Handbook on implementation and adoption barriers of Urban Living Labs developing Nature Based Solutions

UNaLab

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ABOUT THE URBAN NATURE LABS PROJECT (UNALAB) •

Cities all over the world are facing a broad range of challenges due to climate change and ongoing urbanization. The UNaLab project is contributing to the development of smarter, more inclusive, more resilient and more sustainable urban communities through the implementation of nature-based solutions (NBS) co-created with and for local stakeholders and citizens. Each of the UNaLab project's three front-runner cities – Eindhoven (The Netherlands), Genova (Italy) and Tampere (Finland) – have a strong commitment to smart, citizen-driven solutions for sustainable urban development. Nature-based solutions are inspired by, supported by and copied from nature. These include, but are not limited to green roofs, free-standing living wall, single line trees… and many others. The establishment of Urban Living Lab (ULL) innovation spaces in Eindhoven, Genova and Tampere support on-going co-creation, demonstration, experimentation and evaluation of a range of different NBS targeting climate change mitigation and adaptation along with the sustainable management of water resources.

02.

INTRODUCTION ●

Nature-based solutions (NBS) are being promoted by scientists, organisations and policy-makers and increasingly adopted by cities worldwide as strategies for climate change adaptation and improving urban resilience (Kabisch et al., 2016; Lafortezza et al., 2018). Nature-based solutions are inspired by, copied from, and/or supported by nature (European Commission, 2015). Nature-based solutions are able to address multiple societal challenges, simultaneously providing a range of different environmental, economic, and social benefits (Cohen-Shacham et al., 2016; Dumitru & Wendling, 2021a; Raymond et al., 2017). Effective collaboration is recognised as essential for the successful adoption of NBS and achieving multifunctionality (Dorst et al., 2019; Sarabi et al., 2019). Developing NBS requires a flexible governance structure that includes experimentation, learning, reflexivity, and reversibility (von Wirth et al., 2019). Urban Living Labs (ULLs) are introduced as the orchestrators of the collaborations between different stakeholders – including companies, research communities, public sector, and citizens - through co-creation (Ståhlbröst et al., 2018). Urban Living Labs provide a safe environment for learning-by-doing in a real-life setting and provide opportunities for all stakeholders to express their ideas and preferences and decide on solutions that will later affect their lives. Urban Living Labs provide a transparent and open environment to facilitate collaborations and dialogue between stakeholders from different backgrounds.

Developing ULLs is a relatively novel approach in urban areas, and consequently, there are many challenges and barriers that cities face during ULL adoption. This handbook aims to identify and explore some common barriers and provide cities with an understanding and tool that can be used to strategically address barriers to ULL adoption.

03.

Barriers to the adoption of Urban Living Labs in NBS projects

In this section, the barriers that have been identified through a series of workshops and interviews with the experts involved in the co-creation process in the three UNALAB cities: Tampere (Finland), Genova (Italy) and Eindhoven (The Netherlands).

The identified barriers range from institutional barriers that municipalities face daily, to cultural issues related to how different groups of people think and behave.

The barriers are divided into four categories:
- organisational and structural barriers
- cognitive and behavioural barriers
- knowledge and process barriers
- ethical barriers

Organisational and Structural barriers

Political will and long-term commitment

The ULL approach and the collaboration with a wide range of different stakeholders from the early stages of the planning process is not yet universally well-supported by politicians and decision-makers. This issue of 'political acceptance' is even more prominent when the ULL is adopted for NBS implementation as both can be considered novel solutions with associated uncertainties. Politicians typically focus on high-visibility issues such as housing and the job market, and tend to prioritise actions with short-term and certain outcomes (Hawxwell, Mok, Mačiulytė, et al., 2019). Adopting NBS ULLs, developing them and realising their multiple benefits is a medium to long-term process generally not well-aligned with short-term political cycles. Therefore, adopting ULLs to develop NBS can be considered as an afterthought by politicians, to be realised through external projects and using externally-sourced funds.
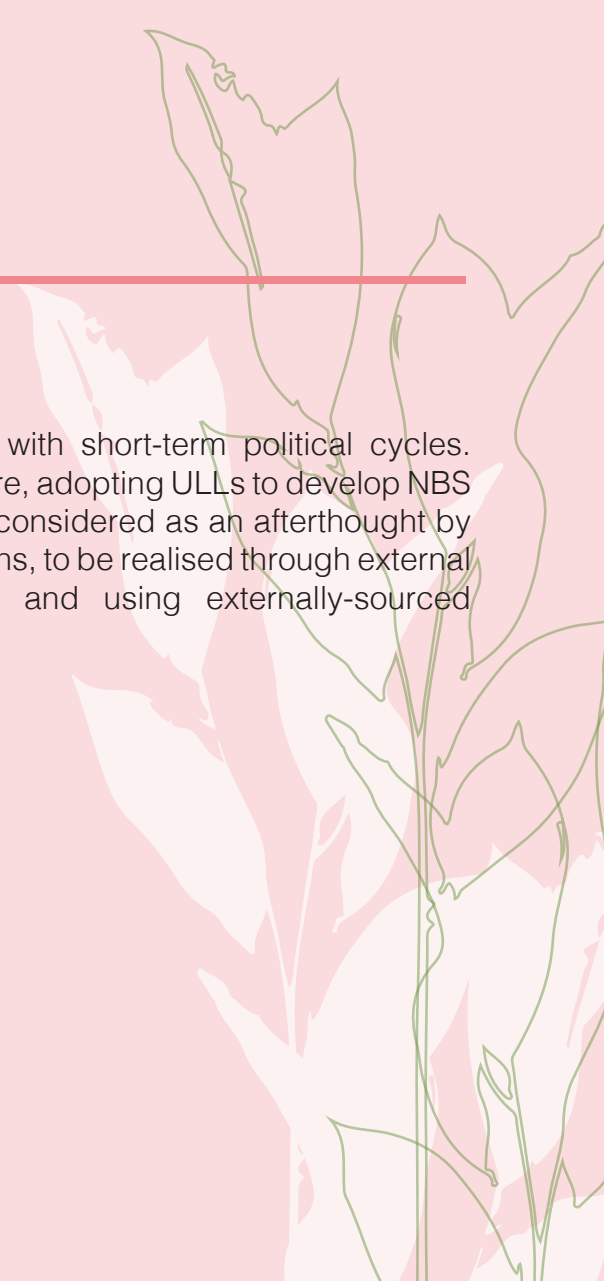
Lack of supportive legal and policy frameworks

