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MapStakes: a tool for mapping, involving and monitoring stakeholders in co-creation processes

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Karina Barquet

Lisa Segnestam

Sarah Dickin

Stockholm Environment Institute
Linnégatan 87D 115 23 Stockholm, Sweden
Tel: +46 8 30 80 44 www.sei.org

Author contact: Karina Barquet
karina.barquet@sei.org
Editor: Naomi Lubick
Layout / graphics: Richard Clay
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Abstract

Despite widespread use of stakeholder approaches in environmental research, the tools and methodologies for mapping and involving actors are not particularly robust. Existing approaches can lead to methodological ambiguity, limited transparency in the process of stakeholder selection, and lack of robustness when monitoring and evaluating these processes. To respond to these challenges, we developed a tool for increasing objectivity of stakeholder mapping, engagement, and monitoring of co-creation processes. The tool provides a stepwise approach for users with little or no experience of participatory methods.

Introduction

Assessing the effectiveness of co-creation approaches is important, as stakeholder engagement is increasingly promoted in research and by funding organizations as an important pathway to achieving impact (Graversgaard et al., 2017; Leino & Puumala, 2021; Mauser et al., 2013). Stakeholder engagement is often accompanied by stakeholder analyses, guided by a framework or model for action to guide the engagement process (Boaz et al., 2018). The outputs of stakeholder analyses are often used to generate knowledge about the behaviors, intentions, connections, agendas, influence, and resources of actors with a stake in a process. This information can then be used to enable the implementation of specific decisions, improve understanding of the social and political feasibility in relation to an issue (Brugha & Varvasovszky, 2000; Raum, 2018), and in turn guide future policy directions.

Despite widespread use of stakeholder approaches in research, the tools and methodologies for initiating the engagement process are not particularly robust. First, transparency is lacking in stakeholder mapping methodologies (Bendtsen et al., 2021), where many questions are often left unaddressed, including how to define the stakes; how to ensure that all relevant stakeholders are considered and fairly involved in the process; how to ensure the process of stakeholder inclusion is designed legitimately to justify the subsequent decision-making process; and how to select stakeholders beyond one's knowledge of the current system to include potential future roles in a transformed system.

Second, clear guidance is needed on how to perform stakeholder analyses and how to document and report findings (Bendtsen et al., 2021). Stakeholder experiences in the co-creation process are not well understood, mostly because monitoring and reporting of the process are rarely carried out (Chambers et al., 2021; Gregory et al., 2020). Yet the adequacy and robustness of co-creation methodologies is rarely questioned (Galvagno & Dalli, 2014). So, how to tell whether the co-creation process indeed led to a fairer process, better results, improved decision-making, or learning outcomes (André et al., 2021; Lyon et al., 2020)?

The aim of this paper is to outline a stakeholder methodology that increases robustness of co-creation processes in the broad field of environmental research. The paper first provides a background on stakeholder theory. Based on this literature, we outline MapStakes, a five-step tool to define system boundaries; identify, map and involve stakeholders; and monitor the engagement process.

Stakeholder theory

Stakeholder theory is concerned with who provides input in decision-making processes, as well as who benefits and who experiences harm from the outcomes of such decisions (Phillips et al., 2003). Freeman et al. (2010) defined stakeholders as any group or individual who can affect or is affected by a process, issue, or objective.

Stakeholder inclusion has become a defining element in public participation and democracy building (Gregory et al., 2020). It is increasingly embedded in national and international environmental policy (Coggan et al., 2021; de Jong et al., 2019), as well as in research on co-production (Chambers et al., 2021; Voorberg et al., 2015). This is partly due to a growing recognition of the need to involve those who are affected by or affect a process, and partly as a response for dealing with complexity, where no single actor has all the answers (Frantzeskaki & Kabisch, 2016; Reed et al., 2009).

Despite the established theory on stakeholders and its successful integration into multiple disciplines, the actual process of stakeholder inclusion – their identification and mapping – has remained vague and superficial, limiting the theory's applicability (Bendtsen et al., 2021; Freeman et al., 2010; Miles, 2017). Generally, there is a lack of systematic frameworks and practical tools for

identifying groups and individuals with something at stake, or even defining the stakes. Instead, the process is more often guided by intuition and opportunity than by structure and transparency (Gregory et al., 2020; Schiller et al., 2013).

The process of stakeholder involvement tends to be be lumped into "stakeholder analysis", which fails to recognize the mapping steps needed before reaching the analytical stage [for instance, Reed et al. (2009) and Reed & Curzon (2015) do not distinguish between mapping and analysis]. Stakeholder analysis is a different step in a co-creation process and one on which we do not dwell in this paper, as a vast body of literature explores this already.

Stakeholder mapping typically focuses on responding to questions such as the following (Mehrizi et al., 2009): What is the problem or the solution affecting a system (in its broadest meaning – a set of interrelated things, processes, and actors forming a whole)? How are these affected by or affecting the system? What are stakeholders' interests and beliefs? How can stakeholders be prioritized in an engagement or decision-making process? By contrast, stakeholder analyses investigate stakeholders' perceptions of risks, causes of and potential solutions to a problem, the distribution of resources among stakeholder coalitions, the interrelations and interactions between them, and the windows of opportunity for influencing policy (Basco-Carrera et al., 2017; Reed & Curzon, 2015; Walker et al., 2008). Based on this analysis, strategies and roadmaps for achieving objectives and paths to collective agreements can be developed (Marques et al., 2020; Raum, 2018; Reed & Curzon, 2015; Wutich et al., 2020).

