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“A Context-based Procedure for Assessing Participatory Schemes in Environmental Planning”

Guy El-Karim Berthomé, Alban THOMAS

A Context-based Procedure for Assessing Participatory Schemes in Environmental Planning

Abstract

The efficiency of participatory schemes in environmental planning is an emerging research area, and many issues are not solved yet regarding the assessment of such procedures. It is essential for decision makers to identify improvement opportunities of participatory schemes. We propose an original procedure to address such issue, through a bargaining model from the signaling game literature, which accounts for participation design as well as for agents' preferences, beliefs and bargaining power. The model is calibrated using qualitative data from surveys in French local communities involved in municipal solid waste management. Model simulations are used to test for assumptions on the stakeholder dialogue and explore sensitivity of game outcomes to structural parameters. We propose a set of performance indicators to identify the most effective participatory schemes in achieving convergence in stakeholder positions regarding environmental and land-use planning.

1. Introduction

Consultation-based management initiatives have emerged over the past decades as a response to social and political factors impeding stakeholders to reach an agreement on local projects. The assessment of their performance is of growing importance for public decision makers and managers (Ansell and Gash, 2007), in particular because of the need to identify suitable resources associated with positive outcomes of such negotiations (Wolf-Powers, 2010). Providing decision makers with a scientifically sound and context-specific information adapted to their needs is therefore a critical issue. However, heterogeneity in stakeholder-dialogue cases does not facilitate the construction of a common benchmark for guiding decision makers who may not be familiar with public participatory procedures.

The efficiency issue in stakeholder dialogues has been addressed with various approaches and applications (Davoudi and Evans, 2005), with few seminal works focusing on the relative role of various factors on the outcome of stakeholder dialogues (Margerum, 2002; Beierle and

32 Cayford, 2002). Participation procedures and stakeholders' satisfaction often stand out as the
33 main drivers of success (Smith and McDonough, 2001). Nevertheless, the literature generally
34 overlooked a large number of context variables from concertation schemes, while at the same
35 time the scope of study of local negotiations became more complex (Menkel-Meadow, 2009),
36 contributing to put forward the importance of context-based aspects of the debate (Braun and
37 Schultz, 2010).

38
39 The role of such contingent, context-based components of stakeholder dialogue was addressed
40 by some authors through approaches originating from governance studies (Koontz, 2005) or
41 negotiation (Raymond, 2006). These studies contributed to shifting attention to political
42 factors (Walker and Hurley, 2004) and the participation process design (Edelenbos and Klijn,
43 2006, Ansell and Gash, 2007), and most were taken from the literature on environmental
44 management and planning. Recent empirical analyses include Ananda and Proctor (2013) on
45 collaborative approaches to water management in Australia, van Rensburg et al. (2015) on
46 wind farm planning decisions in Ireland, Skurray (2015) on institutional arrangements for
47 common-pool resource management.

48
49 A standard approach in the economic literature consists in formal representations of complex
50 relationships between players, even though relationships between the stakeholder dialogue
51 and the outcome of the participatory scheme are often difficult to predict using simple
52 mathematical representations, as acknowledged by Mathur and Skelcher (2007). In many
53 settings, environmental planning with participatory schemes cannot be reduced to a two-
54 player game with, e.g., environmentalists on one side and the industry on the other, but
55 include the *principal* as a third agent (Wolf-Powers, 2010). Motivations for introducing a
56 third agent (or player) include Chiu and Lai (2009), and Davoudi and Evans (2005) and
57 Saarikoski (2006) for a three-player game with a principal facing two opposing coalitions.
58 Moreover, the development of decentralized game models offered an extended perspective to
59 economists willing to analyze collaborative bargaining. In this literature however, the
60 relationship between agents does not always correspond to a participatory process.

61
62 In a majority of articles, the principal remains the first "active segment" facing agents with
63 private information, contrasting with the timing of consultation-based procedures. In the

64 latter, messages received by the principal may be distorted (Goltsman and Pavlov, 2008), and
65 moreover, the principal does not control the way stakeholders behave, or how they will
66 contribute (centralized or decentralized system). This justifies in particular the need to
67 characterize the principal's attitude: neutral or not, but always in reaction to stakeholders.
68 Moreover, standard negotiation models often allow for the possibility that negotiation
69 completely fails, an option the regulator or principal tries in practice to avoid at all costs in
70 local planning procedures. Indeed, stakeholder dialogue always allows for making (little)
71 progress on some technical or managerial features of the sector or process design, such as
72 valuing some new categories of municipal solid waste in our application (see below).