A critical barrier identified in the UNaLab cities is that legal frameworks do not provide sufficient incentives for different stakeholders to commit to ULL activities in the long term. This issue has also been reported in other similar projects (URBAN GreenUP, 2018). A stable and supportive legal structure is necessary for providing the appropriate environment for urban stakeholders to share their innovative ideas. The experimental status of ULLs should be acknowledged by legal frameworks to provide the required flexibility for experimentation, failure, and learning.

Disconnection from the mainstream development process

An assessment of case studies in Tampere, Eindhoven and Genova coupled with a review of available literature indicated that ULLs are usually not identified as part of the mainstream development process (Nevens et al., 2013; von Wirth et al., 2019). Rather, ULL projects are mainly developed based upon the availability of (an) external financial source(s), with the ULL then limited by the duration and scope of the specific project(s). Urban Living Labs have to date not been adopted as part of the mainstream policymaking and planning processes within the studied municipalities, limiting the capacity of different groups within the city to adopt them. The UNaLab partner cities of Tampere, Eindhoven and Genova each developed long-term goals aiming at greater involvement of different stakeholders for their respective transitions towards sustainability. In the short-term, however, the required commitment to adopt the necessary innovations to achieve stated long-term goals may be somewhat lacking. In other words, there is a lack of alignment between short-term actions and long-term goals (Kabisch et al., 2016).

Sectoral Silos

As observed in Tampere, Eindhoven and Genova, different departments and institutions frequently have their own agendas, policy frameworks, and strategies. 'Sectoral silos' was highly emphasised by our interviewees as a critical barrier to successfully communicating and bringing different departments around a common table (Sarabi et al., 2019). Adopting ULLs requires different departments to be actively included in the development process. This is even more critical when NBS are the innovations being implemented in the context of ULLs. As a multi- and transdisciplinary concept, NBS require the active participation of individuals from different departments and different disciplines in the ULL activities. However, it was observed in the present study that the links between municipal departments may not be sufficient for effective collaboration in ULLs for NBS.

Inflexible organisational structure and command and control attitude

Another structural barrier identified in the case studies is the lack of necessary freedoms in the municipal departments to define and adjust their actions and strategies. Traditional public administration is characterised by a hierarchical governance structure. Relatively slow and confusing bureaucratic processes can limit the adoption of ULLs (Nevens et al., 2013). Urban Living Labs involve citizens, companies, research institutions, and universities that can be discouraged from playing an active role by the characteristic inflexibility of municipal structures and processes. Usually, making decisions and modifying plans requires a relatively long time in municipalities that is not aligned with the structure of ULLs. Urban Living Labs need to be dynamic to develop innovations, test, monitor, and improve, which is challenging in the case of ULLs implemented and controlled by municipalities with rigid structures.

Lack of sufficient human resources

The personnel resources committed to co-creation activities in municipalities can be quite limited (Gascó, 2017). Clear examples of this issue were observed in the workshops conducted in the context of the UNaLab project in Tampere, Eindhoven and Genova. Although experts from different departments and groups were present in these workshops, the same people did not necessarily participate in each of the workshops in the series, which challenged the co-creation process. The main reason for this problem was the lack of available time municipal employees could spend on activities other than their direct responsibilities.

Lack of sustainable financial resources

Lack of financial resources to support ULLs and related activities in the long term is another common barrier among cities (Nevens et al., 2013). The UNaLab ULLs are mainly financed through external resources, which are limited to the duration of the UNaLab project. Cities have excessively focused on capital investments while lacking financing mechanisms and business models to support co-creation activities after the capital investment phase (ConnectingNature, n.d.).

Social and behavioural barriers

Negative Past experiences

A cognitive barrier identified during the interviews with participants from Tampere, Eindhoven and Genova was the negative experiences that stakeholders, especially public authorities, have had with co-creation and participatory processes. This barrier was particularly pronounced in the city of Genova. The city has had previous unsuccessful experiences with different participatory approaches, such as participatory budgeting (Hawxwell, Mok, Mačiulytė, et al., 2019). Such negative experiences cause fear of failure, thus limiting the adoption of ULLs despite the motivation of municipal employees to enhance public participation. These negative experiences can be a significant contributor to a negative perception of the ULL approach and co-creation, noted in the present study among some municipal employees.

Negative perceptions toward ULL approach

An additional critical cognitive barrier is the perception of the inclusion of living lab activities and co-creation processes by those responsible for administering municipal processes. In some cases, experts perceive NBS as complex solutions with many uncertainties, and ULLs as an additional complication during the development process. As discussed in the common workshop among representatives from UNaLab partner cities, some experts are averse to include people with different expectations and potentially be drawn into a time-consuming or contentious process.

Risk aversion and path dependency

Lack of willingness to change and risk aversion (Chalmers, 2012) is also a relevant barrier. Aversion to change and risk was observed among many municipal employees, especially those working with more technical issues. These technical experts play an essential role and tend to have a significant amount of power in the organisational structure of municipalities exhibit a preference for actions with clear and predictable development processes and outcomes, which is usually not the case for NBS ULLs.

BARRIERS TO THE ADOPTION OF URBAN LIVING LABS DEVELOPING NATURE-BASED SOLUTIONS

Conflicting Expectations

Diverging expectations among different groups of stakeholders participating in ULL activities can generate conflict (Brink et al., 2018). Various conflicts due to diverging expectations have been observed to some extent in each of the three UNaLab front-runner cities. Conflicting expectations can be present between different departments in the municipality or even between different community stakeholders. In some cases, the private sector participating in the co-creation sessions expected to decide on concrete projects as soon as possible, which conflicts with the NBS co-creation process. Differences between the expectations of different groups of citizens can also create challenges during the co-creation process. For example, in one case, lengthy discussions among citizens with differing opinions regarding the implementation of a playground in a park caused a delay in the overall co-creation process.