In cases where explicit mapping methodologies are followed, criteria underlying the identification of stakeholders are often one-dimensional, for example based on economic function or political role, while other affiliations or multiple identities are unaccounted for (Crane & Ruebottom, 2011). Furthermore, stakeholder mapping often focuses on actors with influence on the system, failing to integrate actors that might be affected by an intervention but who do not have the capacity, resources or reach to influence a decision or a process. The focus on power and influence – however these are defined – at the mapping stage leads to capturing only obvious stakeholders, which may not necessarily be transformational ones (Lyon et al., 2020). Power differences risk reproducing or even reinforcing the inequalities that already caused biased participation in co-creation processes (Brouwer et al., 2012; Turnhout et al., 2020)

A consequence of the lack of rigorousness and transparency throughout the stakeholder engagement is that "stakeholder" becomes a meaningless term (Crane & Ruebottom, 2011). In the absence of a robust methodology, stakeholder identification can easily turn into a subjective selection of easily accessible or well-known actors. In fact, across the sciences, the concept of stakeholders has attracted criticism for how elastic the term tends to be, and for the loose participatory processes that "at best offer limited opportunity for meaningful stakeholder inclusion, and at worst may be a front for corporate self-regulation or government policy whitewashing" (Malcolm, 2015, p. 1).

Indeed, the issue of who should be involved in the decision-making process puts into question the very concept of participation. The act of inclusion also implies exclusion, which can lead to deliberative decisions that often appear to be illegitimate to those that have been left out (Barquet et al., 2021). At the same time, expanding participation widely can reduce the potential of meaningful deliberation (Parkinson, 2003).

Meaningful deliberation needs to be seen in relation to the goals of the process, which in this paper is broadly understood as taking place in the scope of co-creation processes. However, the purpose and even the understanding of co-creation differs widely, and therefore, what might be deemed meaningful is likely to vary depending on the conceptualization of co-creation (Brandsen et al., 2018). Co-production is another term sometimes used in the literature. The conceptual differences between both terms are often unclear. An extensive debate on the issue is beyond the scope of this paper (see discussion in Brandsen et al., 2018). Co-creation is used here to refer to different types of citizen participation as illustrated in Figure 3.

Stakeholders in co-creation

The fields of public administration, environmental governance, and sustainability science all share a similar normative stance to their approach to co-creation, which is strongly connected to the exercise of democratic principles in societies.

Within public administration (Ostrom, 1978), co-creation has become one of the cornerstones of public policy reform globally (Brandsen et al., 2018). Co-creation is increasingly expected to trigger a major shift towards more effective, more efficient, and better public service provision (Boyle & Harris, 2009). As a result, co-creation is touted as a response to the inefficiency of the public sector, seen as a democratic deficit (Pestoff, 2006), and a route to active citizenship and active communities (Osborne et al., 2016).

Within environmental governance (Armitage et al., 2011), co-creation is seen as a way of addressing the complexity inherent in societal shifts by integrating different actors into the same creative process (Gammelgaard et al., 2017; Sillak et al., 2021). Particularly, co-creation is considered to have an important role in establishing conditions for social learning and adaptation in rapidly changing environments (André et al., 2021; Johannessen et al., 2019).

Within sustainability science (Cash et al., 2003), the literature suggests co-creation can lead to more effective solutions for dealing with complex societal and environmental challenges (Barquet et al., 2021; Chambers et al., 2021). For example, Frantzeskaki & Kabisch (2016) found that co-creation in the context of urban environmental governance led to recognition of the policy relevance of research and its policy uptake, as well as identification of research gaps. Co-created solutions, such as in the case of CLEVER Cities, allowed for "tailored" nature-based solutions, which enabled cities to make decisions grounded in validated assumptions (Mahmoud & Morello, 2018).

By contrast, the marketing literature advocates a more instrumental view: stakeholders are not included only for their ideologies or for whom they represent, but because including all stakeholders leads to more profitable outcomes. Here, co-creation is defined as "the joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically" (Galvagno & Dalli, 2014, p. 643). Gains have long been documented from consumer involvement in product design to increase productivity (Lovelock & Young, 1979), improve service delivery (Schneider & Bowen, 1995), and enhance service production processes (Lengnick-Hall, 1996).

What is of interest to us is not whether profit is being made as a result of co-creation, but rather if the marketing field's approach for valuing creation is applicable to non-profit processes. Co-creation in the marketing field encompasses both the specific theoretical and empirical occurrences in which companies and their stakeholders generate value (of a product or a service) through interaction (Vargo & Lusch, 2008). According to this view, customers are treated as active co-producers and not only passive receivers. This process is guided by the question "what can you do with us?" instead of "what can we do for you?" (Wind, 2000). A result from this shift is the ways in which value is perceived. Rather than assuming value, the questions often posed are: what is value? How is it created? And who captures it (Bowman & Ambrosini, 2000)?

These questions reflect a conceptual shift in how a product or service acquires value deriving from its use, rather than from willingness to pay (Vargo et al., 2008). The logic is that value is not simply added in a linear way but is mutually and interactively created (Ramírez, 1999), and that a product or service incorporates value through its actual usage (value-in-use) rather than through its sale price (Alves et al., 2016). This co-creation of value involves a participatory process in which "people and organizations together generate and develop meaning" (Ind & Coates, 2013, p. 86), and end users determine the value of the product or service (Vargo & Lusch, 2008).

