface could be a positive contribution. Additionally, new features such as accessibility to destinations (i.e., the accessibility from possibly destinations, instead of possible origins), could contribute to further metropolitan analysis due to its closer relation with public policy development. For example, an accessibility-to-destination metric could be used to calculate the total number of households with access to a public facility – such as a hospital, park, or civic center– within a certain amount of time. Nonetheless, care needs to be taken in balancing enhanced features and deeper analysis with usability. Comments from SH participants revealed this challenge, for example, suggesting, on the one hand, the need for including more data for analysis, such as penalties for transfers or off-peak periods, while on the other hand, the need to simplify the tool interface because it is still "too technical."

Expanding this research to a broader audience could also be a source for new development. In this regard, applying CoAXs to an existing planning process should be the next step for examining its viability in a more real context. For the case of Chile, several instances could be appropriate for new testing, such as: Transport planning process of intermediate cities, developed by the Chilean Transport Planning Secretariat[26]; and updating municipal zoning codes, developed by the national governments' Urban Development Division[27] and the Municipalities.

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[26] www.sectra.cl

[27] www.minvu.cl

Appendix A

Pre-workshop and Post-workshop Survey

CoAXs - Santiago Workshops.

Nombre del Participante (código): _____

Fecha: _____

Parte #1

1. Conocimientos previos

1.1. **Después de escuchar la introducción del presente Workshop, ¿Cuán significativo cree usted que es el impacto de los proyectos de transporte presentados en cada uno de los grupos identificados abajo?**

Impactos en: (encierre en un círculo)	Impacto muy negativo	Impacto Negativo	Sin impacto	Impacto Positivo	Impacto muy positivo
Usted	1	2	3	4	5
Su barrio	1	2	3	4	5
Su comuna	1	2	3	4	5
El área Metropolitana de Santiago	1	2	3	4	5
Peatones	1	2	3	4	5
La gente que se transporta en bicicleta	1	2	3	4	5
La gente que viaja en auto particular	1	2	3	4	5
La gente que viaja en Transporte Público	1	2	3	4	5

1.2. **En referencia al concepto de accesibilidad, ¿Cuál de las siguientes variables cree ud. que es más importante para determinar la accesibilidad de las personas?**

Indique el ranking de 1 a 4, donde 1 es el más importante y 4 es el menos importante.

Accesibilidad a las salud	Rank:___
Accesibilidad al trabajo	Rank:___
Accesibilidad a la educación	Rank:___
Escriba otra_____	Rank:___

1.3. En que medida ud. esta de acuerdo o no con los siguientes enunciados.

(encierre en un círculo)	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
Los proyectos permitirán avanzar de forma importante en el mejoramiento del transporte.	1	2	3	4	5
Los proyectos ayudarán a mejorar otros aspectos de la planificación urbana (medioambiente, educación, etc).	1	2	3	4	5
Comprender la accesibilidad de las personas es un buen dato para hacer mejores políticas de transporte	1	2	3	4	5
Comprender la accesibilidad de las personas es un buen dato para fomentar la discusión en torno a los impactos de los proyectos de transporte y la participación ciudadana	1	2	3	4	5

1.4. Respecto de los conocimientos adquiridos durante la introducción de este Workshop y su experiencia anterior, ¿cuán de acuerdo o en desacuerdo se siente respecto de los siguientes enunciados?

(encierre en un círculo)	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
He aprendido bastante acerca de los proyectos presentados	1	2	3	4	5
Yo podría describir los proyectos presentados a un amigo o colega.	1	2	3	4	5
Yo podría describir los impactos de los proyectos a un amigo o colega.	1	2	3	4	5
Yo tengo el conocimiento suficiente para debatir acerca de estos proyectos y sus impactos.	1	2	3	4	5

Parte #2

2. Uso de la Herramienta

2.1. Luego de usar la herramienta y en relación a sus respuestas de la pregunta 1.1, ¿Cuánto cambio su percepción del impacto de los proyectos de transporte en cada uno de los grupos identificados abajo?

Cambios en Impactos en: (encierre en un círculo)	Significativamente menor impacto	Menor impacto	Mismo impacto	Mayor impacto	Significativamente mayor impacto
Usted	-1	-2	0	+1	+2
Su barrio	-1	-2	0	+1	+2
Su comuna	-1	-2	0	+1	+2
El área Metropolitana de Santiago	-1	-2	0	+1	+2
Peatones	-1	-2	0	+1	+2
La gente que se transporta en bicicleta	-1	-2	0	+1	+2
La gente que viaja en auto particular	-1	-2	0	+1	+2
La gente que viaja en Transporte Público	-1	-2	0	+1	+2

2.2. En referencia al concepto de accesibilidad y luego de utilizar la herramienta, ¿Cuál de las siguientes variables cree ud. que es más importante para determinar la accesibilidad de las personas?

Indique el ranking de 1 a 4, donde 1 es el más importante y 4 es el menos importante.

Accesibilidad a las salud	Rank:___
Accesibilidad al trabajo	Rank:___
Accesibilidad a la educación	Rank:___
Escriba otra_____	Rank:___

2.3. Luego de usar la herramienta y en relación a sus respuestas de la pregunta 1.3, ¿en qué medida usted está de acuerdo o no con los siguientes enunciados?