Lack of public awareness and demand

Lack of awareness and positive perception by the public is commonly reported as one of the barriers to development of NBS (Sarabi et al., 2019; Wamsler et al., 2020). During the interviews with the cities of Tampere, Eindhoven and Genova, it was mentioned that NBS are viewed as public infrastructure and citizens consider the municipalities to be solely responsible for developing them. The importance of engagement in NBS ULLs and the value obtained through participation are not always sufficiently clear to the public. The importance of public demand was frequently emphasised during the interviews, particularly with regard to the impact of public demand on the willingness and commitment of politicians.

Lack of engagement to take responsibility

In the UNaLab project, the responsibility to adopt and implement the ULLs has largely been limited to the few experts from each front-runner city involved in the project. There has not been widespread motivation and commitment for taking a leadership role among employees of the municipalities involved. This issue has been reported to be limiting the adoption of ULLs as an innovation development approach (BearingPoint, 2016). The successful adoption of ULL requires different departments and groups to engage with one another to work towards a common goal and take responsibility for different aspects of the process. Despite the presence of representatives from different departments in the co-creation sessions in Tampere, Eindhoven and Genova, the ability and willingness to play an active role in ULL development processes was somewhat limited. Motivation from the private sector and the public sector to jointly take responsibility for and commit to ULL and NBS actions was largely lacking in the present case studies.

Knowledge and process barriers

Uncertainties regarding the added values and benefit of ULLs

The ways in which ULLs can provide added value for NBS projects were not clear to every municipal employee (Nevens et al., 2013). Especially when the implemented NBS was a small-scale solution, people did not necessarily interact with the NBS on a daily basis and thus the benefits of including local knowledge in the daily planning practices were generally not well recognised. However, the value of ULLs and using the local knowledge of stakeholders has become more apparent to partner municipalities during the UNaLab project as a result of challenges faced by each during the NBS implementation process.

Lack of skilled knowledge brokers

The knowledge of NBS, ULLs and co-creation is limited to relatively few experts in the UNaLab partner municipalities with high-level knowledge and experience working actively with different stakeholders (BearingPoint, 2016). The presence of professionals with multi- and transdisciplinary expertise and the ability to facilitate effective networking between different departments and/or groups and connect multi-level stakeholders is crucial for adopting ULLs, and co-creating and monitoring NBS (Dumitru & Wendling, 2021a). Education and training programs tend to primarily be dedicated to the development of technical expertise. There is a need for education and training programs to develop technical experts who can communicate with different groups from multiple different disciplines.

Lack of available context tailored engagement tools

A need for guidelines and tools that can help cities to better engage with different groups was reported in the studied cities. One of the main problems that cities are facing is the inability to find relevant stakeholders. In the ULL workshops, it was not clear for organisers who may have sufficient motivation to be part of the co-creation activities and what their motivations may be. The involved stakeholders were mainly individuals who have been previously involved in local municipal planning processes or, as they were called in our interviews, «the usual suspects». Identifying additional stakeholders to play an active role in the co-creation process was highly challenging for cities. A set of tools and guidelines that can help identify the potential benefits provided by different NBS along with the possible beneficiaries was reported to be necessary for the involvement of stakeholders.

NBS Monitoring and assessment challenges

Some real or perceived characteristics of NBS as the innovation to be developed in ULLs have also been shown to present a barrier to ULL adoption. There is a perceived difficulty in assessing the performance or impact of NBS (Sarabi et al., 2020). NBS are different from other innovations that cities have experienced to develop in their ULLs. Some of the NBS benefits are not easily measurable or take a relatively long time to be visible, making the inclusion of different stakeholders challenging (Mok et al., 2021). Within the UNaLab project, there are two project deliverables dedicated to monitoring and evaluation of NBS: D3.1 NBS Performance Impact Monitoring Protocols (Wendling et al., 2019) and D5.3 Preliminary NBS Implementation Handbook (Dubovik et al., 2020). In addition, the NBS Impact Evaluation Framework Task Force comprised of experts from 17 EU Horizon 2020-funded NBS projects and representations from aligned programmes (e.g., JRC, EEA) recently released a comprehensive handbook to guide monitoring and evaluation planning- Evaluating the Impact of Nature-Based Solutions: A Handbook for Practitioners - together with an extensive appendix of methods to support the assessment of NBS performance and impact (Dumitru & Wendling, 2021b, 2021a). These outputs from UNaLab and related H2020 projects represent a significant increase in knowledge of NBS monitoring and evaluation; however, our interviews indicate that additional efforts are required to enhance the adoption of this knowledge and associated practices by local practitioners.

Inability to upscale and replicate the projects

The outcomes obtained from NBS living labs are recognised as highly context and site-specific and replicating the learnings from them can be highly challenging (Nevens et al., 2013). Although it is still too soon to assess the replicability of UNaLab ULLs, based on the past experiences in our front-runner cities, evidence for potential to replicate the findings is necessary to motivate adoption of the ULL approach. The ability to upscale NBS innovations is partially dependent upon the ability to capture the outcomes and learn from the experimental projects. Potential barriers to upscaling and/or replication can also be related to the local organisational culture and the perceptions of the urban experts and policymakers (Junginger, 2014). Successful replication of ULLs requires a strong network of stakeholders from different sectors, departments, and institutions to disseminate the learnings and experiences in various settings, including dissemination of outcomes ranging from technical findings to governance and financing innovations.

Lack of learning from other experiences

One of the barriers limiting the adoption of NBS ULLs, is the lack of sufficient opportunities to share the lessons learned, and also learn from other experiences. There are several knowledge repositories such as Oppla (https://oppla.eu/) and Urban Nature Atlas (https://una.city/) that have been developed during the recent years to gather NBS co-creation experiences from cities across the world. However, as it was reported during our interviews, these platforms are not yet widely known and used by urban stakeholders. Stakeholders are not yet sufficiently aware of how to adopt the information and knowledge provided by these systems and apply them to their contexts. Besides, our interviewees expressed the need for more opportunities to exchange knowledge between stakeholders from different cities interactively.