For companies, this implies seeing end users (e.g., customers) as a resource instead of as a simple

source of information, and companies as resource integrators. For instance, the Apple iPhone, which by some measures is the most successful individual product of our time (Williams-Grut, 2015), is arguably not vastly technically superior to other smart phones. Yet the company can maintain a premium price for its product relative to its competitors. Many of the reasons for the iPhone's success are connected to non-material values that go beyond the mere technical functions of the product. While it is true that consumers tend to associate the iPhone with objectively important aspects such as product quality and intuitive design (Arruda-Filho et al., 2010), Apple's success is often attributed to their adherence to co-creation principles, as they invite consumers to be application creators and in so doing, generate loyal customers (Darmody, 2009). More importantly, this co-creation process creates a natural platform for consumer-to-consumer interactions that create value, not only through the sharing of technical advice, but also by sharing experiences and dreams about the brand (Moreno & Besson, 2009).

While it is not suggested here that complex sustainability problems can and should be treated as mobile phones, there is an important lesson here. Goals and outcomes, rather than moral principles, define how legitimacy and value are defined and explored. Support for this claim can be found in literature on deliberative decision-making (Dryzek & Stevenson, 2011; Fishkin, 2009; Koirala et al., 2021), where legitimacy in the context of complex environmental problems is connected to at least two things: the degree to which outcomes match the actual goals of the society in question, and the degree to which outcomes achieve justifiable or desirable ends (Parkinson, 2003). Both aspects are determined by the people who comprise the society in question, while experts (e.g. researchers and bureaucrats) are subordinates to the people affected. Similarly, Dryzek (2001) argued that the legitimacy of expertise derives from its placement in broader societal concerns and processes of deliberation and is not internal to expertise itself.

Such understanding of legitimacy also provides some guidance for stakeholder mapping processes. Dryzek (2001) suggested detaching the idea of legitimacy from a mere head count of individuals and instead conferring legitimacy by representation. For this, it becomes crucial to "find rules that legitimately exclude, rather than making legitimacy depend, impossibly, on full inclusion" (Parkinson, 2003, p. 188). Bryson (2004) suggested moving away from the concept of stakeholders as actors with power, by including actors that might seem nominally powerless. In fact, the question of defining stakes according to power, interests, or influence is often rather problematic, as these terms are rarely defined or problematized (Bendtsen et al., 2021), and as a result, they are understood differently (Chambers et al., 2021).

Value creation for building resilient societies is strongly emphasized in the literature on social learning. For example, Voorberg et al. (2017) introduced the idea of co-creation as learning processes whereby actors learn how to use each other's competences to develop new ways to confront common challenges. André et al. (2021) pointed out the importance of case-specific circumstances beyond the scope of the co-design process, including the decision-making context as well as intangible outcomes. Similarly, Barquet et al. (2021) highlighted the importance of defining system boundaries, rules of engagement, and identifying biases for co-creation processes to trigger learning.

Accepting the above means that attention to stakeholders and their contexts is important throughout a process because "success" of the outcome will depend on satisfying what key stakeholders consider to be valuable (Bryson, 1995). In a stakeholder mapping exercise, this entails going beyond interest-influence matrices (Reed et al., 2009) and towards a "broader", more systematic view of stakeholders (Gregory et al., 2020) that aims at understanding what value is, how it can be created, and whether the promise of value was fulfilled at the end of the process. In this context, stakeholder mapping is not only independent of stakeholder analysis but also precedes it.

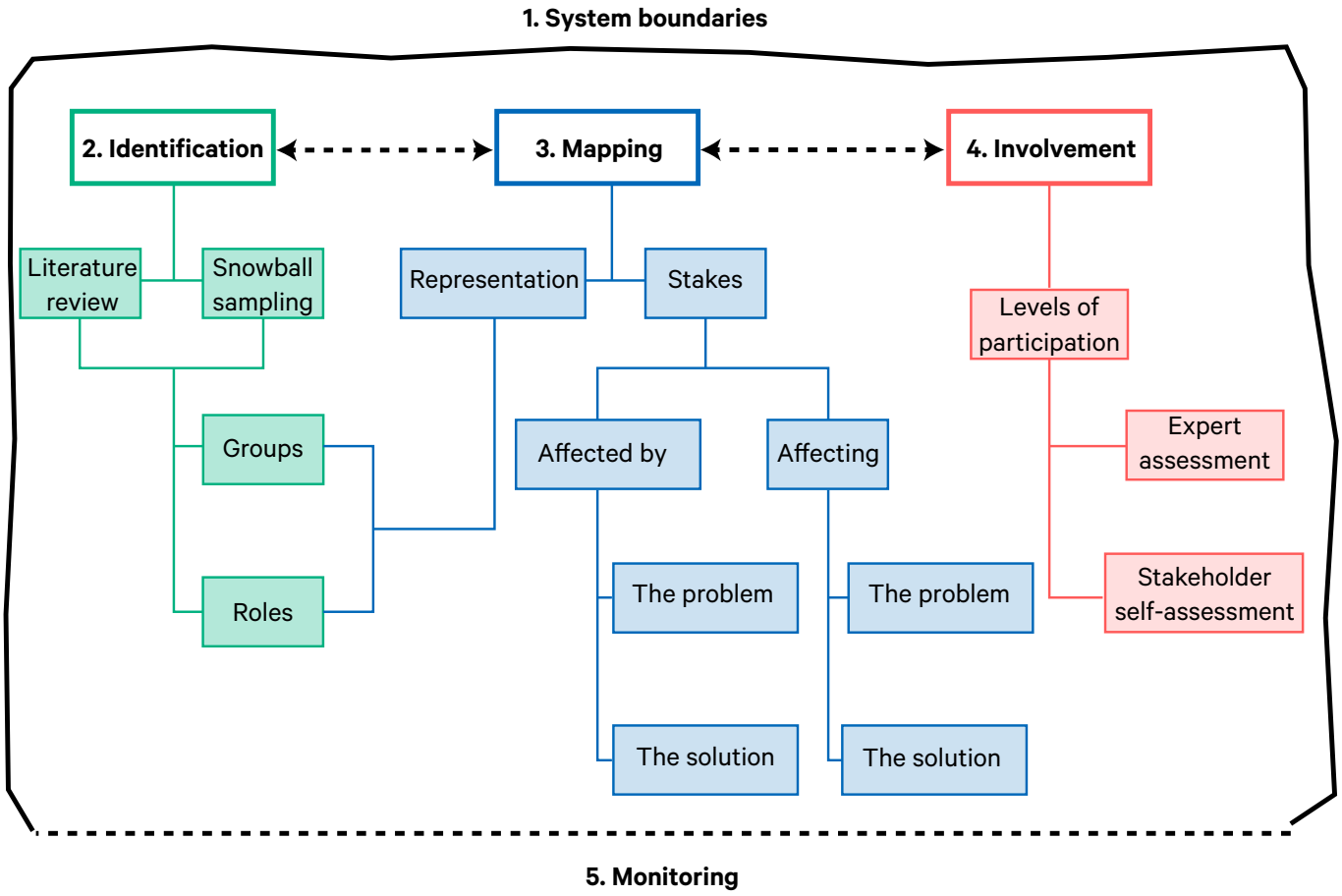
Introducing MapStakes: a tool for stakeholder involvement

