Mapping of innovative governance models to overcome barriers for nature based urban regeneration

Egusquiza A¹, Cortese M², Perfido D²
¹Building Technologies, Tecnalia, 48146 Derio (Spain)
²R2M Solution s.r.l. – Via F.Lli Cuzio 42, 27100 Pavia (Italy)
aitziber.egusquiza@tecnalia.com

Abstract. The implementation of urban Nature Based Solutions (NBS) projects is deeply determined by the novelty of the concept. Its innovation is both an opportunity and a challenge: as a new concept, it generates uncertainty due to lack of technical and operational preparedness, but it also allows to deploy innovative approaches, new ways to address old problems and more inclusive practices. Nature4Cities project has systematically conceptualized the barriers and drivers on NBS projects implementation by a review of the state of the art. To see how these barriers can be overcome by governance strategies, different urban and environmental governance models have been mapped and characterized to assess their suitability for different NBS projects. Five clusters have been identified where models are grouped according to the involved actors, their position in the spectrum from high to low government involvement and their level of participation. This theoretical model has been applied to real cases to check the incidence of the different clusters. Results show that urban and environmental governance is a map where the different models coexist in different degrees regarding some key axes such as level of innovation, polycentric vs. monocentric, involved sectors, level of participation and scale. Collaborative, multisector, polycentric and adaptive governance models address significant number of previously identified cross-domain barriers showing their suitability. The work presented in this paper can be the basis to define new institutional and governance arrangements that will foster multi-stakeholder involvement, citizens' engagement, leveraging both public and private funding of NBS in cities.

1. Introduction
Nature Based Solutions (NBS) are defined by the EU as “solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions” [1]. They can enhance sustainable urbanisation, restore degraded ecosystems, support climate change adaptation and mitigation and develop strategies for improvement of risk management and resilience [2]. But, NBS is a new complex concept that is not totally clear for practitioners. The concept is frequently confused with other concepts such as biomimicry, sustainable development or green infrastructure. This loose definition of the concept and its novelty could be an opportunity for more flexible and inclusive dialogue and innovation [3], but also a challenge due to the diversity of required knowledge, stakeholders to be involved and challenges to be addressed [4]. Some authors believe that NBS concept includes the concept of integrative governance and participatory approaches to co-design, co-creation and co-management [5] and this could be one of the
key differences that distinguish the concept from more traditional and top-down conservation approaches [6]. Governance could be an ambiguous concept also and there is not an agreed and clearly defined governance theory [7]. In this paper we will use the term “governance” to refer to collective action arrangements designed to achieve the implementation of NBS projects, and government to refer to the formal organisations of the “public sector” as in [8]. In Nature4Cities (N4C) project the different urban and environmental governance models have been mapped and characterized in order to assess their suitability for different NBS projects. An Implementation Model Data Base for an extensive range of Nature-Based Solutions has been developed as open-source with the purpose of illustrating the single characteristics, the concerned NBS and the governance, financial and business aspects related to each Implementation Model (IM) identified. The process allowed gathering a large amount of information, which facilitates the systematization of the implementation modalities through which single NBS can be applied in specific urban contexts.

2. Methodology
For the literature survey a snowball approach has been followed. In a first step some primary documents have been identified [4][9][10] taking into account the research outputs that have been generated for similar research project [3][11][12]. These documents guided the posterior literature review to specific fields and issues. The literature review has been complemented by the results of several interviews, on-line surveys and workshops were conducted targeting experts, urban planners and municipality workers. Finally, the results have been verified comparing them with the experiences of the partner cities participating in N4C project. After developing the theorical model, a database with different real cases was built in order to link the predetermined theoretical models with best practices and to study the incidence of them in practice.

3. Barriers and drivers
NBS-oriented urban planning can be considered a process of socio-ecological change. These processes are part of very complex systems with incomplete understanding and profound uncertainties [13] in need of interdisciplinary research [4], social engagement and feasible financing schemes. The literature shows that the main type of barriers for their implementation are the knowledge, governance and economic ones.