Ethical barriers

Intellectual property(IP)

One of the ethical concerns mentioned was regarding the involvement of the private sector in the co-creation process (Mergel, 2018). During the co-creation workshops in Tampere, Eindhoven and Genova, it was observed that participants representing the private companies were frequently not willing to share specific ideas regarding possible innovations and actions. Private companies are often reluctant to share their intellectual property (IP), but during the co-creation process, there was no specific protocol regarding protecting the IPs, which limited the co-creation process with regard to collaboration around specific innovative ideas.

Privacy issues

Protecting citizens' privacy while monitoring the UNaLab NBS living labs has been a critical challenge for the municipalities (Brink et al., 2018). For example, the municipality of Eindhoven had initially planned to install Lidar cameras to monitor the activities of citizens in and around the Clausplein to assess the social functionality of the NBS by observing the behaviour of people around the NBS. However, the cameras could not be installed due to conflict with the privacy regulations in place in the Netherlands.

Inclusiveness

Inclusiveness was further identified as an ethical issue as not all social groups were represented in the co-creation sessions in front-runner cities (Brink et al., 2018). The core groups of attendees in each front-runner city tended to be individuals who frequently attend municipal meetings, but the desired diversity of participants with respect to ethnicity, age, or level of income was not achieved. In the future, a greater focus on inclusion of a broader range of participants from different genders, races, ages, and educational backgrounds is needed.

04.

Analysis & modelling of ● barriers

Identifying and studying the barriers that the front-runner cities experienced demonstrated that addressing them requires a systemic perspective. We found the barriers to be highly interconnected and understanding their interactions to be necessary for developing strategic roadmaps.
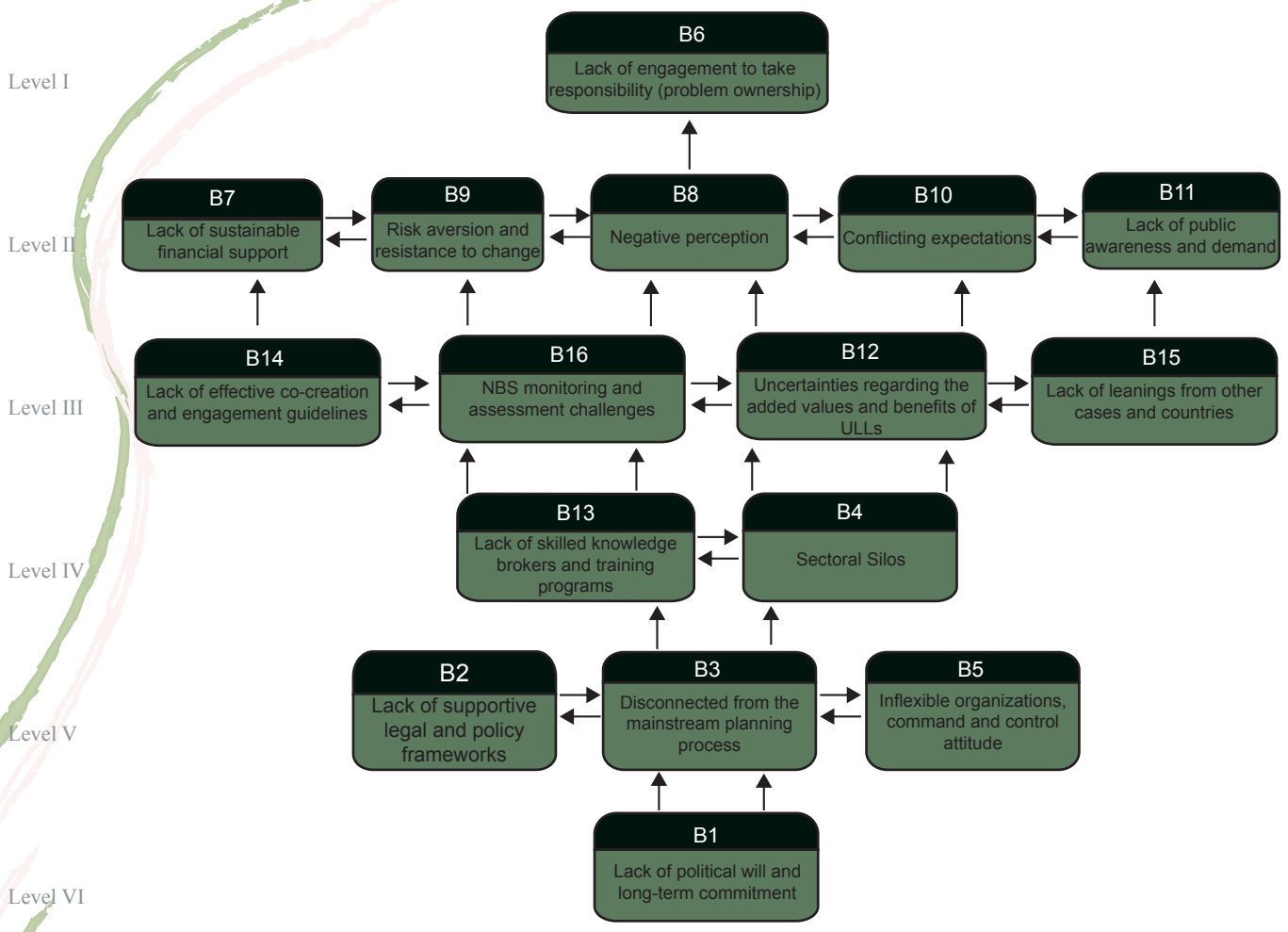
For this purpose, we have used Interpretive Structural Modelling (ISM), a soft system methodology, to find the interrelationships among the barriers and develop a structural model from the barriers. Considering the limitation of the method used, 16 barriers were selected for analysis. These barriers were chosen based on the frequency of their mention during our interviews.