Based on our experiences designing and implementing co-creation approaches across a range of projects and contexts, we have designed a tool that can be used in contexts of complex challenges, for users who may not necessarily be experts in stakeholder theory or participatory methods. The approaches comprising the tool were designed by the authors in an iterative process together with stakeholders and users of the tool across various projects (e.g. RECONECT, the Gridless Initiative, and RISC-KIT). In many cases, these actors did not have any previous experience of participating or implementing a co-creation approach.

Stakeholder maps are understood here as dynamic representations of systems of actors. Following this, the approach presented in this paper attempts to move away from dyadic relationships (e.g. between a company and its customers or between a research project and its informants) and towards a more encompassing approach that distinguishes between stakeholder identification, mapping, involvement and monitoring of the engagement process.

The stakeholder methodology is composed of five steps (Figure 1).

Figure 1. The five steps in MapStakes



Step 1: Defining system boundaries

System boundaries define the system and what is included, excluded and marginalized and why (Midgley, 2003). Boundaries can be jurisdictional (e.g. a catchment, a country, a region, a city), sectoral (e.g. energy, water, agriculture), institutional (e.g. ministries, municipalities), conceptual (e.g. nature-based solutions, biomass innovation), scalar (e.g. landscape, bioregion, networks), temporal (e.g. present, future), and spatial (including social space, such as the policy arena, or absolute space, such as distances; Barabási, 2009; Barquet et al., 2021; Breukers et al., 2014; Lefebvre, 1991; Massey, 2005; Peck, 2011).

Boundaries define the stakeholders that will be identified as relevant to the process and hence represent the first criteria for inclusion and exclusion (Lyon et al., 2020).

While setting system boundaries is necessary for identifying stakeholders, the definition of the system needs to occur iteratively throughout the involvement process, as not all actors will understand the system the same way. The boundaries initially set by researchers can sometimes be interpreted differently by stakeholders (Mehrizi et al., 2009). Therefore, discussing the system with stakeholders is necessary to have a common understanding of what is being assessed.

Step 2: Identifying stakeholders

Researchers' own networks are often the starting point in a co-creation process. Stakeholders who have established a relationship of trust with the person leading the work are more likely to be responsive and dedicated in the subsequent steps. However, there is a need to go beyond researchers' (or the person doing the mapping) own networks. This can be done through literature or document reviews and snowball sampling, for instance of experts in the field and according to predefined groups and roles.

Groups and roles are defined according to the objectives and area of focus in a project (Barquet & Cumiskey, 2018). In a mapping exercise, stakeholders only represent one stakeholder group to avoid conflict of interests. Stakeholders should either represent themselves or a segment of society. Group representatives, whether from civil society (such as associations or unions) or government (e.g. agencies) should have the support from and be trusted by the people they are representing, and they should have the knowledge relevant to the issues to be discussed or willing to acquire the necessary information.

While stakeholders can only represent one group, it is possible for them to have several roles (Gregory et al., 2020). The same stakeholder group could have a different role in a different context. For example, the role of national authorities will be different in centralized versus decentralized systems of governance.

A more robust tracking of stakeholders' groups and roles can reveal biases in the identification process. For example, it could be the case that there are more stakeholders involved in decision-making positions while actors potentially affected by the problem are underrepresented. Alternatively, there may be equal representation in the number of stakeholders, but with very uneven stakes in the process which could lead to a poor problematization of the issue in question. This identification can also help rethink the engagement process to identify gaps in representation.

Step 3: Mapping stakeholders

Different methodologies exist for mapping stakeholders (Reed et al., 2009). To increase accessibility of the approach, we suggest two rather simple methodologies: according to representation (Table 1) and according to influence (Figure 2).

An example of a fictitious case study is provided in Table 1. Notice how stakeholders only represent one group but may play different roles.

