A participatory multicriteria approach to evaluate strategic projects for local sustainable development

Hannia Karime Gonzalez Urango
Author

Mónica García Melón
Supervisor

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Agradecimientos

Y de repente "Nos dimos cuenta que estábamos en la misma barca, todos frágiles y desorientados, pero al mismo tiempo importantes y necesarios".

El momento en el que escribo estas líneas no es precisamente el episodio más agradable de la historia reciente. Cuando se emprende un nuevo proyecto nunca te imaginas finalizarlo en tiempos de pandemia. La cuarentena, autoimpuesta para acabar la tesis, se convirtió en obligatoria y en medio de la ansiedad, la desilusión y muchas inquietudes, solo tienes que acabarla. Termino con la ilusión de poder continuar con mi vida en la academia y de que este mal episodio pase, para poder visitar mi querida Cartagena, la que me inspiro este trabajo. Espero pronto pisar la arena de su playa, disfrutar de una guayaba blanca y el mar Caribe de fondo.

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Un día estas agotada de una vida 24/7 y tu compañero de vida te propone iniciar la más aventura maravillosa de la vida. Ilusionada y con toda la fe en lo que juntos pueden hacer, deciden emprender el viaje hacia una tierra desconocida que resultó siendo un territorio amigo. Moltes gràcies, València!

Summary

The dilemma of development and sustainability in the local context generates multiple interests and concerns. This dissertation arises from the challenge proposed by both concepts in the framework of decision making for urban planning. Its development has been guided by two main motivations. The first and most important is to discuss sustainable development in a context where little had been said, responding to how to improve the practices used for the prioritisation of actions during the planning stages of local development projects, taking as a case study the city of Cartagena de Indias (Colombia). The second, on the other hand, responds to the interest of contributing to the field of multicriteria decision making techniques.

The objective is to design a methodology to help those responsible for territorial planning to evaluate development strategies and projects. In particular, it focuses on the participation of different stakeholders and on the approach to sustainable local development. Therefore, the general research question is: how can a participatory multicriteria methodology help to evaluate local development projects with a sustainable approach? To answer this research question the present dissertation, of an exploratory and descriptive nature, has been designed, and developed from the application of three cases of iterative and complementary studies. The objective has been to propose a framework that systematically allows the taking of decisions and the integration of diverse positions, without trying to find a unique solution with the best decision model.

The proposed methodology has been developed from the combination of two techniques known from the field of Operations Research, Analytic Network Process (ANP) and Social Network Analysis (SNA). SNA is used to find out how the network of actors related to a problem is structured, to study and evaluate the relationships between the actors that make it up, to determine their degree of cohesion, the actors in the most relevant positions and the existing structural gaps. All of this permits the selection of participants in the decision making process carried out through ANP. ANP is a well-known multicriteria decision method, which provides a framework for addressing decision making or problem assessment. It defines a prioritisation model as a network with complex, interdependent and feedback relationships between elements. The elements represent characteristics, requirements, conditions or criteria related to a problem, as well as possible alternative solutions. ANP is used to discover the opinions of the participants, to obtain their decision profiles and to reach a consensus on the prioritisation of projects and strategies. Additionally, this methodological proposal, based on the SNA-ANP combination, can be completed with other techniques, for example, geographic information systems to add some components that improve the decision.

The results suggest that this SNA-ANP methodology is a novel and useful combination for evaluating local development plans with a multicriteria, sustainable and participatory approach. The results establish a basis for proposing new applications and generating new discussions with the local administration and other actors.

With the inclusion of the local and sustainable development approach in the decision framework, throughout this dissertation, the value of different heritages is highlighted, as is the promotion of a more adapted strategic planning and the recognition and inclusion of multiple groups of actors. In addition, the use of practical and replicable methodologies that account for the results is promoted, to be applied at different scales, in order to improve planning and prioritisation of actions.

The proposal has considered the dimensions of sustainability in decision models, the active participation of decision-makers and a better selection of participants. In short, it has facilitated the construction of a more participatory decision making process. Finally, it also allows us to explore future applications and to continue the discussion related to the problem of decision making during the planning and evaluation stages of strategic projects, whether for local sustainable development or for other types of objectives.

Keywords:
Multicriteria assessment; participatory decision making; sustainability; local development; prioritisation; Analytic Network Process (ANP); stakeholders; Social Network Analysis (SNA); Cartagena de Indias; marine and maritime industry; sustainable tourism; pedestrian mobility.

Resumen

El dilema del desarrollo y la sostenibilidad en el contexto local genera múltiples intereses e inquietudes. Esta disertación surge entorno al desafío propuesto por ambos conceptos en el marco de la toma de decisiones para la planeación urbana. Su desarrollo se ha orientado a partir de dos motivaciones principales. La primera y más importante es discutir sobre desarrollo sostenible en un contexto en el que se había hablado poco, respondiendo a cómo mejorar las prácticas utilizadas para la priorización de acciones durante las etapas de planeación de proyectos de desarrollo local, tomando como objeto de estudio la ciudad de Cartagena de Indias (Colombia). La segunda, por su parte, responde al interés por contribuir en el campo de las técnicas de toma de decisiones multicriterio.

El objetivo es diseñar una metodología para ayudar a los responsables de la planificación territorial a evaluar estrategias y proyectos de desarrollo. En particular, se centra en la participación de diferentes partes interesadas y en el enfoque al desarrollo local sostenible. Por lo tanto, la pregunta general de investigación es: ¿Cómo puede una metodología multicriterio participativa ayudar a evaluar proyectos de desarrollo local con un enfoque sostenible? Para responder a esta pregunta de investigación se ha diseñado la presente disertación, de naturaleza exploratoria y descriptiva, desarrollada a partir de la aplicación de tres casos de estudios iterativos y complementarios. El objetivo ha sido proponer un marco que de forma sistemática permita tomar decisiones e integrar diversas posiciones, sin pretender hallar una solución única con el mejor modelo de decisión.

La metodología propuesta se ha construido a partir de la combinación de dos técnicas conocidas del campo de la Investigación de Operaciones, el Proceso Analítico en Red (ANP) y el Análisis de Redes Sociales (SNA). El SNA se utiliza para conocer cómo se estructura la red de actores relacionados con un problema, estudiar y evaluar las relaciones entre los actores que la componen, determinar su grado de cohesión, los actores en posiciones más relevantes y los vacíos estructurales existentes. Todo ello permite seleccionar a los participantes en el proceso de toma de decisiones realizado a través del ANP. El ANP es un conocido método de decisión multicriterio, que proporciona un marco para abordar la toma de decisiones o la evaluación de problemas. Define un modelo de priorización como una red con relaciones complejas, interdependientes y retroalimentadas entre elementos. Los elementos representan características, requerimientos, condiciones o criterios relacionados con un problema, así como las posibles alternativas de solución. El ANP se utiliza para conocer las opiniones de los participantes, obtener sus perfiles de decisión y alcanzar un consenso sobre la priorización de proyectos y estrategias. Adicionalmente, esta propuesta metodológica, basada en la combinación SNA-ANP, se puede completar con otras técnicas, por ejemplo, los sistemas de información geográfica para agregar algunos componentes que mejoren la decisión.

Los resultados sugieren que esta metodología SNA-ANP, es una combinación novedosa y útil para evaluar planes de desarrollo local con un enfoque multicriterio, sostenible y participativo. Los resultados establecen una base para proponer nuevas aplicaciones y generar nuevas discusiones con la administración local y otros actores.

Con la inclusión del enfoque del desarrollo local y sostenible en el marco de las decisiones, a lo largo de esta disertación, se resalta el valor de distintos patrimonios, la promoción de una planeación estratégica más adaptada y el reconocimiento e inclusión de múltiples grupos de actores. Además, se

promueve el uso de metodologías prácticas y replicables que den cuenta de los resultados, para ser aplicadas a diferentes escalas, con el fin de mejorar la planeación y la priorización de acciones.

La propuesta ha considerado las dimensiones de la sostenibilidad en los modelos de decisión, la participación activa de los decisores y una mejor selección de los participantes. En síntesis, ha facilitado la construcción de un proceso de decisión más participativo. Finalmente, también permite explorar futuras aplicaciones y continuar la discusión relacionada con el problema de la toma de decisiones durante las etapas de planeación y evaluación de proyectos estratégicos sean para el desarrollo local sostenible o para otro tipo de objetivos.

Palabras clave:
Evaluación multicriterio; toma de decisiones participativa; sostenibilidad; desarrollo local; priorización; Proceso Analítico en Red (ANP); stakeholders; Análisis de Redes Sociales (SNA); Cartagena de Indias; industria náutica y naval; turismo sostenible; movilidad peatonal.

Resum

El dilema del desenvolupament i la sostenibilitat en el context local genera múltiples interessos i inquietuds. Aquesta dissertació sorgeix entorn al desafiament proposat per ambdós conceptes en el marc de la presa de decisions per a la planificació urbana. El seu desenvolupament s'ha orientat a partir de dues motivacions principals. La primera i més important és discutir sobre desenvolupament sostenible en un context en què s'havia parlat poc, responent a com millorar les pràctiques utilitzades per a la priorització d'accions durant les etapes de planificació de projectes de desenvolupament local, prenent com a objecte d'estudi la ciutat de Cartagena d'Índies (Colòmbia). La segona, per la seva banda, respon a l'interès per contribuir en el camp de les tècniques de presa de decisions multicriteri.

L'objectiu és dissenyar una metodologia per ajudar els responsables de la planificació territorial a avaluar estratègies i projectes de desenvolupament. En particular, es centra en la participació de diferents parts interessades i en l'enfocament al desenvolupament local sostenible. Per tant, la pregunta general d'investigació és: Com pot una metodologia multicriteri participativa ajudar a avaluar projectes de desenvolupament local amb un enfocament sostenible? Per respondre a aquesta pregunta de recerca s'ha dissenyat la present dissertació, de naturalesa exploratòria i descriptiva, desenvolupada a partir de l'aplicació de tres casos d'estudi iteratius i complementaris. L'objectiu ha estat proposar un marc que de forma sistemàtica permeti prendre decisions i integrar diverses posicions, sense pretendre trobar una solució única amb el millor model de decisió.

La metodologia proposada s'ha construït a partir de la combinació de dues tècniques conegudes del camp de la Investigació d'Operacions, el Procés Analític en Xarxa (ANP) i l'anàlisi de xarxes socials (SNA). El SNA s'utilitza per conèixer com s'estructura la xarxa d'actors relacionats amb un problema, estudiar i avaluar les relacions entre els actors que la componen, determinar el seu grau de cohesió, els actors en posicions més rellevants i els buits estructurals existents. Tot això permet seleccionar els participants en el procés de presa de decisions realitzat a través de l'ANP. L'ANP és un conegut mètode de decisió multicriteri, que proporciona un marc per abordar la presa de decisions o l'avaluació de problemes. Defineix un model de priorització com una xarxa amb relacions complexes, interdependents i retroalimentades entre elements. Els elements representen característiques, requeriments, condicions o criteris relacionats amb un problema, així com les possibles alternatives de solució. El ANP s'utilitza per conèixer les opinions dels participants, obtenir els seus perfils de decisió i arribar a un consens sobre la priorització de projectes i estratègies. Addicionalment, aquesta proposta metodològica, basada en la combinació SNA-ANP, es pot completar amb altres tècniques, per exemple, els sistemes d'informació geogràfica per afegir alguns components que millorin la decisió.

Els resultats suggereixen que aquesta metodologia SNA-ANP, és una combinació innovadora i útil per avaluar plans de desenvolupament local amb un enfocament multicriteri, sostenible i participatiu. Els resultats estableixen una base per proposar noves aplicacions i generar noves discussions amb l'administració local i altres actors.

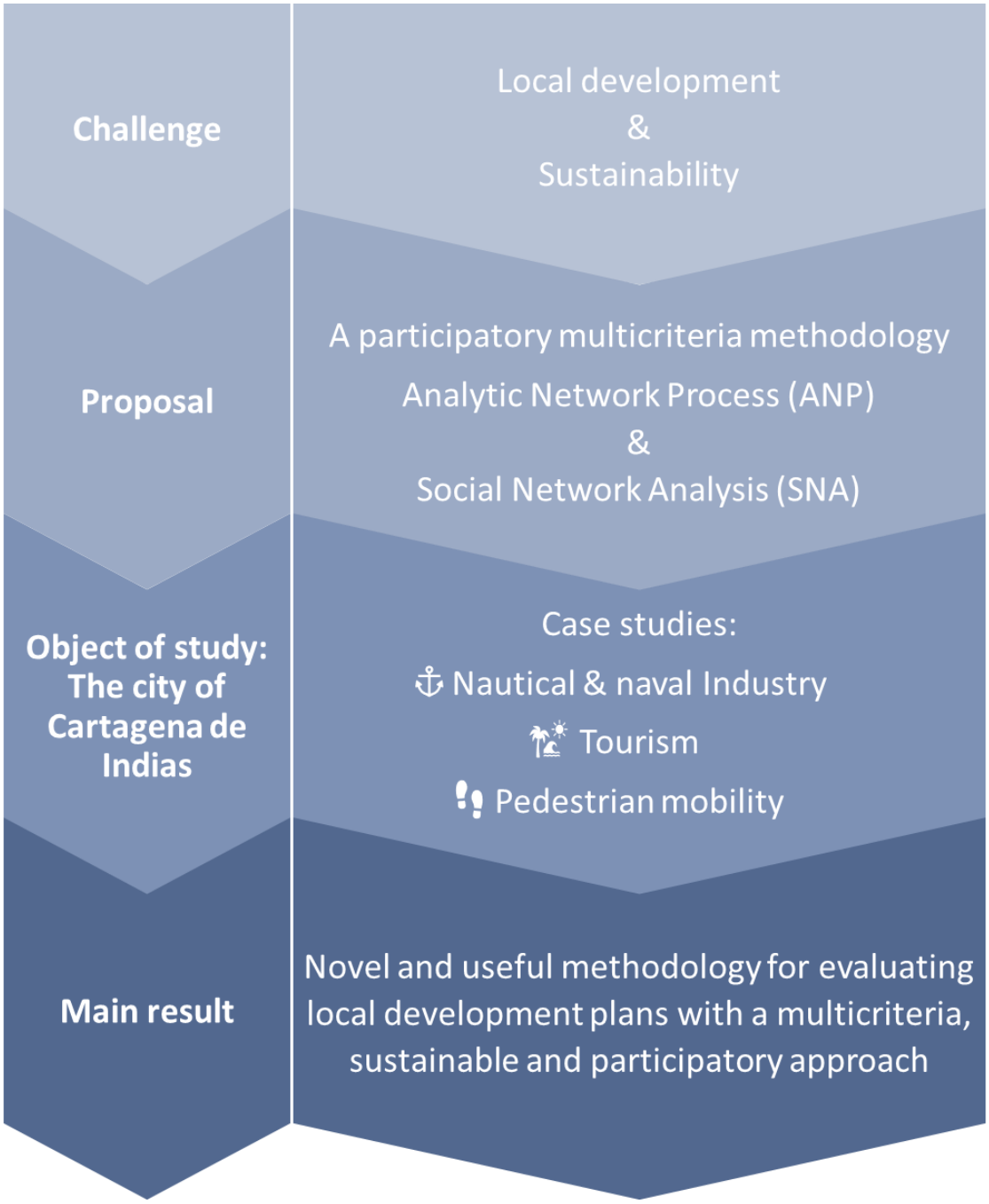
Amb la inclusió de l'enfocament del desenvolupament local i sostenible en el marc de les decisions, al llarg d'aquesta dissertació, es ressalta el valor de diferents patrimonis, la promoció d'una planificació estratègica més adaptada i el reconeixement i inclusió de múltiples grups d'actors . A més,

es promou l'ús de metodologies pràctiques i replicables que donin compte dels resultats, per ser aplicades a diferents escales, per tal de millorar la planificació i la priorització d'accions.

La proposta ha considerat les dimensions de la sostenibilitat en els models de decisió, la participació activa dels decisors i una millor selecció dels participants. En síntesi, ha facilitat la construcció d'un procés de decisió més participatiu. Finalment, també permet explorar futures aplicacions i continuar la discussió relacionada amb el problema de la presa de decisions durant les etapes de planificació i avaluació de projectes estratègics siguin per al desenvolupament local sostenible o per a un altre tipus d'objectius.

Paraules clau:
Avaluació multicriteri; presa de decisions participativa; sostenibilitat; desenvolupament local; priorització; Procés Analític en Xarxa (ANP); stakeholders; Anàlisi de Xarxes Socials (SNA); Cartagena d'Índies; indústria nàutica i naval; turisme sostenible; mobilitat de vianants.

Graphical abstract



CHAPTER 1

Introduction

1.1 Introduction

The challenge of sustainable development extensively permeates our society nowadays. It has become a common catchphrase in different discourses; just take a swift look at different public media, policies and programs to update on this challenge. Both terms, sustainable and development, generate multiple discussions. Even so, the concept of sustainable development is widely pursued with multiple approaches and some agreements have been achieved. In the field of planning, sustainable development has been promoted as a new planning agenda. Planning through the ideal of sustainability has become the banner of planners at all levels.

Hence, planning processes have been strongly influenced by the need to respond to the sustainable development framework. Multiple efforts focused on transforming the concept into planning practices are emerging worldwide and the concept has spread throughout multiple local agendas (Berke and Conroy 2000; United Nations General Assembly 2015). The literature on sustainable development has presented substantial discussions in defining the key characteristics of the concept that are relevant to the theory and practice of planning. Several of them highlight and emphasise the value of the 'local'. Thus, sustainable and local development are intrinsically associated with a multi-dimensional concept of change, bringing together economic, social, cultural and environmental dimensions (Kisman and Tasar 2014; Wentworth 2012).

Sustainable development in practice implies negotiations to address objectives of competing interest groups. Many definitions of sustainable development include statements about open and democratic decision making (Kates, Parris, and Leiserowitz 2005). In contrast, local development involves a participatory process in which local people from all sectors work together to achieve a solid regional economic structure (UN-HABITAT 2005). Two key elements appear: decisions and interest groups. Decisions regarding both sustainable and local development imply multiple perspectives and have to consider a large number of variables, involving multiple fields and applications. Therefore, planning the common challenge of sustainable development is also a local challenge.

This dissertation is based on the concept of strategic planning as a tool to achieve local development with a sustainable approach. Strategic planning is carried out on the basis of participation processes as a systematic decision making process that focuses attention on important issues and on how to resolve them (Terrados, Almonacid, and Hontoria 2007; UN-HABITAT 2005). This dissertation proposes to support decision making processes and concentrates on how to assess projects in planning stages, recognizing the presence of public, private and social actors in decision making problems. With the aim of evaluating projects, a general methodology is provided, a way to determine priorities in order to make better choices and to achieve agreed upon targets by the actors involved.

In the above context, two kinds of motivations appear upon on which to undertake the development of this dissertation. In relation to the *theoretical motivations*, the work is designed in the field of multicriteria decision making (MCDM). This is a widely studied research area of operational research and management sciences. The main goal of MCDM studies is to evaluate and choose among alternatives based on multiple criteria, using systematic analysis and multiple techniques (Kiker et al. 2005). Extensions of traditional multicriteria decision techniques are widely proposed. Indeed, some authors consider that any general integration of MCDM techniques with other tools is a

very promising research line as regards territorial issues (Bottero and Ferretti 2010a; Li et al. 2016). This dissertation is nurtured by the concern about exploring the MCDM technique of the Analytical Network Process (ANP) in combination with the stakeholder analysis technique Social Network Analysis (SNA) as a decision support tool in planning stages.

Regarding *practical motivations*, this approach is applied in the city of Cartagena de Indias, Colombia. Due to the recent entry of Colombia into the OECD in 2018, the country has started some institutional reforms and triggered internal reflections in different sectors that have encouraged and stimulated the promotion of a public sector that engages in more dialogue (OCDE 2015). In addition, the process of formulating the National Plan (2014-2018) coincided with that of negotiating Agenda 2030; therefore some of the proposals of the SDG were included in that plan (CEPAL 2018). These represent a challenge for local governments in Colombia.

In the particular case of Cartagena de Indias, the planning practices clamour for contrasted prioritisation methodologies that allow social groups traceability and justification. Several controversies, much like other coastal and touristic cities, have been generated in Cartagena regarding planning processes and the transfer of sustainability issues into local policy agendas. The city has formulated some strategic plans in the short and long-term (Alcaldía Distrital de Cartagena de Indias 2014a, 2014b; Comisión Regional de Competitividad de Cartagena y Bolívar 2010) that have been under pressure from the public and private sectors, but, mainly, from citizens who demand a local development agenda that does not just generate income to certain private sectors of the city.

Thus, this dissertation proposes a methodology based on a combination of SNA and ANP techniques to support decision-makers in Cartagena de Indias in order to assess strategic projects by considering variously interested and affected stakeholders. The overall aim of this dissertation is, therefore, to study and improve decision making practices in the field of planning territories with a sustainable development approach. Related to the aforementioned aim, the following central research question is addressed in this dissertation: *How can a participatory multicriteria methodology help to evaluate local development projects with a sustainable approach?*

In a nutshell, the main *intention* of this dissertation is to propose a multicriteria approach for supporting planning stages through the combination of two well-known techniques. The proposal has a clear practical orientation supported by scientific basis. It does not claim to deepen discussion around the concept or vision of local or sustainable development. Such a discussion goes beyond the scope of this Ph.D. thesis. Both concepts are taken as a framework to guide the proposed methodology. It is also important to clarify that the evaluation of projects is carried out during planning stages for the prioritisation of actions or strategies, and therefore supports decision making.

The main theoretical framework is presented in the following section of this chapter. The next two sections provide an overview of the research design and the outline of the dissertation. A brief mention of the training beyond this document takes place at the end of this chapter. Once this dissertation is introduced, all the research questions are answered in the next four chapters. The main conclusions are drawn and a final discussion is proposed in the last chapter.

1.2 Theoretical Framework

These sub-sections discuss the theories that are behind this dissertation. Four main frameworks have supported their design. Subsequently, some main concepts regarding sustainable development, local development, multicriteria techniques, and participatory approaches are discussed and explained as they are used in this Ph.D. thesis.

1.2.1 Sustainability and Sustainable Development

The meaning of sustainable development can vary depending on one's perspective and can be confused with the term sustainability. There is a substantial corpus of literature that has adopted stronger and different types and concepts of sustainability. The idea of sustainability originated in the context of renewable resources and was subsequently adopted as a broad slogan by the environmental movement (Lélé 1991). Nowadays, the sustainability issue has become increasingly important, so much so that a new field of sustainability science is emerging. Sustainability science seeks the fundamental character of interactions between nature and society (Kates et al. 2001) involving a wide variety of disciplines and sectors. Hence, there are many definitions and approaches to address it, combining a diversity of knowledge and actors at different levels, and raising multiple questions and challenges.

The term sustainability is applied to a wide range of systems, approaches and practices, from accountancy to architecture. In a narrow technical sense, sustainability is the capacity for continuance of a system. In a more usual interpretation, it is the long-term maintenance and enhancement of human well-being in the context of finite planetary resources (Wentworth 2012). In terms of what is sustained, some writers argue that it is present (or future) levels of production (or consumption) that need to be sustained, others the natural stock of resources, or the critical natural capital (Redclift 2005). At least, there is broad agreement that sustainability requires integrating environmental resilience with human well-being, incorporating a long-term perspective (Wentworth 2012).

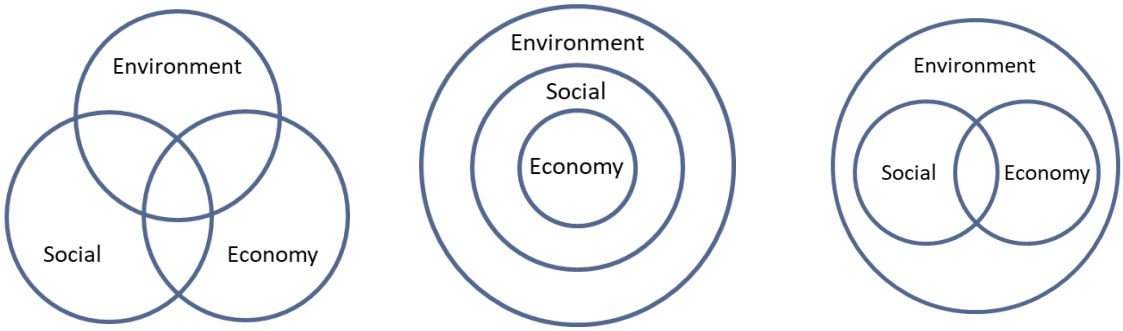
When the term development is introduced, the discussion becomes more ambiguous. Development implies qualitative improvement or at least change, and is often confused and coupled with growth. While development can and should go on indefinitely for all nations, throughput growth cannot (Goodland 1995). Consequently, the term sustainable development should refer to the development that seeks to be sustainable.

Sustainable development

Awareness about how local progress and human activities become unsustainable for the environment as well as the need for new model of development arose in the 60s. But it was not until the 80s the term sustainable development came to prominence. The first important use of the term was in 1980 when the International Union for the Conservation of Nature and Natural Resources (IUCN) presented the World Conservation Strategy (WCS) with "the overall aim of achieving sustainable development through the conservation of living resources" (Eagles, McColl Stephen, and Haynes 2002). It addressed mainly the issue of ecological sustainability. Later in 1987, the concept of sustainable development spread throughout the United Nations system due to the report Our Common Future by the Brundtland Commission (World Commission on Environment and Development). It defined

sustainable development as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Goodland 1995; The Parliamentary Office of Science and Technology 1997). This report led directly to the incorporation of the term in policy discourse (Redclift 2005). However, it was in 1992 at the RIO conference where some principles were proposed to achieve development in the next century. In 2002 the World Summit on Sustainable Development in South Africa marked a further expansion of the standard definition with the inclusion of the widely used three pillars of sustainable development: economic, social, and environmental (Kates et al. 2005; Wentworth 2012).

Both terms, sustainability and sustainable development are essentially represented, classified or expressed as an integration of these three dimensions or categories: (i) environmental/ecological, (ii) social/sociocultural, and (iii) economic (Figure 1.1), known as the pillars of sustainable development. This concept is often represented as three interconnected and mutually reinforcing rings (A), but can also be presented as the economy embedded in society and in the environment (B), or where interconnected social and economic systems are embedded in the environment (C) (Goodland 1995; Watson 2018; Wentworth 2012). Although the literature is awash with many different definitions and interpretations of sustainable development (Mensah, 2019), so these dimensions can be modified in order to enhance one or other dimension.



A. Three-rings B. Nested C. Environmentally dependent

Figure 1.1 *Three visions of sustainable development dimensions. Adapted from: Watson, 2018; Wentworth, 2012*

In 2006, the EU adopted a sustainable development strategy focused on changing consumption and production patterns and integrating policy-making through improved impact assessments and sustainable development principles (Wentworth 2012). Today sustainable development is a worldwide issue. The proposed 2030 Agenda for sustainable development adopted by all United Nations Member States in 2015 considers the same Brundtland definition. All the emerging concepts and policies around sustainable development are related to intergenerational equity and balance, long-term risks and linking local actions to global concerns.

In view of the simplicity of the concept, some authors consider that it is not only problematic but also weak and inconclusive. It does not distinguish among the different concepts of growth and development: "We cannot 'grow' into sustainability" and there is no general agreement on how the concept should be put into practice (Berke and Conroy 2000; Goodland 1995; Kates et al. 2005). Meanwhile, others consider the concept is malleable. It can remain open and dynamic, and be adapted to fit into very different situations and contexts (Kates et al. 2005). It has been adapted to address very diverse challenges, ranging from energy sources to green technology, sustainable cities to sustainable housing communities, and sustainable agriculture to sustainable mining, among many

others. It has also provided a platform on which different areas and sectors have considered and can interact, negotiate, and reflect on their actions' consequences for the environment (Saarinen 2006). Nowadays the concept underpins the future development of all nations, it has been adopted as a policy principle and it is part of everyday language. Sustainable development as a concept, as a goal, and as a movement has likewise become a slogan of companies, international organizations, national institutions, business councils, political parties, governments, NGOs and social movements worldwide (Chang et al. 2015; Kates et al. 2005).

There are many works in all these three directions, at different levels and in multiple application areas. The concept of sustainable development has also been embraced in several fields; each one adopting and adapting the term to its operations. There seems to be a need to transform the general concern regarding of sustainable development into specific targets at all levels, e.g.:

- Public policy: sustainable development has become a highly visible idea in public policy debates. The main challenge for policy-makers is how to bridge the gap between theory and practice (Berke and Conroy 2000).
- Planning: sustainable development has been promoted as a new planning agenda. Efforts focused on transforming the concept into planning practices are emerging (United Nations General Assembly 2015).
- Assessment: assessment approaches can support all levels of decision making and policy processes. Indicators and composite indexes are increasingly recognised as useful tools for policy making and public communication. Numerous initiatives are being worked on that have developed quantitative indicators, metrics and frameworks. They have provided an evaluation from global to local systems, in short and long-term perspectives (Parris and Kates 2003; Singh and Kotzé 2003).
- Participatory process: sustainable development in practice implies multiple negotiations to address multiple purposes of competing interest groups. Many definitions of sustainable development include statements about open and democratic decision making (Kates et al. 2001, 2005).

In summary, we can conclude that sustainable development is the framework, process, or group of processes for integrating environmental, social and economic elements to seek the long-term maintenance and enhancement of human well-being, which implies decisions at different levels. Therefore, this dissertation focuses on how the principles of sustainable development could be considered in decision making processes at planning stages.

1.2.2 Local Development and strategic planning

Local development is a supporting element for sustainable development and vice versa. Local development is addressed theoretically through various interpretations. Those interpretations differ in the way of considering 'the local' based on the theories of development that support them (Nersa Cárdenas 2002). Thus, the conceptual framework related to local development and urban planning in this dissertation hinges mainly on the terminology proposed by the United Nations Human Settlements Program UN-HABITAT. It considers cities as drivers of economic growth, social

development and environmental change, and emphasises improving living conditions in cities, especially in developing countries.

The purpose of local development is to build the capacity of a defined territory to improve its economic future and the quality of life of its inhabitants (Kisman and Tasar 2014). It is a participatory process in which local people from all sectors work together to stimulate a local economy, achieving wellbeing as a mandatory condition, and including and respecting the natural environment (UN-HABITAT 2005).

Local development is closely related to understanding local capabilities and also to building development thereby. One task of local government is to construct a system which encourages and holds together all its various components: public, private and civil society sectors, in a positive tension to establish partnerships and collaboratively find local solutions to common challenges such as sustainable development (Kisman and Tasar 2014; UN-HABITAT 2005). Therefore, promoting local development tends to be relatively complex, as it requires effective coordination between many different types of organizations or stakeholder groups (Kisman and Tasar 2014). It implies strategic planning in terms of territories.

Strategic planning is "a rational-comprehensive approach to strategy formulation that uses a systematic process with specific steps such as external and internal assessments, goal setting, analysis, evaluation and action planning" (Bryson, Edwards, and Van Slyke 2018). In functional terms, it consists of a set of concepts, procedures, tools, and practices that provide a general framework for action, e.g. to determine priorities, make wise choices and allocate scarce resources (Bryson et al. 2018; UN-HABITAT 2005). It has been extended as a tool for local development and territorial structuring (Terrados et al. 2007).

In the public sector strategic planning has been institutionalized as a fairly common practice at all levels of government in several countries (Bryson et al. 2018). At the municipal and city level, Urban and territorial planning can be defined as a "decision making process aimed at achieving economic, social, cultural and environmental goals through the development of spatial visions, strategies and plans and the application of a set of policy principles, tools, institutional and participatory mechanisms and regulatory procedures. It is an integrative and participatory decision making process that takes into account conflicting interests" (UN-HABITAT 2015). It provides strategies and plans and fosters synergies and interactions. It can also contribute to sustainable development in various ways. Since it should be closely linked to the three complementary dimensions of sustainable development (Mensah 2019; UN-HABITAT 2015). It includes an initial focus on a broad agenda, later moving to a more selective action orientation (Bryson et al. 2018). Therefore, at municipal level it is possible to identify three levels of planning:

- Strategic Plans: they represent the strategic planning expressed in a document, which could include mission, vision, objectives, strategies, and operational tactics.
- Strategies: they contain several projects or initiatives to support general objectives or plans for specific sectors or areas.
- Strategic projects/initiatives: strategies are executed as projects or specific activities. Strategic projects are designed to contribute to one or more strategies.

This dissertation is based on these concepts. It focuses on supporting decision making and stakeholder engagement during strategic planning stages in the context of local sustainable development.

1.2.3 Multicriteria Decision Making Techniques

Evaluation and prioritisation of different alternatives to improve planning in a certain context is a decision problem that is addressed from the multicriteria analysis approach. These are a group of techniques known as multicriteria decision making MCDM, multicriteria decision analysis/aid MCDA, or simply multicriteria analysis/assessment MCA, hereafter MCDM, which is a sub-discipline of operations research, also located within management, that groups all the methods that exist to support decision making in cases involving more than one criterion, usually in conflict (Loken 2007). They were developed mainly in the 60s and are applied to decision problems in multiple areas (Govindan and Jepsen 2016).

MCDM techniques provide a framework to attach relative priorities to critical issues and to select the best alternatives (Razavi Toosi and Samani 2016). They are useful when different alternatives have to be managed and compared, for the evaluation of proposals or the weight of a benchmark in relation to other benchmarks (Huang and Wey 2019; Wolfslehner, Vacik, and Lexer 2005).

MCDM methods are flexible, adapting to different types of problems, including uncertainty, integrating social objectives and stakeholder perspectives (Estévez, Walshe, and Burgman 2013). When a method is selected for a particular problem it must be valid, compatible with available data, and understandable (Saaty 1996). Some applications have selected the MCDM approach due to their usefulness when:

- There is a need to structure and use a logical approach to model complex decision making problems (Bottero and Ferretti 2010b; Molinos-Senante et al. 2015; Wolfslehner et al. 2005).
- Problems are multi-objective and sometimes have conflicting objectives involved (Wolfslehner et al. 2005) e.g. Integrating the multiple dimensions of sustainable development and the complex social-ecological systems with potentially conflicting values and goals (Ferretti and Pomarico 2013; Wang et al. 2013; Zhang 2016)
- There are heterogeneous criteria or information or data at different scales included simultaneously. Combining both qualitative and quantitative , tangible and intangible elements or and favourable and unfavourable concerns that must be considered (Bottero and Ferretti 2010b; Ferretti, Bottero, and Mondini 2014; Ferretti and Pomarico 2013; Wang et al. 2013; Wolfslehner et al. 2005)
- It is possible to include conflict, unpredictability, subjectivity and value comparisons on similar scales (Grošelj and Stirn 2015; Zhang 2016);
- There is need for a more rational, transparent, and comprehensive analysis to achieve objective appraisals (Huang and Wey 2019; Wolfslehner et al. 2005);
- It is necessary to integrate different options to generate and compare alternatives through an active participation of the stakeholders and reflecting their opinions in a prospective or retrospective framework (Bottero and Ferretti 2010b; Ferretti 2011; Ferretti and Pomarico 2013).

MCMD techniques offer different solutions based on their applications and according to the context. Many methods have been proposed, some of them designed for a particular problem and others universally used in different areas. There are many possible classification methods of the existing MCDM techniques (Table 1.1).

Table 1.1 MCDM classifications

By schools /approach (Belton and Stewart 2002)	Value measurement models (American school)	A numerical score (or value) is assigned to each alternative, producing an order of preference order for the alternatives. Criteria are given weights that represent their partial contribution to this score. Examples: Multi-attribute value theory (MAVT), multi-attribute utility theory (MAUT), analytical hierarchy process (AHP), analytic network process (ANP)...
	Goal programing GP, aspiration and reference level models	Select alternatives, which are closest to achieving some pre-defined goals or aspirations. For example: the method of displaced ideals, the technique for order of preference by similarity to the ideal solutions (TOPSIS)…
	Outranking models (French school).	Alternatives are compared pairwise to check which of them is preferred regarding each criterion. Preference information is aggregated to determine to what extent one alternative outranks or should be favoured over another. The family of methods known as (ELECTRE), and Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) are part of this group.
By the size of the set of alternatives under consideration (Sierra, Yepes, and Pellicer 2018)	Multi-attribute decision making (MADM)	Methods are designed for problems with a pre-defined discrete set of alternatives. The weights of criteria influence the decision making. E.g. AHP, ANP, PROMETHEE, Life Cycle Assessment (LCA)...
	multi-objective decision making (MODM)	Methods are designed for problems where the alternatives are not predefined (continuous problems). Identify optimal solutions that satisfy different general objectives in conflict. E.g. Complex Proportional Assessment (COPRAS), TOPSIS, GP…
	Complementary	Techniques that facilitate the most representative processing of the data. They are usually hybridizing MCDM methods to address different realities, e.g. Grey Systems Theory, Fuzzy Sets, Monte Carlo Simulation, System Dynamics (SD)...
By the type of problems (Ishizaka, Pearman, and Nemery 2012)	Choosing	The goal is to select a single best action or to reduce the group of actions to a subset of equivalent or incomparable actions.
	Ranking	Actions are ordered in decreasing preference. The order can be complete or partial if we consider incomparable actions.
	Sorting	Alternatives are sorted into ordered, predefined categories. This method is useful for repetitive and/or automatic use. It can also be used for screening in order to reduce the number of actions to consider.
	Description	The goal is to help the description of actions and their consequences.
	Elimination	It is a particular case of the sorting problem where only two classes are defined: accepted and eliminated.
	Designing	The goal is to identify or create a new action, which will meet the goals and aspirations of the decision-maker

Some of the most common MCDM techniques are PROMETHEE, ELECTRE, TOPSIS, VIKOR, the Simple Weighting and AHP, this last is the most popular in different applications. They are used alone, complementing each other or by other approaches such as Fuzzy, GIS and SWOT (Table 1.2).

Due to all the above-mentioned attributes and techniques, MCDM is selected to handle complex problems in various fields of knowledge. More detailed information about MCDM can be found in Barba-Romero and Pomerol (1997), Belton and Stewart (2002) and Loken (2007).

Table 1.2 The most common MCDM techniques

Techniques	Main points	Advantages	Disadvantages	Some applications
AHP	It constitutes a problem within a hierarchical structure to evaluate criteria and alternatives. Use a special ratio scale for pairwise comparisons, which are used both to compare the alternatives with respect to the various criteria and to estimate criteria weights	It is suitable for quantitative and qualitative criteria The consistency of the evaluation process can be measured effectively It is easy to transmit	With the increasing number of criteria and alternatives, massive pairs of comparisons are required. Data are mainly collected based on experience	It is considered the most widely used. Manufacturing, energy, business. Planning, etc. (Dos Santos et al. 2019)
TOPSIS	It is based upon the concept that the chosen alternative should have the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS).	It is easy to utilize and well understandable. It works with fundamental ranking It can easily be revised to eliminate all the subjectivity in the decision process	It does not consider any difference between negative and positive values. It cannot check consistency. It does not consider the relative importance of these distances.	Supplier selection (Boran et al. 2009) Under fuzzy environment (Chen 2000)
VIKOR	VIseKriterijumska Optimizacija i kompromisno Resenje (meaning multicriteria optimization and compromise solution) It focuses on determining compromise solutions (feasible solution which is the closest to the ideal) for a problem. It provides a maximum group utility of the majority and a minimum of the individual regret of the opponent.	It reflects DMs' subjective preferences It calculates ratio of positive and negative ideal solution to remove impact It presents a compromise solution with an advantage rate It considers the lowest performance rating with respect to a specified criterion	Difficult when conflicting situation arises. Needs modification while handling some terse data as it is difficult to build a real time model	Risk evaluation (Liu et al. 2015) Combined fuzzy DEMATEL, fuzzy ANP and fuzzy VIKOR (Šijanec, Zečević, and Krstić 2014)
PROMETHE	It is a family of methods. Pairwise comparison of alternatives is performed upon each recognized criterion to make up a preference function for each criterion.	It involves group level decision It incorporates imprecise and fuzzy information.	Does not structure the objective properly. Depends on DMs to assign weight. Procedure.	Energy (Loken, 2007) Environment management, business, water management (Behzadian et al. 2010)

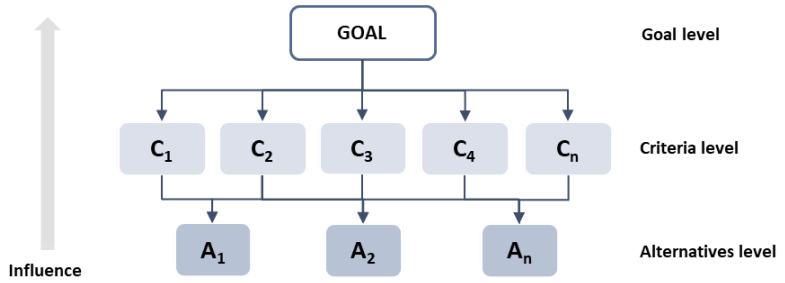
Techniques	Main points	Advantages	Disadvantages	Some applications
ELECTRE	It is a family of methods. Alternatives are evaluated by utilizing thresholds of indifference and preference. The main idea is to choose alternatives that are preferred for most of the criteria and are not unfavourable for any of the criteria. ELECTRE III is the most popular.	It is suitable even when incomparable alternatives exist Models allow imperfect knowledge It is less involved than the other methods, which makes it easier to combine with other MCDM techniques.	It is comparatively difficult because of complex computation It sometimes not able to find the best/preferred alternative	Energy management and natural resources, environmental management (Govindan and Jepsen 2016)
Grey relational analysis (GRA)	Based on grey systems theory applicable with vague, incomplete and indeterminate information. It determines a correlation index of alternatives through which it is possible to obtain a prioritisation	It handles uncertainty It is suitable for solving problems with complicated interrelationships between multiple elements It can provide a better distinction among the alternatives	It contains computational complexity Different distinguishing coefficients may lead to different solution results. Different distinguishing coefficients should be tried	Evaluate suppliers (Dou, Zhu, and Sarkis 2014), energy sources (Celikbilek and Tuysuz 2016), high-tech companies (Ou 2016), manufacturing (Kuo, Yang, and Huang 2008)
Complementary	Qualitative and quantitative methods and techniques have been combined for supporting MCDM.	Incorporate the advantages among methods Complement their weaknesses	Some models become more complex High technical knowledge is required Difficult to apply in different models	Geographic Information Systems GIS, Cost benefit analysis (CBA), cost effectiveness analysis (CEA), life cycle analysis/assessment, environmental impact assessment (EIA), simulation, statistical analysis, fuzzy set theory (Sayyadi and Awasthi 2018; Sierra et al. 2018)

Based on (Loken 2007; Wu et al. 2018)

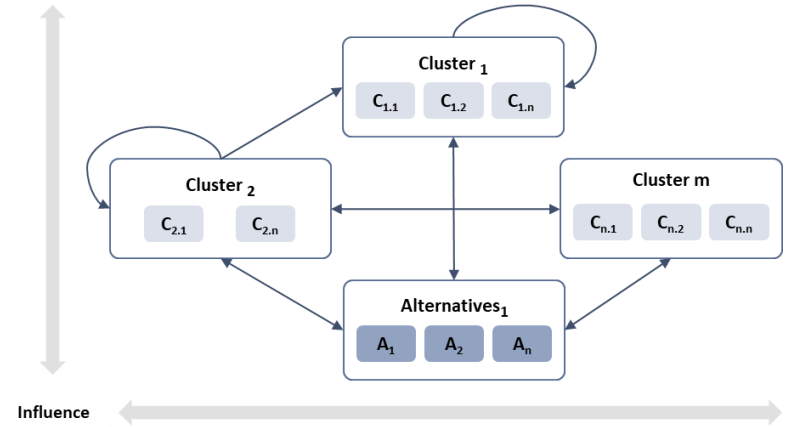
Analytic Network Process ANP

The methodological proposal is based on the Analytic Network Process ANP procedure developed by Saaty (1996, 2001). It is a well-known Multicriteria Decision Method (MCDM), which provides a framework to address decision making or problem assessment. It defines the prioritisation model as a network composed of different elements (e.g. criteria, indicators, alternatives), grouped into clusters and connected to each other. ANP allows for complex, interdependent and feedback relationships between the elements in a problem (Sipahi and Timor 2010).

The method was developed by Saaty (2001) to generalize his original Analytic Hierarchy Process (AHP; Saaty 1990). AHP defines the prioritisation model as a hierarchy with independent assumptions on upper levels from lower levels. ANP is a more evolved technique than AHP (Figure 1.2). Because many decision making problems involve the interaction of several factors; they cannot be structured hierarchically, since factors at a high level depend on factors at a low level. Therefore, while the AHP represents a framework with a unidirectional hierarchical relationship, the ANP replace hierarchies with networks in which the relationships between decision levels and attributes are not easily represented as major or minor, dominant or subordinate, direct or indirect. Therefore, the importance of the criteria determines the importance of the alternatives, but in addition the importance of the alternatives can also have an impact on the importance of the criteria (Boateng, Chen, and Ogunlana 2015; Hsu and Hu 2009; Yüksel and Dagdeviren 2007).



A. Basic AHP Hierarchy



B. Basic ANP Network

Figure 1.2 Structural difference between AHP and ANP

It is used to derive relative priority scales of absolute numbers from individual judgments (or from actual measurements normalized to a relative form) that also belong to a fundamental scale of

absolute numbers (Saaty 2005). Elements are evaluated via pairwise comparisons between pairs of elements to obtain their weights of importance. There are two possible structures for ANP: (1) The 'simple' network of clusters and elements and (2) The 'complex' or BOCR network, which structures the problem by classifying elements into positive (benefits and opportunities) and negatives (costs and risks) categories.

The ANP model can be structured in the following steps (Ligardo-Herrera, Gómez-Navarro, and Gonzalez-Urango 2018; Mu and Stern 2018):

1. Identifying the components and elements of the network and their relationships.
2. Conducting pairwise comparisons of the elements. Elements are compared using Saaty's 1-to-9 scale. The ANP prioritises not just elements but also groups or clusters of elements as is often necessary in the real world.
3. Placing the resulting relative importance weights (eigenvectors) in pairwise comparison matrices within the matrix (unweighted matrix).
4. Conducting pairwise comparisons of the clusters.
5. Weighting the blocks of the unweighted matrix, by the corresponding priorities of the clusters, so that it can be column-stochastic (weighted matrix).
6. Raising the weighted matrix to limiting powers until the weights converge and remain stable (limit matrix).
7. Obtaining the prioritisations of the elements according to any of the columns of the limit matrix.
8. Once the results are obtained, in case some alternatives achieve very similar results, a sensitivity analysis should be carried out in order to demonstrate the robustness of the ranking obtained.

Detailed applications of these steps are presented in the case studies (chapters 3-5). Detailed descriptions of the method can be found in Saaty (2001), Bottero and Ferretti (2010b), Molinos-Senante et al. (2015), Chen et al. (2019) and Mu and Stern (2018) among others.

ANP also facilitates arriving at participative solutions and achieving consensus in the resolution of multicriteria and multi-expert problems. Since its appearance, it has been widely used in the solution of complex problems of decision making (Chen et al. 2019). In this dissertation, ANP has been selected as it considers the relationships of interdependence among elements of the model, typical in problems regarding sustainable development. It is possible to consider political, socio-cultural and environmental aspects in models. Therefore, it allows decision-makers to consider qualitative and quantitative evaluation criteria.

Recent applications involving ANP were found in the areas of operation research and management applied to: manufacturing processes (Vimal and Vinodh 2016), evaluation of suppliers (Abdollahi, Arvan, and Razmi 2015; Hsu and Hu 2009; Piltan and Sowlati 2016), supply chain management, location (Yeh and Huang, 2014), evaluation of strategies, project management (Boateng et al. 2015; Poveda-Bautista, Baptista, and García-Melón 2012; Yüksel and Dagdeviren 2007), health and safety management systems (Abdollahi et al. 2015) among others (Chen et al. 2019).

Evidence regarding the use of ANP on sustainable development includes multiple applications. The already mentioned concerns about sustainable development have been transformed into specific models to support:

- Public policy: Assisting in policy making (Ha, Joo, and Jun 2011); evaluation of sustainable transport policy (Sayyadi and Awasthi 2018)
- Planning: Strategic policy planning (Erdoğmuş, Aras, and Koç 2006; Peris et al. 2013; Ulutaş 2005); evaluation of strategies for urban planning (Grošelj and Stirn 2015; Kao, Chiu, and Tsai 2017); sustainable forest management (Wolfslehner and Vacik 2008); planning of coastal land use (Najafinasab, Karbassi, and Ghoddousi 2015; Pourebrahim et al. 2010); supporting planning to the tourism sector (Aminu et al. 2017; Arsić, Nikolić, and Živković 2017; Bonzanigo, Giupponi, and Balbi 2016; Chen, Chen, and Lee 2009; García-Melón, Goméz-Navarro, and Acuña-Dutra 2010, 2012)
- Assessment: Developing an indicator system for measuring social sustainability (Shiau and Chuen-Yu 2016); representing complex indicator framework (Ferwati et al. 2019); creating aggregated priority or utility values (Wang, Lee, and Chang 2010); developing an environmental pressure assessment (Gómez-Navarro et al. 2009)
- Participatory process: Facilitating communication among decision-makers and stakeholders (Bottero and Ferretti 2010a; Grošelj and Stirn 2015; Jesiya and Gopinath 2018); making subjective judgements explicit (De Brito, Evers, and Almoradie 2018).

A more detailed literature survey was developed focusing on the field of sustainable development. It is presented in chapter 2.

1.2.4 Participatory approach

Promoting local development tends to be relatively complex, as it requires effective coordination between many different types of organizations or stakeholder groups (Kisman and Tasar 2014). Local governments should facilitate the effective and equitable participation of local stakeholders, particularly communities, civil organizations and the private sector, in the preparation and implementation of strategic planning agendas by establishing appropriate participatory mechanisms (UN-HABITAT 2015).

Therefore, strategic planning must include clear terms of coordination and cooperation among sectors, including local communities and the scientific sector (Iglesias-Campos et al. 2015; Sierra-Correa and Cantera Kintz 2015). This is important because it is here, in the planning process, that networks, partnerships and information sharing may occur (UN-HABITAT 2005).

A participatory approach involves the inclusion of different stakeholders so that their views, concerns and issues can be included in the planning process (UN-HABITAT 2005). Incorporating a participatory approach implies considering how to engage stakeholders in decision making processes (Wolfslehner and Vacik 2011). However, it is not always clear how they are included or selected, nor the level of inclusion.

The stakeholder concept emerged in the 80s and rapidly spread through different areas (Freeman et al. 2010). The initial concept, linked to business, has been extended to many other fields (strategic

management, finance, accounting, management, marketing, law, health, public policy, environment) and has influenced several theories such as business, ethics and corporate social responsibility. In the strategic planning context, "stakeholders are defined by their stake in the issues (e.g., the client groups such as the urban poor, policy proponents such as environmental NGOs), their formal position (e.g., government authority), their control over relevant resources (e.g., money, expertise) and their power to promote, hinder or block implementation (e.g. activist groups, lobby groups, implementing agencies)"(UN-HABITAT 2005). The achievement of an optimal solution for all the stakeholders becomes difficult when the intervention of different agents, objectives and factors is considered (Loken 2007).

Decision-makers recognize the need to understand who is affected by the decisions and actions they take and who has the power to influence their outcome. It is helpful to consider the importance and influence of stakeholders. Important stakeholders are those whose interests and priorities are taken into account when solving problems and making decisions (Reed et al. 2009). Influential stakeholders are those who have power over the problem resolution and decision making process (Grimble and Wellard 1997). These two concepts are relevant for decision making processes in which individual power distribution does have an influence on the final result, as is the case of strategic planning. The problem arises when we want to study or individually measure this power. In many situations, however, it is not considered 'politically correct' to assume that some individuals are more powerful (or influential) than others.

The participation of stakeholders in strategic planning is a real problem that has not been fully resolved, although there are different applications to engage the participation of stakeholders in specific problems at organizational, industrial or political level (Le Bars and Le Grusse 2008; Ceccato, Giannini, and Giupponi 2011; Elgin and Weible 2013; Glicken 2000; Goosen, Janssen, and Vermaat 2007; Janssen, Goosen, and Omtzigt 2006; Kua 2016; O'Toole, Keneley, and Coffey 2013). Stakeholder theory proposes some approaches to address the study of stakeholders such as: stakeholder identification (Brugha and Varvasovszky 2000; Prell, Hubacek, and Reed 2009; Varvasovszky and Brugha 2000; Saint Ville, Hickey, and Phillip 2017); qualitative techniques to investigate the relationships among them e.g. power versus interest grids, stakeholder salience (Mitchell, Agle, and Wood 1997), interrelationship diagrams (Bryson 2004), actor-linkage matrices (Biggs and Matsaert 1999) and structured stakeholder self-identification (Mu and Stern 2012); and quantitative methods to study their influence or power such as Social Network Analysis SNA (Wasserman and Faust 2007). This last, brings an approach to determine an individual value for the influence of each actor in a decision-making process.

SNA is a method based on the network paradigm and graph theory. It characterizes social structures in terms of nodes (individual actors, people, or things within the network) and ties, edges or links (relationships or interactions) that connect them. SNA allows the measuring of the strength of ties between stakeholders in order to obtain different values of centrality and power for each of them. Power is a fundamental property of social structures, but there is not a consensus about what power is and how we can describe and analyse it (Hanneman and Riddle 2005). Centrality (based on degree, closeness or betweenness) is the most commonly used index to analyse the influence of participants (Ahmedi et al. 2017; Dempwolf and Lyles 2012). Through SNA we can analyse flows of knowledge in the network; in other words, to whom do people go in the network for answers to

questions (Reed et al. 2009). The position of the participant in the network determines his/her favourable or constrained role in the network in terms of the outcomes under consideration.

Decision-makers facing demands must encourage the participation of stakeholders towards a certain degree of co-management. Facilitating stakeholder participation is one of the main advantages of ANP and one of the main reasons for selecting this technique. In decision models stakeholders can also be named as experts, participants, decision-makers, respondents, etc. They represent the intangible knowledge of the problems.

Some models have addressed the specific problem of dealing with the inclusion of stakeholders, considering different approaches and techniques in some of the ANP stages: i) Structuring the model, testing relevance of elements, understanding the context, capturing the requirements and the availability of information (Arsic et al. 2018; Giordano, Lombardi, and Pagani 2010); ii) Developing the comparison required by the method, integrating different perspectives in the assessment and comparing results from each stakeholder group (Molinos-Senante et al. 2015); and iii) Valuing the process and the results, collecting feedback questionnaires or asking them to comment on the difficulty and future improvements (De Brito et al. 2018; Wang et al. 2013). The more phases that include stakeholders, the more participative the model is, even though it increases opposition and possible conflicts (Ferretti 2011; Li et al. 2016).

To sum up, the implementation of participatory processes is recognized as being useful to address complex sustainable development issues and for planning local strategies of development. SNA is thus the selected technique to study stakeholders' networks in the context of this dissertation in order to implement a participatory process by including different stakeholders in decision making processes.

1.3 Research design

In response to the previously mentioned challenges and opportunities for research, this PhD thesis' *aim* is:

To develop and test a participatory multicriteria methodology for the evaluation of strategic projects for local sustainable development.

The intention is, therefore, to provide insights into planning stages by focusing on decision making processes regarding the prioritisation of actions, with a local and sustainable approach. To address the main aim of this dissertation, the *central research question* is:

How can a participatory multicriteria methodology help to evaluate local development projects with a sustainable approach?

In order to answer this central research question, four *sub-questions* have been formulated. They are discussed in detail in the following chapters.

RQ1. In what ways does ANP support decision making processes in the field of sustainable development?

RQ2. How can ANP support decision making to prioritise strategic projects in the field of sustainable development?

RQ3. How can SNA support ANP in the creation of a participatory multicriteria methodology for the evaluation of strategic projects for sustainable development?

RQ4. How can spatial analysis complement a participatory multicriteria methodology for the evaluation of strategic projects for sustainable local development?

All of the answers are complementary, which means that the final proposal is the result of an iterative process. Each stage is built on the base of the results of the previous one.

The first stage *describes* the literature of ANP in order to establish some lines regarding the state of the art. A systematic literature review guided the following stages and cast some light on the design of the cases studies and on the proposed contributions of this dissertation.

The second research sub-question *explores* the selected framework and tests the ANP methodology in the context of the Cartagena de Indias city, and proposes the evaluation of some strategic projects for one case study.

Hence, the third sub-question *develops* a methodology for an ex-ante evaluation of projects. The recommendations of the first case study feeds the design of the second one; combining two well-known techniques SNA and ANP in order to propose a better approach on decision making regarding the participatory component.

The fourth and final sub-question *enriches* the participatory multicriteria methodology. Following the references and the results of the second case, another case is designed in order to test the proposed methodology and enhance the procedure. Geospatial Information System (GIS) is included in order to enhance the developed methodology by adding spatial elements and further explore the capability of working together with other complementary tools in line with some recent approaches.

The main methodological issues supporting this dissertation were designed based upon Lincoln et al (2011), Thomas and Hodges (2010), and others. A brief overview is presented in Table 1.3.

Table 1.3 Main methodological issues

Paradigm	Post positivism
Type of research	Exploratory-descriptive
Method approach	hypothetical-deductive
Methodological approach	Mixed methods
Research strategy	Case studies (3)
Methods of data collection	Documentary analysis
	Semi-structured interviews
	Structured interviews
	Questionnaires
Data analysis and processing	Literature Survey - TOS Tree of Science©
	SLR – NVivo© Software

	SNA - UCINET© Software
	ANP - Superdecions© Software
	QGIS Software
Reliability / Quality	Replicability
	Feedback to participants
	Publication of the results

More detailed information about the methodology process and the methods is presented in each of the developed cases.

1.3.1 Case selection

Another important point in the design of this dissertation was the selection of case studies. They are the units of analysis in the selected context, which means are the strategic concerns to be studied in Cartagena de Indias (Colombia). An analysis based on the three pillars of sustainable development was developed in order to select them (Table 1.4). Three local sources were selected to study the priorities of the city in terms of each dimension. Two criteria were analysed for each priority: i) the existence of strategic plans, programs and/or proposals defined at local or national level and ii) the existence of local institutions for leading and making decisions. Each criterion was valued according to a scale of Low (No existence), Medium (some intentions, without concrete actions) and High (meet the criterion).

Table 1.4 Case selection

Pillars of sustainable development	Source	Strategic priorities	Criteria i) Planning	Criteria ii) Institutions	Selected sector	Case designed, type of decision
Economic	Regional Competitiveness Plan 2008-2032: Strategic economic sectors with high potential (Comisión Regional de Competitividad de Cartagena y Bolívar 2010)	1. Petrochemical-plastics industry	Low	Medium	Tourism (II) Nautical-Naval (I)	**(I) Nautical & Naval Industry:** Location, Expansion and placement of new nautical facilities. **(II) Tourism:** Evaluation of projects for improving tourism offer **(III) Mobility and Heritage:** Improving and promoting pedestrian mobility in the city centre
		2. Tourism	**High**	**High**		
		3. Logistic district	Medium	Medium		
		4. Naval design, construction and repair industry	**High**	**High**		
Social	Program for monitoring the quality of life of the inhabitants of Cartagena: Priorities to make the city a better place to live. (Cartagena Cómo Vamos 2018)	1. Security	Low	Medium	Mobility (III)	
		2. Governance	Low	Low		
		3. Mobility	**Medium**	**High**		
		4. Cultural offer	Low	High		
		5. Health services	Low	High		
		6. Energy Services	Low	Low		
		7. Public space	Low	High		
Environmental	4C Plan, Cartagena de Indias Competitive and Compatible with the Climate: Plan that promotes a climate compatible development for the city (Alcaldía Distrital de Cartagena de Indias 2014a)	1. Climate compatible ports and industries	Medium	Low	Tourism (II) Heritage protection (III)	
		2. Tourism sector committed to climate change adaptation	**High**	**High**		
		3. Protection of historical heritage	**Medium**	**High**		
		4. Neighbourhoods adapted to climate change	Low	Low		
		5. Adaptation based on ecosystems	Low	High		

1.4 Thesis Outline

This dissertation has been developed as a compendium of papers to report on the central research question and related sub-questions stated above. The layout consists of four parts: this introduction, the theoretical part, the empirical part and the conclusions. The outline of this thesis is graphically represented at the end of this section (Figure 1.3).

The first part, *chapter 1* consists of a general introduction. This outlines a general presentation of the problem addressed, the theoretical bases used and how this compendium has been designed. Theoretical and empirical parts are addressed through the research questions stated above. In the following chapters 2-5, five different papers are presented in order to answer them. Three published and two forthcoming publications.

Chapter 2 RQ1. In what ways does ANP support decision making processes in the field of sustainable development?

Paper 1. Analytic Network Process and its applications to develop the concept of sustainable development: a Systematic Literature Review
Authors: Hannia Gonzalez-Urango and Mónica García-Melón
Journal: ongoing evaluation

Chapter 2 is the theoretical exploration, an extension to the theoretical framework previously presented in section 1.2.3 of this chapter. A detailed overview of the state of the art regarding the use of ANP supporting decision making on sustainability. A Systematic Literature Review about the use of ANP on sustainable development is presented. It focuses on an in-depth analysis of territorial and urban applications. From this review, it was possible to conclude that ANP could support the selected cases. This theoretical exploration was useful to identify some outstanding features associated with ANP, but also some recommendations and emerging topics in order to face some constraints in the design of the empirical part developed in the next stages. The next three chapters present the empirical results.

Chapter 3 RQ2. How can ANP support decision making to prioritise strategic projects in the field of sustainable development?

Paper 2. A multicriteria model to evaluate strategic plans for the nautical and naval industry in Cartagena de Indias, Colombia.
Authors: Hannia Gonzalez-Urango and Mónica García-Melón
https://doi.org/10.3390/su9040653
Journal: Sustainability (2017), 9(4)
JCR (Q2)
Scimago (Q1)

Chapter 3 validates the selected decision making technique in the context. The first case study consists of the design of a decision model to develop an ex-ante evaluation of strategic projects for the nautical and naval sector in Cartagena de Indias; using ANP in the framework of sustainable development. The goal of the decision model is to evaluate alternatives in order to *prioritise* strategic projects. Results demonstrate that ANP is useful for prioritising local development projects in the context of Cartagena de Indias. The procedure allows different sectors to reach an agreement among

participants. The insights obtained after this case enabled us to take some actions concerning the involvement of participants.

Chapter 4 RQ3. How can SNA support ANP in the creation of a participatory multicriteria methodology for the evaluation of strategic projects for sustainable development?

Paper 3. Stakeholder engagement to evaluate tourist development plans with a sustainable approach
Authors: Hannia Gonzalez-Urango and Mónica García-Melón
https://doi.org/10.1002/sd.1849
Journal: Sustainable Development (2018), 26(6)
JCR (Q1)
Scimago (Q1)

Chapter 4 carried out a methodology for the evaluation of projects considering a more participative environment while ANP is used. The purpose was to validate the assumptions that a participatory approach involves a better consideration of stakeholders in the decision process, and that networks, partnerships and information sharing are useful to study stakeholders' relationships. The empirical robustness of this assumption is tested in the second case study for the tourist sector in Cartagena de Indias by means of SNA-ANP combination. The goal of the decision model is to evaluate alternatives in order to *prioritise* strategic projects. Results validate the methodology developed and shed light on the issue of solving problems related to participative planning processes. The results also suggest integrating the SNA-ANP methodology with spatial analysis to improve the decision-making process.

Chapter 5 RQ4. How can spatial analysis complement a participatory multicriteria methodology for the evaluation of strategic projects for sustainable local development?

Paper 4. Planning for pedestrians with a participatory multicriteria approach
Authors: Hannia Gonzalez-Urango; Giuseppe Inturri; Michela Le Pira and Mónica García-Melón
https://doi.org/10.1061/(ASCE)UP.1943-5444.0000585
Journal of Urban Planning and Development (2020), 143(3)
JCR (Q3)
Scimago (Q1)

Paper 5. Designing walkable streets in congested touristic cities: the case of Cartagena de Indias, Colombia
Authors: Hannia Gonzalez-Urango; Michela Le Pira; Giuseppe Inturri; Matteo Ignaccolo and Mónica García-Melón
https://doi.org/10.1016/j.trpro.2020.03.021
Journal: Transportation Research Procedia (2020), 45
Scimago (Q2)

In *chapter 5,* the fourth research question is central. The third empirical study focuses on aid in further strengthening the proposed methodology. This methodology is enhanced by including the spatial component as a key issue of decision analysis. This chapter reports on two separate publications (papers 4 and 5) a decision model to *weight* criteria that support the selection of some

streets in the city centre of Cartagena de Indias to be redesigned in order to increase their attractiveness for pedestrians.

