SPECIAL ISSUE • Co-creative approaches to knowledge production and implementation

practice

Key issues in co-creation with stakeholders when research problems are complex

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The extensive literature on research co-creation is mostly based on problems being treated as clearly defined and solvable. What is the impact on co-creation when problems are complex, with the following characteristics: difficult to delimit, contested definitions, multiple uncertainties and unresolvable unknowns, constraints on what can be done, and no perfect solution? Co-creation on such problems requires a research mindset that appreciates that stakeholders have an essential role in making complexity evident and that limiting stakeholder involvement also limits the ability to understand and effectively act on complex problems. The Integration and Implementation Sciences (i2S) framework is introduced as a way to systematically take into account multiple stakeholders with multiple relevant inputs. In addition, one specific tool, the research-relevant modified International Association for Public Participation (IAP2) spectrum, is described as a way of exploring stakeholder engagement. For complex problems this modified spectrum can be used to describe different ways of including stakeholders, to reflect on appropriate forms of engagement, as well as to take into account both level of researcher control and different categories of stakeholder groups. A research programme examining the feasibility of prescribing pharmaceutical heroin as a treatment for heroin dependence stimulated thinking about co-creation on complex problems and is used as a practice example to illustrate the points covered.

key words co-creation • stakeholders • integration and implementation sciences • complex problems • IAP2 spectrum

key messages
- Understanding research co-creation must expand from defined, solvable problems to complex problems.
- Stakeholders should include decision makers as well as those affected by the complex problem.
- Complex problems require detailed knowledge synthesis and unknowns management to support change.
- Multiple ways to engage stakeholders are needed: inform, consult, involve, collaborate, empower.

Background

A primary driver for co-creation is the expectation, by researchers, that it will increase the likelihood that their research will influence policy and practice change (Boaz, et al, 2018; Concannon et al, 2014; Greenhalgh et al, 2016; Minkler and Wallerstein, 2008). There are two key aspects to this expectation. One is that the research findings will be more useful, because they incorporate decision-maker and other stakeholder perspectives and address their concerns. The second is that the interactions involved in the co-creative research facilitate change happening, through processes that are not well defined, resulting in decision makers becoming more open to using research findings, researchers becoming more savvy about how to support change, and other stakeholders in the research becoming more influential.

There is an extensive literature on the related topics of co-creation, co-production, co-design, stakeholder engagement and participatory research (eg Boaz et al, 2018; Bremer and Meisch, 2017; Concannon et al, 2014; Greenhalgh et al, 2016; Minkler and Wallerstein, 2008; Spears Johnson et al, 2016; Staniszewska et al, 2017). Although some (especially Greenhalgh et al, 2016) recognise non-linear chains of causation, complex interdependencies and other manifestations of complex problems, the literature is mostly based on problems being treated as 'tame', described by Rittel and Webber (1973) as those with a clear mission and solution.

What is different about co-creation when the problem under consideration is complex, or 'wicked' in Rittel and Webber's terminology? Examples of complex problems include: mitigating the effects of global climate change, reducing social and health inequalities, and combatting organised crime.

To explore this question, the first step is to transform Rittel and Webber's characterisation of 'wicked' problems from the planning context in which they conceived them to a research context. Because the term 'wicked' is not easily translatable into many other languages, the term 'complex' is preferred here.

Five key characteristics of complex problems are proposed for the research context (Bammer et al, in preparation):

1. Difficult to delimit.
   Complex problems are open systems problems where everything is connected to everything else, therefore there are no clear boundaries to the problem.
2. Contested problem definitions.
   Different disciplines and stakeholders will define the problem differently and the definition will also change as the context (for example, political, economic or geographic) changes.
3. Multiple uncertainties plus unresolvable unknowns.
   Everything cannot be known or found out about complex problems. Further, ignoring unknowns is a source of major adverse unintended consequences and nasty surprises.

