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Additional Information

23 created as part of this research; it includes criteria to evaluate the development
24 process and the outcomes.

25 Relevant aspects to consider in the participatory development processes include:
26 establishing clear objectives, timing and location of the process; keeping discussions
27 on track; favouring participation and interaction of individuals and groups; and
28 challenging creative thinking of the tool and future scenarios. The case studies that
29 address these issues show better outcomes; however, there is a large degree of
30 uncertainty concerning them because developers have typically neither asked
31 participants about their perceptions of the processes and resultant tools, nor have they
32 monitored the use and legacy of the tools over the long-term.

33 **Keywords:** decision support systems, decision tools, participatory development
34 process, process features, outcomes.

35 **Introduction**

36 Decision support systems (DSS) provide much needed organisation to make decisions
37 within complex systems (Bennet and Bennet 2008). Such tools consist of a data and
38 model management system and a user interface (Cain et al. 2003). The increasing
39 focus on multi-purpose forestry and the resulting wide ranging and often competing
40 demands placed upon forests means that the potential for DSSs to assist in decision-
41 making processes has been heightened (Lawrence and Stewart 2011).

42 A range of DSSs have been developed, but only a few have actually been adopted.
43 Some authors argue that the needs and requirements of users have not been met
44 (Lawrence and Stewart 2010); others suggest the cost of the tools is very high or that

45 they are irrelevant, unreliable and inflexible (Breuer et al. 2008; Evers 2008; Kizito
46 2008; van Meensel et al. 2012). To overcome these deficiencies, changes are required.
47 More specifically, the participation and feedback of potential users and other
48 stakeholders is necessary throughout DSSs development process (Breuer et al. 2008;
49 van Meensel et al. 2012).

50 Participation improves uptake and DSS effectiveness because the process and outputs
51 (it is worth at this point differentiating between outputs, tangible results of the process,
52 and outcomes, intangible) better meet stakeholders' expectations and address
53 problems relevant to decision-makers (van Meensel et al. 2012). For example, in
54 *AgClimate*, participation guided the development of a DSS developed in the US for
55 rainfall prediction. The involvement of farmers and extension agents increased their
56 awareness and interest in climate forecasts and improved the value of the DSS (Breuer
57 et al. 2012). Similarly, in *WaterSense*, a DSS designed in Australia for scheduling
58 limited water supplies, participants emphasized learning as an important outcome;
59 changes in stakeholder values and behaviour are also considered to be valuable
60 outcomes by many developers that use participatory processes (Jakku and Thorburn
61 2010).

62 More positive attitudes towards DSSs and higher uptake levels are fostered when the
63 potential users are involved in the development process. However, what is less well
64 understood is which particular features of the participatory development process are
65 most significant in terms of improving outcomes. In a review of these issues, Lawrence
66 and Stewart (2010) found that much more has been written about the process of

67 stakeholder participation, and less about the outcomes. Nevertheless, they note that
68 evidence does exist, but that it is scattered across the scientific literature, and therefore
69 somewhat hidden. The aim of this research is to analyse that literature rigorously, in
70 order to find out these characteristics.

71 **Materials and methods**

72 A systematic review of case studies reporting on DSSs developed in a participatory
73 way was carried out. In order to get a bigger number of papers, other decision tools
74 were included: information systems (IS), and scenario and software development tools.
75 Also, the search was not restricted to forestry case studies to come up with as many
76 cases as possible; the literature on the topic was found to be scarce. Three weeks
77 were spent on this, looking into these search engines: *Web of Knowledge, Google*
78 *Scholar, Scopus, Scirus and Taylor and Francis*. 24 articles were selected for meeting
79 the requirement of reporting on decision tools developed by means of participation and
80 for providing enough information that allows carrying out an assessment according to a
81 framework whose development and content is explained later in this section. Some
82 articles included two case studies which were analysed separately, resulting in a total
83 of 29 case studies as described in *Table 1*.