3.1. Barriers of NBS implementation (Process Inhibitors)
The identified barriers in the knowledge, governance and economic domains are highly linked to the novelty and complexity of the approach, since that amplifies some of the traditional barriers of urban planning. In addition to the lack of knowledge and evidence generation, integrated solutions, such as NBS, highlight the limited coordination among different actors with divergence of interests, competences and powers, especially in the public sector when different departments are required (urban planning, buildings licensing, infrastructures, water and waste management), all having their own targets, regulatory frameworks and budgetary constraints. Several reasons linked with this complexity and novelty can affect also the cost-effectiveness perception of NBS, such as technology maturity (subsidies to support technology maturing periods proved to be unsuccessful) and market uptake (some new products may be economically competitive only if commercialized at a significant scale). The following table shows the summary of the barriers and the correspondent literature sources (main and secondary).

| Table 1. Identified barriers for NBS oriented planning (M=Main literature source, S=Secondary literature source) |
|---|---|---|---|
| **CATEGORY** | **DESCRIPTION** | **SOURCE** | **CODE** |
| **Knowledge barriers** | | **M** | **S** |
| Uncertainty | Operational unknown | Due to the newness of the approach there is a lack of protocols for design, implementation and maintenance for NBS projects. | [9] | BK1 |
| | Performance unknown | Lack of evidence regarding the quantitative benefits of NBS, especially from policy makers and citizens’ perspective. Designers may encounter | [14][15] | BK2 |
| Access to information | Information overload | Municipalities are already overloaded with knowledge making new concepts and approaches as NBS more difficult to reach. | [16] |
|-----------------------|----------------------|--------------------------------------------------------------------------------------------------|------|
|                       | Unusable presentation of results | Presentation of scientific results in formats that are incomprehensible or not accessible to urban hinders the knowledge transfer between science, policy and planning. | [17] |
| Technical inadequacy  | Lack of ready-to-apply scientific results, concepts and technologies | The lack of ready-to-use technologies, scientific results and concepts and simple and overarching theoretical framework makes the implementation and communication of NBS difficult even if a certain policy receptiveness exists. People in charge of design, implementation regulation and permit granting of NBS would need specialized training. | [17] [18] [19] [20] |
| Governance barriers   | Short-term action and decision-making structures | Usual short-term decision-making and action cycles within municipalities do not match with the whole life cycle of NBS projects (planning, implementation, maintenance processes and sustainable financing) | [9] |
|                       | Establishment of long-term responsibilities | Responsibilities for the maintenance could remain unspecified and actors who will be implied in the maintenance are not implied in the decision and design leading to difficulties not previously foreseen. | [20] |
|                       | Gentrification | The willingness of improve life and urban quality with NBS projects in a short term could lead to risk of gentrification in a long term. | [21] |
| Institutional barriers | Lack of coordination | Lack of coordination between traditional departments traps knowledge in “sectorial silos” hampering e implementation of NBS which usually requires transdisciplinary coordination | [18] |
|                       | Lack of flexibility of decision-making structures | The decision-making structure of municipalities where the different departments have clearly defined responsibilities could not be suitable for multilevel, multiscale and multi- thematic projects as NBS. | [20] |
|                       | Bureaucracy and unsupportive legal frameworks | Lack of knowledge due to the novelty of NBS as concept. Excessive legal rigidity, bureaucracy and lack of specific regulation (e.g. difficult agreements in multi-property dwellings). | [19] |
| Complexity of governance structure | Goal misalignment | Different goals of stakeholders within partnership arrangements could hinder collaboration. | [17] |
|                       | Apathy | A high number of stakeholders could generate inertia and apathy. | [21] |
|                       | Role ambiguity | A high number of involved stakeholders can cancel out some process enablers related with collaboration through unclear responsibilities | [10] |
| Participation and awareness | Perception | The perception of nature as source of problems and the fear due to uncertainty can hinder the participation of the citizens | [10] |
|                       | Lack of participation | Top down processes with no real citizen participation makes the NBS more difficult to accept by the citizens. | [11] |
| Economic barriers     | Under appreciation of benefits | Benefits of NBS are perceived as mostly public and ‘soft’ and not directly related to economic growth-oriented issues as creating jobs and attracting investments. | [16] |
|                       | Short term vision | Lack of insight that investment now will prevent costs later. Economic benefits are long term | [16] |
|                       | Vandalism | Robbery or destructive actions, especially during early stages, could prevent the viability of NBS. | [16] |
|                       | NBS not a priority | City budgets for green development and the maintenance of green spaces often face severe budget constraints, while staff and related expertise is decreasing. | [16] |
|                       | Lack of funding knowledge | Financing mechanisms are available, but they are complicated to apply for requiring additional administrative staff and time resources and, more importantly, require co- financing | [16] |
| Risk perception       | Lack of incentives and motivation to attract private investment | Lack of incentives and motivation to attract private investment | [16] |