4. There are real-world constraints on what can be done.
   Policy and practice responses to complex problems – whether they are by government, business or civil society – are constrained by political, economic, historical, cultural and other circumstances.
5. Solutions are not true/false, but good/bad, and they are partial and temporary. The interrelationships among the characteristics of complexity described above mean that perfect solutions are not possible. For research to proceed, compromises have to be made at all steps: boundaries have to be set to delimit the problem, a specific problem definition has to be decided, not all unknowns can be resolved, and core elements of context (from the multitude available) have to be prioritised. Imperfection is the inevitable result of these essential compromises and the compromises are necessary to be able to move forward on a complex problem. The aim is to find the best possible ways to proceed on a particular problem at a particular time and place.

Dealing with any complex problem requires understanding how these five characteristics play out for that problem, as well as how actions can best be shaped around them. In turn, this requires inputs from multiple disciplines and stakeholders. The focus here is limited to stakeholder inputs.

It is also worth noting that simple (or tame) and complex (or wicked), should be seen as endpoints on a continuum rather than as a dichotomy. Further, researchers may embrace or choose to ignore elements of complexity in their approach to a problem. For example, improving a treatment service, which is often approached as a simple problem, may have elements of complexity. Service failures may be systemic; different stakeholders may define the problem differently; some unknowns may be hidden (unknown unknowns); the history, geographical location, and/or cultural context may be significant; and the solution may involve trade-offs.

The aim of this paper is to start to lay out what complexity means for co-creation, as well as best practices for co-creative research on complex problems. A framework (the Integration and Implementation Sciences or i2S framework) is introduced that allows the elements of complexity to be systematically unpicked and dealt with. The paper then takes one tool – for thinking about how stakeholders are engaged in co-creation – which is relevant to the whole i2S framework and examines three aspects of the use of this tool when the research problem is complex.

The development of Integration and Implementation Sciences (i2S) had its origins in a seven-year research programme that I led from 1990 to 1997. This involved examining the feasibility of prescribing pharmaceutical heroin as a treatment for heroin dependence in Canberra, Australia's capital city (Bammer, 1997). Reducing illicit drug use is a complex problem. Although the research was focused on one potential response, that is, trialling pharmaceutical heroin prescription, the feasibility research was structured to explore the benefits and risks of that response, rather than seeing it as a perfect solution.

In this programme, the research team worked closely with stakeholders affected by the problem, specifically illicit drug users, ex-users, the families of drug users, and the general public, as well as stakeholders in a position to do something about the problem, namely police, treatment and other service providers, and policy makers. The research was unusual in that there were no major funding or time constraints, meaning that we were not limited in which stakeholders we could engage or how. This gave us a unique opportunity, within one programme of research, to learn multiple

lessons about stakeholder engagement and co-creation. Although the research was conducted more than 20 years ago, the lessons are still pertinent and provide a range of examples for the key points of the paper. The i2S framework has subsequently been tested against other complex problems relating to population health, the environment and national security, but none of these has provided a richer set of illustrations for co-creation in research on complex problems.