Table 1. Example of stakeholder mapping according to representation

Stakeholder Group	Name, Position and Organization	Role						
		Decision makers	Implementers	Coordinators	Knowledge Provider	Financers	Lobbyists	Gatekeepers
SH1: Authorities	Regional Coordinator, Contingency Agency	☐	X	X	☐	☐	☐	☐
	Municipal Council, Municipality X	X	X	☐	☐	☐	☐	☐
SH2: Political Representatives	Union Representative	☐	☐	☐	☐	☐	X	☐
	Elected Town Council Representative	X	☐	☐	☐	☐	X	☐
SH3: Civil Society	Representative of association for local inhabitants	☐	☐	X	X	☐	X	X
	House owner	☐	☐	☐	X	☐	☐	X
SH4: Private Sector	Insurance Company	X	☐	☐	X	☐	X	☐
	Private Company	☐	☐	☐	X	☐	X	☐
SH5: Research Community	Climate Adaptation Unit, government agency	☐	☐	X	X	☐	☐	☐
	Researcher, University	☐	☐	☐	X	☐	☐	☐
SH6: NGOs	Transboundary Commission	☐	☐	X	X	☐	☐	☐

A rainbow diagram (Figure 2) can help analyse the extent to which stakeholders

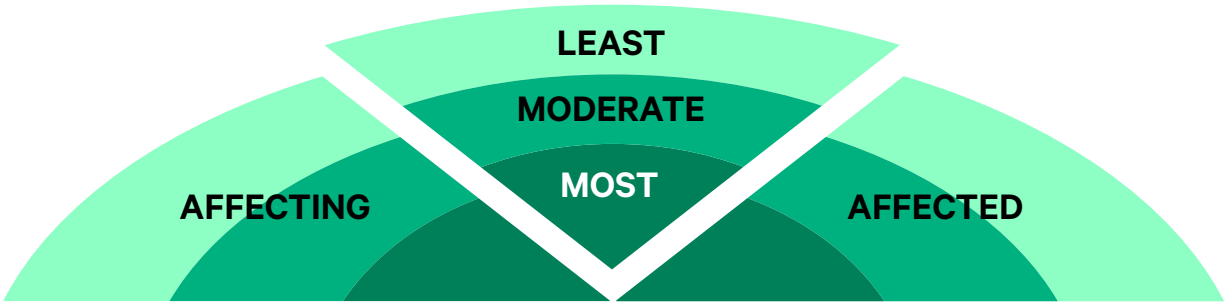
a. affect the problem and the solution, and

b. are affected by the problem and the solution.

Results from this methodology help assess whether the most influential or influenced stakeholders are being included in the stakeholder map. Outputs from the process are highly dependent on the selection of participants and the process design. Unbalanced representation will skew results in favor of the over-represented group.

Therefore, although as many stakeholders as deemed feasible can be included in a process, there is a need for balance across roles. If there are too many stakeholders providing expert knowledge and too few able to influence decisions or implement actions, the result might become a knowledge-rich workshop, but with very few possibilities to influence practice. If, on the contrary, there are too many stakeholders with decision-making roles and too few stakeholders with expert knowledge (including knowledge on everyday experiences like local knowledge), the process could easily become top-down with potentially little connection to everyday practices. Additionally, under-represented groups may become further marginalized and isolated, and outcomes may be biased towards the needs and priorities of those who were able to participate at the expense of those who were excluded (Reed et al., 2009). This, in turn, is likely to jeopardize levels of trust between stakeholders and those with statutory responsibilities (Reed & Curzon, 2015).

Figure 2. Rainbow diagram



Adapted from Burgers & Farida (2017)

Spelling out stakeholders' stakes in a process iteratively and collaboratively is important for establishing a common understanding of what constitutes "impact", whether on or from an event or intervention. In some cases, impact can be understood in relation to exposure, for example, how exposed properties are to floods, and in relation to vulnerability, particularly impacts to livelihoods and lifestyles, for example, how everyday life could change because of an event. It could also be understood as job security, meaning how an individual or a group's access to employment or the possibility to carry out their job could be hampered by impacts from an event, as witnessed during the Covid-19 pandemic. The response or actions to an event could also generate impacts to local governance dynamics depending on society's acceptance, for example how a risk reduction strategy or the lack of it would be judged by constituents. Thus, impact, whether on or from an event, is more multifaceted than often acknowledged.

Step 4: Involving stakeholders

The fourth step helps to assess the level of involvement or participation required and desired by each stakeholder (Figure 3). This addresses the questions: how much should stakeholders be involved and when, according to experts? And how much and in what way do stakeholders want to be involved? These questions require consideration by "process owners" – the individual(s) carrying out the mapping exercise.

Figure 3 depicts an adapted version of a typology of participation developed by Arnstein (1969) and further developed by Basco-Carrera et al. (2017). It includes one level of non-participation (uninvolved), three levels of low participation (awareness, information, and consultation) and three levels of high participation that relate to different stages in a co-creation process (deliberation, co-design and co-decision-making).

As more involvement is needed from stakeholders, the number of individuals interested and available in taking part in the process is likely to decrease. The level of involvement is defined iteratively. In a first step, process owners determine the level of involvement they wish to have from stakeholders, based on the stakeholder's group, role(s), and how affected they are or how much they affect a situation. In a second step, the process owners consult stakeholders regarding their own views on what level of involvement they are willing to have in the project.

This second iteration might result in some stakeholders not being willing to participate to the extent wished for (or not at all), despite their importance to the process. In such cases, it is important to keep these stakeholders in the map and to find out the reason why they are not willing to be part of the project. This may change over the course of the project, for example due to changes in time availability, perceived importance, or interest.