3.2. Drivers of NBS implementation (Process Enablers)
Parallely, in literature can be found drivers and process enablers related to the knowledge, governance and economic barriers that take advantage of the co-benefits of the NBS approach. In the following table these drivers are summarised.
Table 2. Identification of drivers for NBS oriented planning (M=Main literature source, S=Secondary literature source)

| CATEGORY | DESCRIPTION | LITERATURE | CODE |
|----------|-------------|------------|------|
| Knowledge drivers | | | |
| Generation of evidence | Lesson learnt in implemented projects | Successfully implemented projects generate useful evidence regarding the benefits that can be used by other projects. Lessons learned from less successful projects are proved to be instrumental for an effective integration of NBS in urban planning. | | DK1 |
| | Research on benefits | Generation of quantified information and knowledge regarding benefits (direct and indirect) | | DK2 |
| | Research on cost effectiveness | Research on cost effectiveness of implementing NBS might help to justify new investments and to promote long-term funding or public-private arrangements. | [27] [28] | DK3 |
| Collaboration | Networks | Demonstration projects create collaborative networks and communities of practice that cross institutional boundaries and are drivers for legitimizing practices and approaches | [9] [11] | DK4 |
| | Co-creation | Solutions to be developed could be based in collaboration between designers, citizens and companies in the early stages | [25] [26] | DK5 |
| Information accessibility and sharing | Knowledge platforms | Knowledge platforms focused on cities, accessible and open, can be used for knowledge gathering, aggregation and cocreation. Develop online NBS impact calculation tools. | [11] [29] [30] [31] [32] [33] | DK6 |
| Awareness | NBS ambassadors | NBS ambassadors can promote NBS by making benefits and risks communicable to citizens and politicians. Strategically selected NBS could work as flagship projects | | DK7 |
| | Climate Change | Climate change is perceived as a new criterion for decision making and can be a driver for changing priorities and the vision of urban planning, raising awareness and changing | | DK8 |
| | Ecological memory | Processes that enrich and regenerate ecological memory can improve the understanding of different perceptions of urban nature and lead to higher levels of ownership of NBS projects by local communities. | [34] | DK9 |
| Governance drivers | | | |
| Process efficiencies | Collaboration | The combination of the different strengths coming from different sectoral affiliations of a diverse stakeholders’ partnerships lead to improved efficiencies | | DG1 |
| | Coordination role | A specific role that can serve to improve the coordination between departments can help to plan and implement transdisciplinary and multifaceted projects as NBS. | [37] | DG2 |
| | Action-thinking approach | An action-thinking approach (problem-based governance) could help to focus on a better use of existing financial instruments and to coordinate biodiversity and climate change efforts in implementing strategies on NBS. | | DG3 |
| | Capacity building | Capacity building can balance the uncertainty that comes from the newness of the NBS approach. | [9] | DG4 |
| Self-governance | Emerging partnerships | Innovative NBS projects can learn modes of self-governance from emerging partnerships between civil societies in cities | [10] [11] [38] | DG5 |
| | Grassroots innovations/transition initiatives | Grassroots innovations and transition initiatives as collaborative networks of citizens play a significant role in advocating and practicing NBS in cities as re-establishing green urban commons providing on-the-ground evidence of the multiple benefits | [35] [36] [39] [40] | DG6 |
| | Reflexive adaptive governance | An approach thought to include flexible ways to maximize learning opportunities and the experimentation and careful monitoring it is especially suited to overcome barriers related with uncertainty, complexity and system dynamics. Multiple actors possessing different types and degrees of knowledge could engage in a reflexive way to update their planning, governance, knowledge production practice over time to continuously address arising risks and uncertainties. More reflective approaches to urban and environmental governance bring together other drivers as networks and NBS ambassadors. | [9] [4] [36] [41] | DG7 |
| Co-creation and participation | Involvement of urban government | The involvement of local governments is crucial for opening space for innovative approaches and solutions like NBS through a rapid transfer from concepts to action. An urban government can facilitate collaborative arrangements without losing its government role. Its new dual role (steering and orienting when partnerships exhibit capacity for delivering and regulating and directing when strategic planning is required) | [22] [42] [43] [38] | DG8 |
| | Cross sectoral spaces and partnerships | Enabling cross-sectoral partnerships for NBS design implementation and maintenance. Creating different institutional spaces for cross-sectoral dialogue and interactions of different stakeholders for strengthening fostering adaptive co-management and knowledge sharing about urban ecosystems. | [18] [26] [44] [45] [46] [47] [48] | DG9 |
| | Co-production | Design knowledge co-production processes to bring openness, transparency in governance processes, and legitimacy of knowledge from citizens/civil society, practitioners and policy stakeholders | [44] [48] [49] | DG10 |
| | Tools to build a common vision | Stakeholders from different natures and backgrounds are unlikely to share a common vision. One way to reach the goal might be to include NBS in local planning and zoning regulations. | [50] | DG11 |
| Economy drivers | | | |
| De-risking | Sharing risks | Collaborative arrangements enable the distributed responsibilities that can generate a shift from risk aversion to sharing the perception of risk of new approaches like NBS projects | [9] [10] | DE1 |
| | Public de-risking | Due to the newness of the concept NBS is now in a beginning phase in the field of urban | | DE2 |
3.3. Verification with surveys, case studies and pioneer experiences