The generated ISM model has six levels. Level I includes lack of engagement to take responsibility (problem ownership) (B6). Level VI, located at the bottom of the model, includes lack of political will and long-term commitment(B1). In this model, arrows show the direction of the relationships among the barriers. An arrow from barrier i to barrier j means barrier j is affected by barrier i. Each barrier at a higher level is directly affected by at least one barrier at the next lower level and indirectly affected by many other lower-level barriers.
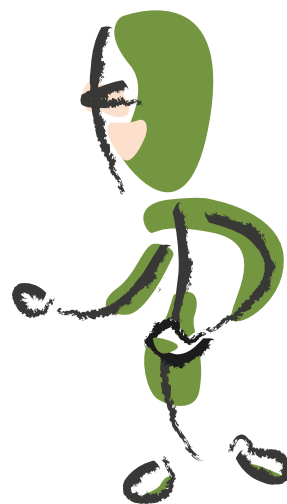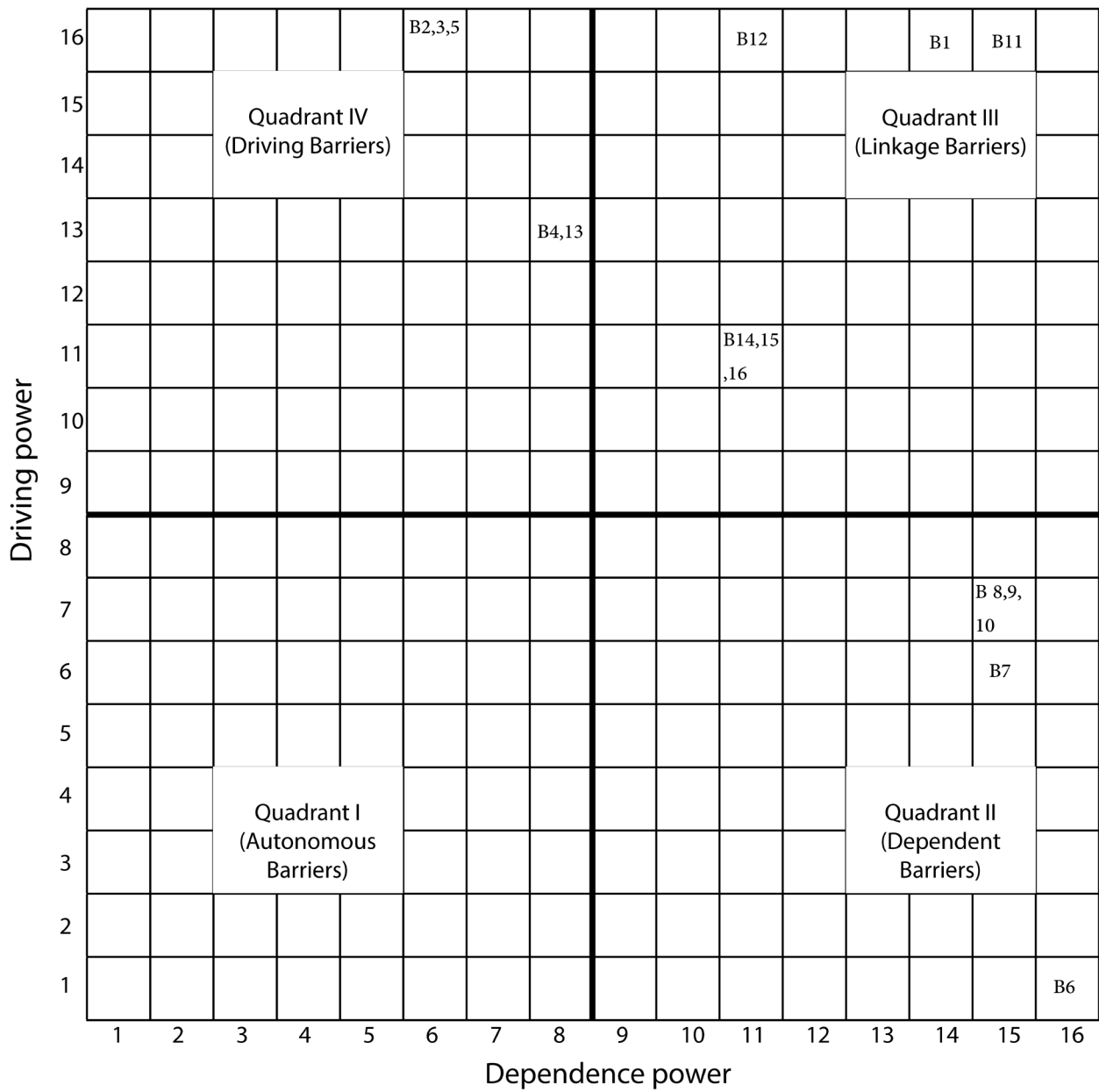
BARRIERS MODEL

Level I

B6
Lack of engagement to take responsibility (problem ownership)

Level II

B7
Lack of sustainable financial support

B9
Risk aversion and resistance to change

B8
Negative perception

B10
Conflicting expectations

B11
Lack of public awareness and demand

Level III

B14
Lack of effective co-creation and engagement guidelines

B16
NBS monitoring and assessment challenges

B12
Uncertainties regarding the added values and benefits of ULLs

B15
Lack of leanings from other cases and countries

Level IV

B13
Lack of skilled knowledge brokers and training programs

B4
Sectoral Silos

Level V

B2
Lack of supportive legal and policy frameworks

B3
Disconnected from the mainstream planning process

B5
Inflexible organizations, command and control attitude

Level VI

B1
Lack of political will and long-term commitment

The ISM model is accompanied by the MICMAC analysis used to classify barriers using their driving and dependence powers. Higher driving power shows the extent of the impact that the barrier has on other barriers, while higher dependence power shows the extent to which the barrier is affected by the other barriers. Barriers are classified into four categories:

- **Autonomous barriers in Quadrant-I:** These barriers have both weak driving and dependence power. These barriers are rather disconnected from the rest of the system. None of the barriers included in the analysis was located in this category.