In paper 4, the participatory multicriteria decision analysis approach proposed in the previous case is applied to define and compute the weights of criteria. The study of the context and the definition of criteria in the model is improved by including interviews that also allow participants to make an early evaluation of criteria during the first stage. The prioritisation model determines an index for each criterion in designing pedestrian routes. The last publication is a follow up on the results that have been presented in the previous one. The results of ANP are combined with spatial data using Geographic Information Systems (GIS) to produce thematic maps. A set of streets in the city centre was evaluated. An index of pedestrian priority in order to derive a priority of intervention is developed.

The results of this case help to enhance the proposed multicriteria decision methodology. GIS provide mapping parameters to improve decision processes and explore a general integration of the proposed methodology with other tools.

Finally, *chapter* 6 briefly summarizes the main research findings. This final chapter presents the main conclusions that can be drawn from the thesis, integrating and discussing the main results of case studies. Furthermore, some theoretical and methodological contributions are provided. This is followed by limitations, implications and directions for future research.

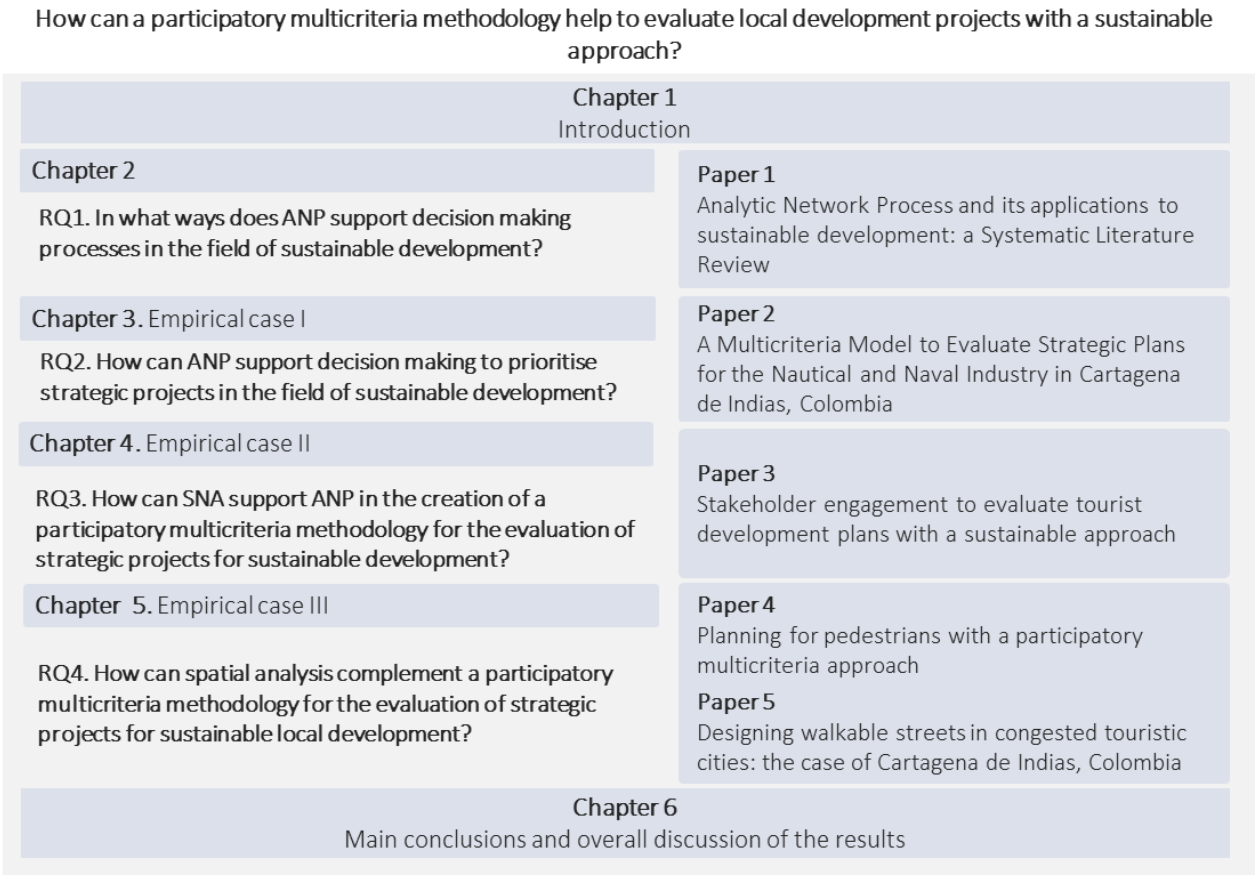


Figure 1.3 Thesis outline.

1.5 The training beyond the document, a brief CV

In this section, I want to briefly present some other experiences that are not expressed in the rest of this document, but that have contributed to my training as a researcher since I started my doctoral training.

At the end of 2015, I was awarded a PhD fellowship supported by the 'Bolívar gana con Ciencia'[1] program from the local government of Bolivar (Gobernación de Bolivar, Colombia). My training started in February 2016. During the ensuing four years, I have participated in different activities and experiences that have contributed to this final result. The first year was focused on the completion of cross-curricular training hours required by the PhD program, attending some masters' courses, and participating in congresses. In the second year, I joined Ingenio Institute. Since that moment it has been possible to participate in different activities and collaborations as well as continuing to develop activities of the research career training. Some of the results of these experiences are summarised in Figure 1.4.

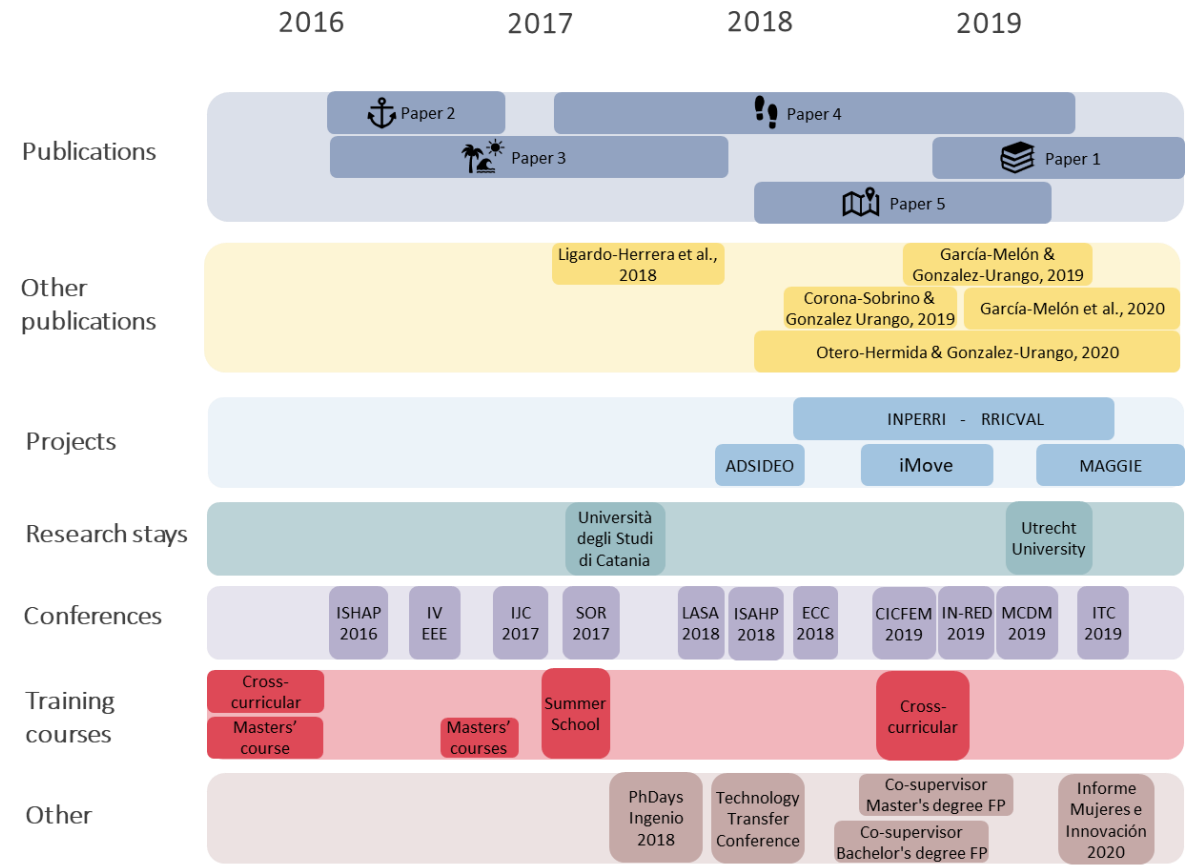


Figure 1.4 PhD Training Process

[1] https://www.ceiba.org.co/site/index.php/component/content/article?id=173:listado-de-elegibles-y-financiables-segundocorte-4-convocatoria-bolivar

Projects

- 2018 Co-responsible partnerships for gender equality (Spanish title: Alianzas corresponsables por la igualdad de género*)* supported by the ADSIDEO program, Universitat Politècnica de València.
- 2019 iMove Project, Real-time recommendation system to assist decision making on mobility based on the context (Spanish title: Sistema de recomendación en tiempo real basado en el contexto para asistir a la toma de decisiones de personas en movilidad) supported by Spanish Ministerio de Economía, Industria y Competitividad (RTC-2016-4951-6).
- 2018-2019 INPERRI Project[2], Proposal for indicators to promote the design of a policy towards the development of Responsible Research and Innovation in Spain (Spanish title: Propuesta de indicadores para impulsar el diseño de una política orientada al desarrollo de investigación e innovación responsable en España), supported by the Spanish Agencia Estatal de Investigación (CSO2016-76828-R).
- 2018-2019 RRICVAL Project. Proposal for Indicators to promote the design of a scientific and innovative policy in the Valencian Community based on RRI Principles (Spanish title: Propuesta de Indicadores para Impulsar el Diseño de Una Politica Cientifica e Innovadora en la Comunidad Valenciana Basada en los Principios de la RRI) supported by the Generalitat Valencia under Grant (AICO/2018/270).
- 2019-2021 MAGGIE Project[3], Monitoring and Assessing Gender Gap in Events supported by Open Society Foundation.

Research stays

- September - December 2017. Università degli Studi di Catania (Italy). Department of Civil Engineering and Architecture
- August - October 2019. Utrecht University (The Netherlands). Department of Human Geography and Spatial Planning

Other publications

- Ligardo-Herrera, I.; Gómez-Navarro, T.; *Gonzalez-Urango, H.* (2018). Application of the ANP to the prioritization of project stakeholders in the context of responsible research and innovation. Central European Journal of Operations Research. 1-23. https://doi.org/10.1007/s10100-018-0573-4
- García-Melón M.; *Gonzalez-Urango H*. (2019). Indicadores de Participación Ciudadana desde una perspectiva de responsabilidad en la ciencia y la innovación: el caso español. INGENIO (CSIC-UPV) Working Paper Series 2019/02. http://doi.org/10.5281/zenodo.3899721
- Corona-Sobrino, C.; *Gonzalez Urango, H.* (2019). La transversalidad en la formación en estudiantes de doctorado. Experiencias innovadoras en la gestión de la propia formación. En IN-RED 2019. V Congreso de Innovación Educativa y Docencia en Red. Editorial Universitat Politècnica de València. 1213-1223. https://doi.org/10.4995/INRED2019.2019.10485
- García-Melón M.; Gómez-Navarro, T.; *Gonzalez-Urango H;* Corona Sobrino, C. Adapting RRI Public Engagement indicators to the Spanish scientific and innovation context. A deliberative participation-AHP based methodology. Annals of Operational Research. Ongoing evaluation

[2] https://rricval.webs.upv.es/index.php/equipo/
[3] https://maggie.webs.upv.es/

- Otero-Hermida, P; *Gonzalez-Urango H*. Businesses as social partners in equality policies? New governance models, role shift and role gaps in other actors' expectations. Gender, Work and Organization. Ongoing evaluation

Conferences
- Evaluating knowledge transfer and impact: metrics, procedures and governance for science and innovation (ITC 2019)
- 25th International Conference on Multiple Criteria Decision Making (MCDM 2019)
- V Congreso de Innovación Educativa y Docencia en Red (IN-RED 2019)
- I Congreso de Ciencia, Feminismo y Masculinidades (CICFEM 2019)
- Eu-SPRI Early Career Researcher Conference (ECC 2018)
- The International Symposium on the Analytic Hierarchy Process (ISAHP 2018). Most Innovative Idea Award.
- XXXVI Congreso Internacional de la Asociación de Estudios Latinoamericanos LASA2018
- 14th International Symposium on Operations Research (SOR 2017)
- 3rd International Joint Conference ICIEOM-ADINGOR-IISE-AIM-ASEM (IJC2017)
- IV Encuentro de Especialización para la Investigación en Economía y Empresa y Derecho 2016
- International Symposium on the Analytic Hierarchy Process (ISHAP 2016) 2016

Co-supervisor
- 2019 Bachelor's degree final project "Estudio para la validación de una aplicación móvil para recomendar ofertas turísticas en movilidad basada en técnicas de decisión multicriterio"[4]. Bachelor's degree in Industrial Engineering.
- 2019 Master's degree final project "Aplicación del Análisis de Redes Sociales y la técnica AHP al desarrollo de indicadores para monitorizar la educación para la ciencia en la política científica española"[5]. Master's degree in Industrial Engineering.

Journal Reviews
- 2020 Journal of Urban Planning and Development
- 2020 Revista Ingeniería Industrial
- 2019 Research in Transportation Economics
- 2018 Tourism Management

Other contributions
- Contributor. Informe Mujeres e Innovación 2020[6]. Observatorio Mujeres, Ciencia e Innovación, Ministerio de Ciencia e Innovación.
- Organizing committee. Technology Transfer Society Annual Conference 2018.
- Organizing committee. Eu-SPRI Early Career Researcher Conference PhDays Ingenio 2018.
- Teaching collaboration. Decision making and Ethics Course. 2019.

[4] Canet Salas, C. (2019). http://hdl.handle.net/10251/126031
[5] Vinagre Fernandez, MR. (2019). http://hdl.handle.net/10251/125064
[6] http://www.ciencia.gob.es/stfls/MICINN/Ministerio/FICHEROS/Publicaciones/AF_Mujeres-e-innovacion_web.pdf

CHAPTER 2

Analytic Network Process and its applications to develop the concept of sustainable development: a Systematic Literature Review

This chapter is based on the paper:
Analytic Network Process and its applications to develop the concept of sustainable development: A Systematic Literature Review. Gonzalez-Urango H. and Mónica García-Melón M.

Abstract

The implementation of sustainable development concepts includes multidisciplinary perspectives and implies multiple decision problems. This study conducts a systematic literature review about analytic network process as a supporting tool for decision making to tackle sustainability issues, focusing on the usefulness of this technique for supporting different areas, structuring some methodological points in its applications and extensions. The analysis was carried out with 258 manuscripts published between 2015-2019 indexed by the Web of Science, Scopus and Science Direct databases. The results are divided into two main parts. The first presents a descriptive analysis of the publications, explains applications using three different classifications, and develops a complementary analysis of all manuscripts regarding the use of ANP and its evolution. In the second part, an in-depth analysis of the area with the greatest number of manuscripts was developed. The paper provides technical aspects related to the construction of models, discusses some advantages and constraints of the technique, and proposes some recommendations for future applications. The findings allow us to conclude that the use of the analytic network process has evolved. The technique can represent the sustainable development approach as models due to its property of representing and considering the correlation between elements. Also, some emerging topics and a comparison between the analytic hierarchy process and the analytic network process are presented.

2.1 Introduction

Sustainable development SD, although a widely used phrase and idea, has many different meanings and provokes many different responses (Hopwood, Mellor, and O'Brien 2005). It is a multidimensional concept that implies diverse perspectives and leads to issues that are characterised by a high degree of conflict (Boyko et al. 2006). Nowadays sustainability seems to have permeated every sphere of society. It is a trendy topic that attracts the interest of academics and practitioners in different areas. Developing the concept of SD is a complex matter that must integrate different levels of action and decisions, including conflicting perspectives. The achievement of appropriate arrangements becomes difficult when the intervention of different agents, objectives and factors and the interaction of complex elements in complex contexts are considered.

The correct implementation of the SD approach includes a multidisciplinary perspective and implies multiple decision problems. Decisions regarding SD imply socio-economic, ecological, technical and ethical perspectives and have to take into account a large number of variables, of both a qualitative and quantitative nature, involving multiple fields and applications. To deal with these kinds of issues multicriteria analysis tools are very useful (Bottero and Mondini 2008).

Multicriteria decision making/analysis/aid (MCDM/MCDA) is a widely studied research area of operational research and management sciences. The aim of MCDM is not to find a final and optimal solution, but to help decision-makers explore decisions and to better inform them. It is an umbrella term to describe a collection of procedures, techniques and algorithms for designing, screening, evaluating, prioritising, ranking, or selecting a set of alternatives with incommensurate and usually conflicting objectives (Belton and Stewart 2002; Loken 2007; Razavi Toosi and Samani 2014). The multicriteria approach is adequate to deal with sustainability issues at both micro and macro levels, and the use of a multicriteria framework is a very useful tool to implement an interdisciplinary approach (Bottero and Ferretti 2010b).

Many authors introduced the use of MCDM techniques for sustainability issues (Ginevičius and Podvezko 2009). Many of them focus on the use of the Analytic Hierarchy Process (AHP), which has stood out as the most often used (Dos Santos et al. 2019). It is easy to use for preferential information elicitation from expert subjects to assign priorities to criteria or indicators in a problem. Analytic Network Process ANP is a generalisation of the AHP technique developed by Saaty in the 90s. It deals with complex interactions among different components of real systems, as for sustainability. Since it allows complex, interdependent and feedback relationships between the elements (Saaty and Peniwati 2008) several authors have moved towards this approach. Following its introduction (Saaty 1996) its uses have increased over the years, especially since 2009 (Chen et al. 2019). Evidence regarding the use of ANP is widespread in the literature for the evaluation and selection of alternatives in different fields.

In this article we will carry out a Systematic Literature Review SLR about ANP as a supporting tool for decision making for sustainability, focusing on the usefulness of this technique for supporting the implementation of processes for SD. This SLR was carefully designed to comply with traditional recommendations such as replicability and transparency, but also some specific ones proposed by some authors regarding AHP and ANP techniques. Two main reviews related to AHP (Dos Santos et al. 2019) and ANP (Chen et al. 2019) reported detailed overviews of how both techniques have been used and developed. The first one conducts an SLR on AHP supporting decision for SD from 2014 to 2018 (Dos Santos et al. 2019). The second reports on a study using bibliometric techniques to present the characteristics of ANP research from 1996 to 2018 (Chen et al. 2019). Both works highlight sustainability as an enduring hot topic and especially (Chen et al. 2019) elicit further focus on a more comprehensive and accurate collection, analysis and in-depth examination of data, characteristics and results of ANP literature. Moreover, the in-depth analysis permits the analysis of practical aspects regarding ANP models and reporting.

In the next sections the use of ANP for the sustainability issue is examined. Firstly, since sustainability can be considered from several some points of view a discussion on the concepts of sustainability and SD is presented in Section 2. Then the research design is described in Section 3. Section 4 offers a descriptive analysis and some bibliometric data of the results. Section 5 presents a content analysis for the area with the greatest number of publications and some recommendations regarding how to structure a model and future applications. Section 6 provides some comparisons between AHP and ANP. Finally, some conclusions are drawn in Section 7.

2.2 Theoretical Background

The theoretical background discussed in this paper was presented in sections 1.2.1 and 1.2.3. They offer a discussion on the concepts of sustainability, SD and ANP respectively.

In summary, this work focuses on the analysis of texts that conceive sustainability and SD as a framework, process, or group of processes for integrating environmental, social and economic elements to seek the long-term maintenance and enhancement of human well-being, which implies decisions at different levels. Therefore, this SLR focuses on how the principles of SD have been considered in different decision making processes. Those works outside this approach have been rejected.

2.3 Research design

The conducted SLR was designed in six stages (Figure 2.1). Following the guidelines proposed by (Denyer and Tranfield 2009; Dixon-Woods et al. 2006; Xiao and Watson 2019) and the previous reviews developed by (Lubberink et al. 2017; Dos Santos et al. 2019). The first three stages were for preparation, the next two for examination and the last one for sharing the results. Each stage is explained in detail in order to facilitate the replicability of this study.

1. Stage 0. Planning stage: In this early stage, authors were mainly interested in topics related to SD and how ANP can support it. Some questions around the topic arose:
    - How much has the ANP been used?
    - Has its use increased? Evolution?
    - Why is it selected?
    - Is it combined with other methodologies or techniques? Which ones?
    - Has it displaced the use of AHP?
    - What are the areas in which it is most used?

    Some previous searches were developed in order to clarify the topic and scan the existing body of knowledge in ANP, sustainability and SD. Some AHP and ANP reviews were consulted.

2. Stage 1. Developing a review protocol: The search strategy was developed. The question that guides the SLR was developed in this stage: *How can ANP support decision processes for sustainable development?* Thus, the scope of the SLR is to examine the ANP literature for supporting decision making related to SD.
    The inclusion criteria were defined. A search period was not established since the ANP was proposed in 1996 and it acquired relevance recently (Chen et al. 2019). The decision was made to review ANP studies published in Web of Science, Scopus and ScienceDirect databases. The subsequent search criterion was the language, only English publications were considered. Finally, a list of keywords was established.

3. Stage 2. Locating studies: The first query was run in April 2019. Some equations were designed to compare the number of contributions found and to select the most suitable for the study. A second query was repeated in February 2020 to include the later 2019 publications (Appendix A.1).
    The selected contributions were original articles, review articles, conference proceedings and book chapters all in English. The initial result was 685 contributions. Full record and cited references of all the retrieved contributions were exported from databases to reference management software (Zotero© and JabRef©). 302 duplicated records were eliminated, and 383 manuscripts remained.

4. Stage 3. Screening for inclusion: A second group of inclusion and exclusion criteria was defined. Contributions that remained were screened for suitability based on the title, abstract and keywords according to the inclusion criterion related to the sustainability definition. The concepts of sustainability and SD established in section 2.2 guided the screening process and the subsequent analysis. Also, as an exclusion criterion, literature reviews were not considered. When we were not sure about a paper, we maintained it. There were subsequently 61 contributions excluded (58 not on topic and 3 reviews). The availability of

the full document was the next considered exclusion criteria. It was not possible to fully obtain 27 manuscripts. The refined result of this stage was 295 manuscripts.

5. Stage 4. Analysis and Synthesis: This is the main stage of the process. First, we verified the doubts arising regarding some manuscripts in the previous stage to confirm whether they should stay inside the analysis or not. Ten (10) manuscripts did not meet the inclusion criteria of the topic and one (1) book chapter was replaced by a paper. The remaining 285 manuscripts were analysed based on a list of criteria for analysis, i.e. area of application, specific topics, goal of the model, type of use, level of application, application country, and combinations with other methods (Appendices A.2 and A.3).

   Some manuscripts were then excluded because they were not related to sustainable development (10), similar or repeated cases (7), were too short to gather some information (3), No ANP applications (3), ongoing works (2) or other reasons (2). 258 refined contributions remained. Since the classifications were developed according to Application areas, the area with the largest amount of manuscripts (Territorial and urban) was selected to further develop a content analysis (Gläser and Laudel 2013). 91 manuscripts were analysed in-depth according to the second list of criteria for analysis, i.e. construction of models, experts' profiles and selection, advantages, constraints and emergent topics (Appendix A.4). The content analysis was carried out with the assistance of a computer-assisted qualitative data analysis software (nVIVO© software).

6. Stage 5. Reporting and using the results: The results and findings of this SLR are presented in the next sections.

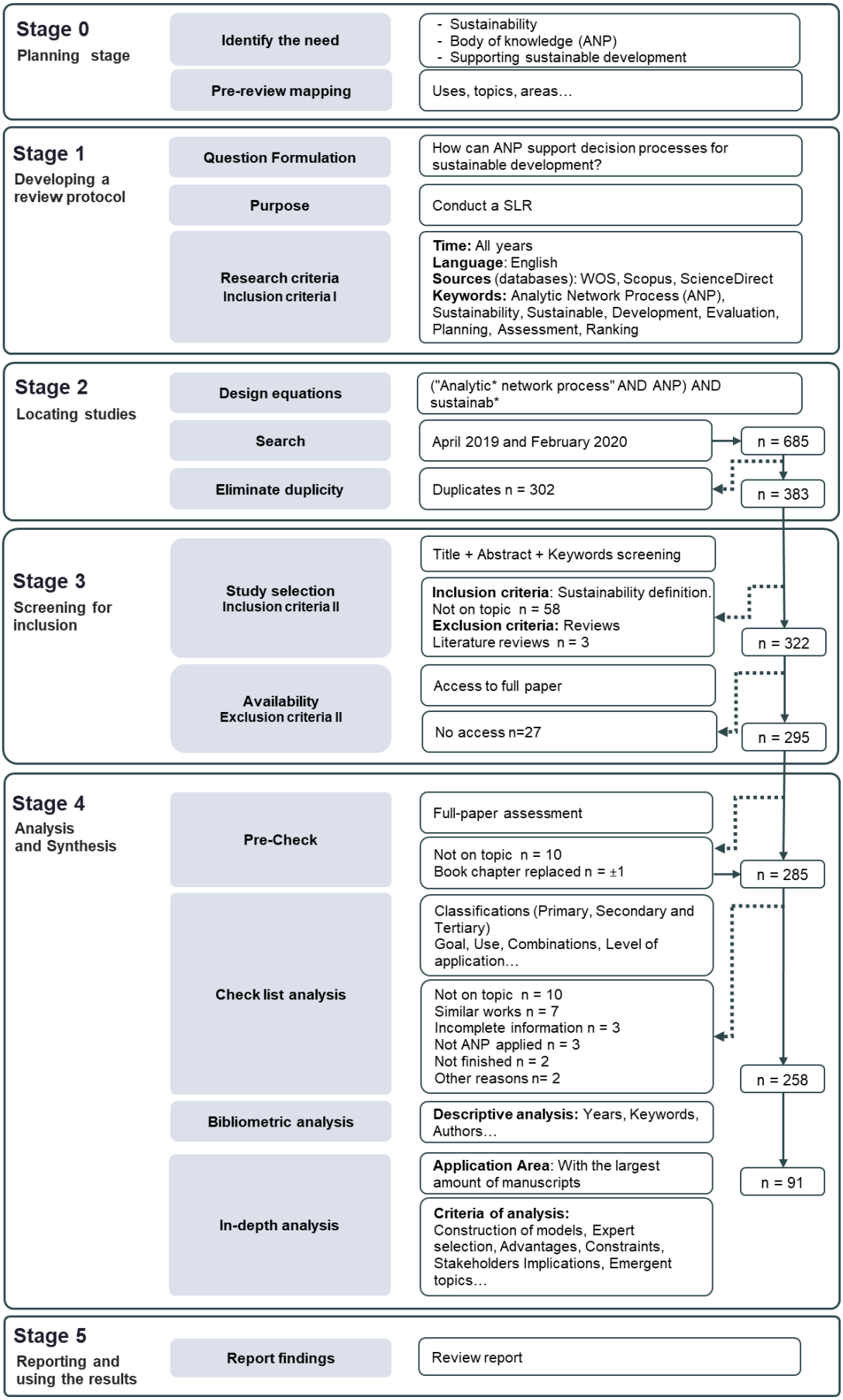


Figure 2.1 Process of the systematic literature review

2.4 Results and discussion

2.4.1 Descriptive analysis

A total of 258 manuscripts were fully analysed (Appendix A.2). They came mainly from journals (88%) and less from conference proceedings (11%) and book chapters (1%) (Figure 2.2). Most of them, 209 manuscripts, are indexed in SCOPUS and 204 in WOS (81% and 79% respectively). The number of manuscripts evidences a positive evolution regarding the use of ANP supporting decision making for sustainable development until 2018. Especially in 2018, an expanding interest is evidenced. During 2019 the number of documents decreased considerably.

The number of manuscripts from journals shows that only three journals concentrate 17% of them. The Journal of Cleaner Productions is the second one and contains 5% of the manuscripts.

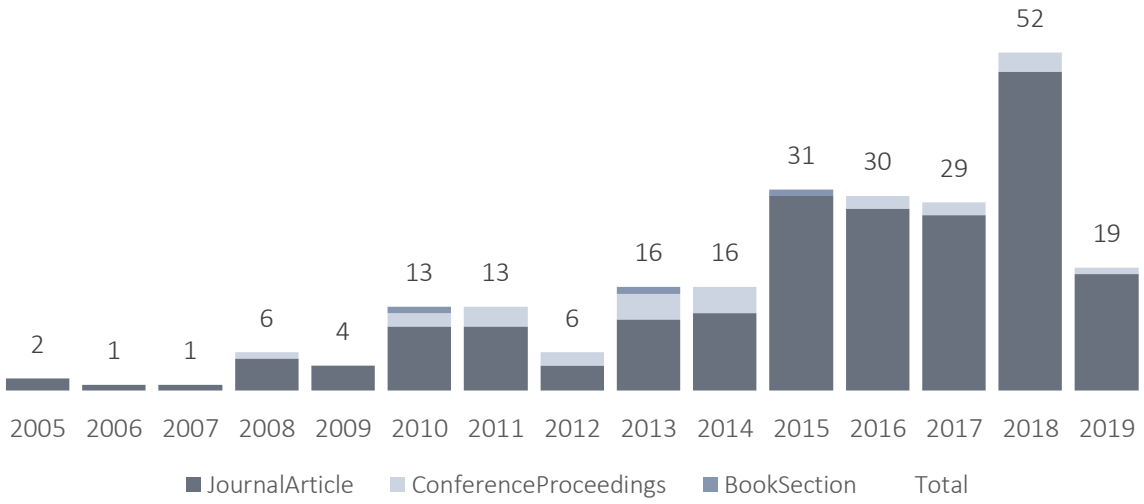


Figure 2.2 Number of manuscripts per year and by type

2.4.2 Application analysis

Regarding the application of the technique, the manuscripts were analysed following the structure proposed by (Dos Santos et al. 2019). Using three different classifications concerning their application area (primary classification), particular area (secondary classification), and specific topic (tertiary classification). These classifications permitted a better presentation and understanding of different perspectives of applications. Furthermore, the types of models regarding their main goals have been considered to analyse other practical details.

The primary classification means knowledge fields in which ANP was used to support decision making (Dos Santos et al. 2019). 11 different application areas were found: Territorial and urban studies have the largest numbers of manuscripts (91), followed by Manufacturing (54), Energy (31), Business and Management (28), and Construction (21); meanwhile, Agricultural (15), Transport (6), Extraction/Mining (3), Fuel/biofuel (2) and Retail (2) areas gathering a small fraction. Five contributions on specifics application areas have been located in the 'Other' group (Figure 2.3).

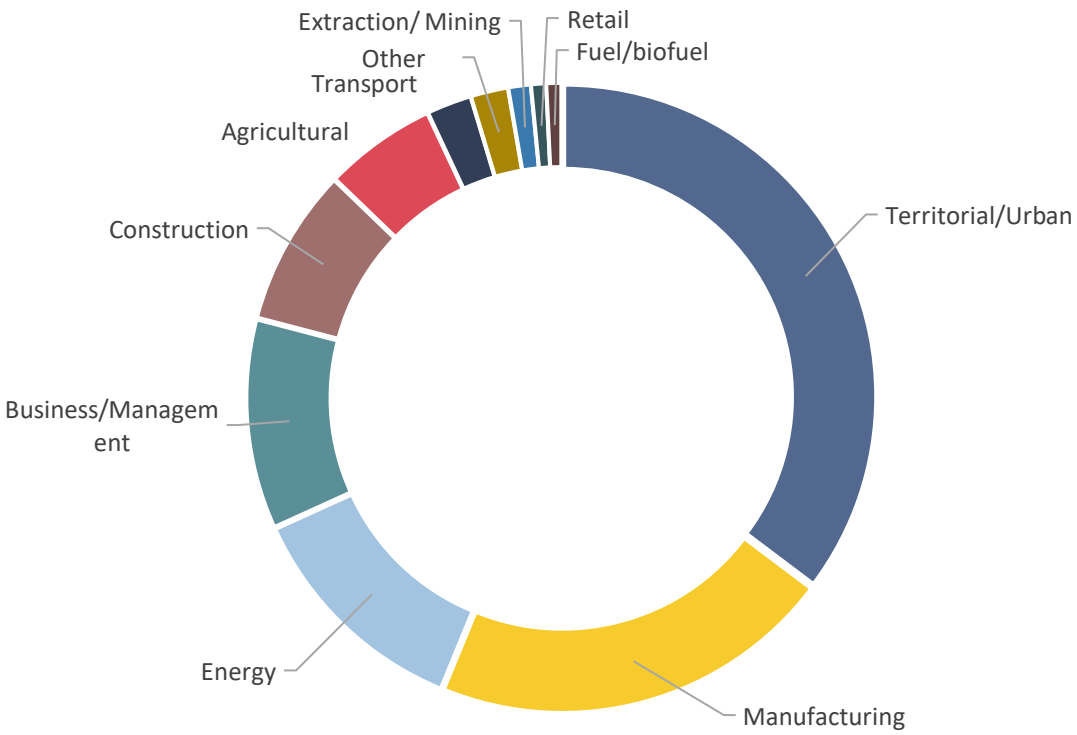


Figure 2.3 Number of manuscripts per Application area

Within each previous area, four different particular areas were defined. This secondary classification details the section or specifies the target in the area in which ANP is applied:

- Decision making on **Product development**: decisions related to the implementation of concepts, processes or strategies that seek sustainability in the conception of products, e.g. Analysing alternatives in reverse logistics for end-of-life, product design, etc.
- Decision making on **Planning of sustainable issues**: managing or planning aspects to be sustainable or implementing sustainable concepts at a micro level in organizations, institutions or small units, e.g. Drivers and Barriers to sustainable implementations, sustainable strategies, Supply chain management, corporate social responsibility, etc.
- Decision making on **Assessment of sustainable aspects**: evaluation of sustainable characteristics or features, e.g. Suppliers' evaluation, Corporate sustainable practices, environment liveability, etc.
- Decision making on **Sustainable Development**: planning processes based on strategies and actions to bring the human-environmental, social and economic systems closer to sustainability. This group includes works that seek sustainability at a broader level as well as enhancement and maintenance of human well-being in the long-term.

Applications regarding assessment of sustainable aspects are the most common (45%), while the Product development area has the smallest portion of manuscripts (5%). Particular vs application areas analysis (Figure 2.4) indicated that the largest group of documents is concentrated in the particular area of Decision making on Sustainable Development for Territorial applications (56). Another significant number of manuscripts belonging to the Assessment area are applied in Manufacturing (34) and Territorial (30) groups. Planning of sustainable issues involves mainly

Business/Management (16) and Manufacturing (13) applications. And a few applications in Product development are on manufacturing (7).

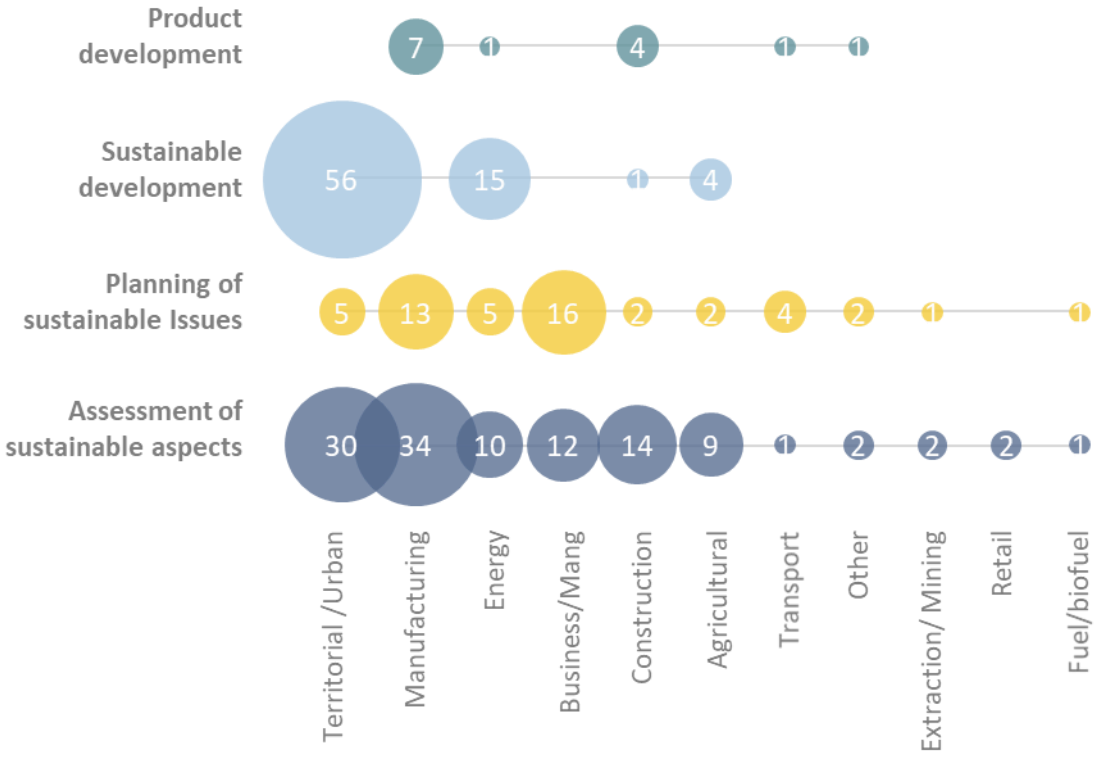


Figure 2.4 Number of manuscripts by Particular vs Application areas

The last classification was made according to 36 specific topics (tertiary classification) deploying each Particular area to facilitate the analysis of each manuscript and find more common points. The 10 first topics represent 59% of the documents (Table 2.1). The most representative are Suppliers' selection/evaluation and Supply chain management; followed by Land/coastal planning, Sustainable strategies and Sustainable operations. The least common are Hospitals, Economic sustainability, Software Products, Investment decisions, Redevelopment of an urban area and Emissions.

Table 2.1 Listing of main Specific Topics

No.	Specific Topic	Number of Manuscripts	% of manuscripts
1	Suppliers' selection/evaluation	26	10%
2	Supply chain management	22	9%
3	Land/coastal planning	18	7%
4	Sustainable strategy	17	7%
5	Sustainable operations	16	6%
6	Corporate sustainable practices	12	5%
7	Sustainable tourism	12	5%
8	Urban regeneration	10	4%
9	Location	10	4%
10	Technology evaluation	9	3%

A detailed analysis is carried out placing each primary application areas in secondary and tertiary classifications to better describe and briefly study the manuscripts. Figures (6-13) show each area.

Numbers next to the bars represent the ID number of manuscripts included in each specific topic. Manuscripts have been identified from 1 to 258 (Appendix A.2). Some works are mentioned in the next paragraphs to better describe each application area.

The Territorial and Urban area (Figure 2.5) is the most important application area of ANP supporting decision making for SD. Models built in this area are mainly aimed at sustainability through:

- spatial analysis: Planning (Grimaldi, Pellecchia, and Fasolino 2017; Pourebrahim, Hadipour, and Bin Mokhtar 2011; Tadic et al. 2019), evaluation of projects (Giordano et al. 2010; Y. Wang et al. 2013) or development of indicators (Pourebrahim et al. 2010);
- improving of urban areas to improve: growth (Bottero and Ferretti 2010b; Daneshvar, Khatami, and Shirvani 2017; Khoshnava, Rostami, Zin, Streimikiene, Yousefpour, Mardani, et al. 2019), redevelopment, regeneration (Huang and Wey 2019; Manupati, Ramkumar, and Samanta 2018; Della Spina 2019; Wang et al. 2013), mobility (Sayyadi and Awasthi 2018; Wey, Zhang, and Chang 2016) or policies (Persada et al. 2018);
- generating indicators and evaluating: land quality (Chen and Tsai 2017; Peng 2019), cities' performance (Baldemir, Kaya, and Sahin 2013; Tao 2019), risk (De Brito et al. 2018; Ferretti et al. 2014), existing infrastructure (C. Chen et al. 2018; Isaacs, Falconer, and Blackwood 2008) or living conditions (Dezhi et al. 2016; Ferwati et al. 2019; Zou, Su, and Wang 2018);
- planning to develop tourism sector (Chen and Tzeng 2010; Gonzalez-Urango and García-Melón 2018; Zarei et al. 2016); and
- location of new infrastructures: (Habib and Sarkar 2017; Li et al. 2016; Wu et al. 2016).

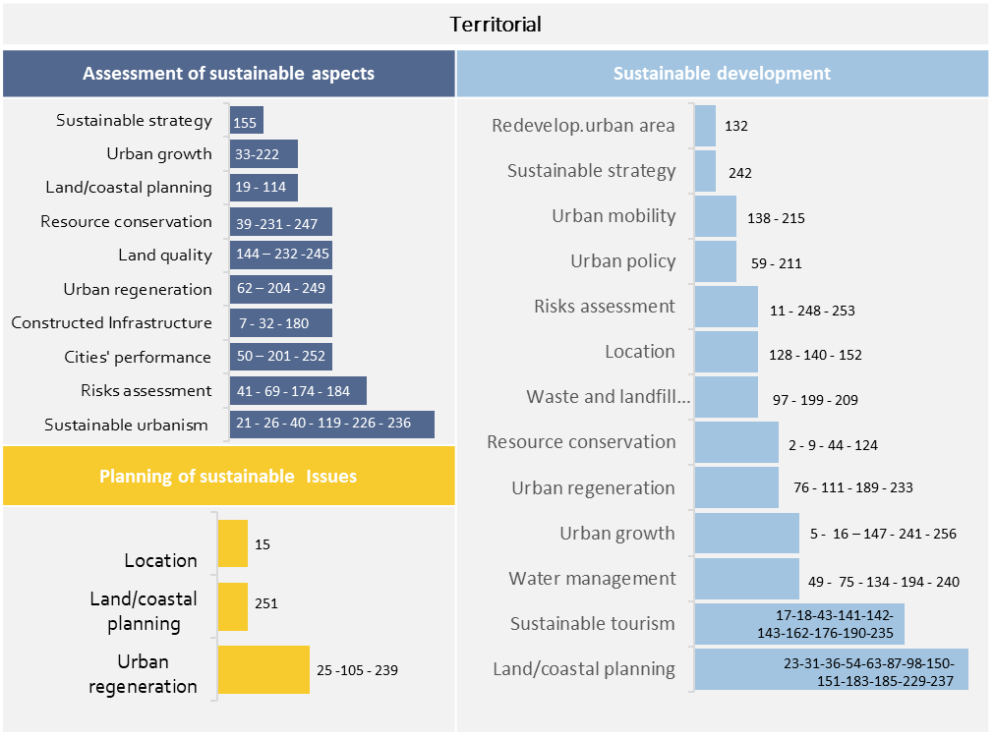


Figure 2.5 Deployment of the Territorial/Urban area

The 54 manuscripts in the area of Manufacturing (Figure 2.6) are concentrated in evaluating and selecting suppliers based on green principles for different types of industries (Chung, Chao, and Lou

2016; Kuo, Wang, and Tien 2010; Phochanikorn and Tan 2019); developing green or sustainable supply chains (Al-Mutairi et al. 2019; Hidayati and Hasibuan 2019); design of products (Jayakrishna, Vimal, and Vinodh 2015; Soota 2017; X. Wang, Chan, and White 2014) and designing and evaluating strategies for more sustainable operations and practices (Aminuddin, Nawawi, and Mohamed 2014; Ocampo and Ocampo 2015; Souza Farias et al. 2019; Tseng, Divinagracia, and Divinagracia 2009).

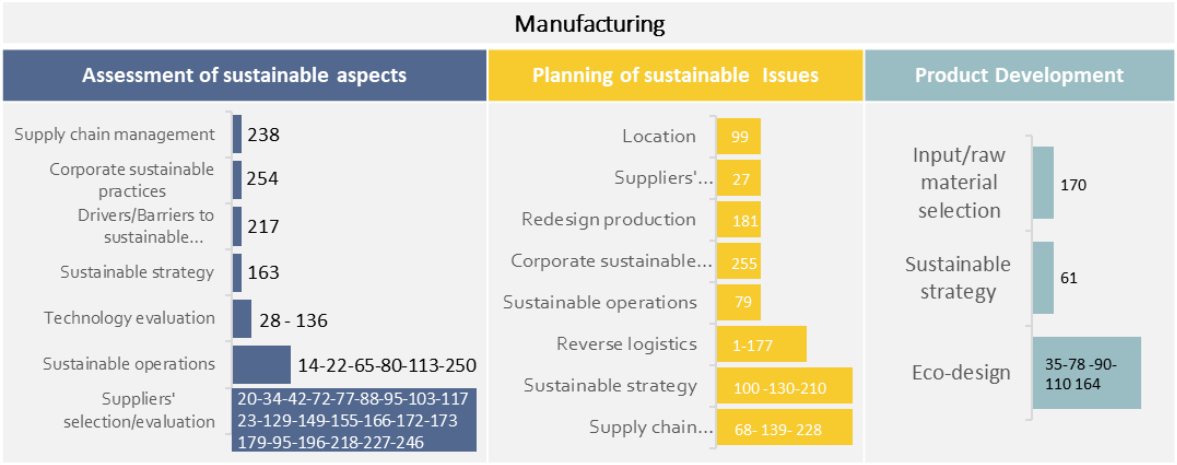


Figure 2.6 Deployment of the Manufacturing area

Energy area (Figure 2.7) is one of the most mixed areas. We found works to guide decision making in, among others, planning and evaluation of energy sources at different levels (Buyukozkan and Guleryuz 2016; Calabrese 2013; Koene and Bueke 2007); and strategies, practices and drivers for the energy industry (Chen, Wang, and Lin 2015; Zhao and Li 2015), for countries (Ervural et al. 2018; Koene et al. 2015; Ren et al. 2015) or for some specific sectors such as tourism (Hu et al. 2013).

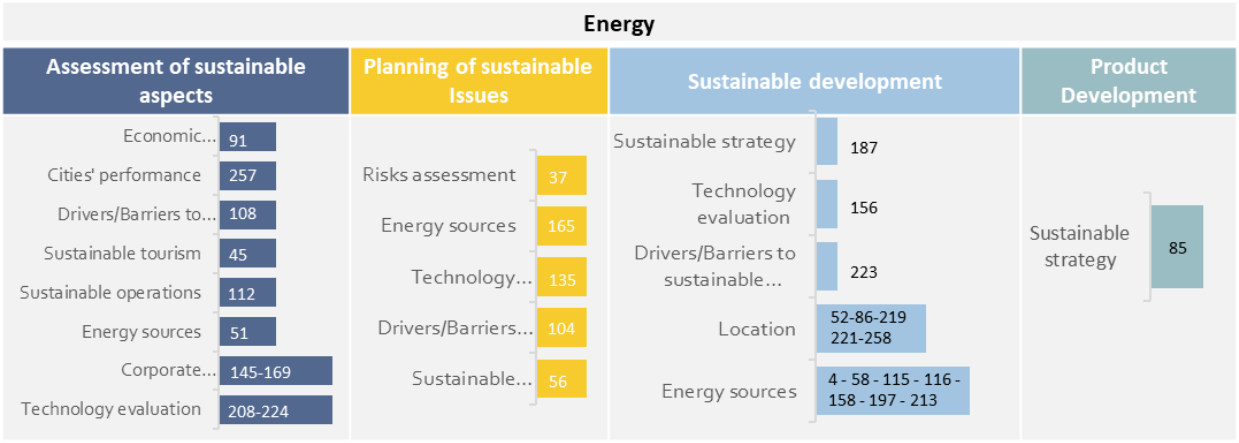


Figure 2.7 Deployment of the Energy area

Manuscripts in Business or Management (Figure 2.8) mainly cover model planning and evaluation of corporate practices (Chung, Chao, Chen, et al. 2016; Horng, Hsu, and Tsai 2018; Tseng et al. 2011), supply chain (De Felice, Petrillo, and Cooper 2013; Hussain, Awasthi, and Tiwari 2016; Malviya, Kant, and Gupta 2018) and strategies (Dong et al. 2019; Hsu et al. 2011). Some other works consider sustainable operations (Duman et al. 2018), risk assessment (Yilmaz 2008) and investment decisions (Tsai, Chou, and Hsu 2009).

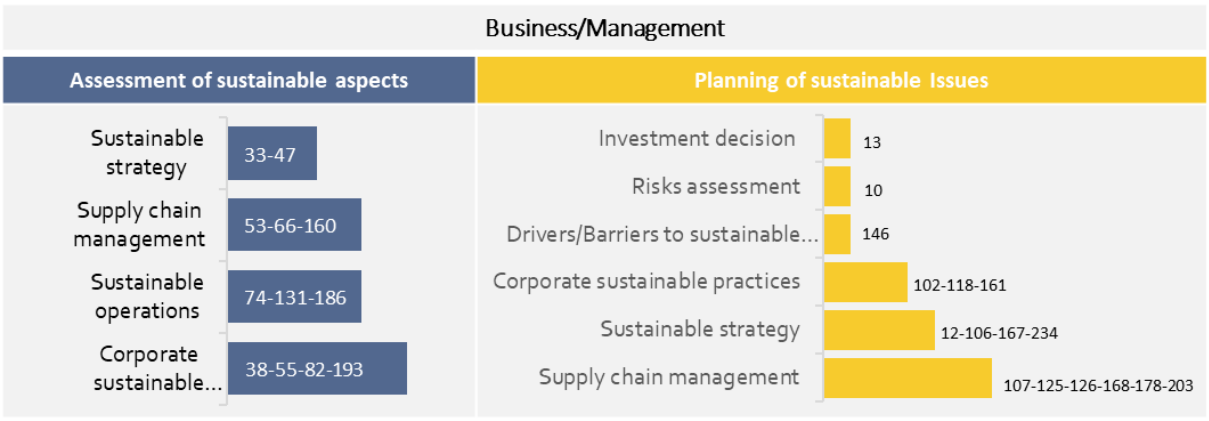


Figure 2.8 Deployment of the Business area

In the Construction area (Figure 2.9), the development of models is aimed at evaluating existing infrastructures (El Chanati et al. 2016; Hu and Zhang 2013; Wang et al. 2018); and planning of efficient use of resources (He et al. 2017; Liu et al. 2018), materials (Khoshnava et al. 2018; Mahmoudkelaye et al. 2018), or technologies (He et al. 2017); as well as generating fewer emissions (Xiaoming Wang et al. 2016).

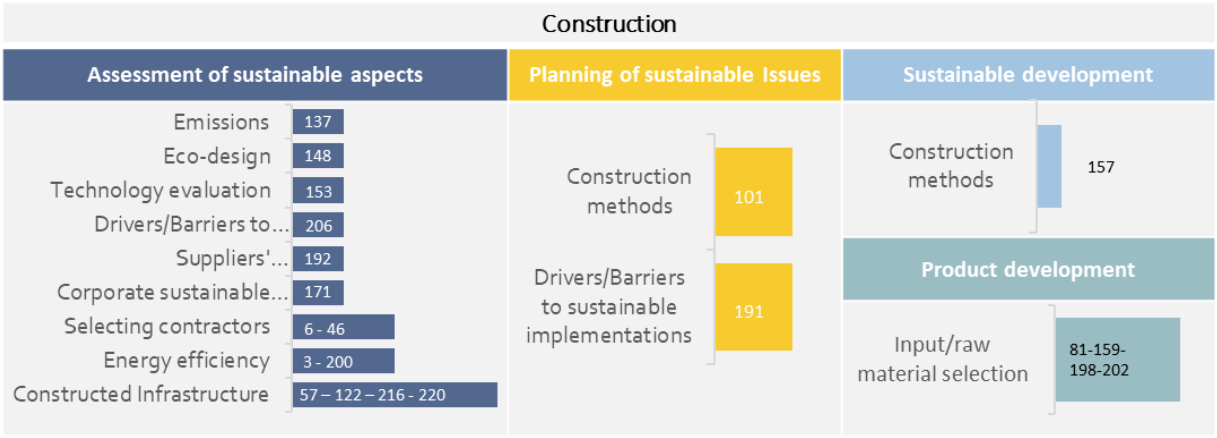


Figure 2.9 Deployment of the Construction area

The Agricultural area (Figure 2.10) embraces sustainable frameworks to improve land and coastal conditions (Mohammadi, Najafi, and Ahmadlo 2015; Parra-Lopez et al. 2008; Sajedi-Hosseini et al. 2018) or to develop operations through some practices, (Yang and Liu 2012) improving the supply chain (Chauhan et al. 2019) or using new technology (Reig, Aznar, and Estruch 2010).

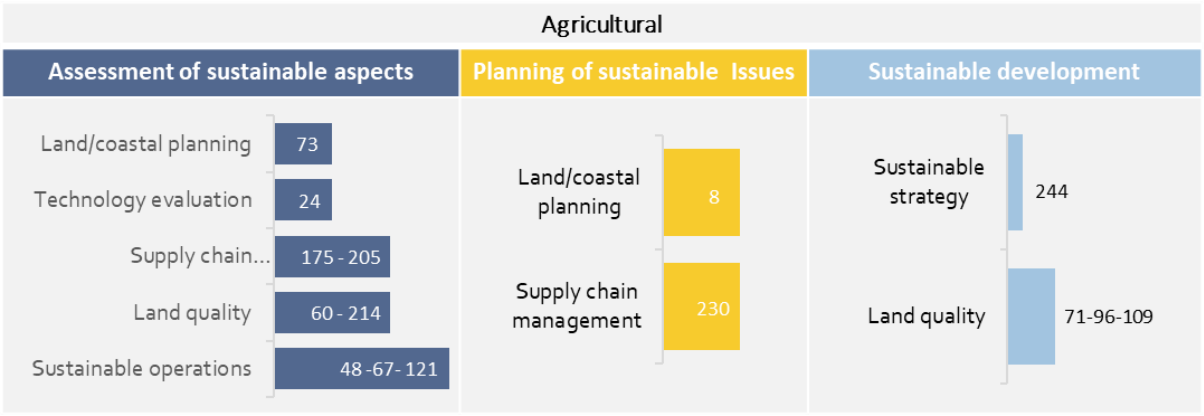


Figure 2.10 Deployment of the Agricultural area

Another group of contributions in the Transport area (Figure 2.11) implement models to develop alternatively fuelled vehicles (Chang et al. 2015), improve the logistics industry (Lam and Dai 2015; Lam and Lai 2015) or other transport industries (Chen and Ren 2018; Dimic et al. 2016).

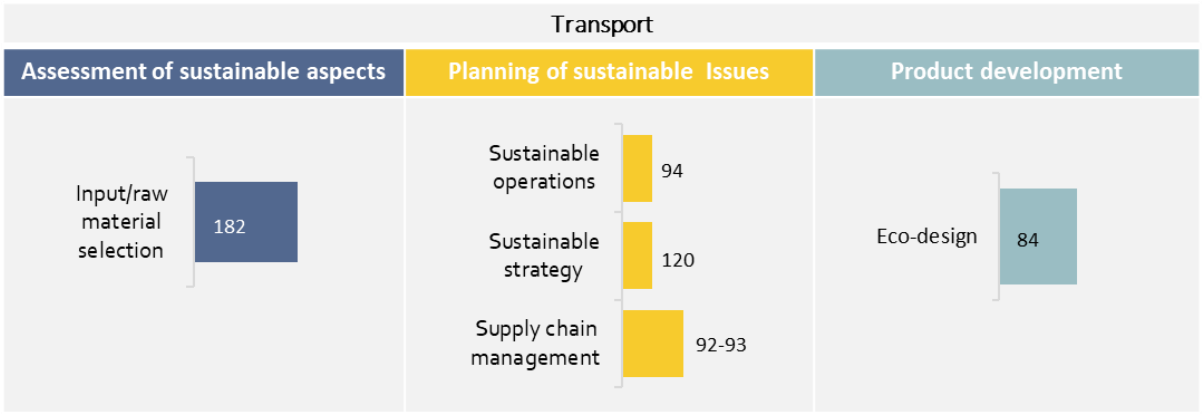


Figure 2.11 Deployment of the Transport area

The Extraction/mining sector is aimed at selecting a best timber extraction method (Jaafari, Najafi, and García-Melón 2015) and to assess green supply chain practices (Kusi-Sarpong, Sarkis, and Wang 2016; Raut et al. 2018). For the Retail and Fuel sectors, we found more supplier selection cases (Buyukozkan and Berkol 2011; Wu, Hsieh, and Chang 2013; Zhou and Xu 2018); and the development of a sustainability index for a biofuel industry (Ngan et al. 2018) (Figure 2.12).

Finally, in the group 'Others' there is a guide for green software developers (Koçak, Alptekin, and Bener 2014), a list of criteria to evaluate global sustainability of hospitals (Bottero et al. 2015) and in the healthcare sector (Leksono, Suparno, and Vanany 2019), a learning technology intervention (Raji and Zualkernan 2016) and a model to improve collaborative innovation networks (Fang et al. 2018).

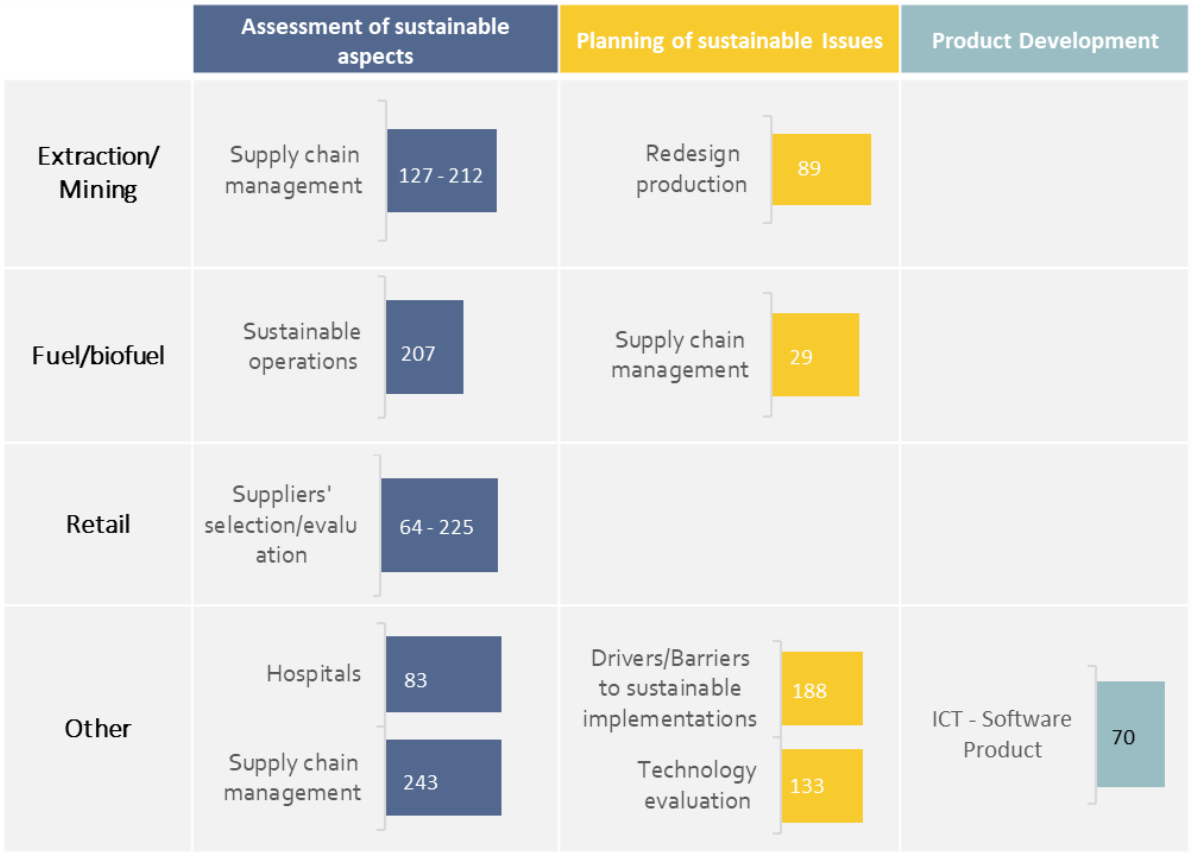


Figure 2.12 Deployment of Mining, Fuel, Retail and Other areas

Previous fields and applications evidence the adaptable nature of ANP. This technique, just like other MCDM techniques, can face different type of problems. The formulation of the models depends on the nature of the problem. This refers to the process of screening, prioritising, ranking, selecting or sorting a set of alternatives (Ishizaka et al. 2012; Razavi Toosi and Samani 2014). We identified four types of models (Figure 2.13):

i. **Evaluate alternatives:** this is the most common use of ANP. The alternatives can be e.g. projects, locations, strategies, suppliers, technologies, scenarios, cities, etc. The goal could be prioritised or evaluated alternatives, for example: Noorollahi et al. (2018) established a ranking of power generation technologies, whereas Tu et al. (2013) evaluated some green package development strategies, presenting their strengths and weaknesses.
ii. **Determine criteria weights:** criteria can be elements to build maps (Jesiya and Gopinath 2018), indicators (Horng et al. 2012), customer requirements (Lin et al. 2010), etc. These models define and compute weights of criteria.
iii. **Develop a performance Evaluation:** construction and application of evaluation indexes. A composite performance measure could be used for cities (Yu, Zheng, and Li 2019), companies (Wicher, Zapletal, and Lenort 2019) or product processes (Alkaff et al. 2018). These applications are more recent. Works with this approach started in 2013.
iv. **Allocation of resources**: only one work was found. This work defines how much money should be assigned into each alternative for a technological updating of an eco-factory (E. Chen et al. 2018).

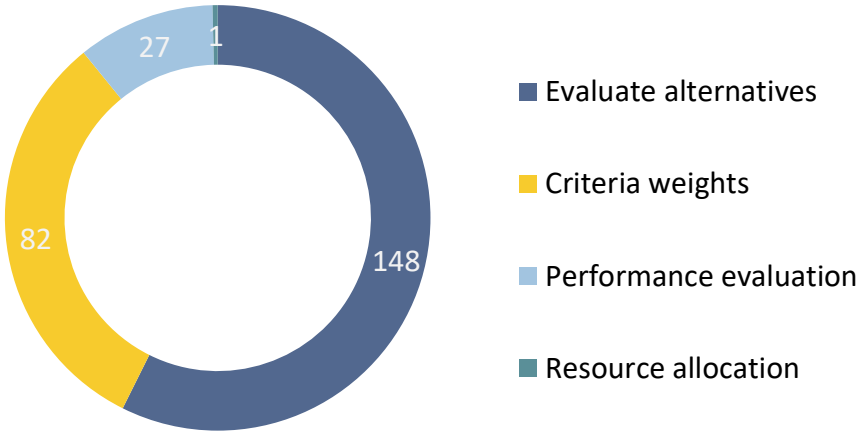


Figure 2.13 The main goal of the models

This result is interesting in the way in which MCDM techniques and mainly ANP was developed 'to decide'. But in depth it is used for more purposes, which gives us an idea of the versatile nature of the technique to tackle different problems.

2.4.3 Complementary analysis

A more exhaustive analysis has been developed to go into more detail about the use of the technique and its evolution. A word frequency analysis of all 258 manuscripts was carried out to identify the more common terms in the main fields (Title, Abstract and Keywords). Some general words such as use, criteria, ANP, models, and decision have been eliminated and words such as stemmed or similar words have been grouped together. The most frequent word is the root word 'sustain' (sustainabilities, sustainability, sustainable…). Additionally, we found terms relative to other approaches (fuzzy, DEMATEL, VIKOR, Delphi…); fields (managing, energy, urbanism, policy…), application topics (suppliers, products, operators…), goals (select, performance, evaluate, indices…) and concepts connected with SD (environment, green, integrity, resources, economic, social, dimensions…).

This previous analysis casts some light on the use of the technique in combination with others. One of the advantages of ANP is its flexibility to be integrated with different techniques. Hence, we examined each manuscript to find combinations, modifications and extensions of ANP from three different perspectives. In the first one, we considered if the integration of ANP along with other techniques is complementing or modifying the ANP methodology. Then, we explored the techniques and methods used together with it, and finally, we analysed the role of ANP as a primary or secondary technique supporting the other ones.

The first perspective indicates that 33% of all studied manuscripts use ANP alone. This tendency has been maintained during the period 2005-2019; it has even increased during the last three years (Figure 2.14). In the next group of documents, models were constructed combining ANP with other techniques as a strategy for complementing methods (36%) e.g. joining Life Cycle Impact Assessment to compare the performances of the two processes (Vimal and Vinodh 2016). In the last group, traditional ANP procedure was modified (31%), for example, adjusting ANP with DEMATEL (DANP),

grey relational analysis (GRA) and technique for order performance by similarity to ideal solution (TOPSIS) to select a material (Zhang et al. 2017). This last practice has increased substantially especially during 2018.