The barriers and drivers identified in the literature survey have been checked with:

- Results from the report “Elicitation of needs and definition of urban and landscape planner requirements” developed within Nature4cities project [56] in which six experts from 13 countries were consulted through semi-structured interviews and 75 completed questionnaires were analysed by experts with strong development background in the fields of urban and landscape planning regarding, specifically, NBS.

- Case studies from partner cities (Ankara in Turkey, Milano in Italy, Alcalá de Henares in Spain and Szeged in Hungary).

- Pioneer experiences investigated in Spain, France, Austria, Germany, Switzerland, Italy, Turkey and Hungary.

- The verification of the barriers and drivers towards real cases was not homogeneous. The key parameter used pertained the previous experience in NBS projects. When this experience is not predominant (as in the interviews and surveys) the barriers were more evident. The Knowledge and Economic Barriers are the ones that are more recognized although only one of the identified barriers is identified in almost all cases (BK1: Operational unknown). The implementation contexts with more experience in NBS (such as Çankaya and German speaking countries) are more inclined to perceive the possible drivers compared to less experienced cases (e.g. most of the urban planners and municipalities interviewed).

4. Governance Implementation Models

Critical decisions about NBS projects (design, costs, location, scale or levels of management intensity) involve a wide range of stakeholders who surely have different ideas and backgrounds. Moreover, a ‘nature-based’ perspective has to adopt a ‘society-based’ perspective also in order to incorporate the notion that human beings have shaped the landscape [57]. These involvement of different groups can bring substantive, instrumental and normative benefits to the process of planning and delivering improvements in environmental management [58] and to the decision regarding role, scope and appropriateness of NBS interventions that will require governance models that can enable NBS with an inclusive, long-term and balanced approach [59].

