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Participatory Backcasting for Sustainable Transport Policy in Lima and Callao

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc Transport and City Planning at University College London: I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

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Abstract

The backcasting approach is gaining prominence in the field of transport planning as a way of exploring scenarios to achieve desirable visions. Embracing a collaborative approach, participatory backcasting includes a broad variety of actors to explore ways of achieving goals in situations of high uncertainty. This approach is suitable to address the complex challenges of transport planning in cities in the Global South where disorganized growth and periods of socio-political instability have led to conflicting city structures and severe mobility issues.

This dissertation presents an innovative bottom-up, participation-oriented, backcasting approach for sustainable transport policy in Lima and Callao, in Peru. For this purpose, a methodology was developed from other existing participatory backcasting approaches. It conducted a series of semi-structured interviews with a wide range of stakeholders in the transport sector and consisted of five distinctive phases: (i) context setting; (ii) visioning; (iii) Policies and initial packaging; (iv) policy packaging and pathways; and (v) validation. The results outline the drivers and trends affecting transport in Lima and Callao and illustrates a desirable vision common to all participants. It also does a process of policy packaging and explores two scenarios based in institutions as a source of uncertainty. This document discusses the related literature, describes the methodology, outlines the results of the process, and then it reflects in its usefulness.

1. Introduction

The grand challenges of sustainability require a new paradigm for transport planning (Willson, 2001). This goes hand in hand with the realisation that collaborative approaches are useful for dealing with highly complex problems such as those related to transport planning (Tornberg and Odhage, 2018). Future studies have also emerged as a method for finding solutions to this kind of problems. Specifically, participatory backcasting studies are gaining prominence, as they merge collaborative rationalities and a focus in shared knowledge to better understand opportunities to attain sustainable transport. However, the meaning of sustainable transport can be interpreted in different ways (Hickman and Vecia, 2016). This is especially true in cities of the Global South, specifically in Lima, Peru where disorganized growth and periods of socio-political instability have led to a conflicting city structure and severe mobility issues (Vasconcellos, 2001). The transition toward a more sustainable and healthier city demands long-term thinking and participation.

This dissertation aims at conducting a backcasting process for sustainable transport policy towards 2050 in the conurbated area of Lima and Callao in Peru. The study develops a novel methodology which touches both transport research and practice, and involves a large variety of stakeholders in the transport sector. It explores the trends and drivers that can influence the development of transport, constructs a vision of sustainable transport for the city and examines the means by which that future can be achieved.

The dissertation will focus in outlining the backcasting process and its most important findings. It is structured as follows. Section 2 presents a revision of the literature about changing rationalities in transport planning and describes the main characteristics of the backcasting approach, including its call for participation, the process of policy packaging and the development of policy pathways. Section 3 describes the background of the case study, while Section 4 details the proposes novel method for backcasting. Section 5 outlines the empirical process and presents the findings. Finally, Section 6 presents the conclusions.

2. Literature review

2.1. Transport planning rationalities

The relation between rationality and planning is in the core of the planning literature (Tornberg and Odhage, 2018). Defining it as the application of reason to transform beliefs into knowledge, decisions and actions, Alexander (2000) identifies no less than 26 variations of rationality that can be applied to planning. Among all those variations, instrumental rationality is one of the most prominent, as it has been dominant in the planning practice (Alexander, 2000) and specially in transport planning (Vigar, 2017). The logic of instrumental rationality is limited to means, and its main purpose is to find optimal solutions when goals are predefined (Alexander, 2000). Precisely, this optimisation approach is argued to be one of the most distinctive features of technocratic transport planning (Banister, 2002).

There is an important and emerging body of literature that criticises transport planning based in instrumental rationality (see Willson, 2001; Bertolini, 2007; Innes and Booher, 2010; Vigar, 2017; Tornberg and Odhage, 2018), deeming it inefficient in addressing highly complex problems. As a response, collaborative approaches that are based on stakeholder participation have emerged as a strategy to better address those problems (Innes and Booher, 2010). Collaborative or communicative rationality argues that knowledge is socially created in the interplay between actors and enables the sharing of learning as part of the process Tornberg and Odhage, 2018). In this sense, it "addresses both means and ends and links transport issues to broader social concerns" (Willson, 2001, p.16), allowing the framing of problems based on different forms of knowledge.

In a collaborative planning approach, the role of the planner is to facilitate participation of actors representing different areas of expertise and perspectives, making sure everyone has the chance to express without constrains (Alexander, 2000). While Tornberg and Odhage (2018) recognise that transport planning based in instrumental rationality can be useful in cases where the problem is clearly defined and the goal is uncontested, Marsden and Reardon (2017) conclude that it can result in "policy making that is unlikely to be applied because of the distance between it and the realities on the ground" (p.245). This is what Banister and Hickman (2013) have called the 'implementation gap', calling for more participation of different stakeholders in the context of future studies.

2.2. Scenario studies and backcasting

Future studies provide various methods for developing strategies and pathways towards more sustainable futures (Robinson, 1990). In general, three categories of future scenarios can be distinguished based on the questions they answer.
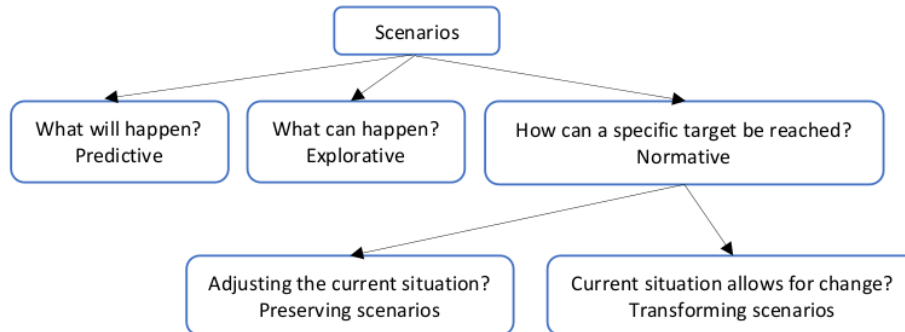
Figure 1 Scenario categories and questions. Based in Böjerson et al., 2006

Normative scenarios, or visions, can be defined as 'a heuristic device for problem defining and solving; a stable frame for target setting and monitoring progress; a narrative for bringing together resources" (Berkhout, 2006, p.305). These scenarios address the inability of forecasting approaches to handle situations of high uncertainty, where trends are going in the wrong direction and the current structure of the system is part of the problem (Banister and Hickman, 2013; Böjerson et al., 2006). This is central to transforming scenario studies, such as backcasting.

The main characteristic of backcasting "is a concern, not with what futures are likely to happen, but with how desirable futures can be attained" (Robinson, 1990; p.3). According to Dreborg (1996), backcasting is particularly useful for highly complex problems; when there is a need for major changes, when dominant trends and externalities are part of the problem and when the scope and time-horizon involved are broad enough to leave room for the development and implementation of a variety of alternatives. It has a quite long-time perspective of 25-50 years (Robinson, 1990). Instead of parting from the present conditions to predict the future, as forecasting does, backcasting imagines a desirable future and works backwards to find out the measures that would be needed to achieve it. In this sense, the term 'scenario' includes both the vision of the future and the discussion of the paths to reach the vision (Hickman and Banister, 2013, Böjerson et al., 2006).

Backcasting has gained prominence in transport research in the past 20 years, especially on the topics of climate change mitigation (Hickman and Banister, 2007; Banister and Hickman, 2009,

2013; Tuominen et al., 2014), sustainable mobility policy (Banister et al., 2000; Soria-Lara and Banister, 2017a, 2017b; Olsson et al., 2014) and now electric mobility (Zimmermann et al., 2012). Following a collaborative approach, backcasting is part of the reorientation of transport planning to a form of reasoning based in a wider discussion in the context of major modern sustainability challenges (Willson, 2001).

An overview of the literature shows that there is a wide variety in backcasting methodologies, as described by Quist (2007) and Fernandez and López (2016). For instance, there are notorious
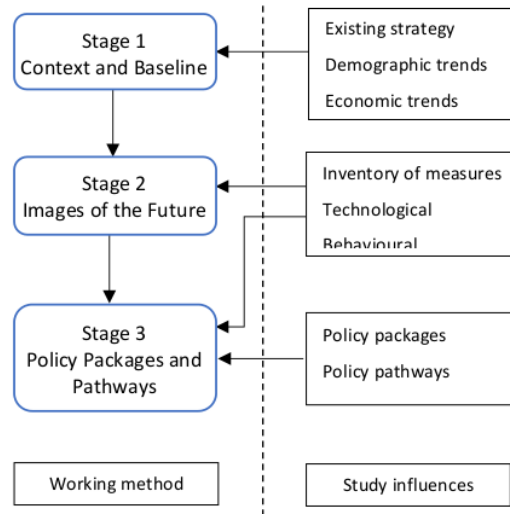
Figure 2 Backcasting process. (Banister and Hickman, 2013)

differences in stakeholder involvement, number of steps of the methodology, number of visions constructed, and if the focus is on learning among stakeholders, or on realising implementation. Despite the differences, Banister and Hickman (2013) clearly identify three stages in the backcasting process (Figure 2). It is important to note that although it is depicted as linear, it is not, as it is a dynamic process where iterations are possible, which also means that some stakeholders may leave the process and new ones might join (Quist and Vergragt, 2006).

While the literature agrees that the methodology for backcasting should accommodate the context and aims of the study (Quist et al, 2011; Zimmermann et al., 2012), two types of backcasting studies are of interest (Wangel, 2011): result-oriented backcasting, when the resulting scenario constitutes the main aim, and participation-oriented backcasting, when the procedural benefits of scenario development are prioritized over the outcomes. Furthermore, the processes can be divided into bottom-up approaches, where the selected actors and discussions constitute the different models of visioning; and top-down approaches, which start

with the visioning and then let these determine which actors and discussion to include (Soria-Lara and Banister, 2017a).

Regarding the number of visions, Quist et al. (2011) points that in participatory backcasting only one vision might be sufficient and even advisable, as multiple visions may "constrain the degree of guidance and orientation" (p.894) specially if the focus of the exercise is in learning, as in participation-oriented backcasting.

2.3. Participation in backcasting

The benefit of including stakeholders in future studies is that it enables the access to their reasoning and heuristic knowledge. Its aim is neither consensus nor to reach an accurate prediction of the future, it seeks to find alternatives, opportunities, drivers, interlinkages and inspire discussion (Varho and Huutoniemi, 2014). Quist et al. (2011) argue that participatory backcasting experiments acts as a space where ideas can be articulated and discussed, which stimulates higher learning among stakeholders and may not only result in increased awareness, but also lead to better understanding of opportunities and guide their behaviour, taking advantage of their multiple resources and knowledge.

Furthermore, Zimmermann (2012) concludes that participants in backcasting often lack ownership of the visions, and therefore their commitment to engage in the planning and implementation of viable solutions is affected.

2.4. Policy packaging and pathways

Holistic thinking in transport planning requires an integrated approach to policy measures. In this sense, a combination of complimentary measures and coordinated action is needed (Tuominen et al., 2014). Policy packages can be defined as groups of individual measures designed to address one or more objectives "created in order to improve the effectiveness of the individual policy measures, and implemented while minimizing possible unintended effects" (Givoni et al., 2013,p.3). The rationale behind policy packaging is that individual measures may have limited impacts as the scale of change needed is too large (Banister et al., 2000; Givoni et al., 2013).

May et al. (2005) describe five ways in which integration of policy instruments can occur within a policy package: (i) integration between measures involving different modes; (ii) between measures of infrastructure, management, information and pricing; (iii) between transport and land use measures; (iv) with other policy areas such as health and education; (v) between authorities in a conurbated area. The same authors argue that, in general, approaches to

packaging can follow two principles: pursuing synergies and removing barriers. The pursuit of synergy requires finding measures that reinforce each another; while removing barriers involves identifying factors that hinder implementation, and using other measures to overcome them. Furthermore, the removal of barriers could be done in three ways: improving feasibility of measures, improving acceptance and compensating the losers May et al. (2005).

It is not uncommon that in transport policy making only a limited amount of policy options is considered because of institutional inertia (Kelly et al., 2008). The effectiveness of packages rely on the variety of measures and the understanding of their interrelations, which could be of pre-condition, synergy or contradiction (Givoni et al., 2013). In this area, (Kelly et al., 2008) recognise that there is a lack of information on interactions of policies and policy packages to harness real synergies and avoid unwanted effects.