Different levels of engagement might be required at different stages of a process. For instance, information meetings and other general types of activities can attract a broader audience. Conversely, tasks related to data provision or co-assessment of risks rely on there being a few dedicated and interested stakeholders – referred to as key stakeholders – at the very top of the ladder. Key stakeholders are often willing to dedicate time to the process but will also expect to be part of making decisions. Therefore, managing expectations among stakeholders is important from the start, as different stakeholders will have different interests and hence reasons for participating.

In theory, stakeholders that are most affected and "most affecting" should be participating at a high level (e.g. co-decision-making), and conversely stakeholders that are less affected but also "less affecting" can afford to be involved to a lower degree. Actors that are more affected by an intervention (e.g. a nature-based solution) or by a problem (e.g. a hazard), even when they are not affecting the intervention or the problem, should also be highly involved in the co-creation process. However, in practice, participation depends on many other aspects, some of which may be pragmatic, ranging from willingness to be involved to time availability or personal interests.

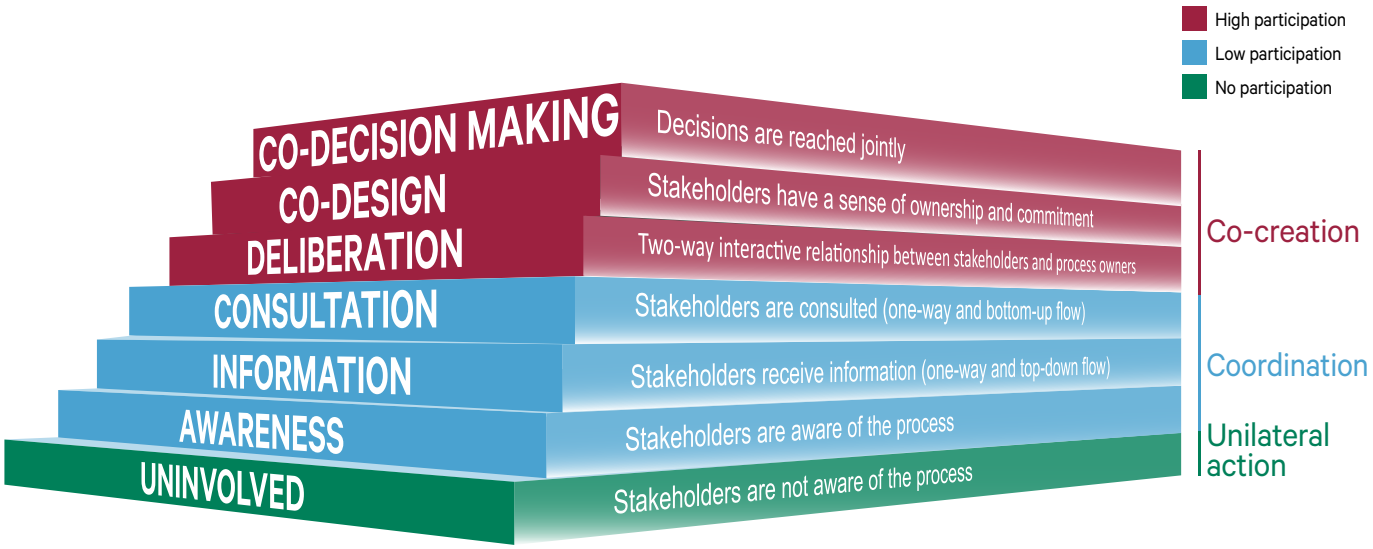
The level of involvement and participation goes hand in hand with stakeholders' interests. The more engaged a stakeholder is, the higher up the participation pyramid he or she will both be willing and expected to be in the process.

Although stakeholders' positions are not static and might change, particularly in longer engagements, understanding involvement is important for managing expectations. This is often done through iterative dialogue.

However, mismatches between expected and desired involvement rarely lead to a more reflective exercise. For example, what leads to mismatching expectations of the process? What determines interest from stakeholders to engage? As increased demands are placed on both

research and policy processes for including stakeholders, understanding this mismatch is fundamental for addressing the dynamics that might deter stakeholders from participating, or discourage researchers from pursuing a more inclusive approach.

Figure 3. Levels of participation



Source: adapted from Arnstein (1969)

Step 5: Monitoring involvement

Co-creation can be highly resource intensive, and therefore it can be challenging to engage stakeholders throughout a process, despite its popularity. Sometimes co-creation processes can result in stakeholder fatigue, which may limit the quality of the results (Barquet et al., 2018). Additionally, it is not clear whether co-creation processes are effective for achieving better results (Mayne, 2008, 2015). Thus, more evidence is needed to assess the impact and effectiveness of different aspects of co-creation processes (Durose et al., 2018).

Improving the evidence base of co-creation could increase the credibility of the results, improve the understanding of social learning, and show the value of co-creation processes (Ensor & Harvey, 2015; Van Epp & Garside, 2019). To achieve this, development and testing of robust indicators are necessary to monitor and evaluate processes, to highlight and target areas for improvement. The indicators will inform the identification of best practices, as there are few standardized approaches for co-creation (Huang & Harvey, 2021).