4.1. Clustering and characterizing Urban NBS Governance Structures

The different urban and environmental governance models that can be found in literature cannot be packed in clearly delimited boxes. Urban and environmental governance is a map of spectrums where
the different models coexist in different degrees regarding some key axes [60]. Four dimensions have been considered to define our typology of governance models.

1. Polycentric vs. monocentric governance: One of the most important current trends in environmental governance is the shift from centralized control to the incorporation of lower-level administrative units and social groups into more democratic decision making processes through co-management, community-based natural resource management, and environmental policy decentralizations [61] [62]. Polycentric systems have advantages (resilience by redundancy, efficiency by competition, participation and accountability, facilitation of learning processes and experimentation and cross-scalarity) and disadvantages (economies of scales may be difficult, more complicated decisions, duplication of efforts and dispersed responsibilities) to be take into account in governance models for NBS implementation[63][61]

2. Initiating actor: One classical way to characterize the governance structures considers the main actors promoting and interacting within the governance structures. Traditionally governance has been identified with the governmental institutions at different levels. However, non-governmental or private actors can also be involved in governing public goods like green infrastructures [7]. The typology of actors that are considered in this paper are classified in three main sectors: government, community and market. The initiative will come from one of these sectors and this will be one of the key parameters that will determine the nature and rules of the arrangement and the overall management of the intervention.

3. Levels of participation: Arnstein in 1969 described a ladder of participation writing about citizen’s involvement in planning processes in the United States. The ladder has eight steps that range from non-participation to citizen power. The first two steps (Manipulation and Therapy) are not participatory approaches. Their goal is to manage to achieve public support for already made decisions through public relations. The next step is what Arnstein called “Tokenism” and comprises Informing, Consultation and Placation. These steps are one level higher in the legitimation scale, although the power is still retained by the government (by means as one-direction information flow and ritualized and not decisive participation). In the last step, Delegated power and Citizen Control, public has the power to assure the accountability or even to plan and manage without intermediaries. The intensity of participation can be also be classified according to the range of parties included in the decision making process, the intensity and direction of information flows and the level of influence in the decisions to be made [64].

4. Governance concepts and steering modes for clustering: The governance framework and its capacity to tie different areas and levels of government, has been identified as a critical factor for the success of integrated interventions such as NBS [65]. Glavovic, mainly based on the work of Hartley, differentiates three broad conceptions of governance that theoretically have evolved sequentially but in practice co-exist, overlap and compete [66]: “Traditional public administration”, “New Public Management” and “Networked Governance”. Van der Steen et al. added a fourth governance concept: “Societal Resilience ” [67] (XX and 1). These four concepts have been used to make the clustering of the types of governance models (see Figure 1): government –led traditional governance models (Cluster 1), market-oriented governance models (Cluster 2), community-based governance models (Cluster 4) and collaborative governance models (Cluster 5). Two additional key dimensions are the degree of involvement of public actors (government) vs. private sectors (communities and markets) [68] together with the hierarchical/non-hierarchical distinction. Using this two axes, Hall [60] classifies four frameworks of governance regarding their steering modes. This classification provides the fifth cluster: private-private partnership that considers all governance models between community and market sectors. Based on the previous references and in the triangle connecting government, market, and community, also used by Lemos and Agrawal [61], a framework for governance model analysis and clustering has been developed (see Figure 1).
4.2. Mapping and characterising the models of governance