- **Dependent barriers in Quadrant-II:** These are the barriers with strong dependence power but low driving power.

- **Linkage barriers in Quadrant-III:** These barriers have strong driving power and also strong dependence power. These barriers are considered to be rather unstable, and any action on any of these barriers is likely to affect several other barriers and create a feedback mechanism affecting the barrier itself.

- **Independent (driving) barriers in Quadrant-IV:** These are barriers with strong driving power but weak dependence power.

	Driving power	Dependence power

Grid (Driving power on Y-axis 1–16, Dependence power on X-axis 1–16):

- Row 16: B2,3,5 (Dependence 6); B12 (Dependence 10); B1 (Dependence 14); B11 (Dependence 15)
- Row 15–14: Quadrant IV (Driving Barriers); Quadrant III (Linkage Barriers)
- Row 13: B4,13 (Dependence 8)
- Row 11: B14,15,16 (Dependence 9)
- Row 7: B 8,9,10 (Dependence 15)
- Row 6: B7 (Dependence 15)
- Row 4–3: Quadrant I (Autonomous Barriers); Quadrant II (Dependent Barriers)
- Row 1: B6 (Dependence 16)

Driving power (Y-axis)

Dependence power (X-axis)

Elaboration of the results

Five barriers are located in Quadrant IV of the MICMAC analysis:
- Lack of supportive policy and legal frameworks (B2);
- Disconnection from the mainstream development process (B3);
- Inflexible organisations, and command-and-control attitude (B5);
- Sectoral Silos (B4); and,
- Lack of skilled knowledge brokers (B13).

Barriers B2, B3, and B5 are relatively independent but have a significant impact on other barriers. This high impact can also be recognised by the position of these three barriers in the ISM model. These barriers are mainly related to municipalities' institutional arrangements.

The presence of B4 and B13 in this Quadrant shows the importance of having appropriate connections among different departments and/or skilled people to make such connections to adopt ULLs. In the ISM model, B4 and B13 directly affect the knowledge-related barriers located in level III of the model. It can be concluded that effective collaboration among stakeholders across disciplines and scales is essential for enhancing the knowledge and awareness of stakeholders and developing holistic monitoring plans in each city.

There are six barriers located in the Quadrant III of the MICMAC analysis:
- Lack of political will and commitment (B1);
- Lack of public awareness and demand (B11);
- Uncertainties regarding the added values and benefits of ULLs (B12);
- Lack of sufficient co-creation and engagement guidelines (B14);
- Lack of learning from other cases and countries (B15); and,
- NBS Monitoring and assessment challenges (B16).

B1 is located at the bottom of the ISM model, while it is in the Quadrant III of the MICMAC analysis. This tells us that B3 is a significant barrier, but it is also affected by the others, especially by the other barriers located in Quadrant III. As mentioned earlier, the barriers located at this Quadrant play a central role. This shows the importance of paying attention to the feedback loops among the barriers while planning to address them.

Besides, the presence of knowledge-related barriers (B12, B14, B15, B16) in this Quadrant, shows that enhancing the awareness of urban stakeholders and providing opportunities to improve the knowledge regarding NBS ULLs is essential to address all other barriers and successfully adopt ULLs.

There should be specific attention paid to the lack of public awareness and demand (B11). The public plays a central role in ULLs, and this analysis shows the lack of demand from the public significantly limits the adoption of ULLs. Improving public awareness and demand can help to improve cities' political and institutional environments and enhance the motivation among urban stakeholders to support ULLs and commit to them.

There are five barriers located in the Quadrant II of the MICMAC analysis:
- Lack of engagement to take responsibility (B6);
- Lack of sustainable financial support (B7);
- Negative perception (B8);
- Risk aversion and resistance to change (B9); and,
- Conflicting Expectations (B10).

These barriers, which are primarily cognitive and behavioural, are located in levels I and II of the ISM model. Addressing these barriers strategically requires paying attention to the other barriers affecting them. One important point here is the presence of the lack of sustainable financial support (B7) in this Quadrant. This barrier, which was frequently mentioned during our interviews as a critical barriers, is highly affected by others. This shows the importance of having a systemic perspective, since designing actions to address this barrier without having a clear picture of the other issues affecting it cannot lead to sustainable outcomes.
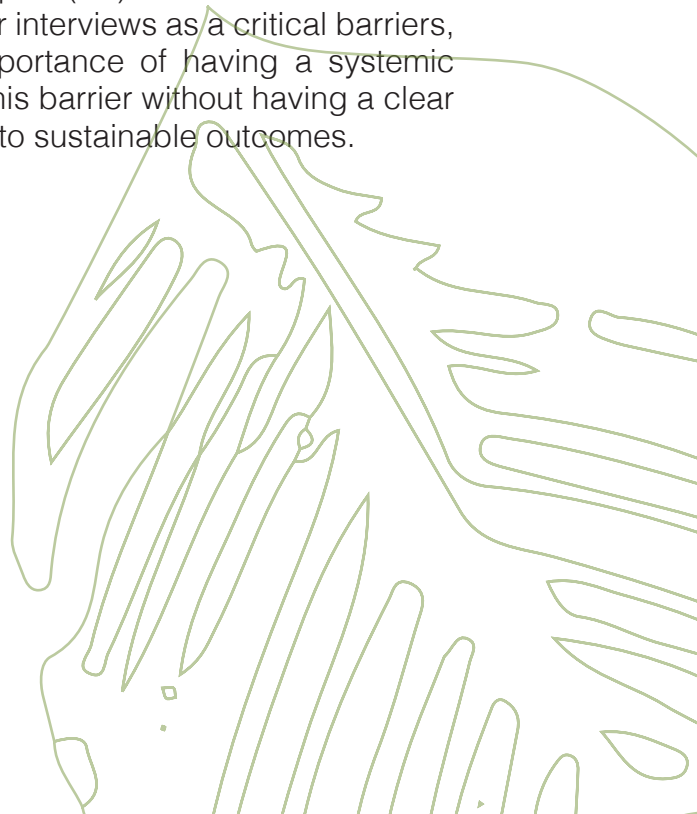
05.