We devised a set of criteria, – relevance, inclusion, learning, effectiveness, and credibility (RILEC) – that captures a number of dimensions that are relevant for assessing the role of co-creation in a process, project, or intervention; these criteria are designed building on existing co-creation and learning criteria in the literature (Bos et al., 2013; Huang & Harvey, 2021; Sarkki et al., 2015; Schuck-Zöller et al., 2017). The proposed criteria differ from previous ones in that we do not consider legitimacy as a criterion to fulfill (see for example Heink et al., 2015; Sarkki et al., 2015). Rather, legitimacy is considered to be an outcome from fulfilling these five criteria:

a. **Relevance** refers to the ability to match applicable knowledge with interests and needs (Sarkki et al., 2015). Technology studies show that perceived relevance is closely connected to perceived usefulness and directly influences public acceptance (Taherdoost, 2018). Perceived usefulness coupled with an inclusive process can grant legitimacy to a project or intervention. Relevance can be monitored by assessing whether interventions have contributed to generating solutions that stakeholders consider legitimate.

b. **Inclusion** refers to whether co-creation led to an inclusive process characterized by openness and transparency, and where equal recognition was granted to all contributions (Chu & Cannon, 2021). An inclusive process is likely to be perceived as fairer, and therefore the decisions reached in that process are likely to have more legitimacy than those emerging from top-down approaches (Barquet & Cumiskey, 2018; Sarkki et al., 2015). Inclusion can be monitored by assessing the type and reach of outreach tools, inquiry-based methods, and scope for co-creative arenas (Chu & Cannon, 2021).

c. **Learning** refers to changes in perceptions and behaviors at the level of individuals that lead to changes in practice within wider networks and systems (Argyris & Schön, 1978; Reed et al., 2010), often occurring in loops (Armitage et al., 2011; Keen et al., 2005). Serious games are often proposed as tools for promoting social learning (e.g. Teichmann et al., 2020). However, metrics are lacking in sustainability studies for assessing whether learning has taken place and the extent to which outcomes can be connected to learning (van der Wal et al., 2014). Approaches from management and organizational studies (Watkins & Dirani, 2013) can serve as inspiration. The seminal work by Marsick & Watkins (2003) on the Dimensions of Learning Organizations Questionnaire (DLOQ) provides indicators for assessing learning at the individual, group, and organizational levels.

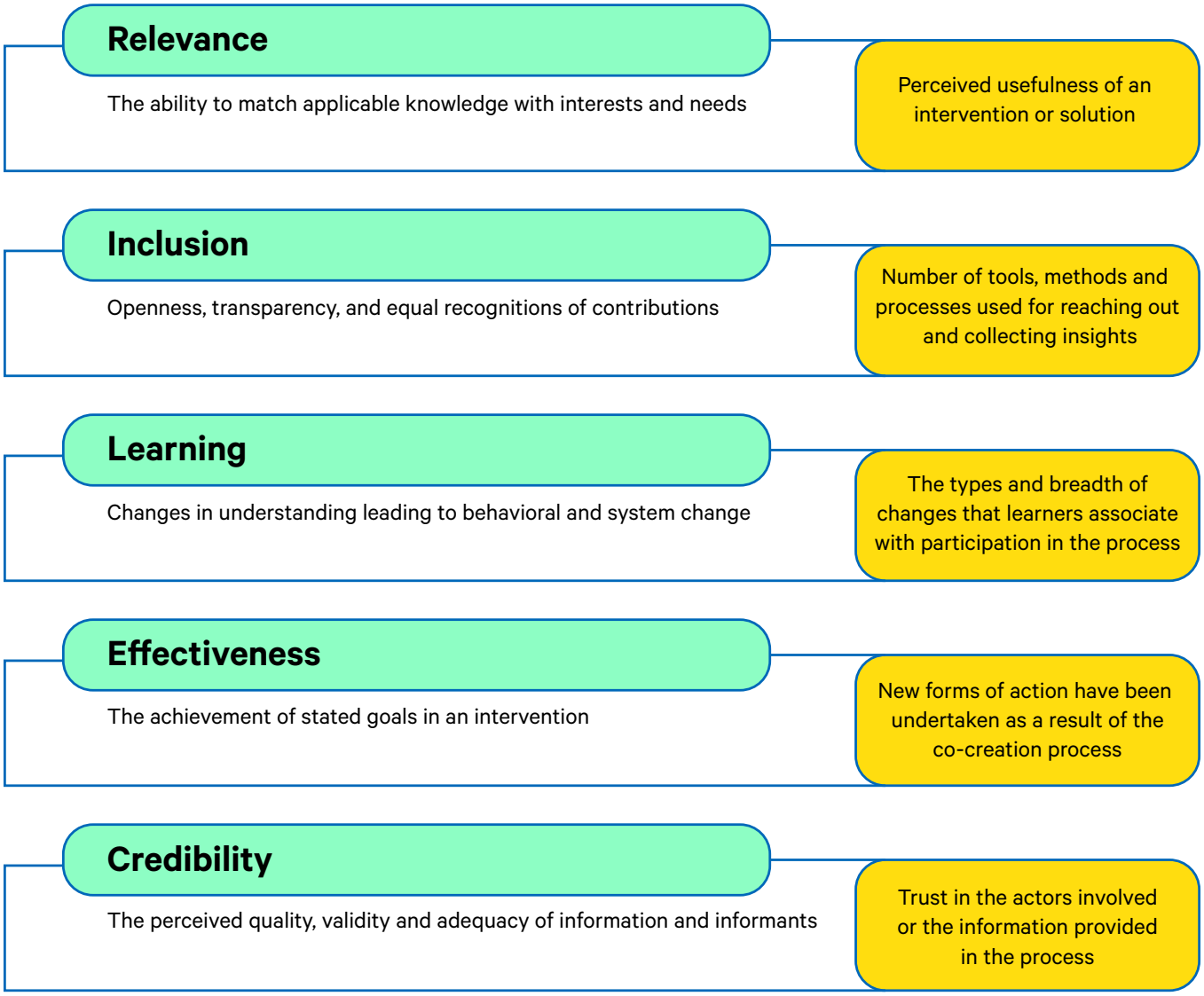
d. **Effectiveness** relates the results of activities to the achievement of objectives and responds to the question, “are we doing the right things?” When assessing effectiveness, the focus is on monitoring whether interventions have achieved their stated goals either in the process (e.g. new forms of action have been undertaken as a result of the co-creation process) or the outcomes (e.g. decrease in economic losses from extreme events; Craft & Fisher, 2016). Effectiveness of a process could lead to impact beyond immediate results, e.g. behavioral or structural changes (Dlouhá et al., 2013), but not necessarily.