Policy packages can vary greatly depending on the context (Tuominen et al., 2014)). Backcasting exercises and policy packaging in transport has been developed in Spain (Soria-Lara and Banister, 2017b), the UK (Hickman and Banister, 2007), Sweden (Åkerman and Höjer, 2006), and Finland (Tuominen et al., 2014). Also, Hickman et al. (2014) developed policy packages in Auckland, but with an exploratory scenario approach. It is notable that no application to a city in the Global South could be found during the extensive literature review.

Following the policy package, the next stage is to develop policy scenarios or policy paths from the present to the future. The generation of successful pathways is based on harnessing synergies contained in the policy packages (Banister et al, 2016) and relies on the timing of implementation of the individual measures (Givoni et al., 2013). "Paths are based on a combination of elements where some can be chosen while others cannot and this process involves uncertainty" (Banister et al., 2000, p.162), consequently, 'lock-in' to specific scenarios is avoided in order to have sufficient manoeuvrability in implementation in face of this uncertainty (Banister et al, 2016). The construction of paths is an integral part of the backcasting process, as it materialises the previous phases and allows the development of innovative solutions. Despite they will unlikely be blueprints for the future, pathways need to be distinctive and represent plausible scenarios (Banister and Hickman, 2013).In this sense, the involvement of stakeholders in developing and validating the pathways is important as they are aware of opportunities and barriers for implementation and it helps in bringing the debate form discussion to action (Banister et al, 2016).

3. The Case of Lima and Callao

The city of Lima is the capital of Peru. Its metropolitan area surrounds the region of Callao, forming a conurbation with 50 different districts and 9.5 million inhabitants (INEI, 2018). Callao does not only constitute part of the urban structure of the city; it is also of great economic importance as it hosts the international airport and main port of the country. Given the nature of this conurbation, throughout this document every mention of the city will be referring to both Lima and Callao.

The city is the centre of major socio-economic and political processes, as it produces 46% of the country's GDP, mainly in the manufacture and service sectors (Villar, 2019).

Around 24 million commutes are made every day (JICA, 2013) in a fragmented transport system composed of one BRT line, one over ground metro line and a mixture of hundreds of formal and informal bus routes. In addition, thousands of unregulated rickshaws and taxis circulate freely. 74% of all trips are made in some sort of public transport, 10% by active modes and only 16% is made in personal vehicles (LCV, 2018).

The city has a very centralised structure (Moschella, 2014) with much of the main activities concentrated in its centre. It faces severe issues of mobility and inadequate infrastructure. The main transport related issues are staggering traffic casualties, low-quality public transport, crippling congestion and pollution (Jauregui et al., 2019).

While there have been some efforts and plans to tackle specific issues, these have fallen short in implementation. In general, transport strategies rely heavily on technological improvements (PlanCC, 2014); while the practice of transport planning focuses mostly in demand modelling (JICA, 2005, 2013), and usually results in a set of specific infrastructure projects with little stakeholder involvement and unclear criteria of appraisal (Bonifaz and Aparicio, 2013; IMP, 2012; Municipalidad de Lima, 2016).

When talking about transport in the city it is possible to identify different competing discourses about the nature of problems and the proper objectives that interventions should address. On the one hand, various authors have argued that the rationalities of transport planning in Lima are grounded in faulty assumptions (Alegre, 2016; Fundación Transitemos et al., 2013; Stucchi, 2016), while on the other, up to very recently, the local government's intention was to build eighteen underpasses as a solution for congestion (Benza, 2016). This discussion recently materialized in the cancellation of projects to increase road capacity commissioned by the last

administration, deemed ineffective by the current metropolitan mayor (Sovero, 2019; Gestión, 2018).

There is an agreement among the literature that the transport problems in the city are a result of, and also exacerbated by, a feeble institutional structure (Poole, 2018; Alegre, 2016), lack of political commitment to planning (Jauregui et al., 2019), and absence of an overarching transport policy framework (Proexpansión, 2008; Fundación Transitemos et al., 2013). About this, Jauregui et al. (2019) conclude that, because of some optimal characteristics, the city could develop a more sustainable transport if it were to have effective governance structures and political commitment.

Within this context, a new single authority for transport is currently being created. This entity is expected to centralize transport planning and management in the city and boost professional capacity in the sector, eliminating the previous fragmented governance structure. With this new authority in Lima, there is a consensus that it represents an opportunity to improve strategic planning and move away from previous chronic problems.
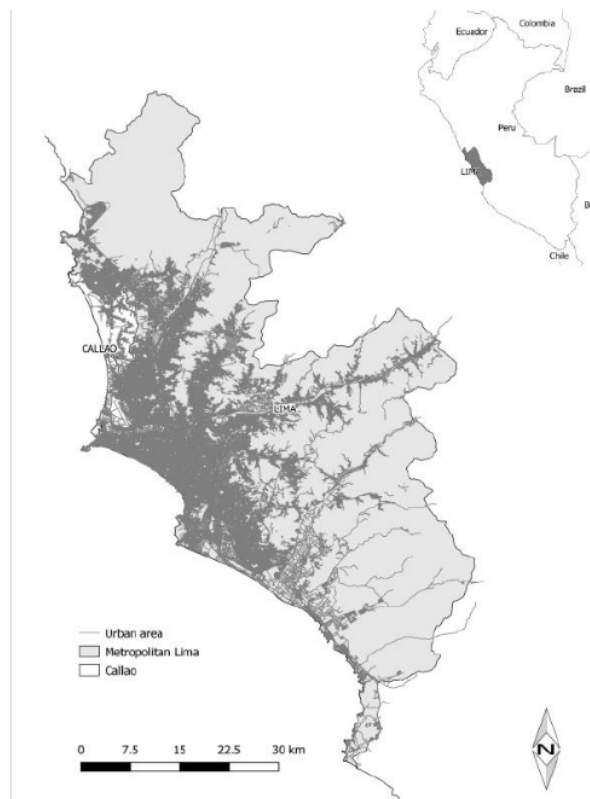
Figure 3 Case study location.

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4. Research design and Methodology

4.1. Research questions

This research aims to conduct a participation-oriented, bottom-up backcasting process for sustainable transport policy in Lima and Callao towards 2050. This year was chosen as it fits the long-term approach of the backcasting exercise described before, and coincides with other local studies (CEPLAN, 2019b; PlanCC, 2014).

Specifically, the research poses the following questions:

- RQ1: What are the drivers and trends that can influence the development of urban transport?

- RQ2: What is a desired vision of sustainable transport common to various stakeholders involved in the sector?

- RQ3: What are the policy measures that can lead to achieve that vision?

- RQ4: What are the policy paths that can lead to that vision?

- RQ5: How can a participatory backcasting process be applied to transport planning in that context?

4.2. Method

This research proposes a novel methodology to answer each research question (see Figure 4). It is structured in five distinctive phases that combine transport practice and research: (i) Context setting; (ii) Visioning; (iii) Policies and initial packaging; (iv) Policy packaging and pathways; and (v) Validation.

The method is based on the overall approach of Banister et al. (2000) and the methods developed by Zimmermann et al. (2012) and Soria-Lara and Banister (2017b).

4.2.1. Phase 1: Context setting

In order to understand the context of the study area, a literature review of the issues, drivers and trends of urban transport was carried out. Due to the long-term approach, other wider social, economic and technological trends were also reviewed.

Two extra interviews were also part of this phase, one with an academic well-familiarised with the institutional model of transport planning in Lima and other with an expert with extensive experience within public transport planning agencies. These interviews were carried out during Phase 3, as the topic of institutions were becoming more prominent and more insight was needed. The interviews are included as part of Phase 1 as their goal is the same.

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4.2.2. Phase 2: Visioning

While backcasting approaches often use focus groups and workshops, these techniques can introduce group inefficiencies[1] that may affect the trustworthiness and transparency of the results (Zimmermann et al, 2012). To eliminate these, Delphi techniques are often used. Delphi is a survey technique "for structuring a group communication process so that the process is effective in allowing a group of individuals […] to deal with a complex problem" (Linstone and Turoff, 1975, p.621). However, the Delphi method has been criticised for the high drop-out rates and inability to deepen the content of the responses (Gnatzy et al, 2011).

Given the contested nature of planning in Lima and Callao and the need for more detail on the perspectives of participants, semi-structured, in-depth interviews were used. The in-depth interview "is a technique designed to elicit vivid pictures of the participant's perspective on a research topic" (Mack et al., 2005, p.29) and are more suitable for attaining detailed views of individual participants (Zimmermann et al, 2012). The quality of answers is superior as there is flexibility to ask detailed questions in response to relevant replies (Soria-Lara and Banister, 2017a) and they are less likely to be influenced by group dynamics. The interviews were individual and anonymous in order to encourage participants to feel more comfortable making judgements on uncertain complex issues (von der Gracht, 2012).

Based on Zimmermann et al. (2012), a survey instrument was developed to structure the interview (Appendix A). This instrument resembles those used in Delphi studies, and here also lies the innovation of this study. It presented a set of future projections on which a vision could be constructed. The projections were developed from the findings of Phase1 and covered relevant and challenging issues about transport and planning in Lima and Callao. Following the conclusion of Soria-Lara and Banister (2017a), the instrument also included projections about general topics in order to familiarise participants with the exercise of visualising desirable futures and contextualising the subsequent projections.

Participants had to assess the expected probability and desirability of each projection being true on a 0-100%-scale (probability) and on a 1-5 Likert-scale (desirability). In the scale, a value of 1 was considered completely undesirable; 2 was somewhat undesirable; 3 was considered neutral; 4, somewhat desirable; and 5, completely desirable. Furthermore, participants could support their quantitative assessment by giving qualitative arguments.

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[1] Such as the "bandwagon" effect, which refer to people adopting the view of the majority.

The interview was structured in the following way. First, they had to assess the set of general projections. Secondly, they were asked, in their personal view, which were the objectives for urban transport towards 2050 in the economic, social, environmental and institutional dimensions. The latter was included given the importance of institutions for the case study identified in Phase 1 and following 'the prism' model of sustainable development (Spangenberg, 2004; Turcu, 2013). It was important to let participants formulate their own objectives in order to increase their ownership of the vision (Zimmermann et al. 2012). Finally, participants had to assess the set of projections related to transport and planning. The interviews lasted approximately 50 minutes.

After the first phase of interviews the objectives and projections were aggregated into the vision. To aggregate the objectives, the data was coded in an iterative process using grounded theory, as described by Glasser and Strauss (1967). The projections that were rated more desirable were turned into the desirable vision and the undesirable projections were changed in their meaning. Contested projections were not included.

4.2.3. Phase 3: Policies and initial packaging

This phase first required a comprehensive review of relevant literature to develop a list of wide-range policy measures.

The participatory part of Phase 3 was operationalised through semi-structured interviews as well. In this case, a different survey instrument was developed.

First, the objectives and desirable vision developed in the previous phase were presented, and participants were asked if it reflected their personal vision. They were later asked to select from a list of measures the ones they thought were most relevant to achieve the vision, independently of the timing of implementation. Next, they rated and discussed the political and financial feasibility, responsibility and timescale of implementation and effects of the selected measures. Political feasibility referred to the possibility that the measures would be implemented without paying attention to financial issues, focusing on issues such as ease of implementation, social acceptance, etc. On the other hand, financial feasibility denotated the possibility that implementation would be affected by their costs (Soria-Lara and Banister, 2017b). Both assessments were done in a 5-point Likert-scale.

Participants were thirdly asked to look at the feasibility levels they had assessed, think about the factors behind those ratings and come up with groupings of measures that could improve their overall feasibility and implementation (Givoni et al., 2013). This process refers to the

principles of packaging found in May et al. (2005). Finally, participants were asked about the barriers they considered most important to achieve the vision and implement the policy packages they had selected. Responses in this phase were also coded in a grounded way.

4.2.4. Phase 4: Policy packaging and pathways

The initial packaging and comments from participants were the inputs for the packaging process. It followed both a systematic approach based on the desirable vision, and an intuitive and inductive approach based on the comments from participants and guidelines from the literature (Givoni et al., 2013, Soria-Lara and Banister, 2017b). Packages had to be convincing as a group, address a delimited issue and provide a significant contribution to a perceived problem raised in Phases 1, 2 and 3 of this study. They also had to have mixed impact on different groups of stakeholders and a fair range of policy orientations.

Several packages were then combined into pathways. Following Banister et al (2000), they were constructed in the basis of uncertainty, therefore, a contextual element with high impact in the development of transport in the future was selected.