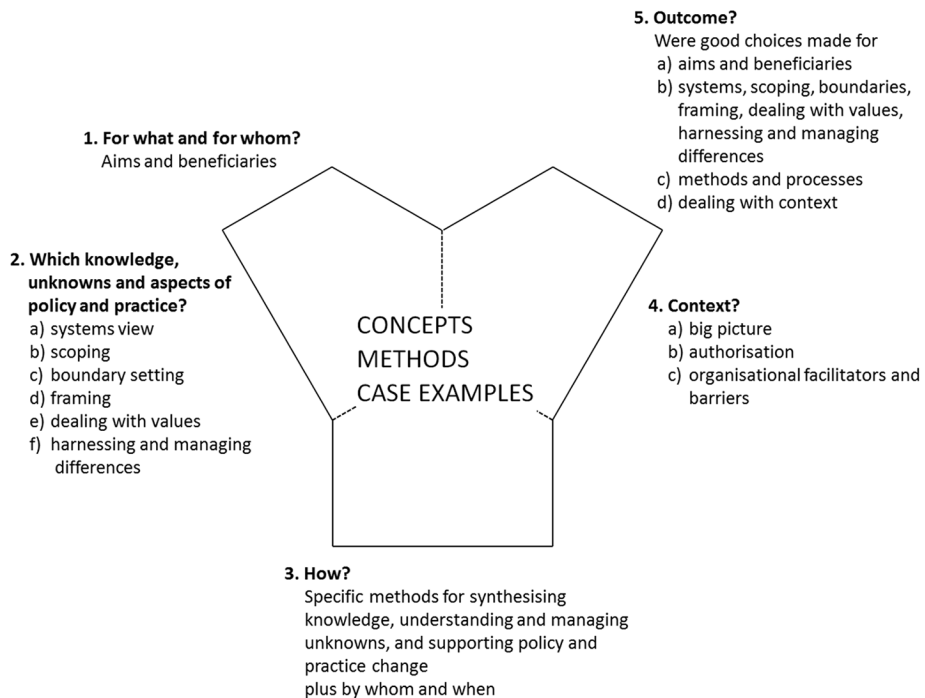## What does complexity mean for co-creation?

Different stakeholders will have different, often unique, perspectives on the five elements of complexity, that is, the problem's connections with other problems, different ways the problem can be defined, important uncertainties and unknowns, some of the real-world constraints on what can be done, and what will make a good solution. For example, in the heroin prescription feasibility research, illicit drug users made us aware of the connection between drug dependence and, for some of them, childhood sexual abuse. Some parents of illicit drug users defined the problem as lack of support by intervention services for young people who had lost their way, while others saw the problem as a failure by society to shield young people from accessing drugs. The police drew our attention to a critical unknown, namely how to prevent an influx of drug users to a city where heroin was provided on prescription. Policy makers pointed out the real-world constraint that heroin prescription would have to fit within Australia's international treaty obligations. Some of the general public thought that making heroin available on prescription was a good option, others opted for strengthened law enforcement, yet others wanted to focus on different treatment options, and others again wanted to see heroin use legalised.

As these examples illustrate, stakeholders have an essential and intimate role in making complexity evident. As a consequence, co-creation on complex problems requires a specific research mindset towards stakeholder involvement. Stakeholders help co-create an understanding of the problem, as well as charting a path forward in dealing with it. This contrasts with the way most researchers have been trained, which is that the problem, and how it will be dealt with, is defined by one or more disciplines. Further, the understanding and path forward will vary depending on the mix of stakeholders involved in the research. In the heroin prescription feasibility research we aimed to be comprehensive, and our appreciation of the problem and recommendations would have been different if we had only worked with treatment providers, or if we had confined input to a range of stakeholders committed to continuing prohibitionist policies.

How can research take into account multiple stakeholders with multiple relevant inputs? The heroin prescription feasibility research led to the development of a framework specifically designed for dealing with complex problems. Integration and Implementation Sciences (i2S; Bammer, 2013) begins by considering three core research domains:

- synthesis of existing knowledge
- developing an understanding of critical unknowns and figuring out what to do about them
- making the research evidence available to support policy and practice change. The research evidence includes the synthesised knowledge, any new knowledge produced by reducing unknowns and the assessment of remaining unknowns.

Figure 1: The three domains of Integration and Implementation Sciences (i2S) highlighting key aspects of research on complex real-world problems, as well as fine-grained considerations for each domain.

5. Outcome?
Were good choices made for
a) aims and beneficiaries
b) systems, scoping, boundaries, framing, dealing with values, harnessing and managing differences
c) methods and processes
d) dealing with context

1. For what and for whom?
Aims and beneficiaries

2. Which knowledge, unknowns and aspects of policy and practice?
a) systems view
b) scoping
c) boundary setting
d) framing
e) dealing with values
f) harnessing and managing differences

CONCEPTS
METHODS
CASE EXAMPLES

4. Context?
a) big picture
b) authorisation
c) organisational facilitators and barriers

3. How?
Specific methods for synthesising knowledge, understanding and managing unknowns, and supporting policy and practice change
plus by whom and when

For each domain a set of fine-grained considerations is then teased out to guide the researchers in planning or documenting the research overall (see below and Figure 1). When used for documenting the research, the questions elicit decisions made about a) the problem (for example, 'how was the problem defined and framed'), and b) the methods employed in the research (for example, 'which systems methods were used'), as well as prompting self-evaluation (question 5). These in turn help the researchers capture what they engaged with stakeholders about and the specific methods they used.