Many problems and urban challenges addressed by NBS (climate change, loss of biodiversity, resource scarcity…), are too broad and too complex to be solved by the government alone. It is necessary to move the focus from individual actors to network structures, to be able to inform about practices that support the emergence of purposeful network structures for ecosystem governance [69]. The identified governance models are not static or definitive. They can coexist in the same initiatives or change during the different stages of the projects. The Figure 1 shows the different analysed governance models clustered in 5 clusters and distributed according to the involved actors (government, community and market), their position in the spectrum from high to low government involvement and their level of participation. In the following sections, the different models are analysed from different perspectives: how they emerge, involved actors, the degree of government involvement, rules, contextual conditions and tools that can be used. Each cluster is also studied regarding the barriers that can help to overcome, drivers that can be triggered. Their suitability for NBS projects has been determined by assessing the capacity of these urban governance structures to allow processes required for the implementation of NBS such as engagement of different stakeholders, intersectoral coordination, transdisciplinary knowledge generation, socio-ecological innovation and continuous improvement and learning.

4.2.1. CLUSTER 1: Traditional public administration. The first cluster comprises government- and producer-oriented governance models. With different levels of low-moderate participation, the community role is mainly to be a client while the role of the government is to be the commander. The needs and problems are defined by professionals and since a key goal is to maintain stability they are uncertainty averse.

![Figure 1. Mapping and clustering of governance models for NBS oriented planning](image-url)
Table 3. Characterisation of Traditional Public Administration governance models (Cluster 1)

|                      | CLUSTER 1: Traditional Public Administration |
|----------------------|----------------------------------------------|
|                      | Hierarchical governance | Closed governance | Participatory planning & budgeting |
| **KEY WORDS**        | Centralized, government led, top-down, hierarchical | Hierarchical, closed participation, top-down | Hierarchical, open participation |
| **HOW EMERGES**      | Default governance regime | Government defines the problem and the participants | Usually required by law. |
| **INVOLVED ACTORS**  | Government. Citizens and community are always at the receiving end. | Access is restricted. Governmental actors are organised and complemented with a few non-governmental selected actors. | Government, citizens, NGOs |
| **GOVERNMENT INVOLVEMENT** | Leading role | Leading role | Very high |
| **RULES**            | Instrumental vision on policy | Government has the power because it controls the resources that can be mobilised. The non-governmental actors can influence the government allows it. Restricted cooperation. Government assigns certain tasks to the involved nongovernmental actors and then monitors them. | Hierarchical participation. There is a need to formalise the rules of the game and provide well established supporting tools (like websites, guidelines) to rebalance the information asymmetry. The stage when the stakeholders are involved depends of the level of collaboration. |
| **CONTEXTUAL CONDITIONS** | Often fails to provide effective solutions for highly contextualized situations | In cases of environmental issues with potentially catastrophic impacts, the predominance of “less than democratic” expert politics could be justified | Some countries have adopted national level instruments to promote different forms of public consultations at local levels providing guidelines and tools. |
| **TOOLBOX**          | Top-down directives or command-and-control policies. | Top-down directives or command-and-control policies. | Neighbourhood planning. Participatory budgeting. E-tools for citizen involvement Workshops, professional moderation of debates. Interactive mapping |
| **REFERENCES**       | [57] [75] | [57] [62] [76] | [23] [74] [77] [78] |
| **BARRIERS**         | BG3, BG5, BG7, BG9, BE1, BE3 | BG2, DG8, DE4, DE8, DE9 | |
| **SUITABILITY FOR NBS** | Low. Often falls short in efforts to coordinate governance across large-scale ecosystems that cross multiple jurisdictional boundaries. Innovation is limited to some large-scale national and universal innovations being not enough for local innovation required. Large step-change improvements could be possible initially, but less capability for continuous improvement | |

4.2.2. CLUSTER 2: New Public Management and CLUSTER 3: Private-private partnerships. The idea beyond the involvement of market actors in environmental collaboration is to overcome the inefficiencies of government action by injecting competitive pressures through market actors that are regarded as capable of achieve bigger profitability in the utilization of environmental resources [61]. The different models for this kind of arrangements could be placed in a spectrum that goes from an almost fully public sector governance to an almost private sector governance.