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
Los proyectos permitirán avanzar de forma importante en el mejoramiento del transporte.	1	2	3	4	5
Los proyectos ayudarán a mejorar otros aspectos de la planificación urbana (medioambiente, educación, etc).	1	2	3	4	5
Comprender la accesibilidad de las personas es un buen dato para hacer mejores políticas de transporte	1	2	3	4	5
Comprender la accesibilidad de las personas es un buen dato para fomentar la discusión en torno a los impactos de los proyectos de transporte y la participación ciudadana	1	2	3	4	5

2.4. En relación a la experiencia adquirida en el workshop y con el uso de la herramienta, ¿en qué medida ud. está de acuerdo o no con los siguientes enunciados?

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
He aprendido mucho acerca de los proyectos presentados	1	2	3	4	5
Yo podría describir los proyectos presentados a un amigo o colega.	1	2	3	4	5
Yo podría describir los impactos de los proyectos a un amigo o colega.	1	2	3	4	5
Yo tengo el conocimiento suficiente para debatir acerca de estos proyectos y sus impactos.	1	2	3	4	5

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
Tuve la oportunidad de recibir respuestas a las preguntas que tuve	1	2	3	4	5
Los participantes discutieron de manera amena y abierta	1	2	3	4	5
Los otros participantes demostraron interés en mis opiniones	1	2	3	4	5
Los puntos de vista alternativos fueron escuchados	1	2	3	4	5
Apoyaría los comentarios y recomendaciones que se generaron en el grupo	1	2	3	4	5

2.5. Por favor evalúe la utilidad de la Herramienta CoAXs, señalando cuan de acuerdo esta o no, con los siguientes enunciados.

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
Me parecería valioso utilizar CoAXs en mi organización.	1	2	3	4	5
Me parecería valioso utilizar CoAXs para capacitar a los miembros de mi organización.	1	2	3	4	5
Si esta herramienta fuera ampliamente utilizada, seria capaz de motivar los tipos de conversación que se necesitan en el ámbito de la Planificación de Transporte.	1	2	3	4	5

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
CoAXs distrae a las personas	1	2	3	4	5
CoAXs provee un entorno ameno y útil para el trabajo colaborativo	1	2	3	4	5
CoAXs ayuda a levantar importantes aspectos para la discusión	1	2	3	4	5
CoAXs presenta resultados poco realistas o alejados de la realidad	1	2	3	4	5
CoAXs me permitió pensar en alternativas para mis viajes	1	2	3	4	5
CoAXs me ayudo a imaginar como son los viajes de otros	1	2	3	4	5

2.6. Por favor evalúe la facilidad de uso de CoAXs, señalando cuan de acuerdo está o no, con los siguientes enunciados.

	Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Muy de acuerdo
Si la tuviera disponible, yo creo que utilizaría CoAXs frecuentemente	1	2	3	4	5
Me pareció que CoAXs era innecesariamente complicada	1	2	3	4	5
Yo pensaba que CoAXs era fácil de usar	1	2	3	4	5
Yo creo que necesitaría de un técnico para utilizar CoAXs	1	2	3	4	5
Me pareció que las distintas funciones de CoAXs estaban bien integradas y eran entendibles	1	2	3	4	5
Yo pienso que había demasiada inconsistencia en CoAXs	1	2	3	4	5
Yo creo que la mayoría de las personas aprendería a utilizar CoAXs rápidamente	1	2	3	4	5
Yo creo que CoAXs es una herramienta engorrosa	1	2	3	4	5
Me sentí seguro utilizando CoAXs	1	2	3	4	5
Siento que necesito aprender muchas cosas antes de poder utilizar adecuadamente CoAXs	1	2	3	4	5

Appendix B

Usted ha sido invitado a participar en un estudio de investigación del Departamento de Estudios Urbanos y Planificación del Instituto Tecnológico de Massachusetts, con la colaboración de la Universidad Católica de Chile (PUC) a cargo del investigador Cristian Navas Duk. Los resultados de este estudio podrían ser utilizados en una tesis, un artículo científico o un informe del MIT o de la PUC. Es importante leer la información del presente documento y hacer preguntas sobre cualquier punto que no se entienda o comprenda antes de decidir si participa o no de la investigación.

- **PARTICIPACION Y RENUNCIA**

Su participación en este estudio es completamente voluntaria y usted está en derecho de elegir si participar en él o no. Si usted decide participar en este estudio, puede renunciar posteriormente en cualquier momento sin sanción ni consecuencias de ningún tipo. El investigador puede retirarlo de esta investigación si surgen circunstancias que lo justifiquen.

- **PROPOSITO DEL ESTUDIO**

El propósito de este estudio es evaluar un software de planificación de transporte público. El software estará disponible para su uso en una pantalla táctil que permite a los participantes comparar proyectos o escenarios y evaluar cómo éstos podrían afectar el transporte de la ciudad a escala local o regional. El objetivo es evaluar cómo esta herramienta de software facilita el aprendizaje colaborativo y la toma de decisiones para temas de política pública y planificación de transporte. Específicamente, esperamos entender si esta herramienta mejora el entendimiento de los impactos de los proyectos o escenarios desde una perspectiva más amplia.