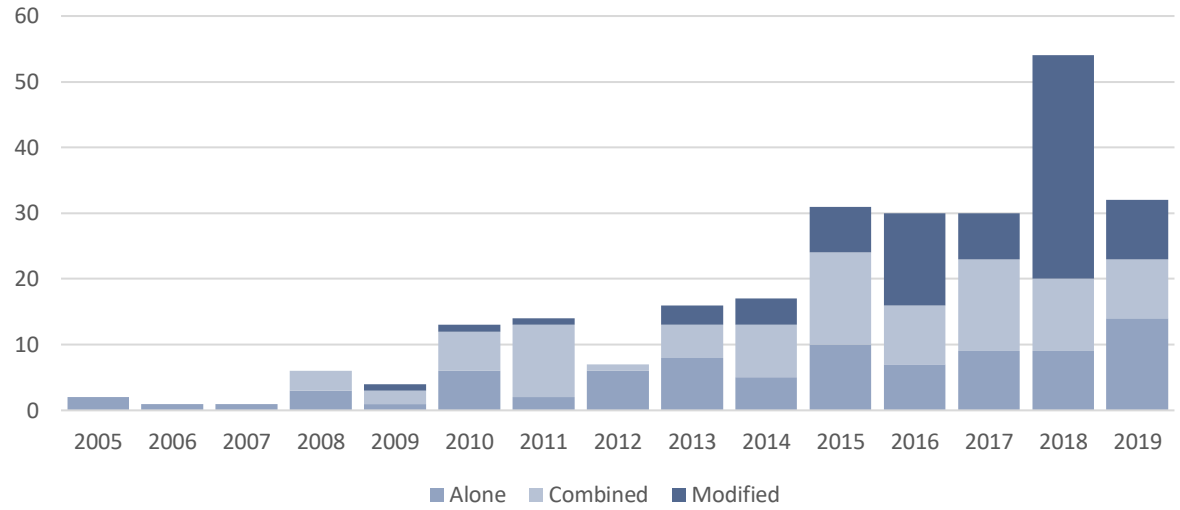


Figure 2.14 ANP uses and other techniques

As we noticed in more than 60% of the manuscripts ANP is used together with other techniques. Therefore, the question in the second perspective is, what are those techniques? Unquestionably fuzzy logic is the most used approach in order to deal with imprecision in ANP and in other techniques. More than 80 applications of fuzzy logic have been found in different models affecting ANP and other MCDM techniques (Fuzzy COPRAS, Fuzzy DANP, Fuzzy ELECTRE, Fuzzy Grey Relational Analysis, Fuzzy Max-Min, Fuzzy Preference Programming…). Besides, DEMATEL (traditional, based on ANP –DANP- or FDEMATEL) and Geographic Information Systems GIS are the most used techniques, followed by Delphi method (traditional and fuzzy Delphi FDM), BOCR and AHP. Sometimes Balanced Scorecard BSC, SWOT, Fuzzy TOPSIS and Interpretive structural model ISM also appear. Several manuscripts combine more than one of the techniques presented.

Results also suggest that the use of ANP with other techniques has changed. The first combinations were more simple combinations with BSC (Ravi, Shankar, and Tiwari 2005), AHP (Wolfslehner et al. 2005), BOCR (Koene and Bueke 2007) or QFD (Parra-Lopez et al. 2008). Recently, applications are more complex using more sophisticated methods such as GIS (Ferretti 2011) or modifying the method with a fuzzy approach (Ren et al. 2016) or DEMATEL (Phochanikorn and Tan 2019).

Finally, given the number and the conditions of ANP combinations together with other techniques, we analysed whether or not ANP is the main technique in the models in the third perspective (Figure 2.15). ANP is the main technique guiding decision -making in 63% of all manuscripts. Applications as a peer with other techniques started in 2008 and have been increasing since. They represent 29% of the manuscripts e.g. Chen et al. (2018) which used Dynamic programming DP, Delphi method and ANP for a technological updating decision. In this case, DP and Delphi accompany ANP and the final results depend mainly on ANP procedure. Instead, the most suggested change occurs when ANP is a complementary technique for supporting others. These applications are fewer (8%) and more recent,

since 2015, but seem to be increasing. E.g. in Wu et al. (2016) ANP supports a cloud model and the PROMETHEE method for selecting the location of electric vehicle charging stations.

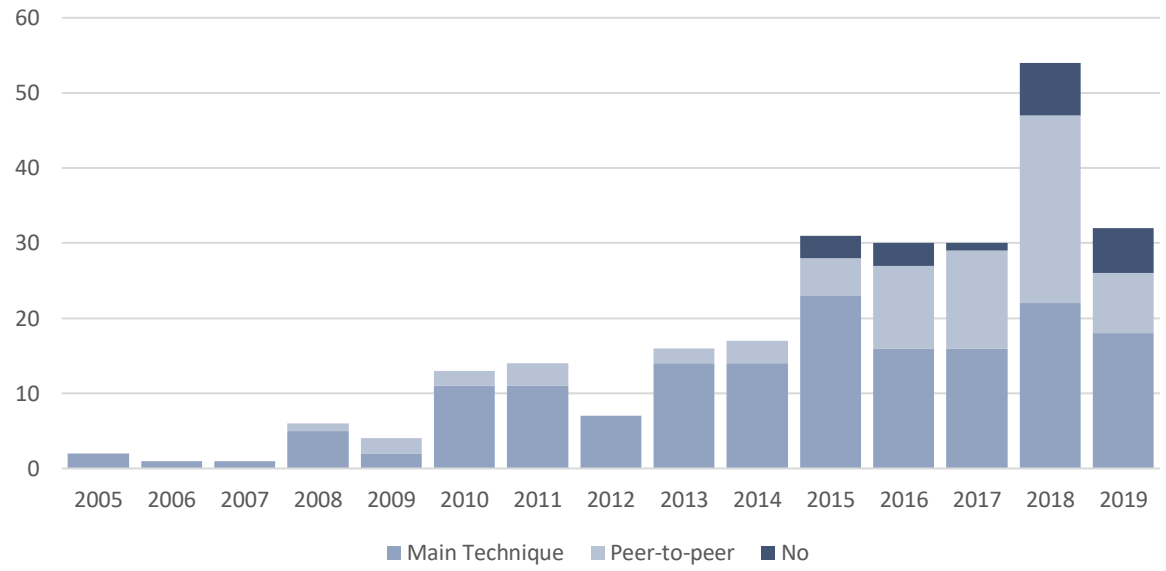


Figure 2.15 ANP as primary or supporting technique.

Moreover, according to the SD approach, sustainability should be tackled from different levels. So, during the analysis of the manuscripts an additional interesting point arose, regarding this idea (Figure 2.16). All the proposed models are empirical. We found that applications to guide decision making in sectors or general industries are the most common applications (79 manuscripts), followed by applications in regions (53), companies (51) and cities (40); and a few for specific countries (20) or projects (13).

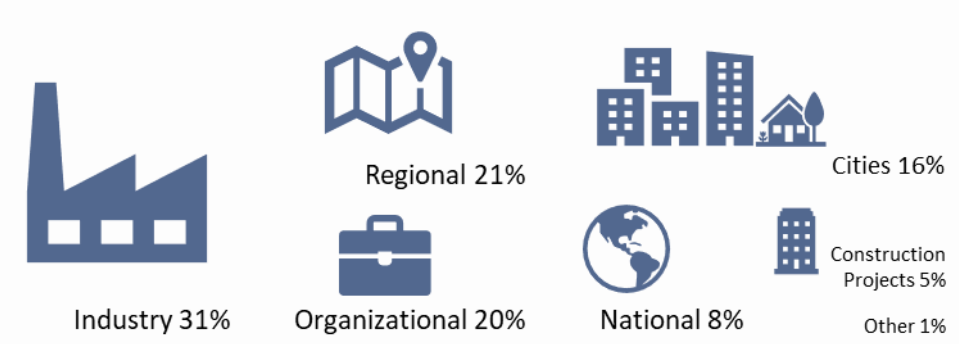


Figure 2.16 Level of applications of models

Applications at territorial level suggest the spread of ANP worldwide. As (Vaidya and Kumar 2006) previously introduced for AHP, we decided to explore the country in which ANP is applied. This means the application country of the empirical model instead of the authors' institutions' country. Although previous reviews show the spread of ANP uses worldwide, applications supporting SD are concentrated in Southeast Asian countries (Figure 2.17). Five countries concentrate more than 50% of the publications. The list is led by China (14%), Taiwan (13%) and Iran (12%); followed by India (8%) and Italy (5%).

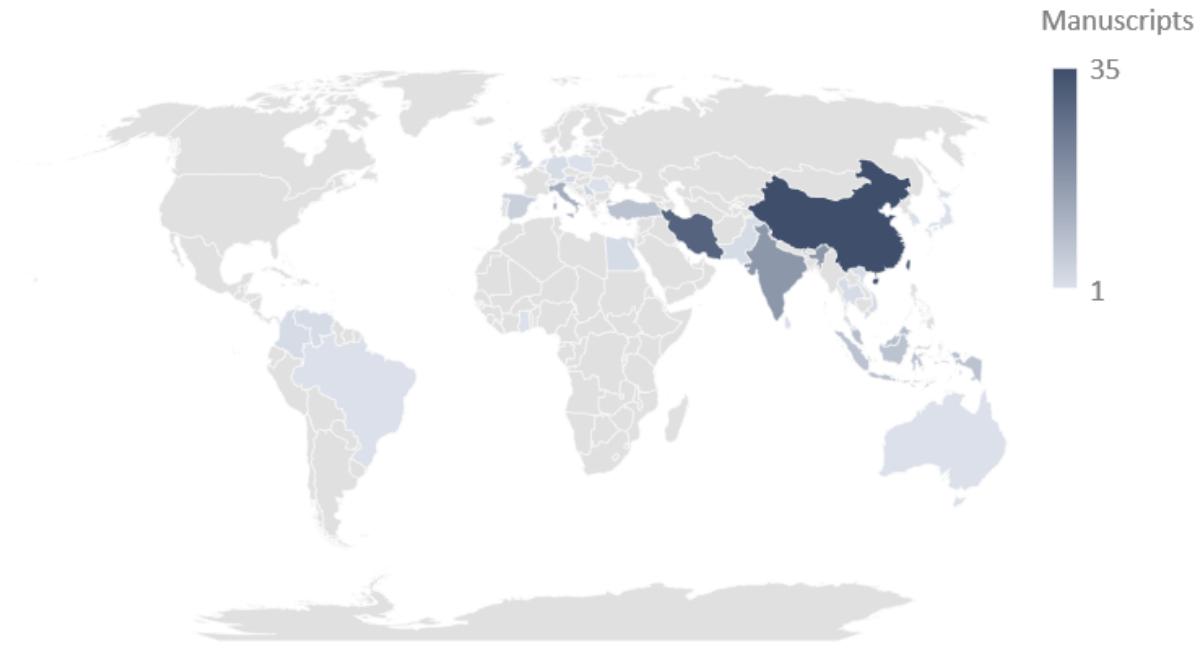


Figure 2.17 Countries of application of ANP models / Application countries of ANP models

2.5 In-depth analysis

Manuscripts in the 'Territorial and urban' application area were selected for an in-depth analysis, since they have the largest number of publications.

2.5.1 Why ANP?

Multicriteria decision making (MCDM) techniques provide a framework to address relative priorities to critical issues and select the best alternatives (Razavi Toosi and Samani 2016). They are useful for the evaluation of proposals or the weight of a benchmark in relation to other benchmarks (Huang and Wey 2019).

The main reason for selecting ANP is, without a doubt, that it takes into account, handles and synthesizes complex relationships, interdependences and feedback that may exist in decision problems between elements or components (indicators, criteria, alternatives…). Many manuscripts state that this is the principal reason for selecting it (Alizadeh et al. 2018; Cui et al. 2011; Ferretti et al. 2014; Ghajar and Najafi 2012; Kao et al. 2017; Molinos-Senante et al. 2015; Wang et al. 2013; Wang et al. 2010; Wolfslehner and Vacik 2008; Wolfslehner et al. 2005; Zhang 2016).

In relation to SD, ANP has the capability to include the three pillars of SD (environmental, social and economic) together with other relevant and diverse factors such as technical or legal issues (Bottero and Mondini 2008; Chuang et al. 2018; Wang and Zeng 2010). Hence, it portrays a more realistic representation of problems by prioritising not only elements but also groups of elements, which is often necessary for solving problems on the ground (Ghajar and Najafi 2012; Peris et al. 2013; Pourebrahim et al. 2011; Shehada et al. 2015).

In addition, we also found that results in previous applications in specific problems are also considered to select ANP over other techniques since it may provide reliable solutions to e.g.:

- provide a quantitative assessment of different types of alternatives (Xu et al. 2018). Allowing DM the best benchmarking and providing more acceptable results compared to other techniques (Grimaldi et al. 2017);
- confirm organizational goals and weighting values on a strategic level in order to systematically achieve decisions (Dezhi et al. 2016; Kao et al. 2017);
- obtain composite weights (Habib and Sarkar 2017);
- investigate the relationships between evaluation indices and indicators (Zou et al. 2018);
- solve the problem that the indicator is difficult to quantify (Zou et al. 2018);
- facilitate determining the limiting influences among all control criteria by forming a supermatrix (Kao et al. 2017);
- synthesise the available data in the decision problem (Bottero and Ferretti 2010a);
- work in scenarios with scarce information and incomplete or inconsistent inputs (García-Melón et al. 2010; Jesiya and Gopinath 2018; Peris et al. 2013);
- feed a great deal of information and expertise to models (Bottero and Mondini 2008);
- avoid the problem of compensation. It is one of the compensatory models (Feyzi et al. 2019; García-Melón et al. 2010; Peris et al. 2013);
- assess and control the consistency of the judgments (Dragoi 2018; Razavi Toosi and Samani 2016; Šijanec et al. 2014);
- work with available user-friendly and commercially supported software packages (Jesiya and Gopinath 2018);
- take advantage of the property of reciprocity in evaluation schemes (Dragoi 2018); and
- treat problems with intrinsic spatial nature effectively (Choubin et al. 2019; Ferretti et al. 2014).

Regarding handling of stakeholders, a considerable number of authors expressed the idea that it allows all stakeholder's opinions, requirements and interests to be considered (Bottero and Mondini 2008; Isaacs et al. 2008; Šijanec et al. 2014), integrates experts' opinions and knowledge (Aminu et al. 2017; Chen and Khumpaisal 2009; Molinos-Senante et al. 2015; Wang et al. 2010) as well as bringing the possibility of performing group decision sessions (Palmisano et al. 2016). It also facilitates stakeholders gaining a better understanding of the problem, learning and increasing their awareness about it (Bottero and Ferretti 2010a; Chuang et al. 2018; García-Melón et al. 2012)

2.5.2 Technical aspects constructing ANP models

In this section, we focus on technical aspects to analyse issues regarding the selection of elements, the experts, the consistency and the treatment of experts, among others.

How the models are built?

Before structuring a model some authors decide to previously study some characteristics of the framework e.g. demographic, climatic, etc. (Grošelj and Stirn 2015) and consult with stakeholders e.g. through interviews (Chen and Khumpaisal 2009) in order to understand the current situation. Then, the elements in the models have to be defined. The most common ways of defining the models are

through a literature survey and expert consultants. The latter through questionnaires (Aminu et al. 2017), interviews (Ferwati et al. 2019; Huang and Wey 2019; Wang et al. 2013; Zhang 2016; Zou et al. 2018), discussion meetings (Sayyadi and Awasthi 2018; Wang et al. 2010), or focus groups and workshops (Arsic et al. 2018; Ferretti 2011; Ferretti and Pomarico 2013; Pourebrahim et al. 2011; Wey et al. 2016; Wu et al. 2016). Another way of element screening is following one or more of the following strategies:

- Data availability, especially in spatial problems (Choubin et al. 2019; Habib and Sarkar 2017), e.g. (Huang and Wey 2019) in an application of Big Data and ANP for the adaptive reuse strategies of school land.
- Existing indicators available in current rating systems or guides e.g. for evaluating a logistic settlement (Giordano et al. 2010), defined by the Cittaslow International Network (Baldemir et al. 2013) Customer Satisfaction Index (ACSI) (Chen et al. 2018) or defining for local plans (Ferretti 2011; Najafinasab et al. 2015; Pourebrahim et al. 2010; Wang et al. 2013)
- based on the authors' knowledge (Chen and Khumpaisal 2009)
- alternatives preconceived for different local/national plans and programs (Gonzalez-Urango and García-Melón 2017)
- As a result of a discussion during a conference regarding the problem (Huang and Wey 2019).

Another important point is the definition of the influences and relationships among elements. Usually, it is done by meeting with experts. Few cases applied traditional or modified Delphi method (Lee and Chi 2010; Li et al. 2016; Pourebrahim et al. 2010; Wang et al. 2010; Wang and Zeng 2010; Wolfslehner et al. 2005; Wu 2011; Zhang 2016). In the particular case of a spatial application, influences among the elements of each cluster reflect the natural dynamics of the environmental and territorial systems, where link and interaction pathways exist between individual elements (Ferretti 2011).

Once the model is agreed upon, judgments are required. Questionnaires based on pairwise comparisons are the most frequent way to obtain expert opinions. It is less common to request judgment from the panel of experts and stakeholders during workshops or focus groups that allow for open discussion among participants (Ferretti et al. 2014; Ferretti and Pomarico 2013; Giordano et al. 2010; Peris et al. 2013; Pourebrahim et al. 2011; Wang et al. 2013). Only three particular applications have applied different proposals. Garcia-Melon et al. (2012) using the Delphi methodology through several rounds that allow participants' judgments to be adjusted as they become aware of the group's judgments. Wang et al. (2013) classified experts in groups. One core team familiar with the ANP approach, determined the comparison on a consensus basis; then, other members were consulted for revision and adjustment of the evaluation scores; and finally, results were also discussed among the other team members for validation of the reasonability. Lastly, Grimaldi et al. (2017) determined groups of DM. Each group was associated with a corresponding cluster and made the comparisons between nodes with respect to its specific cluster. The comparisons to determine the weights of each cluster in comparison to the general goal were assigned to all DM.

How many alternatives should I select?

Regarding the alternatives, these are mainly strategies, scenarios, locations, projects, policies, uses, sites, methods, technologies or programs.

Although there is no consensus or general recommendation as to the number of alternatives a model should have, most models have between 3 and 5 alternatives. The lowest number, two alternatives, is found in Dragoi (2018) about joining or not joining non-industrial private forests into a single management unit. On the other hand we found a model with 7 alternatives of wastewater treatment (Molinos-Senante et al. 2015) and 13 alternatives which correspond to 13 programs but the model is balanced by the number of criteria (six) (Peris et al. 2013). The work of Wang et al. (2013) is interesting since it includes 80 project alternatives to be evaluated. ANP is used to determine the weight of the evaluation criteria, and once defined the evaluation of the alternatives is carried out using the absolute measurement method to compute the rating scores for each alternative (project). A numerical scale was used to rate each alternative against every criterion in terms of how helpful the projects are. The total score of the project was calculated according to the weighs of each criterion and the number assigned.

What kind of criteria should be considered? and how many?

An analysis of the most common words among clusters and criteria shows that the most common tags are related to the terms: environment or natural, economic and sociocultural/social/socio. All of them are proposed to evaluate or regard appraisal aspects such as uses, quality, density, population, risks, distances, infrastructures or facilities, costs, size, plans, employment, landscape and ecosystems, features, access, intangible values, tendencies, impacts and waste. Few recent works include technological (Ghaemi Rad et al. 2018) and political factors (Baldemir et al. 2013).

On the other hand, the number of elements in a cluster should be no more than approximately seven, although nine may be acceptable (Saaty and Vargas 2006). Instead, there are no recommendations for the number of criteria in a model, although it is recommended that the fewer the better. The most common are models with less than 30 criteria. However, Sayyadi and Awasthi (2018) propose a model constituted by three criteria (congestion, fuel consumption, and emission) used to evaluate five transportation policies. Alternatively Baldemir et al.(2013) present a model that consists of 7 main and 59 sub-criteria which were determined and published by the Cittaslow International network to select the most appropriate candidate to be a slow city among 7 options in Turkey. Also noteworthy are the works of Giordano et al.(2010) with forty-nine environmental indicators for evaluating logistic settlement and Wolfslehner et al. (2005) with 43 indicators for evaluating four sustainable forest management strategies.

Software

Superdecisions is the preferred and most often used software. Nouri et al. (2018) use both Superdecision and Expert Choice software. Superdecisions is the leading software in both AHP and ANP while ExpertChoice can be used only for AHP. One of the potentials of ExpertChoice is the provision of graphs related to sensibility analysis (Nouri et al. 2018). Pourebrahim and Amoushahi (2017) and Zhang, (2016) worked with Matlab, and Wu (2011) has used Excel.

Two publications developed the proposal of new software. Pourebrahim et al.(2010) developed adapted programming for the field of coastal land use planning. It covers the list of 148 criteria and indicators applicable in this field and users can choose from the list of criteria without needing to design, build models or calculate in other software. Isaacs et al.(2008) describe a prototype

visualization tool (S-City VT) that models the interactions between sustainability indicators, allowing the users to input opinions and showing results to the user using a 3D visualisation tool.

Consistency

As we mentioned before, one of the main advantages of the ANP is the consistency check. The consistency ratio C.R. ≤0.10 is considered acceptable in most of the works. Values above 0.1 can be acceptable. It depends on the nature of the problem, the complexity of the model or the expertise of the participants, e.g. in Groselj and Stirn (2015) the initial consistency ratios were much higher than 0.1 in some cases, so they decided to allow CR <0.15. This adoption did not change the final results, but it helped stakeholders significantly.

Global Result

Once the questionnaires are returned to the facilitators, results should be combined. Saaty (1996) claims that the geometric mean is the most suitable aggregation technique to obtain the overall results. Indeed, the most common way of integrating experts' opinions is through geometric mean, aggregating individual priorities (AIP) or aggregating individual judgments (AIJ). However, some authors propose applied arithmetic mean to aggregate experts' opinions (Chen and Tsai 2017; Ferretti and Pomarico 2013; Huang and Wey 2019; Wang et al. 2013; Zou et al. 2018). Wey et al. (2016) propose that if each expert represents the viewpoints of a different group the samples are independent of one another, therefore using the arithmetic mean is a suitable calculation approach; if the samples are interrelated, then the geometric mean would apply. In a few cases the different experts worked together in order to achieve a consensus (Ferretti et al. 2014; Giordano et al. 2010; Sayyadi and Awasthi 2018; Y. Wang et al. 2013; Wang et al. 2010). Palmisano et al. (2016) combined both approaches since they determined four categories of stakeholders. The consensus vote on judgements was adopted to obtain the local priority vectors of each group of stakeholders and the geometric mean was applied to aggregate the local priority vectors of each group of stakeholders.

Dispersions among valuations are not usually studied. De Brito et al. (2018) analysed the agreement among experts, measuring the interquartile range (IQR) to quantify the degree of conflict between participants regarding the criteria prioritisation (20% or less). Also, the similarities between the individuals were calculated using cluster analysis with Ward's method, and a heat map of similarities between experts' weights.

The robustness of the model

Sensitivity analysis was the procedure undertaken to study the robustness of a model. However, it is not a common practice. Only one-fifth of the analysed documents presented any kind of sensitivity analysis. This result is similar to those found by (Mu, Cooper, and Peasley 2020) in a recent review about ANP practices.

Sensitivity analysis should be addressed after final priorities are obtained, but as it is an uncommon practice, some models' developers could consider that is unnecessary to report it. Other possible explanations for the lack of this analysis could be that it may be difficult to find an established, clear and strong sensitivity approach to follow. Also, there are not enough references

about the level and the type of analysis required, examples of questions used to validate the result or descriptions of the impacts of sensitivity analysis.

The procedure was carried out by changing the priorities of criteria and by modifying all criteria (Arabsheibani, Sadat, and Abedini 2016; Arsic et al. 2018; Wang et al. 2013); those with higher scores (Razavi Toosi and Samani 2014); or only those nodes in the cluster of main criteria (Palmisano et al. 2016). The second option was to change the cluster weights (Grimaldi et al. 2017; Razavi Toosi and Samani 2016). Ferretti (2011) presented a sensitivity analysis featuring five scenarios of changes in clusters weights. The first one was a neutral perspective where all clusters had equal weights, in all the other perspectives each cluster dominated the other ones. The next option was to modify the influences e.g. of the element with the highest weight, Molinos-Senante et al.(2015) considering changes in the influence that other elements received or exerted on the element with the highest weight, and even considering the influence that alternatives exerted thereon. Bottero and Ferretti (2010a) modified the influences of the alternatives on the criteria and vice versa. The last proposal was to eliminate one alternative at a time and study the resulting final ranking (Bottero and Ferretti 2010a).

To evaluate the robustness of a model Choubin et al (2019) used the receiver operating characteristic or ROC approach to measure the overall performance of predictive models. Furthermore, Aminu et al.(2017) proposed two statistical analysis (Kolmogorov–Smirnov K-S test and t test) for priority weights validation.

Feedback

The main intention of feedback is to confirm the results or the proposed methodology. Some works informed stakeholders about the global and the individual rankings (Grošelj and Stirn 2015; Palmisano et al. 2016; Peris et al. 2013). A few cases collected the opinions of the participants through a feedback questionnaire. Wang et al.(2013) discussed with one of their expert groups, the planning team, for validation of the comparisons. De Brito et al.(2018) developed a web GIS platform to allow participants to have a comprehensive and synthetic view of their results and compare them with the other participants' results. In addition, participants were also asked to comment on the difficulty and future improvements of the MCDM tools.

Experts

We identified three key points regarding experts: the quantity, the profiles and the selection processes.

Quantity: it is noteworthy that in some cases the number of experts has not been specified. As in AHP, in ANP the quality of the experts is more important than the quantity (Saaty 1999) and explicitly, ANP does not need a big sample size (Ferwati et al. 2019). The number varied greatly according to the type of problem, and the way the model was approached. Cases that only developed the evaluation at the criteria level were likely to include more participants. Due to the evolution and the openness of the technique to different types of problems, the term 'expert' tends to be wider now, and the words 'stakeholders' or 'participants' are more broadly used. In general, we looked at models from one to 91 participants. The most common range was approximately from 2 to 20 participants. However,

there were some exceptions. 28 experts (Pourebrahim et al. 2010, 2011); 29 (Molinos-Senante et al. 2015); 35 (Chuang et al. 2018); 45 were divided into three groups of 15 experts each (Chen and Tzeng 2010); 75 answered questionnaires (Ha et al. 2011); 54 (Dezhi et al. 2016); and 60 participants were divided into four categories of stakeholders (Palmisano et al. 2016).

It was also common to involve a larger group in the early stages and a smaller one later. Chen et al. (2018) included 91 expert opinions regarding the construction of rural infrastructures; however, the evaluation was different. Each one ordered the criteria according to their importance and then the authors calculated a score value according to the ratio of accumulated weighting previously received. Lee and Chi(2010) first, defined a list of 100 experts and sent questionnaires to assess criteria in the early stage, 56 questionnaires were returned. The completed pairwise comparisons were sent to those 56, and 36 questionnaires were returned. It is odd that some works with big samples do not have evidence about the treatment of the inconsistencies.

Profiles: the most common profiles were academics, members of governments and public agencies, and specialists in the subject to be discussed e.g. engineers, environmentalists, GIS specialists, transports planners, tourism or sustainability planners. In the following group, urban planners or developers are a little less common, and the last are civil or resident groups, private entities, or NGOs.

Selection: finally, we would like to discuss how experts were selected. Usually they are selected because they belong to a certain group or institution (Alizadeh et al. 2018; Huang and Wey 2019; Molinos-Senante et al. 2015; Zou et al. 2018), on the basis of their specific competences in certain fields (Giordano et al. 2010; Grošelj, Hodges, and Stirn 2016), due to their years of experience (Xia and Cheng 2019), or for their interest in the problem (Grošelj and Stirn 2015). Only a few of the manuscripts detailed the selection processes. Social Network Analysis SNA approach is proposed by De Brito et al. and Gonzalez-Urango and García-Melón (De Brito et al. 2018; Gonzalez-Urango and García-Melón 2018) to select a list of experts. Other experts were invited based on a purposive sampling methods such as Ferwati et al. (2019), or using a named HYDRA technique, similar to a snowball, for selecting one groups for each pillar of sustainability (Najafinasab et al. 2015).

Two manuscripts calculated sampling sizes before consulting experts. Sarvari et al. (2019) used the Cochran formula according to the unknown population, where 65 people were selected as the sample size. Respondents were carefully selected, based on their degree, level of experience, and their profession. In an early stage 48 completed questionnaires were collected. Then, six experts were selected to answer an ANP questionnaire based on their level of experience, background, and their authorization. And finally, Khoshnava et al. (2019) considered the random sample method used for an equal geographic spread amongst samples. According to this around 100 questionnaires were distributed to postgraduate students and researchers who were familiar with some terms.

ANP inadequate reporting miscellaneous

Regarding technical aspects, we would like to highlight some findings related to poor and incomplete ANP reporting findings. Many of the identified shortcomings have also been identified by (Mu et al. 2020). Two kinds of missing information were identified during the screening and analysis stages. During the screening and previous analysis, some works were discarded because:

- The same models or very similar models are reported twice.
- Publications without results, works in progress.
- Reported models in such a way that it was not possible to identify the main aspects of ANP.

Additionally, inquiring about technical aspects of constructing ANP models some issues to highlight in certain models are:

- The definition and source of the elements (criteria and alternatives) are missing.
- When using other techniques, it is not clear why they are combined.
- When fuzzy approach is used, it is not clear why triangular fuzzy numbers are used instead of pentagonal fuzzy numbers, for example.
- Consistency and its treatment are omitted.
- The treatment and selection of experts is one of the most critical points. The number of experts, their profiles, and their participation in the different phases of the study, e.g. in the definition of the elements or in pairwise comparison, have been not specified.
- How global results were obtained.
- The existence of feedback processes.
- Sensitivity analysis is underdeveloped.

2.5.3 Advantages vs Constraints

The reviewed manuscripts highlighted a few outstanding features associated with ANP, but also briefly mentioned some constraints. Both arose during the design and application of the models themselves.

Advantages

One of the most highlighted benefits of ANP is that it can provide the framework to take into consideration the hierarchical as well as the network structure (interdependencies and interactions of variables) of the complex multipurpose problems at hand (Alizadeh et al. 2018; Bottero and Ferretti 2010b; Molinos-Senante et al. 2015; Y. Wang et al. 2013; Wolfslehner et al. 2005).

Models are considered a suitable framework to deal with decision problems (Bottero and Mondini 2008; Chen and Tzeng 2010; Ghajar and Najafi 2012). It is a particularly valuable tool for planners (Wey et al. 2016), allowing them more flexibility to craft policies and recommend policy directions (Chuang et al. 2018; Persada et al. 2018; Sayyadi and Awasthi 2018; Wang et al. 2010), as well as formulating efficient plans at strategic and tactical levels (Agarwal et al. 2013), and designing different assessment models. The procedure is easily adaptable to many cases for example to: i) evaluate several potential scenarios simultaneously (Grošelj et al. 2016); ii) develop appropriate ex-ante and ex-post enquiries and evaluations of projects (Dragoi 2018; Molinos-Senante et al. 2015); iii) support the selection of the most appropriate technology (Molinos-Senante et al. 2015); iv) develop spatial analysis; or v) use land quality indicators properly (Ferretti et al. 2014; Ferretti and Pomarico 2013; Jesiya and Gopinath 2018; Pourebrahim and Amoushahi 2017).

Despite the extension of questionnaires, in some cases, participants considered that they were neither difficult nor tedious to fill in. On the contrary, once the logic of the questioning was grasped

through the first group of questions, they were able to proceed straightforwardly. By doing so, they reflected on their preferences (Peris et al. 2013). So, time and effort are compensated,

ANP made it possible to tackle multidimensional concepts (Palmisano et al. 2016) breaking down a complex system into simpler elements (Y. Wang et al. 2013). The ANP model is expanded by network features within subnets rendering more detailed visualization of the interactions at the lower levels of the model and criterion's effect (Shehada et al. 2015; Wolfslehner and Vacik 2008). It highlights factors that are most significant. Therefore, it can convert the abstract concept of sustainable development into concrete ideas (Wang et al. 2010), considering its different size and scale dimensions (Molinos-Senante et al. 2015; Pourebrahim et al. 2011; Y. Wang et al. 2013)

In addition, ANP has the ability to check inconsistencies (Molinos-Senante et al. 2015) and sensitivity analysis can be performed. The power of ANP lies in the use of a 1-to-9 ratio scale to capture all kinds of interactions between tangible and intangible criteria and translate them into weights or preferences (García-Melón et al. 2012). This subjective component provides important insights into the overall philosophy and underlying participants' conception of the problem (Peris et al. 2013); enabling debates, reflections and awareness on the subject (Ferretti and Pomarico 2013; Gonzalez-Urango and García-Melón 2017). In some cases, Delphi technique has allowed participants to adjust their judgments to better connect with global results (García-Melón et al. 2012). This is also possible as ANP is ideal to deal with prioritisation in an organized and systematic way (Peris et al. 2013) which facilitates traceability and results (Grimaldi et al. 2017).

Furthermore, the ability to enable the use of qualitative characteristics, subjective opinions and quantitative data is one of the most important advantages (Habib and Sarkar 2017; Shehada et al. 2015; Wang et al. 2010; Wang and Zeng 2010). ANP fills the gaps between complex mathematical planning models, difficult to feed with data, and social enquiry, which is barely supported by mathematical models focused on easing any decision making process (Dragoi 2018). Although ANP requires the use of more sophisticated tools to construct and solve the supermatrix (De Brito et al. 2018), the most useful software for dealing with its calculations is free.

ANP also allows facilitators to easily include and integrate the opinions or preferences of the various groups of stakeholders and the knowledge of interdisciplinary experts (De Brito et al. 2018; Ferretti 2011; Molinos-Senante et al. 2015; Palmisano et al. 2016; Pourebrahim et al. 2011; Wolfslehner and Vacik 2011). Another important advantage of ANP to deal with multiple stakeholders is that they can participate asynchronously. ANP acts as a good facilitator between different stakeholders who may agree or disagree on the outcomes of any decision (Dragoi 2018; Sayyadi and Awasthi 2018). The model could be the result of a participative process, involving a bottom-up process among all the main stakeholders (Giordano et al. 2010). Resources related to involving more actors have to be considered. Nevertheless, it has been demonstrated that ANP procedure is cheaper than other evaluation exercises.

Evaluations made by participants value the results as useful and participation as positive (García-Melón et al. 2012; Grošelj et al. 2016), facilitating decision-makers' engagement with relevant stakeholders in order to substantialize discussions of trade-off in sustainable issues (Chuang et al. 2018; Grošelj et al. 2016), allowing transparency and participation, bringing more credibility (Ferretti 2011; Gonzalez-Urango and García-Melón 2018; Grimaldi et al. 2017). The possibility of

documentation of the whole procedure is useful especially If the results have to be communicated and justified to various related groups (Bottero and Ferretti 2010a; Shehada et al. 2015; Wang and Zeng 2010). This transparency and the feedback are well evaluated and valued by participants (De Brito et al. 2018), all of which also leads to more easily accepted results (Shehada et al. 2015).

The key point is that in several cases experts were very satisfied with the global results, with the way in which the opinions are combined and an agreement is reached. This is more real than reaching optimal solutions. For this issue feedback is valuable. Keeping in mind that the ultimate goal of applying MCDM is to reach a decision. (Ferretti et al. 2014) add that the ANP approach allows models to take influence and interaction effects among the decision elements into account and this is unique and particularly important in environmental decision making problems.

Constraints

In contrast, one of the most notable objections is regarding the considerable number of comparisons needed and how they might restrict the number of factors, criteria and alternatives as well as their interdependencies, to fewer than are desirable (De Brito et al. 2018; Šijanec et al. 2014; Wolfslehner et al. 2005). In this regard, two more disadvantages came up. The first one regarding the number of alternatives to be evaluated (Molinos-Senante et al. 2015) and the second one, due to each cluster having to have at least two nodes within; because it is not possible to evaluate one element in isolation. So, new nodes cannot pop up when the problem is presented (Dragoi 2018) because pairwise comparisons are always required (Šijanec et al. 2014). Therefore, selecting elements is very time-consuming and difficult (Feyzi et al. 2019). Moreover, the increase in the number of elements would greatly increase the number of comparisons needed.

Hence, it is recommended to strongly emphasise defining elements, designing models and involving as many actors as possible. In order to reduce the size of the elements set, to establish clear definitions and delineations of elements, and define only the direct interconnections among system elements (Wolfslehner et al. 2005). Some authors draw upon different techniques and strategies to better involve and consult with experts e.g. Delphi, interviews, open questionnaires, workshops, etc. It is important to avoid the tendency to deter from incorporating different indirect outcomes just so as to avoid complicated networks (Dragoi 2018), but to keep in mind that indirect dependencies are presumably covered by the limit supermatrix calculation procedure (Saaty 1999), and the analysis should highlight which factors are most significant for the decision.

ANP applications are embedded in a very technical environment. Pairwise comparisons are cognitively demanding and a large number of them are impractical (Aminu et al. 2017; Habib and Sarkar 2017; Šijanec et al. 2014; Wolfslehner et al. 2005). Models occasionally become too complex to communicate and understand for DM who are not familiar with the method (Bottero and Ferretti 2010a; Wolfslehner and Vacik 2011). DM are easily confused with respect to the pairwise comparison and more time needs to be spent on thinking about them (García-Melón et al. 2010; Li et al. 2016). Questionnaires are not applicable to persons with low education levels due to their complexity (De Brito et al. 2018; Wolfslehner et al. 2005). In contrast, models should include influence criteria and decision variables that can easily be interpreted, calculated and compared (Wang et al. 2013; Zhang 2016). Hence, a great deal of attention should be devoted to the elaboration of questionnaires. Following studies should simplify the questionnaire design and the comparison process must be

helped by a facilitator (Bottero and Ferretti 2010a; Li et al. 2016; Wolfslehner et al. 2005). When properly used, ANP has the ability to facilitate a quicker, cheaper and more intuitive evaluation, while still coming up with a scientific foundation (Peng 2019; Wang et al. 2013; Wolfslehner and Vacik 2008). A great effort should be put into communicating with participants and designing more balanced models and interactive questionnaires, as well as validating models.

Sensitivity analysis is another important ANP flaw. This is a not-so-well solved problem, however, several authors propose strategies to address or replace it which bring an interesting range of options for future applications (Arabsheibani et al. 2016; Arsic et al. 2018; Ferretti 2011; Grimaldi et al. 2017; Molinos-Senante et al. 2015; Palmisano et al. 2016; Razavi Toosi and Samani 2014, 2016; Wang et al. 2013).

Risks of participation also have to be considered when developing participatory MCDM studies, such as potential costs, time consumption, the domination of the process by strong leading voices, and exclusion of important stakeholders (De Brito et al. 2018). Strong voices should be controlled by a different kind of technique, weak voices can be included and the identification of stakeholders should be carried out carefully (De Brito et al. 2018; Gonzalez-Urango and García-Melón 2018).

To deal with many participants' judgments, the geometric mean method is widely used in the literature. It is convenient as a mean since it fulfils some necessary axiomatic conditions such as reciprocity. However, some authors considered the aggregation of weights through the geometric mean resulted in a loss of information since one number can hardly express an ill-defined group opinion because of the dispersion of individual judgments, as several prioritisations were reduced to a single vector (De Brito et al. 2018). Therefore, the solutions generated are trade-offs among the multiple objectives and not optimal ones (Sayyadi and Awasthi 2018). Another critical point is the subjective evaluation, which affects the evaluation's result (Grimaldi et al. 2017). Regarding these concerns, some believe that a fuzzy number approach could be more suitable for this task (Grošelj et al. 2016). However, many others believe that the fuzzy approach does not maintain the basic principles of ANP (Zhü 2014). the confidence of decision-makers will depend on the ability of the models to generate reliable and consistent results (Wolfslehner et al. 2005).

Concerning the influences, Manupati et al.(2018) highlight that in this methodology the derived weighted supermatrix by normalising the unweighted supermatrix appears irrational because there are different degrees of influence among the criteria. Hence, many attempts have been made using the DEMATEL technique to determine the degrees of influence of criteria and apply them to normalize the unweighted.

2.5.4 Future applications, recommendations and emerging topics

The main recommendations for future applications are reproducing the applied procedures in similar areas given some general suggestions, extending the developed studies to integrate larger size networks, as well as taking the approach as a whole procedure and devoting the necessary time to it (Chen and Khumpaisal 2009; García-Melón et al. 2012; Sayyadi and Awasthi 2018; Wolfslehner and Vacik 2008).

Some extensions of the traditional decision models are proposed and more applications appear, especially for supporting assessing processes through developing indicators systems or modelling performances of strategies by means of ANP (Wolfslehner and Vacik 2008). A combination of ANP with geospatial analysis can also be one of the most important current lines. Applications of spatial MCDM to solve location problems were few for many years, but in the past decade, location problems have increased (Ferretti 2011). Geographic Information Systems (GIS) and the decision support tool Marxan are widely accepted and they can provide mapping parameters to improve decision processes (Gonzalez-Urango and García-Melón 2017; Najafinasab et al. 2015). It would also be interesting to try to endorse models by structuring the ANP with indirect influence relationships of DPSIR (Driver-Pressure-State-Impact-Response) (Bottero and Ferretti 2010b). Any general integration of ANP with other environmental support tools constitutes a very promising research line concerning territorial transformations (Bottero and Ferretti 2010a; Li et al. 2016).

One of the main challenges in the ANP approach is to reduce the complexity of the models e.g. by involving some additional methods which would extract those essential for the studied problem, from a broader set of elements. The application of Delphi, interviews or surveys has been used in the definition of some models (Šijanec et al. 2014).

In the design of the model, small and balanced clusters have to be considered, clusters that are easily manageable by the Decision-makers (Ferretti 2011). An extra recommendation is the development of user-friendly, intelligent or dynamic linguistic software approaches and graphic interfaces to further promote and support better applications in order to provide better and appropriates means of communication (Wang and Zeng 2010; Wolfslehner et al. 2005). Online collaborative tools can help to fill the gap between civil society and experts (Ferretti 2011), to achieve a better understanding of participants positions (De Brito et al. 2018), as well as to involve multidisciplinary knowledge.

Evaluation of the robustness of models, some authors decline to compare and combine MCDM methods, others consider that they might be usefully applied, complement and compare results with different approaches or standardization procedures in order to test the robustness of the obtained results (Ferretti 2011; Wolfslehner et al. 2005) e.g. The financial viability of the projects may be appraised separately by using financial analysis techniques such as the net present value (NPV) and rate of return (Y. Wang et al. 2013); or testing the proposed model with real data and comparing the results with other comparable studies in the literature (Sayyadi and Awasthi 2018). Other authors propose statistical analysis for priority weights validation, validation of models and checking the subjective nature of expert opinion (Aminu et al. 2017; Grošelj and Stirn 2015)

The management of consistency has generated some interest. Dragoi (2018) highlights another worthwhile theoretical contribution proposed by Ergu et al. (2014) who proposed a maximum eigenvalue threshold index as a new consistency index for the ANP that helps make consistent evaluations, without computing the consistency ratio.

Uncertainty and Sensitivity analysis also attract some attention. It should be very interesting to introduce and integrate different perspectives at the moment of the evaluation and compare results obtained to learn more about the features and behaviour of a complex ANP model (Molinos-Senante et al. 2015; Wolfslehner et al. 2005). The management of uncertainty and imprecision has been

addressed from different approaches. Several authors recommend developing models according to the fuzzy sets theory to deal with preference relations and uncertainties inherent in decision making (Ferretti 2011; Wey et al. 2016), a few others have used Rough numbers (Chatterjee, Pamucar, and Zavadskas 2018) or the grey system theory (Duman et al. 2018; Hashemi, Karimi, and Tavana 2015). However, there are not many applications that confirm the effectiveness of this combination, nor have they been widely reproduced.

ANP is helpful in that it helps increase the number of experts and the subjective willingness of experts. Promoting more collaborative decision processes is another way of supporting SD. Expert selection should include representatives and relevant stakeholders as decision-makers in the decision making process (Šijanec et al. 2014) by taking into consideration allocation and future simulation issues using new methods and techniques (Pourebrahim et al. 2011). Different approaches could be explored to respond better to this challenge (Gonzalez-Urango and García-Melón 2017). Also to integrate social issues and the preferences of other interest groups such as civil organizations and residents (Molinos-Senante et al. 2015).

The challenge is also to increase the number of participants in prioritisation tasks, using participative approaches to solve discrepancies among participants but also improving the engaging and the quality of the deliberation itself and fostering a common language and understanding of stakeholders (Peris et al. 2013; Wolfslehner and Vacik 2008). The treatment of multiple participants is another interesting line. Methods that involve different opinions should consider methodological complements (Sierra et al. 2018). We identified the following strategies for involving stakeholders, according to the interest of the decision maker or the available resources. It would be possible to implement one or more of these: focus groups or workshops (Giordano et al. 2010); organized actions groups (Arsic et al. 2018); promoting discussion at all stages to build consensus (García-Melón et al. 2010); enabling their inclusion at particular stages (Grošelj et al. 2016; Grošelj and Stirn 2015); including a cluster called stakeholders in the model (Palmisano et al. 2016); giving a leading role to a certain group e.g. users (C. Chen et al. 2018); or studying their relationships and selecting just the most influential ones (De Brito et al. 2018; Gonzalez-Urango and García-Melón 2018).

In this line, issues of aggregation and consensus appear. How to aggregate individual judgments and how these influence the final ranking (Razavi Toosi and Samani 2014) is still one of the problems in group decision making. Some of the proposals are: assigning weights to participants' evaluations; assigning cluster evaluation to a certain group of stakeholders; aggregating preferences by groups to discover underlying conflicts and then tackling them openly; discarding the results of less influential or incoherent stakeholders before aggregating individual results; arranging meetings or evaluation rounds to obtain a greater convergence among the stakeholders' positions; or integrating different perspectives in the assessment and then comparing results from each group.

Lastly, another future challenge for future studies proposes developing more precise methods for studying the dynamics and also the patterns of behaviour among the components. It could be computationally expensive and requires a huge amount of work (Ghaemi Rad et al. 2018).

2.6 Comparisons ANP and AHP techniques

Both techniques consider models involving proposals, frameworks and indicators that operationalise or assess sustainability through multiple applications. Regarding the number of publications, AHP is more widely used. Supporting SD, Dos Santos et al. (2019) found a higher number of documents for AHP during 2014-2017, although publications have decreased since 2016, suggesting that AHP is more used, although several authors move from one to the other approach.

More application areas were found for AHP (Dos Santos et al. 2019). The main number of manuscripts were found in the Manufacturing area, although the principal areas are almost the same as ANP (Manufacturing, Territorial and Business/Management). ANP is little used in areas such as Health, ICT or Education, and more used in Agriculture, Transport and Retail. No ANP applications related to Banking were found. AHP is more broadly used and in more fields. The specific topics of supply chain management and supplier selections are the most common in both techniques. Others related to technology performance, sustainable packing, reverse logistic, product life-cycle and end-of-life are dealt with more with AHP.

According to the keywords, the manuscripts' most cited words were the same root word 'sustain' and all derived terms, as well as other terms related to other techniques and models' goals. AHP-only is slightly more used than ANP-only (Dos Santos et al. 2019). Fuzzy logic is the most frequent combination with both techniques. Delphi and TOPSIS are more used together with AHP while DEMATEL and GIS with ANP. In terms of countries, AHP general applications also reveal the significant number of publications in Asian countries.

The most recent manuscripts applying AHP support manufacturing processes mainly in problems related to the supply chain (Dos Santos et al. 2019). While for ANP applications the territorial field increased constantly. Regarding the most cited works and future applications, AHP maintains a clear tendency as regards supply chain management, supplier selection and how to promote sustainable operations in the manufacturing sector. ANP maintains the same applications in supply chain management and supplier selection, but territorial applications and spatial analysis continue to attract attention.

As a brief conclusion, despite AHP having wider application fields, it is not possible to value one technique over the other one or suggests that one is replacing the other. It seems that due to applications and current tendencies, AHP appears to be more used at a micro level as in manufacturing processes whereas ANP allows for more complex representations such as at the territorial level.

2.7 Conclusions

This study found that ANP as a supporting tool for decision making to tackle sustainability issues has been used since 2005. During the period 2005-2019 258 documents were found in 11 different application areas and mainly indexed by the Web of Science and Scopus databases. Results demonstrate that ANP is useful for supporting the implementation of sustainability concepts. Proposed models are concentrated in Decision making on Sustainable Development for the Territorial

applications; followed by Assessment of sustainable aspects applied in Manufacturing and Territorial areas. Fewer applications were found in Planning sustainable issues and Product development.

The manuscripts' classification based on application area facilitated the visualization and analysis of the current state of-the-art from both macro and micro perspectives. The main application areas are Territorial, Manufacturing and Energy. Cases are applied mostly in the specific topics of suppliers' selection/evaluation, supply chain management, Land/coastal planning and sustainable strategies. The most common goal is Evaluate and Rank alternatives. However, models for the definition of weights of criteria for construction of indexes and to develop performance evaluations have been increasing.

The numbers of techniques and methods used along with the ANP have increased. But also, the kind of combination or modification developed. Thus, it is possible to say that the use of technique has evolved. First combinations were more in order to enrich the models. Current applications enrich them but also modify the traditional ANP procedure. No significant data were found for authors and co-authorship.

The main ANP advantage is that it considers the correlation between various factors, but also can give feedback to the entire model, creating a network relationship, reflecting better the characteristics of the context of the problem and being more in line with the SD approach.

The interpretation of sustainability often varies. Nevertheless, the inclusion of the SD approach is translated into the models using the triple bottom concepts: social, economic and mainly environmental. This last one expressed through green concepts such as environmental management, eco-design, green design, green production, green warehousing, green transportation, etc. It is also important to highlight that in the social dimension, cultural integrity, ecological processes, ecological diversity, life support systems and liveability have been included and gained ground. Decision models use principles, criteria and indicators that can be used to make a judgment about the relative sustainability of some options or scenarios. In order to reach or be more sustainable, defining indicators to measurable past or present values; or to set standards against which future performance can be assessed (Isaacs et al. 2008). Some concepts have been associated regarding the application found, like sustainable transportation policies in the context of urban development, sustainable operations in manufacturing context, or sustainability reporting in corporative practices. In summary, decisions according to the SD approach have now to be environmentally effective, economically affordable and socially acceptable (Ferretti 2011).

Publications also stress the importance of including participatory processes. Usually, the participation of stakeholders is fragmented and limited to consultation at specific stages, as in the weight assessment step. To tackle this issue, the development of SD models should be aided using participatory multicriteria tools. To include expert participation is another ANP advantage and one of the key reasons for selecting this technique. However, the way of selection and the justification of the number of experts selected are some of the points of improvement where we would suggest future contributions. Moreover, feedback processes, valuation of consensus and sensitivity analysis can be explored in new models.

Some weaknesses regarding the way of reporting the results have been found. Incomplete

information makes it difficult to validate and replicate the models. Some of the most common missing information is the definition and source of the elements (criteria and alternatives), the treatment of the global results and consistency, and mainly the treatment of the experts, their selection, quantity, and profiles. Technical aspects studied can contribute to improving the way of reporting the results of future models. In this respect, the review developed for the technical aspects constitutes a review of practices and recommendations to develop new models.

Regarding SLR, some difficulties arose when trying to classify the works. It is important to define criteria and concepts before classifying. The proposed SLR methodology can be improved following a snowball model through the references of the publications, but the process is already too long. It could be considered for some specific fields. Also, documents could be discussed following a chronological order, enabling the readers to get an overview of the latest trend and the past coverage. In any case, the goal of this study has been achieved through the SLR performed. Results can be useful for anyone who wants to apply, extend or combine ANP in any field.

CHAPTER 3

A Multicriteria Model to Evaluate Strategic Plans for the Nautical and Naval Industry in Cartagena de Indias

This chapter is based on the paper:
A Multicriteria Model to Evaluate Strategic Plans for the Nautical and Naval Industry in Cartagena de Indias. Gonzalez-Urango H. and Mónica García-Melón M. Sustainability 2017, 9, 653; https://doi.org/10.3390/su9040653

Abstract

The evaluation of urban development plans is a key concern of the strategic planning of the city of Cartagena de Indias (Colombia) due to the pressure exerted by both public and private sectors. Any strategic planning requirement deserves the inclusion of clear terms of coordination and cooperation among sectors, including local communities and the scientific sector. In this paper, we present a methodology for the sustainable evaluation of strategic nautical and naval projects for the development of the city of Cartagena de Indias. The methodology is based on the multicriteria technique Analytic Network Process, which allows considering political, socio-cultural and environmental aspects. The aim is to provide answers and guide the decision-makers towards the optimal selection of strategies. Results provide some important insights into the overall conception of what sustainable evaluation means for the experts consulted. The procedure enhances participation and transparency and becomes a support for their decisions.

3.1 Introduction

Coastal and marine ecosystems are among the most productive, yet highly threatened, systems in the world (Iglesias-Campos et al. 2015). They are being altered continuously by the pressure generated as a result of the infrastructure increase needed to sustain residential, commercial and touristic operations related to human activity development (Baser and Biyik 2016; Bulleri and Chapman 2010; Cao and Wong 2007; Di Franco et al. 2011; Petrosillo et al. 2009; Sierra-Correa and Cantera Kintz 2015).

Of all marine activities, the nautical and naval industries are among the most significant and fastest growing industries. Their importance lies in their high added value and their impact in job generation (European Commission 2014; Papageorgiou 2016). Specifically, in the recreational nautical sector, according to the International Council of Marine Industry Associations ICOMIA (ICOMIA 2014), there are more than 100000 companies throughout the world, generating more than one million jobs and more than €40 million in annual revenues. Although the amounts of recreational vessels throughout the world is only an estimate, sector statistics indicate that there are nearly 25 million of them, close to 25000 marinas and more than 700 new mega yachts under construction (ICOMIA 2014). Good predictions for this sector are maintained, and, for 2030, the marine industry is expected to duplicate its actual power. In particular, the commercial maritime transport, the naval and offshore energy production sectors are expected to grow (Nicholas, Carnie, and Atilla 2014).

However, activities related to the nautical and naval sector are responsible for high water and air contamination levels. Consequently, recent literature has witnessed strong debates, controversy and contradictions among economic sectors and several groups over maritime use interaction (Brida et al. 2012; Cao and Wong 2007; Papageorgiou 2016). Therefore, its expansion must be very carefully studied and considered.

Colombia has a great development potential in its nautical recreational sector. First, thanks to its location outside the hurricane belt and on the main international navigation routes. It has extensive coastal lines over the Pacific and Atlantic oceans (3800 km), several water bodies across the length and breadth of the country (18000 km of navigable rivers, 1800 lagoons, and 1900 reservoirs), a wide and recognized touristic offer, a growing integration into international markets and a positive

international perception after the peace agreement signing (Colombia Náutica 2017; Ministerio de Comercio Industria y Turismo 2013). Additionally, the solid growth of the main world markets, such as the United States market, the increase of ship moorings' demand and the construction of several small sports marinas and touristic facilities all over the world, has to be considered (Baser and Biyik 2016; Di Franco et al. 2011).

Cartagena de Indias is one of Colombia's main cities located on the country's northern coast. It is favoured by its good morphologic and location conditions, thanks to its proximity to the Panama Canal. The city is recognized by its natural attractions and its historical heritage, which has benefited the development of its nautical and naval industry. Thus, Cartagena de Indias represents the epicentre of the activity in the Colombian Caribbean with the highest offer of nautical facilities and related services (Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Ministerio de Comercio Industria y Turismo 2012; Moreno-Egel et al. 2006).

Along the city's coastline, a variety of coastal structures can be found, over which an important proportion of their main economic activities take place (Moreno-Egel et al. 2006). Much like other coastal cities, several controversies have been generated in Cartagena over the expansion and placement of new nautical facilities, considering the high urban density in some areas, the involved areas protection, new activities development and the enhancement of the already existing activities. These actions sometimes contradict each other and compete for the same limited resources and/or spaces (Baser and Biyik 2016; Freeman, Whiting, and Kelly 2016; Gumusay, Koseoglu, and Bakirman 2016). Thus, in terms of planning and management of local development, it is very important to identify places for the location and expansion of nautical and naval facilities in adequate areas in the coastal zone, so it is essential to adopt an integrated approach to address these multifaceted issues (Cao and Wong 2007).

Any environmental planning requirement deserves the inclusion of clear terms of coordination and cooperation among sectors, including local communities and the scientific sector (Iglesias-Campos et al. 2015; Sierra-Correa and Cantera Kintz 2015). Many efforts have been made within the European Community (EC) to put environmental participative processes into practice since the EC signed the Aarhus Convention on access to information, public participation in decision making and access to justice in environmental matters (United Nations Economic Commission for Europe UNECE 1998). The first two have been transposed in Directives 2003/4/EC on "public access to environmental information" (European Parliament and of the Council 2003b), and 2003/35/EC on "providing for public participation in respect of the drawing up of certain plans and programs relating to the environment" (European Parliament and of the Council 2003a). Some recent publications in the field of sustainable planning also stress the importance of these participatory processes (Le Pira et al. 2016). The achievement of an optimal solution for all of the stakeholders becomes difficult when the intervention of different agents, objectives and factors is considered (Loken 2007). Although Colombia is not part of the EC, the authors have considered relevant to include these issues.

Recent conceptualizations of the coast as a 'commons' facilitate the view of this area as a holistic, interconnected, complex social–ecological system (Berkes 2006) where different users have different and, sometimes, conflicting interests (Petrosillo et al. 2009). Therefore, coastal space planning and ordination must consider methodologies that take this complexity into account. Complex approaches

on linear analysis are preferred, as well as multidisciplinary and multisectoral approaches (Sierra-Correa and Cantera Kintz 2015).

Domínguez-Tejo et al. (2016) in their work on social, economic and environmental values integration into the analysis of land-use planning and regulations, in the context of coastal and marine space planning, indicate the need to implement better methodological frameworks and clearer execution guidelines to be incorporated into spatial planning decisions. Moreover, they consider the existence of an important knowledge gap when trying to improve the integrated management approach in marine resources planning. Izadikhah and Saen (2016) try to fill this gap in their study of a new method of preferential voting for sustainable location planning, a technique of multicriteria decision making based on Data Envelopment Analysis (DEA), criteria assessment and the use of Geographic Information System (GIS). However, they recognize, at the end of their work, that their proposal can be enhanced by a Multiple Criteria Decision Making (MCDM) technique such as the Analytical Hierarchy Process (AHP). Moreover, they do not consider interdependence between criteria.

In the specific case of Cartagena, planning processes are under the pressure of public and private sectors, but, mainly, of its citizens. They demand developments that not only generate income to certain private sectors of the city, but also these developments should recognize the value of the coastal and marine spaces in the wellbeing generation for its residents (Baser and Biyik 2016). Therefore, the city needs to understand that a more explicit and integrated inclusion of trade-offs and synergies among ecosystem services will make coastal strategic planning more adaptive and sustainable, and that a structured method to assess this inclusion is needed (Xia Wang et al. 2016).

The analysis of the environment by a multicriteria analysis will provide answers and orient the decision-maker towards the selection of the facilities of a nautical infrastructure (Kovačić 2010). Thus, the arguments expressed that lead to defining that strategic planning for the nautical and naval industry in Cartagena de Indias should be treated as a multicriteria decision problem. Therefore, this work's objective is to show how a multicriteria technique (MCDM) such as the Analytic Network Process (ANP) is useful for prioritising local development strategies. It is the first time that this type of exercise is developed for the nautical and naval sector in Cartagena. The model is carried out with the participation of actors from different sectors, the alternatives were preconceived for different local and national plans and programs, and the criteria were selected to seek sustainability and expansion of this sector. With the aim of verifying in practice the relevance and usefulness of this methodology and to draw some conclusions on their potentialities and limitations, this work intends to prove that ANP is an appropriate tool to reach a consensus among different sectors on the essential issues of the territorial development in Cartagena, according to previous experience developed (García-Melón et al. 2010).

This work is divided in six principal sections. In the second one, a brief exposition of the related literature found is presented. In the following one, the methodological process is described. In the next two sections, a detailed description of the case study is presented, explaining the steps and results of the construction and application of the decision making model through the ANP. Finally, conclusions and the challenges posed by this work are included.

3.2 Literature Review

Several authors introduced the use of MCDM techniques for Sustainability Assessment (Ginevičius and Podvezko 2009). Many of them focused on the use of the Analytic Hierarchy Process (AHP)(Saaty 1990), which has been accepted as a leading multi-criteria decision model due to its ease of use for preferential information elicitation from expert subjects (Akbari et al. 2017; Ramzan, Degenkolbe, and Witt 2008; Šijanec, Žarnić, and Šelih 2009; Sólnes 2003; Strojny 2015) to assign priorities to the criteria or indicators involved in the problem. However, AHP does not allow considering the interdependences among criteria. For this reason, the use of the Analytic Network Process (ANP) is proposed because it allows for better representing the complex interactions among the different components of a real system (De Lotto et al. 2016; Wu and Cui 2016), as is the case in the field of sustainable evaluation.

The ANP procedure, a method developed by Saaty (2001) to generalize his original AHP, provides a framework to address decision making or problem assessment. It allows for more complex, interdependent and feedback relationships between the elements of a hierarchy (Sipahi and Timor 2010), thus avoiding the compensation problem of other models (Peris et al. 2013). It constitutes a problem in a structure or network system composed of different elements (criteria and alternatives), grouped in clusters and connected to each other in any possible way. The network provides a more accurate modelling of complex environments and allows for handling the usual situation of interdependence between elements in sustainable planning scenarios (Bottero and Mondini 2008; Saaty and Peniwati 2008; Shiau and Chuen-Yu 2016). In this work, interdependence among the different criteria of the evaluation model has been determined in collaboration with the experts (Table 3.2).

Regarding the nautical and naval sector, Kovačić (2010), in his work on the location of a nautical tourism port, mentions the shortage of publications in which the relevant factors for location selection and installation of nautical infrastructures are analysed, due to the complexity of its development and the economic effects generated.

An important part of the work regarding the use of MCDM methods for planning in the maritime industry (nautical and naval) is related to selecting places for new structures' locations. This includes: selecting the location of a nautical tourism port (Kovačić 2010); selecting sites for dry ports (Ka 2011); selecting a cruise port of call location (Y. Wang et al. 2014); assessing coastal reclamation suitability (Feng, Zhu, and Sun 2014); and strategies selection for risk mitigation associated with offshore wind parks (Shafiee 2015).

The use of AHP in this sector includes the capacity evaluation of several ports for the location of a port facility (Akbari et al. 2017); planning of a transport infrastructure (Deluka-Tibljaš et al. 2014); and the selection of the location for the construction of a marina (Gumusay et al. 2016).

Some recent applications of ANP to the field of sustainable development are found in strategic policy planning (Erdoğmuş et al. 2006; Peris et al. 2013; Ulutaş 2005); evaluation of strategies for urban sustainable planning (Kao et al. 2017); environmental assessment tools of sustainability strategies (García-Melón et al. 2010, 2012); development of an indicator system for measuring the social sustainability (Shiau and Chuen-Yu 2016); environmental pressure assessment (Gómez-Navarro

et al. 2009); sustainable tourism development (Chen et al. 2009); sustainable forest management (Wolfslehner and Vacik 2008); regional sustainability assessment (Bottero and Mondini 2008); or sustainable development of housing communities (Wang et al. 2010).

Evidence regarding the use of ANP for the evaluation of strategies to improve the nautical and naval industry has not been found. No ANP applications were located in the consulted sources, regarding the concepts of marine spatial planning, coastal and/or marine location planning, environmental site selection or Integrated Coastal Zone Management (ICZM).

The use of ANP in the sector of interest was found in the work developed by Pourebrahim et al. (2010) considered as the first work in which this technique is used for criteria selection to guarantee sustainability in the planning of coastal land use. Beside Hasanzadeh et al. (2014; 2013) and Najafinasab et al. (2015) ANP has been used in criteria identification and prioritisation for the selection of sites for wharfs locations to prioritise the most convenient location for crude oil docks: and with the objective of selecting and integrating criteria regarding the planning of the use of land in coastal zones.

3.3 Methodology

The methodological proposal is based on the ANP procedure developed by Saaty (2001). The model comprises the following steps:

1. Identifying the components and elements of the network and their relationships.
2. Conducting pairwise comparisons of the elements.
3. Placing the resulting relative importance weights (eigenvectors) in pairwise comparison matrices within the matrix (unweighted matrix).
4. Conducting pairwise comparisons of the clusters.
5. Weighting the blocks of the unweighted matrix, by the corresponding priorities of the clusters, so that it can be column-stochastic (weighted matrix).
6. Raising the weighted matrix to limiting powers until the weights converge and remain stable (limit matrix).
7. Obtain the elements' prioritisations according to any of the columns of the limit matrix.
8. Once the results are obtained, in case some alternatives achieve very similar results, a sensitivity analysis should be carried out in order to demonstrate the robustness of the ranking obtained.