4.2.5. Phase 5: Validation

It was seen important to validate the overall rationale of the study and the pathways generated since the backcasting study deals with complex systems and involves various perspectives from different participants. Also, it is a way of getting ratification from the same stakeholders that were part of the process and starting the dissemination of the project results. The following aspects were validated:

1. The overall methodology
2. The policy paths and the consideration of institutions as a determinant aspect in the future
3. The overall conclusions

All interviews were done via video chat, in which only audio was recorded for later analysis. The empirical work was completed during the summer of 2019.

Finally, the research method is represented in Figure 4.
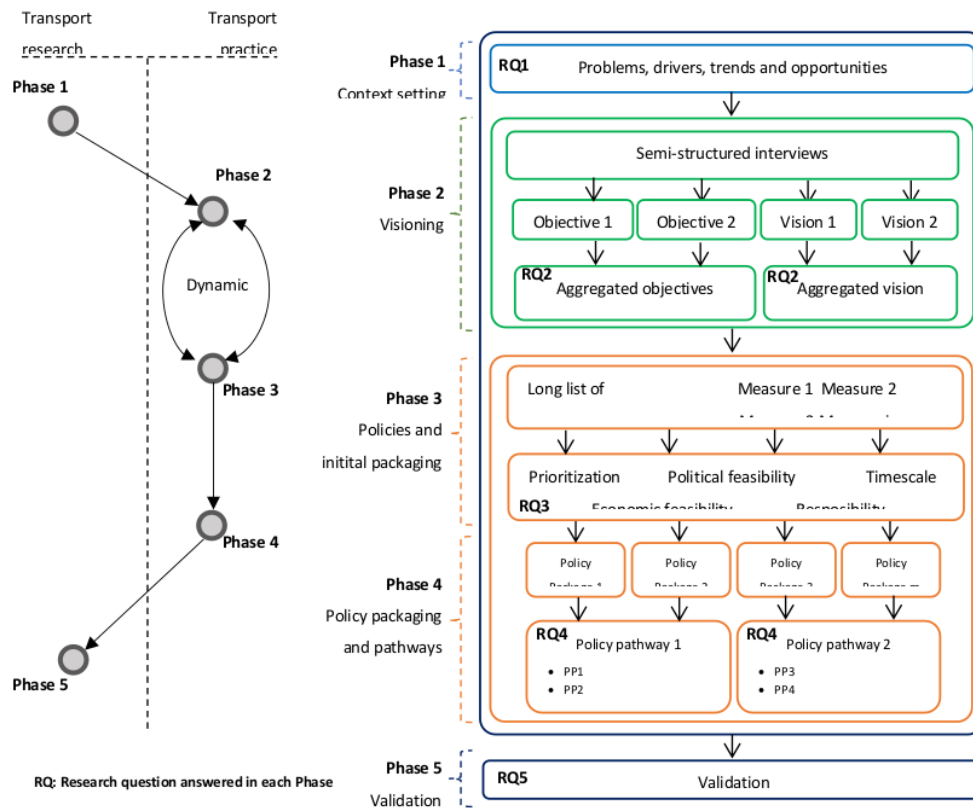
Figure 4 Research method. Inspired by Soria-Lara and Banister (2017b)

4.3. Selection of participants

The quality of a participatory process depends to great extent of the composition of the participants. However, is a task that cannot be achieved through a straightforward methodology (Varho and Huutoniemi, 2014), rather, it has to be tailored to the context and aims of the exercise Wangel (2011).

Several authors call for a combination of different profiles and generations of participants (Soria-Lara and Banister, 2017a; Tuominen et al., 2014) Therefore, this study used a plurality policy (Kuusi, 1999), the aim is to include disruptive ways of framing the transport problem and take more creative solutions into consideration.

A total of 44 invitation emails were sent to people of different stakeholder group, all related to transport and city planning research and practice. A total of 23 participated in this study, an

expertise matrix was used to ensure adequate diversity (see Appendix E). It is worth mentioning that neither group of participants are representative samples, but rather panels where different backgrounds and views were represented.

4.4. Problem orientation

Based on the literature review about the case study, it was concluded that there is no document that describes to some extent what sustainable transport means in this context. Therefore, it was decided to take a wider scope in this backcasting study and focus in all dimensions important to urban transport and on stakeholder learning as a first step towards holistic action.

4.5. Ethical statement

This study involved interaction with participants to gather data and opinions but the perceived ethical risk is low. All participants were informed of the purpose of the study and its anonymity before accepting to participate. It is anticipated that this dissertation poses no ethical risks to any party during or after the research process.

5. Research findings

5.1. Drivers and trends

The following are the drivers and trends considered most important for this study. The classification follows Nijkamp et al (1997) classification of aspects of mobility behaviour.

Spatial

1. Gentrification. These processes are beginning to be common in Lima, local governments encourage private-led revitalization projects in inner-city areas without a clear strategy or knowledge of the possible impacts (Semana Económica, 2016).
2. Uncontrolled urban expansion. Informal land occupation drives urban sprawl towards the periphery, also lack of enforcement triggers land trafficking.

Institutional

3. Regulation. There is a strong trend towards regulation in transport. This can be seen in recent attempts to regulate bus services (Glave, 2016) and a newly created transport authority. However, it is not clear how it will develop in the future, as wider political instability threatens the continuity of this kind of policies.
4. Subsidies. National government has recognised public transport as a basic service, enabling the possibility of granting subsidies for public transport.
5. Centralisation. Following the creation of the new transport authority centralising responsibilities from local municipalities and other ministries, it is not clear what approach future administrations will have towards urban governance.
6. Corruption. Following a long history of cases and a recent corruption scandal that have put former presidents and mayors in prison, it is unclear that this will be a breaking point in governance.
7. Sustainable development. This approach is rapidly getting importance inside government. Future policies are expected to pay more attention to it.

Economic

1. Economic growth. A base scenario of steady economic growth is set at around 4.8% annually for the next 10 years. Other scenarios set the growth rate between 3.3% (pessimistic) and 6.5% (optimistic) (CEPLAN, 2019a). This trend usually leads towards higher mobility rates (Banister et al., 2000).
2. Poverty. Extreme poverty is set to disappear in the next 10 years under any scenario, and all population will have access to basic services in the same time (CEPLAN, 2019).

3. Globalization. There is a clear trend towards globalization, the country is increasingly taking part in the world economy and Lima and Callao are its principal economic hubs.

Socio-psycological

1. Public demand. Steady economic growth has strengthened middle income population and provided access to education and services. This plays a crucial role in citizen empowerment. Low quality of life and distrust towards public institutions seems to be sparking 'citizen effervescence' (Alegre, 2015) that demand changes (CEPLAN, 2016b).

2. Changing population. Birth rates are decreasing (INEI, n.d.) and the number of older people is increasing. This could affect activity and travel patterns as elder people could be more prone to driving or not travel if public transport is not accessible.

3. Individualisation. Individualisation is a worldwide trend identified since the last century, where ties become weaker and social isolation becomes more common (Nijkamp et al, 1997).

4. Communications technology in transport. This is a worldwide trend more consolidated in developed countries. The development of on-demand transport schemes is now key for more transport efficiency and poses new challenges for transport planning.

The main drivers and uncertainties identified are the following:

1. Weak institutions. There is extensive literature about institutional weakness in Peru, both in a broader sense (Brinks et al, 2019; Crabtree, 2006) and how it relates to transport (Poole, 2018). Furthermore, various authors cite it as the main reason for the current state of transport (Jauregui et al., 2019; Alegre, 2016).

2. Political instability. In recent years, confrontation between government powers have created an unstable environment for private and public investment (Andina, 2018). Constant change in ministry officials directly affect policy making.

3. Economic growth. Economic growth and transport development are circularly interlinked (Banister et al., 2000). Lima's steady economic development has accentuated congestion as the transport system hasn't followed the trend, but it has allowed to have available funds to invest.

4. Sustainability. The increasing realisation of the impacts of human behaviour in the environment can drive a critical mass to call for change, especially when incomes increase but the quality of the urban environment does not follow.

5.2. Objectives and vision

In addition to the drivers and trends listed above, relevant documents were consulted[2] to construct the projections of the future used in the survey instrument. Initially, 88 projections were generated, of which 37 were used in the survey instrument, including 5 about general topics. 22 stakeholders were interviewed in this Phase.

For the construction of objectives, 47 different factors were identified by coding the arguments gathered in the interviews in a grounded way (Charmaz, 2006). In an iterative process, the number of codes was reduced to 29. The 12 "top factors" are presented in Table 1, these gather 81% of all mentions.

Factor	Mentions
Cutting emissions	16
Affordable public transport	14
Clean fuels and sustainable modes	14
Integrated policy and planning	14
Institutional strengthening	13
Improve accessibility	10
Inclusion of vulnerable groups	10
Competitivity	10
Capacity building	7
Multimodality	7
Travel time reduction	6
Subsidies	5

Table 1 Most mentioned factors in objectives

Here is important to say that since the economic, social and environmental impacts of transport are closely interrelated and many of the objectives could fall in more than one category. In this sense, objectives are listed in the category where the majority of interviewees mentioned them.

All participants stated that cutting emissions was crucial and promoting more sustainable modes of transport was an immediate priority. Mentions about economic and social objectives were more diverse, although most of them were around accessibility, affordable public transport fare and competitivity.

It is noteworthy that, giving the state of road safety in the city, the subject of reducing traffic casualties was only mentioned by one participant. This could be because interviewees see this

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[2] The documents consulted were CEPLAN (2019), Municipalidad Metropolitana de Lima (2014), MUSAL (2014), Bonifaz and Aparicio (2013) and Alegre (2016).

topic as embedded in others, and that higher objectives could address this issue in a collateral way. Even though it is most important, it was decided to leave this issue out of the aggregated objectives as it was not mention as a top factor, and to see if participants realised its absence. In the second interview only two commented about it.

Following these main factors, the set of objectives was constructed.

Category	Objectives
Economic	Achieve a more efficient transport system for people and freight, to foster productivity, competitiveness and economic growth, in line with the principles of a human, inclusive and sustainable city.
	Have subsidies for public transport that allows for a high-quality system and the achievement of social and economic objectives
Social	Ensure accessibility to opportunities and services for all people; without discrimination of socio-economic level, disability, age or gender; through a multimodal and high-quality transport system.
	Improve the quality of life of people by reducing travel time.
	Consider those affected by transport interventions.
Environmental	Dramatically reduce emissions and particulate matter from the transport sector.
	Promote the use of environmentally efficient modes of transport.
Institutional	Significantly improve technical and political capacity of institutions to implement transport strategies and achieve objectives.
	Improve the design of institutions and the transport planning system with an integrated approach.

Table 2 Policy objectives for sustainable transport

It was seen that all factors mentioned lead towards a same objectives and none of them were contradictory. No dimension was deemed more important than other, but there was an agreement that the institutional objectives were enablers of the rest.

It is also notable that having subsidies to improve access to public transport was cited as an objective rather than a mean to achieve the objective of accessibility. This was picked up by two participants in the second interview, reflecting how the means become objectives in a precarious planning system.

The vision[3] was constructed from the desirability ratings of future projections. Furthermore, probability was also assessed. Since it mainly served as an "anchoring point" for the desirable projections and to make participants conscious of the radicalness of their desirable vision (Zimmermann et al., 2012), probability will not be discussed further.

The final desirability ratings were calculated as the mean from all responses. Also, a simple standard deviation (SD)[4] was used as a measure of dispersion of opinions.

Projection	Desirability	SD
The public transport fare is affordable for the majority of the low-income population.	5.00	0.00
People have changed their travel patterns due to higher environmental and social awareness.	4.94	0.24
There has been a drastic reduction in the use of private vehicles.	4.89	0.32
There is a restriction of parking spaces	4.83	0.38
Value capture mechanisms have allowed the development of more and better transport infrastructure.	4.82	0.39
New labour and commercial centralities have balanced the attraction of trips.	4.74	0.45
All transport (massive and private) of the city is done under formal conditions.	4.72	0.75
Speed limit in residential and commercial areas is 30 km/h.	4.71	0.59
There are 'Mobility as a Service' apps with coverage in most parts of the city.	4.61	0.70
The six lines of the metro system are in operation.	4.60	0.75
The government encourages and regulates mixed land use.	4.57	0.68
There is a considerable increase in cycling and scooters	4.44	0.78
In some areas of the city centre, there is congestion pricing and low-emission zones.	4.41	0.71
Freight lorries have a specific time to drive.	4.35	1.11
Telecommuting and teleshopping have reduced the need for travel	4.33	0.97
There are rail and coach terminals that connect Lima with other neighbour cities.	4.28	1.07
Mobile apps for bicycles and scooters are widely used	4.22	0.94
The planning system is centralised in special authorities.	4.13	1.20
The State promotes the purchase of electric vehicles.	4.06	1.11
The formal bus system serves more than half of the trips	4.00	1.08
There is a cable car system to connect the hill areas with public transport systems.	3.93	1.33
There are car-sharing services promoted and regulated by the local government.	3.84	1.07
Vehicle tax has increased considerably as a measure to discourage the use of the private car.	3.76	1.20

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[3] Due to capacity reasons, the desirable vision is presented in Appendix B, together with the objectives.