e. **Credibility** can be understood as the perceived quality, validity, and adequacy of the information (source credibility) or the informant(s) exchanging information (actor credibility; Lachapelle et al., 2014; Sarkki et al., 2015). Perceptions of credibility play a key role in the likelihood of being persuaded. Credibility directly influences attitudes toward risk and policy issues more generally (Lachapelle et al., 2014).

This proposed framework is not only relevant for evaluating co-creation processes at the end of a project, but also to regularly monitoring them. This can provide real-time information on how to adjust the co-creation process where needed. The RILEC criteria can be monitored through indicators, as exemplified in the yellow boxes in Figure 4. This is not an exhaustive list, and indicators need to be further contextualized according to the system boundaries and purpose of the process.

Data to track RILEC indicators can be collected using qualitative and quantitative methods, including key informant interviews, surveys, and questionnaires. For monitoring purposes, a baseline assessment should be followed by data collection at regular intervals (e.g. annually), using the same set of indicators in order to ensure comparability over time.

Figure 4. Criteria for RILEC and examples of indicators for monitoring co-creation processes. Source: authors



Conclusions

Here we have introduced MapStakes, a multi-dimensional stakeholder mapping approach that combines pre-defined criteria for categorizing stakeholders according to groups and roles. This mapping technique incorporates a more fluid understanding of actors' positionality in the system.

MapStakes builds on the assumption that stakeholder selection needs to go beyond a moral obligation of inclusion. Identification and mapping should be better connected to value creation and the possibilities to create better and more lasting outcomes. This includes awareness, the possibility of identifying and using windows of opportunity more actively through stakeholder interaction, improving data sharing across research projects, contributing to institutional cooperation through "softer" means, or connecting local challenges to regional agendas (e.g. EU entry, climate adaptation goals, achieving the Sustainable Development Goals, etc.).

As stakeholder engagement in co-creation is resource intensive, it is also critical to assess its value through monitoring. We suggest that successful co-creation should lead to an increase in five main indicators: relevance, inclusion, learning, effectiveness, and credibility (RILEC). The RILEC indicators need to be tracked over time, periodically, and in relation to a baseline assessment. Periodic assessments provide a critical opportunity to make changes in the process to work towards improved outcomes. Results will indicate the value in co-creation processes for achieving specific goals.

A more robust identification and monitoring of stakeholders can contribute to open science for bridging scientific knowledge with other types of knowledge (Boon et al., 2021). However, this requires researchers to make choices about how, and the degree to which, stakeholders should and could be involved in the activities. MapStakes provides a guideline for defining criteria for inclusion, determining how and to what extent stakeholders can be involved, organizing the interactions, monitoring, and evaluating whether the interactions generated learning or contributed to transformation.

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Visit us

SEI Headquarters
Linnégatan 87D Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org

Måns Nilsson
Executive Director

SEI Africa
World Agroforestry Centre
United Nations Avenue
Gigiri P.O. Box 30677
Nairobi 00100 Kenya
Tel: +254 20 722 4886
info-Africa@sei.org

Philip Osano
Centre Director

SEI Asia
10th Floor, Kasem Uttayanin Building,
254 Chulalongkorn University,
Henri Dunant Road, Pathumwan, Bangkok,
10330 Thailand
Tel: +66 2 251 4415
info-Asia@sei.org

Niall O'Connor
Centre Director

SEI Tallinn
Arsenal Centre
Erika 14, 10416
Tallinn, Estonia
Tel: +372 6276 100
info-Tallinn@sei.org

Lauri Tammiste
Centre Director

SEI Oxford
Oxford Eco Centre, Roger House,
Osney Mead, Oxford,
OX2 0ES, UK
Tel: +44 1865 42 6316
info-Oxford@sei.org

Ruth Butterfield
Centre Director

SEI US
Main Office
11 Curtis Avenue
Somerville MA 02144-1224 USA
Tel: +1 617 627 3786
info-US@sei.org

Michael Lazarus
Centre Director

SEI US
Davis Office
400 F Street
Davis CA 95616 USA
Tel: +1 530 753 3035

SEI US
Seattle Office
1402 Third Avenue Suite 900
Seattle WA 98101 USA
Tel: +1 206 547 4000

SEI York
University of York
Heslington York
YO10 5DD UK
Tel: +44 1904 32 2897
info-York@sei.org

Sarah West
Centre Director

SEI Latin America
Calle 71 # 11–10
Oficina 801
Bogota Colombia
Tel: +57 1 6355319
info-LatinAmerica@sei.org

David Purkey
Centre Director

SEI Stockholm Environment Institute

sei.org

@SEIresearch @SEIclimate