The fine-grained considerations are:

1. What was the aim and who was intended to benefit?
2. Which aspects of knowledge, unknowns and of policy or practice?
   o Which systems methods were used to approach the problem, the unknowns and the intervention space?
   o What possibilities were canvassed, for example: What were all the perceived relevant kinds of knowledge and unknowns? Which disciplines and stakeholders would have had something to contribute? Where in the intervention space could support have been provided?
   o Having charted all the possibilities, which were most critical and feasible in this project?
   o How was the problem defined and framed?
   o How were values expressed? Were there value conflicts and how were they managed?

    o   How did the co-creative team work together? What were the desirable differences in knowledge, skills and dispositional attributes among team members and how did the project harness them? What differences had the potential to get in the way of the collaboration and how were they managed?

3.   How was the knowledge synthesis undertaken? How were unknowns identified, understood and managed? How was research support (bringing together the knowledge synthesis and the approach to unknowns) for policy and practice change undertaken?

    o   Which methods were used for knowledge synthesis?

    o   Which research questions were addressed? How were unknowns that were not the topic of investigation managed to reduce the likelihood of adverse unintended consequences and nasty surprises?

    o   Which action options were considered and employed? Was the focus on government, business or civil society? Were policy or practice change the target?

4.   What were the contextual factors?

    o   What was the relevant big-picture context, for example, the history of the problem, the political situation?

    o   What sort of authorisation was needed to research this problem?

    o   How did the structure and culture of the organisations involved in the research facilitate or inhibit what research was possible?

5.   How well was each of these questions addressed? Were good choices made?

In planning or documenting research on complex problems, these questions and sub-questions can generally be asked in any order. The key issue is that all questions are addressed.

In documenting the research and the co-creation with stakeholders, the i2S framework serves an analogous purpose to the frameworks available for co-creation on more straightforward research problems, such as those developed by Brown and Vega (2008), Concannon and colleagues (2014), Mercer and colleagues (2008), and Staniszewska and colleagues (2017). There are many overlaps, but the i2S framework has a broader scope and does not deal with more administrative issues, such as stakeholder engagement on funding applications.

As well as providing a useful framework for tackling complex problems, i2S also provides a growing compilation of concepts and methods for elucidating different elements of the i2S framework. For example, there are several dialogue methods that can be used for synthesis of knowledge from researchers and stakeholders (McDonald et al, 2009), a helpful concept for understanding values and value conflict has been developed by Schwartz (2012), and Mendizabal (2010) and Mitchell and colleagues (1997) have provided frameworks for stakeholder analysis. One of the challenges is that these concepts and methods are scattered throughout the published and grey literatures and are therefore not easily accessible. Compilations are available through the Integration and Implementation Sciences website (http://i2s.anu.edu.au) and the Integration and Implementation Insights blog (http://i2Insights.org).

It is beyond the scope of this paper to deal with the i2S framework in full or to compare it with other frameworks. Instead the paper focuses on one tool that is useful across the i2S framework – for thinking about how stakeholders are engaged

in co-creation – and examines three aspects of the use of this tool when the research problem is complex.

What does complexity mean for how stakeholders are engaged?

Two frameworks are widely used to describe how stakeholders are engaged: Arnstein's ladder (Arnstein, 1969) and the International Association for Public Participation (IAP2) spectrum of participation (2014). It is noteworthy that neither was developed for the research context; instead they address public participation in government decision making. Most research studies have used these frameworks to identify where in the ladder or spectrum they are operating, rather than in any more analytic way.