Enablers to the adoption of NBS ULLs ●

Enablers that can help to address the barriers to the adoption of NBS ULLs have been identified by extensively reviewing relevant literature, including scientific papers and reports concerning topics such as open innovation in the public sector, social innovation, and urban experimentation. The reports and deliverables of the UNaLab project have also been reviewed. After developing the initial list of enablers, it was shared with experts from the front-runner cities in the UNaLab project to select those considered to be the most relevant. The identified enablers are presented in the following pages.

Supportive legal and authoritative acts

Experimenting in urban areas typically requires dealing with multiple complex legal and bureaucratic processes. Municipalities can play a critical role as stakeholders with high authoritative power that can directly affect regulations and policies. Municipalities can use their formal decision-making power to bypass restricting regulations and acts. Planning and building acts were identified to be among the most restricting regulations. As a strategy, municipalities can help to address these issues by clarifying the experimental status of ULLs, since regulatory experiments are allowed to fail (Steen & van Bueren, 2017).

Another approach that municipalities can take to improve the legal frameworks in favour of ULLs is to use hybrid regulatory structures. Performance-based regulations are known to better support innovative approaches compared with prescriptive-type regulations. Performance-based regulations define the desirable result, but provide the flexibility required to adopt ULLs successfully as opposed to prescriptive regulations. However, it is essential to define the performance standards to cover both short and long-term performance across multiple disciplines. Therefore, taking a hybrid approach and combining qualitative and quantitative judgments and standards can facilitate the adoption of ULLs.

Develop shared visions and roadmaps

Developing integral visions in which the role of ULLs is clear can strongly facilitate their adoption (Mukhtar-Landgren et al., 2019). Having a shared vision can improve the acceptance of ULLs as a normal procedure in developing NBS. The other important issue is the inclusion of different disciplines within the strategies of developing NBS ULLs. Using design thinking methods to define challenges, visions, roles, actions and barriers is recognised as a suitable method for planning multidisciplinary innovations. One of the activities shown in the UNaLab project to be an effective method to facilitate the adoption of NBS ULLs was conducting roadmapping sessions. During a roadmapping session, stakeholders from different groups collaboratively define problems, identify visions, and define paths to achieve their objectives. It is not only a strategic planning session, but it also has an educational function to familiarise stakeholders with the benefits and functionalities of the proposed innovations. Bringing together stakeholders from different sectors and disciplines can help establish trust and overcome sectoral, institutional and/or disciplinary silos.

Align ULL themes with local visions

An effective and practical approach to overcoming identified barriers is to align the ULL theme and actions with the visions and strategies defined by municipalities, which can provide ULLs with the necessary support from municipalities and politicians. A good example is the Concept House Village Lab (CHVL) in Rotterdam, which became very important for the municipality due to the lab's housing and energy-efficient building theme (Mukhtar-Landgren et al., 2019). For this purpose, the ULL team should be familiar with local visions and actions to identify how ULL can best fit them.

Appointing and empowering transboundary facilitators

Having people with the knowledge about municipal procedures and the required communication skills to interact with different stakeholders in ULLs is important. These experts can help address the uncertainties regarding the municipal legal and bureaucratic procedures, and reflect the concerns of other actors to local officials more effectively (Sarabi et al., 2019). We saw an example of these actors in the UNaLab front-runner cities; however, in the UNaLab project these transboundary facilitators did not have the required power and resources to encourage other groups to take new responsibilities.

Formalising informal networks and relationships

Establishing formal structures to bring different sectors together can serve to bring together key stakeholders (Mukhtar-Landgren et al., 2019). Dedicating a part of official working hours to the establishment of informal networks and relationships facilitates the engagement of stakeholders. Such a structure is already present in Eindhoven, which is facilitating the coordination between different departments. Further adoption of this idea can help to bring stakeholders from different institutional levels and different disciplines together.

Formalising informal networks and relationships

Another possible method to bring the stakeholders together is establishing formal structures for bringing different sectors together (Mukhtar-Landgren et al., 2019). Dedicating a part of official working hours to such activities facilitates the engagement of stakeholders. Such a structure seemed to be already present in Eindhoven, which is facilitating the coordination between different departments. Further adoption of this idea can help to bring stakeholders from different institutional levels and different disciplines together.

Empowering informal networks

In the case studies examined in Tampere, Eindhoven and Genova, informal networks have critical roles in the adoption of NBS ULLs. According to the experiences in these UNaLab front-runner cities, these networks are even more effective in bringing different departments together. Informal networks must be further developed, e.g., by physically locating relevant stakeholders in the same working space, establishing open spaces, and sponsoring seminars and breakfasts, etc. Actors from various departments and sectors can gather, talk about what they are working on and get to know one another. Empowering informal networks is important not only to connect stakeholders within municipalities. Most citizen involvement actions also occur through informal networks, and recognising and empowering these networks can significantly facilitate the inclusion of different stakeholders.

ULL location

When an ULL is restricted by a geographic boundary, the location of the ULL can play an essential role in its recognition and adoption. Based on past experiences, when a ULL is visible to different stakeholders, it can lead to a better engagement. It is crucial to choose the location for setting up the ULLs strategically to facilitate active co-creation (Mukhtar-Landgren et al., 2019). The location should be sufficiently visible and accessible for different stakeholders to interact with the ULL on a daily basis.

Innovative financing mechanisms

Cities need to adopt new financing mechanisms to successfully upscale NBS ULLs. For example, by introducing incentives such as tax benefits and development rights, the private sector can be encouraged to actively engage in ULLs. Such mechanisms are essential for sharing the responsibilities between different stakeholders. Developing a business model canvas can be a possible action here. This can help bridge silos, broaden the value proposition, develop long-term financing plans, and facilitate capacity building (ConnectingNature, n.d.).