Table 4. Characterisation of New Public Management and Private-Private Partnerships governance models (Cluster 2 and 3)

|                      | CLUSTER 2: New Public Management | CLUSTER 3: Private-private partnerships |
|----------------------|----------------------------------|-----------------------------------------|
|                      | Public–private partnership (PPP) | Business-led self-regulation | Non-State Market-driven governance (NSMD) | Business–NGO partnerships | SLENs (Sustainable Local Enterprise Networks) |
| **KEY WORDS**        | Marked-oriented, competitive, top-down | Business-led, decentralized | Market-oriented, decentralized | Hybrid governance, decentralized, non-hierarchical | Self-organizing, complex adaptive systems |
| **HOW EMERGES**      | Usually from a flexible, opportunistic approach, drawing from experiences in other cases. Not always the most evident solution, but a widely acknowledged crisis can trigger the arrangement. | When government is not perceived anymore as the only source of legitimacy and market forces are strong enough. | NGOs develop their sets of responsible business practices due to the difficulty to influence the government providing recognition in the marketplace to responsible companies. | A reactive approach is adopted by companies in the beginning, but partnerships could evolve, where pressures from NGO lead to go from mere compliance to strategic actions. | Provide an integrating opportunity for stakeholders to acknowledge a shared asset base and construct a virtuous cycle. |
4.2.3. **CLUSTER 4: Societal Resilience and CLUSTER 5: Network Governance.** Societal Resilience comprises the governance models in the higher steps of the participation ladder when communities have the power for planning and managing without (almost) intermediaries. The Network Governance instead, aims to add the community and local voices to environmental governance models supported by the government with the hope to solve complex problems and allowing a more equitable allocation of benefits [61].

| INVOLVED ACTORS | Government + private sector | Business sector. Efforts may be undertaken to include community | Environmental and social stakeholders participate with business interests | Markets + NGO | NGOs + civil society members + companies. |
| --- | --- | --- | --- | --- | --- |
| GOVERNMENT INVOLVEMENT | Can range from high to low involvement. | Announcers and commissioners | Not necessarily | Medium-low | Not mandatory. |
| RULES | Private sector involvement does not eliminate public sector responsibilities. Continued government involvement in certain services helps ensure the efficiency of markets by reducing capital risks, increasing access to information, and reducing monopoly | Utilization of market exchanges and incentives to encourage environmental compliance. Corporate self-regulation initiatives create their own (usually voluntary) rules and procedures to guide corporate behavior. | Steering by market parties, regulation on basis of supply and demand. The viability of NSMD is determined by whether it can achieve legitimacy to operate. Authority emanates from the market | Depending of the type i) threat-induced, compliance or charity-driven responses, ii) transactional partnerships for improving profitability or market share, iii) businesses move beyond bottom-line iv) other key stakeholders are involved | Require at least one for-profit business to anchor the network and ensure that it is financially sustainable. |
| CONTEXTUAL CONDITIONS | PPP are deeply context based. | In neo-liberal contexts | General dissatisfaction with old policy instruments; neoliberal institutionalism and free trade agreements and a requirement for market innovations. | Differences in organizational cultures between business and NGOs due to differing missions and accountability systems. | Depend on mobilizing all four key assets: human, social, financial and ecological (natural) capital. |
| TOOLBOX | Outsourcing, Joint Venture Public-Private Partnerships | Voluntary agreements, third-party certifications, eco-labelling, corporate social responsibility | Forums for exchanges of expert information, databases of experiences and best practices. Norm generation and mutual building | Sponsorship, Short-term problem-solving. Sustained dyadic Eco-labelling. Industry sustainability standards. | Re-conceptualization of roles. |
| REFERENCES | [33] [49] [71] | [80], [81] | [62] [79] [80] [81] [82] [83] [84] | [86] [88] | [89] [90] |
| BARRIERS | BE2, BE6 | BK4, BK5, BG7, BG10, BE1, BE2, BE5, BE6 | DK3, DK4, DG3, DG9, DE1, DE6, DE7, DE9 | DK7, DK8, DG1, DG3, DE6 |
| DRIVERS | DK3, DK4, DG3, DG9, DE1, DE6, DE7, DE9 | BK4, BK5, BG7, BG10, BE1, BE2, BE5, BE6 | DK7, DK8, DG1, DG3, DE6 |
| SUITABILITY FOR NBS | Low-medium depending the scale of the NBS project (the smaller the scale the easier to implement only market-oriented approaches). Risk aversion of the private sector often result in a choice for proven technology rather than for innovative solutions (such NBS). | Medium-high. But currently the required conditions for the more complex models are met only in rare cases. This implies the need for a significant change in relationships between enterprise-based activities in the developing world and broader social, economic and political systems in which they are embedded. |