Rewriting the IAP2 spectrum for the research context provides a useful framework for exploring how stakeholders are engaged, including on complex problems (Figure 2). The key aspects of the original have been maintained, notably:

- the five types of engagement: inform, consult, involve, collaborate, empower
- the idea that 'differing levels of participation are legitimate and depend on the goals, time frames, resources, and levels of concern' in the research to be undertaken
- the 'promise' to the stakeholder group for each type of participation.

The five types of engagement in the original spectrum can be easily translated from public decision making to research. Only one modification is required to make the spectrum relevant for complex problems. In the stakeholder participation goal

Figure 2: Research-relevant modified IAP2 spectrum. This spectrum for stakeholder participation in research is adapted from the International Association for Public Participation (IAP2) spectrum of public participation in decision making.

INCREASING STAKEHOLDER INFLUENCE ON THE RESEARCH				
INFORM	**CONSULT**	**INVOLVE**	**COLLABORATE**	**EMPOWER**
Researchers provide stakeholders with balanced and objective information to assist them in understanding the research process.	Researchers obtain stakeholder feedback on the research process.	Researchers work directly with stakeholders to ensure that stakeholder concerns and aspirations are consistently understood and considered in the research process.	Researchers partner with stakeholders for salient aspects of the research process.	Researchers assist stakeholders in conducting their own research.
We will keep you informed.	We will keep you informed, listen to and acknowledge your concerns and aspirations and provide feedback on how your input influenced the research process.	We will work with you to ensure your concerns and aspirations are directly reflected in the research process and we will provide feedback on how your input influenced the research.	We will look to you for advice and innovation in designing and conducting the research process and incorporate your advice and recommendations to the maximum extent possible.	We will provide advice and assistance as requested in line with your decisions for designing and conducting your research, as well as for implementing the findings.

The leftmost column labels read "STAKEHOLDER PARTICIPATION GOAL" (first data row) and "PROMISE MADE TO STAKEHOLDERS BY RESEARCHERS" (second data row).

for 'collaboration', 'each' is replaced with 'salient' as in 'Researchers partner with stakeholders for *salient* aspects of the research process'. While full collaboration may be possible on a straightforward research question (with, for example, few stakeholder groups and one simple form of data collection), it is unlikely that any stakeholder groups will be able (or even want) to contribute meaningfully to each aspect of the research on a complex problem.

Three issues are particularly pertinent when the research problems are complex. These are the ability to:

1. involve different stakeholder groups in different ways
2. think deeply about which forms of stakeholder engagement are likely to be most appropriate
3. take into account when researchers do and do not have control and different categories of stakeholder groups.

Involving different stakeholder groups in different ways

The particular value of the research-relevant modified IAP2 spectrum when the research problem is complex is that – given that such research generally involves a large number of stakeholder groups – it makes it possible to consider that different groups (separately or together) can be involved in different ways. Further, over the course of the study or in different aspects of the study, the same stakeholder group can also be involved in different ways. Sterling and colleagues (2017, p. 166) also make this point, conceptualising 'these engagements as iterative and non-linear, with different groups of stakeholders engaging in dynamic ways through various stages of a program or activity'.

A useful illustration comes from the inclusion of illicit drug users and police in the heroin prescription feasibility research. Each group was involved in three major ways. First, both groups, as a whole, were *informed* about the research, using a variety of mechanisms tailored to the specific group. Second, police representatives (chosen to represent a spectrum of views about heroin prescription) *collaborated* in designing and interpreting a survey of police; similarly drug user representatives collaborated in a survey of their peers. Finally, representatives of each group were *consulted* about how the research findings would be presented to policy makers.

Thinking deeply about which forms of stakeholder engagement are likely to be most appropriate

The modified research-relevant IAP2 framework not only provides a way of describing different levels of engagement, but also provides a way of thinking deeply about which forms of engagement are likely to be most appropriate, given the different aspects of complexity the stakeholders can provide information about, including delimiting the problem, problem definition, relevant unknowns, real-world constraints, and possible ways forward. The point is to think about these in the overall context of the research and the mix of stakeholder groups involved.