[4] In some cases, adding or subtracting one SD to the mean value can exceed the extreme values of the likert scale (1-5). This occurs because the data is skewed and does not follow a normal distribution. It must not be interpreted as if there were responses beyond said scale.

All moto-taxis are formal and only serve as last-mile trips	3.58	1.57
Special infrastructure (underpasses, tunnels, etc.) has been built in key locations to ease congestion.	3.23	1.56
Public-private partnerships finance most of the transport infrastructure.	3.06	1.09
There is a higher travel demand due to economic growth.	3.00	1.10
The criteria for project appraisal is based on a cost-benefit economic perspective.	2.94	1.56
License plate restrictions have reduced congestion.	2.93	1.39
Autonomous vehicles do not yet enter the market due to lack of infrastructure.	2.75	1.00
The BRT system has not been significantly expanded because of the prioritisation of the Metro network.	2.29	1.10
Conventional fuel technologies (based on oil and gas) make up the majority of the new vehicles on the market.	1.72	1.13

Table 3 Desirability of future projections

The vision (Appendix B) describes a desired state where transport in the city is sustainable and just. The projection of an affordable public transport for low-income population stands out with the highest value of desirability possible. It is important to highlight the consensus around the reduction in private car use and parking spaces. It also stands out that 20 out of the 32 projections got high desirability ratings (4 or higher), hinting the dire need for change. The use of the standard deviation allows to easily see which projections had more disperse answers, and since the participants were able to qualitatively argue their ratings some important nuances were picked up. There was disagreement on how participants view the last-mile of trips in hilly and peripheric areas. Some of them viewed the cable car as the most desirable system for this kind of trips, as current moto-taxis are chaotic, pollutant and highly unsafe. Others stated that formalization and proper regulation of moto-taxis was a better solution. Both systems were included in the vision.

Undesirable projections such as the use of conventional fuel technologies had disagreement as well, as some participants point out that large natural gas reserves were available and they must be used to also boost the economy. There was high scepticism about the role autonomous vehicles would play in the future, so they were not included in the vision.

5.3. Policies

The creation of policy packages started with identifying suitable policy measures. The consulted literature included international scientific literature (Tuominen et al, 2014; Banister et al, 2000), policy papers and guidebooks (ITS, 2011; Victoria Transport Policy Instrument, 2012; SUMMA, 2005) and local plans and studies (Alegre, 2016; Municipalidad Metropolitana de Lima; 2014). A long list of 48 policy measures relevant to the case study was selected, and it also included some

measures that came up during the first phase of interviews. The list was later reduced to 30 measures used in the survey instrument for policy evaluation (see Appendix C).

The measures were assessed according to the extend in which they might contribute to the four broad categories of objectives. There were 21 measures with economic, social and environmental impact, while 10 measures addressed the institutional objectives.

The number of interviews were reduced to 12 in this Phase, as more expertise was required. All participants agreed that the aggregated objectives and vision reflected their personal views. In the interviews, the measures were prioritised and rated by their political and economic feasibility, responsibility and timescale for implementation. The results are shown in the comprehensive matrix in Appendix C. All participants agreed that the list of measures reflected what the city needed and only two additional measures were added to the list, regarding capacity building and housing policies. The most selected measure was the reform and formalization of bus transport, with 11 selections; followed by improvements for walking and cycling, with 10; and land use measures and the construction of the metro network, both with 9 selections.

Participants argued about the necessity to implement most of the measures in the period between 2021 and 2025, and that their effects can also start to be seen around the same period and towards 2030. Regarding the responsibility in implementation, most responsibility was given to metropolitan authorities, followed by the national government. Interestingly, the private sector was considered overall third in terms of involvement. It also stands out that one third of the policies had more economic than political feasibility. The detailed results can be found in Appendix C.

After coding the responses of participants about the possible packages, some important relations were identified. They focused mostly in the necessary connection of governance measures and the rest of them. The most common relation was between integrating planning and land use planning (9 mentions), followed by governance and bus transport reform (5). Other groupings highlighted were between walking and cycling measures and vision cero (2), financial incentives with clean fuel technologies (2) and fleet renewal (2).

5.4. Policy packaging and pathways

Policy packages were constructed taking into account the relations made by the participants. Then, the packages were combined to form paths.

A major issue throughout this study has been institutions as a source of uncertainty. First identified in the literature as the main barrier for the development of transport planning (Sections 3 and 5.1), and later mentioned by experts as the main enabler of policy implementation (Sections 5.1 and 5.2), institutional and political uncertainty seems to be the determinant factor for the future of transport in the city. In addition, there is an extensive body of literature that expands on the decisive nature of institutions in urban transport in developing countries (Vasconcellos, 2001; Dimitriou, 1992; Hidalgo and Huizenga, 2012; Gwilliam, 2003).

Therefore, taking "institutional uncertainty", two different pathways were developed. Path A, where institutions remain weak and transformative change have to spark from other sectors if the vision is to be achieved; and Path B where institutions are strengthened to the extent that they are able to create a proper environment to implement suitable measures to achieve the objectives. In this sense, the difference between both pathways is in the strength and relative priority of policy measures.

Naturally, pathways based on institutional uncertainty require different groups of stakeholders to take part at different levels. In a scenario study towards 2020, Wenban-Smith (2000) explored the possibilities of a future were complexity is left to manage itself and identified that weak institutions lead to raising market systems. Therefore, it seems reasonable to take policy orientations as principles to create the pathways. Defining policy orientation as the 'generic rationale' which lies behind the policy measures, Banister et al. (2000, p.214) differentiates four basic policy orientation that show the scope of action needed to achieve sustainability:

- Lifestyle-oriented policies. Supposes a change in personal attitudes towards mobility and consumption. This can be basically bottom-up. In this, information is an important. Knowledge about transport externalities and consequences of decisions can steer behaviour.
- Market-oriented policies: Assumes that a system of incentives can change behaviour. This will have top-down elements, especially pricing instruments.
- Regulation-oriented policies: Relies on norms, standards and reforms. Also, top-down.
- Infrastructure-oriented policies: Also includes service provision. This is strongly related to regulatory policies.

Lifestyle-oriented policies are less dependent on institutions to be implemented. Marked-oriented policies could fill the gaps left by weak institutions given proper mechanisms of accountability and monitoring, along with an efficient and more socially responsible private sector that act as a partner delivering social and development outcomes. On the other hand,

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regulation and infrastructure-oriented policies do rely heavily on institutions, as they refer to norms and a top-down governance structure able to enforce them. Then, it is clear that a combination of policies with more focus on lifestyle and markets have higher affinity with Path A, while infrastructure and regulation-oriented policies fit better into Path B. However, it is important to note that, in practice these orientations always overlap. It notable as well that, while having departed from different argumentations, the pairings of policy orientations in this study are the same as those utilised by Banister et al. (2000).

UNCERTAINTY: Different futures

Scenario A: Weak institutions	Scenario B: Strong institutions
Path A: market and lifestyle orientation	Path B: regulation and service orientation
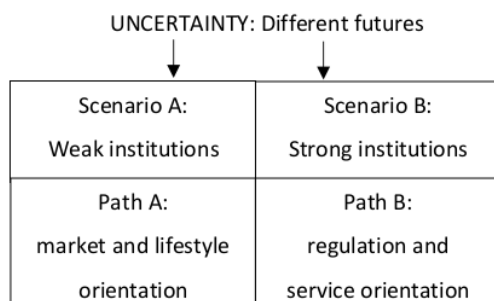
Figure 5 Uncertainty in Policy Paths

A total of 12 policy packages were developed. They were based in comments by the participants in the interview in Phase 2 and a further desk work based in the criteria described above. The packages intent to be illustrative and not comprehensive, meaning that they can be modified. Some of them appear in two different variants designed for different paths. The description of packages is presented below. for the complete list of measures in each package and their objective and orientation assessment see Appendix D.

PP1: Public transport systems

Designed for:	Main policy orientation:
Scenario A: *Variant A*	*Variant A*: Infrastructure
Scenario B: *Variant B*	*Variant B*: Infrastructure, regulation
This package aims at providing quality public transport options to discourage the use of private vehicles. In both variants the construction of the metro network and formalization of the bus system are the central measures. • *Variant A*: In Scenario A, strong institutions are not prevalent and there are still strong barriers for implementation of an integrated planning system. Due to the consensus on the	

importance of these infrastructure, transport system projects are still built but their impact is reduced as they are not accompanied by land use measures.

- *Variant B*: With a stronger institutional framework more comprehensive measures can be taken in this package, integrating land use and public transport infrastructure.

PP2: Ecological action

Designed for:	Main policy orientation:
Scenario A	Market, regulation and lifestyle
Scenario B	

This package is composed of 8 measures aimed at reducing transport emissions. Road pricing and an ecological tax can help internalise these externalities into the overall cost of transport and create funds for mitigation action. Stricter norms and emission standards can cut local pollution and, together with strong media and education campaigns, it can help create an awareness and steer behaviour towards more sustainable mobility habits. The central measures in this package are ecological tax, strengthening emission standards and investment in development of clean fuel technologies. It also covers ecological driving (e.g. decreased speeds) This package is the same for both scenarios as social consensus and political support may play a bigger part than institutions in the implementations of the measures. However, strong institutions can be important in their strength and enforcement.

PP3: Institutional reform

Designed for:	Main policy orientation:
Scenario B	Regulation

As stated before, Scenario B is where institutions become stronger and develop the ability to implement measures for sustainable transport. This package of 8 measures is aimed at proving institutional structure and capacity to the transport planning system. Here, building technical and political capacity and developing a new integrated planning system are the central measures. Action from the central and metropolitan government here is key, but the public have also a role to play through citizen demand and academia.

PP4: Land use

Designed for:	Main policy orientation:
Scenario A: *Variant A*	*Variant A*: Regulation and market
Scenario B: *Variant B*	*Variant B*: Regulation and market

This package focuses on land use to support sustainable transport. In both variants mixed land use, centralities measures and a new integrated planning system are central measures, but the differ in their strength and orientation.

- *Variant A*: As government support is limited in this scenario, the role of supporting sustainable travel patterns thought land use predominantly lays on the market. Thus, the measures in this variant are market-led.
- *Variant B*: Here, land use measures are implemented by the state through comprehensive regulation and market incentives.

PP5: Livable city

Designed for:	Main policy orientation:
Scenario A: *Variant A*	*Variant A*: Regulation and lifestyle
Scenario B: *Variant B*	*Variant B*: Regulation and lifestyle

This package is composed by 13 measures that explore using urban form and traffic management to improve the quality of urban life. improving the conditions for walking and cycling is one of the central measures and the other one depends on the variant.

- *Variant A*: Vision zero measures also are central to this package, along with land use measure described in PP4 and the reform of the traffic light system.
- *Variant B*: In this variant, urban regeneration schemes complete the central measures of the package.

PP6: Transport management

Designed for:	Main policy orientation:
Scenario A	Regulation
Scenario B	

This package is composed by 10 measures and focuses on regulation and reforms to support sustainable transport. The package covers the following purposes: (i) Traffic management (e.g. traffic lights, congestion charging); (ii) improving the efficiency of the road network; (iii) coach transport reform. Given the current conditions of the city in this issue, traffic control system reform and congestion charging are the main measures in this package.

PP7: Freight

Designed for:	Main policy orientation:
Scenario A	Market, regulation and infrastructure
Scenario B	

A policy looking for new concepts in freight transport is the central measure of this package. It is supported by other measures, from ICTs for information systems to integrated planning and infrastructure provision, mostly related to logistics centres.

PP8: ICT

Designed for:	Main policy orientation:
Scenario A	Lifestyle
Scenario B	

A set of 2 measures were considered in this package. They aim to explode the potential of telecommuting for reducing trips and develop ICT systems to support more sustainable mobility patterns.

PP9: Multimodality

Designed for:	Main policy orientation:
Scenario A: *Variant A*	*Variant A*: Infrastructure
Scenario B: *Variant B*	*Variant B*: Infrastructure and regulation

It covers measures intended to provide better connection between mass transport modes. Thus, the improvement of the current road network is the central measure.

- *Variant A:* Includes the formalization of the main bus corridors. Here the taxi system is left to manage itself.