84 **TABLE 1**

85 A framework for the analysis of case studies was also developed, drawing on a wider
86 participatory evaluation literature. This highlighted the need to distinguish between
87 evaluation of the development process, and evaluation of the outcomes (Rowe and
88 Frewer 2000; Lawrence 2006; Blackstock et al. 2007). A two part framework was

89 therefore designed. Framework criteria were assessed based on relating information
90 contained within each paper: either quotations from participants or statements from
91 developers of the process. The evaluation was carried out by the first author of this
92 paper and a score of low, moderate or high was given to each criterion depending on
93 the degree to which it was met; an uncertain category was also used where evidence
94 was missing or unclear. The evaluation of each criterion was accompanied by the
95 evidence from the text that supported it, as it can be seen in the downloadable
96 appendix to the paper (whose internet link is referenced in this text before the
97 references section), so that it can be verified and judged by oneself. *Tables 2, 3, 4* and
98 *5* show the criteria employed, their definitions and their sources.

99 TABLE 2

100 TABLE 3

101 TABLE 4

102 TABLE 5

103 Based on the authors' own experience and a general overview of the papers, four
104 stages of tool development process were identified: scope, prototype, usability, and
105 testing. Scope covers the initial meetings where the objectives and context of the tool
106 are established. Prototype is the stage in which an early concept of the look and feel of
107 the tool is developed and tested by the stakeholders. The usability stage involves the
108 tool being improved in terms of its appearance and ease of use. In the testing stage a
109 trial of the tool is undertaken before its release. The assessment of the development
110 process of each of the case studies involved considering the same criteria (*Table 2*) for

111 each of the four stages of development. It was also assessed in each stage the degree
112 of involvement of stakeholders according to the scale presented in *Table 3*, this
113 concept refers to the degree to which stakeholders are engaged in the process (Reed
114 2008), also described as a ladder of participation that ranges from passive information
115 to active engagement (Arnstein 1969).

116 Concerning the outcomes, two sets of criteria were used to evaluate them. 1) Criteria
117 evaluating personal outcomes: attitude changes and stakeholders' perceptions towards
118 the decision tool, its context and the decision problem, and the participatory
119 development process (*Table 4*). And 2) criteria evaluating factual outcomes: changes
120 the tool and the development process have brought or influenced (*Table 5*).

121 Frequency tables for the number of times each criterion was given a certain score were
122 developed and then transformed into graphical outputs (see *Figures 1, 2, 3, 4, 5 and 6*
123 in the results section). The aim of this step is to see the predominant scores in each
124 criterion. Then, the criteria score profile of each case study (that means, the score that
125 all the criteria get in each case study) is written down in an excel file. This information
126 was used to complete a Principal Coordinate Analysis (PCO) in order to visualise the
127 similarities within the criteria scores of the 29 case studies.

128 PCO takes a similarity matrix constructed between every possible pair of case studies.
129 To estimate the similarity between two case studies, a score and weight were
130 calculated for each criterion: the weight prioritises when a criterion gets a score in both
131 case studies (low, moderate or high), compared to when one or both of them are
132 categorised as uncertain; the score prioritises the closer the evaluation of any criterion

133 in both case studies is (it will be higher if both case studies are categorised as
134 uncertain than if just one does, and it will be higher if both are scored low than if one
135 scores low and the other high); formulas are out of the scope of this research. The final
136 similarity score between both case studies was obtained by adding the scores of all the
137 criteria together and dividing by the sum of the weights, resulting in a value between 0
138 and 1. For the calculation of the similarity matrix, a single number for the four
139 development process stages is used for each development process criteria; it
140 corresponds to the last chronological score (chronology: scope, prototype, usability and
141 testing stages), for example, if a criterion is evaluated the following way across four
142 development stages: low, uncertain, high, uncertain, it would be scored “high” for
143 calculating the matrix.

144 Afterwards, the PCO algorithm is used to estimate coordinates for each case study in
145 such a manner that most of the variance in the data was captured in the first axis, with
146 each subsequent axis containing progressively less information. It is then possible to
147 visualize the main structures in the data by plotting the first two axes against each
148 other (see *Figures 7 and 8* in the results section). Case studies that are positioned
149 close together in the PCO plot would be expected to have a similar criteria score
150 profile. Further interpretations of case study clusters are required: groupings might
151 occur where most criteria have been scored high, uncertain, or a group may exist
152 where a specific subset of criteria is constantly scored high with other criteria scored
153 low.