73
74 In participatory processes, information transmission is not really costly, there is partial
75 cooperation and always partial results from the negotiation. These limitations justify in our
76 view the use of a *cheap talk* model à la Crawford and Sobel (1982), where information is
77 transmitted between agents through ordinary, informal signals, before the final decision is
78 made. Cheap talk can be seen as a way to reach, in some circumstances, more proximity
79 between parties in a negotiation (Messer et al., 2013). In order to model the interactions
80 between agents involved in stakeholder dialogue, we consider an original approach based on a
81 signaling game, formally close to an extension of Alonso et al. (2008). It is necessary
82 however to augment this model by introducing negotiation power and familiarity among
83 players, considering a greater variety of dialogue modes. Based on this, the cheap talk
84 approach can be reinterpreted in such a way that it shares similar features with actual
85 stakeholder dialogue situations. Although the modeling strategy introduced in this paper is far
86 from sufficient for representing the complexity of agent interactions, we believe it is an
87 original methodological step in an effort to explore stakeholder dialogue effectiveness.

88
89 The complex nature of stakeholder dialogues requires a detailed characterization of agents'
90 preferences, beliefs, and other drivers of their behavior. An additional contribution of the
91 paper is therefore to present an original method to calibrate a cheap talk model, including the
92 major determinants behind negotiation objectives and outcomes, with qualitative data
93 obtained from field surveys. However, for calibration purposes, we consider not only
94 information on stated preferences collected from stakeholders, but also revealed evidence

95 gathered during negotiation by means of a survey.¹ The cheap-talk model is calibrated by
96 converting such qualitative survey data to numerical values, on each of three selected study
97 areas. Predictions from the theoretical model are then obtained by a numerical root-finding
98 algorithm. We consider as an empirical application the case of municipal solid waste
99 management in France, as an illuminating example of environmental planning where
100 stakeholder attachments are often clear cut, even incorporating a sophisticated amount of
101 expertise during the stakeholder dialogue.

102

103 A final contribution of the paper is a method of performance assessment associated with
104 stakeholder dialogue in environmental planning. Assessing the performance of participatory
105 schemes is a challenging task, and this paper does not propose a comprehensive and generic
106 method for evaluating such negotiation-based procedures. Rather, we consider only two
107 indicators of performance that are relevant to facility siting process in environmental
108 planning: the degree of convergence in the positions of opposing stakeholder groups, and the
109 intensity of capital investment achieved through dialogue. We discuss in the paper the
110 motivation for these indicators in relation with the literature on collaborative policy making.

111

112 The outline of the paper is as follows. Section 2 describes the way stakeholder dialogue is
113 typically used in environmental and land-use planning, in particular in local solid waste
114 management. We also present in this section the survey method and the study areas: three
115 French sites concerned with municipal solid waste management. The cheap talk model is
116 presented in Section 3 with its assumptions on preferences and dialogue modes, and the
117 derivation of final outcomes. In Section 4, we present the calibration exercise, and we discuss
118 the model simulation and validation checks. Section 5 concludes.

119

120 2. Stakeholder dialogue in controversial environmental planning, with an 121 application to waste management

122

123 The upgrading of public services that rely on infrastructure subject to the NIMBY (Not In My
124 Backyard) phenomenon often gives rise to difficult local negotiations (Feinerman et al.,

¹ The advantages of in-depth interviews with stakeholders are also discussed by Avci, Adaman and Özkaynak (2010).

125 2004). Because of comparable difficulties in policy making, the design of participatory
126 procedures for achieving a collective agreement is not fundamentally different for a wide
127 range of projects impacting the environment (industrial hub, landscape-modifying
128 infrastructures, transportation, tourist facility, waste management, water dam, etc.)

129

130 *The usual features of stakeholder dialogue in environmental planning*

131

132 It is interesting for local planners, when they have the opportunity of designing their own
133 procedure, to know which participatory scheme is preferable, regarding in particular the
134 probability of success. Participatory approaches at the local level correspond broadly to a
135 stakeholder dialogue, and in most developed countries a typical procedure for environmental
136 planning can be described as follows. Stakeholders are involved in a series of participatory
137 sessions (public hearing, working group, public event, open forum, etc.) during a process
138 which can take several years. In practice, the process starts with a proposal from a company
139 (public or under delegation) in charge of the facility design and/or upgrading investment.
140 Such proposal is a combination of technical, financial and management options together with
141 a size of operation, which can in principle all be opposed by (some) stakeholders.
142 Stakeholders respond with counter-proposals consisting in required modifications on some
143 components of the project design. If proposals and counter-proposals made by stakeholders
144 for facility siting or upgrading investments do not converge to a satisfactory outcome for the
145 majority of stakeholders, then this long and iterative process produces poor results. In the case
146 of a more successful outcome, then the participatory process succeeds in achieving a final
147 outcome in the form of a larger set of new management provisions, which have been subject
148 to negotiation and approval by both sides. In case of real success, the fraction of strong
149 disagreement remaining among groups is expected to be small.