- *Variant B*: Includes a more comprehensive reform of the bus network and the taxi system led by the government.

PP10: Public awareness

Designed for:	Main policy orientation:
Scenario A	Lifestyle
Scenario B	

This package aims at raising awareness and educating about road safety, the impacts and externalities of transport, as well as the different transport options besides the private car. This package is the spearhead for behavioural change, making transport interventions more visible and creating a public conversation about around transport.

PP11: Infrastructure investments

Designed for:	Main policy orientation:
Scenario A: *Variant A*	*Variant A*: Infrastructure
Scenario B: *Variant B*	*Variant B*: Infrastructure and regulation

Its focus is in supporting sustainable transport with proper infrastructure. The investment will be mostly aimed at bridging the infrastructure gap, mainly targeted at public transport infrastructure, but taking into consideration more sustainable principles of appraisal. The variants differ mostly in the extent in which this last point can be implemented.

PP12: Vision Zero

Designed for:	Main policy orientation:
Scenario B	Regulation and lifestyle

Package aimed specifically at reducing traffic casualties. This package was constructed solely for Scenario B as more integrated planning is necessary for a comprehensive policy of this kind.

The developed packages allow to construct two possible pathways. None of the pathways can be detailed here. The paths with the detailed measures can be found in Appendix D.

	Policy package	Objectives	Orientation	Responsibility	Timescale	
					Start	Effect
1A	Public transport systems A	ECO SOC ENV	I R M	MET PRIV NAT	2021-25	2026-30
2	Ecological action	ENV SOC	R M L	NAT MET DIS	2021-25	2026-30
4A	Land use A	ECO INS SOC	R M	PRIV DIST MET	2021-25	2026-30
5A	Livable city A	SOC ENV ECO	R L I	DIS	2021-25	2021-25
6	Transport management	SOC ENV ECO	R I	MET DIS	2021-25	2021-25
7	Freight	ECO	R I	MET NAT PRIV	2026-30	2031-36
8	ICT	ECO SOC	L	PRIV CIT	2021-25	2026-30
9A	Multimodality A	SOC ECO ENV	I R L	DIS MET	2021-25	2026-30
10	Public awareness	SOC ECO	L	MET CIT	2021-25	2026-30
11A	Infrastructure investments A	ECO SOC ENV	I R	MET NAT DIS	2021-25	2026-30

Objectives	Orientation	Involved
ECO-Economic	L-Lifestyle	NAT-National
SOC-Social	M-Market	MET-Metropolitan
ENV-Environmental	R-Regulation	DIS-District
INS-Institutional	I-Infrastructure	PRIV-Private
		CIT-Citizen

Table 4 Path A: Weak Institutions

			PATH B			
	Policy package	Objectives	Orientation	Responsibility	Timescale	
					Start	Effect
1B	Public transport systems B	ECO SOC ENV	R I M	MET NAT PRIV	2021-25	2026-30
2	Ecological action	ENV SOC	R M L	NAT MET DIS	2021-25	2026-30
3	Institutional reform	INS ECO SOC	REG MAR	NAT MET DIS CIT	2021-25	2021-25
4B	Land use B	ECO SOC	R M	NAT MET PRIV	2021-25	2026-30
5B	Livable city B	SOC ENV ECO	R L I	DIS MET	2021-25	2021-25
6	Transport management	SOC ENV ECO	R I	MET DIS	2021-25	2021-25
7	Freight	ECO	R I	MET NAT PRIV	2026-30	2031-36
8	ICT	ECO SOC	L	PRIV CIT	2021-25	2026-30
9B	Multimodality B	SOC ECO ENV	I R L	MET DIS	2021-25	2026-30
10	Public awareness	SOC ECO	L	MET CIT	2021-25	2026-30
11B	Infrastructure investments B	ECO SOC ENV	I R	NAT MET DIS	2021-25	2026-30
12	Vision Zero	SOC ECO	R I L	NAT MET DIS CIT	2021-25	2021-25

Objectives	Orientation	Involved
ECO-Economic	L-Lifestyle	NAT-National
SOC-Social	M-Market	MET-Metropolitan
ENV-Environmental	R-Regulation	DIS-District
INS-Institutional	I-Infrastructure	PRIV-Private
		CIT-Citizen

Table 5 Path B: Strong Institutions

5.4.1.Analysis and comparison of paths

Both paths are directed towards the same vision, and while most of the policy elements are similar, they differ in the orientation of the measures, the actors involved and the strength in which the measures can be applied.

The main characteristic of Path A is weak institutions. In this Path, important measures related to land use and public transport are market-led and rely in the private sector having stronger social responsibility and realising that the externalities of unsustainable development and travel patterns also affect their market. However, capital gain would remain their higher incentive, which could result in well-intentioned but fragmented and competing measures. Furthermore, institutional weakness can lead to reinforce unwanted trends, such as gentrification and urban sprawl.

On the other hand, packages of Path B are supported by a special institutional reform package, which is designed to stablish the ground for a coordinated implementation of the rest of the measures, harnessing synergies and preventing unwanted effects. Path B includes a Vision Zero package, which is composed of the same measures that are spread between other packages in Path A, but its intention is to create synergies packaging them under the same issue. It is important to note that, while Path B relies in Institutional Reform, it is not exactly a precondition for executing the rest or measures. On the contrary, Institutional Reform can act as an umbrella and run parallel to the implementation of other measures, providing an environment of learning and coordination.

Both paths require rather aggressive measures in order to reach the vision but it is notable that, despite Path A being more market and lifestyle oriented, regulation is still very much required, which talks about its strong interrelation with transport. Indeed, "transport cannot be a self-regulatory system" Banister et al., 2000, p.14). Leaving complexity to manage itself requires plenty assumptions about the uncertain future, as a consequence it seems impossible to reach the objectives by following Path A.

5.5. Validation

Three participants were invited for in the validation process, but only one interview could be carried out do to scheduling issues. The main points from the validation discussion are the following:

- The backcasting approach was considered useful as a framework to explore the future of transport and the possibility of different strategies.

- Measures were adequately packaged and assessed in terms of their orientation and their ability to meet the objectives.

- Uncertainty about institutions is an interesting and suitable factor to explore different paths, as it is now the main barrier for implementation and most probably it will continue to be.

- It would be impossible to achieve the objectives following Path A, as the market and society by itself would not internalise the externalities of transport, especially those related to emissions derived from fossil fuels. To a certain point, market can indeed engage in more responsible practices, but severe regulation from strong institutions are required to achieve sustainability challenges.

- Deregulation of transport has already been tried before in Peru and far from working it has led to the critical state of today.

- Planners in Lima are still used to develop planning instruments with little to no input from other stakeholders and manage a language hard to engage with. The idea seems to be that the final product is the objective of planning and the process of learning is overlooked. Adopting backcasting as a planning process can provide a solution, but it would be challenging since stakeholders are not used to this kind of thinking.

5.6. Methodological lessons

5.6.1.The selection of participants

- The composition of the participants was crucial for including a variety of perspectives about the future of transport. Members of activist groups, multilateral agencies, NGOs, academia, business, consultancy and different levels of government were included in this study. As shown in Appendix E, this study was successful in achieving not only a variety of expertise in the sample, but also different ages and backgrounds.

- Some of those invited that did not 'technically' belong in the transport sector (e.g. the media) were reluctant to participate stating that they were not experts in the topic. In addition, it was seen that some participants of activist groups were doubtful during the first interview because of the same reason. It was important to reiterate that they were also stakeholders in the transport sector and that the study was focused on their perspectives and not on technical knowledge.

5.6.2.Data collection

- The in-depth individual interviews were successful in eliminating group dynamics. This was important when including the voices of less dominant, younger participants rarely included in this kind of exercises (Soria-Lara, 2017a).

- The innovative use of the survey instruments for interviews proved to be most useful as it not only helped structure them but also provide a ground for participants to develop their ideas and a way for them to quantifying otherwise qualitative views. It also eliminated the need for long explanations about how to use the instrument, as any doubt could be directed immediately to the interviewer. On this, one participant stated that this methodology was simpler and clearer than Delphi studies.

5.6.3.The visualisation of the desirable future

- The approach towards desirability and not probability was problematic for some participants, as they would base their answers on past events and how specific policy had developed. This was seen specially among older participants with extensive experience in the field.

- The long-term approach was problematic as well, as many participants set their discourses in the near future.

- Participants with technical background (e.g. engineers, economists) were focused on technical details of the possible future.

- In all cases, participants were constantly reminded about the heuristic nature of the study and encouraged to think in more holistic terms.

- While sometimes challenging, participants were engaged and enthusiastic with the process of thinking in desirable terms and some of them stated that they had never done this kind of exploration.

5.6.4.Methodological limitations

- Individual interviews do not allow for interaction among the participants, which is a condition for knowledge sharing. However, they do allow for deep understanding of their perspective and this can be taken as a first step to understand better each view before facilitating interaction.

- The qualitative nature of the research does not produce quantitative targets, limiting the potential for monitoring and evaluation.

- It was difficult to assess the relations of the measures in order to form packages. It would be useful to pay especial focus on this issue and create a special instrument for this.

5.7. Reflections

- To the knowledge of the author, there has not been a transport backcasting study with such wider scope, it resulted to be rather challenging, but it was useful to set a framework towards more specific studies.

- This study has produced a great amount of data of which only a small amount has been able to analyse here. It would be important to link future experiments with other studies in order to harness the potential of the data to better understand the rationalities and perceptions of different stakeholders in transport.

- The policy paths were constructed on the basis of institutions as a source of uncertainty. However, it is not entirely out of our hands, as the realisation that sustainable transport might be unattainable without the strengthening of institutions can lead to decision makers to take effective action.

6. Conclusions

Highly complex problems, such as those present in urban transport in Lima and Callao, require wider collaborative planning approaches rather than those merely based in instrumental rationality. This implies a strive for knowledge sharing and consensus among diverse actors. Future studies, and specifically, backcasting approaches provide a suitable framework for addressing this kind of problems, as its normative nature allows to think beyond current trends and explore ways in which desirable futures can be attained.

This study carried out a participatory backcasting process for sustainable transport policy in Lima and Callao, for this purpose, a novel methodology based on personal interviews and consisting of 5 distinctive phases was developed. The method was successful in representing the views of all participants about long-term objectives, desirable transport vision and suitable policy measures for implementation. The exploration of two policy paths based on the strength of institutions concluded that transport is too complex to be left to manage itself and that for attaining sustainable transport, strong institutions are required to provide a framework of regulation and cooperation.

The wide scope of the study, focused in all dimensions of urban transport, proved to be useful as a first step towards a holistic understanding of transport, especially in a context like the case study, where instrumental rationalities are still dominant in transport planning.

The findings suggest that there might be a consensus among stakeholders in the transport sector about a desirable vision but the differences may lie in their views about the role of market-oriented policies, such as taxing, and restrictive regulation to curb the increase of the private vehicle.

Future research could attempt to include more actors in the backcasting process and provide an environment for interaction in order to encourage the sharing of knowledge. Another promising area of research could be the refinement of a methodology for adequate policy packaging. In practice, collaborative and backcasting approaches can provide a framework for understanding other actors involved and move from planning to action.

This dissertation has attempted to provide a method by which a wide variety of actors can construct understanding, objectives and find ways to work together towards them. The author hopes this research might inform future discussion to talk about transport and help realise that the future is in our hands.

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Appendix A: Desirable Vision Interview Instrument

Evaluate the probability and desirability of each statement for Lima and Callao towards 2050.

No.	Projection	(0-100%) Probability	(1-5) Desirability	Don't know
1	Measures to reduce the informal economy have been successful			
2	More than half of the population is overweight.			
3	There is a strong environmental awareness, better habits and consumption practices.			
4	Economic growth has been reduced to 1% per year.			
5	Only a very small percentage of the population does not yet have internet access.			
6	Internal migration has been significantly reduced due to a better system of cities and decentralization.			
7	Corruption has ceased to be a major problem within the government.			