154 *Figures 7 and 8* (see results section) highlight different features of the case studies and
155 it can be seen that the ones in the lower left quadrant perform better than those in the
156 others. More details are given in the next section, but considering this fact two groups
157 of case studies have been created for comparing their criteria score profiles: those in
158 the lower left quadrant (LL), against those in the upper right (UR). The UR group has
159 been broadened by adding cases out of both quadrants that develop a DSS. It is done
160 like this so that the two groups have a similar number of cases (LL: 14; UR: 12) and
161 because DSSs are the tools originally aimed to look at in this study. Therefore, the
162 following case studies form the LL group: 2, 4, 5, 8, 14, 16, 18, 21, 22, 23, 25, 26, 27,
163 28; and form the UR group: 1, 3, 6, 7, 9, 10, 11, 12, 13, 19, 20 and 29 (see *Table 1* for
164 a complete reference of the case studies). For the comparison, the score profiles of the
165 case studies of each group were put together (see *Tables 6, 7, 8, 9, 10 and 11* in the
166 next section), separating development process and outcomes for both groups.

167 **Results**

168 *Figures 1, 2, 3 and 4* in this section do not show that, in relation to the four process
169 development stages, not all case studies included information on all of them: 26 cases
170 included the scope stage, 6 discussed the prototype stage, 7 explored the usability
171 stage and 5 described the testing stage. The uncertainty shown in the graphs
172 corresponds to case studies showing evidence on that stage but categorised as
173 “uncertain” for that specific criterion.

174 **FIGURE 1**

175 In the scoping stage (*Figure 1*), the criterion with the lowest degree of uncertainty is
176 *representation*, and the one with the highest is *conflict resolution*. For all the criteria,
177 the score “high” is the most frequent. *Structured group interaction*, *opportunity to*
178 *influence outputs and process development*, and *challenging status quo* were found to
179 be the criteria with strongest evidence of impact after *representation*. In relation to the
180 degree of stakeholder involvement (see *Table 3*), “involve” is the most frequently
181 recorded (50% of the case studies).

182 FIGURE 2

183 The level of uncertainty remains about the same in the prototype stage (*Figure 2*). The
184 score “high” reduces in favour of more “moderate” and “low” scores. Concerning the
185 degree of involvement, there is a slight reduction of “involve” cases and an increase of
186 “partner” and “empower”.

187 FIGURE 3

188 The results for the usability stage criteria remain similar to previous stages (*Figure 3*);
189 *structured group interaction* is an exception because the amount of uncertainty
190 increases noticeably. The score “high” remains frequent. In this stage, the main type of
191 stakeholder involvement is “consult”.

192 FIGURE 4

193 In the testing stage (*Figure 4*), it is interesting to note that there is an increase in the
194 number of cases which can be described as fitting “empower” degree of stakeholder
195 involvement (40%).

196 FIGURE 5

197 In respect to personal outcomes (*Figure 5*), the criterion with the lowest uncertainty is
198 *acceptance of process and outputs*. The other criteria (see *Table 4*) score
199 predominantly “high”, but they show high levels of uncertainty (more than 50%). The
200 factual outcomes (see *Table 5*) reveal “high” scores but, with the exception of the
201 criterion *objectives met*, the others have more than 70% of uncertainty (*Figure 6*).

202 FIGURE 6

203 *Figure 7* tells that case studies in the lower left quadrant get between 6 and 10
204 development criteria scored and an average score between 2.6 and 3, whereas the
205 cases in the upper right one get between 2 and 6 criteria scored and average scores
206 between 2 and 2.5. Regarding the outcomes, the graph shows that most of the case
207 studies having a high average score (over 2.6) are concentrated in the lower left
208 quadrant; these average scores include the factual and personal outcomes together.

209 FIGURE 7

210 *Figure 8* shows that in the lower left quadrant 10 out of 14 cases carry out an “involve”
211 degree of stakeholder involvement, there is also one “partner” case and two
212 “empower”. By contrast, in the upper right quadrant three case studies are consultative,
213 one informative and only two “involve”. Note that figure 8 shows the last chronological
214 degree of involvement of the four development stages, excluding those stages that
215 were not considered in the case study.