Following the route suggested by the technique, the procedure proposal shown in Figure 3.1 was designed. First, the problem of the Cartagena's nautical and naval sector was analysed, defining the objective to be achieved. Then, on the basis of the local and national plans posed to strengthen the sector, the alternatives to be considered in the model were selected. The criteria were identified through a literature review, revised by an expert. Once criteria, clusters and strategies were defined, the ANP model was designed for evaluation.

Afterwards, experts were selected on the basis of their profile and knowledge about the sector, and contacted. The experts performed the pairwise comparison between criteria and alternatives, following the ANP procedure, through the questionnaire designed by the facilitators. In the following

stage, calculations related with the weight of each criterion and alternative prioritisation were performed. The results were obtained through the individual judgements issued by the experts, which were aggregated using the geometric mean, as suggested by Saaty (2001). Once the final results were obtained, the facilitators informed the experts about the individual and global results.

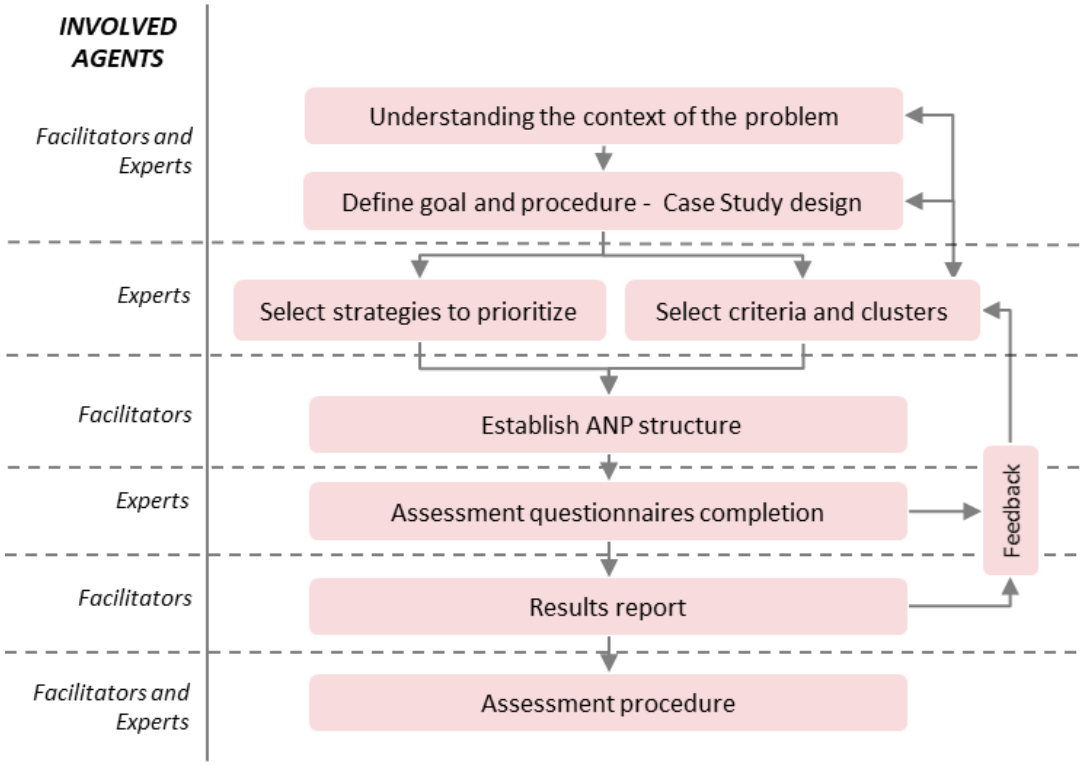


Figure 3.1 Methodology flow chart

3.4 Case Study: Nautical and Naval Industries in Cartagena de Indias, Colombia

In order to demonstrate its proper functioning, the present methodology has been applied to the case study of the nautical and naval sector in Cartagena de Indias. This city, located in the South Caribbean zone, has good morphologic and geographic conditions, so its bay represents a strategic point for the northern Colombian economy (Moreno-Egel et al. 2006). The city is the leader in the Colombian nautical sector, concentrating the broadest offer in nautical facilities as well as vessel and nautical recreational related services (López et al. 2015). Furthermore, its shipbuilding industry is renowned in the Caribbean basin, and it has been designated as a "producer of high strategic value innovative products" (COTECMAR 2016).

For several years, the city has been exercising long-term planning, in which a unified regional vision is defined through the development of strategic sectors and transversal factors. In this plan, the city defines its vocation and focuses its efforts on achieving productive transformation and increasing its competitiveness through recognized economic development potentials, such as tourism, logistic and transportation for foreign trade, petrochemical-plastic production and the design, construction and vessel repair industry (Comisión Regional de Competitividad de Cartagena y Bolívar 2010). This last industry is recognized as the city's most recent and growing industry.

The nautical cluster is essentially related to companies, which directly or indirectly offer leisure services or recreational activities in small vessels with an average length of 25 m. These vessels are sailboats, yachts or boats. The naval cluster is focused on big vessels, with a commercial or military profile (López et al. 2015). Both clusters are born from the city's port vocation, so a close relationship exists between them. Many of the associated services are overlapped because they are included in the so-called naval, maritime, fluvial and port industries, and they are promoted by almost the same support institutions. Thus, in this work, beyond separating the clusters, it is considered that, by supporting one, both are being fostered.

For many years, the sector has been promoting the location, construction and consolidation of shipyards for military, commercial and nautical tourism vessels. These efforts have been reflected in the increase of the number of companies dedicated to vessels construction and repair (COTECMAR 2016), in recreational/sports vessels registration in Cartagena (Colombian Maritime Authority: Dirección General Marítima DIMAR) and in the request for permits to construct new nautical facilities (marinas, marina–shipyard–boatyard MSBs, dry marinas, nautical clubs and docks and shipyards). The new nautical facilities are the most controversial issue among the different city sectors because they are projects for construction in zones owned by the Nation. These zones are either located along the coast (Figure 3.2) close to residential and high commercial flow zones or they will affect the natural value and scenic beauty of some areas. As mentioned by Petrosillo et al. (2009) and Freeman, Whiting and Kelly (2016), the increase in these activities will boost the conflict potential between activities that compete for the same scarce resources and/or coastal spaces.

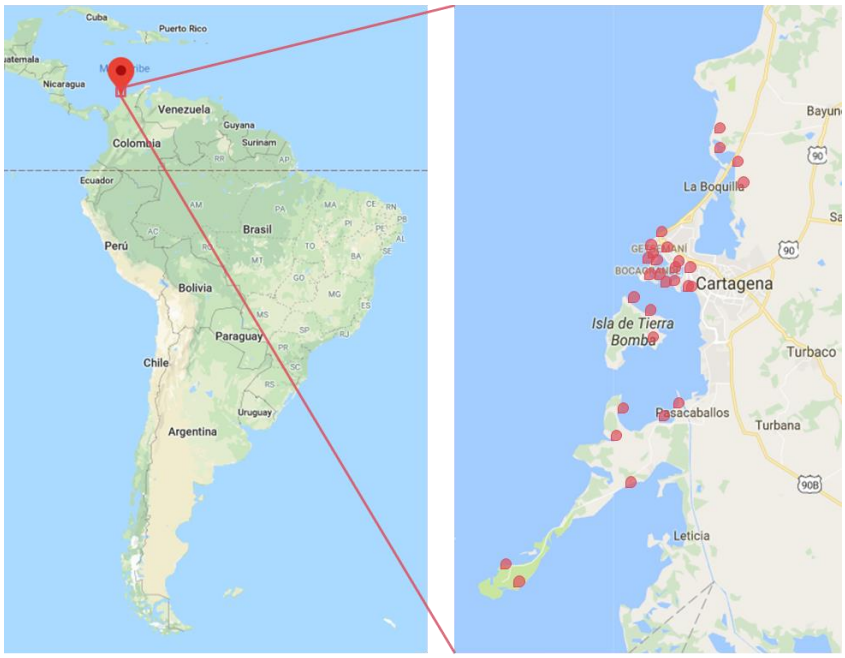


Figure 3.2 Zones requested for marinas location. Adapted from Google Maps.

For the previously mentioned reasons, this work aims to support decision making in order to determine where the nautical development pole should be located, that is to say, which zone is the most suitable for the location of the new nautical facilities.

A detailed description or the methodology implementation is shown below.

3.4.1 Experts Selection

This work has been developed in collaboration with the private sector in order to present to the public sector a relevant and useful tool to reach a consensus among different stakeholders involved in a controversial issue related to the expansion of nautical facilities. Thus, we will consider the academic expert as representative of the public sector, as a first approach.

Three experts were contacted during the selection of criteria and in order to structure the decision model. They came from the private sector, the policy adviser group for the sector and from the Naval Engineering school.

For the assessment questionnaire's completion, four experts were contacted and two of them made the comparison. The first one is a local businessman, who leads some initiatives to strengthen the sector. He is also a member of the regional University–Business–State Committee as well as of the board of directors of the Nautical Association of Colombia. This expert will represent the private sector, as main financers and promoters of the strategies, which will be prioritised. Representing the academic sector of the city, the second expert was a member of the Naval Engineering master's degree in the Colombian Naval School, who has research experience in aspects related.

3.4.2 Strategies Selection

In order to define development strategies, a review of local and national plans and programs designed to strengthen the sector was performed. Some of the consulted documents were: Plan Regional de Competitividad Cartagena y Bolívar 2008–2032 (Comisión Regional de Competitividad de Cartagena y Bolívar 2010); Plan de Desarrollo Local 2016–2019 (Alcaldía Distrital de Cartagena de Indias 2016); Plan Sectorial de Turismo de Cartagena de Indias 2014–2017 (Alcaldía Distrital de Cartagena de Indias 2014b); and Plan Nacional de Turismo Náutico de Colombia 2012 (Ministerio de Comercio Industria y Turismo 2012) among others.

Four proposals (alternatives) were selected, oriented to the definition of the most appropriate area to locate nautical and naval development zones in the city (Figure 3.3). Prioritising the considered zones should allow channelling most of this sector's development and should help solving the approval status of many of the requests submitted to the competent authorities. The alternatives are:

Alternative 1 (A1). Construction of a Civic External Marina: this facility would be placed offshore with the aim of reducing its impact in the historical centre surroundings and circumvent the limitations of the Historical Centre and Influence Zones Management and Protection Plan. This alternative can be considered together with another development initiative contemplated for the same area.

Alternative 2 (A2). Construction of a Civic Internal Marina: located in the Bay interior, between the zones where the city's touristic dock currently stands and the entrance of the main hotel area (Bocagrande). This option would minimize the impact on landscape, although it requires resizing the available coastline. The advantage of this alternative compared to the External Marina alternative is

its cost and the arrangement and integration in a singular and leisure manner of the Muelle de la Bodeguita and the Naval Base of the city.

Alternative 3 (A3). Design of a network of marinas, docks and nautical bases in zones of the city to be recovered: to constitute a network of marinas and zones for nautical and naval development in water bodies and internal spaces of the city to be recovered (Bazurto and Ciénega de las Quintas, Ciénaga de la Virgen). This alternative promotes the recovery of urban spaces, diminishing concentration in very densely populated zones of the city.

Alternative 4 (A4). Design of a network of marinas, docks and nautical bases in the insular districts of the city: construction of different nautical and naval facilities in the insular districts of the city. This alternative decreases concentration in the urban centre and enables its future expansion. This option would minimize the landscape impact and would foster development in other zones.

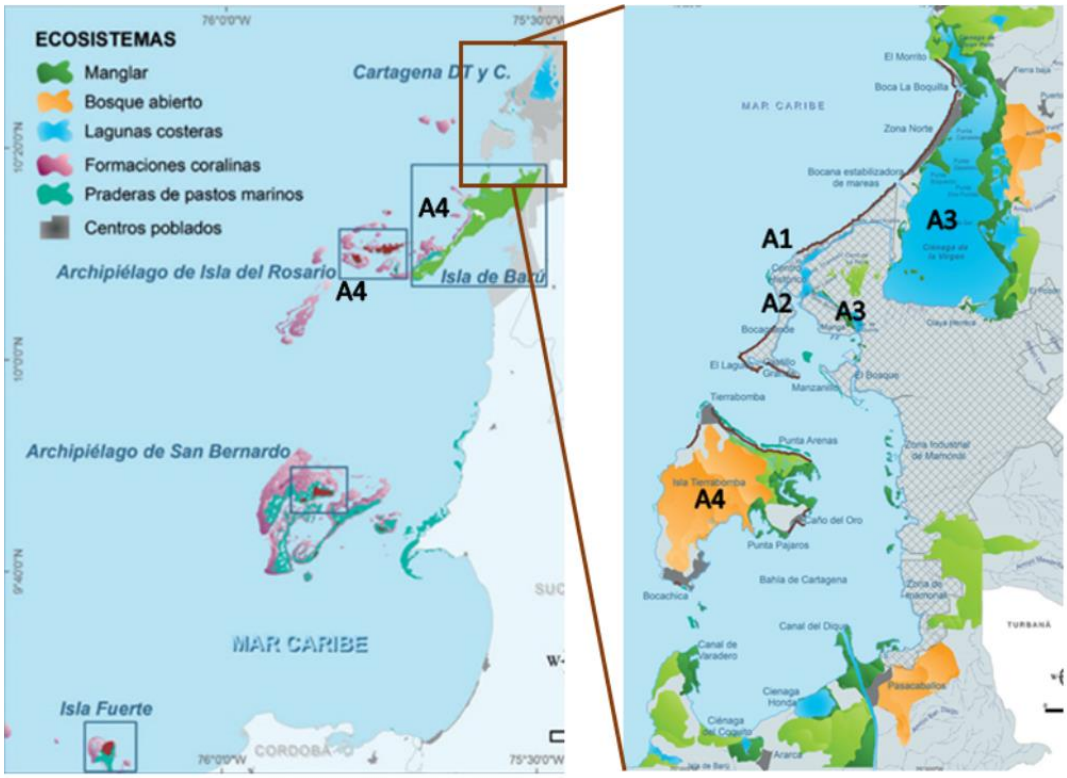


Figure 3.3 Location areas proposed by the alternatives (adapted from: Plan 4C Cartagena Competitiva y Compatible con el Clima).

3.4.3 Selection of Sustainability Criteria

Criteria that could influence the sustainable evaluation of the proposed alternatives were identified. It was necessary to make sure that these criteria could be grouped, that they were relevant, not redundant and easy to understand for the different actors.

The final list of 14 criteria grouped in four evaluation clusters (

Table 3.1) was defined on the basis of a bibliographic review and with the assistance of one of the experts.

Table 3.1 Criteria and clusters

Cluster	Definition	Criteria	Definition	Reference
Environmental	Groups criteria aimed at assessing the relationship between alternatives considered and the environment.	C 1.1 Use of natural spaces and material heritage.	Use of natural areas and tangible assets of the city, mainly those considered heritage.	(Izadikhah and Saen 2016; Najafinasab et al. 2015; Pourebrahim et al. 2010)
		C 1.2 Environmental risks and threats.	Environmental risk level associated with alternatives, such as: coastal erosion, sea level rise, sea swells, floods...	(R. Li et al. 2016; Papageorgiou 2016; Pourebrahim et al. 2010; Sierra-Correa and Cantera Kintz 2015; Timmermanab and White 1997)
		C 1.3 Environmental impact.	Considers the use of mangroves, water removal, solid waste production and people agglomeration.	(Di Franco et al. 2011; Kovačić, Jugovic, and Perić Hadžići 2014; Lee and Hsieh 2016; R. Li et al. 2016; Najafinasab et al. 2015; Sierra-Correa and Cantera Kintz 2015)
		C 1.4 Water and soil quality.	Water quality of the main water body to be affected, and of the considered terrain.	(Kovačić et al. 2014; R. Li et al. 2016; Pourebrahim et al. 2010)
Sociocultural	Assesses alternatives impact on the city's inhabitants.	C 2.1 Urban density.	Urban, commercial and industrial settlements concentration in the area.	(Izadikhah and Saen 2016; Lee and Hsieh 2016)
		C 2.2 Generated urban renovation.	Possibility to generate urban renovation and recovery of spaces required by the city.	(R. Li et al. 2016)
		C 2.3 Population acceptance.	Compatibility between the inhabitants of the zone to be impacted and the considered alternative.	Expert opinion. (Domínguez-Tejo et al. 2016; Lee and Hsieh 2016; Papageorgiou 2016)
		C 2.4 Impact on the quality of life of the population.	Impact on the quality of life of citizens in general.	(Domínguez-Tejo et al. 2016; Hasanzadeh and Danehkar 2014; Hasanzadeh et al. 2013; Kovačić et al. 2014; Lee and Hsieh 2016; Pourebrahim et al. 2010)
Economic	It relates the potential activities to be performed to the city economy.	C 3.1 Promotion of other economic activities.	Relationship with other sectors of the city's economy.	(Hasanzadeh and Danehkar 2014; Lee and Hsieh 2016; Papageorgiou 2016)
		C 3.2 Expansion capacity.	Possibilities of long-term expansion.	(Kovačić et al. 2014)
		C 3.3 Public-private necessary investments.	Investment required for the alternatives launching.	(Izadikhah and Saen 2016; Ka 2011; Kovačić et al. 2014)
		C 3.4 Connectivity	Connection with the rest of	(Ka 2011; Kovačić et al. 2014;

Cluster	Definition	Criteria	Definition	Reference
		with the rest of the city.	the city.	Pourebrahim et al. 2010)
Political	Association with the city's dispositions and plans.	C 4.1 Compatibility with land-use planning and existing regulations.	Affinity of each alternative with land-use planning over the potential areas to be used by each alternative.	Expert opinion. (Cao and Wong 2007; Hasanzadeh et al. 2013; Izadikhah and Saen 2016; Ka 2011; Kovačić 2010; Kovačić et al. 2014; Papageorgiou 2016; Pourebrahim et al. 2010)
		C 4.2 Compatibility with local plans and other strategic initiatives of the city and the region.	Affinity of each alternative with policies, plans, projects and/or local, departmental and national existing programs.	

3.4.4 Structure of the Decision Problem

After the identification of the model elements, influences among them were determined using a relationship matrix (Table 3.2), where 1 means that the row element influences the column element and 0 means that there is no influence among them.

Table 3.2 Influence matrix

	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	A1	A2	A3	A4
1.1	0	1	1	1	0	1	1	0	0	1	1	0	0	1	1	1	1	1
1.2	1	0	1	0	0	0	1	1	0	1	1	0	1	0	1	1	1	1
1.3	0	1	0	1	0	0	1	1	0	1	0	0	0	0	1	1	1	1
1.4	1	1	1	0	0	1	0	0	0	1	1	0	0	0	1	1	1	1
2.1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1
2.2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1	1
2.3	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	1
2.4	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1
3.1	1	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1	1	1
3.2	1	0	1	0	0	0	0	0	1	0	0	0	0	1	1	1	1	1
3.3	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1
3.4	1	0	0	0	0	0	1	1	1	1	1	0	0	1	1	1	1	1
4.1	1	0	0	0	1	1	1	0	0	1	1	0	0	1	1	1	1	1
4.2	1	0	0	0	0	1	1	0	1	1	1	0	0	0	1	1	1	1
A1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
A2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
A3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
A4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0

The proposed ANP evaluation model is illustrated by the network shown in Figure 3.4. The bidirectional arrows indicate influences between clusters in both directions. That is to say, the elements in a cluster (i) exert some influence over elements in another cluster (j). Feedback means that there is influence between criteria belonging to the same group.

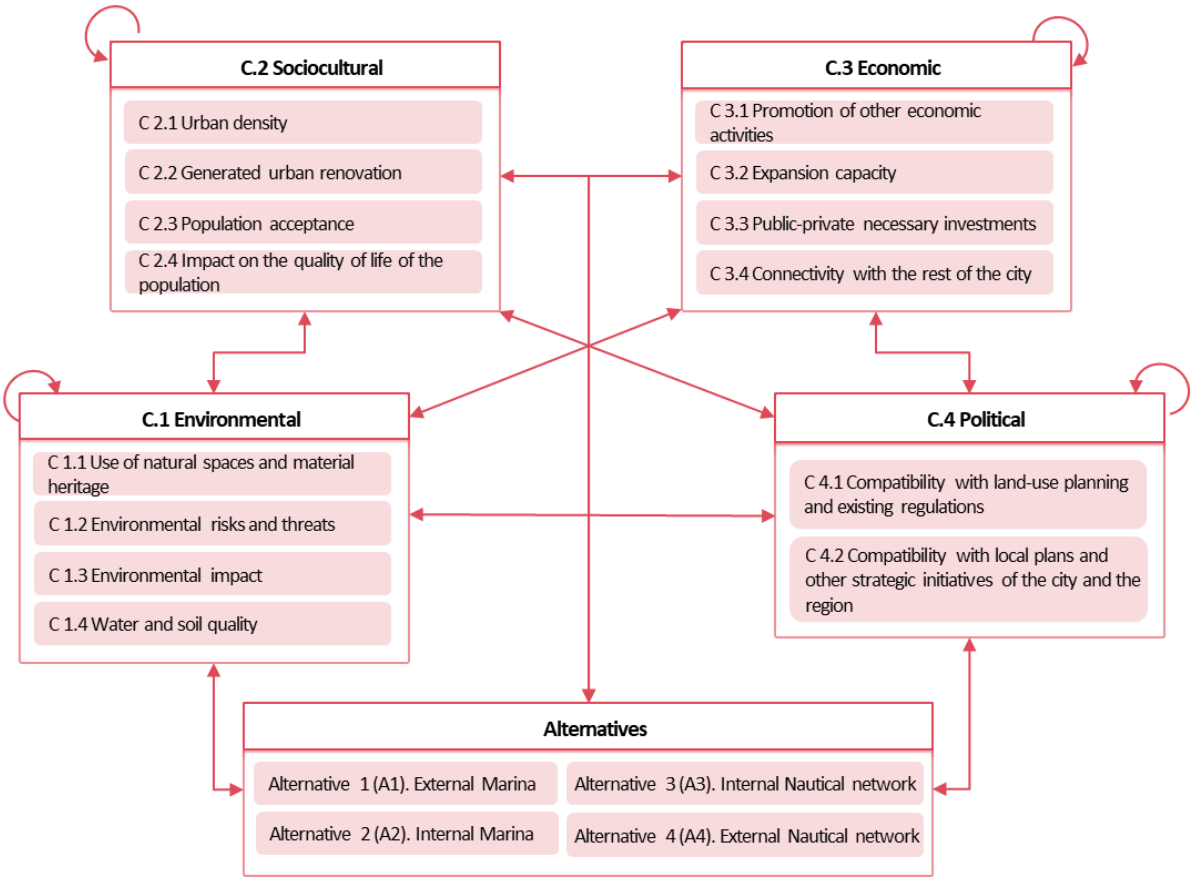


Figure 3.4 Analytic Network Process ANP network model of the case study

3.4.5 Application of ANP

Once the influences among the model elements are determined, a questionnaire was designed with the aim of determining a compliance index of the model objective for each alternative with regard to all considered criteria. This information was collected from the experts through a questionnaire designed to allow pairwise comparisons. Figure 3.5 shows an example of a question posed for the criteria analysis. The complete questionnaire used is presented in Appendix B.1.

In your opinion, which of the two criteria sets (clusters) contributes more to improve the nautical and naval sector of the city of Cartagena? Place an X where appropriate.

	Extreme		Very Strong		Strong		Moderate		Equal	Moderate		Strong		Very Strong		Extreme	
Environmental	9	8	7	6	X	4	3	2	1	2	3	4	5	6	7	8	9	Socio cultural

The answer in this example means that: it is considered the set of environmental criteria contributes strongly (5) more than the sociocultural criteria set in improving the nautical and naval sector of the city of Cartagena.

Figure 3.5 Example of a question used for the ANP questionnaire

All of the calculations were performed using the SuperDecision© v.2.0.8. software (Creative Decisions Foundation, Pittsburgh, PA, USA). Once all pairwise comparisons matrixes were completed, a limit supermatrix was obtained (Appendix B.2). The results correspond to the global judgements. Judgement aggregation was performed using the geometric mean (Saaty 2001). Care was taken during the pairwise comparison to ensure that the consistency ratio (CR) was less than 10%.

3.5 Results

There is a high degree of concordance among the experts' assessments, so the results can be evaluated as a whole. The existence of these close positions among the experts is a good sign for the sector because they can be a good starting point to obtain wider consensus. Thus, results will be globally analysed, initially for criteria and then for strategies.

3.5.1 Results Obtained for the Criteria

The final limit matrix shows the obtained priority for each criterion, a non-dimensional value that can be considered as their relative importance. Results show (Table 3.3 and Figure 3.6) that, altogether, most valued clusters were the environmental (0.37) and the sociocultural (0.30) ones. The less valued cluster is the economic one (0.14).

In concordance with the results by cluster, the global results for each criterion show that the most important is C2.1 Urban density (0.22); followed by C4.1 Land-use planning and regulations (0.16). Subsequently, criterion C1.2 Environmental risk and threats (0.12), C1.1 Use of natural areas and heritage (0.11) and C1.3 Environmental impact (0.09) show an intermediate value. The least valued criteria are C2.3 Local acceptance (0.02), C3.3 Required investment (0.02) and C3.4 Connectivity (0.02).

Table 3.3 Cluster and criteria relative importance

Cluster	Importance	Criteria	Importance
1. Environmental	0.374	C 1.1 Use of natural areas and heritage	0.114
		C 1.2 Environmental risks and threats	0.119
		C 1.3 Environmental impact	0.088
		C 1.4 Water and land quality	0.054
2.Sociocultural	0.297	C 2.1 Urban density	0.217
		C 2.2 Urban renewal	0.037
		C 2.3 Local acceptance	0.017
		C 2.4 Quality of life	0.027
3. Economic	0.138	C 3.1 Promoting other activities	0.042
		C 3.2 Expandability	0.055
		C 3.3 Required investment	0.019
		C 3.4 Connectivity	0.022
4. Political	0.190	C 4.1 Land-use planning and regulations	0.156
		C 4.2 Existing plans and strategies	0.034

The low evaluation of the economic criteria is noteworthy, especially the one related to the required investment. This can be explained due to the closeness among the estimated costs of the alternatives and also because the projects for the construction of new nautical facilities are already designed, and they are just waiting for the approval from the competent authorities. Thus, beyond the economic costs and benefits associated with each alternative, results show a greater interest for the environmental effects, good or bad, that the considered strategies can have over the city's water bodies; and the current capacity of the city to accommodate these new initiatives. As stated above, the new infrastructure requests' purposes are directed to zones of high urban and commercial

density, and this directly affects other aspects such as the local acceptance or the population life quality.

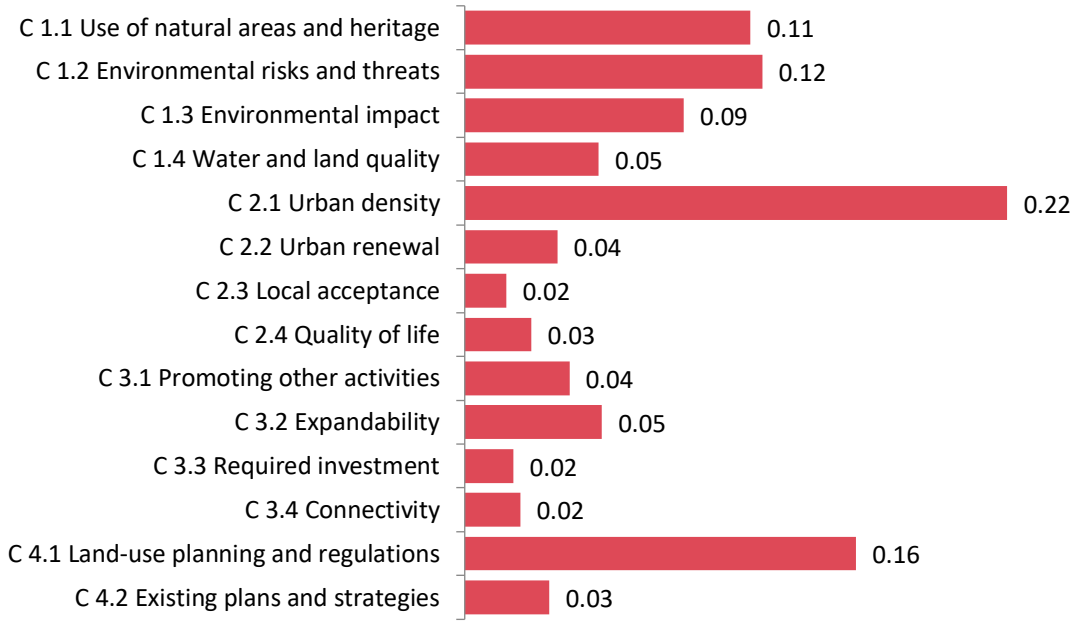


Figure 3.6 Results for the criteria

3.5.2 Results Obtained for the Alternatives

The final objective of this work is to establish a priority for each alternative. The results obtained for the analysed development strategies are shown in Figure 3.7 Priorities obtained for the alternatives can be considered as their Preference Index, so the higher this index value, the better the proposal prioritisation will be. Concordance in the assessment of the relative importance among the two experts is maintained so, considering the closeness between their answers, the results will continue to be globally analysed.

Results indicate that the best strategy to be implemented to improve the nautical and naval sector in the city of Cartagena is the A4. External Nautical Network (39%), followed by A3. Internal Nautical Network (30%) and A1. External Marina (24%). The Alternative A2. Internal Marina (7%) is the less valued by far.

These results are coherent with the weights assigned to the criteria. The proposal A4. Design of a network of marinas, docks and nautical bases in the insular districts of the city has been positively valued due to the importance assigned to the criterion related to urban density. Thanks to this external location and the construction of different nautical and naval facilities in several zones, the future expansion of these activities could be enabled, avoiding the concentration of nautical and naval activities in a single geographical area. The fact that this alternative must also consider the importance of land-use planning in the insular zone is relevant. This factor must be strongly laboured by the city, and it is reflected in the importance of the criterion related to compatibility with land-use planning and regulations.

Altogether, the environmental criteria received a good valuation, thus the alternative A3. Design of a network of marinas, docks and nautical bases in zones of the city to be recovered also received a good valuation. This is due to the generalized awareness that some of the city's water bodies are currently highly contaminated and it is important to recover them. These water bodies are located in zones that must be recovered by the city, so this also benefits the urban density criterion.

Alternative A1. Construction of a Civic External Marina also received a good assessment due to the density criterion, to its integration with other initiatives and the possibility of its closeness with the city's historic heritage.

Finally, regarding the alternative A2. Construction of a Civic Internal Marina, despite its main advantage being its cost, it has received the lower valuation probably because the zone in which this alternative would be located is a site considered as not feasible. This site has been involved in some disputes regarding its property and its compatibility for certain uses.

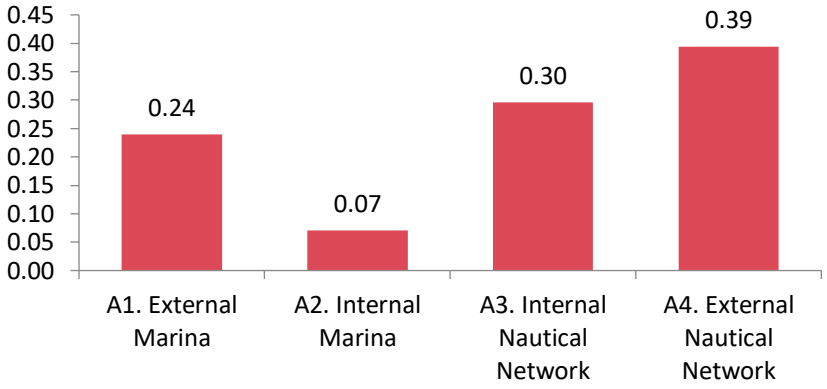


Figure 3.7 Results for the alternatives

3.6 Discussion

Through the use of ANP for prioritising the Cartagena nautical and naval strategic plans, some conclusions are reached concerning both the results and the appropriateness of the methodology itself.

The results obtained with the model allow concluding that beyond the economic aspects, there is concern over the environmental effects the alternatives could produce, or the way in which they could benefit the current conditions of some water bodies. Furthermore, to answer certain demands of the general population is considered to be very important—for example, the issues that most affect their everyday life and indirectly represent an improvement of their quality of life. In this case, it is specifically the generalized need to diminish the concentration of new urban developments on certain areas of the city. In general, the results practically exclude the alternative A2. Construction of a Civic Internal Marina.

The technique ANP used allowed for obtaining an agreement on the final assessment of the alternatives, where the highest valuation was obtained by alternative A4. Design of a network of marinas, docks and nautical bases in the insular districts of the city, and the lowest valuation was

obtained by alternative A2. Construction of a Civic Internal Marina. The results maintain a coherence with the importance assigned to some elements of the model. Thus, the better valued alternatives are those that least affect the urban density of certain zones of the city and those which potentially provide higher environmental benefits for the city.

Concerning the use of ANP as a tool for prioritisation of strategic plans, we can conclude that it allowed transparency and participation of the stakeholders. There is not a maximum or minimum number of stakeholders required. Experts involved have to be interested and have knowledge about the decision problem. In addition, they have to be willing to answer the questionnaires because they might be very time-consuming.

The ANP procedure becomes not only interesting in terms of reaching final prioritisation but also in terms of enabling reflection on the subject. Both stakeholders felt that the ANP procedure has allowed them to deal with prioritisation in an organized and systematic way.

The ANP is a good tool for the sector managers because it facilitates the prioritising process of strategic plans. This procedure allows for naval and nautical achieving an agreement among experts in an organized and systematic manner, thus it can be adopted and applied to other types of decisions. Considering also the closeness between participants' answers, achieving consensus in the nautical and naval sector can be a good starting point.

Different actors perceive estrangement between the city's inhabitants and the nautical and naval sector, thus it is worth noting that the involved parties must work towards the generation of a nautical culture in the city and promote the generation of knowledge about the sector, in order to motivate a rapprochement of both sides.

As future lines to be developed, we suggest involving more experts. However, to avoid ambiguities in the process, other expert selection tools could be considered, such as Stakeholder Analysis and Social Network Analysis (SNA). In this way, only key decision-makers would be involved. Moreover, if the model is to be used as a prioritisation tool of other strategic plans, such as plans for development of different strategic sectors of Cartagena, the experts, criteria and alternatives would have to be adapted to the new scenario.

Furthermore, a combination of ANP with geospatial analysis can be also considered to support the decision making process. As the information found on this topic concludes, the Geographic Information Systems (GIS) are widely accepted and they can provide mapping parameters that characterize the earth's surface, improving the decision process.

The uncertainties in climate change predictions and the local scale risks at which the city is exposed could also be considered in the long-term planning and regulation processes of the coastal and marine space, in contrast with other economic sectors of the city, the central interest of which is also the utilization of the coast and can also be affected by climate change. Concerning the utility and applicability of this tool to similar cases, the procedure is easy to adapt to other strategic sectors of the city as long as experts and the evaluation criteria are accurately selected.

CHAPTER 4

Stakeholder engagement to evaluate tourist development plans with a sustainable approach

This chapter is based on the paper:
Stakeholder engagement to evaluate tourist development plans with a sustainable approach.
Gonzalez-Urango H, García-Melón M. Sustainable Development. 2018; 26:800–811.
https://doi.org/10.1002/sd.1849

Abstract

This study provides an evaluation of tourist development plans in the city of Cartagena de Indias (Colombia). Different stakeholders are involved in the search for solutions to this problem. The proposal is based on a model that combines two techniques, namely the analytic network process (ANP) and social network analysis (SNA). SNA is used to assess the relationships among stakeholders by identifying those who are most relevant and ANP is used to aggregate their opinions and evaluate tourist development plans of Cartagena to improve tourist experiences in a participatory way. The results suggest that the combination of SNA and ANP is a novel and suitable tool for strategic planning of a city.

4.1 Introduction

Tourism is an important industry that is currently going through a period of great change. The sector accounts for 10% of world's gross domestic product (GDP), 7% of global trade and accounts for one in every 10 jobs (World Tourism Organization UNWTO 2017). According to UNWTO, these figures are expected to keep rising, especially in emerging economic destinations, such as South America (Mariani et al. 2014; World Tourism Organization UNWTO 2014, 2017).

This growth in tourism comes with some drawbacks, including increasing pressure on territories (Berzina, Grizane, and Jurgelane 2015). The tourism sector can and is firmly committed to playing its role in the 2030 Sustainable Development Agenda and its 17 Sustainable Development Goals (United Nations General Assembly 2015), especially in Goal 11: sustainable cities and communities. Promoting governments, the private sector, academia and civil society are expected to work together to implement sustainable tourism activities with an emphasis on sustainable land use (World Tourism Organization UNWTO 2017; Yfantidou and Matarazzo 2017).

Colombia as an emerging tourist destination and Cartagena de Indias as its most representative and important destination are included in this aim. This city needs to prepare and to adapt public policies and managerial strategies to face new challenges and opportunities both for the tourist industry as a whole and for particular destinations. Challenges relate to increasing competition among tourist destinations; the modification of target markets for established tourist destinations; the increasing importance of collaboration (Mariani et al. 2014; Xia Wang et al. 2016); and integrating sustainable planning (Dvarskas 2017; S. Singh 2016).

For several years, Cartagena de Indias has been developing long-term plans, but which have not yet evolved to deal with upcoming challenges such as those of sustainable development. Environmental perception and the attitude of stakeholders generate debates, controversy and contradictions among economic sectors and groups.

In this paper, we will shed some light on solving this problem. We propose to evaluate the different tourist development plans that the city has currently in mind considering sustainable criteria together with integrative and participative approaches supported by technical and scientific knowledge (Alves et al. 2013; Loken 2007; Le Pira et al. 2016). This is a decision making problem that should be approached from the perspective of multicriteria analysis, with the participation of different stakeholders.

We propose a methodology based on the combination of two techniques: social network analysis (SNA) to assess the relationships among stakeholders by identifying the most relevant ones, and analytic network process (ANP) to aggregate their opinions and evaluate the tourist development plans of Cartagena to improve the city's attractiveness to tourists. The aim is to verify in practice the relevance and usefulness of the methodology in planning and to draw some conclusions on their potential and limitations.

4.2 State of the Art

4.2.1 The participation of stakeholders in the evaluation process

Due to the complexity and interrelations of the problems caused by global society (economic development, natural resource management, etc.) public policy managers should conduct a stakeholder analysis to identify and take account of the individuals, groups and organizations involved in or affected by such policies (Bryson 2004; Kua 2016). The effective participation of stakeholders requires that decision-makers work with them appropriately, use the right stakeholders, elicit information from them in a rigorous way, and apply appropriate analysis techniques to the information provided (Glicken 2000).

Several approaches have been proposed to investigate the relationships among stakeholders, such as power versus interest grids, stake- holder salience (Mitchell et al. 1997), interrelationship diagrams (Bryson 2004) and actor-linkage matrices (Biggs and Matsaert 1999). However, these techniques do not allow us to determine an individual value for the influence of each actor in a decision making process.

SNA (Wasserman and Faust 2007) is thus a technique that allow this individual value to be determined. It investigates social structures through the use of networks and graph theory. It characterizes networked structures in terms of nodes (individual actors, people, or things within the network) and the ties, edges or links (relationships or interactions) that connect them. Through SNA we can analyse flows of knowledge in the network: in other words, to whom do people go in the organization for answers to questions (Reed et al. 2009). The position of the participant in the network determines his/her favourable or constraining role in the network in terms of the outcomes under consideration. Centrality (based on degree, closeness or betweenness) is the most commonly used index to analyse a participant's influence (Ahmedi et al. 2017; Dempwolf and Lyles 2012).

4.2.2 The multicriteria evaluation approach

The selection and interpretation of sustainable criteria in the evaluation of the different tourist development plans that Cartagena is considering should be done carefully to maximize the correlation between the index values obtained in the evaluation procedure (individual weights for criteria and alternatives of the model) and the quality to be measured. Multicriteria Decision Making (MCDM) techniques are appropriate to solve problems of this type. General information regarding MCDM can be found in Barba-Romero and Pomerol (1997), Belton and Stewart (2002) and Loken (2007).

Several authors introduce the use of MCDM techniques for assessment of sustainability. Many of them focus on the use of the Analytic Hierarchy Process AHP (Saaty 1990), which has been accepted as a leading multicriteria decision model (Akbari et al. 2017; Ramzan et al. 2008; Šijanec et al. 2009; Sólnes 2003) to assign priorities to the criteria or indicators involved. In our case, we use a more evolved technique, namely ANP. ANP was proposed by Saaty (2001) to generalize his original AHP in situations of interdependence and feedback among the decision elements. A detailed description of the method can be found in Saaty (2001).

Evidence regarding the use of ANP for tourism development is widespread in the literature (Aminu et al. 2013; Bonzanigo et al. 2016; Bramwell 2015; Chen et al. 2009; García-Melón et al. 2010; Jeong et al. 2014). ANP has also been integrated with other tools such as Geographic Information Systems (GIS) for sustainable tourism planning (Aminu et al. 2013, 2017)(Aminu et al. 2013, 2017); with Delphi as an environmental assessment tool of sustainable tourist strategies (García-Melón et al. 2012); and Hybrid SWOT-ANP-Fuzzy ANP model for prioritisation strategies of sustainable development of ecotourism (Arsić et al. 2017).

The use of ANP for this purpose is novel because the decision making processes in Cartagena are tackled in a little structured and participative way. It is therefore vital to explore new prioritisation tools that contribute to show greater coherence in the selection and public justification of the actions to be taken (Peris et al. 2013).

Finally, the combination of SNA and ANP represents a novel methodology in tourist development plans.

4.3 Materials and Methods

In this paper we propose a methodology based on a combination of SNA and ANP to support decision-makers in Cartagena de Indias to assess tourist plan considering the views of the various interested and affected stakeholders. The steps followed are shown in Figure 4.1. A detailed description and its implementation are presented in the case study section.

The application of this methodology is organized in three main stages:

I. Understanding the context of the problem
II. Stakeholders identification and analysis through SNA
III. Participative prioritisation of tourist developments plans through ANP

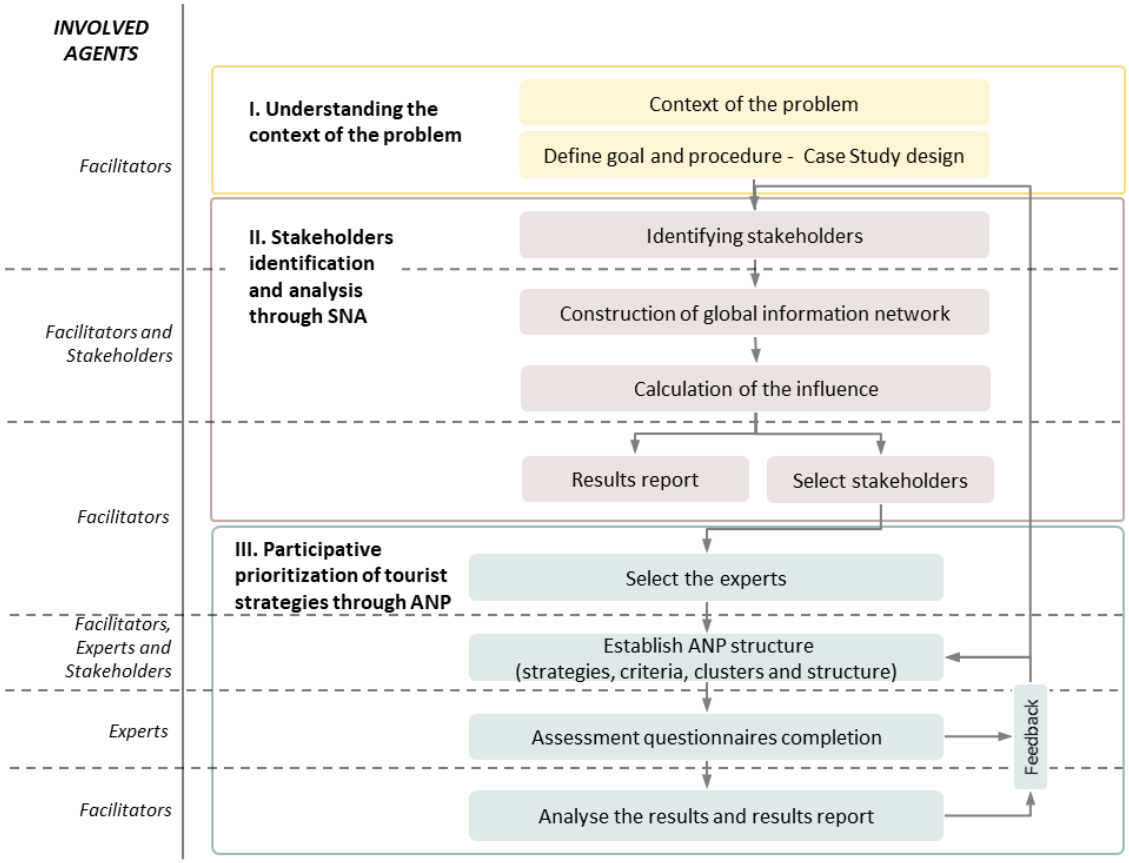


Figure 4.1 Methodology proposed

Thus, our research is based in two techniques, SNA and ANP, which are analysed in the next section.

Two types of agents were contacted by the facilitators during the above stages. The next table shows the number of the agents involved and the rate of answers.

Table 4.1 Involved agents

Agents	Stage	Identified	Contacted	Replied	Comments
Stakeholders	SNA	49 actors	71 people belonging to 46 actors	46	3 inconsistent answers eliminated
Experts	ANP – Establish structure	5 people	5 people	4	World Tourism Organization UNWTO Local Tourist Office Two researchers: Public Policies and Tourism.
	ANP – Assessments questionnaires	12 actors	12 people	7	The most influential actors presented in Section 4.4.2

4.4 Case study: prioritising tourist development plans in the city of Cartagena

4.4.1 Understanding the context of the problem

After the revision of local and regional plans, international experiences, and a literature review (Alcaldía Distrital de Cartagena de Indias 2014b, 2016; Comisión Regional de Competitividad de Cartagena y Bolívar 2010) three proposals (alternatives) were selected, with the help of the Local Tourist Office and additional experts. Alternatives are comparable, that is they have similar budgets, and are aimed at developing new urban projects in the city. Prioritising these proposals should allow channelling most of this sector's development and resources, and should help improve the city's appeal to tourists. The selected alternatives are:

- Alternative 1: A1. Tourist complex. Develop an area where facilities are comprehensively established for various tourism purposes and for relaxation, mainly ecoactivities. Located in an insular territory consistent with geographic and cultural conditions.
- Alternative 2: A2. Tourist boulevard. Develop coastal protection to improve the connection and spaces between the most relevant tourist neighbourhoods and the airport.
- Alternative 3: A3. Waterborne transport system. Develop a network of public transport using the water resources available around the city.

The programs and actions declared in the different plans and programs mentioned above have until now been prioritised according to the concerns and capacities of the participants. The lack of inclusion and use of more structured techniques for the definition of the Action Plan are the main factors favouring the use of multicriteria multi-stakeholder prioritisation techniques.

4.4.2 Stakeholders identification and analysis through SNA

The first step was the identification of stakeholders. An initial review of secondary sources (Alcaldía Distrital de Cartagena de Indias, 2014c; Corpoturismo, 2015, The National Colombian Tourist Register RNT), and a 'snowball technique' were used. Following the method proposed by Brugha and Varvasovszky (2000); Reed et al. (2009); and Saint Ville et al (2017). 45 actors were identified among institutions, organizations and groups. A questionnaire to analyse the amount of information exchanged was sent to all of them (Table 4.2 and Appendix C.1). According to Hanneman and Riddle (2005) the sharing of information can be used to establish links between two nodes in a social network. Our model is based on the analysis of information exchange among stakeholders.

Table 4.2 Example of the questionnaire for stakeholder A1. Local Government

Regarding tourist sector management, with which of the following actors have you exchanged information? How often?				
Actor	Do you send information to him/her/it?	How often? (Daily, weekly, monthly …)	Do you receive information from him/her/it?	How often? (Daily, weekly, monthly…)
Local Tourist Office				
Local Planning Office				
Local Institute of Heritage and Cultural				
…				

We gathered answers from 43 actors (Table 4.3).The information gathered was scaled in the following way: 0 means none information exchange, 1 means an exchange at least every two months, and 2 means that the information exchange is monthly or more frequently.

Table 4.3 List of stakeholders and multiple centrality measures

ID	Actors	Freeman Degree		Closeness		Betweenness
		Out	In	Out	In	
A1	Local Government	25	23	68	71	37.49
A2	Local Tourist Office	66	58	46	53	376.53
A3	Local Planning Office	4	4	85	90	0.17
A4	Local Institute of Heritage and Cultural	23	19	66	75	21.36
A5	Departmental (Regional) Tourist Office	34	33	61	65	58.78
A6	Ministry of Commerce, Industry and Tourism	23	22	69	74	13.00
A7	Colombian Agency for the Promotion of Exports, Tourism and Investment	35	31	63	71	21.02
A8	National Tourism Promotion Office	43	38	58	66	72.73
A9	Local Chamber of Commerce	47	42	56	6	118.12
A10	Hotel Association A	21	17	71	77	8.82
A11	Hotel Association B	16	13	76	80	1.70
A12	Travel Agency Association	18	16	73	78	2.69
A13	Restaurant Association	11	9	80	85	0.91
A14	Society for local heritage	17	12	76	83	15.74
A15	Colombian Association of Micro, Small and Medium Enterprises (Bolivar)	5	4	93	95	0.27
A16	National Federation of Merchants (Bolivar)	5	8	83	85	1.18
A17	Professional group of tourist guides	9	6	80	91	0.45
A18	Other associations, groups or guild.	6	6	82	87	0.54
A19	Local Airport	12	8	77	85	1.32
A20	Cruise terminal	25	17	66	77	21.41
A21	Museums	19	11	71	81	5.04
A22	Hotels	36	39	57	59	146.01
A23	Tour Operators	29	29	63	65	51.17
A24	Tour Operator A	29	44	68	62	66.71
A25	Tourist Guides	16	14	76	80	5.96
A26	Promotion Websites	16	11	74	81	42.55
A27	Local transporters	12	10	79	82	0.87
A28	Restaurants and similar	26	24	70	74	32.84
A29	University-Business-State Committee	8	14	78	75	4.06
A30	University A	21	29	70	64	115.58
A31	University B	11	17	82	74	21.17
A32	University C	8	22	79	70	5.83
A33	University D	26	28	66	68	48.14
A34	Research Institutes and Centres	19	25	70	68	44.66
A35	Environmental Institutions	11	22	82	74	5.68
A36	NGOs	6	7	87	88	0.69

ID	Actors	Freeman Degree		Closeness		Betweenness
		Out	In	Out	In	
A37	NGO A	2	4	111	102	0.15
A38	NGO B	10	3	76	91	1.82
A39	Insular Community Representative	7	5	79	88	0.57
A40	Other Communities Representative	12	9	77	81	2.28
A41	Civil Society Groups	2	12	115	77	1.37
A42	Citizen	0	5	168	82	0.00
A43	Other Institutions/actors	7	8	86	79	3.64

The 43 actors analysed created the network, which was introduced in software program UCINET©. The nodes´ centrality based on: degree, closeness, and betweenness (Prell et al., 2009; Yang, 2014) was chosen as the most appropriate SNA indicator to assess the relevance of the stakeholders. The centrality indices of the actors were calculated (Table 4.3). The graphical representation of the whole information exchange network is shown in Figure 4.2 using the results of betweenness centrality.

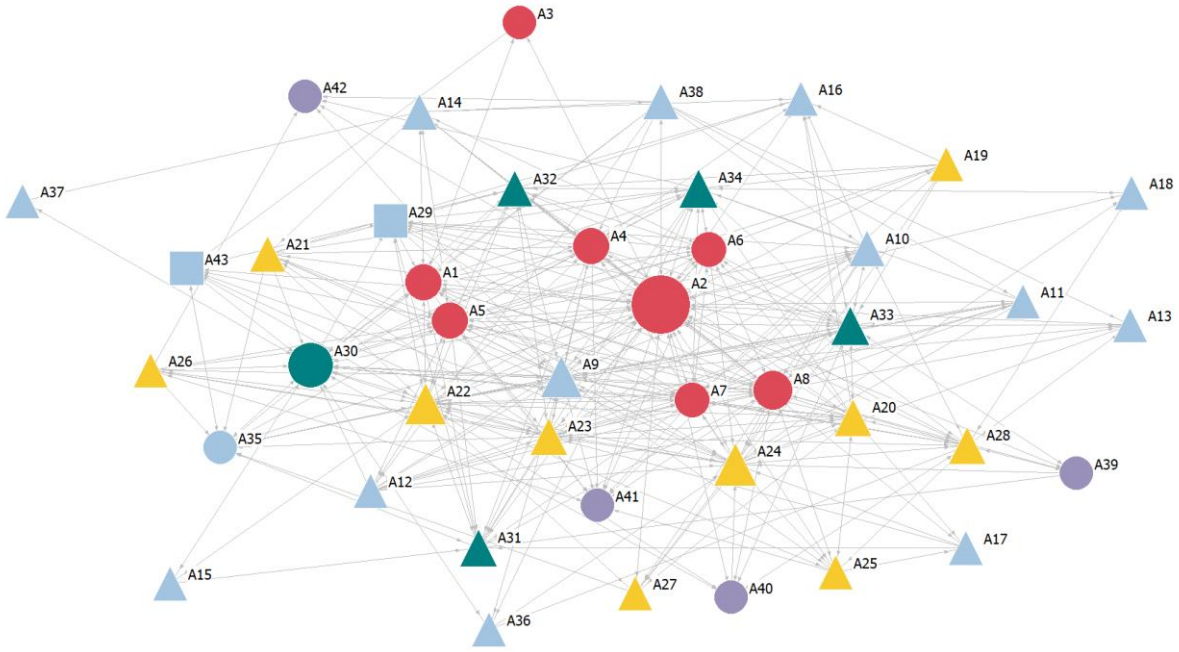


Figure 4.2 Graphs showing social network of stakeholders – According to betweenness. Obtained by UCINET software©.

** Shapes: circle (public), triangle (private) and square (mixed).*

***Colours: red (public administration), yellow (tourist service providers), blue (support organizations), green (academia), and purple (civil society).*

The betweenness centrality of a node is given by the expression:

$$C_B(n_i) = \sum_{j<k} g_{jk}(n_i)/g_{jk} \quad (1)$$

Being $g_{jk}(n_i)$ the number of geodesic paths (shortest) from node j to node k that pass through node i.

This measure allows us to establish clearer differences among actors. The bigger the size of the geometric figure, the higher the betweenness centrality, that is the higher the influence of the actor within the network.

Analysis of the network as a whole shows that it is a very dense, given the number of actors and the number of connections that are observed. All the actors are linked by more than one connection, which denotes good communication within the network. We can also see that the local tourist sector has strong ties, which means that it is a consolidated sector and able to respond quickly and effectively.

To select the most influential actors, we decided to select those with higher betweenness centrality. They are the actors who would have more control on the network, because more information will pass through them (Mok, Shen, and Yang 2017; Yamaki 2017). High betweenness centrality grants the actor the ability to influence the flow of resources between others, and it also provides him/her with a diversity of resources provided by the bridging tie (Bodin and Crona 2009).

According to this measure, the most influential actors are:

1. The Local Tourist Office (A2): the institution in charge of the planning and management of tourist development of the city. It is the most relevant authority in terms of tourist management.
2. Hotels (A22): one of the most important and relevant tourist service providers. The city has at least 530 hotels and two main associations.
3. Local Chamber of Commerce (A9): a private non-profit institution whose primary purpose is to promote regional development.
4. University A (A30): the only public University in the city.
5. National Tourist Promotion Office (A8): national institution created for the promotion of tourism and its competitiveness.

Once the list of relevant actors has been obtained, we have our preliminary list of experts for the ANP process. However, to follow the suggestions proposed by some scholars (Bodin, Crona, and Ernstson 2006; Prell et al. 2009). aimed at making the group of experts more resilient and adaptative to environmental changes, we have included two more actors who were not considered central, but were willing to collaborate in this process.

1. Social group leader (A41)
2. International expert (A43)

The next stages of the proposed methodology were carried out with the collaboration of the seven actors acting as experts.

4.4.3 Participative prioritisation of tourist development plans through ANP

This part aims to support the experts chosen to evaluate and prioritise sustainable tourist plans. The three proposals to be analysed have been described in section 4.4.1: Tourist complex (A1), Tourist boulevard (A2) and Waterborne transport system (A3).

Selection of evaluation criteria

Following the ANP procedure, the criteria to evaluate the proposed alternatives were identified. After a thorough revision of the literature, the facilitators proposed a list of criteria, which was then reviewed and accepted by the experts. It was necessary to ensure that these criteria could be grouped, and that they were relevant, not redundant and easy to understand for the different actors. The final list of 25 criteria, grouped in five evaluation clusters (Table 4.4), was defined based on a bibliographic review (Chen and Bau 2016; Eldrandaly and AL-Amari 2014; Grošelj and Stirn 2015; Jeong et al. 2014; Liu and Chou 2016; Mariani et al. 2014; Xia Wang et al. 2016) and with the assistance of the experts (Liu and Chou 2016).

Table 4.4 Evaluation criteria

Cluster	Criteria	Definition	References
C.1 Enviromental	C 1.1 Use of heritage and natural spaces	The use of monuments, buildings, spaces and natural areas, especially those considered as heritage	(Acuña-Dutra 2013; Chen and Bau 2016; Díaz Martín 2015; Eldrandaly and AL-Amari 2014; Estevão and Nunes 2015; Grošelj and Stirn 2015; Jeong et al. 2014; World Tourism Organization UNWTO 2015)
	C 1.2 Environmental risk and threats	Actual or potential threat of adverse effects transmitted through environmental conditions i.e. erosion, sea-levels rise, swell, floods...	(Alcaldía Distrital de Cartagena de Indias 2001; de Carvalho and Pimentel 2012; Díaz Martín 2015; GSTC 2013; ICONTEC 2014)
C.2 Socio-cultural	C 2.1 Qualified labour	Training and skills required to implement and support alternatives.	(Gobernación de Bolívar et al. 2011; Gobernación de Bolívar and Camara de Comercio de Cartagena 2006)
	C 2.2 Available infrastructure and public services	The existing basic systems and services, such as transport, routes and public services.	(Acuña-Dutra 2013; de Carvalho and Pimentel 2012; Eldrandaly and AL-Amari 2014; Estevão and Nunes 2015; Monteiro and Odete 2015)
	C 2.3 Integration of ethnic groups	To allow native communities and ethnic groups to participate.	(Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Grošelj and Stirn 2015)
	C 2.4 Exploitation of cultural identity	The use of elements of cultural identity	(Alcaldía Distrital de Cartagena de Indias 2001; Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Grošelj and Stirn 2015)
	C 2.5 Quality of life	The beneficial effects of alternatives in the city.	(Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Grošelj and Stirn 2015)
	C 2.6 Linking to postconflict	The possibility of linking alternatives with current postconflict processes.	Expert opinion (de Carvalho and Pimentel 2012)
	C 2.7 Associativity among actors	Degree of coordination and integration of the involved actors in the city.	(Gobernación de Bolívar, Colciencias, and Camara de Comercio de Cartagena 2014; Grošelj and Stirn 2015)
C.3 Sectorial	C 3.1 Origin of visitors	Origin of tourist arrivals in the city.	(Monteiro and Odete 2015)

Cluster	Criteria	Definition	References
	C 3.2 Visitor expenditure	Tourist spending particularly related to each alternative.	(Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Monteiro and Odete 2015)
	C 3.3 Length of stay of visitors	Tourists' trip duration (nights, hours...), particularly related to each alternative.	(Monteiro and Odete 2015)
	C 3.4 Positioning in national and international markets	Perceptions of the city in national and international segments of tourism.	(Gobernación de Bolívar and Camara de Comercio de Cartagena 2006)
	C 3.5 Global tourism trend	Preferences and world tourism tendency.	(Comisión Regional de Competitividad de Cartagena y Bolívar 2010; Gobernación de Bolívar and Camara de Comercio de Cartagena 2006; Grošelj and Stirn 2015)
	C 3.6 Integration with other destination	The possibility to connect the city with regional destinations.	(Grošelj and Stirn 2015)
	C 3.7 Experiential content	A closer bond between the visitor and the city created by memorable experiences.	(de Carvalho and Pimentel 2012; Corpoturismo 2015a; Gobernación de Bolívar and Camara de Comercio de Cartagena 2006; Xia Wang et al. 2016)
C.4 Economic-Productive	C 4.1 Promoting other economic activities	The influences of the alternative in other economic sectors.	(Acuña-Dutra 2013) (Alcaldía Distrital de Cartagena de Indias 2001) (Gobernación de Bolívar et al. 2014)
	C 4.2 Generated revenues	Incomes that the city will get from new activities.	(Alcaldía Distrital de Cartagena de Indias 2001; de Carvalho and Pimentel 2012)
	C 4.3 Required investment	The required capital to implement and support these alternatives.	(Acuña-Dutra 2013; Alcaldía Distrital de Cartagena de Indias 2001; Eldrandaly and AL-Amari 2014)
	C 4.4 Tax Policy	Compatibility of new activities with tax benefits.	(Alcaldía Distrital de Cartagena de Indias 2001; Eldrandaly and AL-Amari 2014)
C.5 Political-Administrative	C 5.1 Compatibility with the city's vision	Affinity with local, regional and national projects and programs.	Expert opinion
	C 5.2 Institutional support	Governability framework for the implementation of each alternative.	(Acuña-Dutra 2013; Díaz Martín 2015)
	C 5.3 Compatibility with land-use, existing plans and regulations	Compatibility with legal regulations, controls or restrictions.	(Acuña-Dutra 2013; Eldrandaly and AL-Amari 2014; Gobernación de Bolívar and Camara de Comercio de Cartagena 2006; ICONTEC 2014)
	C 5.4 Estimated time for development	Required period to implement each alternative.	Expert opinion
	C 5.5 Responsible and sustainable management	Opportunity to insert responsible and sustainable policies into new services.	(Grošelj and Stirn 2015; GSTC 2013; ICONTEC 2014)

Representation of the evaluation problem as a network model

Influences among criteria were determined using a relationship matrix (Table 4.5). This procedure was carried out during face-to-face meetings with the experts. The final ANP model proposed is shown in Figure 4.3. The bidirectional arrows in this figure indicate influences between clusters in both directions. That is to say, the elements in a cluster (i) exert some influence over elements in another cluster (j). Feedback means that there is influence between criteria belonging to the same group.