- **PROCEDIMENTO**

Si usted está dispuesto a participar de la investigación, le pediremos que haga lo siguiente:

1. Seguir atentamente la introducción referida al uso de la herramienta.
2. Llenar la encuesta inicial
3. Trabajar en un grupo pequeño (6 a 10 personas) para explorar el uso de la herramienta y los diferentes proyectos que presenta.
4. Participar en la discusión con el grupo en referencia a lo útil o no que fue el uso de la herramienta.
5. Llenar una encuesta final
6. Facilitar cualquier feedback referido a la herramienta.

Este taller debe durar entre 1-2 horas, periodo durante el cual el investigador principal permanecerá en la sala del taller.

La información y las opiniones obtenidas en este taller no serán individualizadas en la investigación con el objetivo de salvaguardar su información personal. Sin embargo, tenga en cuenta que estaremos tomando notas sobre las conversaciones e interacciones que se generen en el marco del taller.

Por favor, consulte acerca de cualquier duda o inquietud antes de decidir si participará o no de la investigación.

- **RIEGOS POTENCIALES**

Si tiene preguntas o inquietudes sobre el estudio, comuníquese con el investigador principal (la información se encuentra al final de este formulario). Si experimenta cualquier efecto adverso (mental o físico) durante o después del estudio, por favor informe al investigador principal inmediatamente.

En referencia a la información, se han tomado las siguientes medidas para minimizar cualquier riesgo asociado a posibles invaciones de privacidad:

- Todos los datos estarán vinculados únicamente a códigos alfanuméricos que lo identificar a usted y a los demás participantes. No se utilizarán identificadores personales en la investigación.
- Cualquier archivo en el que recopilamos información estará vinculado a un identificador codificado en lugar de un nombre personal. Los nombres de los archivos serán codificados y no serán identificables por el usuario.
- Todos los datos del experimento se almacenarán en un servidor seguro y de acceso restringido accesible únicamente al investigador principal y al profesor patrocinante.

- **BENEFICIOS POTENCIALES**

No se esperan beneficios directos para usted por su participación en este taller, sin embargo su participación podría ayudar a mejorar el diseño de una herramienta que puede mejorar los futuros procesos de planificación de transporte.

- **PAGO POR PARTICIPACION**

No se ofrece ningún pago por participar en los talleres.

- **CONFIDENCIALIDAD**

Cualquier información que se obtenga en relación con este estudio y que pueda identificarse con usted permanecerá confidencial y será revelada solo con su permiso o según lo requiera la ley. Además, la información puede ser revisada por representantes autorizados del MIT para asegurar el cumplimiento de las políticas y procedimientos del MIT.

Se establecen varias medidas para evitar la invasión de la privacidad:

- Cualquier dato será borrado inmediatamente a su solicitud.
- Todos los datos estarán vinculados únicamente a identificadores codificados que lo identificarán a usted y a los demás participantes. No se guardará ningún identificador personal.
- Cualquier archivo o información estará vinculado a un identificador codificado en lugar de un nombre personal explícito. Los nombres de los archivos serán codificados y no serán identificables por el usuario.
- Este estudio finalizará en septiembre de 2017. Todos los datos del taller y del experimento se almacenarán en un lugar seguro y de acceso restringido, accesible sólo al investigador principal y al patrocinador de la facultad hasta un año después del final del estudio. Después de ese período, toda la información será destruida.

- **IDENTIFICACION DE LOS INVESTIGADORES**

Si tiene alguna pregunta o inquietud sobre la investigación, no dude en ponerse en contacto con:

Investigador Principal

Cristian Navas – cnavasd@mit.edu +1 857 930 9066

Patrocinador de la Facultad

Dr. Chris Zegras – czegras@mit.edu +1 617-452-2433

- **DERECHOS DE LOS INDIVIDUOS SUJETOS A INVESTIGACION**

Usted no renuncia a reclamos legales, derechos o recursos debido a su participación en este estudio de investigación. Si considera que ha recibido un trato injusto o si tiene preguntas sobre sus derechos como sujeto de investigación, puede comunicarse con el Presidente del Comité sobre el Uso de Humanos como sujetos experimentales, MIT, Sala E25-143B, 77 Massachusetts Ave, Cambridge , MA 02139, teléfono 1-617 - 253 6787.

FIRMA DEL INDIVIDUO O REPRESENTANTE LEGAL

Entiendo los procedimientos descritos anteriormente. Mis preguntas han sido contestadas a mi satisfacción, y estoy de acuerdo en participar en este estudio. Me han dado una copia de este formulario.

_____

Nombre del Individuo y Firma

_____

Nombre del Representante Legal (si aplica)

_____   _____

Firma del Representante Legal   Fecha

FIRMA DEL INVESTIGADOR

A mi juicio el individuo voluntariamente y conscientemente da su consentimiento informado y posee la capacidad legal de dar su consentimiento informado para participar en este estudio de investigación.

_____   _____

Firma del Investigador   Fecha

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