216 FIGURE 8

217 The main findings from comparing the criteria score profiles of the LL and the UR
218 groups are now reported. In relation to the development process (*Tables 6 and 7*),

219 *structured group interaction* gets a high average score (2.85) in the LL group and is
220 scored in 13 of the cases, whereas for the UR it gets a medium score (2.2) and is only
221 scored in 5 cases. *Opportunity to influence process development and outputs* and
222 *challenging status quo* also show higher scores and lower uncertainty in LL compared
223 to UR. There is also a contrast between both groups for *clear mandates and goals*: it
224 has 100% uncertainty in the UR group and gets a high score (2.86) in the LL group. It
225 happens in the two groups that the number of case studies that consider the prototype,
226 usability and testing stages is small; thus, these results are based in the comparison of
227 the scores for the scope stage. Note that these scores do not coincide with the ones
228 displayed in *Figure 7*, which are the ones used to develop the similarity matrix as it has
229 been explained in the materials and methods section.

230 TABLE 6

231 TABLE 7

232 Referring to the factual outcomes, *Tables 10 and 11* show good scores in both groups
233 for the criterion *objectives met*, which also has the lowest uncertainty. There is diversity
234 in scores for the other factual outcome criteria: LL gets high scores for all of them,
235 whereas UR has moderate or low scores; however, they show a high level of
236 uncertainty in both groups. The personal outcomes (*Tables 8 and 9*) *acceptance of*
237 *process and outputs* and *recognised impacts* get high scores in both groups but there
238 is higher uncertainty in the UR group. *Relationships and social capital building* and
239 *social learning* have a high degree of uncertainty in both groups and moderate results,
240 except for *social learning* that gets a high score in LL.

241 TABLE 8

242 TABLE 9

243 TABLE 10

244 TABLE 11

245 **Discussion**

246 This research set out to analyse the literature on participatory DSS development
247 rigorously, by developing a framework of evaluation criteria. This framework builds on
248 recommendations of experts in participatory processes and analyses separately the
249 development process and the outcomes. Therefore, it allows assessing which
250 characteristics of the participatory development process lead to better outcomes.
251 Another remarkable feature of the framework is the differentiation between personal
252 and factual outcomes: the aim of a participatory process is not just about involving
253 stakeholders to make decisions, but also to infer some changes in their attitudes and
254 knowledge about the topic of the decision.

255 This discussion is based on the analysis and comparison of the two groups of case
256 studies mentioned in the materials and methods section: LL and UR. Not all case
257 studies are included in them, but they are two good samples to look at since they
258 represent different situations of the characteristics intended to study: both for the
259 development process and for the outcome criteria scores are higher and uncertainty
260 lower in LL compared to UR.

261 Starting by the degree of stakeholder involvement, looking at LL group case studies in
262 *Figure 8*, 10 out of 14 carry on an “involve” degree, and it is the lowest among all case

263 studies of the group. On the other hand, in the UR group the most frequent degree of
264 stakeholder involvement is “consult” (6 out of 12). Considering the fact that criteria
265 scores are better for LL than for UR, it can be said that the higher the involvement of
266 participants, the better the outcomes. Pretty (1995) supports this statement: *according*
267 *to the analysis, it was quite clear that as involvement increases, project effectiveness*
268 *does so from medium to high*; and he bases his argument in a previous study of 121
269 participatory water supply projects in Africa with different degrees of involvement.

270 In respect to the development process, *Tables 6 and 7* reveal contrast for criteria
271 *Structured group interaction, opportunity to influence process development and*
272 *outputs, challenging status quo and fostering creative thinking and clear mandates and*
273 *goals*; so, these are important criteria to consider in the development process. It does
274 not mean that these criteria have the best results in LL and the worst in UR, but that
275 results vary between groups: for example, *clear mandates and goals* has medium level
276 of uncertainty in LL (scored 7 times), but it has a total level of uncertainty in UR. On the
277 other hand, *representation* gets a high score and a low uncertainty in both groups.

278 The analysis of the outcomes reflects high uncertainty. Apart from the fact that paper
279 authors report on the tools developed more than on the outcomes, an explanation for
280 this uncertainty in the case of the factual ones is that these criteria (*impact on policy*
281 *making, uptake of the tools, legacy and impact on users’ practice*) require long-term
282 monitoring of the tools and the case studies included in this research are generally
283 reported after the development of the tools. Personal outcomes have to be directly
284 asked to participants after the process and it does not usually happen. Nevertheless,

285 the scores are better in the LL group and this suggests that when considering the
286 development criteria of the framework, especially the ones highlighted in the previous
287 paragraph, outcomes are improved.