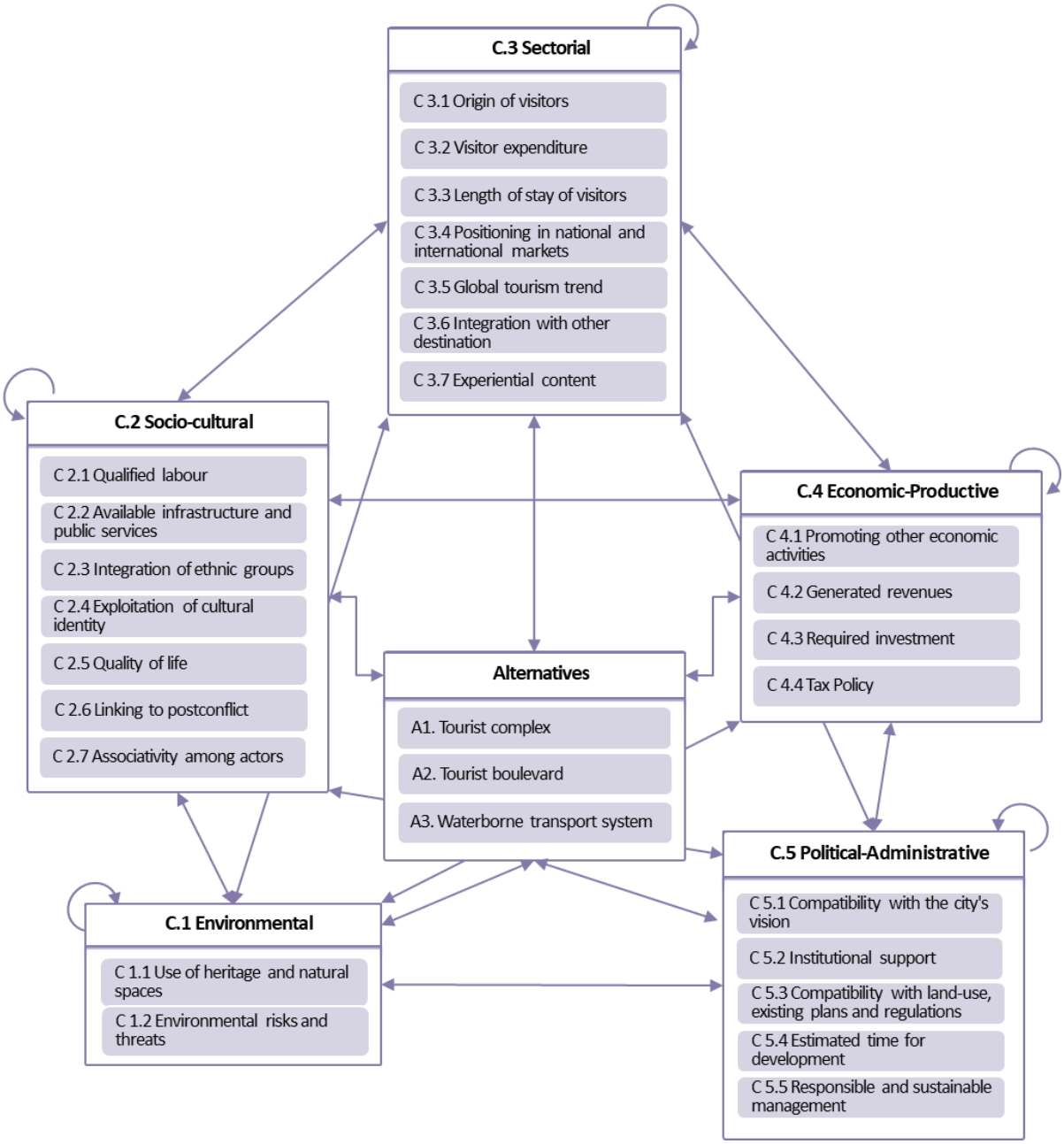


Figure 4.3 ANP network model of the case study

Table 4.5 Influence matrix

	C 1.1	C 1.2	C 2.1	C 2.2	C 2.3	C 2.4	C 2.5	C 2.6	C 2.7	C 3.1	C 3.2	C 3.3	C 3.4	C 3.5	C 3.6	C 3.7	C 4.1	C 4.2	C 4.3	C 4.4	C 5.1	C 5.2	C 5.3	C 5.4	C 5.5	A1.	A2.	A3.
C 1.1	0	1	0	1	1	1	1	0	1	0	1	0	1	0	1	1	1	1	1	0	1	1	0	0	1	1	1	1
C 1.2	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1
C 2.1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
C 2.2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	1	1
C 2.3	1	0	1	0	0	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	1	1	1
C 2.4	1	0	0	0	1	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	1	1
C 2.5	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	1
C 2.6	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
C 2.7	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	1	1	1	1	1	1
C 3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
C 3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1
C 3.3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1
C 3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
C 3.5	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1
C 3.6	1	0	0	0	1	1	1	0	0	0	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	1	1	1
C 3.7	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	1	1	1
C 4.1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	1	1
C 4.2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1
C 4.3	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1
C 4.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1
C 5.1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	1
C 5.2	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	1	1
C 5.3	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	1	1	1	1
C 5.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1
C 5.5	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1
A1.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
A2.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
A3.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0

Prioritising strategies

Once the model was agreed upon, the ANP questionnaire with the required judgements based on pairwise comparisons was designed and sent to the experts (Appendix C.2). From the local priorities derived through pairwise comparisons, the results were obtained with the help of Superdecision© v.2.0.8. software.

The final limit matrix shows the priority obtained for each criterion, a nondimensional value that can be considered their relative importance of each one (Appendix C.3). Because a total of seven people were interviewed, seven individual results were obtained each of which shows the preference index according to the opinion of one particular expert. Aggregation of individual judgements (AIJ) was performed using the geometric mean to obtain a global judgement (Saaty 2001). Care was taken to ensure that all pairwise comparison matrices had a consistency ratio (CR) of less than 10%. It assesses the degree of inconsistency an expert has when eliciting his/her judgements. Whenever judgments were inconsistent, experts were suggested to reconsider their judgment so that they would fall within the acceptable limit.

4.5 Results

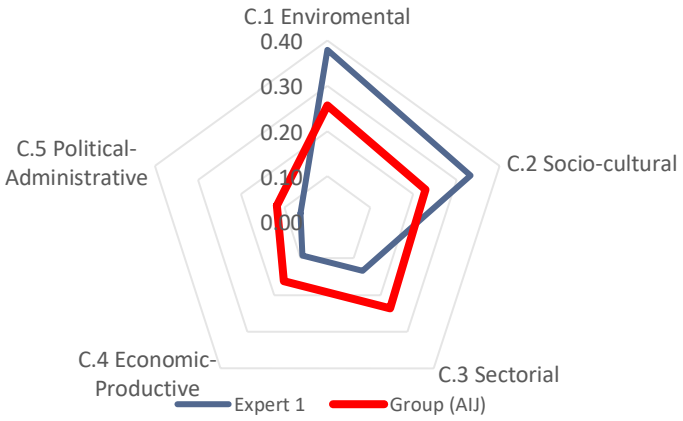
4.5.1 Weights of the criteria

At the clusters level

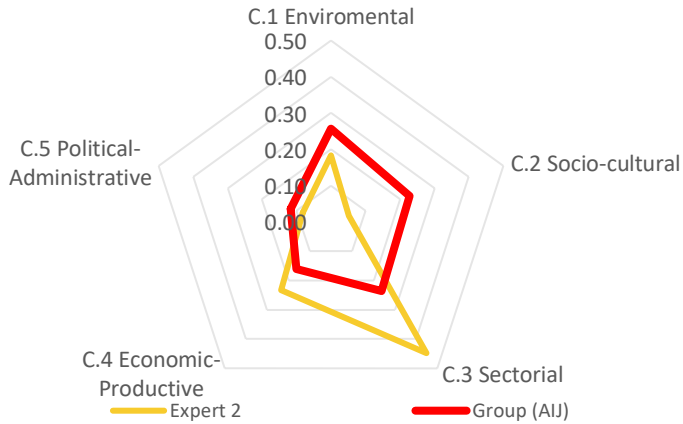
The cluster weighting provides important insights into the overall philosophy and underlying participants' conception of what sustainable tourism in the city of Cartagena is. We can analyse their individual decision making profiles (Table 4.6 and Figure 4.4). Experts 1 and 4 show similar profiles. They both give the highest importance to Environmental (C1) and Socio-cultural (C2) aspects and the lowest importance to Economic-Productive (C4) and Political-administrative (C5) aspects. We could thus conclude that they show a s*ocio-environmental* profile. By contrast, Experts 5 and 7, who do not belong to the city of Cartagena, give the highest importance to C5 and C4. In this case we could conclude that these two experts present a *political-economic* profile. Expert 2 gives the highest importance to C4, followed by C3. So we could define this expert as having an *economic* profile. Expert 6 has a *social* profile and Expert 3 shows a more balanced profile.

Table 4.6 Results obtained for the clusters of criteria

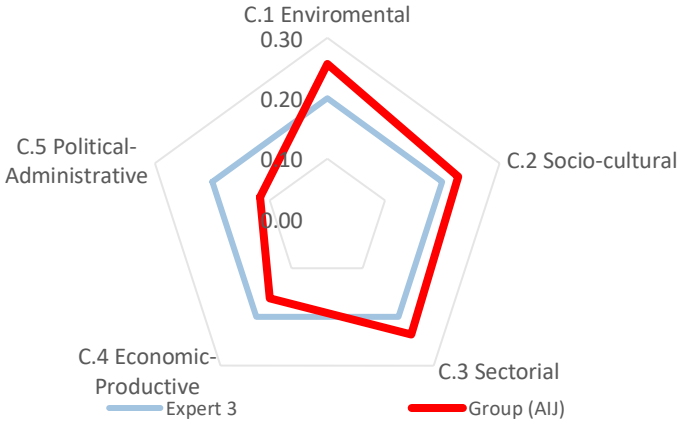
Cluster	Expert 1 Tourist Office	Expert 2 Hotels	Expert 3 Chamber of Commerce	Expert 4 University	Expert 5 National Tourist Promotion Office	Expert 6 Social group leader	Expert 7 International expert	Group (AIJ)
C1Environmental	0.379	0.183	0.200	0.464	0.039	0.276	0.039	0.257
C2 Socio-cultural	0.333	0.052	0.200	0.209	0.076	0.397	0.113	0.228
C3 Sectorial	0.134	0.448	0.200	0.133	0.161	0.205	0.131	0.236
C4 Economic-Productive	0.092	0.234	0.200	0.076	0.362	0.080	0.225	0.162
C5 Political-Administrative	0.062	0.082	0.200	0.119	0.362	0.042	0.492	0.117



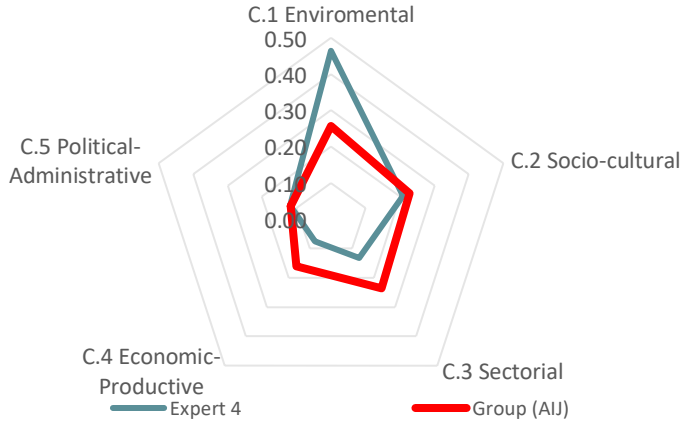
Expert 1. Tourist Office



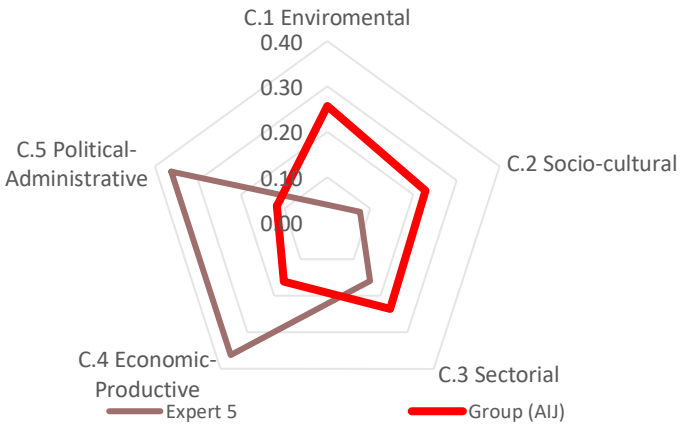
Expert 2 Hotels



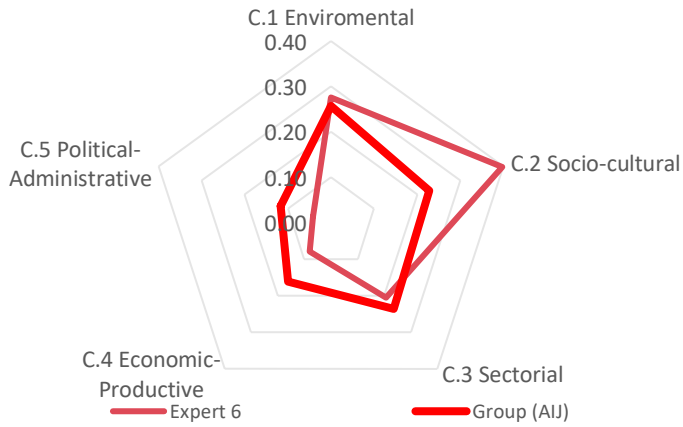
Expert 3. Chamber of Commerce



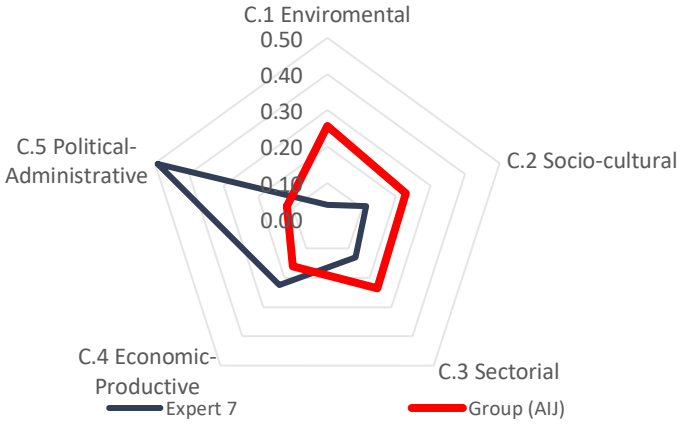
Expert 4. University



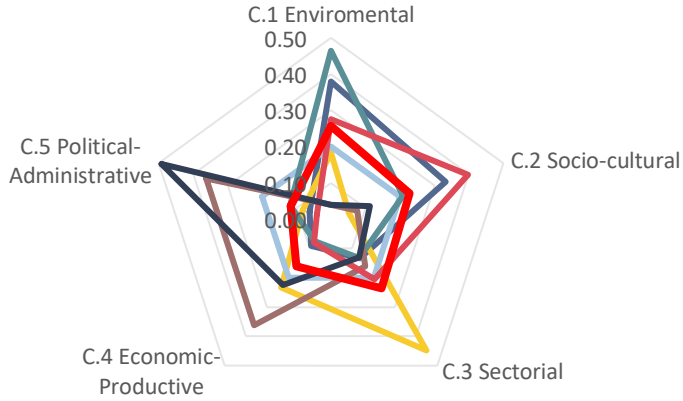
Expert 5. National Tourist Promotion Office



Expert 6. Social group leader



Expert 7. International expert



Group (AIJ)

Figure 4.4 Cluster results according to different experts and global result

At the criteria level

From these results the main conclusion is that the most relevant criterion for all the experts is C1.1 *Use of Heritage and natural spaces (16.4%)* followed by C1.2 *Environmental risk and threats (10%)* (see Figure 4.5 for differences). Next in importance are a group of criteria formed by C5.5 *Responsible and sustainable management,* C3.6. *Integration with other destinations*, C2.7 *Associativity between actors*, *C5.3 Compatibility with land-use, existing plans and regulations, C4.1 Promoting other economic activities, C4.3 Required investment and* C5.2 *Institutional support*, which also have an importance of between 5 and 8%. The least important criteria have an importance of 1% or less (Table 4.7).

Table 4.7 Results obtained for the criteria

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Group (AIJ)
C1.1 Use of heritage and naturals spaces	0.198	0.185	0.129	0.196	0.136	0.166	0.154	0.164
C1.2 Environmental risk and threats	0.093	0.062	0.124	0.119	0.066	0.097	0.057	0.100
C2.1 Qualified labour	0.021	0.003	0.019	0.011	0.003	0.037	0.005	0.016
C2.2 Available infrastructure and Public services	0.012	0.026	0.023	0.032	0.037	0.025	0.035	0.025
C2.3 Integration of ethnic groups	0.029	0.031	0.026	0.047	0.026	0.071	0.051	0.041
C2.4 Exploitation of cultural identity	0.063	0.041	0.027	0.044	0.034	0.041	0.016	0.041
C2.5 Quality of life	0.043	0.020	0.047	0.027	0.033	0.035	0.017	0.037
C2.6 Linking to postconflict	0.018	0.005	0.016	0.003	0.003	0.012	0.002	0.010
C2.7 Associativity between actors	0.064	0.039	0.054	0.050	0.043	0.056	0.064	0.052
C3.1 Origin of visitors	0.006	0.005	0.007	0.002	0.003	0.005	0.001	0.006
C3.2 Visitor expenditure	0.016	0.030	0.010	0.004	0.007	0.012	0.022	0.013
C3.3 Length of stay of visitors	0.011	0.017	0.013	0.005	0.012	0.016	0.015	0.015
C3.4 Positioning in nat. and intern. markets	0.005	0.016	0.008	0.006	0.014	0.007	0.004	0.011
C3.5 Global Tourism Trend	0.010	0.048	0.033	0.029	0.027	0.032	0.010	0.032
C3.6 Integration with other destination	0.053	0.064	0.042	0.045	0.061	0.061	0.051	0.054
C3.7 Experiential Content	0.045	0.073	0.049	0.045	0.032	0.027	0.052	0.044
C4.1 Promoting other economic activities	0.050	0.040	0.045	0.041	0.047	0.053	0.035	0.050
C4.2 Generated Revenues	0.029	0.055	0.036	0.010	0.033	0.011	0.043	0.026
C4.3 Required investment	0.028	0.053	0.042	0.062	0.075	0.041	0.057	0.049
C4.4 Tax Policy	0.006	0.006	0.020	0.004	0.040	0.002	0.019	0.009
C5.1 Compatibility with the city's vision	0.018	0.033	0.040	0.026	0.030	0.022	0.046	0.027
C5.2 Institutional support	0.046	0.041	0.047	0.039	0.094	0.041	0.087	0.047
C5.3 Compatibility with land-use, existing plans and regulations	0.067	0.045	0.058	0.052	0.056	0.042	0.068	0.051
C5.4 Estimated time for development	0.003	0.008	0.014	0.008	0.013	0.004	0.019	0.008
C5.5 Responsible and sustainable manag.	0.066	0.054	0.072	0.092	0.073	0.081	0.069	0.075

In general, criteria from the Environmental (A1) cluster are more valued and criteria from the Sectorial (A3) cluster are less valued.

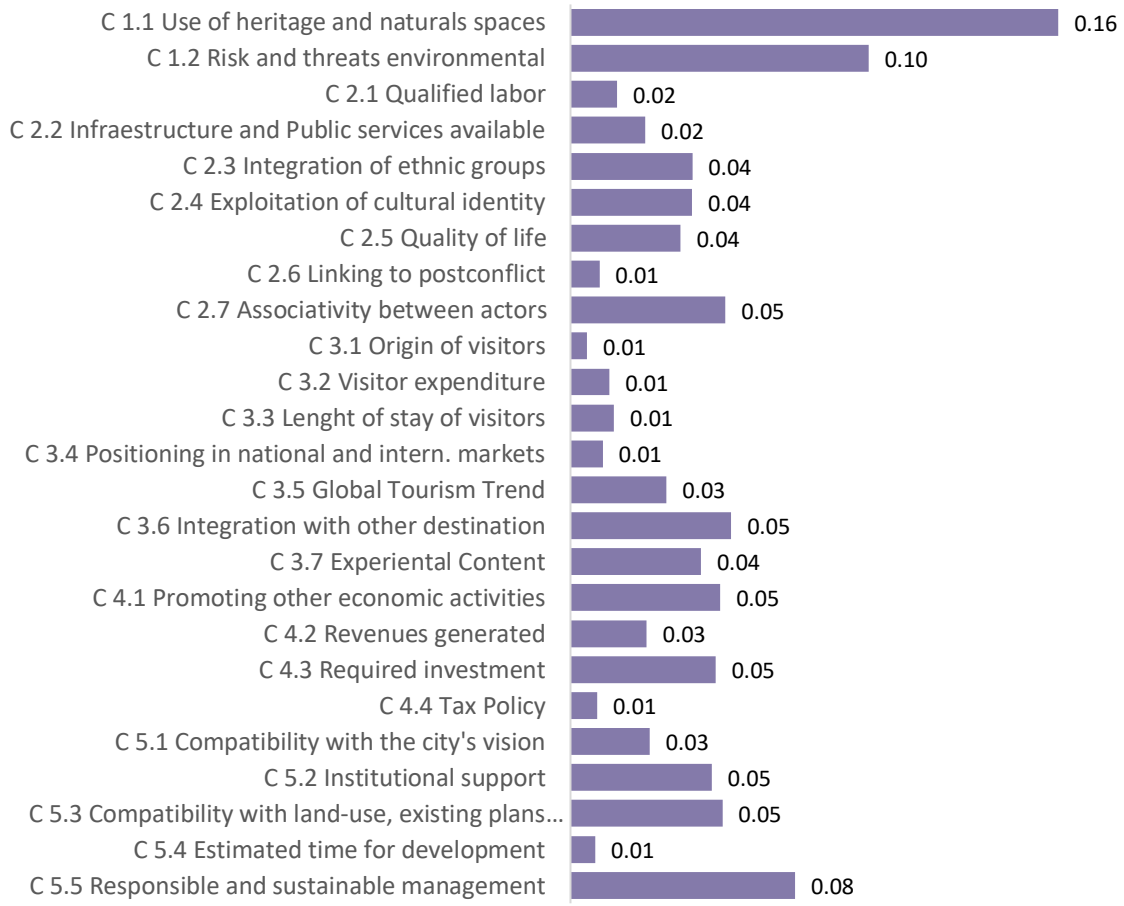


Figure 4.5 Group results for all the criteria

4.5.2 Regarding of the alternatives

We can conclude that although the different experts show very different ranking preference of the three alternatives that have been analysed (Table 4.8 and Figure 4.6), when we aggregate the results as a group, the results indicate that the preferred alternative to be implemented is *A3. Waterbourne transport system* (45%), followed by *A1. Tourist Complex* (34%).

Table 4.8 Results obtained for the alternatives

	Expert 1 Tourist Office	Expert 2 Hotels	Expert 3 Chamber of Commerce	Expert 4 University A	Expert 5 National Tourist Promotion Office	Expert 6 Social group leader	Expert 7 International expert	Group (AIJ)
A1. Tourist Complex	0.359	0.440	0.347	0.427	0.190	0.375	0.561	0.344
A2. Tourist Boulevard	0.351	0.230	0.211	0.221	0.337	0.087	0.182	0.207
A3. Waterborne transport system	0.290	0.330	0.442	0.351	0.474	0.538	0.257	0.449

The Waterborne transport system has been positively valued due to the importance assigned to the criterion related to *Use of Heritage and natural spaces*, and thus its aim is to develop a public transportation system using the water resources available around the city, and connecting insular and continental zones.

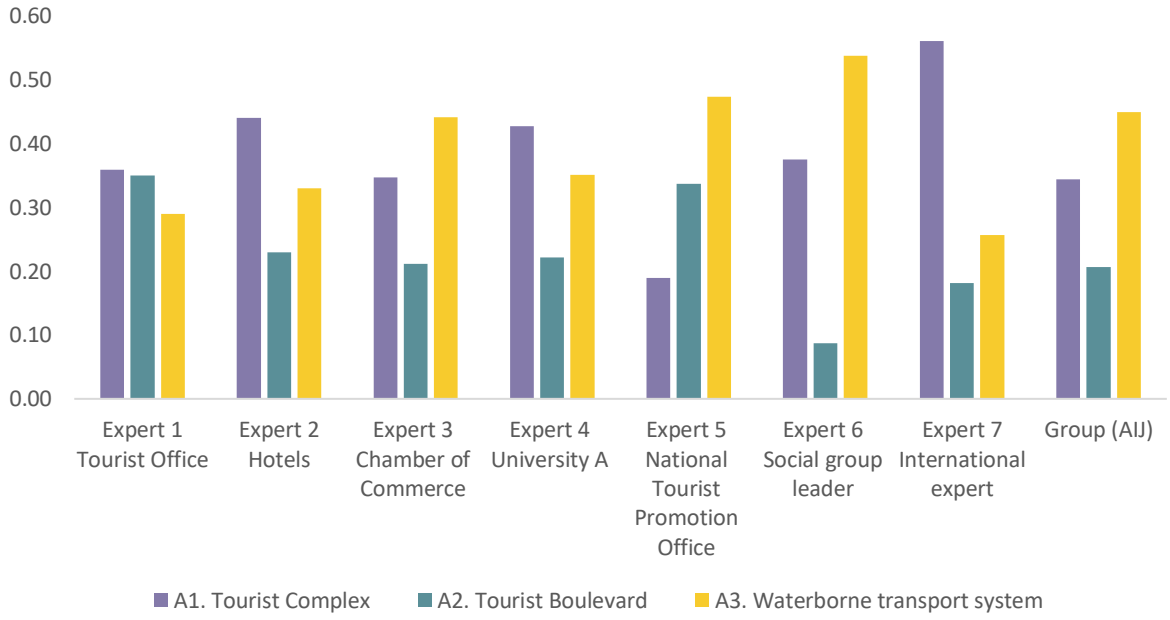


Figure 4.6 Results for the alternatives

4.6 Conclusions

We used SNA to identify and take account of the actors involved in or affected by the tourist sector in Cartagena de Indias (Colombia). Individual values were obtained through the centrality measures. The betweenness results allowed us to determine an individual value for the influence of each actor to involve the most influential stakeholders as decision-makers (experts).

The application of SNA also offered some insights into how consolidated the sector is. Some unexpected results came out. On the one hand, we found that some associations are less representative than expected, for example, the Colombian Association of Micro, Small and Medium Enterprises. Other actors such as The Nautical Association were not mentioned. On the other hand, it was also surprising that Tour Operator A (A24) was far more prominent than the other tour operators.

The variety of results obtained for the individual ranking of the alternatives shows the differences in perception and attitude among the stakeholders. In the final aggregated ranking *A3 Waterborne transport system* has the highest level of preference. The use of ANP encouraged participation.

The results obtained were presented to the experts. They all agreed that the prioritisation process carried out reduced the debates, controversy and contradictions typical in other types of decision making sessions. They also stressed that the tourist development plan that was finally selected would improve the city's attractiveness to tourists and would also provide an interesting mobility offer for inhabitants and tourists, thus promoting sustainable development in line with global trends.

The combination of SNA-ANP techniques for prioritisation of development plans allowed transparency and participation. This study thus sheds light on the issue of solving problems related to participative planning processes.

As future lines of development, we suggest integrating the SNA-ANP model with other tools such as GIS, to improve the decision- making process, in particular if GIS is used to present the impacts of the different solutions to stakeholders as specified in Marcucci et al. (2017). Finally, we suggest to the Cartagena Local Administration promote this participative approach

CHAPTER 5

Planning for pedestrians and redesigning walkable streets with a participatory multicriteria approach

This chapter is based on the papers:

Planning for Pedestrians with a Participatory Multicriteria Approach Stakeholder Hannia Gonzalez-Urango; Giuseppe Inturri; Michela Le Pira, Mónica García-Melón Journal of Urban Planning and Development, Forthcoming. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000585

Designing walkable streets in congested touristic cities: the case of Cartagena de Indias, Colombia Hannia Gonzalez-Urango, Michela Le Pira , Giuseppe Inturri, Matteo Ignaccolo, Mónica García-Melón. Transportation Research Procedia 45 (2020) pp. 309-316.https://doi.org/10.1016/j.trpro.2020.03.021

Abstract

The design of accessible walking paths needs to take into account the different stakeholders' preferences and factors affecting walking. It is a complex issue which policy-makers should deal with to foster sustainable mobility. A participatory multicriteria decision analysis approach is presented to help the planning and designing of pedestrian paths, based on a sound analysis of factors that influence walkability, pedestrians' perception and the attributes of the roads, and a stakeholder-driven evaluation of the same. A group of different stakeholders has been involved to select the criteria for redesigning pedestrian paths in the city centre of Cartagena de Indias (Colombia), which experiences serious problems of traffic congestion and accessibility. Some of the stakeholders have been selected based on the results of a Social Network Analysis (SNA) to be involved as key stakeholders for the evaluation of the selected criteria through Analytic Network Process (ANP). An index to measure the importance of each criterion in designing pedestrian paths has been obtained. A set of streets in the city centre has been evaluated, by combining the results of ANP with spatial data using Geographic Information Systems (GIS), producing thematic maps and an index of pedestrian priorities to derive a priority of intervention. Some streets have been redesigned with the aim of increasing their walking attractiveness. The results lay the foundations for discussion with local administrations and stakeholders to validate them and propose further applications of the methodology. The results provide valuable inputs to understand how to redesign and reconfigured streets for pedestrians in a city so as to improve walkability and foster a shift toward active and sustainable transport modes.

5.1 Introduction

Cities are continuously growing in population, raising several challenges related to their use of resources, and pointing to the need for them to adapt to emerging trends and to new dynamics of urbanisation "in an evolving landscape of change" (Hickman and Banister 2014). Urban transport systems need to be adapted to satisfy the needs of citizens, while reducing their negative externalities, the most severe being environmental and road damage, accidents, congestion, and oil dependence (Santos et al. 2010). Promoting a shift towards sustainable transport modes in cities should be considered as a priority by local administrations in order to limit the increase in motorisation and transport energy dependence, acknowledging their important contribution to total energy consumption (Fichera et al. 2018; Ignaccolo et al. 2016). In this respect, walking is among the most sustainable transport modes providing social, environmental and economic benefits (Caprì et al. 2016; Moura, Cambra, and Gonçalves 2017; Southworth 2005).

Walking is one of the basis of sustainable urban mobility, nevertheless, it has been in long-term decline, being considered as a secondary mode together with cycling (Tight et al. 2011). It is also a good way to attract visitors and tourists to cities, following the concept of 'transport as tourism', where the transport mode is the containing context for travel and a basis for the tourist experience, as opposed to the utilitarian theory of 'transport for tourism' (Page 2009).

It has been promoted via regional, national and local policies and projects for fostering better walking conditions and encouraging people to travel on foot, e.g. via several urban regeneration programs (Mayor of London 2005). In general, pedestrian-oriented policies should aim at increasing

walkability, defined as "the extent to which the built-up environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network" (Southworth 2005). Thus, the design of pedestrian paths and areas involves consideration of different technical, economic, environmental, and social factors (Sayyadi and Awasthi 2013).

Location planning and design of pedestrian zones has multifaceted aspects (Sayyadi and Awasthi 2013) that involve different stakeholders and multiple criteria, resulting in a multi-stakeholder multicriteria problem. Besides, barriers to the implementation of pedestrian-oriented policies can arise, e.g. in terms of opposition from residents and motorists, and local merchants (Parajuli and Pojani 2017). Understanding the factors that influence walkability and pedestrians' perceptions enables planners to build more walkable and liveable cities (Jabbari, Fonseca, and Ramos 2017). Research in urban environments and among different social groups is needed to understand which design factors are most effective in promoting walking (Southworth 2005). Therefore, these design factors should be a priority for local authorities.

This work intends to prove that a procedure based on a multicriteria decision making (MCDM) technique, i.e. Analytic Network Process (ANP), is appropriate to elicit stakeholder preferences and obtain a stakeholder-driven evaluation of the important issues for pedestrian paths in the city centre of Cartagena de Indias (Colombia). The problem is quite relevant, since it has been demonstrated that pedestrian facilities and policies, such as pedestrian malls, have met limited success outside of Europe (Parajuli and Pojani 2017).

Cartagena de Indias is a case in point, being a well-known international touristic destination with a vibrant historic centre with different characteristics that make it a vital point for the city. This area combines different formal and informal activities, such as commercial, educational and touristic ones. In terms of mobility, it is one of the most vulnerable areas. Pedestrians, vehicles, and formal and informal commerce interact in the same spaces daily.

The methodology proposed is therefore intended to support the local administration of the city in the redesign of walkable paths to improve pedestrian accessibility in the city centre, involving stakeholders in the definition of the important elements and characteristics of pedestrian paths. The paper adopts a case study strategy based on a participatory multicriteria technique. It combines two recognized techniques, Social Network Analysis (SNA) and Analytic Network Process (ANP), which allow decision-makers to achieve more transparent and traceable results. The research also attempts to build an index of pedestrian priority using a spatial analysis that takes into consideration the stakeholders' perspective and considering the context.

The SNA-ANP approach has been previously applied on issues related to the evaluation of projects and the definition of indicators (Gonzalez-Urango and García-Melón 2018). However, to the best of the authors' knowledge, it is the first time that this approach is considered for issues related to the planning of pedestrian paths or mobility. Unlike previous applications this case is novel in the way the model is developed. Due to the potential of the proposed approach, the development and results of this study provide valuable inputs for planning and implementing plans aiming to promote pedestrian mobility and spatial analysis involving stakeholders.

5.2 Conceptual Framework

5.2.1 Pedestrian mobility and pedestrian path design

The planning and designing of walking facilities is crucial for promoting a healthy public life, creating sustainable areas, enhancing social life and economy (R. Singh 2016). The literature review carried out by Tong et al.(2016) discusses the importance of walkability focusing on new urban development. In terms of research content, most of the studies consider different dimensions and approaches.

Several works have faced the problem of improving mobility in terms of pedestrian access using different approaches, to accessibility measurement based on infrastructure, activity or utility performances (Blečić, Cecchini, Congiu, et al. 2015; Talavera-Garcia and Soria-Lara 2015; Taleai and Taheri Amiri 2017). However, factors affecting walking differ according to many elements, such as pedestrian characteristics, walking purpose, urban context and other environmental and cultural aspects (Moura et al. 2017).

Many works were found in terms of walkability and how to assess it, but few of them in relation to the parameters of design of pedestrian paths. The main research methods include subjective perception (self-reporting and questionnaires), objective assessment (accelerometers, mathematical model, spatial analysis and geographic information system GIS), and some composite assessment tools (Tong et al. 2016).

Jan Gehl's work (Gehl 2010) presents details on how to design good cities for walking. But, in most of the cities, instead of designing new ones, spaces have to be redesigned to improve walkability. Several actions will be necessary in order to improve walkability. According to Southworth(2005), some of them are related to: the assessment of current walkability conditions; development of policies and plans for the total pedestrian environment; revision of standards and regulations to promote the walkable city; research on walking behaviour in varied urban environments; urban designers and transportation planners need to begin to work together in creative and experimental ways; involvement of the public through educational activities and participation in the planning process will be crucial; and finally, a new generation of transportation and urban planners, who see pedestrian access as a necessary and integral part of the total transportation environment, is needed.

Some authors also recognize the importance of tools which not only evaluate but also assist road design processes, beyond the problems of standard road networks, since this involves a 'thicker' and more multidimensional description of the urban environment and its actors (Blečić, Cecchini, and Trunfio 2015). In this respect, a multicriteria evaluation approach is needed to analyse the problem from different perspectives or points of view.

5.2.2 The multicriteria evaluation approach

To differentiate the importance of each criterion in the design process, a weighting process is required. There are many ways to calculate weights, and MCDM techniques are widely adopted. Several authors introduce the use of MCDM techniques (Barba-Romero and Pomerol 1997; Belton and Stewart 2002; Loken 2007). One of the most used methods is the so called Analytic Hierarchy

Process (AHP) by Saaty (1990), based on the creation of a problem hierarchy, and pairwise comparisons between criteria through the building of matrices to derive priority scales and weights.

AHP for mobility issues has been used e.g. to compare route alternatives in terms of different variable weights in (Kim et al. 2014), to find the best transport system among different alternatives (Ignaccolo et al. 2017), and to examine the interconnection between retail activity and non-motorised accessibility (Arranz-López et al. 2017). Applications related to pedestrian mobility also include some works related to locating pedestrian zones (Sayyadi and Awasthi 2013); ranking walkability performance metrics for prioritising pedestrian corridors (Oswald Beiler et al. 2015); understanding of environmental attributes, which encourage pedestrians to walk (or not) (Mateo-Babiano 2016); developing a GIS-based integrated approach to assess a pedestrian network by combining multi-criteria and network analysis based on space syntax (Jabbari et al. 2017); and developing a methodology based on the integration of geospatial information science, remote sensing and group multi-criteria analysis to assess the walkability of pathways in a city (Taleai and Taheri Amiri 2017).

In this case, authors propose a more evolved technique called Analytic Network Process (ANP). The ANP method, developed by Saaty (2001) to generalize his original AHP, provides a framework to address decision making or problem assessment. It allows for more complex, interdependent and feedback relationships between the elements (Sipahi and Timor 2010). In this respect, it defines the prioritisation model as a network, instead of as a hierarchy, composed of different elements, grouped into clusters and connected to each other. General information of the method can be found in Saaty (2001), Ligardo-Herrera et al (2018) and others.

So far, no ANP application to pedestrian problems has been found in literature. However, the use of ANP is considered more appropriate in this field, since the complexity of the urban environments makes criteria for pedestrian paths highly correlated. Besides, multiple actors can have different views and express heterogeneous preferences related to pedestrian mobility. Addressing stakeholder needs and taking into account different perspectives is important when designing spaces capable of promoting a potential shift toward walking, avoiding potential opposition to the rehabilitation of urban areas. The important criteria to design walkable streets can be defined together with stakeholders and evaluated using ANP in order to ascertain their importance.

5.2.3 Participatory approach and stakeholders' analysis

Public participation in transport decision making and planning processes is considered fundamental to foster decisions that are technically consistent, while maximizing stakeholder consensus and acceptability of the proposed solutions (Le Pira 2018). The involvement of citizens, stakeholders and policy-makers should be guaranteed throughout the planning process, with appropriate methods and tools according to the specific decision making context and the desired level of involvement (Cascetta et al. 2015).

Planning and designing with stakeholders means involving them from the beginning of decision making up to the final decision via a transparent process (Cascetta et al. 2015). In this respect, transport policies should be the results of technical evaluations and consensus building (Le Pira 2018). Identifying stakeholders is the first important step. Interviews with them can help to set up the state

of the art and provide relevant information about the important elements to consider. Besides, given the variety of stakeholders and interest and the difficulty to involve a large number of them in the evaluation process, it becomes important to perform appropriate *ex-ante* stakeholder analysis to have a clear insight regarding them (Le Pira et al. 2018).

However, in recent years, few studies have dealt with the involvement of stakeholders and decision-makers in the planning process of pedestrian mobility. In this respect, Moura et al. (2017) propose a participatory walkability assessment framework for distinct pedestrian groups and trip purposes. Taleai and Amiri (2017) develop a participation process in which 'experts' and 'non-experts' are asked to rate criteria based on their importance in terms of encouraging people to walk. The European Union Pedestrian Quality Needs Project (2010) encourages cooperation and dialogue with stakeholders outside government/administration.

Understanding who are the relevant stakeholders that need to be involved is one of the most challenging phases of a participation process. It is desirable to use tools that can help to identify and select stakeholders. In this respect, the 'snowballing' technique aims at identifying stakeholders starting from a small number of people that are asked to nominate others; the nominees are in turn asked for further nominations and the network builds up like a snowball (Scott 2013). Besides, in recent years, techniques belonging to Social Network Analysis (SNA) (Wasserman and Faust 2007) have been used to study the social importance of a given individual in a network via centrality indexes, and to understand potential problems due to topology (Scott 2013). It allows us to determine the individual value of the influence of each actor in a group of stakeholders based on graph theory. Through SNA, one can analyse interactions and flows of information in a network. The 'position' of a participant in the network (centrality) is the most commonly used index to analyse his/her influence (Ahmedi et al. 2017).General information regarding stakeholder involvement can be found in Glicken (2000) and a detailed description of SNA can be found in Wasserman and Faust (2007), Reed et al. (2009), and Gonzalez-Urango and García-Melón (2018).

5.2.4 Spatial Analysis

Spatial data are needed to evaluate streets according to the chosen criteria and define a priority of intervention. Nowadays, with the diffusion of new technology, open data, e.g. Volunteered Geographic Information (VGI), their acquisition becomes easier and they can be managed and analysed via GIS-based software. By combining the results of ANP with spatial data, i.e. by selecting the most weighted criteria from ANP and assessing them via appropriate measurement scales and data sources, it is possible to produce thematic maps and an overall index of pedestrian priority. This would allow us to choose some streets to be redesigned so as to become more pedestrian-friendly. The results of this analysis and design process should be discussed with policy-makers and stakeholders for their validation. Some previous works combining multicriteria approach and spatial analysis are presented in (Ferretti 2011; Pourebrahim et al. 2011; Talavera-Garcia and Soria-Lara 2015).

5.3 Research Methods

The proposed participatory multicriteria approach is arranged in three main stages (Figure 5.1).

- *Understanding the context of the problem.* The problem is analysed by defining the objective to be achieved. This could derive from specific needs expressed by local administration, users, or from programs and planning documents currently in force. The case study is then designed.

- *Involving stakeholders.* Following the approach proposed by Bryson (2004), Prell et al. (2009), Saint Ville et al. (2017) and Yang (Yang 2014) a list of stakeholders is interviewed to assess the relationships among them and to define the final list of criteria to be assessed through the ANP model. The main aim of this stage is to determine stakeholders' centrality measures through SNA in order to analyse their influence and select some key stakeholders. They are analysed with UCINET© software (Borgatti, Everett, and Freeman 2002).

- *Evaluation of criteria for designing pedestrian paths through ANP*. In the ANP model, according to (Saaty 2001), a problem is represented as a network composed of decision elements, i.e. criteria and alternatives, grouped in clusters and connected by influences among them. In this case, criteria express quantitative and qualitative characteristics or attributes that should be evaluated in the existing road network. We develop the ANP model at the criteria level by evaluating criteria that should be defined before considering some streets as pedestrians.
  The selection and evaluation of criteria for designing pedestrian paths is solved following the ANP procedure (Saaty 2001):
  1. *Establishing the elements*: the ANP elements are the criteria for pedestrian paths. To define them, three steps are developed in this study: (1) document analysis, (2) revision by experts and (3) by stakeholders. Following the method proposed by Liao et al. (2011) and others.
  2. *Developing the evaluation problem as a network model*: experts establish the structure of the ANP model by determining influences among criteria.
  3. *Application of the ANP model*: once the model is agreed upon, the ANP questionnaire with the required judgements based on pairwise comparisons is designed and sent to key stakeholders, selected via SNA. The obtained results are analysed with the help of Superdecision© v.2.0.8. Software (https://www.superdecisions.com/), which is widely used to support the resolution of ANP/AHP problems. A prioritisation result for each individual stakeholder is obtained according to his/her judgments. In order to obtain a global judgement, individual judgements' aggregation via AIJ (Saaty and Peniwati 2008) is performed using the geometric mean for all the stakeholders. Priorities obtained for each criterion can be considered their 'Importance Index', so the higher this index value, the more important the criterion will be.

- *Spatial planning.* Criteria with the higher 'Importance Index' were selected. Open data and maps from OpenStreetMap© (https://www.openstreetmap.org) and Google© (https://www.drivingdirectionsandmaps.com) were used to assign scores to each link of the

road network in the city centre. Thematic maps for each criterion were produced and an overall pedestrian priority index (PPI) was calculated combining scores for each criterion with the normalized weights derived from ANP. A map with the overall (PPI) was produced. Streets with the maximum PPI values need to be intervened more urgently. Finally, one street was redesigned to increase its walking attractiveness. General results support an adequate scheduling of interventions. Local administrations could select a set of priority streets in the city centre to be considered as pedestrian and redesigned.

A detailed description of the approach implementation is presented in the case study in the following sections.

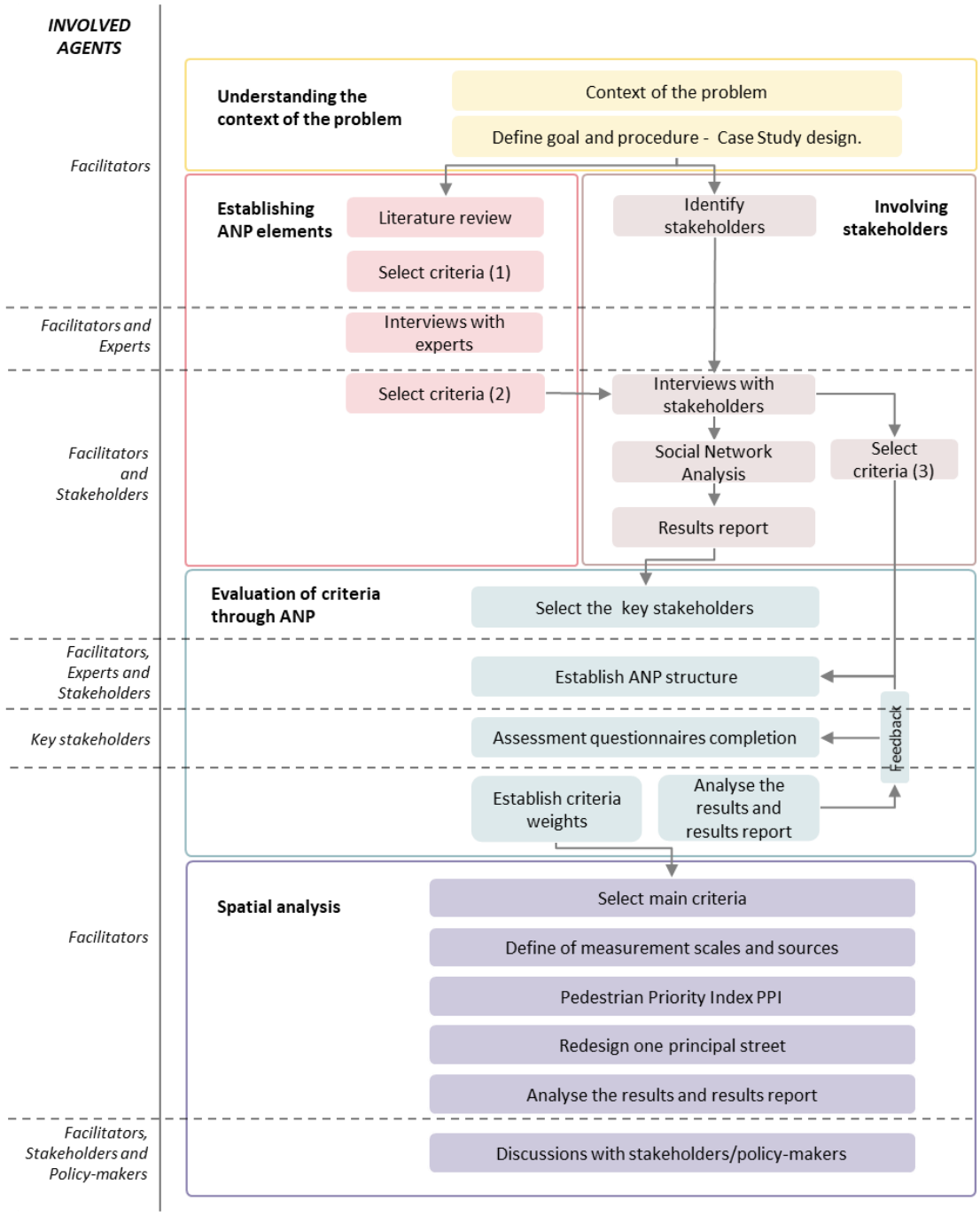


Figure 5.1 Methodology proposed

The next table shows the different types of agents that were contacted by the facilitators during the above stages, the number involved and the rate of answers.

Table 5.1 Involved agents

Agents	Stage	Identified	Contacted	Replied	Comments
Stakeholders	SNA and Rating criteria	29 actors	34 actors	28	------
Experts	ANP – Establish structure	5 people	5 people	4	Two experts on transport planning and mobility Two researchers on public policies.
Key stakeholders	ANP – Assessments questionnaires	12 actors	12 people	7	The most influential actors presented in Section 5.4.3

5.4 Case Study: Defining Criteria for Pedestrian Paths in The City Centre of Cartagena de Indias

5.4.1 The context

Cartagena de Indias is located on the northern coast of Colombia (Figure 5.2.A). It is the fifth-largest city in the country with more than 1 million inhabitants (National Administrative Department of Statistics DANE, https://www.dane.gov.co/). It is one of the most important tourist destinations in the Caribbean, recognized by its natural attractions and its historical heritage.

The city stands out in different tourist segments due to its historical heritage; the most important one is the city centre. It has different attractions that make it a vital point for the city with different actors and perceptions. The historical centre of the city was chosen as a testbed for spatial analysis. It consists of an area of about 0,5 km^2 characterized by a grid-like street network with many narrow streets (Figure 5.2.C). The area is developed as a shared space for vehicles, pedestrians and street-sellers due to the presence of many touristic attractions and several services (e.g. University), thus resulting in a congested zone with plenty of users where pedestrians are the least safe.

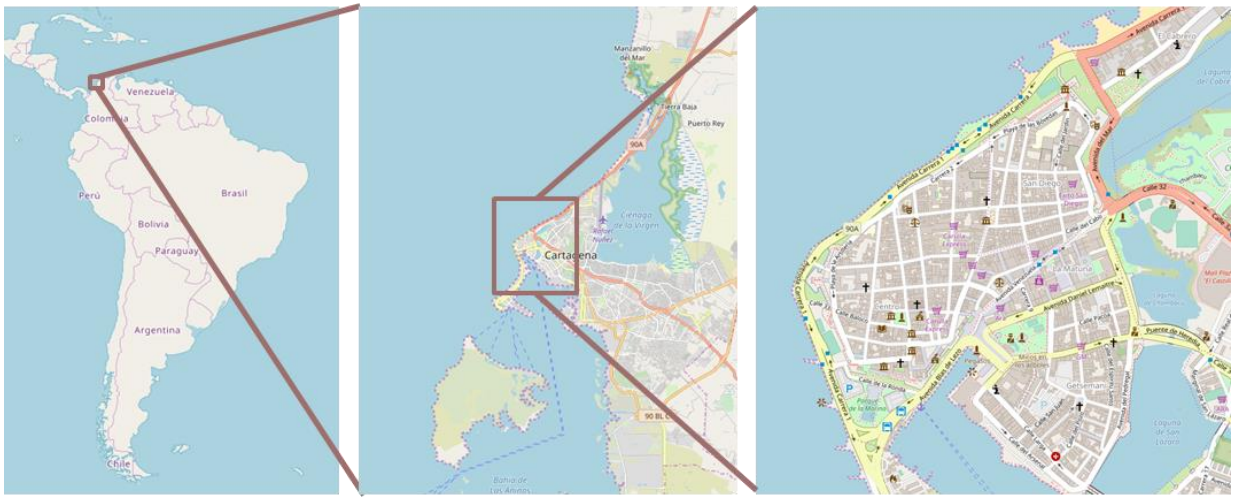


Figure 5.2 Location of: (A) Cartagena de Indias in Colombia; (B) the city; and (C) the area of study. OpenStreetMap©.

Mobility in Cartagena is mainly focused on motor vehicles. Since 2008 the numbers of motor vehicles registered in the city have increased year by year, mainly motorcycles and cars (Cartagena Cómo Vamos 2018). The city has only two main avenues, where a massive transport system has been operating since 2016. Hence some illegal services have arisen in response to the lack of alternatives for mobility.

As a part of an intervention in the city centre, the Local Administration has proposed different plans and alternatives to improve mobility and rehabilitate spaces to make them available for locals and tourists (Local Tourism Plan 2016-2019), i.e.:

i. Enhancing and redesigning of different pedestrian paths through the main historic and tourist places around the city centre;
ii. better distribution of the traffic of vehicles and persons on the streets; and
iii. safe-sharing of public spaces among the different traffic components, thus improving the liveability among citizens and tourists.

However, these planning processes are under the pressure of stakeholders belonging to public and private sectors, but, mainly, of citizens, who demand actions that generate incomes and wellbeing. Including an active participation of citizens and stakeholders from the beginning of any transport decision making process is a precondition in order to avoid the failure of a project as a consequence of a lack of consensus (Le Pira et al. 2017).

In recent years, the Local Administration has been implementing some restrictions in the area. Traffic is restricted during certain seasons or hours of the day. However, the conditions for these measures are irregular, the hours and the restricted streets are always changing. Citizens, businesses and transports complain about those measures even though they recognize measures for pedestrians are necessary. Pedestrians are still the most vulnerable. They daily interact in the same spaces with vehicles, and formal and informal commerce. Pedestrian spaces are also badly used and occupied by other types of users (Figure 5.3). According to the stakeholders that were involved in the study, pedestrianizing some streets is necessary and viable, but should be permanent with long-term investments.

(A) Calle de la Moneda

(B) Calle del Quero

(C) Calle Santo Domingo

(D) Calle del Pilar

Figure 5.3 Examples of scarcely used and badly maintained streets. (Images by the author)

The city centre streets are similar in terms of some geometric and infrastructure features (Figure 5.4). Also, the city centre is a UNESCO World Heritage Site. Thus, it is more difficult to retrofit built-up areas because the patterns are already established. While it is not impossible to modify existing street networks to serve pedestrians and to insert some density and mixed uses, it will require imagination and persistence (Southworth 2005). Preserving the identity of places while providing an appropriate new use of the spaces (Galdini 2019).

(A) Calle de las Bovedas

(B) Calle Antonio Ricaurte

Figure 5.4 Examples of city centre streets. (Images by the author)

5.4.2 Involving stakeholders

The first step was the identification of stakeholders. An initial list was defined with the assistance of the Local Administration, and then the 'snowball technique' was used to complete it. A total amount of 28 actors were identified among public administration, academia, civil society, private sector, and informal commerce. We collected their opinions to obtain their perceptions of the problem, establish

the most important criteria for designing pedestrian paths in the area (next section) and build the networks.

The model is based on the analysis of information exchanged and mobility projects developed among stakeholders. The flow of information can be used to establish links between two nodes in a social network (Hanneman and Riddle 2005). A questionnaire to find out the amount of information exchanged and whether they have ever worked or developed a mobility project together was collected during the interviews (Table 5.2 and Appendix D.1).

Table 5.2 Example of the questionnaire

Stakeholder	Regarding mobility in the city Centre, with whom of the following actors have you exchanged information? How often? Daily, weekly, monthly…	Have you ever worked or developed a project together related to mobility issues?
City Centre Administration		
Local Council		
Local Authority of Transit and Transportation		
…		

The information gathered was scaled in the following way:

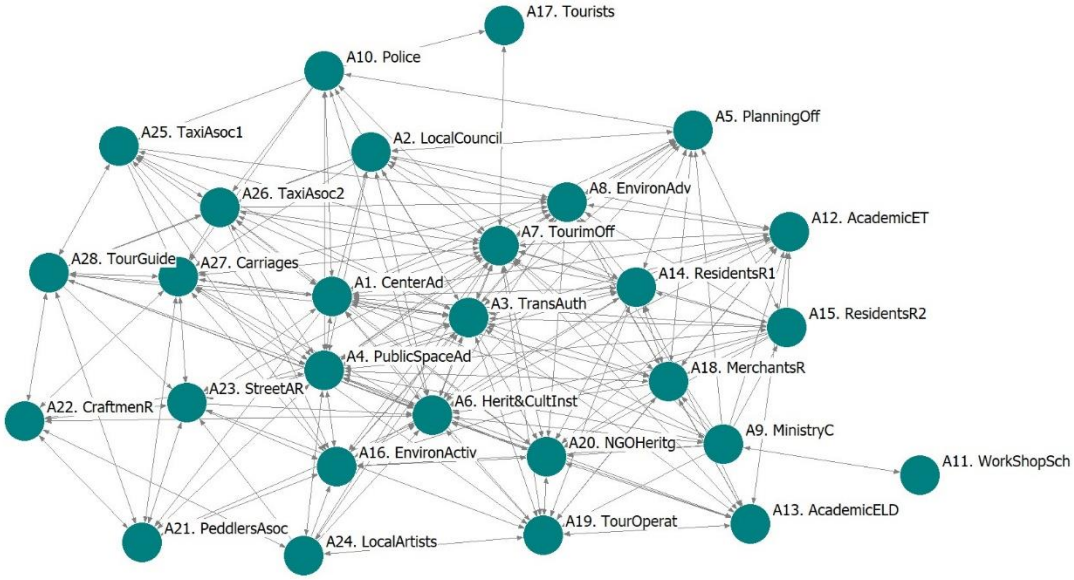
- Regarding information exchange: 0 indicates no information exchange, 1 means an exchange at least every 3 months, and 2 means that information exchange occurs more frequently.
- Regarding mobility projects: 0 indicates never and 1 means at least once during the last 2 years.

The 28 stakeholders analysed allowed us to construct two social networks, one for the exchange of information and the other for mobility projects. Each stakeholder is represented by a node. The most central actors in the networks are considered those who have more access or control over the information within the network or those who are the most active brokers (Wasserman and Faust 2007). Centrality indices were calculated in order to reflect which actors are the most central ones (Table 5.3). The nodes´ betweenness centrality (Prell et al. 2009; Yang 2014) was chosen as the most appropriate SNA indicator to assess the relevance of the stakeholders. It measures the number of shortest paths that each actor passes through, thus allowing us to understand who are the actors that can facilitate a dialogue, acting as a 'bridge' among distant actors (Hanneman and Riddle 2005; Wasserman and Faust 2007). A graphical representation of the whole information exchange network is shown in Figure 5.5 using the results of betweenness centrality.

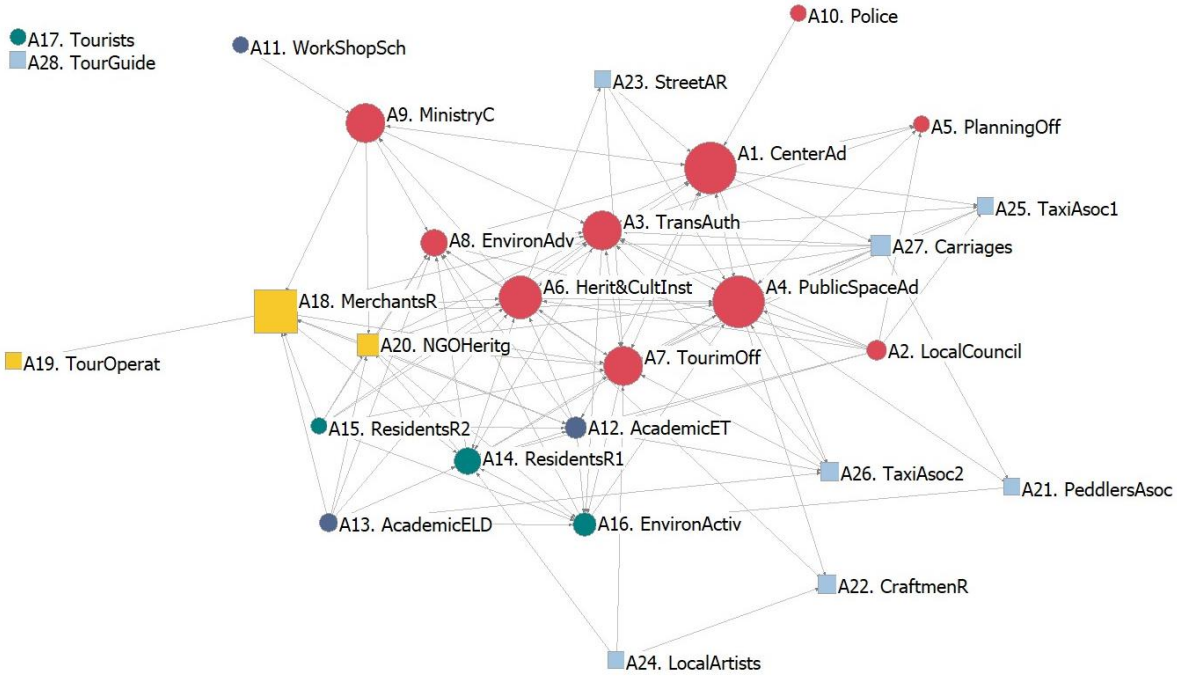
Table 5.3 List of stakeholders and multiple centrality measures

Stakeholder	ID	Group		Information Betweenness	Projects Betweenness
City Centre Administration	A1. CentreAd	Public administration	Public	55.53	86.75
Local Council	A2. LocalCouncil	Public administration	Public	3.13	0.00
Local Authority of Transit and Transportation	A3. TransAuth	Public administration	Public	48.65	94.45

Stakeholder	ID	Group		Information Betweenness	Projects Betweenness
Local Public Space Administration Office	A4. PublicSpaceAd	Public administration	Public	80.85	60.34
Local Planning Office	A5. PlanningOff	Public administration	Public	5.23	0.00
Local Institute of Heritage and Culture	A6. Herit&CultInst	Public administration	Public	66.85	62.66
Local Tourism Office	A7. TourimOff	Public administration	Public	77.77	33.62
Environmental advisor	A8. EnvironAdv	Public administration	Public	10.55	2.16
The Ministry of Culture	A9. MinistryC	Public administration	Public	52.72	44.51
Police	A10. Police	Public administration	Public	4.49	0.00
The Workshop School of Cartagena	A11. WorkShopSch	Academia	Public	0.00	0.00
Academic expert in transportation	A12. AcademicET	Academia	Public	2.87	13.34
Academic expert in local development	A13. AcademicELD	Academia	Public	1.53	0.00
Residents representative 1	A14. ResidentsR1	Civil society	Public	9.83	29.88
Residents representative 2	A15. ResidentsR2	Civil society	Public	0.74	6.73
Environmental activist	A16. EnvironActiv	Civil society	Public	5.88	42.66
Tourists	A17. Tourists	Civil society	Public	0.00	0.00
Local Merchant Representative	A18. MerchantsR	Private Sector	Private	3.01	33.94
Tour Operator	A19. TourOperat	Private Sector	Private	13.71	0.00
NGO on heritage conservation	A20. NGOHeritg	Private Sector	Private	8.63	17.05
Association of peddlers of Cartagena	A21. PeddlersAsoc	Informal	Private	1.25	1.33
Craftsmen/Informal seller representative	A22. CraftmenR	Informal	Private	2.89	0.00
Street artist representative	A23. StreetAR	Informal	Private	5.39	0.00
Local artist representative	A24. LocalArtists	Informal	Private	1.86	0.00
Taxi driver association 1	A25. TaxiAsoc1	Informal	Private	1.70	0.25
Taxi driver association 2	A26. TaxiAsoc2	Informal	Private	2.66	1.75
Coachmen representative Carriages	A27. Carriages	Informal	Private	15.09	1.52
Tour guide	A28. TourGuide	Informal	Private	9.06	0.00



(A) network related to information exchange



B) network related to mobility projects. Obtained by UCINET software©.

Figure 5.5 Graphs showing the social network of stakeholders — according to betweenness.
** Shapes: circle (public) and square (private)*
***Colours: red (public administration), purple (academia), green (civil society), yellow (private sector), and blue (informal)*

The analysis of the networks as a whole shows that network 5A is denser than network 5B. Some actors are data sources and information sinks. It means that they are useful for gathering and receiving information related to mobility, but they have never been considered for mobility projects. In order to select the actors that would likely have a major role regarding mobility issues, the authors decided to focus on network 5B.

In the networks for mobility projects (5B), only a few actors are linked by more than one connection, which denotes bad communication within the network. There are few connections among private actors while there are many among the public ones. Depending on the group to which they belong, public administration is the best connected one, civil society and private sector have few connections, and academia and the informal are disconnected. Local administration is the main broker in the network.

In Figure 5B the bigger the size of the geometric figure, the higher the betweenness centrality, which means a higher influence of the actor within the network. They are the actors who would have more control on the network, because more information would pass through them (Yamaki 2017). High betweenness centrality grants the actor the ability to influence the flow of resources between others, and it also provides him/her with a diversity of resources provided by the bridging tie (Bodin and Crona 2009). According to this measure, the most influential actors form a preliminary list of key stakeholders for the ANP process. Most of them belong to Public Administration. Since decision making regarding local development projects requires different points of view and opinions (Bodin et al. 2006; Newman and Dale 2007), it may be beneficial to increase the diversity of stakeholders involved, making the group more resilient and adaptive to changes (Bodin et al. 2006; Prell et al. 2009). Therefore, for the next phase of the study, the authors decided to include two more actors who were not among the most central ones, but nevertheless they knew the problem very well. More information about the stakeholders selected is presented in section '*Application of ANP*'.

5.4.3 Evaluation of criteria for designing pedestrian paths through ANP

Establishing the elements: criteria

Three steps were developed to define the criteria: document analysis, revision by experts and by stakeholders.

Document analysis was based on a literature search with the following keywords: "pedestrian accessibility", "walkability", "urban planning" and similar terms focused on the "decision making" and "design process". There is abundant literature on pedestrian mobility, but it is mainly devoted to encouraging pedestrian mobility and assessing pedestrian levels of service. After studying the first findings, initial keywords and equations were reviewed yielding the ones included in Table 5.4.

Table 5.4 Outcomes of the literature review

No.	Equation Query	Results	Comments
1	"pedestrian zones" OR "pedestrian routes" OR "pedestrian way" OR "pedestrian facilities" AND design	103	Analysed by ToS* tool
2	"pedestrian zones" OR "pedestrian routes" OR "pedestrian way" OR "pedestrian facilities" AND design AND Decision making	6	--
3	"pedestrian zones" OR "pedestrian routes" OR "pedestrian way" OR "pedestrian facilities" AND decision making	15	--
4	walkability AND design AND path	26	All related literature developed in recent years from 2005 onwards
	Total without unrelated and duplicates	**35**	

*Tree of Science ToS is a free web based tool for science articles selection. Robledo et al. 2014.

In the end, the document analysis comprised a definitive set of 35 papers and 12 reports and guidelines. They were read in full and analysed guided by the question: Which criteria were considered? A list of 30 criteria categorized in 5 groups was defined.

An in-depth discussion with experts on transport planning and mobility followed this literature review in order to reduce the initial list of criteria and the complexity of the decision making model. The initial list was reduced to 22 criteria grouped in 5 clusters.

The next step was to present the selected criteria to stakeholders in order to obtain a more comprehensive and understandable model and to adapt it to the case study. All the stakeholders considered in section 5.4.2 were asked to evaluate the corresponding criteria. Each criterion was evaluated according to its importance via a scale from "Not at all" (0) to "Extreme" (4) (Table 5.5 and Appendix D.1).