Table 5: Characterisation of Societal Resilience and Network governance models (Cluster4 and 5)
5. Implementation model’s database and results

After developing the theoretical model, a database with different real cases was built to link the models with best practices and to study the incidence of them. To systematize all the information, all the
identified cases were included in the same “card template” which constitute the narrative. Implementation Models were organized in 56 detailed cards containing: i) Short description of the NBS with picture, ii) Implementation context (location, scale, urban density), iii) Classification/typology, iv) Urban challenges addressed, v) NBS Stakeholders and Governance, vi) NBS financial aspects, vii) Business model, and vii) Enablers and inhibitors. The complete database is available on-line [70]. The Implementation Model (IM) collection has been built at first taking into consideration the availability of information regarding a series of practical experiences that refer to different IM. The main aim was to have a catalogue with a reasonable number of examples. The database now comprehends 56 detailed examples. The analysis was conducted based on online and free information. All the existing databases (i.e. the EEA database [71], Naturvation database [72] and others) are based on the description of NBS classification, scale, and dimension of the expected effects and not on the way in which they can be realized and carried out as full projects. The aim of this database was to give the possibility to users to consult a list of real projects crossing different variables (features or characteristics) in order to build further levels of knowledge about NBS.

![Figure 2. Governance Models incidence in the NBS IMs](image)

The results that emerged from the governance models in the IM database (see Figure 2) showed that the more usual governance models are the ones from the Cluster 5 – “Network governance” (around 43% of the cases). Although, this confirms the theoretical conclusion that this type of governance is the most suitable for NBS oriented planning (see Table 5), this correlation between the suitability of the governance models and their incidence in real cases is not so evident for the rest of the models. The second is the Cluster 2- “New public management” (21%) and the third is the Cluster 1- “Traditional public administration” (16%) with a theoretical suitability level of “low” or “medium low”. The frequency of these types of governance could be more related with the traditional inertia of government structures than with the suitability of them.

6. Conclusions

The implementation of NBS projects is deeply determined by the opportunity and challenge that involves the novelty and complexity of the approach. As a new concept, it generates uncertainty due the lack of technical and operational preparedness, but it also allows to deploy innovative approaches, new ways to address old problems and more inclusive practices. Collaborative, multisector, polycentric and adaptive governance models have been considered the more suitable governance models for NBS projects, especially when urban scales are addressed. Drivers related to network governance models (such as coordination, co-production, cross-sectorial cooperation and reflexive/adaptive governance) are drivers that address a significant number of identified cross-domain barriers showing the suitability of these kind of governance models for NBS projects. The study of 56 real cases have demonstrated that the type of governance models that fulfils these requirements, “Network Governance” models, is decisively prevalent as compared to the other governance models. This result demonstrates that the collaborative and adaptive governance together with the scale-crossing borders are relevant aspects and play a crucial role in the regulatory and decision-making framework when it comes to NBS implementation in urban contexts. However, frequency cannot be
considered as the only indicator for suitability. The significant incidence of less suitable but more traditional governance models, shows the high inertia that remains in urban planning. The work presented in this paper could be the basis to define new institutional and governance arrangements and new finance and business models, that will foster multi-stakeholder involvement, citizens’ engagement and empowerment, leveraging both public and private funding of NBS in cities.

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