No.	Projection	(0-100%) Probability	(1-5) Desirability	Don't know
1	New labour and commercial centralities have balanced the attraction of trips.			
2	The government encourages and regulates mixed land use.			
3	The six lines of the metro system are in operation.			
4	There are rail and coach terminals that connect Lima with other neighbour cities.			
5	All transport (massive and private) of the city is done under formal conditions.			
6	The BRT system has not been significantly expanded because of the prioritisation of the Metro network.			
7	The formal bus system serves more than half of the trips			
8	The public transport fare is affordable for the majority of the low-income population.			
9	All moto-taxis are formal and only serve as last-mile trips			
10	There is a considerable increase in cycling and scooters			
11	There is a cable car system to connect the hill areas with public transport systems.			
12	Mobile apps for bicycles and scooters are widely used			
13	There has been a drastic reduction in the use of private vehicles.			
14	There are 'Mobility as a Service' apps with coverage in most parts of the city.			
15	There are car-sharing services promoted and regulated by the local government.			
16	There is a restriction of parking spaces			
17	Freight lorries have a specific time of circulation.			
18	Speed limit in residential and commercial areas is 30 km / h.			
19	Special infrastructure (underpasses, tunnels, etc.) has been built in key locations to ease congestion.			

20	The criteria for project evaluation is based on a cost-benefit economic perspective.			
21	Public-private partnerships finance most of the transport infrastructure.			
22	The State promotes the purchase of electric vehicles.			
23	Autonomous vehicles do not yet enter the market due to lack of infrastructure.			
24	People have changed their travel patterns due to higher environmental and social awareness.			
25	Telecommuting and teleshopping have reduced the need for travel			
26	There is a higher travel demand due to economic growth.			
27	Conventional fuels (based on oil and gas) make up the majority of the new vehicles on the market.			
28	License plate restrictions have reduced congestion.			
29	Vehicle tax has increased considerably as a measure to discourage the use of the private car.			
30	In some areas of the city centre, there is congestion pricing and low-emission zones.			
31	Value capture mechanisms have allowed the development of more and better transport infrastructure.			
32	The planning system is centralised in special authorities.			

Appendix B: Desirable Vision for Urban Transport in Lima and Callao for 2050
Participatory visioning and backcasting for transport policy in Lima

Objectives

Dimension	Objectives
Economic	Achieve a more efficient transport system for people and freight, to foster productivity, competitiveness and economic growth, in line with the principles of a human, inclusive and sustainable city.
	Have subsidies for public transport that allows for a high-quality system and the achievement of social and economic objectives
Social	Ensure accessibility to opportunities and services for all people; without discrimination of socio-economic level, disability, age or gender; through a multimodal and high-quality transport system.
	Improve the quality of life of people by reducing travel time.
	Consider those affected by transport interventions.
Environmental	Dramatically reduce emissions and particulate matter from the transport sector.
	Promote the use of environmentally efficient modes of transport.
Institutional	Significantly improve technical and political capacity of institutions to implement transport strategies and achieve objectives.
	Improve the design of institutions and the transport planning system with an integrated approach.

Characteristics of urban transport in Lima and Callao towards 2050

General	The use of private cars has been significantly reduced.
	Transport volumes have increased due to economic and population growth.
	Widespread use of telecommuting and teleshopping keep traffic volumes under control.
Urban	Change from private vehicles to public transport and active modes.
	Restriction of parking spaces
	Less space for private cars.
	New commercial and labour centralities.
	20 mph zones and priority for public transport.
Public transport	Formal and integrated public transport system, composed mainly of Metro, BRT and buses.
	Affordable transport fares for low-income population.
	At least 4 Metro lines in operation.
	The formal bus system serves more than half of trips.
	Last-mile journeys, depending on the location, are made by cable car or moto-taxi, which now uses clean fuels.
Personal mobility	Higher use of the bicycle as a mode of transport.
	Better conditions for walking and cycling.
	Car sharing systems grow in popularity.
Safety	Traffic casualties have been minimized
Information and communication technologies (ICTs)	ICTs facilitate mobility and access to cars and cycle sharing
	Mobility as a Service applications are widely used.
Freight and logistics	Intermodality is promoted in the freight system.
Inter-regional transport	There is a formal coach terminal system that promotes intermodality

Organization, planning and financing	Market incentives, such as congestion charging, have been introduced in certain areas.
	The government regulates mixed land use.
	Value capture mechanisms are widely used.
	The State subsidizes public transport.
	There is a greater balance between public-private partnerships and government contracting due to a higher capacity for government management.
	There is a better evaluation of transport interventions, with greater emphasis on social impacts.
Infrastructure	Special infrastructure has been built only in critical locations, as a last resort to relieve congestion and considering all modes of transport.
	Street and intersection design follow international best practices.
Technologies and fuels	Electric cars make up the majority of the new vehicles on the market and public transport fleet.
	Traditional fuels (gasoline, diesel and gas) meet the highest international standards

Society at large

There is a strong trend towards healthier lifestyles and greater environmental and social awareness, which significantly guides people's attitudes and consumption habits. Citizens are more involved in participatory processes and press their authorities to take stricter environmental action, especially in urban areas.

The fight against corruption has paid off, and it has ceased to be a major problem within the government. Economic growth has remained one of the highest in the region, partly driven by the significant reduction of informality and the strengthening of medium and small cities, creating opportunities for people outside the capital and reducing internal migration.

General approach to transport policy

In Lima and Callao, in 2050, transport is actively used as a tool to improve quality of life. The State has an active role in the support, financing and regulation of all public and private transport systems and works together with the private sector in the provision of these services.

The change in lifestyle and values of the population has led to higher acceptability towards new residential and travel patterns. The government has played a crucial role in the creation of new economic centralities through mixed land use. This, together with greater use of telecommuting and teleshopping, has been fundamental to generate a decoupling between economic growth and transport demand.

Public transport is widely considered as an essential basic service, so the State provides subsidies and guarantees its quality and coverage, with emphasis on providing accessibility to low-income people. The entire transport system is done under formal conditions and has physical and fare integration.

Mainly, transport policies and interventions focus on cutting emissions; for public, private and freight modes; and influence people's mode choice by providing accessibility and quality public transport. This, together with a congestion charging and low-emission zones, has significantly reduced the use of the private car. As for infrastructure, it follows the best international design practices and prioritizes non-motorized and massive modes. New infrastructure projects are evaluated considering their social and environmental impact and special infrastructure, such as

Appendix C: Results of Policy Evaluation

No.	Measures	Selection	Obj: Economic	Obj: Social	Obj: Environmental	Obj: Institutional	Ori: Lifestyle	Ori: Market	Ori: Regulation	Ori: Infrastructure	Feas: Political	Feas: Economic	Resp: Citizens	Resp: Private sector	Resp: District	Resp: Metropolitan	Resp: National	Impl 2021-25	Impl 2026-30	Impl 2031-35	Impl 2036-40	Impl 2041-45	Impl 2046-50	Eff 2021-25	Eff 2026-30	Eff 2031-35	Eff 2036-40	Eff 2041-45	Eff 2046-50
1	Public and private parking policy reform	1	x	x	x			x	x	x	4	1	0	1	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0
2	Other – Housing policies to approach people to their destinations	1	x	x	x			x	x		1	3	1	0	1	1	1	0	0	1	0	0	0	0	0	0	1	0	0
3	Other – Capacity building	2				x			x		3.5	3	0	0	1	1	2	2	0	0	0	0	0	1	1	0	0	0	0
4	Speed restrictions (zones 20) and pedestrianization	2		x	x		x		x		4	4	0	1	2	2	1	1	1	0	0	0	0	0	2	0	0	0	0
5	Investment in new infrastructure projects	2	x	x	x	x				x	3.5	2.5	0	1	1	2	2	1	1	0	0	0	0	1	0	1	0	0	0
6	Ecological tax	2	x	x	x		x	x	x		4	5	0	1	0	1	1	2	0	0	0	0	0	2	0	0	0	0	0
7	Promotion of ICTs for mobility (cycle and car share, Mobility as a Service)	3	x	x		x	x				4	4.33	1	2	2	2	2	1	2	0	0	0	0	1	1	1	0	0	0
8	Priority lanes for buses (not BRT) and high occupancy vehicles	3	x	x	x				x	x	4	4.67	3	0	2	3	0	2	1	0	0	0	0	1	2	0	0	0	0
9	Strengthening of emission standards	3		x	x	x		x	x		3.33	4	1	2	0	0	3	2	1	0	0	0	0	0	3	0	0	0	0
10	Media and education campaigns for road safety the promotion of sustainable modes and awareness of the externalities of the private car	3		x	x		x				4	4.67	2	1	2	2	2	2	1	0	0	0	0	0	1	2	0	0	0
11	Reform of traffic control system (traffic lights)	3	x	x	x				x	x	4.67	4	0	1	2	3	2	3	0	0	0	0	0	2	1	0	0	0	0
12	New system for project evaluation and monitoring	3	x		x				x		3.67	4	3	1	0	3	2	2	0	1	0	0	0	0	2	0	1	0	0
13	Investment and subsidy for development and adaptation of clean fuel technologies	4		x	x			x			3.5	3.5	0	3	1	1	4	1	2	1	0	0	0	0	2	2	0	0	0

#	Measure																													
14	Improvement of the existing road network and retrofitting	4		x	x	x			x	3	3.5	0	2	0	0	0	4	4	3	1	2	0	4	0	0	0	2	2	0	0	0
15	Fleet renewal incentives	4		x			x	x		3.75	2.75	2	2	0	2	0	4	2	0	2	2	0	1	0	0	1	2	1	1	0	0
16	Creation of a Ministry of Cities or similar institutions	4		x		x		x		2.5	3.25	0	0	0	2	0	4	2	1	0	2	0	1	0	0	1	1	1	2	0	0
17	Institutional strengthening for the execution and financing of public infrastructure	4	x			x		x		4	4.25	1	0	1	1	0	4	3	3	1	3	0	1	0	0	1	2	1	1	0	0
18	Reform of the taxi system	4	x	x	x				x	4	4	2	3	2	2	0	4	3	3	1	1	0	2	0	0	2	1	1	1	0	0
19	Terminals for coach transport	4	x	x					x	3.75	3.25	0	3	0	3	0	3	3	1	2	2	1	0	0	0	0	1	1	1	1	0
20	Encouraging telecommuting and teleshopping	4	x	x	x	x				3.25	3.25	2	3	2	0	1	4	2	2	1	1	1	0	0	0	0	2	1	0	1	0
21	Extension of BRT	5	x	x	x				x	3.4	4	2	2	0	5	0	3	4	2	0	1	0	0	0	0	2	2	1	0	0	0
22	Value capture policy for public transport infrastructure	5	x		x	x	x	x		3.4	4.2	2	3	0	4	1	5	2	2	2	1	1	0	0	0	1	1	3	0	0	0
23	Congestion charging and low emission zones	6			x	x		x		3.5	4	4	2	1	4	1	6	1	1	5	0	0	0	0	0	1	3	2	0	0	0
24	New concepts of freight transport (urban logistics centres, multimodality, etc.)	6	x				x	x	x	3	3.5	0	5	1	6	1	4	4	4	1	1	0	0	0	0	1	2	3	0	0	0
25	Subsidy policy and new fare scheme for public transport	6	x	x	x		x	x		3.67	3.33	2	2	0	6	0	6	6	6	0	0	0	0	0	0	3	3	0	0	0	0
26	Vision Zero policies	7	x			x		x	x	3.86	4	5	3	6	7	1	7	7	4	2	1	0	0	0	1	3	0	4	0	0	0
27	New binding system of integrated planning	7			x		x	x		3.71	4	5	4	5	7	0	7	7	3	4	0	0	0	0	0	0	3	3	1	0	0
28	Construction of the Metro network	9	x	x		x	x		x	3.78	3	2	4	1	7	1	8	5	5	1	2	1	0	0	0	1	4	0	2	1	1
29	Measures for mixed land use and densification	9	x	x	x	x		x		3.78	3.67	2	4	5	8	0	5	6	3	0	0	0	0	0	0	2	3	2	1	1	0
30	Urban regeneration schemes and promotion of centralities	9	x	x	x	x		x	x	3.67	3.67	3	5	2	9	0	5	5	5	0	0	0	0	0	0	0	4	2	1	1	1
31	Improve conditions for walking and cycling	10		x	x	x			x	3.9	4.1	4	3	10	10	1	3	9	1	1	0	0	0	0	0	6	4	0	0	0	0
32	Reform and formalization of public bus transport (SIT)	11	x	x	x	x	x	x	x	3.55	3.55	5	10	1	10	6	7	4	4	0	0	0	0	0	0	5	4	2	0	0	0