Table 5.5 Rating scale

Criteria		Definitions	Rate				
			Not at all	Moderate	Medium	High	Extreme
1. Connectivity	1. Presence of public transport	Access to public transport e.g. bus, taxi.	0	1	2	3	4
	2. Access to final destination	Evaluate the accessibility to a final destination in a route. In terms of presence of destinations e.g. shops, workplaces, etc. and elements that facilitate the access to them.	0	1	2	3	4
	…		0	1	2	3	4

According to (Chang 2013; Soleimani and Valmohammadi 2017; Tavana et al. 2016) a cut-off value based on the geometrical mean was used to determine the most important criteria. 13 criteria grouped in four clusters were selected for the ANP Model (Table 5.6). Some criteria such as Land use diversity, Infrastructure, Physical features, Quality features, Path quality, Technical features, Amenities, Universal design and Climate protection are widely used in literature. However, they are excluded from the model, maybe because of the specific conditions of the case study where there are no major differences among streets in the City Centre. In this respect, they show very similar physical conditions and features, and land use.

A total amount of 4 clusters and 13 criteria were chosen for the prioritisation model.

Table 5.6 Clusters and criteria

Cluster	Definition	Criteria		Mean	Definition	References
1. Connectivity	It refers to the connection between areas and with key 'attractors' such as public transport stops, schools, work, and leisure destinations. Routes should form a comprehensive network.	C1.1	1. Presence of public transport	3.51	Access to public transport e.g. bus, taxi	Aghaabbasi et al., 2017; Cambra, 2012; Cervero et al., 2009; Jabbari et al., 2017; Mateo-Babiano, 2016; Sayyadi and Awasthi, 2013; Southworth, 2005; Taleai and Taheri Amiri, 2017; Pedestrian Environment Review System PERS software; Walk Europe Project.
		C1.2	2. Access to final destination	3.78	Evaluate the accessibility to a final destination in a route. In terms of presence of destinations e.g. shops, workplaces, etc. and elements that facilitate the access to them	
		C1.3	3. Street connectivity	3.41	Related to the presence of intersections in a route e.g. presence of alternative routes, connection among paths	Aghaabbasi et al., 2017; Bentley et al., 2010; Cambra, 2012; Cervero et al., 2009; Mateo-Babiano, 2016; Moura et al., 2017; Nuworsoo and Cooper, 2013; Sayyadi and Awasthi, 2013; Singh and Keitsch, 2016; Sisiopiku et al., 2007; Southworth, 2005; Talavera-Garcia and Soria-Lara, 2015; Taleai and Taheri Amiri, 2017; PERS, Walkscore; Walkshed; Walk Europe Project
		C1.4	4. Pathway continuity	3.46	Absence of interruptions or physical elements that force a change of route	
		C1.5	5. Path directness	3.46	Between two nodes, evaluate the difference between shortest route and designed one	
2. Urban function	It refers to the different uses that the inhabitants develop in the territory. Determine the purpose or role of a space and therefore the usability of a territory.	C2.1	6. Parking areas	3.62	Proximity to or presence of parking areas	Lotfi and Koohsari 2011; Sayyadi and Awasthi 2013
		C2.2	7. Cultural elements	4.17	Presence of cultural elements or social points	Mateo-Babiano, 2016; Moura et al., 2017; Nuworsoo and Cooper, 2013; Singh, 2016; Cedex Centro de Estudios y Experimentation de Obras Públicas; Montgomery County's PBEF Pedestrian and Bicycle Environmental Factor; Walk Europe Project
		C2.3	8. Street vitality	3.35	The liveliness that a space can transmit e.g. Areas available for street vendors, bazaars, etc.	

Cluster	Definition	Criteria		Mean	Definition	References
3. Route attributes	Elements in the routes and their context related to urban design and performance.	C3.1	9. Path performance	4.03	Characteristics and performance measures of streets or routes, related to volumes, densities, effective spaces, etc.	Cervero et al. 2009; Huff Herbie and Liggett 2014; Kadali and Vedagiri 2016; Kalakou and Moura 2014; Monteiro and Odete 2015; Oswald Beiler et al. 2015; Rahman et al. 2013; Sayyadi and Awasthi 2013; Sisiopiku et al. 2007
		C3.2	10. Street traffic	3.67	Vehicular traffic conditions	Cambra, 2012; Guo and Loo, 2013; Kadali and Vedagiri, 2016; Moura et al., 2017; Park et al., 2017; Sayyadi and Awasthi, 2013; Talavera-Garcia and Soria-Lara, 2015
4. Comfort	Elements that affect performance, behaviour and perceptions of a path.	C4.1	11. Aesthetic	3.61	Related to the enjoyment or the perception of a nice and beautiful environment e.g. maintenance, cleanliness, attractiveness from an architectural and urban point of view, transparency and permeability of the public-private space, etc.	Aghaabbasi et al., 2017; Bentley et al., 2010; Blečić et al., 2015; Cambra, 2012; Gant, 1997; Guo and Loo, 2013; Jabbari et al., 2017; Moura et al., 2017; Sahani and Bhuyan, 2013; Singh, 2016; Walkanomics; Walk Europe Project;
		C4.2	12. Feeling/ Perception	3.38	Attributes that generate less stress or a nice feeling of being relaxed e.g. pollution, quality of path, noise and construction, path enclosure, etc. Reflect attributes that could protect pedestrians from climate conditions	Aghaabbasi et al., 2017; Cambra, 2012; Guo and Loo, 2013; Kadali and Vedagiri, 2016; Kalakou and Moura, 2014; Mateo-Babiano, 2016; Mayor of London, 2005; Moura et al., 2017; Sahelgozin et al., 2015; Sayyadi and Awasthi, 2013; Singh, 2016; Sisiopiku et al., 2007; Southworth, 2005; Tong et al., 2016; Zegeer and Bushell, 2012; Walkanomics; Walk Europe Project.
		C4.3	13. Personal Security	3.47	Evaluate the state of being and feel safe from harm or danger	Aghaabbasi et al., 2018; Bentley et al., 2010; Guo and Loo, 2013; Mateo-Babiano, 2016; Moura et al., 2017; Sahelgozin et al., 2015; Sisiopiku et al., 2007; Southworth, 2005; Cedex, Walkanomics; Walk Europe Project

The evaluation problem as a network model

Influences among criteria were determined using a relationship matrix (Appendix D.3). This procedure was carried out during face-to-face meetings with experts in transport planning and mobility. The proposed network model is shown in Figure 5.6.

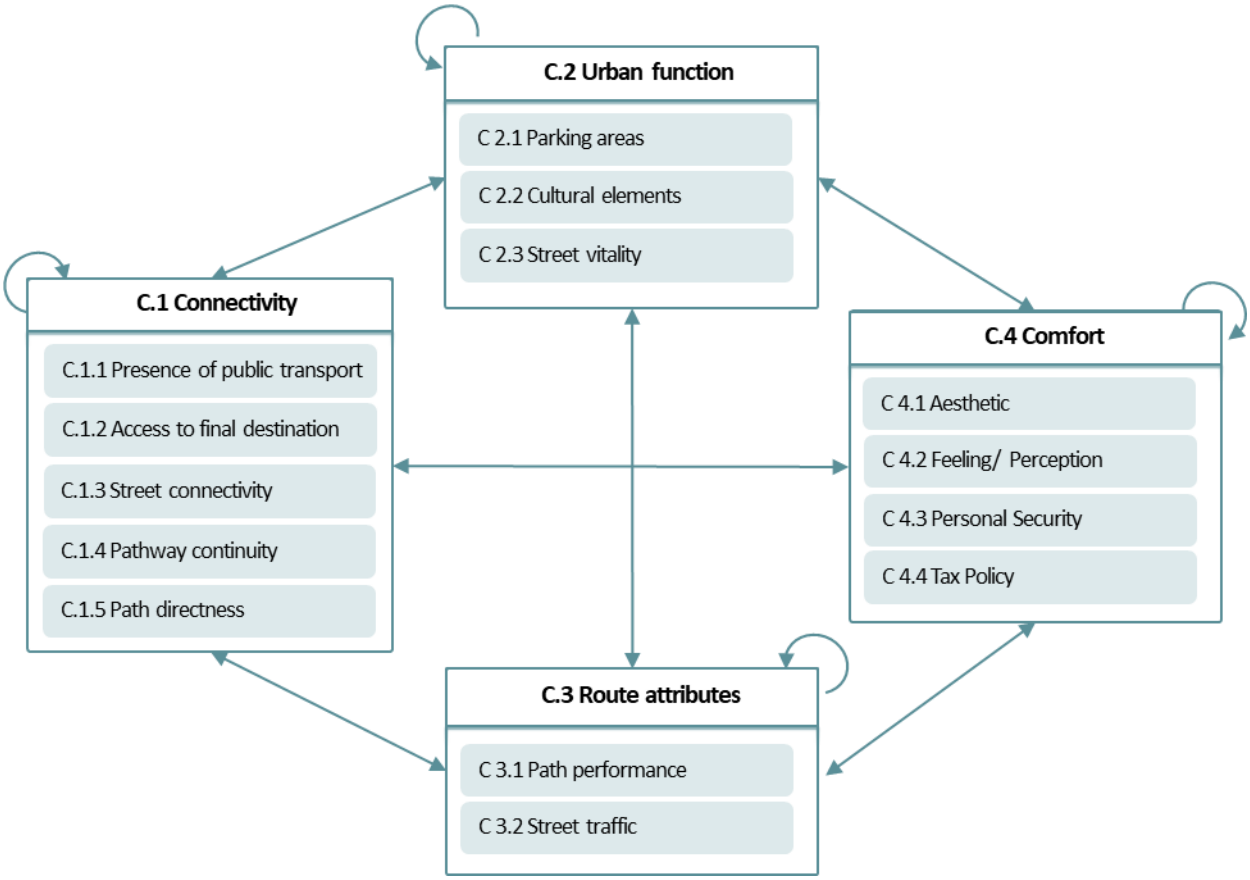


Figure 5.6 ANP network model of the case study

Application of ANP

This step was carried out with the collaboration of the seven key stakeholders (KS). Selected according to the results of the SNA and who demonstrated willingness to collaborate in this process. Five of the most influential ones:

- KS 1. Local Authority of Transit and Transportation,
- KS 2. City Centre Administration,
- KS 3. Local Public Space Administration Office,
- KS4. The Ministry of Culture,
- KS 5. Local Merchants.

And two among the non-central

- KS 6. Academic, and
- KS 7. Citizens.

Once experts and KS agreed upon the model, the ANP questionnaire was designed and sent to the KS with the aim of determining an importance index for each criterion (Figure 5.7 and Appendix D.2).

In your opinion, which of the two criteria has more influence on criterion ***1. Presence of Public Transport***?

	Extreme	Very Strong	Strong	Moderate	Equal	Moderate	Strong	Very Strong	Extreme	
C2 Access to destination	9	7	5	3	1	3	x	7	9	C3. Street connectivity

The answer in this example means that: With respect to ***C1. Presence of Public Transport, C3. Street connectivity*** influences **strongly (5) more** than ***C2 Access to destination***.

Figure 5.7 Example of a question used for the ANP questionnaire

Since a total of seven KS were interviewed, seven individual results were obtained. Aggregation of individual judgments (AIJ) was performed using the geometric mean to obtain a global judgment (Saaty 2001). The results were treatment with Superdecision© v.2.0.8. software during the interviews in order to ensure that all pairwise comparison matrices had a consistency ratio (CR) of less than 10% (Saaty 2001). The final limit matrix shows the priority obtained for each criterion, a nondimensional value that can be considered the relative importance of each one (Appendix D.3).

The next step in the case study was to consider the definition of measurement scales for the most important criteria for a spatial analysis (weighted evaluation), and then one street was reconfigured.

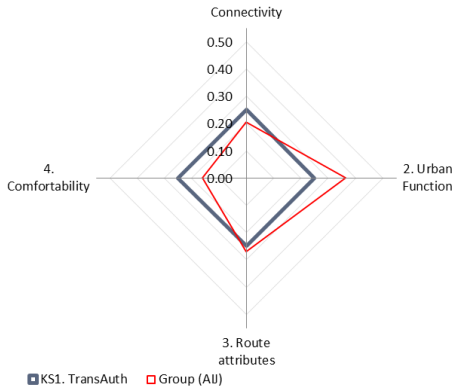
5.5 Results and Discussion

5.5.1 Results Obtained for the clusters

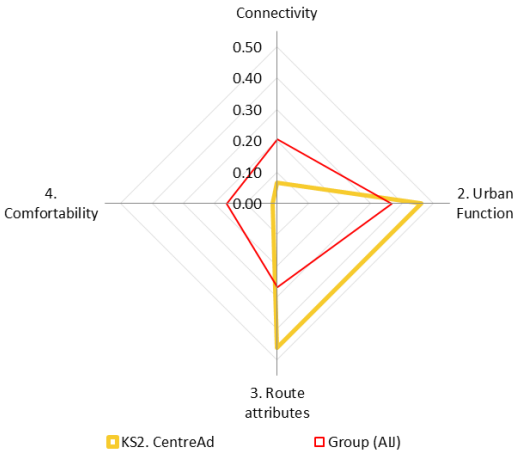
At the global level, the Urban Function cluster (C2) is the most valued one, followed by Route attributes (C3) and Connectivity (C1). Comfort (C4) cluster is less valued. Results are quite different for each KS. Therefore, it is worthwhile analysing their individual results (Figure 5.8 and Table 5.7). The cluster weighting provides important insights into the overall attitude and underlying participants' conception of what aspects are the most important for improving pedestrian accessibility in the city centre of Cartagena. In general, KS present results in line with the profile they represent:

- KS 1. Transport Authority: Is the most balanced profile. It gives equal importance to all clusters.
- KS 2. Centre Administration: Is more concerned with the different uses and elements in the routes (C2. Urban Function and C3. Route attributes).
- KS 3. Public Space Administration: In addition to the previous two (C2. Urban Function and 3. Route attributes), gives high importance to C1. Connectivity.
- KS 4. Ministry of Culture: Gives the highest importance to the elements that affect performance, behaviour and perceptions of a path (C4. Comfort), and the lowest importance to Urban Function (C2) and Connectivity (C1) aspects.

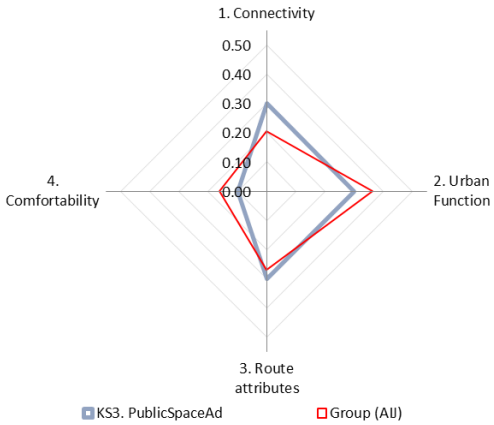
- KS 5. Merchant: Gives the highest importance to the different uses of the territory (C2. Urban Function) and very little to the comfort aspects (C4).
- KS 6. Academic: Recognizes the importance of Comfort (C4) and the Urban functions (C2). KS 7. Citizen: Values more the Connectivity (C1) and the function of the territory (C2).



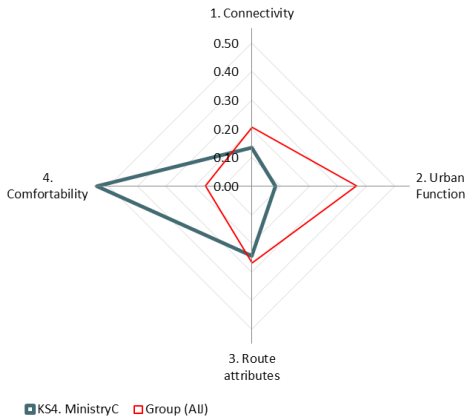
KS 1. Tranp. Auth



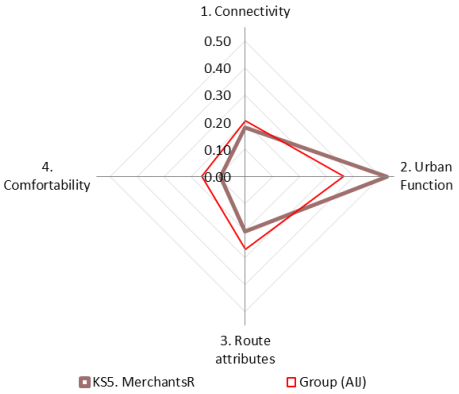
KS 2. Centre Ad



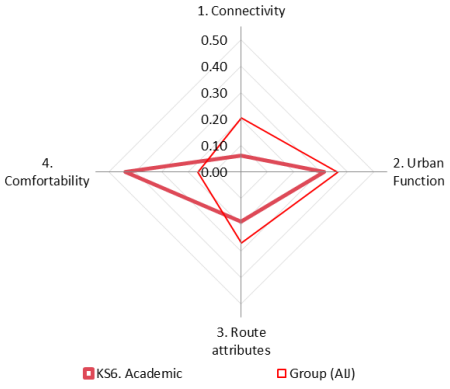
KS 3. Public Space Ad



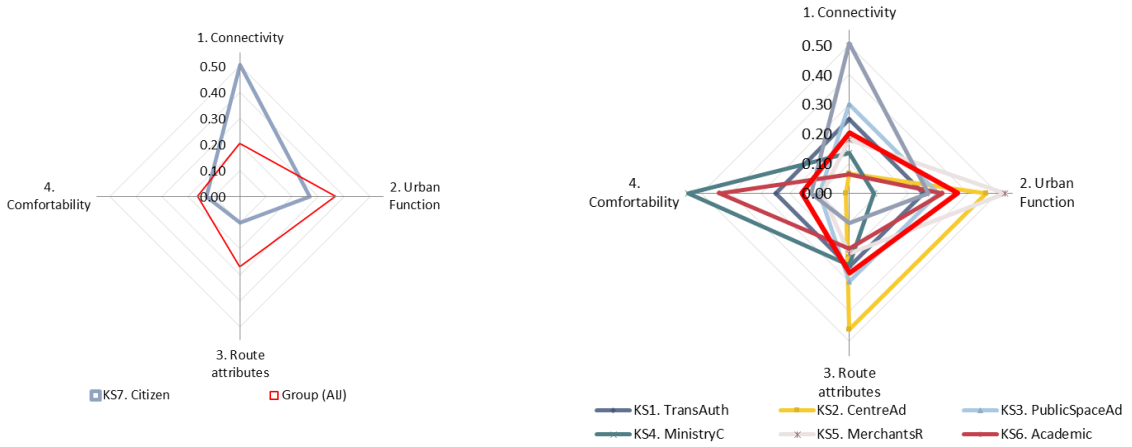
KS 4. Ministry Cult.



KS 5. Merchant



KS 6. Academic



KS 7. Citizen Group AIJ

Figure 5.8 Results obtained for the clusters

Table 5.7 Cluster results according to different KS and global result

Cluster	KS 1. Tranp. Auth	KS 2. Centre Ad	KS 3. Public Space Ad	KS 4. Ministry Cult.	KS 5. Merchant	KS 6. Academic	KS 7. Citizen	Group AIJ
1. Connectivity	0.250	0.066	0.300	0.134	0.180	0.062	0.504	0.204
2. Urban Function	0.250	0.461	0.300	0.082	0.523	0.312	0.267	0.365
3. Route attributes	0.250	0.461	0.300	0.243	0.204	0.188	0.100	0.269
4. Comfort	0.250	0.013	0.100	0.542	0.093	0.438	0.129	0.162

5.5.2 Results Obtained for the Criteria

At the criteria level, results are more similar among KS, except for some specific points (Figure 5.9); even the results between KS4 (The Ministry of Culture) and KS7 (Citizen) which were the most different ones at the cluster level. They have a high degree of concordance at a criteria level. Therefore, the results can be analysed as a whole. Parking Areas (C6) is the criterion that presents the most controversial results. It reflects a problem that the city has been having for years, since there is a deficit of parking lots in the City Centre, which has favoured illegal parking lots and the occupation of public spaces as parking areas. The main conclusion is that the most relevant criterion for all the KS is C8. Street vitality (21.8%), followed by C10. Street traffic (15.4%), C3. Street connectivity (12.2%) and C7. Cultural elements (11.7%). Next in importance are a group of criteria formed by C2. Access to destination (8.23%), C1. Presence of Public Transport (8.02%), and C13. Personal Security (6.29%) The least important criteria show an importance between 1 and 5% (Figure 5.10).

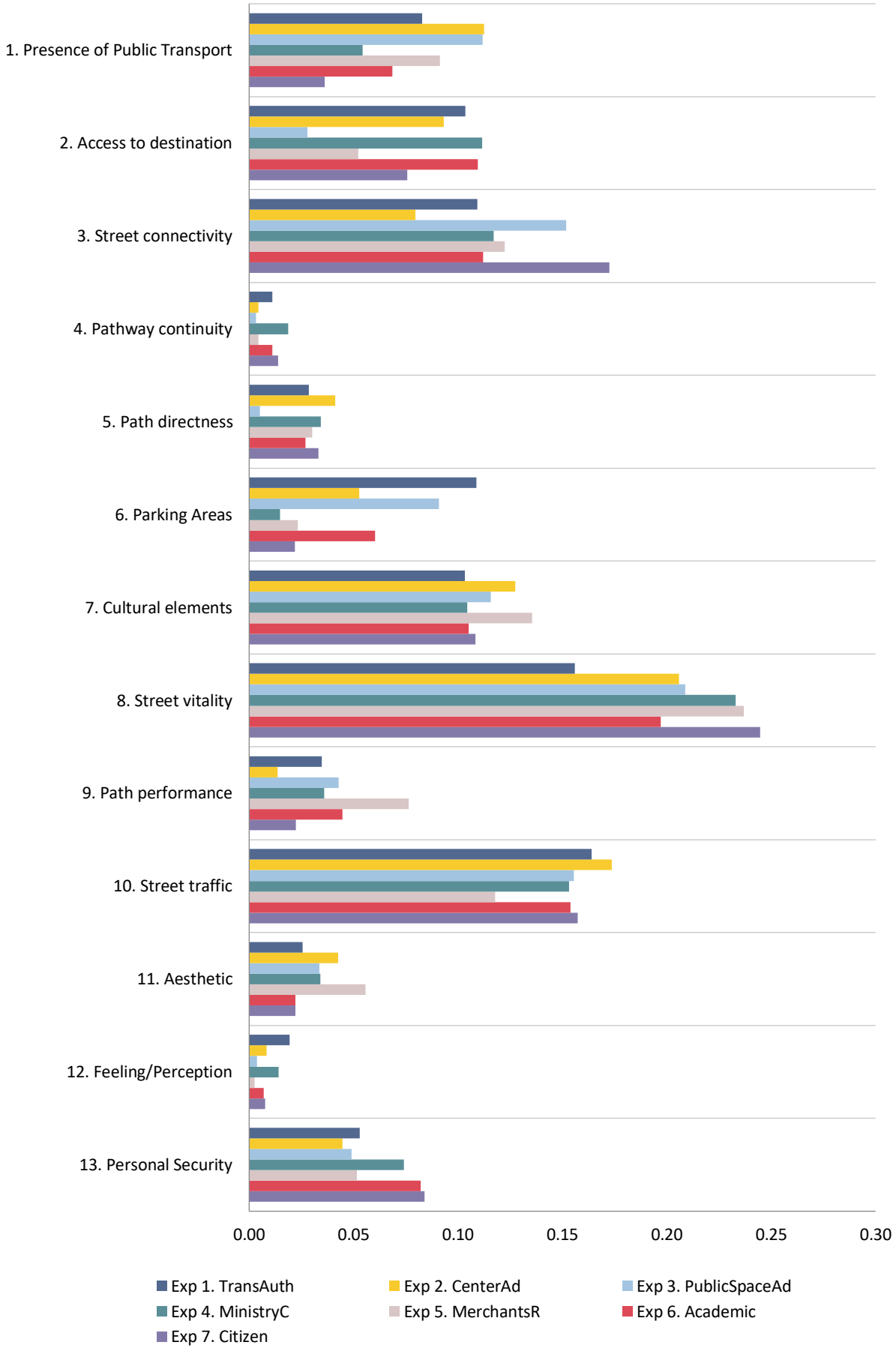


Figure 5.9 Results obtained for the criteria

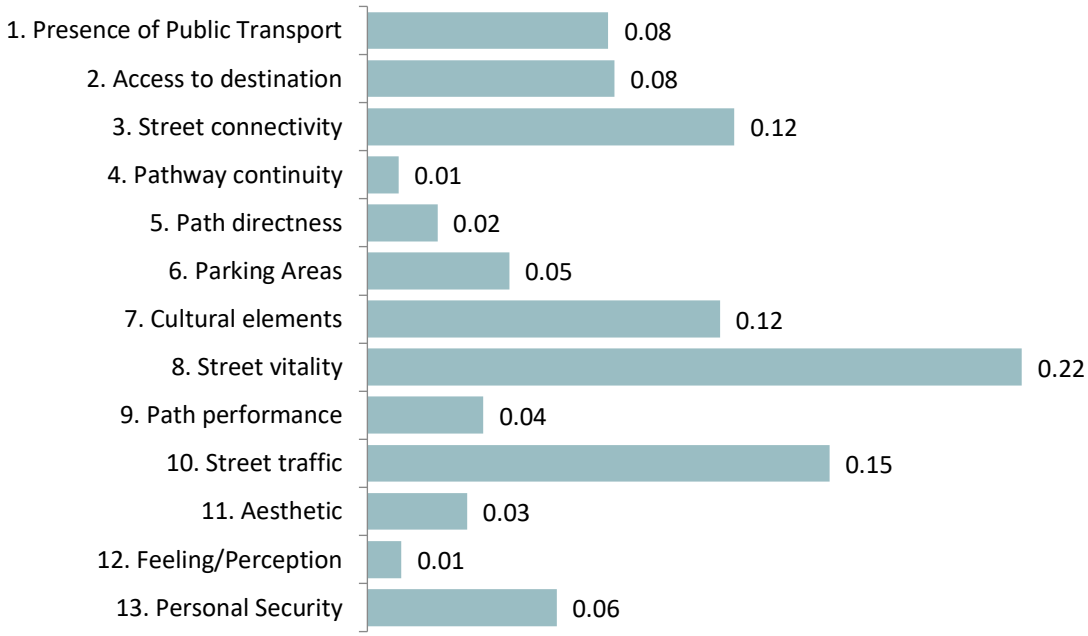


Figure 5.10 Group results for all the criteria

The results represent an important index of each criterion in designing pedestrian paths. These allow a weighted evaluation in a spatial analysis of the existing road network in the city centre, and to eventually select a set of priority streets to be considered as pedestrian and reconfigured accordingly. Based on the results, the assessment of current walkability conditions as well as some policies can also be developed.

5.5.3 Street evaluation and redesign

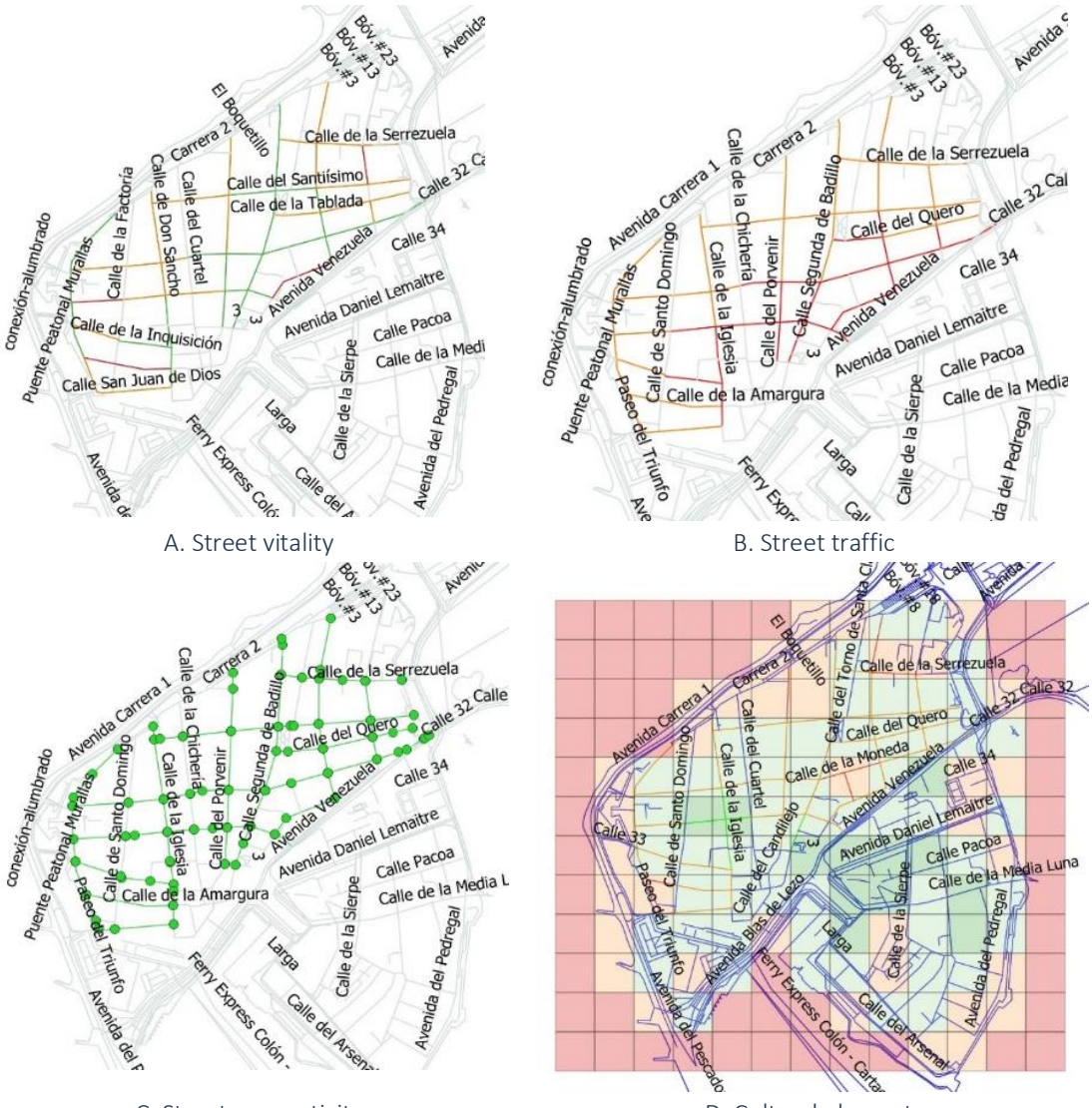
The first four most weighted criteria from ANP: street vitality (V), street traffic (T), street connectivity (C) and cultural elements (CE) were chosen for data search. Taking advantage of open data and maps from OpenStreetMap (https://www.openstreetmap.org), in particular, GPS track data and points of interests (POI), and traffic data from Google Traffic (https://www.drivingdirectionsandmaps.com/traffic-conditions-on-google-map/), it was possible to assign scores to each link of the network. A numerical scale (from 1 to 3) was chosen for each criterion and thematic maps were created (see Table 5.8 and Figure 5.11).

Table 5.8 Definition of measurement scale for the criteria for the spatial analysis

Criteria	Definition	Evaluation standard	Source	Measurement scale
Street vitality (V)	The liveliness that a space can transmit	More is better	GPS track data OpenStreetMap	(1) low (2) medium (3) high
Street traffic (T)	Vehicular traffic conditions	Less is better	Traffic data from Google Traffic – Wednesday h 12:00:00	(1) high (2) medium (3) low

Criteria	Definition	Evaluation standard	Source	Measurement scale
Street connectivity (C)	Related to the number of connections with other links	More is better	Street network from OpenStreetMap	(1) connected with just 1 link (2) connected with 2 links (3) connected with more than 2 links
Cultural elements (CE)	Presence of cultural elements or social points	More is better	Points of interests (POIs) from OpenStreetMap	(1) few: 0-5 POI (2) medium: 6-20 POI (3) many: 21-83

In particular, V and T scores derive from qualitative values (from low to high) assigned by simply looking at the different spatial maps (e.g. street vitality from the density of trajectories recorded by GPS). C was evaluated according to the number of link connections. In this specific case, since we have a grid-like network, all the streets have the highest connectivity. CE were evaluated by creating a regular 1m x 1m grid and assigning POI to each square (see Figure 5.11d). By doing this, it was possible to assign a score to each link related to 'cultural elements' according to the intensity of POI in the square where they were located.



A. Street vitality B. Street traffic

C. Street connectivity D. Cultural elements

Figure 5.11 Thematic maps of the main criteria (link colours: red = score 1; yellow = score 2; green = score 3).

Then, an overall index of pedestrian priority for each link *i* (PPI_i) was defined combining scores for each criterion with the normalized weights derived from ANP:

$$PPI_i = w_V * V + w_T * T + w_C * C + w_{CE} * CE \quad (2)$$

Finally, the index was normalized with the maximum and the minimum so as to have values between 0 and 1. Although this normalization scale does not allow us to maintain proportionalities of judgments, it allows us to create a clear separation between similar values. In this respect, we decided to use it to obtain a priority of streets since values were not substantially different from each other. The PPI map is visible in Figure 5.12.

$$PPI_{i,norm} = \frac{PPI_i - PPI_{min}}{PPImin_{max}} \quad (3)$$

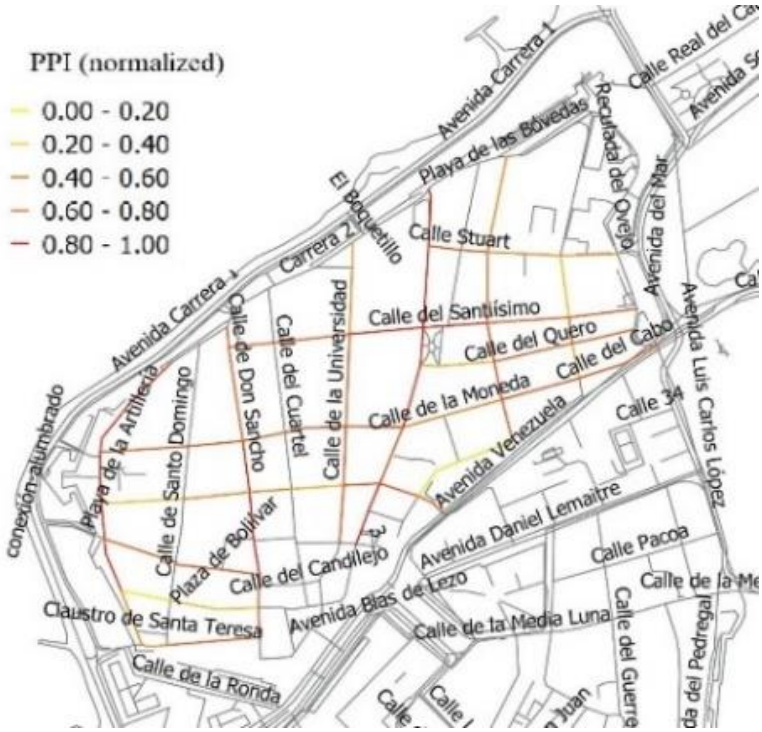
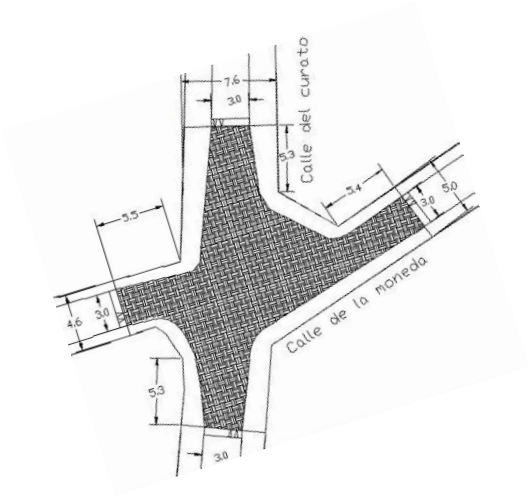


Figure 5.12 Overall pedestrian priority index (PPI)

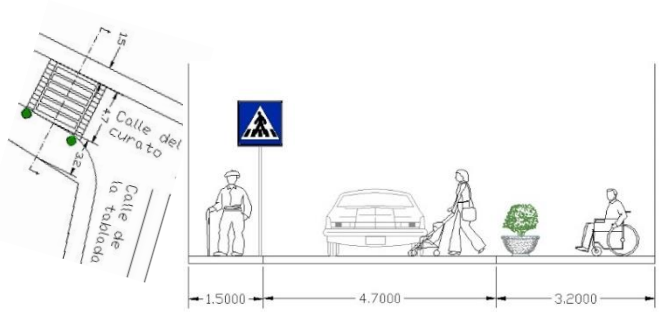
According to these results, there are some streets where intervention is more urgent. Specifically, one of the streets with the maximum values (PPI=1), i.e. Calle del Curato, was selected and redesigned (Figure 5.13). It is about 650 m long and it has many services, shops, and touristic attractions. There is a high concentration of pedestrians, but pedestrian facilities (i.e. sidewalks) are not sufficient for adequate and safe pedestrian flows. Besides, there is high volume of private traffic, and parking is allowed in some parts (see Figure 5.13a and Figure 5.13c). In order to improve the walkability of this street, it should be redesigned first by widening the sidewalks on both side (at least 1,50 m to guarantee good walking conditions, e.g. for disabled people), and by limiting or prohibiting car parking. Moreover, to guarantee continuity of paths and protection from car traffic, car lanes can be raised at the level of sidewalks, both with raised pedestrian crossings and by raising the level of the overall intersections (Figure 5.13B and Figure 5.13D). Attention should be paid to adapt street travel direction and framing these interventions into a general local traffic calming scheme.

A. Calle. del Curato (PPI=1) – Calle de la Moneda (PPI=0.54)



B. Proposal of raising intersection between Calle del Curato and Calle de la Moneda

C. Calle del Curato - Calle de la Tablada



D. Proposal of raised pedestrian crossing in C. del Curato

Figure 5.13 Examples of street redesign

This preliminary spatial analysis could be extended to the entire city centre, also by including the other less-weighted criteria of evaluation. The next step would be to discuss the results of the analysis and the proposed interventions with the Public Administration and stakeholders, in order to validate them. In this respect, both thematic and PPI maps can be useful to have an overall idea of the actual conditions of pedestrian paths from different points of view. Finally, these maps could be made available to all citizens, so to raise their awareness and involve them directly by asking them to complete the maps with user-generated information (in terms of VGI) so as to create an open database and help locals and tourists to walk safely and pleasantly in the city centre, while helping administrators to understand how and where to improve street walkability.

5.5.4 Policy implications

The participatory procedure adopted allowed us to understand which factors are most likely to be effective in making pedestrian paths attractive in the city centre of Cartagena de Indias. The stakeholders felt included, both in the definition and in the evaluation of criteria, which facilitates the acceptance of the results by the participants. The authors also confirmed that the problem is relevant for all the actors involved. Stakeholders recognize the problem and consider that a better planning and management of urban spaces in the area is required. This concern has to be translated into

pedestrian-oriented policies that increase walkability and focus on pedestrianizing as an alternative to improving the mobility in the area.

According to the most relevant criterion, some context-specific recommendations on both long and short-term policies to be implemented could be formulated. First, in order to increase *street vitality* and *cultural elements*, Local Administrations should encourage and promote different events, reserving spaces for those activities, and activate a long-term land use change by fostering land use diversity via economic incentives and tax benefits. Second, for controlling *street traffic*, some traffic restriction/calming measures are also recommended to encourage the presence of pedestrians, limiting the amount of car traffic (e.g. via limited traffic zones) and its impact (e.g. via 30 km/h zones). This could also foster cycling in the streets or other soft mobility modes (e.g. e-scooter, segway). Third, the importance attributed to the criterion *street connectivity* reinforces the idea that priority should be given to revitalizing and redesigning streets in urban areas with a grid network structure (i.e. with many intersections), fostering accessibility by guaranteeing multiple path alternatives and an easy access to destinations. Finally, regarding the most controversial criterion, *parking areas*, regulatory and economic policies aimed at discouraging on-street parking by providing alternative off-street parking areas at a walkable distance from points of interests could be beneficial to avoid cruising for parking (Shoup 2011) and release spaces for other street uses (e.g. peddlers, restaurants, cycling lanes).

Although literature and guidelines dedicated to policies and design methods to improve walkability are abundant, the abovementioned policies are likely to be accepted and be effective in a context since they are the result of a well-thought out and methodologically sound participatory approach. In this respect, stakeholder involvement should be guaranteed in all the phases of a planning process to tailor policies and find appropriate measures in line with stakeholder needs. Although those recommendations often require a top-down approach to planning, it is important to consider them as a mechanism toward sustainable development planning (Cheshmehzangi and Thomas 2016). Also, these and other policy implications will have to be discussed with pedestrians.

5.6 Conclusions

The proposed methodology is a novel application for defining and ranking criteria for pedestrian paths. It is addressed in two phases, the first one focuses on an analysis of the actors to involve them in the evaluation of criteria and the second one on criteria prioritisation. The aim is to support the local administrations in the redesigning of walkable paths to improve pedestrian accessibility, involving stakeholders in the definition of the important elements and characteristics of pedestrian paths. The authors found that a procedure based on a participatory multicriteria approach (SNA-ANP) is appropriate to collect stakeholder preferences on the issues of designing pedestrian paths. Stakeholders related to the case study were analysed through SNA. The results of this analysis allow the identification of different types of networks. In this case, the authors identified two. The first one related to the exchanged information. This network is dense and it is well connected, allowing a good information flow. The second one is related to the collaboration in mobility projects. It shows a certain degree of connection thanks to the Local Administration.

The goal of improving pedestrian mobility was broken down into four clusters or groups of criteria related to connectivity, urban function, route attributes and comfort. These clusters were disaggregated into criteria to be evaluated through ANP. The selection of the criteria to be included in the ANP model is one of the main contributions of this methodology. They were selected through a document analysis, a revision by experts and stakeholders, and an evaluation of them via ANP by key stakeholders. Given the number of selected criteria (13), the ANP model was viable and the questionnaire for evaluating them was easy to understand, which allowed us to obtain an index for each criterion. The index evaluates the greater or lesser importance of criteria in designing pedestrian paths. Regarding the results of the evaluation of criteria via ANP, the criterion (C8) Street Vitality was considered the most important one.

ANP allowed accounting for complex interrelationships among the criteria. This is particularly important for the specific case of designing walkable paths, where activities and people with heterogeneous interests and needs share the same public space, and criteria can be strongly related. For example, street connectivity or multiple destinations in a street can favour the presence of public transport. The results allowed the formulation of tailored policy implications for the specific case study, for both the long and the short term, related to transport and land use, and the identification of future steps of the research.

This work also has a potential impact on professional and urban communities. In this respect, findings will allow urban managers to make better decisions combining the opinions of experts with different profiles and answering the greater demand for more inclusive decisions and more accessible walking paths. This is performed by taking into consideration some tangible and intangible characteristics affecting walking and getting more transparent and traceable results. To the best of the authors' knowledge, this is the first time that this participatory multicriteria approach (SNA-ANP) has been considered for issues related to the planning of pedestrian paths or mobility. Thus, for urban and planning studies the methodology proposed will facilitate and support the design of urban routes, spatial analysis, assessment of walkability conditions, and the proposal of some policies, especially in sensitive zones and involving multiple stakeholders. In this respect, a new application of participatory multicriteria decision analysis for sustainable mobility has been presented. The methodology could be easily extended to other urban planning areas.

Regarding limitations and avenues for future research, the participatory multicriteria approach (SNA-ANP) is a proper combination of two well-known methodologies. Such integration will help to make use of the strengths of both the methods. However, a poor application of one of them can affect the validity of the results. The identification of the stakeholders in the SNA should be careful in order to avoid some tendencies such as homophily, when actors associate and bond with similar ones, leaving out of the network some other actors. The size of the network can be another problem. To deal with both problems, it is recommended to select and combine proper techniques during stakeholder identification. Another important limitation can be caused if the suitable person is not selected for answering the questionnaire, particularly when networks are composed by organizations. In addition, for SNA the relational contents, i.e. what to study (flow of information, the content of the information or for how long the relationships have existed), can be studied but sometimes cannot offer much valuable information. As regards ANP limitations, a very important concern is which actors to include. Involved actors should have a key role in the decision process, be aware of the problem

and interested in the results. Some of the key stakeholders invited to participate in our model did not answer. Finally, a general limitation is the availability of resources, especially time.

The results should be shared with Public Administrations and stakeholders, both to validate them, and as the first step of a wider participatory planning process aimed at improving walkability in Cartagena de Indias. Future works can consider the redefinition of measurement scale for all criteria and propose the layout of pedestrian paths and the reconfiguration of some spaces. Pedestrians will be involved in these later steps, validating and evaluating results. More appropriate techniques and procedures should be considered to capture information from larger groups, e.g. surveys. We recommend the communication of the results in different environments, which allows the constant feedback of the process and the participation of other audiences.

Finally, some general suggestions are provided regarding some key aspects to take into account in future works using SNA-ANP as an evaluation tool: first, involved decision-makers have to be interested in the decision problem; second, previous references and experiences related to the case have to be collected; third, the points of view and opinions of central and non-central stakeholders have to be collected; fourth, appropriate channels between them have to be provided and; fifth, ANP has to be considered as a complete procedure and it needs to have the necessary time dedicated to it. In this way, the ANP procedure becomes not only interesting in terms of reaching a final prioritisation of projects, indicators or criteria under evaluation, but mainly in terms of allowing debates and reflections.

Promoting walking in cities is fundamental to making them more liveable, and to relieve them from the burden of car traffic. In order to do so, one should understand the most important factors that influence walkability and pedestrians' perception, and provide spatial evidence of the current condition of walkability, so as to define priority of interventions.

CHAPTER 6

General discussion and conclusions

6.1 Introduction

This thesis arises as a response to the concern to approach urban planning from a broader perspective in the face of challenges related to sustainability and local development. The problem was addressed by generating a methodology that allows the evaluation of projects and the prioritisation of strategies with a sustainable approach and with the participation of different groups of stakeholders. This methodology has been structured in four stages, operationalised through four guiding questions.

This chapter presents a general discussion of the results. It draws the main conclusions from the research questions, as well as the general contribution, followed by the proposal of some recommendations, reflections and concluding remarks.

6.2 General discussion of results

RQ1. In what ways does ANP support decision making processes in the field of sustainable development?

The key and simplest answer to this question is to say that ANP does work as a support tool for sustainable development planning. The broader answer, described in detail in the literature, found that evidence of the use of ANP in models for decision making related to sustainability.

ANP considers the correlation between various elements and characteristics of the context, which allows us a better alignment with the sustainable development approach. Although the interpretation of the concept of sustainability may vary, the inclusion of the sustainable development approach is translated into models based on the three pillars of sustainable development: economic, environmental and social.

A systematic literature review (SLR) has been carried out in order to analyse the presence of the concept of sustainability in ANP models. Its main conclusion is that this multicriteria technique has permeated different areas of knowledge and has been applied in fields as diverse as: territorial and urban studies, manufacturing, energy, business, construction, agriculture, transportation and others. At the same time, these applications are mainly oriented to the evaluation of aspects of sustainability and the planning of sustainable development. In the field of planning, the literature shows that the use of the ANP has supported processes from both macro and micro perspectives and has addressed several topics (Chapter 2).

The in-depth analysis of the works applied in the field of territorial and urban studies allowed us to identify the main aspects related to the construction of decision models with ANP. It also highlights the requirement to transmit the dimensions of sustainability in the models, maintaining the active participation of decision-makers, including more open processes and paying special attention to the selection of participants.

The findings of the systematic review were used in the design of the case studies, in the definition of criteria, the number of experts, the way of involving stakeholders and the selection of complementary techniques.

Based on the categories of analysis proposed, the three case studies were designed in the field of urban and territorial studies in the city of Cartagena de Indias. In the particular area of Planning of sustainable aspects, the first case was a location problem, in relation to the location, expansion and placement of new nautical and naval facilities. The main objective of the model was to prioritise possible locations. The second case was designed within the particular area of sustainable development planning, specifically, sustainable tourism. The objective of this model was the evaluation and prioritisation of projects to improve the tourist offer. The third case was defined within the particular area of Evaluation of sustainable aspects in the specific topic of urban regeneration. The main objective of this third model was to give weighting to attributes related to pedestrian routes and to apply an evaluation index to the streets of the city centre in order to improve pedestrian mobility.

RQ2. How can ANP support decision making to prioritise strategic projects in the field of sustainable development?

The third chapter explores through the first case study, the use of the ANP in decision making for a specific problem in the nautical and naval sector of the city of Cartagena. An ANP model aimed at the prioritising of four possible locations for the new infrastructure of this sector was replicated, with the participation of two key groups in this decision: industry and academia. In general, the results show that ANP is a useful tool for prioritising local development projects in this context and achieving consensus.

The results revealed a concern for the environmental effects and the long-term consequences that these could generate on the city's nautical and naval industry. Furthermore, they allowed participants a reflection on aspects beyond their environment such as the effects on the daily life and habitability conditions of the citizens, as well as the use of the island territories.

Based on the recommendations made in the previous chapter, this case focused on the inclusion of the dimensions of sustainability in the model and the participation of decision-makers. It raised concerns regarding the number of participants and the selection of actors involved and proposed the use of spatial parameters to support the participatory decision-making process.

RQ3. How can SNA support ANP in the creation of a participatory multicriteria methodology for the evaluation of strategic projects for sustainable development?

The fourth chapter offers the answer to this question. The central methodology of this thesis was designed and tested through the evaluation of strategic projects in the tourist sector of Cartagena de Indias in order to prioritise them. The results validate the SNA-ANP combination as relevant and useful in the planning process.

The proposed methodology places special emphasis on the selection of participants and sheds light on the problem of participatory planning processes. The concerns raised above regarding the selection and justification of participants and regarding the participatory component were addressed through Social Network Analysis (SNA).

Using SNA it was possible to study in detail the composition of the network of actors involved or affected by the tourism sector in the city in order to determine the degree of cohesion and consolidation of this sector, as well as the position of some actors, and the existing connections and disconnections. This allowed us to propose the participation of central actors. Moreover, actors in less 'influential' positions were included in order to represent some groups that were left out of the decision making process. Due to the diversity of profiles a decision profile for each participant was generated.

Once again, the interest to benefit the sector, as well as the inhabitants of the city is clearly shown in the prioritisation carried out. Reports were sent with the results of the process in a more summarized and practical format to the participants with the aim of facilitate the process of evaluation and feedback.

For the following case, a better definition of elements was proposed for the model, greater participation of the local administration of Cartagena, and once again, the inclusion of spatial analysis to improve the decision making process.

RQ4. How can spatial analysis complement a participatory multicriteria methodology for the evaluation of strategic projects for sustainable local development?

This last empirical experience integrated the SNA-ANP model with a Geographic Information System (GIS). The participatory multicriteria methodology was enriched by exploring its ability to work together with other complementary techniques. Therefore, the key answer to the question asked is that the proposed participatory multicriteria analysis methodology is an iterative and adaptable tool.

Two important changes were introduced in the early stages. The first related to the more active participation of the local administration in Cartagena, and the second in relation to the inclusion of semi-structured interviews at the beginning of the process. The objective of the interviews was to better understand the perception of the problem and the proposed solutions, to collect information for the analysis of two types of stakeholder networks, and to carry out a first assessment of the criteria defined in the literature and proposed by experts on mobility and transport issues. All of this also facilitated greater interaction with different groups from the early stages of the methodology through the use of instruments that allowed for greater participation of the stakeholders: interviews, partial and final reports of the results, and an evaluation form.

The SNA was used to identify the actors related to the problem, but also to analyse two types of networks among actors, which allowed a more accurate picture of the reality of the sector and its relationships. The results highlight the value of the local administration as a broker in the network; however, they also reveal the reality of other sink actors who claim a more important role in decision making. The selection of the criteria to be included in the ANP model is another of the main modifications proposed for this case. Due to the three screening phases carried out, the number of criteria selected for the decision model was more viable and the questionnaire to evaluate them was easier to understand. The indexes obtained permitted the formulation of actions and policy implications related to transport and land use in the short and long term.

Modifications facilitated a more fluent feedback process and higher quality results since they were more contextualised. Although it is not possible to compare with the previous case in terms of the quality of the process or the decision, it is clear that the inclusion of more open dialogue and spatial elements better integrate the results of the decision model and also facilitate feedback and diffusion of the results. However, given that this problem is closer to the citizens, it also poses new challenges in relation to the dissemination and evaluation of the results before the implementation of any action.

In summary, this last case included the concerns raised at the beginning of the thesis regarding the consideration of the dimensions of sustainability in the model, the active participation of decision-makers, and the selection and justification of the participants. In summary, it allowed the construction of a more participatory decision process.

6.3 General conclusions and implications

RQ. How can a participatory multicriteria methodology help to evaluate local development projects with a sustainable approach?

The objective of this dissertation has been to contribute to the question of 'how', that is, how to make decisions. Trying to answer this question, we can highlight the following contributions discussed throughout this dissertation:

i. The inclusion of the local and sustainable development approach in the framework of strategic planning decisions recognizes the value of different types of heritage and promotes more locally adapted planning.
ii. The recognition of the existence of different groups of actors, the importance of studying their roles from different perspectives and promoting their inclusion.
iii. The use of practical and replicable methodologies that account for results to be applied at different scales.

Some conclusions and recommendations in particular for the context and in general for the proposed methodology are proposed below.

6.3.1 Reflections regarding the study context

The models designed for the case studies are the first experiences that arose in the city of Cartagena. Participants claimed to have obtained a broader view of the decision problem, considering elements or criteria that other actors included. Another positive aspect is that the intention to make decisions focused on the growth of a certain sector was perceived, but also on improving the quality of life in the city.

The proposed methodology responds to the need of different sectors to feel included or represented in decision-making processes by including some actors who have traditionally been excluded from these processes or have only maintained the figure of receivers or followers. The cohesion and power of the existing links between some groups has been highlighted, as well as the disconnection among others; suggesting that the local administration should promote more spaces

for conversation between actors. A distance has also been perceived between the inhabitants of the city and some sectors, so it should be noted that the parties involved, especially the local administration and private groups, must work to generate actions that promote conciliation.

Regarding the utility and applicability of this instrument to similar cases, the procedure is easy to adapt to other strategic sectors of the city, at different scales and at different stages of urban strategic planning. The results could represent support for planners, local administrators and urban managers, responding to the demand for more inclusive decisions and obtaining more transparent and traceable results.

6.3.2 Reflections regarding the methodology

The methodology of participatory multicriteria decision making proposed meets with the characteristics of the techniques used, and at the same time it meets some of the concerns raised in the literature. The objective was not to obtain a single solution with the 'best' model, but to propose a framework that promotes transparency and integrates contrasting opinions towards more open decision making. The approach basically responds to the challenges of local and sustainable development; however, it also allows other challenges to be addressed using the same systematic and participatory approach.

Among the most significant contributions of this methodology are the integration of SNA and ANP techniques, the consideration of non-central actors in the decision model and the construction of decision profiles. Among the main advantages, it is worth mentioning that it allows for a wider vision of the problem posed, combining qualitative and quantitative techniques that allowed for a better approach to the reality of the problem and for reaching a consensus from the perspective of multiple actors. Even though the application of the methodology may require more time than other alternative decision methods, we would like to emphasize that it encourages participation and promotes more structured and adapted strategic planning. The results also provide some insights into the degree of consolidation of a sector and allows for differences in perceptions and attitudes among stakeholders.

For multicriteria decision making studies, the methodology takes advantage of the strengths of two well-known techniques such as SNA and ANP. However, a poor application of one of them can affect the validity of the results. In general, some practical recommendations and implications are set out below:

- The participation of at least one local agent, interested in the decision and as far as possible key to the decision making, is required.
- Gather information, documentation and previous experiences related to the case, both local and external.
- The identification of stakeholders should be careful. It is recommended to select and combine techniques. Also, when dealing with organizations, select the right person to answer the questionnaire and even include several profiles of the same organization.
- During the stage of contextualization of the problem, it is convenient to collect views and opinions from central and non-central stakeholders.
- When building one or several stakeholder networks, it is recommended to pay special attention to the relational content to be studied.

- No maximum or minimum number of participants is required. The participants involved must be aware of the problem and interested in the results, and therefore must be willing to complete the questionnaires required by the ANP.
- Defining elements is very sensitive. The elements considered denote the focus of the decision, e.g. considering only economic aspects denotes a decision based on economic benefit principles.
- Make use of appropriate communication mechanisms and channels

6.4 Main contributions

The main contributions of this dissertation have been of an empirical nature, as stated at the beginning. The most important is the development in the use of multicriteria decision methods by complementing the use of the ANP technique with the SNA in practical applications in order to generate a participatory multicriteria approach. It has been demonstrated that it is an appropriate combination of two techniques widely studied in the field of operational research

It is an important, novel and very interesting contribution for the users of multicriteria analysis techniques for decision making. It allows the study of the existing relationships between stakeholders related to a problem thus facilitating the identification and differentiation of stakeholders before considering them in a decision making process. It also opens the possibility of exploring the differentiations between judgments according to the centralities of an actor; or establishing a limit of centrality where actors above a certain threshold may or may not be considered. In general, the proposal opens the possibility of exploring new applications and combining various methodologies that permit the strengthening of processes associated with decision making, so its use and exploitation is relevant and can be extended.

One of the perceived weaknesses of the studies in the area is related to the presentation of the approach used in the choice of participants (Mu et al. 2020). The proposed methodology allows for a clear approach to their selection and also allows for a better study of the preferences among different groups of actors related to the same problem. This is of great interest in issues related to territorial planning and development, as well as in many other areas of application to meet other types of objectives.

Each of the publications resulting from this dissertation represents a particular contribution in the area by itself. Other innovative proposals introduced throughout this dissertation are the inclusion of central and non-central actors in the decision making processes and the generation of decision profiles among the participants. The novel synthesis of the proposed literature is also highlighted, and additionally, the application of the multicriteria approach in problems related to the naval industry and the planning of pedestrian routes. In the case of tourism there is evidence of the separate use of the two techniques, but not of the combined use.

In summary, we have found that the proposal to combine ANP-SNA methodologies is a novel and useful way to address any type of decision problem with a multicriteria, sustainable and participatory approach

6.5 Limitations and future lines

The first of the limitations to be mentioned is related to access to information. The proposed cases were carried out in different sectors of the city's local government; however, during the development of the three cases the city's political circumstances were changing, so access to certain actors, the conditions for collecting information and the practices within each sector were different. This same period of government instability did not allow for fluid communication with decision-makers.

This is also related to the next limitation, distance working, which mainly affected the collection of information. Some of the actors invited to participate did not respond and in other cases the responses took longer than expected, it would also have been interesting to make the presentation and return of the results directly in the city.

The next limitation is the traceability of other experiences. Although the city has carried out other planning exercises with the participation of different actors, no data were found that would allow for the comparison of results between experiences. A final limitation suggests that during the stakeholder identification phase, some groups or collectives may also have been left out of this exercise, in line with other currents of urban planning that can be explored in new applications.

With regard to future lines of research, in the environment of the city of Cartagena, we highlight the need to promote the use of structured methodologies and processes resilient to governmental instability

As for the proposed methodology, the clearest way is its application in other contexts and the use of other approaches. It is also interesting to explore new complementary strategies during different stages of the decision, feedback and implementation process. The most important thing is that new applications and strategies to be included should be considered, trying to maintain and improve the simplicity of the models. Some of the recommendations may be: to develop instruments that facilitate information collection, stakeholder identification and interaction with participants; to design monitoring and evaluation indicators during project implementation stages based on the selected evaluation criteria; or to explore the combination with other MCDM and DEMATEL techniques, which have gained strength in the literature. The latter has proven useful for identifying components of the cause-effect chain of a complex system and has been widely used over the last decade (Sheng-Li et al. 2018).

Conflict management, the study of consensus and sensitivity analyses of the results can be other interesting avenues to explore, for example, through the analysis of the dispersion of the judgements made (Saaty and Vargas 2007).

On the other hand, although the intention of complementarity and not comparison between the case studies designed for this thesis was clear, the strategy of multiple case research suggests the use of some comparison methodologies and the documentation of other decision processes that would allow the comparison of experiences.

Finally, from other perspectives it is also possible to open new discussions based on the concept of stakeholder participation and the concepts of sustainability, sustainable and local development, as well as how to approach them from different practical aspects of planning. For example, from the

application in other strategic sectors in the same city, the same sectors in other cities of the same country or in similar contexts; or through approaches such as infrastructure and green economy (Khoshnava, Rostami, Zin, Streimikiene, Yousefpour, Mardani, et al. 2019), inclusive cities (World Bank and UN Women), smart cities, ubiquitous 'u-cities' (Ghaemi Rad et al. 2018), slow cities (Cittaslow movement) or mission-oriented planning

In conclusion, given the exploratory and descriptive nature of this dissertation, it opens up new debates, new ideas and new strategies. Therefore, the problem of decisions during the planning and evaluation stages of strategic projects for local sustainable development remains an interesting field to explore in search of solutions.

General discussion and conclusions - Spanish version

Introducción

Esta tesis surge como respuesta a la inquietud de enfocar la planeación urbana desde una visión más amplia, frente a los desafíos relacionados con la sostenibilidad y el desarrollo local. El problema se abordó a partir de la generación de una metodología que permite la evaluación de proyectos y la priorización de estrategias con un enfoque sostenible y con la participación de diferentes grupos de stakeholders. Esta metodología se ha estructurado en cuatro etapas operacionalizadas a través de cuatro preguntas orientativas.

Este capítulo presenta una discusión general de los resultados. En él se extraen las principales conclusiones de las preguntas de investigación, así como la contribución general, seguido de la proposición de algunas recomendaciones, reflexiones y observaciones finales.

Discusión general de los resultados

RQ1. In what ways does ANP support decision making processes in the field of sustainable development?

¿Cómo puede ayudar el ANP a los procesos de toma de decisiones en el campo del desarrollo sostenible?

La respuesta clave y más sencilla a esta pregunta es afirmar que el ANP sí funciona como herramienta de apoyo para la planeación del desarrollo sostenible. La respuesta más amplia, describe detalladamente la literatura encontrada que evidencia el uso del ANP en modelos para la toma de decisiones relacionadas con la sostenibilidad.

El ANP considera la correlación entre varios elementos y características del contexto del problema, lo que permite una mejor alineación con el enfoque del desarrollo sostenible. Por lo tanto, aunque la interpretación del concepto de sostenibilidad puede variar, la inclusión del enfoque de desarrollo sostenible se traduce en modelos basados en los tres pilares del desarrollo sostenible: económico, ambiental y social.

Para analizar la presencia del concepto de sostenibilidad en modelos ANP se ha realizado un análisis sistemático de la literatura (ASL) cuya conclusión principal es que esta técnica multicriterio ha permeado en diferentes áreas del conocimiento, y ha sido aplicada en campos tan diversos como: estudios territoriales y urbanos, manufacturero, energía, negocios, construcción, agricultura, transporte y otros. A su vez se ha observado que estas aplicaciones están orientadas principalmente a la evaluación de aspectos de la sostenibilidad y la planeación del desarrollo sostenible. En el campo de la planeación, la literatura muestra que el uso del ANP ha apoyado procesos tanto desde perspectivas macro como micro y ha abordado temas muy variados (ver capítulo 2).

El análisis en profundidad de los trabajos aplicados en el campo de los estudios territoriales y urbanos permitió identificar los principales aspectos relacionados con la construcción de modelos de decisión con ANP. También se destaca la necesidad de transmitir las dimensiones de la sostenibilidad

en los modelos, mantener la participación activa de los decisores, incluir procesos más abiertos y prestar atención especial a la selección de los participantes.

Los hallazgos de la revisión sistemática propuesta se utilizaron en el diseño de los casos de estudio, en la definición de criterios, la cantidad de expertos, la forma de involucrar a los stakeholders y la selección de técnicas complementarias.

A partir de las categorías de análisis planteadas, los tres casos de estudio se diseñaron en el campo de estudios urbanos y territoriales en la ciudad de Cartagena de Indias. En el área particular de Planeación de aspectos sostenibles, el primer caso fue un problema de localización, en relación con la ubicación, expansión y colocación de nuevas instalaciones náuticas y navales. El objetivo principal del modelo fue la priorización de las posibles ubicaciones. El segundo caso se diseñó dentro del área particular de Planeación del desarrollo sostenible, específicamente, del turismo sostenible. El objetivo de este modelo fue la evaluación y priorización de proyectos para mejorar la oferta turística. El tercer caso, se definió en el área particular de la Evaluación de aspectos sostenibles en el tema específico de regeneración urbana. El objetivo principal de este tercer modelo fue ponderar atributos relacionados con rutas peatonales y aplicar un índice de evaluación a las calles del centro de la ciudad para mejorar la movilidad peatonal.

RQ2. How can ANP support decision making to prioritise strategic projects in the field of sustainable development?

¿Cómo puede ANP ayudar en la toma de decisiones para priorizar proyectos estratégicos en el campo del desarrollo sostenible?

El tercer capítulo explora, a través del primer caso de estudio, el uso del ANP en la toma decisiones para un problema específico en el sector náutico y naval de la ciudad de Cartagena. Se replicó un modelo ANP orientado a la priorización de cuatro posibles ubicaciones para la nueva infraestructura de este sector, con la participación de dos grupos clave en esta decisión: la industria y la academia. En general, los resultados demuestran que ANP es una herramienta útil para priorizar proyectos de desarrollo local en este contexto y lograr un consenso.