288 This research analyses reports of various authors. This means that the quantity and
289 quality of information provided differs among papers, depending on what their authors
290 want to emphasize, what implies that our evaluations might be slightly different if more
291 or other kind of data relative to the accomplishment of the criteria had been given. But,
292 the objective was to answer the research question by means of analysing the scientific
293 literature. However, to get a better answer, further research is recommended to include
294 other sources apart from literature review, like direct interviews with both developers
295 and participants of tool development processes and participatory processes.

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305 **Appendix**

306 An appendix that contains the evaluation of every case study according to the
307 evaluation framework including the supporting evidence can be consulted in the
308 following link: **LINK REQUIRED**.

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425 **Tables**

Case study	Topic area	Type of tool	Sources
1	Agriculture	DSS	Breuer et al. 2008.
2	Agriculture	DSS	Jakku & Thorburn 2010.
3	Water management	DSS	Schielen & Gijsbers 2003.
4	Water management	DSS	Bunch & Dudycha 2004.
5	Medicine	DSS	Peleg et al. 2009.
6	Land management	DSS	Reed & Dougill 2010.
7	Land management	DSS	Barac et al. 2004.
8	Agriculture	DSS	Cain et al. 2003.
9	Agriculture	DSS	van Meensel et al. 2012.
10	Forestry	DSS	von Geibler et al. 2010.
11	Agriculture	DSS	Newman et al. 2000.
12	Medicine	DSS	Thursky & Mahemoff 2007.
13	Water management	DSS	Kizito 2008.

14	Land management	IS	Drew et al. 2004.
15	Business	IS	Jiye & Wenmo 2008.
16	Medicine	IS	Byrne & Sahay 2007.
17	Medicine	IS	Driedger et al. 2007.
18	Water management	Software development	Kautz 2011.
19	Business	Software development	livari 2011.
20	Business	Software development	livari 2011.
21	Land management	Scenario development	Chakraborty 2011.
22	Land management	Scenario development	Chakraborty 2011.
23	Agriculture	Scenario development	Atwell et al. 2011.
24	Land management	Scenario development	Kowalski et al. 2009.
25	Land management	Scenario development	Kowalski et al. 2009.
26	Water management	Scenario development	Cinderby et al. 2011.
27	Water management	Scenario development	Cinderby et al. 2011.
28	Water management	Scenario development	Jessel & Jacobs 2005.
29	Agriculture	DSS	Cain et al. 2003.

Table 1. Case studies revealed by the literature review.

Criteria	Definition	Sources
Structured group interaction	Control of the meeting is with the planners of the process, who allow participation and interaction of all participating individuals and groups and keep discussions on track.	Menzel et al. 2012; Rowe & Frewer 2000; Tuler & Webler 1999.
Representation	Diversity of views and spread of representation from affected interests.	Blackstock et al. 2007; Menzel et al. 2012; Rowe & Frewer 2000.
Opportunity to influence process development and outputs	Participant's opportunity to influence, express their preferences and values. This is achieved considering the following: enough time to participate, stakeholders involved early enough, clear structure of the process, etc.	Blackstock et al. 2007; Menzel et al. 2012; Sheppard & Meitner 2005.
Quality and selection of information and resources	Adequacy, quality and quantity of information provided. Necessary resources include: (1) information resources (summaries of the pertinent facts), (2) human resources (access to scientists, witnesses or decision analysts), (3) material resources (overhead projectors, whiteboards) and (4) time resources (participants should have sufficient time to make decisions).	Blackstock et al. 2007; Menzel et al. 2012; Rowe & Frewer 2000.
Challenging status quo and fostering creative thinking	Process encourages questioning the status quo and challenges the imagination of alternative futures.	Innes & Booher 1999; Menzel et al. 2012.
Clear mandate and goals	The nature and scope of the participation tasks are clearly defined at the beginning of the process: scope, time and place of the	Duinker 1998; Menzel et al. 2012; Rowe & Frewer 2000.

	meetings, expected output, mechanisms for the process, and expectations towards participants.	
Transparency	Participants understand how decisions are made.	Blackstock et al. 2007; Menzel et al. 2012.
Independence and neutrality of the process	The process is conducted in an independent manner. Participants are free to conduct themselves in a voluntary and self-directed manner, without coercion. The process seeks the common good, not just accommodating specific interests.	Menzel et al. 2012; Rowe & Frewer 2000; Sheppard et al. 2004.
Conflict resolution	The way conflict among participants is resolved during the process.	Blackstock et al. 2007.
Develop a shared vision and goals	The creation of an agreed vision, objectives and goals for the process/project.	Blackstock et al. 2007.