Information systems and experience sharing mechanisms

Providing well-defined mechanisms and systems to share outcomes of different experiences can help the adoption and replication of NBS ULLs. These mechanisms can include online information-sharing platforms or regular sessions to bring stakeholders from different disciplines, sectors, and locations to share their knowledge. Such mechanisms and actions can have many advantages. For example, they can help to increase confidence in the benefits NBS ULLs can provide, or support the identification of suitable financing and governance approaches. In the context of the UNaLab project, the buddy system has been designed for cities to interact and share their experiences and learnings by conducting regular workshops and seminars, and providing opportunities for discussions between experts and stakeholders from different cities.

Co-creation toolkit

Knowledge regarding existing co-creation methods is not widely available. The co-creation toolkit developed in the UNaLab project can serve as an educational system to find appropriate methods of co-creation in different conditions and guidance regarding how to operationalise them. The toolkit gathers the tools and methods used to co-create NBS, including tools for need-finding, ideation, strategic planning, experimentation, and feedback gathering (UNaLab, n.d.).

Awareness campaigns

As evidenced by the barriers model, raising the awareness of stakeholders from different groups is vital for the successful adoption of ULLs. Increasing public awareness and satisfaction with NBS ULLs can lead to increased support and commitments for further projects. Awareness campaigns can have different forms, from conducting workshops and conferences to using social media for familiarising different stakeholders with co-creation, ULLs, their role, and the benefits of NBS ULLs.

Training programs

Adopting ULLs as environments where decision-making power is distributed among stakeholders as opposed to the dominant hierarchical power structure in cities requires specific knowledge and skills for which municipal workers need to be prepared (Davies & Lafortezza, 2019). For this purpose, organising training programs focused on management, communication, and presentation skills are necessary. Infrastructure professionals also need to receive more education on NBS and be equipped with multi- and transdisciplinary skills and expertise needed to adopt, implement, and assess NBS (Harvard Law School, 2014).

Stakeholder mapping and value models

Appropriate stakeholder mapping can facilitate the successful adoption of ULLs. By correctly identifying the relevant stakeholders, ULL managers can understand which actors are key to the success of the ULL and how to include them. Stakeholder mapping can help to identify and predict the common motivations and points of conflict between different actors. Additionally, it can help to include useful skills in the ULL. In the case of NBS, linking ecosystem services to stakeholder end-users/beneficiaries can be a suitable approach to find out who is being affected by the delivery of ecosystem services and how (Raum, 2018).

Updating and defining monitoring plans

Developing context-based monitoring plans can help to learn from ULLs, improve and replicate them. Providing well-defined indicators showing the performance and impacts of NBS ULLs is essential for their further adoption. Identifying appropriate methods to assess the less tangible benefits of NBS ULLs is an important part of this enabler. The recent publication Evaluating the impact of nature-based solutions: A handbook for practitioners (Dumitru & Wendling, 2021a) and its associated appendix of methods (Dumitru & Wendling, 2021b) provides a holistic framework and clear guidance for the co-development of context-based monitoring plans, along with an extensive selection of NBS assessment methodologies across 12 societal challenge areas.

06.

ACRONYMS AND TERMS ●

ABBREVIATION

URBAN LIVING LAB	**ULL**
URBAN NATURE LABS	**UNaLab**
NATURE BASED SOLUTION	**NBS**
INTERPRETIVE STRUCTURAL MODELING	**ISM**
MATRICE D'IMPACTS CROISES-MULTIPLICATION APPLIQUE AN CLASSMENT	**MICMAC**

07.

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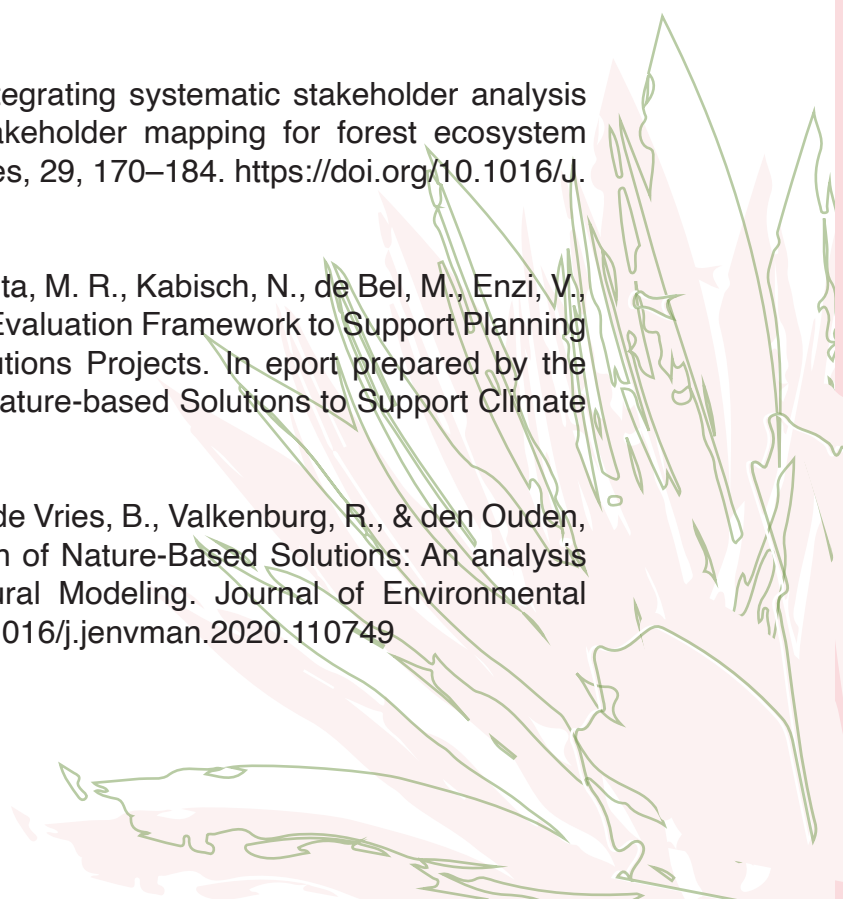
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