Los resultados pusieron de manifiesto una preocupación por los efectos ambientales y las consecuencias a largo plazo que estos podrían generar sobre la industria náutica y naval de la ciudad. Además, permitieron reflexionar sobre aspectos más allá del entorno de los participantes, como los afectos sobre la vida cotidiana y las condiciones de habitabilidad de los ciudadanos, así como el uso de los territorios insulares.

A partir de las recomendaciones planteadas en el capítulo anterior, este caso se centró en la inclusión de las dimensiones de la sostenibilidad en el modelo y la participación de los decisores. En él se plantearon inquietudes con respecto a la cantidad de participantes y la mejor selección de los actores involucrados y, además, se propuso la utilización de parámetros espaciales para apoyar el proceso participativo de toma de decisiones.

RQ3. How can SNA support ANP in the creation of a participatory multicriteria methodology for the evaluation of strategic projects for sustainable development?

¿Cómo puede SNA apoyar al ANP en la creación de una metodología multicriterio participativa para la evaluación de proyectos estratégicos para el desarrollo sostenible?

El cuarto capítulo ofrece la respuesta a esta pregunta. La metodología central de esta tesis se diseñó y se testeó con la evaluación para la priorización de proyectos estratégicos del sector turístico de Cartagena de Indias. Los resultados validan que la combinación de SNA-ANP es relevante y útil en el proceso de planeación.

La metodología propuesta hace énfasis especial en la selección de los participantes y arroja luz sobre el problema de los procesos de planeación participativa. Las inquietudes planteadas anteriormente con relación a la selección y justificación de los participantes y con respecto al componente participativo, se abordaron a través del Análisis de Redes Sociales (SNA por sus siglas en inglés).

El SNA permitió estudiar con más detalle la composición del tejido de actores involucrados o afectados por el sector turístico en la ciudad, conocer el grado de cohesión y consolidación de este, así como la posición de algunos actores, y las conexiones y desconexiones existentes. Lo anterior permitió proponer la participación de actores centrales. Asimismo, sirvió para incluir a otros actores en posiciones menos 'influyentes' que representaban a algunos grupos que quedaban fuera del proceso de decisión. La variedad de perfiles, además, permitió generar un perfil de decisión para cada participante.

Nuevamente el interés por beneficiar al sector, pero también a los habitantes de la ciudad se muestra de manera clara en la priorización realizada. Para facilitar el proceso de valoración y retroalimentación por parte de los participantes, se entregaron informes con los resultados del proceso en un formato más resumido y práctico.

Para el siguiente caso se propuso una mejor definición de elementos para el modelo, mayor participación de la administración local de Cartagena, y una vez más, la inclusión del análisis espacial para mejorar el proceso de toma de decisiones.

RQ4. How can spatial analysis complement a participatory multicriteria methodology for the evaluation of strategic projects for sustainable local development?

¿Cómo puede el análisis espacial complementar una metodología multicriterio participativa para la evaluación de proyectos estratégicos para el desarrollo local sostenible?

Esta última experiencia empírica integró el modelo SNA-ANP con un Sistema de Información Geográfica (GIS, por su sigla en inglés). La metodología multicriterio participativa se enriqueció al explorar su capacidad de trabajar junto con otras técnicas complementarias. Por lo tanto, la respuesta clave a la pregunta planteada es que la metodología de análisis multicriterio participativa propuesta es una herramienta iterativa y adaptable.

Dos cambios importantes se introdujeron en las primeras etapas. El primero relacionado con la participación más activa de la administración local de Cartagena y el segundo, con relación a la inclusión de entrevistas semiestructuradas al inicio del proceso. El objetivo de las entrevistas fue conocer más en profundidad la percepción sobre el problema, las soluciones propuestas, recolectar información para el análisis de dos tipos de redes de actores y realizar una primera valoración de los criterios definidos en la literatura y propuestos por expertos en temas de movilidad y transporte. Todo ello facilitó asimismo una mayor interacción con diferentes grupos desde las primeras etapas de la metodología, a través del uso de instrumentos que permitieron una mayor participación de los stakeholders: entrevistas, informes parcial y final de resultados, y formulario de evaluación.

El SNA se utilizó para identificar a los actores relacionados con el problema, pero además para analizar dos tipos de redes entre actores, lo que permitió una fotografía más acertada de la realidad del sector y sus relaciones. Los resultados resaltan el valor de la administración local como broker del sector, sin embargo, también revelan la realidad de otros actores receptores que reclaman un rol más importante dentro de la toma de decisiones. La selección de los criterios a incluir en el modelo ANP es otras de las principales modificaciones propuestas para este caso. Gracias a las tres fases de cribado realizadas, el número de criterios seleccionados para el modelo de decisión fue más viable y el cuestionario para evaluarlos fue más fácil de entender. Por su parte, los índices obtenidos permitieron formular acciones e implicaciones políticas relacionadas con el transporte y el uso de la tierra a corto y largo plazo.

Las modificaciones realizadas permitieron un proceso de retroalimentación más fluido y resultados de mayor calidad puesto que estaban más contextualizados. Aunque no es posible comparar con el caso anterior, en términos de la calidad del proceso o de la decisión, es evidente que la inclusión del dialogo más abierto y de elementos espaciales integran mejor los resultados del modelo de decisión y facilitan, asimismo, la retroalimentación y divulgación de los resultados. Sin embargo, dado que este problema es mucho más cercano al colectivo de la ciudadanía en general, también plantea nuevos desafíos con relación a la divulgación y valoración de los resultados antes de la puesta en marcha de cualquier acción.

En resumen, este último caso logró incluir las inquietudes planteadas al inicio de la tesis con relación a la consideración de las dimensiones de la sostenibilidad en el modelo, la participación activa de los decisores, y la selección y la justificación de los participantes. En síntesis, permitió la construcción de un proceso de decisión más participativo.

Conclusiones e implicaciones generales

RQ. How can a participatory multicriteria methodology help to evaluate local development projects with a sustainable approach?

¿Cómo puede una metodología multicriterio participativa ayudar a evaluar los proyectos de desarrollo local con un enfoque sostenible?

El objetivo de esta disertación ha sido contribuir a la cuestión del 'cómo', es decir, cómo tomar decisiones. Tratando de responder a esta pregunta, podemos resaltar las siguientes aportaciones discutidas a lo largo de esta disertación:

iv. La inclusión del enfoque del desarrollo local y sostenible en el marco de las decisiones para la planeación estratégica reconoce el valor de distintos tipos de patrimonio y promueve una planeación más adaptada a nivel local.
v. El reconocimiento de la existencia de diferentes grupos de actores, la importancia de estudiar sus roles desde diferentes perspectivas y promover su inclusión.
vi. El uso de metodologías prácticas y replicables que den cuenta de los resultados para ser aplicadas a diferentes escalas.

A continuación, se exponen algunas conclusiones y recomendaciones desde un punto de vista particular para el contexto estudiado y general para la metodología planteada.

Reflexiones relacionadas con el contexto de estudio

Los modelos diseñados para los casos de estudio son las primeras experiencias que se plantearon en el entorno de la ciudad de Cartagena. Los participantes afirmaron haber obtenido una visión más amplia del problema de decisión, al considerar elementos o criterios que otros actores incluyeron. Otro aspecto positivo, es que se percibió la intención de tomar decisiones enfocadas en el crecimiento de un sector determinado, pero también en mejorar la calidad de vida en la ciudad.

La metodología propuesta responde a la necesidad de diferentes sectores de sentirse incluidos o representados en procesos de toma de decisión, al incluir a algunos actores que tradicionalmente han sido excluidos de estos procesos o solo han mantenido la figura de receptores o seguidores. A su vez, se ha resaltado la cohesión y el poder de los vínculos existentes entre algunos grupos, así como la desconexión entre otros; lo que sugiere que la administración local debe promover más espacios de conversación entre actores. También se ha percibido un distanciamiento entre los habitantes de la ciudad y algunos sectores, por lo que cabe señalar que las partes implicadas, especialmente la administración local y grupos privados, deben trabajar por generar acciones que promuevan un acercamiento.

En cuanto a la utilidad y aplicabilidad de este instrumento a casos similares, el procedimiento es fácil de adaptar a otros sectores estratégicos de la ciudad, a diferentes escalas y en diferentes etapas de la planeación estratégica urbana. Los resultados podrían representar un apoyo para planificadores, administradores locales y gestores urbanos, respondiendo a la demanda de decisiones más incluyentes y obteniendo resultados más transparentes y trazables.

Reflexiones relacionadas con la metodología

La metodología de decisión multicriterio participativa planteada cumple con las características propias de las técnicas utilizadas y al mismo tiempo, cumple con algunas de las inquietudes planteadas en la literatura. El objetivo no fue obtener una solución única con el 'mejor' modelo, sino proponer un marco que promueva la transparencia e integre opiniones contrastadas hacia la toma de decisiones más abierta. El enfoque responde básicamente a los desafíos del desarrollo local y sostenible, sin embargo, también permite abordar otros desafíos utilizando el mismo enfoque sistemático y participativo.

Entre los aportes más significativos de esta metodología se resalta la integración de las técnicas SNA y ANP, la consideración de actores no centrales en el modelo de decisión y la construcción de perfiles de decisión. Entre las principales ventajas se resalta que permite ampliar la visión del problema planteado, combinar técnicas cualitativas y cuantitativas que permitieron acercarse mejor a la realidad del problema y llegar a un consenso desde la perspectiva de múltiples actores. A pesar de que la aplicación de la metodología puede requerir de mayor tiempo que otros métodos de decisión alternativos, queremos destacar que fomenta la participación y promueve una planeación estratégica más estructurada y adaptada. Los resultados también ofrecen algunas ideas sobre el grado de consolidación de un sector y permiten captar diferencias entre percepciones y actitudes entre los interesados.

En cuanto a los estudios de toma de decisiones multicriterio, la metodología aprovecha los puntos fuertes de dos técnicas tan conocidas como SNA y ANP. Sin embargo, una aplicación deficiente de uno de ellos puede afectar la validez de los resultados. De manera general, algunas recomendaciones prácticas e implicaciones se exponen a continuación:

- Se requiere la participación de al menos un agente local interesado por la decisión y en la medida de lo posible que sea clave en la toma de decisión.
- Reunir información, documentación y experiencias anteriores relacionadas con el caso, locales y externas.
- La identificación de los interesados debe ser cuidadosa, se recomienda seleccionar y combinar técnicas. Así mismo, cuando se trate de organizaciones, seleccionar a la persona adecuada para responder al cuestionario e incluso incluir varios perfiles de la misma organización.
- Durante la etapa de la contextualización del problema, conviene recoger puntos de vista y opiniones de interesados centrales y no centrales.
- A la hora de construir una o varias redes de actores se recomienda prestar atención especial al contenido relacional a estudiar.,
- No se requiere un número máximo o mínimo de participantes. Los participantes implicados deben ser conscientes del problema e interesarse por los resultados, por lo que tienen que estar dispuestos a completar los cuestionarios requeridos por el ANP.
- El proceso de elección de elementos es muy sensible. Los elementos considerados denotan el enfoque de la decisión, por ejemplo, considerar solo aspectos económicos denota una decisión basada únicamente en principios de beneficios económicos.
- Hacer uso de mecanismos y canales apropiados de comunicación.

Principales contribuciones

Las principales contribuciones de esta disertación han sido de tipo empírico, tal y como se planteó al inicio. La más importante es el desarrollo en el uso de los métodos de decisión multicriterio, al complementar el uso de la técnica ANP con el SNA en aplicaciones prácticas, para generar un enfoque multicriterio participativo. Se ha demostrado que es una combinación adecuada de dos técnicas ampliamente estudiadas en el campo de la investigación de operaciones.

Es una contribución importante, novedosa y de gran interés en lo referente al uso de técnicas de análisis multicriterio para la toma de decisiones. Permite estudiar las relaciones existentes entre los stakeholders relacionados con un problema, por lo que facilita identificarlos y diferenciarlos antes de considerarlos en un proceso de toma de decisión. Abriendo, además, la posibilidad de explorar las diferenciaciones entre juicios de acuerdo con las centralidades de un actor; o establecer un límite de centralidad donde los actores que superan cierto umbral puedan o no ser considerados. En general, la propuesta abre la posibilidad de explorar nuevas aplicaciones y combinar diversas metodologías que permitan robustecer los procesos asociados a la toma de decisiones, por lo que su uso y explotación es relevante y puede extenderse.

Una de las debilidades percibidas en los estudios en el área está relacionada con la presentación del enfoque utilizado en la elección de los participantes (Mu et al. 2020). La metodología propuesta permite abordar de manera clara su selección, además permite estudiar mejor las preferencias entre distintos grupos de actores relacionados con un mismo problema. Lo cual, resulta de gran interés en temas relacionados con la planeación y el desarrollo territorial, así como en muchas otras áreas de aplicación para dar cumplimiento a otros tipos de objetivos.

Por su parte, cada una de las publicaciones producto de esta disertación representan una contribución particular en el área. Entre otras propuestas novedosas introducidas a lo largo de esta disertación, se destaca la inclusión de actores centrales y no centrales en los procesos de decisión, y la generación de perfiles de decisión entre los participantes. También se resalta la síntesis novedosa de la literatura propuesta, y adicionalmente, la aplicación del enfoque multicriterio en problemas relacionados con la industria naval y la planeación de rutas peatonales. En el caso del turismo hay evidencias del uso por separado de las dos técnicas, pero no del uso combinado.

En resumen, hemos encontrado que la propuesta de combinar las metodologías ANP-SNA es una manera novedosa y útil de abordar cualquier tipo de problema de decisión con enfoque multicriterio, sostenible y participativo.

Limitaciones y líneas futuras

La primera de las limitaciones a mencionar está relacionada con el acceso a la información. Los casos propuestos se llevaron a cabo en diferentes sectores del gobierno local de la ciudad, sin embargo, durante el desarrollo de los tres casos las circunstancias políticas de la ciudad fueron cambiantes, por lo que el acceso a ciertos actores, las condiciones de recolección de información y las prácticas al interior de cada sector fueron diferentes. Este mismo periodo de inestabilidad gubernamental, no permitió mantener una comunicación fluida con los decisores.

Lo anterior también está relacionado con la siguiente limitación, el trabajo a distancia, que afectó principalmente a la recolección de la información. Algunos de los actores invitados a participar no respondieron y en otros casos las respuestas tomaron más tiempo del esperado, también hubiera sido interesante realizar la presentación y devolución de los resultados directamente en la ciudad.

Como siguiente limitación se puede mencionar la trazabilidad de otras experiencias, aunque la ciudad ha realizado otros ejercicios de planeación con la participación de diferentes actores, no se han encontrado datos que permitieran contrastar resultados entre experiencias. Una última

limitación sugiere que durante la fase de identificación de actores o stakeholders, algunos grupos o colectivos también pudieron haber quedado fuera de este ejercicio, en línea con otras corrientes de planeación urbana que pueden ser explorados en nuevas aplicaciones.

En lo que respecta a líneas de investigación futura, en el entorno de la ciudad de Cartagena, resaltamos la necesidad de fomentar el uso de metodologías estructuradas y procesos resilientes a la inestabilidad gubernamental.

En cuanto a la metodología propuesta, la vía más clara es su aplicación en otros contextos y la utilización de otros enfoques. También es interesante explorar nuevas estrategias complementarias durante diferentes etapas del proceso de decisión, retroalimentación y puesta en marcha de las decisiones. Lo más importante es que las nuevas aplicaciones y estrategias a incluir deben ser consideradas, procurando mantener y mejorar la sencillez de los modelos. Algunas de las recomendaciones pueden ser: desarrollar instrumentos que faciliten la recolección de información, la identificación de stakeholders y la interacción con los participantes; diseñar indicadores de seguimiento y evaluación durante las etapas de ejecución de los proyectos a partir de los criterios de evaluación seleccionados; o explorar la combinación con otras técnicas MCDM y con DEMATEL, que han tomado fuerza en la literatura. Este último, ha demostrado ser útil para la identificación de componentes de la cadena causa-efecto de un sistema complejo y ha sido ampliamente utilizado durante la última década (Sheng-Li et al. 2018).

El manejo del conflicto, el estudio del consenso y los análisis de sensibilidad de los resultados pueden ser otras vías interesantes por explorar, por ejemplo, a través del análisis de la dispersión de los juicios emitidos (Saaty and Vargas 2007).

Por otra parte, aunque estaba clara la intención de complementariedad y no de comparación entre los casos de estudio diseñados para esta tesis, la estrategia de investigación de múltiples casos sugiere el uso de algunas metodologías de comparación y la documentación de otros procesos de decisión que permitieran comparar experiencias.

Finalmente, desde otras perspectivas también es posible plantear nuevas discusiones a partir de la concepción de la participación de actores y de los conceptos de sostenibilidad, desarrollo sostenible y local, así como la forma de abordarlos desde diferentes aspectos prácticos de la planeación. Por ejemplo, a partir de la aplicación en otros sectores estratégicos en la misma ciudad, los mismos sectores en otras ciudades del mismo país o en contextos similares; o a través de enfoques como la infraestructura y la economía verde (Khoshnava, Rostami, Zin, Streimikiene, Yousefpour, Mardani, et al. 2019), las ciudades inclusivas (Banco Mundial y el Programa ONU Mujeres), las ciudades inteligentes, las ciudades ubicuas ‘u-cities’ (Ghaemi Rad et al. 2018), las ciudades lentas (movimiento ‘Cittaslow’) o la planeación orientada por misiones.

En conclusión, dada la naturaleza exploratoria y descriptiva de esta disertación, a partir de ella se abren nuevos debates, surgen nuevas ideas y se exploran nuevas estrategias. Por lo tanto, el problema de las decisiones durante las etapas de planeación y de la evaluación de proyectos estratégicos para el desarrollo local sostenible sigue siendo un campo interesante por explorar y resolver.

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Appendices

Appendix A.1. Preliminary search equations and keywords combination used on the systematic literature review. Query developed on April 20, 2019.

Database	Search field	Equations query	Results	Comments
Web of Science WOS	Core Collection/ Basic Search/ Topic	"Analytic Network Process"	1,929	A general search to scan the existing body of knowledge.
		"Analytic* Network Process" AND ANP	1,673	
		("Analytic* Network Process" AND ANP) AND ("strategic planning" AND sustainab*)	8	Little results. Rejected.
		("Analytic* Network Process" AND ANP) AND ("sustainable development" OR "sustainable evaluation" OR "sustainable planning" OR sustainab*)	260	Similar results. Rejected.
		("Analytic* Network Process" AND ANP) AND (sustainab* AND (development OR evaluat* OR planni* OR prioriti* OR select* OR assess* OR rank*))	253	
		(Analytic* Network Process AND ANP) AND Sustainab*	256 291*	Selected.
Scopus	Document search/ Article title, Abstract, Keywords	"Analytic Network Process"	2,681	A general search to scan the existing body of knowledge.
		"Analytic* Network Process" AND ANP	2,087	
		("Analytic* Network Process" AND ANP) AND ("strategic planning" AND sustainab*)	19	Little results. Rejected.
		("Analytic* Network Process" AND ANP) AND ("sustainable development" OR "sustainable evaluation" OR "sustainable planning" OR sustainab*)	283	Similar results. Rejected.
		("Analytic* Network Process" AND ANP) AND (sustainab* AND (development OR evaluat* OR planni* OR prioriti* OR select* OR assess* OR rank*))	273	
		(Analytic* Network Process AND ANP) AND Sustainab*	271 301	Selected.
ScienceDirect	Advanced search/ Title, abstract, keywords:	("Analytic network process" AND ANP) AND (sustainability OR sustainable)	85 93*	Selected.
		("Analytic network process" AND ANP) AND (“sustainable development”)	29	Rejected.
Total results			**612** **685***	

*Updating query developed on February 20, 2020.

Appendix A.2. List of manuscripts obtained in the systematic literature review.

Item	Year	Author	Title
1	2005	Ravi, V., Shankar, R. and Tiwari, M.K.	Analyzing alternatives in reverse logistics for end-of-life computers: ANP and balanced scorecard approach
2	2005	Wolfslehner, B., Vacik, H. and Lexer, M.	Application of the analytic network process in multi-criteria analysis of sustainable forest management
3	2006	Chen, Z., Clements-Croome, D., Hong, J., Li, H. and Xu, Q.	A multicriteria lifespan energy efficiency approach to intelligent building assessment
4	2007	Koene, A.C. and Bueke, T.	An Analytical Network Process (ANP) evaluation of alternative fuels for electricity generation in Turkey
5	2008	Bottero, M.C. and Mondini, G.	An appraisal of analytic network process and its role in sustainability assessment in Northern Italy
6	2008	Chen, Z., Li, H., Ross, A., Khalfan, M.M.A. and Kong, S.C.W.	Knowledge-Driven ANP Approach to Vendors Evaluation for Sustainable Construction
7	2008	Isaacs, J., Falconer, R., Blackwood, D., Bannatyne, M., Counsell, J., Cowell, A.J., Dastbaz, M., Hou, M., Khosrowshahi, F., Laing, R., Scarano, V., Tian, G.Y., Ursyn, A. and Zhang, J.	A unique approach to visualising sustainability in the built environment
8	2008	Parra-Lopez, C., Groot, J.C.J., Carmona-Torres, C. and Rossing, W.A	Integrating public demands into model-based design for multifunctional agriculture: An application to intensive Dutch dairy landscapes
9	2008	Wolfslehner, B. and Vacik, H.	Evaluating sustainable forest management strategies with the Analytic Network Process in a Pressure-State-Response framework
10	2008	Yilmaz, A.K.	The enterprise risk management model for corporate sustainability and selection of the best ERM operator in the Turkish Automotive Distributor Company: ANP based approach
11	2009	Chen, Z. and Khumpaisal, S.	An analytic network process for risks assessment in commercial real estate development
12	2009	Tsai, W.-H. and Chou, W.-C.	Selecting management systems for sustainable development in SMEs: A novel hybrid model based on DEMATEL, ANP, and ZOGP
13	2009	Tsai, W.-H., Chou, W.-C. and Hsu, W.	The sustainability balanced scorecard as a framework for selecting socially responsible investment: an effective MCDM model
14	2009	Tseng, M.-L., Divinagracia, L. and Divinagracia, R.	Evaluating firm's sustainable production indicators in uncertainty
15	2010	Bottero, M.C. and Ferretti, V.	An analytic network process-based approach for location problems: The case of a new waste incinerator plant in the province of torino (Italy)
16	2010	Bottero, M.C. and Ferretti, V.	Integrating the analytic network process (ANP) and the driving force-pressure-state-impact- responses (DPSIR) model for the sustainability assessment of territorial transformations
17	2010	Chen, V.Y.-C. and Tzeng, G.-H.	The best project selection for the environment planning of coastal wetlands region based on a hybrid MCDM model
18	2010	Garcia-Melon, M., Gomez-Navarro, T. and Acuna-Dutra, S.	An ANP approach to assess the sustainability of Tourist strategies for the coastal national parks of Venezuela
19	2010	Giordano, S., Lombardi, P., Pagani, R., Lehmann, S., AlWaer, H. and AlQawasmi, J.	Ecologies: A New Tool for Evaluating Logistic Settlement
20	2010	Kuo, R.J., Wang, Y.C. and Tien, F.C.	Integration of artificial neural network and MADA methods for green supplier selection
21	2010	Lee, Y.-F. and Chi, Y.-Y.	Using the analytic network process to establish a new evaluation model of environment livability
22	2010	Lin, Y.-H., Cheng, H.-P., Tseng, M.-L.	Using QFD and ANP to analyze the environmental production

Item	Year	Author	Title
		and Tsai, J.C.C.	requirements in linguistic preferences
23	2010	Pourebrahim, S., Hadipour, M., Bin Mokhtar, M. and Mohamed, M.I.H.	Analytic network process for criteria selection in sustainable coastal land use planning
24	2010	Reig, E., Aznar, J. and Estruch, V.	A comparative analysis of the sustainability of rice cultivation technologies using the analytic network process
25	2010	Wang, H.-J. and Zeng, Z.-T.	A multi-objective decision-making process for reuse selection of historic buildings
26	2010	Wang, W.-M., Lee, A.H.I. and Chang, D.-T.	An integrated FDM-ANP evaluation model for sustainable development of housing community
27	2010	Zhu, Q., Dou, Y. and Sarkis, J.	A portfolio-based analysis for green supplier management using the analytical network process
28	2011	Bottero, M.C., Comino, E. and Riggio, V.	Application of the Analytic Hierarchy Process and the Analytic Network Process for the assessment of different wastewater treatment systems
29	2011	Buyukozkan, G. and Berkol, C.	Designing a sustainable supply chain using an integrated analytic network process and goal programming approach in quality function deployment
30	2011	Cui, S., Yang, X., Guo, X., Lin, T., Zhao, Q. and Feng, L.	Increased challenges for world heritage protection as a result of urbanisation in Lijiang City
31	2011	Ferretti, V.	A Multicriteria Spatial Decision Support System Development for Siting a Landfill in the Province of Torino (Italy)
32	2011	Ha, E., Joo, Y. and Jun, C.	An empirical study on sustainable walkability indices for transit-oriented development by using the analytic network process approach
33	2011	Hsu, C.-W., Hu, A.H., Chiou, C.-Y. and Chen, T.-C.	Using the FDM and ANP to construct a sustainability balanced scorecard for the semiconductor industry
34	2011	Jajimoggala, S., Rao, V.V.S.K. and Beela, S.	Supplier evaluation using hybrid multiple criteria decision making approach
35	2011	Kengpol, A. and Boonkanit, P.	The decision support framework for developing Ecodesign at conceptual phase based upon ISO/TR 14062
36	2011	Pourebrahim, S., Hadipour, M. and Bin Mokhtar, M.	Integration of spatial suitability analysis for land use planning in coastal areas; case of Kuala Langat District, Selangor, Malaysia
37	2011	Rivza, S., Pilvere, I., Rivza, P., Rivza, B., Baralt, J., Callaos, N., Ham, C., Lace, N., Lesso, W. and Zinn, C.D.	Conceptual Models of Risk Assessment in Renewable Energy Production in Latvia
38	2011	Tseng, M.-L., Lan, L.W., Wang, R., Chiu, A. and Cheng, H.-P.	Using hybrid method to evaluate the green performance in uncertainty
39	2011	Wolfslehner, B. and Vacik, H.	Mapping indicator models: From intuitive problem structuring to quantified decision-making in sustainable forest management
40	2011	Wu, K.-Y.	Applying the Fuzzy Delphi Method to analyze the sustainable neighborhood unit evaluation factors
41	2011	Xu, Z.	An ANP-SD model for the early warning analysis of sustainable residential development
42	2012	Agarwal, G., Vijayvargy, L., Ao, S.I., Castillo, O., Douglas, C., Feng, D.D. and Lee, J.A.	Green Supplier Assessment in Environmentally Responsive Supply Chains through Analytical Network Process
43	2012	Garcia-Melon, M., Gomez-Navarro, T. and Acuna-Dutra, S.	A combined ANP-delphi approach to evaluate sustainable tourism
44	2012	Ghajar, I. and Najafi, A.	Evaluation of harvesting methods for Sustainable Forest Management (SFM) using the Analytical Network Process (ANP)
45	2012	Horng, J.-S., Hu, M.-L., Teng, C.-C. and Lin, L.	Energy saving and carbon reduction management indicators for natural attractions: a case study in Taiwan
46	2012	Sarkis, J., Meade, L.M. and Presley,	Incorporating sustainability into contractor evaluation and

Item	Year	Author	Title
		A.R.	team formation in the built environment
47	2012	Vinodh, S., Prasanna, M. and Manoj, S.	Application of analytical network process for the evaluation of sustainable business practices in an Indian relays manufacturing organization
48	2012	Yang, S., Liu, Y., Xu, Q.J., Ge, H.H. and Zhang, J.X.	Evaluation System of Sustainable Development for Farmland Shelterbelt Network Based on ANP
49	2013	Agarwal, E., Agarwal, R., Garg, R.D. and Garg, P.K.	Delineation of groundwater potential zone: An AHP/ANP approach
50	2013	Baldemir, E., Kaya, F., Sahin, T.K. and Ozsahin, M.	A Management Strategy within Sustainable City Context: Cittaslow
51	2013	Calabrese, R., Cizelj, L., Leskovar, M. and Ursic, M.	Sustainability and Nuclear Energy: Main Concepts and the Analytic Network Process (ANP) Approach
52	2013	De Carlo, F. and Schiraldi, M.M.	Sustainable choice of the location of a biomass plant: An application in Tuscany
53	2013	De Felice, F., Petrillo, A. and Cooper, O.	An integrated conceptual model to promote green policies
54	2013	Ferretti, V. and Pomarico, S.	Ecological land suitability analysis through spatial indicators: An application of the Analytic Network Process technique and Ordered Weighted Average approach
55	2013	Hsu, C.-W., Lee, W.-H. and Chao, W.-C.	Materiality analysis model in sustainability reporting: a case study at Lite-On Technology Corporation
56	2013	Hu, M.-L., Horng, J.-S., Teng, C.-C. and Chou, S.-F.	A criteria model of restaurant energy conservation and carbon reduction in Taiwan
57	2013	Hu, Z., Zhang, L., Zhou, X.Y., He, G.J., Fan, Y.L., Xiao, Y., Kunnath, S.K. and Monti, G.	Sustainable Comprehensive Evaluation of highway Construction Project Based on ANP-FCE Model
58	2013	Öztaysi, B., Uğurlu, S. and Kahraman, C.	Assessment of green energy alternatives using fuzzy anp
59	2013	Peris, J., Garcia-Melon, M., Gomez-Navarro, T. and Calabuig, C.	Prioritizing Local Agenda 21 Programmes using Analytic Network Process: A Spanish Case Study
60	2013	Pourkhabbaz, H.R., Javanmardi, S., Yavari, A.R. and Sabokbar, H.F.	Application of multi criteria decision making method and the integrated ANP- DEMA TEL model for agricultural land suitability analysis (Case study: Qazvin plain)
61	2013	Tu, J.-C., Chan, H.-Y., Hsu, C.-Y., Chen, C.-K. and Meen, T.H.	Strategy of Lightweight Green Package Development
62	2013	Wang, W.-M., Lee, A.H.I., Peng, L.-P. and Wu, Z.-L.	An integrated decision making model for district revitalization and regeneration project selection
63	2013	Wang, Y., Deng, X., Marcucci, D.J. and Le, Y.	Sustainable Development Planning of Protected Areas near Cities: Case Study in China
64	2013	Wu, C.-M., Hsieh, C.-L. and Chang, K.-L.	A Hybrid Multiple Criteria Decision Making Model for Supplier Selection
65	2014	Aminuddin, A.S.A., Nawawi, M.K.M., Mohamed, N.M.Z.N., Shitan, M., Lee, L.S. and Eshkuvatov, Z.K.	Analytic Network Process Model For Sustainable Lean And Green Manufacturing Performance Indicator
66	2014	Bhattacharya, A., Mohapatra, P., Kumar, V., Dey, P.K., Brady, M., Tiwari, M.K. and Nudurupati, S.S.	Green supply chain performance measurement using fuzzy ANP-based balanced scorecard: a collaborative decision-making approach
67	2014	Carmona-Torres, C., Parra-López, C., Hinojosa-Rodríguez, A. and Sayadi, S.	Farm-level multifunctionality associated with farming techniques in olive growing: An integrated modeling approach
68	2014	Dou, Y., Zhu, Q. and Sarkis, J.	Evaluating green supplier development programs with a grey-analytical network process-based methodology
69	2014	Ferretti V, Bottero, M.C, Mondini, G., Murgante B., Misra S., Rocha A., Torre, C., Rocha, J.G., Falcao, M., Taniar, D., Apduhan, B & Gervasi, O.	An Integrated Approach for Exploring Opportunities and Vulnerabilities of Complex Territorial Systems
70	2014	Koçak, S.A., Alptekin, G.I. and Bener, A.B.	Evaluation of software product quality attributes and environmental attributes using ANP decision framework

Item	Year	Author	Title
71	2014	Modica, G., Laudari, L.L., Barreca, F. and Fichera, C.R.	A GIS-MCDA based model for the suitability evaluation of traditional grape varieties: The case-study of 'Mantonico' grape (Calabria, Italy)
72	2014	Paul, V. and Jayant, A.	A green supplier selection model for an agriculture-machinery industry
73	2014	Pourkhabbaz, H.R., Javanmardi, S. and Sabokbar, H.F.	Suitability Analysis for Determining Potential Agricultural Land Use by the Multi-Criteria Decision Making Models SAW and VIKOR-AHP (Case study: Takestan-Qazvin Plain)
74	2014	Rabbani, A., Zamani, M., Yazdani-Chamzini, A. and Zavadskas, E.K.	Proposing a new integrated model based on sustainability balanced scorecard (SBSC) and MCDM approaches by using linguistic variables for the performance evaluation of oil producing companies
75	2014	Razavi Toosi, S.L. and Samani, J.M.V.	A New Integrated MADM Technique Combined with ANP, FTOPSIS and Fuzzy Max-Min Set Method for Evaluating Water Transfer Projects
76	2014	Tadic, S., Zecevic, S. and Krstic, M.	A novel hybrid MCDM model based on fuzzy DEMATEL, fuzzy ANP and fuzzy VIKOR for city logistics concept selection
77	2014	Theissen, S. and Spinler, S.	Strategic analysis of manufacturer-supplier partnerships: An ANP model for collaborative CO2 reduction management
78	2014	Wang, X., Chan, H.K. and White, L.	A comprehensive decision support model for the evaluation of eco-designs
79	2014	Wong, W.P. and Wong, K.Y.	Synergizing an ecosphere of lean for sustainable operations
80	2014	Wong, W.P., Ignatius, J. and Soh, K.L.	What is the leanness level of your organisation in lean transformation implementation? An integrated lean index using ANP approach
81	2014	Wu, K.-Y., Wu, Y.-Y., Tsai, I.-T., Yung, S.-W., Lai, Y.S. and Hsu, F.Y.	Critical Factors for the Construction Company to Select the Green Building Materials
82	2015	Baviera-Puig, A., Gomez-Navarro, T., Garcia-Melon, M. and Garcia-Martinez, G.	Assessing the Communication Quality of CSR Reports. A Case Study on Four Spanish Food Companies
83	2015	Bottero, M.C., Buffoli, M., Capolongo, S., Cavagliato, E., di Noia, M., Gola, M., Speranza, S., Volpatti, L., Capolongo, S., Bottero, M.C., Buffoli, M. and Lettieri, E.	A Multidisciplinary Sustainability Evaluation System for Operative and In-Design Hospitals
84	2015	Chang, D.-S., Chen, S.-H., Hsu, C.-W., Hu, A.H. and Tzeng, G.-H.	Evaluation Framework for Alternative Fuel Vehicles: Sustainable Development Perspective
85	2015	Chen, W.-C., Wang, L.-Y. and Lin, M.-C.	A Hybrid MCDM Model for New Product Development: Applied on the Taiwanese LiFePO4 Industry
86	2015	Fetanat, A. and Khorasaninejad, E.	A novel hybrid MCDM approach for offshore wind farm site selection: A case study of Iran
87	2015	Groselj, P. and Stirn, L.Z.	The environmental management problem of Pohorje, Slovenia: A new group approach within ANP - SWOT framework
88	2015	Hashemi, S.H., Karimi, A. and Tavana, M.	An integrated green supplier selection approach with analytic network process and improved Grey relational analysis
89	2015	Jaafari, A., Najafi, A. and Garcia-Melon, M.	Decision-making for the selection of a best wood extraction method: An analytic network process approach
90	2015	Jayakrishna, K., Vimal, K.E.K. and Vinodh, S.	ANP based sustainable concept selection
91	2015	Koene, A.C., Garcia-Melon, M., Aragones-Beltran, P. and Bueke, T.	Measuring economic sustainability of energy use: An ANP-based evaluation of some European Union countries and Turkey
92	2015	Lam, J.S.L.	Designing a sustainable maritime supply chain: A hybrid QFD-ANP approach
93	2015	Lam, J.S.L. and Dai, J.	Environmental sustainability of logistics service provider: an ANP-QFD approach

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94	2015	Lam, J.S.L. and Lai, K.-h.	Developing environmental sustainability by ANP-QFD approach: the case of shipping operations
95	2015	Lin, C., Madu, C.N., Kuei, C.-h., Tsai, H.-L. and Wang, K.-n.	Developing an assessment framework for managing sustainability programs: A Analytic Network Process approach
96	2015	Mohammadi, M.F., Najafi, A. and Ahmadlo, F.	Using the Analytical Network Process (ANP) based on BOCR Model to select the most suitable region for forestation with almond species
97	2015	Molinos-Senante, M., Gomez, T., Caballero, R., Hernandez-Sancho, F. and Sala-Garrido, R.	Assessment of wastewater treatment alternatives for small communities: An analytic network process approach
98	2015	Najafinasab, F., Karbassi, A.R. and Ghoddousi, J.	Fuzzy analytic network process approach to evaluate land and sea criteria for land use planning in coastal areas
99	2015	Neumueller, C., Kellner, F., Gupta, J.N.D. and Lasch, R.	Integrating three-dimensional sustainability in distribution centre selection: the process analysis method-based analytic network process
100	2015	Ocampo, L. and Ocampo, C.O.	A robust evaluation of sustainability initiatives with analytic network process (ANP)
101	2015	Ozcan-Deniz, G. and Zhu, Y.	A multi-objective decision-support model for selecting environmentally conscious highway construction methods
102	2015	Poplawska, J., Labib, A. and Reed, D.M.	A hybrid multiple-criteria decision analysis framework for corporate social responsibility implementation applied to an extractive industry case study
103	2015	Ramkumar, M. and Jenamani, M.	Sustainability in Supply Chain Through E-Procurement-An Assessment Framework Based on DANP and Liberatore Score
104	2015	Ren, J., Tan, S., Goodsite, M.E., Sovacool, B.K. and Dong, L.	Sustainability, shale gas, and energy transition in China: Assessing barriers and prioritizing strategic measures
105	2015	Shehada, Z.M.M., Bin Ahmad, Y., Yaacob, N.M. and Keumala, N.I.M.	Developing Methodology for Adaptive Re-Use: Case Study of Heritage Buildings in Palestine
106	2015	Staš, D., Lenort, R., Wicher, P. and Holman, D.	Green transport balanced scorecard model with analytic network process support
107	2015	Tseng, M., Lim, M. and Wong, W.P.	Sustainable supply chain management A closed-loop network hierarchical approach
108	2015	Xu, P., Chan, E.H.W., Visscher, H.J., Zhang, X. and Wu, Z.	Sustainable building energy efficiency retrofit for hotel buildings using EPC mechanism in China: analytic Network Process (ANP) approach
109	2015	Zabihi, H., Ahmad, A., Vogeler, I., Said, M.N., Golmohammadi, M., Golein, B. and Nilashi, M.	Land suitability procedure for sustainable citrus planning using the application of the analytical network process approach and GIS
110	2015	Zafeirakopoulos, I.B. and Genevois, M.E.	An Analytic Network Process approach for the environmental aspect selection problem - A case study for a hand blender
111	2015	Zhang, Y. and Wang, J.	Optimization of the scheme for natural ecology planning of urban rivers based on ANP (analytic network process) model
112	2015	Zhao, H. and Li, N.	Evaluating the performance of thermal power enterprises using sustainability balanced scorecard, fuzzy Delphic and hybrid multi-criteria decision making approaches for sustainability
113	2016	Amrina, E., Ramadhani, C. and Vilsi, A.L.	A Fuzzy Multi Criteria Approach for Sustainable Manufacturing Evaluation in Cement Industry
114	2016	Arabsheibani, R., Sadat, Y.K. and Abedini, A.	Land suitability assessment for locating industrial parks: a hybrid multi criteria decision-making approach using Geographical Information System
115	2016	Buyukozkan, G. and Guleryuz, S.	An integrated DEMATEL-ANP approach for renewable energy resources selection in Turkey
116	2016	Celikbilek, Y. and Tuysuz, F.	An integrated grey based multi-criteria decision making approach for the evaluation of renewable energy sources
117	2016	Chung, C.-C., Chao, L.-C. and Lou, S.-J.	The Establishment of a Green Supplier Selection and Guidance

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			Mechanism with the ANP and IPA
118	2016	Chung, C.-C., Chao, L.-C., Chen, C.-H. and Lou, S.-J.	A Balanced Scorecard of Sustainable Management in the Taiwanese Bicycle Industry: Development of Performance Indicators and Importance Analysis
119	2016	Dezhi, L., Yanchao, C., Hongxia, C., Kai, G., Hui, E.C.-M. and Yang, J.	Assessing the integrated sustainability of a public rental housing project from the perspective of complex eco-system
120	2016	Dimic, S., Pamucar, D., Ljubojevic, S. and Dorovic, B.	Strategic Transport Management ModelsThe Case Study of an Oil Industry
121	2016	Egea, P. and Pérez y Pérez, L.	Sustainability and multifunctionality of protected designations of origin of olive oil in Spain
122	2016	El Chanati, H., El-Abbasy, M.S., Mosleh, F., Senouci, A., Abouhamad, M., Gkountis, I., Zayed, T. and Al-Derham, H.	Multi-Criteria Decision Making Models for Water Pipelines
123	2016	Girubha, J., Vinodh, S. and Kek, V.	Application of interpretative structural modelling integrated multi criteria decision making methods for sustainable supplier selection
124	2016	Groselj, P., Hodges, D.G. and Stirn, L.Z.	Participatory and multi-criteria analysis for forest (ecosystem) management: A case study of Pohorje, Slovenia
125	2016	Hussain, M., Awasthi, A. and Tiwari, M.K.	Interpretive structural modeling-analytic network process integrated framework for evaluating sustainable supply chain management alternatives
126	2016	Jayant, A., Srivastava, T., Rani, S. and Kakkar, S.	An Application of Analytic Network Process (ANP) To Evaluate Green Supply Chain Management Strategies: A Case Study
127	2016	Kusi-Sarpong, S., Sarkis, J. and Wang, X.	Assessing green supply chain practices in the Ghanaian mining industry: A framework and evaluation
128	2016	Li, C.-N., Lo, C.-W., Su, W.-C., Lai, T.-Y. and Hsieh, T.-K.	A Study on Location-Based Priority of Soil and Groundwater Pollution Remediation
129	2016	Neumueller, C., Lasch, R. and Kellner, F.	Integrating sustainability into strategic supplier portfolio selection
130	2016	Ocampo, L. and Promentilla, M.A.	Development of a sustainable manufacturing strategy using analytic network process
131	2016	Ou, Y.-C.	Using a Hybrid Decision-Making Model to Evaluate the Sustainable Development Performance of High-Tech Listed Companies
132	2016	Palmisano, G.O., Loisi, R.V., Ruggiero, G., Rocchi, L., Boggia, A., Roma, R. and Dal Sasso, P.	Using Analytic Network Process and Dominance-based Rough Set Approach for sustainable requalification of traditional farm buildings in Southern Italy
133	2016	Raji, M. and Zualkernan, I.	A Decision Tool for Selecting a Sustainable Learning Technology Intervention
134	2016	Razavi Toosi, S.L. and Samani, J.M.V.	Evaluating water management strategies in watersheds by new hybrid Fuzzy Analytical Network Process (FANP) methods
135	2016	Ren, J., Xu, D., Cao, H., Wei, S., Dong, L. and Goodsite, M.E.	Sustainability Decision Support Framework for Industrial System Prioritization
136	2016	Vimal, K.E.K. and Vinodh, S.	LCA Integrated ANP Framework for Selection of Sustainable Manufacturing Processes
137	2016	Wang, X., Zhao, G., He, C., Wang, X. and Peng, W.	Low-carbon neighborhood planning technology and indicator system
138	2016	Wey, W.-M., Zhang, H. and Chang, Y.-J.	Alternative transit-oriented development evaluation in sustainable built environment planning
139	2016	Wu, C. and Barnes, D.	An integrated model for green partner selection and supply chain construction
140	2016	Wu, Y., Yang, M., Zhang, H., Chen, K. and Wang, Y.	Optimal Site Selection of Electric Vehicle Charging Stations Based on a Cloud Model and the PROMETHEE Method
141	2016	Zarei, M., Mohamad Reza, F., Mohammad Seddiq, M., Pourebrahim,	Selection of the optimal tourism site using the ANP and fuzzy TOPSIS in the framework of Integrated Coastal Zone

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		S. and Ghoddousi, J.	Management: A case of Qeshm Island
142	2016	Zhang, J.	Weighing and realizing the environmental, economic and social goals of tourism development using an analytic network process-goal programming approach
143	2017	Aminu, M., Matori, A.N., Yusof, K.W., Malakahmad, A. and Zainol, R.B.	Analytic network process (ANP)-based spatial decision support system (SDSS) for sustainable tourism planning in Cameron Highlands, Malaysia
144	2017	Chen, R.-S. and Tsai, C.-M.	Development of an Evaluation System for Sustaining Reservoir Functions-A Case Study of Shiwen Reservoir in Taiwan
145	2017	Chou, Y.-C., Yang, C.-H., Lu, C.-H., Dang, V.T. and Yang, P.-A.	Building Criteria for Evaluating Green Project Management: An Integrated Approach of DEMATEL and ANP
146	2017	Dalvi-Esfahani, M., Ramayah, T. and Nilashi, M.	Modelling upper echelons' behavioural drivers of Green IT/IS adoption using an integrated Interpretive Structural Modelling - Analytic Network Process approach
147	2017	Daneshvar, M.R.M., Khatami, F. and Shirvani, S.	GIS-based land suitability evaluation for building height construction using an analytical process in the Mashhad city, NE Iran
148	2017	Deniz, G.O.	An analytic network process (ANP) model to examine LEED-certified buildings' operational performance
149	2017	Faisal, M.N., Al-Esmael, B. and Sharif, K.J.	Supplier selection for a sustainable supply chain Triple bottom line (3BL) and analytic network process approach
150	2017	Gonzalez-Urango, H. and Garcia-Melon, M.	A Multicriteria Model to Evaluate Strategic Plans for the Nautical and Naval Industry in Cartagena de Indias, Colombia
151	2017	Grimaldi, M., Pellecchia, V. and Fasolino, I.	Urban Plan and Water Infrastructures Planning: A Methodology Based on Spatial ANP
152	2017	Habib, M.S. and Sarkar, B.	An Integrated Location-Allocation Model for Temporary Disaster Debris Management under an Uncertain Environment
153	2017	He, C., Zhang, Q., Ren, J. and Li, Z.	Combined cooling heating and power systems: Sustainability assessment under uncertainties
154	2017	Ismail, A.H. and Mahardika, R.Z.Z.	Supplier selection in supply chain management using analytical network process for Indonesian cement industry
155	2017	Kao, L.-S., Chiu, Y.-H. and Tsai, C.-Y.	An Evaluation Study of Urban Development Strategy Based on of Extreme Climate Conditions
156	2017	Noorollahi, E., Fadai, D., Ghodsipour, S.H. and Shirazi, M.A.	Developing a new optimization framework for power generation expansion planning with the inclusion of renewable energy-A case study of Iran
157	2017	Noorzai, E., Hosseini, A., Jafari, K.G. and Aghaeipoor, M.	Providing a Model to Select an Optimum Multifamily Housing Method in Iran
158	2017	Pak, B.K., Albayrak, Y.E. and Erensal, Y.C.	Evaluation of Sources for the Sustainability of Energy Supply in Turkey
159	2017	Pakand, M. and Toufigh, V.	A multi-criteria study on rammed earth for low carbon buildings using a novel ANP-GA approach
160	2017	Poh, K.L. and Liang, Y.	Multiple-Criteria Decision Support for a Sustainable Supply Chain: Applications to the Fashion Industry
161	2017	Poplawska, J., Labib, A. and Reed, D.M.	From vicious to virtuous circles: problem structuring for quantified decision making in operationalization of corporate social responsibility
162	2017	Pourebrahim, S. and Amoushahi, S.	Land quality management for ecotourism development; Case of Mahallat district
163	2017	Sen, P., Roy, M. and Pal, P.	Evaluation of environmentally conscious manufactuiing programs using a three-hybrid multi-criteria decision analysis method
164	2017	Soota, T.	Integrated approach for sustainable product development using QFD and ANP
165	2017	Tahseen, S. and Karney, B.	Opportunities for increased hydropower diversion at Niagara: An SWOT analysis

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166	2017	Tavana, M., Yazdani, M. and Di Caprio, D.	An application of an integrated ANP-QFD framework for sustainable supplier selection
167	2017	Wang, X., Li, C., Shang, J., Yang, C., Zhang, B. and Ke, X.	Strategic Choices of China's New Energy Vehicle Industry: An Analysis Based on ANP and SWOT
168	2017	Wu, J.-Z., Santoso, C.H. and Roan, J.	Key factors for truly sustainable supply chain management an investigation of the coal industry in Indonesia
169	2017	Wu, Y., Wang, Y., Chen, K., Xu, C. and Li, L.	Social sustainability assessment of small hydropower with hesitant PROMETHEE method
170	2017	Zhang, H., Peng, Y., Tian, G., Wang, D. and Xie, P.	Green material selection for sustainability: A hybrid MCDM approach
171	2017	Zhao, X., Chen, L., Pan, W. and Lu, Q.	AHP-ANP-Fuzzy Integral Integrated Network for Evaluating Performance of Innovative Business Models for Sustainable Building
172	2017	Zhou, X. and Xu, Z.	An Integrated Decision Making Model for Sustainable Supplier Selection Under Uncertain Environment
173	2018	Abdel-Basset, M., Mohamed, M. and Smarandache, F.	A Hybrid Neutrosophic Group ANP-TOPSIS Framework for Supplier Selection Problems
174	2018	Alizadeh, M., Ngah, I., Hashim, M., Pradhan, B. and Pour, A.B.	A Hybrid Analytic Network Process and Artificial Neural Network (ANP-ANN) Model for Urban Earthquake Vulnerability Assessment
175	2018	Alkaff, M., Marimin, Arkeman, Y., Sukardi and Purnomo, H.	Supply chain management on the production process and distribution flows of the superior teak seeds production
176	2018	Arsic, S., Nikolic, D., Mihajlovic, I., Fedajev, A. and Zivkovic, Z.	A New Approach Within ANP-SWOT Framework for Prioritization of Ecosystem Management and Case Study of National Park Djerdap, Serbia
177	2018	Chakraborty, K., Mondal, S. and Mukherjee, K.	Developing a causal model to evaluate the critical issues in reverse supply chain implementation
178	2018	Chand, M., Bhatia, N. and Singh, R.K.	ANP-MOORA-based approach for the analysis of selected issues of green supply chain management
179	2018	Chatterjee, K., Pamucar, D. and Zavadskas, E.K.	Evaluating the performance of suppliers based on using the R'AMATEL-MAIRCA method for green supply chain implementation in electronics industry
180	2018	Chen, C., Ao, Y., Wang, Y. and Li, J.	Performance appraisal method for rural infrastructure construction based on public satisfaction
181	2018	Chen, E., Cao, H., Wang, K., Jafar, S. and He, Q.	Technological updating decision-making model for eco-factory through dynamic programming
182	2018	Chen, L. and Ren, J.	Multi-attribute sustainability evaluation of alternative aviation fuels based on fuzzy ANP and fuzzy grey relational analysis
183	2018	Chuang, Y.H., Yu, R.F., Chen, W.Y., Chen, H.W. and Su, Y.T.	Sustainable planning for a coastal wetland system with an integrated ANP and DPSIR model for conflict resolution
184	2018	De Brito, M.M., Evers, M. and Almoradie, A.D.S.	Participatory flood vulnerability assessment: a multi-criteria approach
185	2018	Dragoi, M.	Joining or not joining non-industrial private forests into a single management unit: A case-study shaped as an Analytic Network Process
186	2018	Duman, G.M., Taskaynatan, M., Kongar, E. and Rosentrater, K.A.	Integrating Environmental and Social Sustainability Into Performance Evaluation: A Balanced Scorecard-Based Grey-DANP Approach for the Food Industry
187	2018	Ervural, B.C., Zaim, S., Demirel, O.F., Aydin, Z. and Delen, D.	An ANP and fuzzy TOPSIS-based SWOT analysis for Turkey's energy planning
188	2018	Fang, W., Tang, L., Cheng, P. and Ahmad, N.	Evolution Decision, Drivers and Green Innovation Performance for Collaborative Innovation Center of Ecological Building Materials and Environmental Protection Equipment in Jiangsu Province of China
189	2018	Ghaemi Rad, T., Sadeghi-Niaraki, A., Abbasi, A. and Choi, S.-M.	A methodological framework for assessment of ubiquitous cities using ANP and DEMATEL methods

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190	2018	Gonzalez-Urango, H. and Garcia-Melon, M.	Stakeholder engagement to evaluate tourist development plans with a sustainable approach
191	2018	Haruna, A., Shafiq, A., Montasir, O.A. and Haruna, S.	Barriers for developing Building with low embodied energy multi criteria decision making approach
192	2018	Hashemi, S.H., Abdi, M. and Goh, M.	An integrated approach to evaluate suppliers in a sustainable supply chain
193	2018	Horng, J.-S., Hsu, H. and Tsai, C.-Y.	An assessment model of corporate social responsibility practice in the tourism industry
194	2018	Jesiya, N.P. and Gopinath, G.	Groundwater suitability zonation with synchronized GIS and MCDM approach for urban and peri-urban phreatic aquifer ensemble of southern India
195	2018	Jiang, P., Hu, Y.-C., Yen, G.-F. and Tsao, S.-J.	Green supplier selection for sustainable development of the automotive industry using grey decision-making
196	2018	Kannan, D.	Role of multiple stakeholders and the critical success factor theory for the sustainable supplier selection process
197	2018	Khan, M.A., Ali, A., ul Husnain, M.I. and Zakaria, M.	Analysis of power plants in China Pakistan economic corridor (CPEC): An application of analytic network process (ANP)
198	2018	Khoshnava, S.M., Rostami, R., Valipour, A., Ismail, M. and Rahmat, A.R.	Rank of green building material criteria based on the three pillars of sustainability using the hybrid multi criteria decision making method
199	2018	Liu, K.-M., Lin, S.-H., Hsieh, J.-C. and Tzeng, G.-H.	Improving the food waste composting facilities site selection for sustainable development using a hybrid modified MADM model
200	2018	Liu, R., Sun, H., Zhang, L., Zhuang, Q., Zhang, L., Zhang, X. and Chen, Y.	Low-Carbon Energy Planning: A Hybrid MCDM Method Combining DANP and VIKOR Approach
201	2018	Liu, Y., Wang, H. and Tzeng, G.-H.	From Measure to Guidance: Galactic Model and Sustainable Development Planning toward the Best Smart City
202	2018	Mahmoudkelaye, S., Taghizade Azari, K., Pourvaziri, M. and Asadian, E.	Sustainable material selection for building enclosure through ANP method
203	2018	Malviya, R.K., Kant, R. and Gupta, A.D.	Evaluation and Selection of Sustainable Strategy for Green Supply Chain Management Implementation
204	2018	Manupati, V.K., Ramkumar, M. and Samanta, D.	A multi-criteria decision making approach for the urban renewal in Southern India
205	2018	Marimin and Safriyana	Evaluation of palm oil supply chain's performance, added value, and performance improvement: A case study at X Co.
206	2018	Mavi, R.K. and Standing, C.	Critical success factors of sustainable project management in construction: A fuzzy DEMATEL-ANP approach
207	2018	Ngan, S.L., Promentille, M.A.B., Yatim, P., Lam, H.L. and Er, A.C.	Developing sustainability index for Malaysian palm oil industry with fuzzy analytic network process
208	2018	Noorollahi, E., Fadai, D. and Ghodsipour, S.H.	A hybrid multi-criteria assessment framework to prioritise power generation technologies in Iran
209	2018	Nouri, D., Sabour, M.R. and GhanbarzadehLak, M.	Industrial solid waste management through the application of multi-criteria decision-making analysis: a case study of Shamsabad industrial complexes
210	2018	Ocampo, L.	A probabilistic fuzzy analytic network process approach (PROFUZANP) in formulating sustainable manufacturing strategy infrastructural decisions under firm size influence
211	2018	Persada, C., Sitorus, S.R.P., Marimin and Djakapermana, R.D.	Policy Model of Sustainable Infrastructure Development (Case Study : Bandarlampung City, Indonesia)
212	2018	Raut, R., Kharat, M., Kamble, S. and Kumar, C.S.	Sustainable evaluation and selection of potential third-party logistics (3PL) providers: An integrated MCDM approach
213	2018	Sadeghi, A. and Larimian, T.	Sustainable electricity generation mix for Iran: A fuzzy analytic network process approach
214	2018	Sajedi-Hosseini, F., Choubin, B., Solaimani, K., Cerda, A. and Kavian, A.	Spatial prediction of soil erosion susceptibility using a fuzzy analytical network process: Application of the fuzzy decision making trial and evaluation laboratory approach

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215	2018	Sayyadi, R. and Awasthi, A.	An integrated approach based on system dynamics and ANP for evaluating sustainable transportation policies
216	2018	Shao, Q.-G., Liou, J.J.H., Weng, S.-S. and Chuang, Y.-C.	Improving the Green Building Evaluation System in China Based on the DANP Method
217	2018	Torkabadi, A.M., Pourjavad, E. and Mayorga, R.V.	An integrated fuzzy MCDM approach to improve sustainable consumption and production trends in supply chain
218	2018	Wang, C.-N., Nguyen, V.T., Duong, D.H. and Do, H.T.	A Hybrid Fuzzy Analytic Network Process (FANP) and Data Envelopment Analysis (DEA) Approach for Supplier Evaluation and Selection in the Rice Supply Chain
219	2018	Wang, C.-N., Su, C.-C. and Nguyen, V.T.	Nuclear Power Plant Location Selection in Vietnam under Fuzzy Environment Conditions
220	2018	Wang, L., Xue, X., Wang, Z. and Zhang, L.	A Unified Assessment Approach for Urban Infrastructure Sustainability and Resilience
221	2018	Wu, Y., Zhang, B., Xu, C. and Li, L.	Site selection decision framework using fuzzy ANP-VIKOR for large commercial rooftop PV system based on sustainability perspective
222	2018	Xu, X., Liu, J., Xu, N., Wang, W. and Yang, H.	Quantitative Study on the Evolution Trend and Driving Factors of Typical Rural Spatial Morphology in Southern Jiangsu Province, China
223	2018	Yang, J., Yang, C., Song, Y. and Wang, X.	Exploring Promotion Effect for FIT Policy of Solar PV Power Generation Based on Integrated ANP: Entropy Model
224	2018	Yazdani, M., Chatterjee, P., Zavadskas, E.K. and Streimikiene, D.	A novel integrated decision-making approach for the evaluation and selection of renewable energy technologies
225	2018	Zhou, X. and Xu, Z.	An Integrated Sustainable Supplier Selection Approach Based on Hybrid Information Aggregation
226	2018	Zou, T., Su, Y. and Wang, Y.	Research on the Hybrid ANP-FCE Approach of Urban Community Sustainable Construction Problem
227	2019	Abdel-Baset, M., Chang, V., Gamal, A. and Smarandache, F.	An integrated neutrosophic ANP and VIKOR method for achieving sustainable supplier selection: A case study in importing field
228	2019	Al-Mutairi, G.; Mhaisen, F.; Al-Humaidi, R.; Al-Ajran, M.; Al-Bather, H.; Smew, W.	Developing Green Supply Chains for New Kuwait: A strategic approach
229	2019	Cerreta, M.; Poli, G.; Regalbuto, S.; Mazzarella, C.	A Multi-dimensional Decision-Making Process for Regenerative Landscapes: A New Harbour for Naples (Italy)
230	2019	Chauhan, A., Kaur, H., Yadav, S. and Jakhar, S.K.	A hybrid model for investigating and selecting a sustainable supply chain for agri-produce in India
231	2019	Chen, V.Y.-C., Lin, J.C.-L. and Tzeng, G.-H.	Assessment and improvement of wetlands environmental protection plans for achieving sustainable development
232	2019	Choubin, B., Rahmati, O., Tahmasebipour, N., Feizizadeh, B. and Pourghasemi, H.R.	Application of fuzzy analytical network process model for analyzing the gully erosion susceptibility
233	2019	Della Spina, Lucia	Multidimensional Assessment for "Culture-Led" and "Community-Driven" Urban Regeneration as Driver for Trigger Economic Vitality in Urban Historic Centers
234	2019	Dong, J., Liu, D., Wang, D. and Zhang, Q.	Identification of key influencing factors of sustainable development for traditional power generation groups in a market by applying an extended MCDM model
235	2019	Falcone, P.M.	Tourism-based circular economy in Salento (South Italy): A SWOT-ANP analysis
236	2019	Ferwati, M.S., Al Saeed, M., Shafaghat, A. and Keyvanfar, A.	Qatar Sustainability Assessment System (QSAS)-Neighborhood Development (ND) Assessment Model: Coupling green urban planning and green building design
237	2019	Feyzi, S., Khanmohammadi, M., Abedinzadeh, N. and Aalipour, M.	Multi- criteria decision analysis FANP based on GIS for siting municipal solid waste incineration power plant in the north of Iran

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238	2019	Hidayati, J.; Hasibuan, S.	Performance improvement of shrimp feed raw materials in green supply chain
239	2019	Huang, J. and Wey, W.	Application of Big Data and Analytic Network Process for the Adaptive Reuse Strategies of School Land
240	2019	Kamangar, M.; Katorani, S.; Tekyekhah, J.; Sohrabnejad, C.; Haderi, F.G.	A novel hybrid MCDM model to select a suitable location for implement groundwater recharge
241	2019	Khoshnava, Seyed Meysam; Rostami, Raheleh; Zin, Rosli Mohamad; Streimikiene, Dalia; Yousefpour, Alireza; Mardani, Abbas; Alrasheedi, Melfi	Contribution of green infrastructure to the implementation of green economy in the context of sustainable development
242	2019	Khoshnava, Seyed Meysam; Rostami, Raheleh; Zin, Rosli Mohamad; Streimikiene, Dalia; Yousefpour, Alireza; Strielkowski, Wadim; Mardani, Abbas	Aligning the Criteria of Green Economy (GE) and Sustainable Development Goals (SDGs) to Implement Sustainable Development
243	2019	Leksono, Eko Budi; Suparno, Suparno; Vanany, Iwan	Integration of a Balanced Scorecard, DEMATEL, and ANP for Measuring the Performance of a Sustainable Healthcare Supply Chain
244	2019	Movarej, M.; Fami, H.S.; Ameri, Z.D.; Asadi, A.	Analyzing interventions affecting the development of nutrition-sensitive agriculture production using the analytical network process (ANP)
245	2019	Peng, S.-H.	Landscape assessment for stream regulation works in a watershed using the analytic network process (ANP)
246	2019	Phochanikorn, Patchara; Tan, Chunqiao	A New Extension to a Multi-Criteria Decision-Making Model for Sustainable Supplier Selection under an Intuitionistic Fuzzy Environment
247	2019	Putra, E.I.; Supriyanto; Purnomo, H.; Haneda, N.F.; Matangaran, J.R.	The use of Analytical Network Process (ANP) Approach to Assess the Health of Natural Production Forest
248	2019	Sarvari, Hadi; Rakhshanifar, Mansooreh; Tamosaitiene, Jolanta; Chan, Daniel W. M.; Beer, Michael	A Risk Based Approach to Evaluating the Impacts of Zayanderood Drought on Sustainable Development Indicators of Riverside Urban in Isfahan-Iran
249	2019	Shafaghat, A.; Jing, K.S.; Keyvanfar, A.; Jamshidnezhad, A.; Lamit, H.; Khorami, M.	An urban river park restoration assessment model using analytical network process (ANP)
250	2019	Souza Farias, L.M., Santos, L.C., Gohr, C.F. and Rocha, L.O.	An ANP-based approach for lean and green performance assessment
251	2019	Tadic, Snezana; Krstic, Mladen; Roso, Violeta; Brnjac, Nikolina	Planning an Intermodal Terminal for the Sustainable Transport Networks
252	2019	Tao, ZhiMei	Research on the Degree of Coupling between the Urban Public Infrastructure System and the Urban Economic, Social, and Environmental System: A Case Study in Beijing, China
253	2019	Thilini, Malka; Wickramaarachchi, Nishani Champika	Risk assessment in commercial real estate development An application of analytic network process
254	2019	Wicher, Pavel; Zapletal, Frantisek; Lenort, Radim	Sustainability performance assessment of industrial corporation using Fuzzy Analytic Network Process
255	2019	Wu, Kuo-Jui; Gao, Shuo; Xia, Li; Tseng, Ming-Lang; Chiu, Anthony S. F.; Zhang, Zhigang	Enhancing corporate knowledge management and sustainable development: An inter-dependent hierarchical structure under linguistic preferences
256	2019	Xia, L. and Cheng, W.	Sustainable development strategy of rural built-up landscapes in Northeast China based on ANP approach
257	2019	Yu, S., Zheng, Y. and Li, L.	A comprehensive evaluation of the development and utilization of China's regional renewable energy
258	2019	Ziemba, P.	Inter-Criteria Dependencies-Based Decision Support in the Sustainable wind Energy Management

Appendix A.3. Criteria for the analysis of all manuscripts

Item / Number		
Year		
Author		
Title		
Comments		
Primary Classification Application Area	Manufacturing	
	Urban/Territories	
	Business/Management	
	Construction	
	Energy	
	Fuel/biofuel	
	Extraction/ Mining	
	Transport	
	Agricultural	
	Retail	
	Other	
Secondary classification Particular Areas	Decision making on Product development	
	Decision making on Planning of sustainable issues	
	Decision making on Assessment of sustainable aspects	
	Decision making on Sustainable development	
Tertiary classification Specific topics	Cities' performance	Product sustainability level
	Competitive strategies	Product-service system
	Constructed Infrastructure	Quality of public services
	Construction methods	Redesign production
	Corporate sustainable practices	Redevelopment of a urban area
	Drivers/Barriers to sustainable implementations	Resource conservation
		Reverse logistics
	Eco-design	Risks assessment
	Economic sustainability	Selecting contractors
	Emissions	Suppliers' selection/evaluation
	Energy efficiency	Supply chain management
	Energy sources	Sustainability reporting
	Green performance	Sustainable operations
	Hospitals	Sustainable strategy
	ICT - Software Product	Sustainable urbanism
	Impact of pollution emissions	Technology evaluation
	Input/raw material selection	Tourism
	Investment decision	Urban growth
	Land quality	Urban mobility
	Land/coastal planning	Urban policy
	Learning technologies	Urban regeneration
	Location	Waste and landfill management
	New product development	Water management
Goal	Evaluate alternatives	
	Criteria weights	
	Performance evaluation	
	Resource allocation	
Other methods	Other methods and techniques used along with ANP	

Main tool	Main technique
	Peer-to-peer
	No
Use	Alone
	Combined
	Modified
Level of application	Industry/Sector
	Firms/Organizational
	Regional
	Cities
	National
	Buildings/Construction project
	Other
Application country	
Source type	Journal article
	Conference proceedings
	Book
Database	ScienceDirect
	SCOPUS
	WOS

Appendix A.4. Second list of criteria for in-depth analysis.