Table 2. Criteria to evaluate each stage of the development process of the decision tools (scope, prototype, usability and testing). The table also shows the definition of the criteria and their sources.

Level	Definition	Sources
Inform	To provide participants with objective information to help them understand the problems, alternatives, and solutions. Suitable for more knowledge-base decisions (e.g., technical risks assessments).	Blackstock et al. 2007; Forestry Commission 2011; Rowe and Frewer, 2000.
Consult	To obtain public feedback on analysis, alternatives or decisions. It is used when decisions are being shaped and information can improve them. Developers are not obliged to take participants' views into account.	Blackstock et al. 2007; Forestry Commission 2011; Pretty 1995.
Involve	To work directly with the public throughout the process to ensure that public concerns and aspirations are understood and considered. Involvement may be interactive and include some kind of shared decision making, but major decisions are made by developers.	Forestry Commission 2011; Pretty 1995.
Partnership	To partner with the public each aspect of the decision including the development of alternatives and the identification of the preferred solution. Participation is perceived as a right, not just as a means to achieve project goals.	Forestry Commission 2011; Pretty 1995.
Empower	To place final decisions in the public. To achieve this, developers have to support people with information. Suitability towards this degree increases the less knowledge-based and the more value-based the decisions are.	Forestry Commission 2011; Lawrence 2006; Rowe and Frewer, 2000.

Table 3. In each stage of the development process of the decision tools (scope, prototype, usability, testing) the degree of involvement of stakeholders according to the scale presented in this table (which is adapted from *The International Association for Public Participation* and presented in Forestry Commission 2011, and State of Victoria 2005) is evaluated.

Criteria	Definition	Sources
Relationships and social	Creation of new social networks and	Blackstock et al. 2007; Menzel

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capital building	reinforcement of existing ones as a result of the process.	et al. 2012.
Acceptance of process and outputs	Different parties involved (developers, participants) report that the process or the resultant outputs address their needs, concerns, expectations or values.	Blackstock et al. 2007; Menzel et al. 2012; Moote et al. 1997; Rowe & Frewer 2004.
Recognised impacts	Participants perceive their recommendations from the process in the outputs.	Blackstock et al. 2007.
Social learning	The way that the process has changed individual and group values and behaviour.	Blackstock et al. 2007.

Table 4. This table displays the criteria, their definitions and their sources, to evaluate the personal outcomes of each case study.

Criteria	Definition
Objectives met	The objectives of the participatory process have been met (usually the development of certain decision tools).
Uptake of the tool	The created decision tools are demanded/used.
Legacy	Long lasting use or continuity in the use of the tools.
Impact on policy making	Whether tool helps making policy, or decision-makers informing policies.
Impact on users' practice	The tool improves users activity (reduced times, better outcomes, etc.).

Table 5. This table displays the criteria, and their definitions, to evaluate the factual outcomes of each case study.

Case study	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
18	1	3	3	3	0	3	3	3	0	1
28	3	3	3	0	3	3	0	3	0	0
14	3	3	3	3	3	0	0	3	0	0
25	3	3	3	3	3	0	3	0	0	0
27	3	3	3	3	3	0	0	0	0	0
5	0	2	1	0	1	0	1	0	0	0
21	3	3	3	3	3	2	0	0	0	3
22	3	3	3	3	3	0	0	0	0	3
26	3	3	3	3	3	3	0	0	0	0
2	3	3	3	0	3	0	0	3	0	3
16	3	3	3	0	3	0	0	3	0	3
4	3	3	3	0	3	3	0	0	0	3
23	3	3	2	3	3	3	3	3	0	0
8	3	3	1	3	3	3	0	3	0	3
Average	2.85	2.93	2.64	3	2.85	2.86	2.5	3	0	2.71
Uncertainty	1	0	0	5	1	7	10	7	14	7

Table 6. Evaluation that case studies of the LL group get in each criterion of the scope stage of the development process (0=uncertain; 1=low; 2=moderate;

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3=high). Uncertainty tells the number of case studies categorised as 0. Average just considers case studies not categorised as 0.