For example, in the heroin prescription feasibility research, we recognised a major conflict between those who thought action was required to strengthen prohibition (and therefore opposed heroin prescription) and those who argued for drug law

reform (and therefore supported heroin prescription). This reflected different values about self-direction, hedonism, conformity and benevolence (Schwartz, 2012). We wanted to be even-handed, respecting both value systems, and that affected our collaboration with different stakeholder groups. 'Inform', 'consult' and 'involve' were all relatively unproblematic, but we had to be much more careful when we wanted to 'collaborate' with or 'empower' stakeholder groups, because these are much harder to implement in a neutral fashion.

We did engage through collaboration and empowerment when we worked with the local Aboriginal and Torres Strait Islander community, however (Humes et al, 1993). Not only was this the most appropriate and respectful way to work with them, but they also represented both sets of values, so that maintaining neutrality was not an issue.

Take into account when researchers do and do not have control and different categories of stakeholder groups

One aspect of co-creation that is made evident by the i2S framework but rarely discussed is that while researchers have a high degree of control over the processes pertaining to knowledge synthesis, and understanding and managing unknowns, they have little control over supporting policy and practice change. Knowledge synthesis and understanding and managing unknowns are the core business of research, and it is up to researchers to cede some control to 'let in' stakeholders. On the other hand, policy and practice change is not core research business, and it is up to decision makers to cede some control to 'let in' researchers. Researchers can determine what they set out to do, but not whether any necessary interactions with decision makers are achieved or how their inputs are acted on (Cairney and Oliver, 2017 make the same point).

It can also be helpful to specifically consider stakeholders in two categories:

- those affected by the problem
- those in a position to do something about the problem (Bammer, 2013).

This is not a hard and fast distinction, but rather a useful heuristic. (As an aside, it is noteworthy that in many co-creation studies it is only stakeholders from the first category who are included (Concannon et al, 2014), with those in the second category often poorly represented or ignored completely.)

The research-relevant modified IAP2 spectrum works for both categories of stakeholders, but there is an additional set of considerations under 'empower', especially for stakeholders in a position to do something about the problem. Researchers can seek to increase the power of decision makers to achieve change. Most commonly, this involves applying pressure from outside the policy or practice systems – through advocacy – with the aim of strengthening the influence of decision makers arguing for particular action on a problem (see also Cairney and Oliver, 2017). Researchers can do this by advocating for particular outcomes themselves or they can seek to strengthen the advocacy of stakeholder groups affected by the problem, by giving their perspectives legitimacy through including them in the research. Researchers can also take the additional step of activism, where they specifically contribute to the lobbying and other actions required to make change happen. For an example, see Chapman's description (2015) of activism by researchers to support the introduction and passing of legislation for plain-packing of tobacco products. There is a substantial discussion

to be had about the appropriate roles of advocacy and activism by researchers and how closely they should engage with decision makers in the research process, but that is beyond the scope of this paper.

In the heroin prescription feasibility research, our starting point was to keep decision makers informed about the research, and – where they were willing – to consult, involve and/or collaborate with them. We chose a neutral stance, reviewing carefully both the potential costs and benefits of heroin prescription, and therefore eschewed advocacy and activism.

These distinctions about control and different categories of stakeholders are also useful in considering how the specific elements of the research-relevant modified IAP2 spectrum play out in practice. Combining them, as shown in Table 1, provides a useful way to tease out key questions to guide researcher engagement with stakeholders. The point here is not to be comprehensive, but to illustrate that the type of stakeholder involved, and where in the research process they are involved (understanding or action) influences the considerations that are relevant.