Node of analysis	Manuscripts (Quantity)
Advantages	51
Concept of sustainability	6
Sustainable development	11
Consistency	5
Constraints	20
Emergent themes	11
Evolution_use	5
Experts	
→ Quantity	37
→ Profile	50
→ Selection	12
Feedback	5
Future_applications	20
Global Result	27
Models	
→ Alternatives	30
→ Cluster	11
→ Construction	64
→ Criteria	71
Selection_reason	63
→ MCDM	18
New_concepts	42
Other techniques	43
Recommendations	4
Sensitivity analysis	17
Software	41
Stakeholders	12

Appendix B.1 Pairwise comparison of model elements. Case 1. Spanish version

EVALUACIÓN DE ESTRATEGIAS PARA MEJORAR EL SECTOR NÁUTICO-NAVAL DE CARTAGENA DE INDIAS

El objetivo de este cuestionario es evaluar las estrategias consideradas como alternativas para mejorar el sector náutico-naval de la ciudad de Cartagena.

El método a utilizar es el Proceso Analítico en Red ANP, que permite valorar criterios de evaluación y comparar alternativas, a partir de la cuantificación de evaluaciones entre pares. Para iniciar se han de realizar comparaciones pareadas entre los grupos de criterios (clústeres) seleccionados (Parte I), luego se valora el grado de influencia (negativa o positiva) entre criterios (Parte II), se compara cada alternativa con los mismos criterios (Parte III); y finalmente, se valora la influencia de los criterios sobre las alternativas (Parte IV). Todo lo anterior nos conduce a una escala de medida relativa de prioridades.

Le solicitamos responda cada parte siguiendo las instrucciones iniciales. Una vez se realicen las primeras comparaciones, las siguientes se realizarán de manera mucho más rápida.

Muchas gracias por su tiempo y dedicación.

INSTRUCCIONES GENERALES

Se deben realizar comparaciones entre los dos criterios o grupos de cada fila. Usted deberá escoger cuál es más influyente y en qué grado, de acuerdo con la escala establecida.

NOTA: Al final del documento, se encuentra la definición de los criterios, clústeres y alternativas consideradas.

Ejemplo: Para usted, ¿Cuál de los dos conjuntos de criterios (Clúster) contribuye más en mejorar el sector náutico-naval de la ciudad de Cartagena? Marque con una "X"

	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
Ambiental	x	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Socio-cultural

La respuesta en este ejemplo significa que: Se considera que el conjunto de criterios Ambientales contribuye extremadamente (9) más que el conjunto de criterios Socio-culturales en mejorar el sector náutico-naval de la ciudad de Cartagena.

INICIO DEL CUESTIONARIO

PARTE I. COMPARACIÓN ENTRE CLUSTERES

Para usted, ¿Cuál de los dos conjuntos de criterios (Clúster) contribuye más en mejorar el sector náutico-naval de la ciudad de Cartagena? Marque con una "X"

	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
1. Ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	2. Socio-cultural
1. Ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	3. Económico
1. Ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	4. Político
2. Socio-cultural	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	3. Económico
2. Socio-cultural	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	4. Político
3. Económico	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	4. Político

PARTE II. INFLUENCIA ENTRE CRITERIOS

En este apartado escoja entre cada par de criterios, cuál de ellos influye más sobre el otro y en qué grado.

Para el criterio **C 1.1 Uso de espacios naturales y del patrimonio material**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad Urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.1 Densidad Urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.3 Aceptación por la población	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

Para el criterio **C 1.2 Riesgos y amenazas medioambientales**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte			Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra

Para el criterio **C 1.3 Impacto ambiental**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte			Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra

Para el criterio **C 1.4 Calidad del agua y de la tierra**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte			Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental

Para el criterio **C 2.2 Renovación urbana generada** ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte			Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

Para el criterio **C 2.3 Aceptación por la población**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte			Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población

C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

Para el criterio **C 2.4 Impacto sobre la Calidad de vida de la población**, ¿Cuál de los dos es más influyente?

	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad

Para el criterio **C 3.1 Impulso a otras actividades económicas**, ¿Cuál de los dos es más influyente?

	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad

Para el criterio **C 3.2 Capacidad de ampliación**, ¿Cuál de los dos es más influyente?

	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

Para el criterio **C 3.3 Inversión necesaria público-privada**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra

Para el criterio **C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región**, ¿Cuál de los dos es más influyente?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad

PARTE III. EVALUACIÓN DE LAS ALTERNATIVAS

En este apartado escoja entre cada par de alternativas, ¿Cuál de ellas prefiere más sobre la otra y en qué grado?

Para el criterio: **C 1.1 Uso de espacios naturales y del patrimonio material**, ¿Cuál de las dos prefiere?																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 1.2 Riesgos y amenazas medioambientales**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 1.3 Impacto ambiental**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 1.4 Calidad del agua y de la tierra**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 2.1 Densidad urbana**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior

A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 2.2 Renovación urbana generada**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 2.3 Aceptación por la población**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 2.4 Impacto sobre la Calidad de vida de la población**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar

A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 3.1 Impulso a otras actividades económicas**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 3.2 Capacidad de ampliación**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 3.3 Inversión necesaria público-privada**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 3.4 Conectividad con el resto de la ciudad,** ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

Para el criterio: **C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región**, ¿Cuál de las dos prefiere?																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A2. Marina Cívica interior
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A1. Marina Cívica exterior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A3. Red interna en zonas a recuperar
A2. Marina Cívica interior	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares
A3. Red interna en zonas a recuperar	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	A4.Red externa en corregimiento insulares

PARTE IV. INFLUENCIA DE LOS CRITERIOS EN LAS ESTRATEGIAS

En este apartado escoja entre cada par de criterios, ¿Cuál de ellos influye más en la priorización de una alternativa?

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A1. Marina Cívica exterior?**																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.3 Aceptación por la población	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A2. Marina Cívica interior?**																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A2. Marina Cívica interior?**																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.3 Aceptación por la población	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A3. Red interna en zonas a recuperar?**																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.3 Aceptación por la población	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A3. Red interna en zonas a recuperar?**																	
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo	
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A4.Red externa en corregimiento insulares?**																		
	Extremo		Muy fuerte		Fuerte		Moderado		Igual	Moderado		Fuerte		Muy fuerte		Extremo		
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.2 Riesgos y amenazas medioambientales
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.1 Uso de espacios naturales y del patrimonio material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.3 Impacto ambiental
C 1.2 Riesgos y amenazas medioambientales	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 1.3 Impacto ambiental	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 1.4 Calidad del agua y de la tierra
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.2 Renovación urbana generada
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.1 Densidad urbana	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.3 Aceptación por la población
C 2.2 Renovación urbana generada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 2.3 Aceptación por la población	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 2.4 Impacto sobre la Calidad de vida de la población
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.2 Capacidad de ampliación
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.1 Impulso a otras actividades económicas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.3 Inversión necesaria público-privada
C 3.2 Capacidad de ampliación	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 3.3 Inversión necesaria público-privada	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 3.4 Conectividad con el resto de la ciudad
C 4.1 Compatibilidad con el ordenamiento territorial y reglamentos existentes	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C 4.2 Compatibilidad con los planes locales y otras iniciativas estratégicas de la ciudad y la región.

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Appendix B.2 Model matrices. Case 1.

B.2.1 Unweighted supermatrix

		C1.				C2.				C3.				C4.		Alt.			
		1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	A1	A2	A3	A4
C1.	1.1	0.000	0.056	0.144	0.167	0.000	0.875	0.333	0.000	0.000	0.102	0.143	0.000	0.000	1.000	0.394	0.487	0.508	0.539
	1.2	0.750	0.000	0.760	0.000	0.000	0.000	0.528	0.250	0.000	0.442	0.429	0.000	1.000	0.000	0.223	0.118	0.075	0.114
	1.3	0.000	0.701	0.000	0.833	0.000	0.000	0.140	0.750	0.000	0.393	0.000	0.000	0.000	0.000	0.287	0.118	0.265	0.103
	1.4	0.250	0.243	0.096	0.000	0.000	0.125	0.000	0.000	0.000	0.063	0.429	0.000	0.000	0.000	0.096	0.276	0.151	0.244
C2.	2.1	0.709	1.000	1.000	1.000	0.000	1.000	0.119	0.249	1.000	0.750	1.000	1.000	1.000	0.000	0.183	0.167	0.092	0.528
	2.2	0.000	0.000	0.000	0.000	0.000	0.000	0.134	0.594	0.000	0.000	0.000	0.000	0.000	0.000	0.540	0.500	0.565	0.090
	2.3	0.179	0.000	0.000	0.000	0.000	0.000	0.000	0.157	0.000	0.250	0.000	0.000	0.000	0.000	0.175	0.167	0.072	0.060
	2.4	0.113	0.000	0.000	0.000	0.000	0.000	0.747	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.102	0.167	0.271	0.322
C3.	3.1	0.147	0.000	0.000	0.000	0.000	0.000	0.750	0.833	0.000	0.875	0.000	0.000	0.000	0.641	0.337	0.400	0.438	0.313
	3.2	0.483	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.875	0.000	0.000	0.000	0.000	0.197	0.161	0.049	0.052	0.519
	3.3	0.257	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.108	0.067	0.244	0.162	0.109
	3.4	0.113	0.000	0.000	0.000	0.000	0.000	0.250	0.167	0.125	0.125	1.000	0.000	0.000	0.054	0.435	0.307	0.348	0.059
C4.	4.1	0.875	0.000	0.000	0.000	1.000	0.250	0.167	0.000	0.000	0.750	0.000	0.000	0.000	1.000	0.833	0.167	0.250	0.833
	4.2	0.125	0.000	0.000	0.000	0.000	0.750	0.833	0.000	1.000	0.250	1.000	0.000	0.000	0.000	0.167	0.833	0.750	0.167
Alt.	A1	0.317	0.143	0.191	0.151	0.288	0.115	0.161	0.221	0.101	0.304	0.247	0.321	0.226	0.376	0.000	0.000	0.000	0.000
	A2	0.052	0.065	0.058	0.075	0.041	0.045	0.053	0.048	0.046	0.040	0.480	0.317	0.091	0.053	0.000	0.000	0.000	0.000
	A3	0.252	0.505	0.523	0.508	0.158	0.540	0.281	0.312	0.415	0.103	0.092	0.312	0.289	0.169	0.000	0.000	0.000	0.000
	A4	0.378	0.288	0.228	0.265	0.514	0.300	0.505	0.419	0.438	0.553	0.182	0.050	0.395	0.402	0.000	0.000	0.000	0.000

B.2.2 Weighted supermatrix

		C1.				C2.				C3.				C4.		Alt.			
		1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	A1	A2	A3	A4
C1.	1.1	0.000	0.019	0.036	0.056	0.000	0.175	0.067	0.000	0.000	0.020	0.029	0.000	0.000	0.250	0.217	0.269	0.280	0.297
	1.2	0.150	0.000	0.190	0.000	0.000	0.000	0.106	0.063	0.000	0.088	0.086	0.000	0.333	0.000	0.123	0.065	0.041	0.063
	1.3	0.000	0.234	0.000	0.278	0.000	0.000	0.028	0.188	0.000	0.079	0.000	0.000	0.000	0.000	0.158	0.065	0.146	0.057
	1.4	0.050	0.081	0.024	0.000	0.000	0.025	0.000	0.000	0.000	0.013	0.086	0.000	0.000	0.000	0.053	0.152	0.083	0.135
C2.	2.1	0.142	0.333	0.250	0.333	0.000	0.200	0.024	0.062	0.250	0.150	0.200	0.500	0.333	0.000	0.050	0.046	0.025	0.145
	2.2	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.148	0.000	0.000	0.000	0.000	0.000	0.000	0.148	0.137	0.155	0.025
	2.3	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.050	0.000	0.000	0.000	0.000	0.048	0.046	0.020	0.017
	2.4	0.023	0.000	0.000	0.000	0.000	0.000	0.149	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.046	0.074	0.088
C3.	3.1	0.029	0.000	0.000	0.000	0.000	0.000	0.150	0.208	0.000	0.175	0.000	0.000	0.000	0.160	0.044	0.052	0.057	0.041
	3.2	0.097	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.219	0.000	0.000	0.000	0.000	0.049	0.021	0.006	0.007	0.068
	3.3	0.051	0.000	0.000	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.009	0.032	0.021	0.014
	3.4	0.023	0.000	0.000	0.000	0.000	0.000	0.050	0.042	0.031	0.025	0.200	0.000	0.000	0.013	0.057	0.040	0.046	0.008
C4.	4.1	0.175	0.000	0.000	0.000	0.500	0.050	0.033	0.000	0.000	0.150	0.000	0.000	0.000	0.250	0.037	0.007	0.011	0.037
	4.2	0.025	0.000	0.000	0.000	0.000	0.150	0.167	0.000	0.250	0.050	0.200	0.000	0.000	0.000	0.007	0.037	0.033	0.007
Alt.	A1	0.063	0.048	0.048	0.050	0.144	0.023	0.032	0.055	0.025	0.061	0.049	0.160	0.075	0.094	0.000	0.000	0.000	0.000
	A2	0.010	0.021	0.014	0.025	0.020	0.009	0.011	0.012	0.012	0.008	0.096	0.159	0.030	0.013	0.000	0.000	0.000	0.000
	A3	0.050	0.168	0.131	0.169	0.079	0.108	0.056	0.078	0.104	0.021	0.018	0.156	0.096	0.042	0.000	0.000	0.000	0.000
	A4	0.076	0.096	0.057	0.088	0.257	0.060	0.101	0.105	0.109	0.111	0.036	0.025	0.131	0.101	0.000	0.000	0.000	0.000

B.2.3 Limit supermatrix

		C1.				C2.				C3.				C4.		Alt.			
		1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	A1	A2	A3	A4
C1.	1.1	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
	1.2	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
	1.3	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
	1.4	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
C2.	2.1	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
	2.2	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	2.3	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
	2.4	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
C3.	3.1	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	3.2	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
	3.3	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	3.4	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
C4.	4.1	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118
	4.2	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Alt.	A1	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
	A2	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
	A3	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
	A4	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097

B.2.4 Cluster comparison matrices

Clusters	C1.	C2.	C3.	C4.	Alt.
C1.	0.200	0.200	0.200	0.200	0.551
C2.	0.200	0.200	0.200	0.200	0.274
C3.	0.200	0.200	0.200	0.200	0.131
C4.	0.200	0.200	0.200	0.200	0.044
Alt.	0.200	0.200	0.200	0.200	0.000

Appendix C.1. SNA for Case 2. Tourism sector - Spanish version

ANÁLISIS DE ACTORES DEL SECTOR TURISTICO DE CARTAGENA DE INDIAS

El objetivo de este cuestionario es analizar las relaciones que se dan entre los grupos de interés (stakeholders) relacionados con el sector turístico de la ciudad de Cartagena.

Este es un ejercicio académico, como parte de un trabajo de investigación de doctorado en la Universidad Politécnica de Valencia (España), cuyo objetivo es diseñar un modelo de toma decisiones relacionado con el sector turístico en Cartagena. Los resultados obtenidos serán utilizados solo con fines académicos y serán compartidos con los participantes como parte de un proceso de retroalimentación activo. Manteniendo siempre el anonimato de los participantes.

Como miembro del sector le solicitamos responder las siguientes preguntas.

Cuestionario

1. Marque los actores (grupos, organizaciones, instituciones o personas) con los que intercambia información (informes, E-mails, llamadas, asesorías, etc.) relacionada con el sector turístico de la ciudad de Cartagena:

Nombre	¿Les envía información?	¿Recibe información?	Frecuencia (diaria, semanal…)
Alcaldía de Cartagena			
Gobernación de Bolívar			
Corporación Turismo Cartagena de Indias - Corpoturismo			
Instituto de Patrimonio y Cultura de Cartagena de Indias IPCC			
Instituto de Cultura y Turismo de Bolívar (Icultur)			
Ministerio de Comercio, Industria y Turismo.- Viceministerio de Turismo			
ProColombia			
Fondo Nacional de Turismo Fontur			
Cámara de Comercio de Cartagena			
Asociación Hotelera de Colombia COTELCO			
Asociación Hotelera Colombiana ASOTELCA			
Asociación Colombiana de la Industria Gastronómica ACODRÉS			
Asociación Colombiana de Agencias de Viajes y Turismo ANATO			
Representante Comunidad insulares - Nativos de islas			
Representantes comunitarios ¿Cuáles?			
Otras asociaciones, grupos o gremios del sector ¿Cuáles?			
Prestadores de servicios turísticos ¿Cuáles?			
Consejo Profesional de Guías de Turismo/ Agentes de viajes			
Sociedad Aeroportuaria de la Costa			
Sociedad Portuaria - Terminal de cruceros			
Museo Histórico Cartagena de Indias			
ONGs ¿Cuáles?			
Portales – Sitios web de promoción de la ciudad ¿Cuáles?			
Universidades o Centros e investigación ¿Cuáles?			
Medios de comunicación ¿Cuáles?			
Otros…			

2. Para usted, ¿Quiénes (grupos, organizaciones, instituciones o personas) influyen sobre las decisiones que se toman en Cartagena en relación con el sector turístico?

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Appendix C.2 Pairwise comparison of model elements. Case 2. Spanish version

EVALUACIÓN DE ESTRATEGIAS PARA MEJORAR LA OFERTA DEL SECTOR TURISTICO EN CARTAGENA DE INDIAS

El objetivo de este cuestionario es evaluar las alternativas consideradas para mejorar la oferta turística de la ciudad de Cartagena. Utilizamos la técnica del Proceso Analítico en Red ANP, método que permite valorar criterios de evaluación y comparar alternativas, a partir de la cuantificación de comparaciones entre pares, que nos conducen a una escala de medida relativa de prioridades. Las alternativas se evaluarán a partir de 25 criterios, cuyas definiciones se encuentran al final de este formulario.

Alternativas	Implicaciones
A1. Complejo turístico en la zona insular de la ciudad.	- Requiere trabajar y definir en el ordenamiento territorial de zona insular. - Debe incluir la participación activa de comunidades nativas. - Incluir actividades al aire libre y para diferentes segmentos. - Considerar diferentes formas de conexión desde Cartagena y sus alrededores.
A2. Paseo turístico Cartagena de Indias (Av. Bicentenario).	- Este proyecto se encuentra actualmente en prefactibilidad. - Debe considerar algunas adecuaciones al diseño considerado actualmente. - Contempla la adecuación de la infraestructura del servicio de playa, la recuperación de espacio público. - Iluminación y mejoramiento de la movilidad a lo largo de la Avenida Santander y primera de Bocagrande. - Incluir actividades al aire libre y para diferentes segmentos.
A3. Sistema público acuático local	- Integrado al Sistema de Transporte Transcaribe. - Requiere de la recuperación y reordenación intensiva de algunas áreas alrededor de toda la ciudad. - Genera alta expectativa y demanda desde diferentes actores de la ciudad. - Selección del área más adecuada para que sea el epicentro del sistema. - Desarrollo de embarcadores y muelles complementarios en diferentes zonas de la ciudad.

Le solicitamos responda cada parte siguiendo las instrucciones iniciales. Una vez se realicen las primeras comparaciones, las siguientes se realizarán de manera mucho más rápida.

PARTE I. COMPARACIÓN ENTRE CLUSTERES

Se deben realizar comparaciones entre los dos criterios o grupos de cada fila. A partir de un aspecto a comparar, usted deberá escoger cuál es más influyente y en qué grado, de acuerdo con la escala establecida.

Ejemplo:

	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
Ambiental	9	7	5	3	1	3	x	7	9	Socio-cultural

La respuesta en este ejemplo significa que: Se considera que el conjunto de criterios Socio-culturales contribuye fuertemente (5) mas que el conjunto de criterios Ambientales en mejorar la oferta Turistica de la ciudad de Cartagena.

Para usted, ¿Cuál de los dos conjuntos de criterios (Clúster) contribuye mas PARA EVALUAR UNA ESTRATEGIA TURÍSTICA de la ciudad de Cartagena? Marque con una "X"

	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
C1. Ambientales	9	7	5	3	1	3	5	7	9	C2. Socio-culturales
C1. Ambientales	9	7	5	3	1	3	5	7	9	C3. Oferta turística
C1. Ambientales	9	7	5	3	1	3	5	7	9	C4. Económico-productivo
C1. Ambientales	9	7	5	3	1	3	5	7	9	C5. Político-Administrativo
C2. Socio-culturales	9	7	5	3	1	3	5	7	9	C3. Oferta turística
C2. Socio-culturales	9	7	5	3	1	3	5	7	9	C4. Económico-productivo
C2. Socio-culturales	9	7	5	3	1	3	5	7	9	C5. Político-Administrativo
C3. Oferta turística	9	7	5	3	1	3	5	7	9	C4. Económico-productivo
C3. Oferta turística	9	7	5	3	1	3	5	7	9	C5. Político-Administrativo
C4. Económico-productivo	9	7	5	3	1	3	5	7	9	C5. Político-Administrativo

PARTE II. INFLUENCIA ENTRE CRITERIOS

En este apartado escoja entre cada par de criterios, cuál de ellos influye más sobre el otro y en qué grado. La escala de comparación es la siguiente:

Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo
9	7	5	3	1	3	5	7	9

Ejemplo:

Ejemplo: ¿Cuál de los dos es más influyente sobre: C 1.1 Uso de espacios naturales y del patrimonio material		
C 2.2 Infraestructura y servicios públicos requeridos	9 7 5 x 1 3 5 7 9	C 2.3 Integración de Comunidades especiales
La respuesta quiere decir que el **Uso de espacios naturales y del patrimonio material** está moderadamente más influenciado por la **Infraestructura y servicios públicos requeridos** que por la **Integración de Comunidades especiales.**		

¿Cuál de los dos es más influyente sobre: **C 1.1 Uso de espacios naturales y del patrimonio material**									
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
C 4.2 Ingresos generados por la actividad	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.2 Apoyo institucional requerido
	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los dos es más influyente sobre: **C 2.1 Calificación del recurso humano**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto

¿Cuál de los dos es más influyente sobre: **C 2.2 Infraestructura y servicios públicos requeridos**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales

¿Cuál de los dos es más influyente sobre: **C 2.3 Integración de Comunidades especiales**										
C 2.1 Calificación del recurso humano	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores

C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.6 Vinculación al postconflicto	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los dos es más influyente sobre: **C 2.4 Aprovechamiento de la identidad cultural**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.2 Apoyo institucional requerido
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los dos es más influyente sobre: **C 2.5 Calidad de vida de la población**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural

¿Cuál de los dos es más influyente sobre: **C 2.7 Asociatividad entre actores**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes

¿Cuál de los dos es más influyente sobre: **C 3.2 Gasto de los visitantes**										
C 3.3 Tiempo de permanencia de los visitantes	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial

¿Cuál de los dos es más influyente sobre: **C 3.3 Tiempo de permanencia de los visitantes**										
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial

¿Cuál de los dos es más influyente sobre: **C 3.4 Posicionamiento en mercados nacionales e internacionales**										
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial

¿Cuál de los dos es más influyente sobre: **C 3.6 Integración con otros destinos turísticos**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores

¿Cuál de los dos es más influyente sobre: **C 3.7 Contenido experiencial**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada

¿Cuál de los dos es más influyente sobre: **C 4.1 Impulso a otras actividades económicas**										
C 3.2 Gasto de los visitantes	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes

¿Cuál de los dos es más influyente sobre: **C 4.2 Ingresos generados por la actividad**										
C 3.2 Gasto de los visitantes	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.3 Tiempo de permanencia de los visitantes	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial

¿Cuál de los dos es más influyente sobre: **C 4.3 Inversión necesaria público-privada**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.4 Tiempo previsto para su desarrollo	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los dos es más influyente sobre: **C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural**										
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural

¿Cuál de los dos es más influyente sobre: **C 5.2 Apoyo institucional requerido**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
C 4.2 Ingresos generados por la actividad	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes

¿Cuál de los dos es más influyente sobre: **C 5.4 Tiempo previsto para su desarrollo**										
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los dos es más influyente sobre: **C 5.5 Gestión responsable sostenible**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes

PARTE III. EVALUACIÓN DE LAS ALTERNATIVAS

En este apartado escoja entre cada par de alternativas, ¿Cuál de ellas prefiere más sobre la otra y en qué grado? (La escala es la misma)

Para el criterio: **C 1.1 Uso de espacios naturales y del patrimonio material**, ¿Cuál de las dos prefiere?										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 1.2 Riesgos y amenazas medioambientales**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.1 Calificación del recurso humano**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.2 Infraestructura y servicios públicos requeridos**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.3 Integración de Comunidades especiales**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.4 Aprovechamiento de la identidad cultural**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.5 Impacto sobre la Calidad de vida de la población** , ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.6 Vinculación al postconflicto**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 2.7 Asociatividad entre actores**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.1 Origen de los visitantes**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.2 Gasto de los visitantes**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.3 Tiempo de permanencia de los visitantes**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.4 Posicionamiento en mercados nacionales e internacionales**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.5 Tendencias turísticas mundiales**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.6 Integración con otros destinos turísticos**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 3.7 Contenido experiencial** , ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 4.1 Impulso a otras actividades económicas**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 4.2 Ingresos generados por la actividad**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 4.3 Inversión necesaria público-privada** , ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 4.4 Política tributaria**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 5.2 Apoyo institucional requerido**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 5.4 Tiempo previsto para su desarrollo**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

Para el criterio: **C 5.5 Gestión responsable sostenible**, ¿Cuál de las dos prefiere?										
A1. Complejo Eco-turístico Insular	9	7	5	3	1	3	5	7	9	A2. Paseo Turístico Av. Santander-Bgde
	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público
A2. Paseo Turístico Av. Santander-Bgde	9	7	5	3	1	3	5	7	9	A3. Sistema acuático público

PARTE IV. INFLUENCIA DE LOS CRITERIOS EN LAS ESTRATEGIAS:

En este apartado escoja entre cada par de criterios, ¿Cuál de ellos influye o favorece más en la priorización de una alternativa?

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A1. Complejo Eco-turístico?**									
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.1 Calificación del recurso humano	9	7	5	3	1	3	5	7	9	C 2.2 Infraestructura y servicios públicos requeridos
	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.6 Vinculación al postconflicto	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.1 Origen de los visitantes	9	7	5	3	1	3	5	7	9	C 3.2 Gasto de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.2 Gasto de los visitantes	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.3 Tiempo de permanencia de los visitantes	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 3.4 Posicionamiento en mercados nacionales e internacionales	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial

C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 4.2 Ingresos generados por la actividad	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 4.3 Inversión necesaria público-privada	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.2 Apoyo institucional requerido
	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.4 Tiempo previsto para su desarrollo	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A2. Paseo Turístico Av. Santander-Bgde?**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.1 Calificación del recurso humano	9	7	5	3	1	3	5	7	9	C 2.2 Infraestructura y servicios públicos requeridos
	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.6 Vinculación al postconflicto	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.1 Origen de los visitantes	9	7	5	3	1	3	5	7	9	C 3.2 Gasto de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.2 Gasto de los visitantes	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.3 Tiempo de permanencia de los visitantes	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 3.4 Posicionamiento en mercados nacionales e internacionales	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 4.2 Ingresos generados por la actividad	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria

C 4.3 Inversión necesaria público-privada	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.2 Apoyo institucional requerido
	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.4 Tiempo previsto para su desarrollo	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

¿Cuál de los siguientes criterios contribuye más a que se priorice la alternativa **A3. Sistema acuático público?**										
C 1.1 Uso de espacios naturales y del patrimonio material	9	7	5	3	1	3	5	7	9	C 1.2 Riesgos y amenazas medioambientales
C 2.1 Calificación del recurso humano	9	7	5	3	1	3	5	7	9	C 2.2 Infraestructura y servicios públicos requeridos
	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.2 Infraestructura y servicios públicos requeridos	9	7	5	3	1	3	5	7	9	C 2.3 Integración de Comunidades especiales
	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.3 Integración de Comunidades especiales	9	7	5	3	1	3	5	7	9	C 2.4 Aprovechamiento de la identidad cultural
	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.4 Aprovechamiento de la identidad cultural	9	7	5	3	1	3	5	7	9	C 2.5 Calidad de vida de la población
	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.5 Calidad de vida de la población	9	7	5	3	1	3	5	7	9	C 2.6 Vinculación al postconflicto
	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 2.6 Vinculación al postconflicto	9	7	5	3	1	3	5	7	9	C 2.7 Asociatividad entre actores
C 3.1 Origen de los visitantes	9	7	5	3	1	3	5	7	9	C 3.2 Gasto de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.2 Gasto de los visitantes	9	7	5	3	1	3	5	7	9	C 3.3 Tiempo de permanencia de los visitantes
	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.3 Tiempo de permanencia de los visitantes	9	7	5	3	1	3	5	7	9	C 3.4 Posicionamiento en mercados nnales. e intern.
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
C 3.4 Posicionamiento en mercados nacionales e internacionales	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
	9	7	5	3	1	3	5	7	9	C 3.5 Tendencias turísticas mundiales
	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.5 Tendencias turísticas mundiales	9	7	5	3	1	3	5	7	9	C 3.6 Integración con otros destinos turísticos
	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 3.6 Integración con otros destinos turísticos	9	7	5	3	1	3	5	7	9	C 3.7 Contenido experiencial
C 4.1 Impulso a otras actividades económicas	9	7	5	3	1	3	5	7	9	C 4.2 Ingresos generados por la actividad
	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 4.2 Ingresos generados por la actividad	9	7	5	3	1	3	5	7	9	C 4.3 Inversión necesaria público-privada
	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 4.3 Inversión necesaria público-privada	9	7	5	3	1	3	5	7	9	C 4.4 Política tributaria
C 5.1 Compatibilidad con la Visión de Distrito turístico y cultural	9	7	5	3	1	3	5	7	9	C 5.2 Apoyo institucional requerido
	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

C 5.2 Apoyo institucional requerido	9	7	5	3	1	3	5	7	9	C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes
	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.3 Compatibilidad con el ordenamiento territorial, planes y reglamentos existentes	9	7	5	3	1	3	5	7	9	C 5.4 Tiempo previsto para su desarrollo
	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible
C 5.4 Tiempo previsto para su desarrollo	9	7	5	3	1	3	5	7	9	C 5.5 Gestión responsable sostenible

MUCHAS GRACIAS POR SU TIEMPO Y DEDICACIÓN!!!

Appendix C.3 Model matrices. Case 2.

C.3.1 Unweighted supermatrix

		Alt.			C.1		C.2							C.3							C.4				C.5				
		A1.	A2.	A3.	C 1.1	C 1.2	C 2.1	C 2.2	C 2.3	C 2.4	C 2.5	C 2.6	C 2.7	C 3.1	C 3.2	C 3.3	C 3.4	C 3.5	C 3.6	C 3.7	C 4.1	C 4.2	C 4.3	C 4.4	C 5.1	C 5.2	C 5.3	C 5.4	C 5.5
Alt.	A1.	0.000	0.000	0.000	0.275	0.196	0.471	0.328	0.404	0.659	0.376	0.446	0.278	0.438	0.363	0.367	0.321	0.329	0.453	0.558	0.307	0.415	0.363	0.335	0.330	0.256	0.299	0.359	0.397
	A2.	0.000	0.000	0.000	0.172	0.250	0.284	0.238	0.154	0.123	0.195	0.177	0.141	0.224	0.219	0.265	0.196	0.155	0.159	0.173	0.225	0.211	0.160	0.378	0.272	0.205	0.244	0.147	0.243
	A3.	0.000	0.000	0.000	0.554	0.554	0.245	0.434	0.442	0.217	0.430	0.377	0.581	0.338	0.418	0.367	0.483	0.516	0.388	0.269	0.468	0.374	0.477	0.286	0.397	0.539	0.458	0.494	0.360
C.1	1.1	0.642	0.454	0.548	0.000	1.000	0.000	0.401	1.000	1.000	0.346	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	1.000	1.000	1.000	0.320	0.000	1.000	0.270	0.000	0.000	0.301
	1.2	0.358	0.546	0.452	1.000	0.000	0.000	0.599	0.000	0.000	0.654	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.680	0.000	0.000	0.730	1.000	1.000	0.699
C.2	2.1	0.111	0.165	0.171	0.000	0.000	0.000	0.000	0.426	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.2	0.117	0.111	0.109	0.198	0.000	0.000	0.000	0.000	0.000	0.653	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.532	0.000	0.000	0.415	0.000	0.761	0.000
	2.3	0.167	0.161	0.111	0.162	0.000	0.718	0.000	0.000	0.719	0.180	0.000	0.563	0.000	0.000	0.000	0.000	0.000	0.142	0.254	0.000	0.000	0.000	0.000	0.441	0.000	0.000	0.000	0.196
	2.4	0.241	0.100	0.100	0.175	0.000	0.000	0.000	0.218	0.000	0.167	0.000	0.437	0.000	0.000	0.000	1.000	0.000	0.473	0.746	0.000	0.000	0.000	0.000	0.559	0.000	0.000	0.000	0.139
	2.5	0.130	0.135	0.306	0.297	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.273	0.000	0.000	0.293	0.000	0.000	0.451
	2.6	0.094	0.156	0.088	0.000	0.000	0.282	0.000	0.163	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.7	0.139	0.172	0.114	0.168	0.000	0.000	0.000	0.193	0.281	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.384	0.000	1.000	0.000	0.195	0.000	0.000	0.292	1.000	0.239	0.215
C.3	3.1	0.090	0.064	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.2	0.146	0.176	0.154	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.134	0.239	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.3	0.191	0.159	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.543	0.000	0.000	0.000	0.000	0.000	0.000	0.281	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.4	0.151	0.210	0.178	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.5	0.153	0.159	0.146	0.295	0.000	0.000	0.000	0.533	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.430	0.000	0.000	0.451	0.223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.6	0.109	0.093	0.117	0.305	0.000	0.000	0.000	0.467	0.513	1.000	0.000	0.000	0.000	0.204	0.462	0.332	0.000	0.000	0.549	0.223	0.234	0.438	0.000	0.000	1.000	0.000	0.000	0.000
	3.7	0.159	0.139	0.168	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.253	0.538	0.238	0.000	0.000	0.000	0.420	0.246	0.562	0.000	1.000	0.000	0.000	0.000	0.000
C.4	4.1	0.204	0.253	0.281	0.306	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.734	0.000	0.000	0.000	0.000	0.000	0.000	0.296	0.000	0.000	1.000	0.000	0.000	0.292	0.000	0.000	0.000
	4.2	0.280	0.293	0.332	0.288	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.266	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000
	4.3	0.266	0.229	0.215	0.406	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.704	0.000	0.000	0.000	0.000	0.000	0.458	0.000	1.000	1.000
	4.4	0.250	0.224	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C.5	5.1	0.148	0.200	0.255	0.152	0.000	0.000	0.000	0.482	0.264	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.351	0.000	0.000	0.000
	5.2	0.208	0.257	0.255	0.307	0.000	0.000	0.000	0.000	0.405	0.000	1.000	0.758	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.519	0.000	0.225	0.000	0.000	0.000	0.000	0.642	0.609
	5.3	0.158	0.198	0.189	0.242	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.242	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.481	0.000	0.251	0.000	0.000	0.649	0.000	0.000	0.391
	5.4	0.286	0.139	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.284	0.000	0.000	0.000	0.000	0.000	0.000
	5.5	0.200	0.206	0.150	0.299	1.000	0.000	0.000	0.518	0.331	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.240	0.000	0.000	0.000	1.000	0.358	0.000

C.3.2 Weighted supermatrix

		Alt.			C.1		C.2							C.3							C.4				C.5				
		A1.	A2.	A3.	C 1.1	C 1.2	C 2.1	C 2.2	C 2.3	C 2.4	C 2.5	C 2.6	C 2.7	C 3.1	C 3.2	C 3.3	C 3.4	C 3.5	C 3.6	C 3.7	C 4.1	C 4.2	C 4.3	C 4.4	C 5.1	C 5.2	C 5.3	C 5.4	C 5.5
Alt.	A1.	0.000	0.000	0.000	0.046	0.065	0.235	0.066	0.081	0.132	0.063	0.149	0.056	0.438	0.121	0.184	0.064	0.329	0.113	0.093	0.061	0.138	0.060	0.335	0.083	0.043	0.075	0.072	0.079
	A2.	0.000	0.000	0.000	0.029	0.083	0.142	0.048	0.031	0.025	0.032	0.059	0.028	0.224	0.073	0.133	0.039	0.155	0.040	0.029	0.045	0.070	0.027	0.378	0.068	0.034	0.061	0.029	0.049
	A3.	0.000	0.000	0.000	0.092	0.185	0.123	0.087	0.088	0.043	0.072	0.126	0.116	0.338	0.139	0.184	0.097	0.516	0.097	0.045	0.094	0.125	0.080	0.286	0.099	0.090	0.114	0.099	0.072
C.1	1.1	0.165	0.116	0.141	0.000	0.333	0.000	0.080	0.200	0.200	0.058	0.000	0.200	0.000	0.333	0.000	0.200	0.000	0.250	0.167	0.200	0.333	0.053	0.000	0.250	0.045	0.000	0.000	0.060
	1.2	0.092	0.140	0.116	0.167	0.000	0.000	0.120	0.000	0.000	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.113	0.000	0.000	0.122	0.250	0.200	0.140
C.2	2.1	0.025	0.038	0.039	0.000	0.000	0.000	0.000	0.085	0.000	0.000	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.2	0.027	0.025	0.025	0.033	0.000	0.000	0.000	0.000	0.000	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.089	0.000	0.000	0.069	0.000	0.152	0.000
	2.3	0.038	0.037	0.025	0.027	0.000	0.359	0.000	0.000	0.144	0.030	0.000	0.113	0.000	0.000	0.000	0.000	0.000	0.036	0.042	0.000	0.000	0.000	0.000	0.110	0.000	0.000	0.000	0.039
	2.4	0.055	0.023	0.023	0.029	0.000	0.000	0.000	0.044	0.000	0.028	0.000	0.087	0.000	0.000	0.000	0.200	0.000	0.118	0.124	0.000	0.000	0.000	0.000	0.140	0.000	0.000	0.000	0.028
	2.5	0.030	0.031	0.070	0.049	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.049	0.000	0.000	0.090
	2.6	0.021	0.036	0.020	0.000	0.000	0.141	0.000	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.7	0.032	0.039	0.026	0.028	0.000	0.000	0.000	0.039	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.096	0.000	0.200	0.000	0.032	0.000	0.000	0.049	0.250	0.048	0.043
C.3	3.1	0.021	0.015	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.2	0.034	0.042	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.3	0.045	0.038	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.181	0.000	0.000	0.000	0.000	0.000	0.000	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.4	0.036	0.050	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.5	0.036	0.038	0.034	0.049	0.000	0.000	0.000	0.107	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000	0.075	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3.6	0.026	0.022	0.028	0.051	0.000	0.000	0.000	0.093	0.103	0.167	0.000	0.000	0.000	0.068	0.231	0.066	0.000	0.000	0.092	0.045	0.078	0.073	0.000	0.000	0.167	0.000	0.000	0.000
	3.7	0.037	0.033	0.040	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.084	0.269	0.048	0.000	0.000	0.000	0.084	0.082	0.094	0.000	0.250	0.000	0.000	0.000	0.000
C.4	4.1	0.033	0.041	0.046	0.051	0.000	0.000	0.200	0.000	0.000	0.167	0.000	0.147	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.000	0.000	0.167	0.000	0.000	0.049	0.000	0.000	0.000
	4.2	0.045	0.048	0.054	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.000
	4.3	0.043	0.037	0.035	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.000	0.000	0.117	0.000	0.000	0.000	0.000	0.000	0.076	0.000	0.200	0.200
	4.4	0.041	0.036	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C.5	5.1	0.017	0.023	0.030	0.025	0.000	0.000	0.000	0.096	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.000	0.000	0.000	0.000	0.000	0.058	0.000	0.000	0.000
	5.2	0.024	0.030	0.030	0.051	0.000	0.000	0.000	0.000	0.081	0.000	0.333	0.152	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.104	0.000	0.038	0.000	0.000	0.000	0.000	0.128	0.122
	5.3	0.018	0.023	0.022	0.040	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.096	0.000	0.042	0.000	0.000	0.108	0.000	0.000	0.078
	5.4	0.033	0.016	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.000	0.000	0.000	0.000	0.000	0.000
	5.5	0.023	0.024	0.018	0.050	0.333	0.000	0.000	0.104	0.066	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.250	0.072	0.000

C.3.3 Limit supermatrix

		Alt.			C.1		C.2							C.3							C.4				C.5				
		A1.	A2.	A3.	C 1.1	C 1.2	C 2.1	C 2.2	C 2.3	C 2.4	C 2.5	C 2.6	C 2.7	C 3.1	C 3.2	C 3.3	C 3.4	C 3.5	C 3.6	C 3.7	C 4.1	C 4.2	C 4.3	C 4.4	C 5.1	C 5.2	C 5.3	C 5.4	C 5.5
Alt.	A1.	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071
	A2.	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
	A3.	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093
C.1	1.1	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
	1.2	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079
C.2	2.1	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	2.2	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
	2.3	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	2.4	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	2.5	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
	2.6	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	2.7	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
C.3	3.1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	3.2	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	3.3	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	3.4	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	3.5	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
	3.6	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
	3.7	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
C.4	4.1	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
	4.2	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
	4.3	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
	4.4	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
C.5	5.1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
	5.2	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038
	5.3	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
	5.4	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	5.5	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060

C.3.4 Cluster comparison matrices

	ALT.	C.1	C.2	C.3	C.4	C.5
ALT.	0.000	0.167	0.167	0.167	0.167	0.167
C.1	0.257	0.167	0.167	0.167	0.167	0.167
C.2	0.228	0.167	0.167	0.167	0.167	0.167
C.3	0.236	0.167	0.167	0.167	0.167	0.167
C.4	0.162	0.167	0.167	0.167	0.167	0.167
C.5	0.117	0.167	0.167	0.167	0.167	0.167

Appendix D.1. Interview for Case 3 - Spanish version

Criterios de diseño para rutas peatonales en el Centro de Cartagena de Indias
Entrevista con actores principales
Cuestionario

Actor / Stakeholder: Nombre: Cargo:

Presentación: En el marco del diseño de rutas y corredores peatonales en el Centro Histórico de Cartagena de Indias, le pedimos que por favor conteste las preguntas relacionadas a continuación. El objetivo de esta entrevista es fortalecer el proceso de identificación de los **criterios a tener en cuenta para el diseño de los corredores peatonales**, a partir de su percepción, experiencia y papel como uno de los actores clave de la zona.

Puntos para aclarar antes de iniciar:
- Autorización para la grabación de la entrevista.
- Uso de la información. Los resultados finales serán entregados a la Alcaldía.
- Confidencialidad en los datos, opiniones…

Problemática

1. Para usted, ¿Cuáles son los problemas más importantes para la movilidad de los peatones en el Centro de la Ciudad? (por ejemplo: seguridad vial, espacios reducidos, falta de arborización, congestión vehicular, etc.).

Nota: Contextualizar sobre los muchos problemas de movilidad, enfocarnos en los peatones.
seguridad vial, espacios reducidos, falta de arborización, congestión vehicular, etc.
Mencionar los problemas más importantes en materia de movilidad peatonal: Comparten espacios con otros usuarios…

Acciones

2. Para usted, ¿Cuáles son las soluciones más viables y prioritarias para mejorar e incentivar la movilidad de los peatones en el Centro de la Ciudad? (por ejemplo, medidas de limitación del tráfico, prohibir el tránsito de vehículos particulares, establecer rutas exclusivas, etc.)

i. ¿Cree usted que es necesario diseñar rutas peatonales en el Centro de Cartagena de Indias? ¿Por qué?
ii. ¿Fijas o temporales?
iii. ¿Cuáles serían las principales ventajas y desventajas de peatonalizar ciertas rutas en el Centro Histórico?
iv. ¿Qué apoyo puede dar usted o su organización a este proyecto?

3. Teniendo en cuenta las alternativas que existen para hacer que una calle sea "transitable", ¿Qué piensa usted sobre la implementación de las siguientes alternativas en el Centro de la Ciudad?
Alternativa
i. Zona 30: Establece que la velocidad máxima permitida para vehículos es de 30km/h.
ii. Zonas de tráfico restringido: Controles de acceso permanente para restringir el tráfico privado en determinadas zonas.
iii. Zonas y calles peatonales: áreas donde está fuertemente restringido o prohibido la circulación de vehículos motorizados.
iv. Zona tráfico tranquilo: áreas que utilizan el diseño físico y otras medidas para el control del tráfico.
v. Otras.

Criterios de diseño

4. Teniendo en cuenta los siguientes criterios a considerar durante el diseño de rutas peatonales, por favor califique con una puntuación de 0 a 4 su importancia.

Criterios		Definiciones	Importancia				
			Ninguna	*Poca*	*Media*	*Alta*	*Extrema*
1. Conectividad	1. Presencia del transporte público	Acceso al transporte público (por ejemplo, autobús, taxi)	0	1	2	3	4
	2. Acceso a los destinos finales	Valora la accesibilidad a un destino final en una ruta. En términos de presencia de destinos (por ejemplo, tiendas, lugares de trabajo, etc.) y elementos que facilitan el acceso a ellos.	0	1	2	3	4
	3. Conectividad de la calle	Relacionado con la presencia de intersecciones en una ruta (por ejemplo, presencia de rutas alternativas, conexión entre rutas)	0	1	2	3	4
	4. Distancia	Evalúa la distancia de la ruta a diferentes lugares de interés y/o destinos	0	1	2	3	4
	5. Continuidad del camino	Ausencia de interrupciones en una ruta. La continuidad evita la presencia de elementos que obliguen al peatón a cambiar o cruzar la ruta elegida (Ej.: una acera en malas condiciones o incompleta, etc.)	0	1	2	3	4
2. Función Urbana	6. Diversidad en el uso del suelo	Uso del suelo (por ejemplo: residencial, comercial, servicios, instalaciones públicas, recreativas, áreas verdes, etc. o una combinación de ellos)	0	1	2	3	4
	7. áreas de parqueaderos	Proximidad o presencia de áreas de estacionamiento	0	1	2	3	4
	8. Elementos culturales	Presencia de elementos culturales o puntos de convivencia	0	1	2	3	4
	9. Vitalidad	El dinamismo que un espacio puede transmitir (por ejemplo, áreas disponibles para vendedores ambulantes, bazares, festivales, etc.)	0	1	2	3	4
3. Atributos de la ruta	10. Infraestructura	Sistemas e instalaciones provistos (por ejemplo: sistema de drenaje, pavimento táctil, señalización, etc.)	0	1	2	3	4
	11. Características físicas y facilidades existentes	Relacionadas con el aspecto, la geometría o la infraestructura proporcionada para una ruta más cómoda, p. ancho de la carretera, pendiente, acera, superficie, alumbrado público, áreas de descanso, baños público, canecas de basura, etc.	0	1	2	3	4
	12. Condiciones la de ruta	Refleja las condiciones de calles y rutas, p. calidad del pavimento	0	1	2	3	4
	13. Medidas de desempeño	Características y medidas de rendimiento de calles o rutas, relacionadas el uso actual (por ejemplo: volúmenes, densidades, espacios efectivos, etc.)	0	1	2	3	4
4. Confort	14. Estética	Relativo a disfrutar o percibir un ambiente agradable y de bonito (por ejemplo: mantenimiento, limpieza, atractivo arquitectónico y urbano, transparencia y permeabilidad del espacio público-privado, etc.)	0	1	2	3	4
	15. Elementos de ocio	Contenido destinado a hacer la vida más agradable o confortable para las personas de una ciudad (Por ejemplo: oferta de servicios y actividades)	0	1	2	3	4
	16. Diseño para un acceso equitativo	El entorno peatonal amigable proporciona acceso equitativo a todos (por ejemplo, personas con discapacidad), según las características y las necesidades de los diversos grupos de usuarios peatonales.	0	1	2	3	4
	17. Protección del clima	Atributos que podrían proteger a los peatones de las condiciones climáticas.	0	1	2	3	4
	18. Percepción	Atributos que generan menos estrés o una sensación agradable de relajación (por ejemplo: contaminación, calidad del camino, ruido, encerramiento del camino, etc.)	0	1	2	3	4
	19. Seguridad personal	Evalúe el estado del sentirse a salvo de daños o peligros.	0	1	2	3	4
5. Coexistencia	20. Peligro en la carretera	Elementos que sugieren condiciones de inseguridad para peatones	0	1	2	3	4
	21. Elementos de protección peatonal	Medidas, controles y elementos para proteger la movilidad y las actividades de los peatones (Ej. Reductores de velocidad, cebras, límites de velocidad, prohibición o restricción a la circulación…).	0	1	2	3	4
	22. Tráfico de la calle	Condiciones de tráfico vehicular	0	1	2	3	4
Otros:							
			0	1	2	3	4
			0	1	2	3	4
			0	1	2	3	4

5. ¿Cree usted que es necesario diseñar rutas peatonales en el Centro de Cartagena de Indias? ¿Por qué? ¿Qué apoyo puede dar usted o su organización a este proyecto?

6. Por favor mencione para usted, ¿Cuáles serían las principales ventajas y desventajas de peatonalizar ciertas rutas en el Centro Histórico?

Ventajas	Desventajas
Puntos fuertes Oportunidades	Debilidades Amanezas Dificultades

Relaciones con otros actores

7. En relación con los actores identificados como clave en el diseño de rutas peatonales en el Centro Histórico, por favor indique su grado de aceptación (del 1 al 5) con cada una de las afirmaciones presentadas a continuación:
Siendo: 1 totalmente en desacuerdo, 2 parcialmente en desacuerdo, 3 no sabe, 4 parcialmente de acuerdo, 5 totalmente de acuerdo.

Stakeholder	Frecuencia del intercambio de información relacionada con la gestión de la movilidad en el centro (semanal, mensual, trimestral, semestral...)	Hemos realizado proyectos conjuntos que son relevantes para la movilidad	Tiene un papel importante en el tema de la movilidad
Gerencia Centro Histórico – Alcaldía Mayor			
Concejo de Cartagena			
Ministerio de Cultura Nacional (Dirección General de Patrimonio Cultural)			
Departamento de Tránsito y Transporte DATT			
Corpoturismo			
Residentes			
Comerciantes			
Artistas Callejeros			
Academia			
ONG ambientales /Ambientalistas			
Transportadores (Taxistas)			
Sociedad de Mejoras Públicas de Cartagena			
Ciudadanos			
Otro:			

Comentarios adicionales:

Appendix D.2 Pairwise comparison of model elements. Case 3. Spanish version

DISEÑO DE RUTAS Y CORREDORES PEATONALES EN EL CENTRO HISTÓRICO DE CARTAGENA DE INDIAS

Inicialmente queremos agradecer su amable participación en la primera parte del proyecto que busca el diseño de rutas y corredores peatonales en el Centro Histórico de Cartagena de Indias. Ahora le invitamos a participar en la segunda etapa del proyecto, en la cual queremos establecer el grado de importancia de cada uno de los criterios seleccionados en la primera parte (13 criterios cuyas definiciones se encuentran al final de este formulario).

Utilizamos la técnica del Proceso Analítico en Red ANP, método que permite valorar criterios de evaluación y comparar la influencia entre ellos, a partir de comparaciones entre pares. Le pedimos nos exprese su opinión a partir de su percepción, experiencia y papel como uno de los actores clave de la zona.

Por favor responda cada parte del cuestionario siguiendo las instrucciones iniciales. Una vez se realicen las primeras comparaciones, las siguientes se realizarán de forma más rápida.

PARTE I. COMPARACIÓN ENTRE CLUSTERES

Existen cuatro grupos de criterios, llamados clústeres: 1. Conectividad, 2. Función Urbana, 3. Atributos de la ruta y 4. Confort. A continuación, compárelos de dos en dos, columna derecha versus columna izquierda; partiendo desde la opción 'IGUALES' ubicada en el centro de la escala, marque hacia la derecha o hacia la izquierda, de acuerdo con el grupo más influyente para usted.

Ejemplo: Para usted, ¿Cuál de los dos conjuntos de criterios (Cluster) influye mas en el DISEÑO DE RUTAS PEATONALES en el centro histórico de Cartagena? Marque con una "X":											La respuesta en este ejemplo significa que: Para el diseño de rutas petonales en el Centro de Cartagena, los criterios relacionados con la FUNCION URBANA tienen una influencia mas FUERTE (5) que los criterios de CONECTIVIDAD.
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo		
1. Conectividad	9	7	5	3	1	3	x	7	9	2. Función Urbana	

Inicio del cuestionario:

	Extremo	Muy fuerte	Fuerte	Moderado	AMBOS IGUALES	Moderado	Fuerte	Muy fuerte	Extremo	
1. Conectividad	9	7	5	3	1	3	5	7	9	2. Función Urbana
1. Conectividad	9	7	5	3	1	3	5	7	9	3. Atributos de la ruta
1. Conectividad	9	7	5	3	1	3	5	7	9	4. Confort
2. Función Urbana	9	7	5	3	1	3	5	7	9	3. Atributos de la ruta
2. Función Urbana	9	7	5	3	1	3	5	7	9	4. Confort
3. Atributos de la ruta	9	7	5	3	1	3	5	7	9	4. Confort

PARTE II. INFLUENCIA ENTRE CRITERIOS

En este apartado escoja entre cada par de criterios, cuál de ellos influye/se relaciona o afecta más sobre el otro y en qué grado.

Ejemplo: ¿Cuál de los dos es más influyente sobre: **1. Presencia del transporte público**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
C2 Acceso a los destinos finales	9	7	5	x	1	3	5	7	9	C3. Conectividad de la calle
La respuesta quiere decir que el criterio **Presencia del transporte público** está moderadamente más influenciado por el criterio **Acceso a los destinos finales** que por la **Conectividad de la calle.**										

Inicio del cuestionario:

¿Cuál de los dos es más influyente sobre: **1. Presencia del transporte público**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
2. Acceso a los destinos finales	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
6. Áreas de parqueaderos	9	7	5	3	1	3	5	7	9	7. Elementos culturales

¿Cuál de los dos es más influyente sobre: **2. Acceso a los destinos finales**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
	9	7	5	3	1	3	5	7	9	4. Continuidad del camino
	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
3. Conectividad de la calle	9	7	5	3	1	3	5	7	9	4. Continuidad del camino
	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
4. Continuidad del camino	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
9. Medidas de desempeño- Afluencia	9	7	5	3	1	3	5	7	9	10. Tráfico de la calle
12. Percepción	9	7	5	3	1	3	5	7	9	13. Seguridad personal

¿Cuál de los dos es más influyente sobre: **6. Áreas de parqueaderos**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	2. Acceso a los destinos finales

¿Cuál de los dos es más influyente sobre: **8. Vitalidad**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	2. Acceso a los destinos finales
	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
2. Acceso a los destinos finales	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
9. Medidas de desempeño- Afluencia	9	7	5	3	1	3	5	7	9	10. Tráfico de la calle
11. Estética	9	7	5	3	1	3	5	7	9	13. Seguridad personal

¿Cuál de los dos es más influyente sobre: **9. Medidas de desempeño- Afluencia**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
	9	7	5	3	1	3	5	7	9	4. Continuidad del camino
	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
3. Conectividad de la calle	9	7	5	3	1	3	5	7	9	4. Continuidad del camino
	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
4. Continuidad del camino	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
7. Elementos culturales	9	7	5	3	1	3	5	7	9	8. Vitalidad

¿Cuál de los dos es más influyente sobre: **10. Tráfico de la calle**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	2. Acceso a los destinos finales
	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
2. Acceso a los destinos finales	9	7	5	3	1	3	5	7	9	3. Conectividad de la calle
6. Áreas de parqueaderos	9	7	5	3	1	3	5	7	9	8. Vitalidad

¿Cuál de los dos es más influyente sobre: **11. Estética**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
6. Áreas de parqueaderos	9	7	5	3	1	3	5	7	9	7. Elementos culturales

¿Cuál de los dos es más influyente sobre: **12. Percepción**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
4. Continuidad del camino	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino
11. Estética	9	7	5	3	1	3	5	7	9	13. Seguridad personal

¿Cuál de los dos es más influyente sobre: **13. Seguridad personal**										
	Extremo	Muy fuerte	Fuerte	Moderado	Igual	Moderado	Fuerte	Muy fuerte	Extremo	
1. Presencia del transporte público	9	7	5	3	1	3	5	7	9	5. Direccionalidad del camino

FIN DEL CUESTIONARIO
MUCHAS GRACIAS POR SUS RESPUESTAS

Appendix D.3. Model matrices. Case 3.

D.3.1 Influence matrix

		C1.					C2.			C3.		C4.			
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**Goal**
C1.	**1.1**	0	1	0	0	0	1	0	1	1	1	1	0	1	1
	1.2	1	0	0	0	0	1	0	1	0	1	0	0	0	1
	1.3	1	1	0	1	1	0	0	1	1	1	0	0	0	1
	1.4	0	1	0	0	0	0	0	0	1	0	0	1	0	1
	1.5	0	1	0	0	0	0	0	0	1	0	0	1	1	1
C2.	**2.1**	1	0	0	0	0	0	0	0	0	1	1	0	0	1
	2.2	1	0	0	0	0	1	0	1	1	0	1	0	0	1
	2.3	0	0	0	0	0	0	1	0	1	1	0	1	1	1
C3.	**3.1**	0	1	0	0	0	0	0	1	0	0	0	0	0	1
	3.2	1	1	0	0	0	1	0	1	1	0	1	1	1	1
C4.	**4.1**	0	0	0	0	0	0	0	1	1	0	0	1	0	1
	4.2	0	1	0	0	0	0	0	0	0	0	0	0	0	1
	4.3	0	1	0	0	0	0	0	1	0	0	0	1	0	1
Goal		0	0	0	0	0	0	0	0	0	0	0	0	0	0

D.3.2 Unweighted supermatrix

		C1.					C2.			C3.		C4.			
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**Goal**
C1.	**1.1**	0.000	0.253	0.000	0.000	0.000	0.256	0.000	0.287	0.286	0.253	1.000	0.000	0.500	0.200
	1.2	0.773	0.000	0.000	0.000	0.000	0.744	0.000	0.367	0.000	0.259	0.000	0.000	0.000	0.200
	1.3	0.227	0.310	0.000	1.000	1.000	0.000	0.000	0.346	0.270	0.487	0.000	0.000	0.000	0.200
	1.4	0.000	0.188	0.000	0.000	0.000	0.000	0.000	0.000	0.280	0.000	0.000	0.452	0.000	0.200
	1.5	0.000	0.249	0.000	0.000	0.000	0.000	0.000	0.000	0.164	0.000	0.000	0.548	0.500	0.200
C2.	**2.1**	0.342	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.383	0.261	0.000	0.000	0.333
	2.2	0.658	0.000	0.000	0.000	0.000	1.000	0.000	1.000	0.727	0.000	0.739	0.000	0.000	0.333
	2.3	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.273	0.617	0.000	1.000	1.000	0.333
C3.	**3.1**	0.000	0.395	0.000	0.000	0.000	0.000	0.000	0.424	0.000	0.000	0.000	0.000	0.000	0.500
	3.2	1.000	0.605	0.000	0.000	0.000	1.000	0.000	0.576	1.000	0.000	1.000	1.000	1.000	0.500
C4.	**4.1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.336	1.000	0.000	0.000	0.424	0.000	0.333
	4.2	0.000	0.363	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
	4.3	0.000	0.637	0.000	0.000	0.000	0.000	0.000	0.664	0.000	0.000	0.000	0.576	0.000	0.333
Goal		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D.3.3 Weighted supermatrix

		C1.					C2.			C3.		C4.			
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**Goal**
C1.	**1.1**	0.000	0.084	0.000	0.000	0.000	0.085	0.000	0.072	0.071	0.127	0.333	0.000	0.167	0.041
	1.2	0.258	0.000	0.000	0.000	0.000	0.248	0.000	0.092	0.000	0.130	0.000	0.000	0.000	0.041
	1.3	0.076	0.103	0.000	1.000	1.000	0.000	0.000	0.087	0.067	0.244	0.000	0.000	0.000	0.041
	1.4	0.000	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.070	0.000	0.000	0.113	0.000	0.041
	1.5	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.000	0.000	0.137	0.167	0.041
C2.	**2.1**	0.114	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.191	0.087	0.000	0.000	0.122
	2.2	0.219	0.000	0.000	0.000	0.000	0.333	0.000	0.250	0.182	0.000	0.246	0.000	0.000	0.122
	2.3	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.068	0.309	0.000	0.250	0.333	0.122
C3.	**3.1**	0.000	0.132	0.000	0.000	0.000	0.000	0.000	0.106	0.000	0.000	0.000	0.000	0.000	0.134
	3.2	0.333	0.202	0.000	0.000	0.000	0.333	0.000	0.144	0.250	0.000	0.333	0.250	0.333	0.134
C4.	**4.1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.084	0.250	0.000	0.000	0.106	0.000	0.054
	4.2	0.000	0.121	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.054
	4.3	0.000	0.212	0.000	0.000	0.000	0.000	0.000	0.166	0.000	0.000	0.000	0.144	0.000	0.054
Goal		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D.3.4 Limit supermatrix

		C1.					C2.			C3.		C4.			
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**Goal**
C1.	**1.1**	0.080	0.080	0.000	0.000	0.000	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
	1.2	0.082	0.082	0.000	0.000	0.000	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
	1.3	0.122	0.122	0.000	0.000	0.000	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122
	1.4	0.010	0.010	0.000	0.000	0.000	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	1.5	0.023	0.023	0.000	0.000	0.000	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
C2.	**2.1**	0.047	0.047	0.000	0.000	0.000	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
	2.2	0.117	0.117	0.000	0.000	0.000	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117
	2.3	0.218	0.218	0.000	0.000	0.000	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218
C3.	**3.1**	0.039	0.039	0.000	0.000	0.000	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
	3.2	0.154	0.154	0.000	0.000	0.000	0.154	0.154	0.154	0.154	0.154	0.154	0.154	0.154	0.154
C4.	**4.1**	0.033	0.033	0.000	0.000	0.000	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
	4.2	0.011	0.011	0.000	0.000	0.000	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
	4.3	0.063	0.063	0.000	0.000	0.000	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
Goal		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D.3.5 Cluster comparison matrices

	C.1	**C.2**	**C.3**	**C.4**	**C.5**
C.1	0.250	0.250	0.250	0.250	0.204
C.2	0.250	0.250	0.250	0.250	0.365
C.3	0.250	0.250	0.250	0.250	0.269
C.4	0.250	0.250	0.250	0.250	0.162
C.5	0.000	0.000	0.000	0.000	0.000