Criteria: 1: structured group interaction; 2: representation; 3: opportunity to influence process development and outputs; 4: quality and selection of information and resources; 5: challenging status quo and fostering creative thinking; 6: clear mandates and goals; 7: transparency; 8: independence and neutrality of the process; 9: conflict resolution; 10: develop a shared vision and goals.

Case study	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
3	1	3	3	0	2	0	0	3	0	0
12	3	3	1	0	0	0	3	0	0	0
19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	0	3	0	0	0	0	0	0	0	2
7	0	3	1	0	0	0	0	0	0	0
1	1	1	3	0	3	0	0	0	0	0
13	0	3	3	3	3	0	2	0	0	0
9	0	3	0	3	2	0	3	0	3	3
11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10	3	3	0	0	0	0	0	0	0	0
29	3	3	1	0	1	0	1	0	0	3
Average	2.2	2.78	2	3	2.2	0	2.25	3	3	2.67
Uncertainty	7	3	6	10	7	12	8	11	11	9

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Table 7. Evaluation that case studies of the UR group get in each criterion of the scope stage of the development process (0=uncertain; 1=low; 2=moderate; 3=high). ND (no data) refers to case studies that have not considered the scope stage. Uncertainty tells the number of case studies categorised as 0 or ND. Average just considers case studies not categorised as 0 or ND.

Criteria: 1: structured group interaction; 2: representation; 3: opportunity to influence process development and outputs; 4: quality and selection of information and resources; 5: challenging status quo and fostering creative thinking; 6: clear mandates and goals; 7: transparency; 8: independence and neutrality of the process; 9: conflict resolution; 10: develop a shared vision and goals.

Case study	C1	C2	C3	C4
18	3	3	3	0
28	1	2	3	0
14	0	3	3	0
25	0	3	2	3
27	0	3	0	0
5	0	3	0	0
21	0	3	0	0
22	0	0	0	3

26	0	3	0	0
2	3	3	3	3
16	1	0	0	0
4	0	0	0	0
23	0	3	3	0
8	0	2	0	0
Average	2	2.82	2.83	3
Uncertainty	10	3	8	11

Table 8. Evaluation that case studies of the LL group get in each criterion of the personal outcomes (0=uncertain; 1=low; 2=moderate; 3=high). Uncertainty tells the number of case studies categorised as 0. Average just considers case studies not categorised as 0.

Criteria: 1: relationships and social capital building; 2: acceptance of process and outputs; 3: recognised impacts; 4: social learning.

Case study	C1	C2	C3	C4
3	0	2	2	0
12	2	3	0	3
19	0	0	0	0
20	0	0	0	0
6	0	0	0	0
7	2	0	0	1
1	0	2	3	0
13	0	0	0	2
9	0	3	3	0
11	0	0	0	0
10	0	3	0	0
29	0	3	0	0
Average	2	2.67	2.67	2
Uncertainty	10	6	9	9

Table 9. Evaluation that case studies of the UR group get in each criterion of the personal outcomes (0=uncertain; 1=low; 2=moderate; 3=high). Uncertainty tells the number of case studies recognized as 0. Average just considers case studies not recognized as 0.

Criteria: 1: relationships and social capital building; 2: acceptance of process and outputs; 3: recognized impacts; 4: social learning.

Case study	C1	C2	C3	C4	C5
18	3	3	0	0	3
28	3	3	0	3	3

14	2	0	0	0	0
25	3	0	0	3	0
27	3	0	0	0	0
5	3	0	0	0	0
21	0	0	3	1	0
22	3	0	3	3	0
26	3	0	0	0	0
2	3	0	0	0	3
16	3	0	0	0	0
4	3	0	0	0	0
23	3	0	0	0	0
8	2	0	0	0	0
Average	2.85	3	3	2.5	3
Uncertainty	1	12	12	10	11

Table 10. Evaluation that case studies of the LL group get in each criterion of the factual outcomes (0=uncertain; 1=low; 2=moderate; 3=high). Uncertainty tells the number of case studies categorised as 0. Average just considers case studies not categorised as 0.

Criteria: 1: objectives met; 2: uptake of the tool; 3: legacy; 4: impact on policy making; 5: impact on users' practice.