Poltical and economic feasibility of measures

Responsibility of measures

Reform and formalization of public bus transport (SIT)
Improve conditions for walking and cycling
Urban regeneration schemes and promotion of centralities
Measures for mixed land use and densification
Construction of the Metro network
New binding system of integrated planning
Vision Zero policies
Subsidy policy and new fare scheme for public transport
New concepts of freight transport (urban logistics centres,…
Congestion charging and low emission zones
Value capture policy for public transport infrastructure
Extension of BRT
Encouraging telecommuting and teleshopping
Terminals for coach transport
Reform of the taxi system
Institutional strengthening for the execution and financing…
Creation of a Ministry of Cities or similar institutions
Fleet renewal incentives
Improvement of the existing road network and retrofitting
Investment and subsidy for development and adaptation of…
New system for project evaluation and monitoring
Reform of traffic control system (traffic lights)
Media and education campaigns for road safety the…
Strengthening of emission standards
Priority lanes for buses (not BRT) and high occupancy vehicles
Promotion of ICTs for mobility (cycle and car share, Mobility…
Ecological tax
Investment in new infrastructure projects
Speed restrictions (zones 20) and pedestrianization
Other – Capacity building
Other – Housing policies to approach people to their…
Public and private parking policy reform

Number of votes to measures
Citizens
Private sector
District
Metropolitan
National

55

Timescale for implementation of measures

Number of votes to measures

Legend: ■ 2021-25 ■ 2026-30 ■ 2031-35 2036-40 ■ 2041-45 ■ 2046-50

Measures (top to bottom):
- Reform and formalization of public bus transport (SIT)
- Improve conditions for walking and cycling
- Urban regeneration schemes and promotion of centralities
- Measures for mixed land use and densification
- Construction of the Metro network
- New binding system of integrated planning
- Vision Zero policies
- Subsidy policy and new fare scheme for public transport
- New concepts of freight transport (urban logistics centres,…
- Congestion charging and low emission zones
- Value capture policy for public transport infrastructure
- Extension of BRT
- Encouraging telecommuting and teleshopping
- Terminals for coach transport
- Reform of the taxi system
- Institutional strengthening for the execution and financing of…
- Creation of a Ministry of Cities or similar institutions
- Fleet renewal incentives
- Improvement of the existing road network and retrofitting
- Investment and subsidy for development and adaptation of clean…
- New system for project evaluation and monitoring
- Reform of traffic control system (traffic lights)
- Media and education campaigns for road safety the promotion of…
- Strengthening of emission standards
- Priority lanes for buses (not BRT) and high occupancy vehicles
- Promotion of ICTs for mobility (cycle and car share, Mobility as a…
- Ecological tax
- Investment in new infrastructure projects
- Speed restrictions (zones 20) and pedestrianization
- Other - Capacity building
- Other - Housing policies to approach people to their destinations
- Public and private parking policy reform

Timescale of effects of measures

Reform and formalization of public bus transport (SIT)
Improve conditions for walking and cycling
Urban regeneration schemes and promotion of centralities
Measures for mixed land use and densification
Construction of the Metro network
New binding system of integrated planning
Vision Zero policies
Subsidy policy and new fare scheme for public transport
New concepts of freight transport (urban logistics centres,…
Congestion charging and low emission zones
Value capture policy for public transport infrastructure
Extension of BRT
Encouraging telecommuting and teleshopping
Terminals for coach transport
Reform of the taxi system
Institutional strengthening for the execution and financing of public…
Creation of a Ministry of Cities or similar institutions
Fleet renewal incentives
Improvement of the existing road network and retrofitting
Investment and subsidy for development and adaptation of clean…
New system for project evaluation and monitoring
Reform of traffic control system (traffic lights)
Media and education campaigns for road safety the promotion of…
Strengthening of emission standards
Priority lanes for buses (not BRT) and high occupancy vehicles
Promotion of ICTs for mobility (cycle and car share, Mobility as a…
Ecological tax
Investment in new infrastructure projects
Speed restrictions (zones 20) and pedestrianization
Other - Capacity building
Other - Housing policies to approach people to their destinations
Public and private parking policy reform

Number of votes to measures

0   2   4   6   8   10   12

■ 2021-25   ■ 2026-30   ■ 2031-35   ■ 2036-40   ■ 2041-45   ■ 2046-50

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Policy Packages of Path A

		Objectives				Orientation				Selection	Feasibility	
		Economic	Social	Environmental	Institutional	Lifestyle	Market	Regulation	Infrastructure		Political	Economic
1A	**Public transport systems A**	5	5	4	2	0	2	3	4		3.7	3.7
x	Construction of the Metro network	x	x	x					x	9	3.8	3.0
	Extension of BRT	x	x	x					x	5	3.4	4.0
x	Formalization of certain bus corridors	x	x	x	x		x	x	x	11	3.5	3.5
	Priority lanes for buses (not BRT) and high occupancy vehicles	x	x	x				x	x	3	4.0	4.7
	Subsidy policy and new fare scheme for public transport	x	x		x		x	x		6	3.7	3.3
2	**Ecological action**	1	5	8	0	4	5	5	1		3.7	4.0
	Speed restrictions (zones 20) and pedestrianization		x	x		x		x		2	4.0	4.0
	Improve conditions for walking and cycling		x	x		x		x	x	10	3.9	4.1
	Congestion charging and low emission zones		x	x			x			6	3.5	4.0
x	Ecological tax	x	x	x		x	x	x		2	4.0	5.0
x	Strengthening of emission standards		x				x	x		3	3.3	4.0
	Fleet renewal incentives		x				x	x		4	3.8	2.8
x	Investment and subsidy for development and adaptation of clean fuel technologies		x				x			4	3.5	3.5
	Media and education campaigns for road safety the promotion of sustainable modes and awareness of the externalities of the private car		x	x		x				3	4.0	4.7
4A	**Land use A**	3	2	2	3	2	3	5	0		3.6	3.7
	Measures for mixed land use and densification (bottom-up)	x	x	x		x	x	x		9	3.8	3.7
x	Urban regeneration schemes and promotion of centralities (bottom-up)	x	x	x		x	x	x		9	3.7	3.7
x	New binding system of integrated planning				x			x		7	3.7	4.0
	Value capture policy for public transport infrastructure	x			x			x	x	5	3.4	4.2
	Other - Capacity building				x			x		2	3.5	3.0
5	**Livable city A**	6	10	9	1	6	3	8	5		3.9	3.7
	Measures for mixed land use and densification (bottom-up)	x	x	x		x	x	x		9	3.8	3.7
	Urban regeneration schemes and promotion of centralities (bottom-up)	x	x	x		x	x	x		9	3.7	3.7
	Speed restrictions (zones 20) and pedestrianization		x	x		x		x		2	4.0	4.0
x	Improve conditions for walking and cycling		x	x		x		x	x	10	3.9	4.1
	Public and private parking policy reform	x	x	x			x	x		1	4.0	1.0
	Priority lanes for buses (not BRT) and high occupancy vehicles	x	x	x				x	x	3	4.0	4.7
	Improvement of the existing road network and retrofitting		x	x	x				x	4	3.0	3.5
	Reform of traffic control system (traffic lights)	x	x	x				x	x	3	4.7	4.0

#	Measure	C1	C2	C3	C4	C5	C6	C7	C8	N	S1	S2
	x Vision Zero policies	x	x			x		x	x	7	3.9	4.0
	Media and education campaigns for road safety the promotion of sustainable modes and awareness of the externalities of the private car		x	x		x				3	4.0	4.7
6	**Transport management**	5	8	7	2	3	3	6	5		3.8	3.6
	Speed restrictions (zones 20) and pedestrianization		x	x		x		x		2	4.0	4.0
	Public and private parking policy reform	x	x	x			x	x		1	4.0	1.0
	Priority lanes for buses (not BRT) and high occupancy vehicles	x	x	x				x	x	3	4.0	4.7
	Improvement of the existing road network and retrofitting		x	x	x				x	4	3.0	3.5
	Terminals for coach transport (market led)	x					x		x	4	3.8	3.3
	x Congestion charging and low emission zones		x	x			x			6	3.5	4.0
	x Reform of traffic control system (traffic lights)	x	x	x				x	x	3	4.7	4.0
	Vision Zero policies	x	x			x		x	x	7	3.9	4.0
	Media and education campaigns for road safety the promotion of sustainable modes and awareness of the externalities of the private car		x	x		x				3	4.0	4.7
	Other - Capacity building				x			x		2	3.5	3.0
7	**Freight**	3	2	1	3	1	1	2	2		3.6	3.6
	Investment in new infrastructure projects (market-led)	x	x	x	x				x	2	3.5	2.5
	Promotion of ICTs for mobility (cycle and car share, Mobility as a Service)	x	x		x	x				3	4.0	4.3
	New binding system of integrated planning				x		x			7	3.7	4.0
	x New concepts of freight transport (urban logistics centres, multimodality, etc.)	x					x	x	x	6	3.0	3.5
8	**ICT**	2	2	1	1	2	0	0	0		3.6	3.8
	x Encouraging telecommuting and teleshopping	x	x	x		x				4	3.3	3.3
	x Promotion of ICTs for mobility (cycle and car share, Mobility as a Service)	x	x		x	x				3	4.0	4.3
9A	**Multimodality A**	5	6	5	4	2	0	4	6		3.6	3.7
	Improve conditions for walking and cycling		x	x		x		x	x	10	3.9	4.1
	Construction of the Metro network	x	x	x					x	9	3.8	3.0
	Extension of BRT	x	x	x					x	5	3.4	4.0
	x Improvement of the existing road network and retrofitting		x	x	x				x	4	3.0	3.5
	Formalization of certain bus corridors	x	x	x	x			x	x	11	3.5	3.5
	New binding system of integrated planning				x		x			7	3.7	4.0
	Terminals for coach transport	x						x	x	4	3.8	3.3
	Promotion of ICTs for mobility (cycle and car share, Mobility as a Service)	x	x		x	x				3	4.0	4.3
10	**Public awareness**	3	4	2	1	4	0	1	1		3.8	4.1
	Vision Zero policies	x	x			x		x	x	7	3.9	4.0
	Encouraging telecommuting and teleshopping	x	x	x		x				4	3.3	3.3
	Promotion of ICTs for mobility (cycle and car share, Mobility as a Service)	x	x		x	x				3	4.0	4.3
	x Media and education campaigns for road safety the promotion of sustainable modes and awareness of the externalities of the private car		x	x		x				3	4.0	4.7
11A	**Infrastructure investments A**	7	7	6	4	2	2	6	8		3.6	3.7
	Improve conditions for walking and cycling		x	x		x		x	x	10	3.9	4.1

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	Construction of the Metro network	x	x	x					x	9	3.8	3.0
	Extension of BRT	x	x	x					x	5	3.4	4.0
	Improvement of the existing road network and retrofitting		x	x	x				x	4	3.0	3.5
x	Investment in new infrastructure projects	x	x	x	x				x	2	3.5	2.5
	Reform of traffic control system (traffic lights)	x	x	x				x	x	3	4.7	4.0
	Vision Zero policies	x	x			x		x	x	7	3.9	4.0
	New binding system of integrated planning				x			x		7	3.7	4.0
	Value capture policy for public transport infrastructure	x			x		x	x		5	3.4	4.2
	New concepts of freight transport (urban logistics centres, multimodality, etc.)	x					x	x	x	6	3.0	3.5

Policy Packages of Path B

			Objectives				Orientation				Selection	Feasibility	
			Economic	Social	Environmental	Institutional	Lifestyle	Market	Regulation	Infrastructure		Political	Economic
1		Public transport systems B	6	5	4	4	0	1	5	4		3.	3.
	x	Construction of the Metro	x	x	x					x	9	3.	3.
		Extension of BRT	x	x	x					x	5	3.	4.
	x	Reform and formalization of	x	x	x	x			x	x	11	3.	3.
		Priority lanes for buses (not	x	x	x				x	x	3	4.	4.
		Subsidy policy and new fare	x	x		x		x	x		6	3.	3.
		New binding system of				x			x		7	3.	4.
		Institutional strengthening for	x			x			x		4	4.	4.
2		Ecological action	1	5	8	0	4	5	5	1		3.	4.
		Speed restrictions (zones 20)		x	x		x		x		2	4.	4.
		Improve conditions for walking		x	x		x		x	x	10	3.	4.
		Congestion charging and low		x	x			x			6	3.	4.
	x	Ecological tax	x	x	x		x	x	x		2	4.	5.
	x	Strengthening of emission			x			x	x		3	3.	4.
		Fleet renewal incentives			x			x	x		4	3.	2.
	x	Investment and subsidy for			x			x			4	3.	3.
		Media and education		x	x		x				3	4.	4.
3		Institutional reform	5	3	2	5	1	2	8	1		3.	3.
		Subsidy policy and new fare	x	x		x		x	x		6	3.	3.
		New system for project	x		x				x		4	3.	4.
		Vision Zero policies	x	x			x		x	x	7	3.	4.
	x	New binding system of				x			x		7	3.	4.
		Creation of a Ministry of Cities				x			x		4	2.	3.
		Institutional strengthening for	x			x			x		4	4.	4.
	x	Other - Capacity building				x			x		2	3.	3.
		Other - Housing policies to	x	x	x			x	x		1	1.	3.
4		Land use B	4	3	3	3	2	4	6	0		3.	3.
		Comprehensive measures for	x	x	x		x	x	x		9	3.	3.
	x	Comprehensive urban	x	x	x		x	x	x		9	3.	3.
	x	New binding system of				x			x		7	3.	4.
		Value capture policy for public	x			x		x	x		5	3.	4.
		Other - Capacity building				x			x		2	3.	3.
		Other - Housing policies to	x	x	x			x	x		1	1.	3.
5		Livable city B	7	11	10	1	6	4	9	5		3.	3.
		Measures for mixed land use	x	x	x		x	x	x		9	3.	3.
	x	Urban regeneration schemes	x	x	x		x	x	x		9	3.	3.
		Speed restrictions (zones 20)		x	x		x		x		2	4.	4.
	x	Improve conditions for walking		x	x		x		x	x	10	3.	4.