By and large these questions are self-explanatory, but it may be helpful to illustrate four of them with examples from the heroin prescription feasibility research. First, on the question of action and urgency from the first quadrant of Table 1, the stakeholder groups mostly agreed that illicit drug use was a problem that needed action. But there was disagreement on urgency, for example families of drug users tended to see the need for considering heroin prescription as urgent, whereas some treatment providers thought that existing treatment services should be improved first.

Second – relevant to quadrant 2 in Table 1 – although this was not the case in Australia, in some countries it would not be possible for government policy makers to be seen to liaise with 'criminals' such as illicit drug users, so that research may be the only way for these stakeholders to be heard. This also relates to the issue of accessibility and organisation in quadrant 1 of Table 1. In Australia, government acceptance and (sometimes) funding meant that illicit drug users had formed a small number of organisations, the most prominent being AIVL (Australian Injecting and Illicit Drug Users League, http://aivl.org.au/). This meant that we could access effective and legitimate representatives at least of the organisation, if not the group as a whole.

Third – relevant to quadrant 3 in Table 1 – in the heroin trial feasibility research, policy makers from the affected jurisdiction gave the research legitimacy by putting discussion of the progress and findings on the agenda of an influential national policy committee, ensuring that the committee stayed abreast of what was in train and eventually made a decision.

Finally – relevant to understanding trade-offs important for decision makers (quadrant 4 in Table 1) – early in the research, key politicians made us aware of the perspectives that would be most influential in their decision making, including those of the police commissioners and the key medical professional association, so that we were able to ensure that we included those perspectives in our research.

Conclusion

The aim of this paper has been to describe the key characteristics of complex problems and to start to unpack what these mean for good practice relevant to co-creation. It has highlighted that a different research mindset to stakeholder engagement is required, one that recognises that stakeholders help co-create an understanding of

Table 1: Illustrative questions for researchers relevant to implementing the research-relevant modified IAP2 spectrum, differentiated by where researchers do and do not have control and two major categories of stakeholder groups.

	Research Domain	
	Knowledge synthesis and Understanding and managing unknowns	**Supporting policy and practice change**
Stakeholders affected by the problem	• What experience and expertise do these stakeholders have to offer? Are their perspectives homogeneous? • How big is the stakeholder group? Does it have influence beyond sheer size? • How accessible are these stakeholders? Are they organised into one or more groups? If not, can representatives be identified? If representatives are unwilling to participate who else can help? • Do these stakeholders see the problem as requiring action? If so, how urgent is it? • Will being involved in the research give these stakeholders additional legitimacy?	• Can the researchers access stakeholders who are not able to be accessed by decision makers? • Can the involvement of stakeholders affected by the problem strengthen the influence of particular decision makers? If so, how should this be handled?
Decision makers (stakeholders in a position to do something about the problem)	• What experience and expertise do these stakeholders have to offer? Are their perspectives homogeneous? • Are these stakeholders at the right level to provide useful input? • Are these stakeholders constrained by confidentiality? • Is the input of these stakeholders likely to be influenced by vested interests? • Are there other sources who can counterbalance unwillingness to participate or distortions in input (for example, retired decision makers) • Will the participation of these stakeholders be seen as giving the research legitimacy?	• Are we researchers working with decision makers at the right level of power and influence? • Have all the relevant sectors (that is, government, business, civil society) been adequately considered? • Has the research considered the trade-offs that are important to these stakeholders? How have these been balanced against other trade-offs? • Can the research increase the influence of particular stakeholders? If so, how should this be handled?

the problem, as well as charting a path forward in dealing with it. The Integration and Implementation Sciences (i2S) framework was introduced to show how multiple stakeholders with multiple relevant inputs could be systematically taken into account. One specific tool, the research-relevant modified IAP2 spectrum, was then described, focusing on its particular relevance to dealing with complex problems.

The paper has aimed to contribute a piece to the jigsaw of co-creation, complementing existing insights into, for example, stakeholder engagement on straightforward problems and detailed co-creation processes. As well as highlighting areas for further theorising and research, the overall purpose is to improve the effectiveness of co-creative research, in order to find more effective responses to the complex problems faced by society.

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