Case study	C1	C2	C3	C4	C5
3	1	3	0	3	0
12	3	3	0	0	3
19	0	0	0	2	0
20	3	0	0	2	0
6	0	0	0	0	0
7	3	0	0	0	0
1	0	0	0	0	0
13	3	1	0	0	0
9	3	0	0	0	0
11	0	0	0	0	0
10	3	0	0	0	0
29	2	0	0	0	0
Average	2.63	2.33	0	2.33	3
Uncertainty	4	9	12	9	11

Table 11. Evaluation that case studies of the UR group get in each criterion of the factual outcomes (0=uncertain; 1=low; 2=moderate; 3=high). Uncertainty

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tells the number of case studies categorised as 0. Average just considers case studies not categorised as 0.
Criteria: 1: objectives met; 2: uptake of the tool; 3: legacy; 4: impact on policy making; 5: impact on users' practice.

Figures

Figure 1. This figure shows, on the left, what percentage of case studies in each criterion has been scored as “low”, “moderate”, “high” or “uncertain” in the scope stage. On the right, it shows the percentage of case studies that fit the different degrees of stakeholder involvement in the scope stage.

Acronyms for the criteria: SGR: structured group interaction; R: representation; OIOP: opportunity to influence outputs and process development; QSI: quality and selection of information; ChSQ: challenging status quo; CMG: clear mandates and goals; T: transparency; INP: Independence and neutrality of the process; CR: conflict resolution; DShVG: develop a shared vision and goals.

Figure 2. This figure shows, on the left, what percentage of case studies in each criterion has been scored as “low”, “moderate”, “high” or “uncertain” in the prototype stage. On the right, it shows the percentage of case studies that fit the different degrees of stakeholder involvement in the prototype stage.

Acronyms for the criteria: SGR: structured group interaction; R: representation; OIOP: opportunity to influence outputs and process development; QSI: quality and selection of information; ChSQ: challenging status quo; CMG: clear mandates and goals; T: transparency; INP: Independence and neutrality of the process; CR: conflict resolution; DShVG: develop a shared vision and goals.

Figure 3. This figure shows, on the left, what percentage of case studies in each criterion has been scored as “low”, “moderate”, “high” or “uncertain” in the usability stage. On the right, it shows the percentage of case studies that fit the different degrees of stakeholder involvement in the usability stage.

Acronyms for the criteria: SGR: structured group interaction; R: representation; OIOP: opportunity to influence outputs and process development; QSI: quality and selection of information; ChSQ: challenging status quo; CMG: clear mandates and goals; T: transparency; INP: Independence and neutrality of the process; CR: conflict resolution; DShVG: develop a shared vision and goals.

Figure 4. This figure shows, on the left, what percentage of case studies in each criterion has been scored as “low”, “moderate”, “high” or “uncertain” in the testing stage. On the right, it shows the percentage of case studies that fit the different degrees of stakeholder involvement in the testing stage.

Acronyms for the criteria: SGR: structured group interaction; R: representation; OIOP: opportunity to influence outputs and process development; QSI: quality and selection of information; ChSQ: challenging status quo; CMG: clear mandates and goals; T: transparency; INP: Independence and neutrality of the process; CR: conflict resolution; DShVG: develop a shared vision and goals.

Figure 5. This figure shows what percentage of case studies in each personal outcome criterion has been scored as “low”, “moderate”, “high” or “uncertain”.

Acronyms for the criteria: RSCB: relationships and social capital building; APO: acceptance of process and outputs; RI: recognised impacts; SL: social learning.

Figure 6. This figure shows what percentage of case studies in each factual outcome criterion has been scored as “low”, “moderate”, “high” or “uncertain”.

Acronyms for the criteria: OM: objectives met; UpT: uptake of the tool; L: legacy; IPM: impact on policy making; IUP: impact on users’ practice.

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Figure 7. These figures display for all the case studies their coordinates, which result from applying the PCO algorithm and plotting the first two axes (capturing most of the variance) against each other. *Figure 7a* shows the number of criteria that get a score (“low”, “moderate” or “high”) in the development process for each case study (each case study is represented by a circle). *Figure 7b* reflects the average score of the criteria not categorised as uncertain in the development process for each case study (low=1, moderate=2, high=3). *Figure 7c* presents which case studies get an average outcome score above and below 2.6; again only for the criteria not categorised as uncertain and according to the same scale of *Figure 7b*.

Figure 8. This figure displays for all the case studies their coordinates, which result from applying the PCO algorithm and plotting the first two axes (capturing most of the variance) against each other. It tells the degree of stakeholder involvement in each case study.