#		Measure										A	B
		Public and private parking	x	x	x			x	x		1	4.	1.
		Priority lanes for buses (not	x	x	x				x	x	3	4.	4.
		Improvement of the existing		x	x	x				x	4	3.	3.
		Reform of traffic control	x	x	x				x	x	3	4.	4.
		Vision Zero policies (top-down)	x	x			x		x	x	7	3.	4.
		Media and education		x	x		x				3	4.	4.
		Other - Housing policies to	x	x	x			x	x		1	1.	3.
6		**Transport management**	**5**	**8**	**7**	**2**	**3**	**3**	**7**	**5**		**3.**	**3.**
		Speed restrictions (zones 20)		x	x		x		x		2	4.	4.
		Public and private parking	x	x	x			x	x		1	4.	1.
		Priority lanes for buses (not	x	x	x				x	x	3	4.	4.
		Improvement of the existing		x	x	x				x	4	3.	3.
		Terminals for coach transport	x					x	x	x	4	3.	3.
	x	Congestion charging and low		x	x			x			6	3.	4.
	x	Reform of traffic control	x	x	x				x	x	3	4.	4.
		Vision Zero policies	x	x			x		x	x	7	3.	4.
		Media and education		x	x		x				3	4.	4.
		Other - Capacity building				x			x		2	3.	3.
7		**Freight**	**3**	**2**	**1**	**3**	**1**	**1**	**2**	**2**		**3.**	**3.**
		Investment in new	x	x	x	x				x	2	3.	2.
		Promotion of ICTs for mobility	x	x		x	x				3	4.	4.
		New binding system of				x			x		7	3.	4.
	x	New concepts of freight	x					x	x	x	6	3.	3.
8		**ICT**	**2**	**2**	**1**	**1**	**2**	**0**	**0**	**0**		**3.**	**3.**
	x	Encouraging telecommuting	x	x	x		x				4	3.	3.
	x	Promotion of ICTs for mobility	x	x			x				3	4.	4.
9		**Multimo**	**6**	**7**	**5**	**4**	**2**	**0**	**5**	**6**		**3.**	**3.**
		Improve conditions for walking		x	x		x		x	x	10	3.	4.
		Construction of the Metro	x	x	x					x	9	3.	3.
		Extension of BRT	x	x	x					x	5	3.	4.
	x	Improvement of the existing		x	x	x				x	4	3.	3.
		Reform and formalization of	x	x	x	x			x	x	11	3.	3.
		Reform of the taxi system	x	x					x		4	4.	4.
		New binding system of				x			x		7	3.	4.
		Terminals for coach transport	x						x	x	4	3.	3.
		Promotion of ICTs for mobility	x	x		x	x				3	4.	4.
1		**Public awareness**	**3**	**4**	**2**	**1**	**4**	**0**	**1**	**1**		**3.**	**4.**
		Vision Zero policies	x	x			x		x	x	7	3.	4.
		Encouraging telecommuting	x	x	x		x				4	3.	3.
		Promotion of ICTs for mobility	x	x		x	x				3	4.	4.
	x	Media and education		x	x		x				3	4.	4.
1		**Infrastructure investments B**	**8**	**7**	**7**	**4**	**2**	**2**	**7**	**8**		**3.**	**3.**
		Improve conditions for walking		x	x		x		x	x	10	3.	4.
		Construction of the Metro	x	x	x					x	9	3.	3.
		Extension of BRT	x	x	x					x	5	3.	4.
		Improvement of the existing		x	x	x				x	4	3.	3.
		New system for project	x		x				x		4	3.	4.
	x	Investment in new	x	x	x	x				x	2	3.	2.

			1	2	3	4	5	6	7	8			
		Reform of traffic control	x	x	x				x	x	3	4.	4.
		Vision Zero policies	x	x			x		x	x	7	3.	4.
		New binding system of				x			x		7	3.	4.
		Value capture policy for public	x			x		x	x		5	3.	4.
		New concepts of freight	x					x	x	x	6	3.	3.
	1	**Vision Zero**	**3**	**6**	**6**	**1**	**4**	**0**	**5**	**4**		**3.**	**4.**
		Speed restrictions (zones 20)		x	x		x		x		2	4.	4.
x		Improve conditions for walking		x	x		x		x	x	10	3.	4.
x		Improvement of the existing		x	x	x				x	4	3.	3.
		New system for project	x		x				x		4	3.	4.
		Reform of traffic control	x	x	x				x	x	3	4.	4.
x		Vision Zero policies	x	x			x		x	x	7	3.	4.
		Media and education		x	x		x				3	4.	4.

Appendix E: Expertise Matrix of Participants

	Participation			Gender		Age					Background organization								Field of education						Expertise in …								Familiar transport mode								
Participant	Phase 1: Visioning	Phase 2: Packaging and pathways	Validation	Male	Female	<30	30 - 39	40 - 49	50 - 59	60 +	Administration	Interest group	Consultancy	NGO	Activism	Business	Academy / Research	Other	Social sciencies / humanities	Economics or administration	Law	Public policy	Architecture, urbanism or planning	Engineering or Sciences	Generalist	Design	Development projects	Project management	Public policy	Business	Research	Others	Metro / rail	BRT	Bus, combi, coaster	Motorcycle	Cablecar	Private car	Taxi	Paratransit	Walking, cycling and micromobility
1	x				x		x								x						x								x				x	x	x						x
2	x				x		x								x					x						x	x	x													x
3	x				x	x									x								x									x	x		x			x			x
4	x			x				x								x							x	x						x								x			
5	x			x						x		x												x	x									x	x	x		x	x	x	
6	x			x					x		x													x		x	x	x						x	x						x
7	x			x			x										x							x							x							x			x
8	x				x		x							x							x		x		x		x								x			x			x
9	x			x					x								x		x				x								x		x	x	x	x	x	x	x	x	x
15	x			x						x			x							x									x				x	x	x		x	x	x	x	x
22	x				x			x				x									x			x				x					x	x	x		x				x
10	x	x		x		x									x								x			x	x							x							
11	x	x			x		x					x								x					x		x						x	x	x			x			x
12	x	x			x		x					x							x					x			x	x	x				x	x	x	x	x	x	x	x	x
13	x	x	x	x			x						x						x				x	x		x	x	x					x	x	x			x		x	x
14	x	x		x			x										x		x				x								x							x			
16	x	x		x				x					x										x			x		x					x	x	x		x	x	x	x	x
17	x	x		x			x										x					x							x				x	x							
18	x	x		x		x					x										x								x				x	x		x			x		x
19	x	x		x			x						x											x	x			x	x				x					x	x	x	
20	x	x			x		x				x									x									x				x	x	x		x	x	x	x	x
21	x	x		x			x				x													x				x					x	x							x
23		x			x		x						x						x					x			x	x		x				x				x			x
%	96	52	4	61	39	13	57	13	9	9	17	17	22	4	17	4	17	0	22	17	17	4	35	43	17	22	35	39	30	9	13	4	61	70	57	17	26	65	35	35	74

Appendix F: Research Ethics and Risk Assessment

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

▲UCL

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form

http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION THE BARTLETT SCHOOL OF PLANNING
LOCATION(S) LONDON, UK
PERSONS COVERED BY THE RISK ASSESSMENT Rafael Gonzalo Alarcon Rodriguez - Paiva - SN 18151517

BRIEF DESCRIPTION OF FIELDWORK.
Online interviews from London with different participants in Lima, Peru.

Consider, in turn, each hazard (white on black). If NO hazard exists select NO and move to next hazard section.
If a hazard does exist select YES and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ? No hazard

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- [ ] work abroad incorporates Foreign Office advice
- [ ] participants have been trained and given all necessary information
- [ ] only accredited centres are used for rural field work
- [ ] participants will wear appropriate clothing and footwear for the specified environment
- [ ] trained leaders accompany the trip
- [ ] refuge is available
- [ ] work in outside organisations is subject to their having satisfactory H&S procedures in place
- [ ] OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	Where emergencies may arise use space below to identify and assess any risks

e.g. fire, accidents	Examples of risk: loss of property, loss of life

No hazard

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- ☐ participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
- ☐ fire fighting equipment is carried on the trip and participants know how to use it
- ☐ contact numbers for emergency services are known to all participants
- ☐ participants have means of contacting emergency services
- ☐ participants have been trained and given all necessary information
- ☐ a plan for rescue has been formulated, all parties understand the procedure
- ☐ the plan for rescue /emergency has a reciprocal element
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EQUIPMENT	Is equipment used?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. clothing, outboard motors.	Examples of risk: Inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangement for equipment is followed
- ☐ participants have been provided with any necessary equipment appropriate for the work
- ☐ all equipment has been inspected, before issue, by a competent person
- ☐ all users have been advised of correct use
- ☐ special equipment is only issued to persons trained in its use by a competent person
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? No hazard

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- [ ] an appropriate number of trained first-aiders and first aid kits are present on the field trip
- [ ] all participants have had the necessary inoculations/ carry appropriate prophylactics
- [ ] participants have been advised of the physical demands of the trip and are deemed to be physically suited
- [ ] participants have been adequate advice on harmful plants, animals and substances they may encounter
- [ ] participants who require medication have advised the leader of this and carry sufficient medication for their needs
- [ ] OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	Will transport be required	NO	X	Move to next hazard
		YES		Use space below to identify and assess any risks
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- [ ] only public transport will be used
- [ ] the vehicle will be hired from a reputable supplier
- [ ] transport must be properly maintained in compliance with relevant national regulations
- [ ] drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
- [ ] drivers have been trained and hold the appropriate licence
- [ ] there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
- [ ] sufficient spare parts carried to meet foreseeable emergencies
- [ ] OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

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DEALING WITH THE PUBLIC	Will people be dealing with public	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

☐ all participants are trained in interviewing techniques
☐ interviews are contracted out to a third party
☐ advice and support from local groups has been sought
☐ participants do not wear clothes that might cause offence or attract unwanted attention
☐ interviews are conducted at neutral locations or where neither party could be at risk
☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

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WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

☐ lone working on or near water will not be allowed
☐ coastguard information is understood; all work takes place outside those times when tides could prove a threat
☐ all participants are competent swimmers
☐ participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
☐ boat is operated by a competent person
☐ all boats are equipped with an alternative means of propulsion e.g. oars
☐ participants have received any appropriate inoculations
☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	Do MH activities take place?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES		Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangement for MH is followed
- ☐ the supervisor has attended a MH risk assessment course
- ☐ all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- ☐ all persons performing MH tasks are adequately trained
- ☐ equipment components will be assembled on site
- ☐ any MH task outside the competence of staff will be done by contractors
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangements for dealing with hazardous substances and waste are followed
- ☐ all participants are given information, training and protective equipment for hazardous substances they may encounter
- ☐ participants who have allergies have advised the leader of this and carry sufficient medication for their needs
- ☐ waste is disposed of in a responsible manner
- ☐ suitable containers are provided for hazardous waste
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	NO	If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES	Give details of control measures in place to control the identified risks

Have you identified any risks that are not adequately controlled?	NO	X	Move to Declaration
	YES	☐	Use space below to identify the risk and what action was taken

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? | NO

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

| DECLARATION | The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment. |

Select the appropriate statement:

[X] I the undersigned have assessed the activity and associated risks and declare that there is no significant residual
risk

[ ] I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by
the method(s) listed above

NAME OF SUPERVISOR Robin Hickman

** SUPERVISOR APPROVAL TO BE CONFIRMED VIA E-MAIL **

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