150

151 Municipal solid waste is often considered an “environmental bad” (Davoudi, 2000; Feinerman
152 et al., 2004) implying political, economic and cultural aspects (Bulkeley et al., 2005; Wagner,
153 2011). It is less the choice of the management mode in itself that matters in practice, than
154 aspects of quality of life and environmental conservation, technical process safety and
155 efficiency. Management decisions for municipal solid waste are often conditional on public
156 participation procedures (Petts, 2004). As these procedures can be in practice difficult and

157 subject to major sources of conflicts (Wiedemann and Femers, 1993), it is a particularly
158 interesting sector for exploring the performance of participatory schemes implemented for
159 environmental planning.

160 In a way similar to the general procedure presented above, in the case of municipal solid
161 waste management, an operator in charge of the public service of waste collection and
162 disposal has at some point in time to upgrade the waste management system on a large area.
163 In France for example, this operator will be acting on behalf of an association of local
164 communities in a given district. In cases where the operator faces opposition from local
165 residents, and/or lacks expertise or space to deal satisfactorily with solid waste, the operator
166 can initiate a consultation procedure, opening a dialogue period among numerous
167 stakeholders.

168

169 During the stakeholder dialogue, stakeholders exchange over various aspects of the design of
170 a project. Such design has a particularly sophisticated nature, as environment-related projects
171 have typically to deal jointly with several resource flows and are characterized by various
172 intermediate stages (transformation, transportation, collection, possible marketing of co-
173 products, etc.). Moreover, besides investment in new or upgraded capital stock, management
174 options may also be modified, e.g., modified procedures for labor management and
175 supervision, expertise and capacity building. Hence, aspects related to human capital are part
176 of the project features that are relevant to the dialogue among stakeholders.

177

178 Consider for instance the main issue of dealing with the interdependencies between the
179 different flows, reclamation and treatment facilities of the waste management system, i.e.,
180 complementarities in the logistic chain. On this aspect, some stakeholders on one extreme will
181 prefer a single final treatment of waste that reduces coordination problems, while at the other
182 extreme other stakeholders will be in favor of diversification of industrial solutions, implying
183 more difficult coordination issues. On the basis of such oppositions among stakeholders,
184 groups are formed among stakeholders that will defend a project design according to
185 (presumably fairly homogeneous) internal preferences. Groups are then pushing for outcomes
186 that remain distinct, but not necessarily far apart from each other at the end of the process, if
187 successful.

188

189 Our framework seems to be more consistent with European waste management systems than
190 North America regarding waste treatment aspects. Indeed, the variety of possible disposal
191 options is much wider in European countries. According to Hoornweg and Bhada-Tata
192 (2012), sanitary landfill accounts for about 27 percent of solid waste disposal in Europe but
193 91 percent in North America, while open dump and incineration represent a significant part of
194 waste treatment in Europe but are almost nonexistent in North America. This implies that the
195 planning issue in North America is limited, in the case of solid waste treatment, to the choice
196 of a landfill site than in the European case.

197

198 *Main variables influencing stakeholder dialogue*

199

200 Whatever counter-proposals stakeholders are put forward during the process, they are always
201 related to their preferences or objectives, typically assumed stable private information in the
202 literature. We consider in this paper that both terms (preferences and objectives) are
203 equivalent, as we do not explore multiple objectives from the same economic agent.
204 Stakeholders' moderation, or on the contrary extremism, in their preferences may determine
205 whether consultation is worth trying (Krishna and Morgan, 2001; Mitusch and Strausz, 2005).
206 In the economic literature, the discrepancy between agents' objectives is the preferred
207 determinant of the poor quality of information exchange between participants to the
208 negotiation, even under incomplete information (Goltsman and Pavlov, 2008). As in any
209 negotiation with participants sharing different objectives, their messages are likely to be
210 strategically designed for the state of negotiation. Hence, during stakeholders' dialogue,
211 private information can be revealed but not necessarily verified.

212

213 Other determinants than stakeholders' own preferences or objectives are likely to play a role
214 in the building of their proposals and communication to other stakeholders. As noted by
215 Ansell and Gash (2007), the stakeholders' level of commitment to collaboration is related to
216 the motivation to participate in collaborative governance, the legitimacy of the project, or the
217 fulfilment of a legal obligation. Therefore, the shared need for negotiation to succeed may
218 explain the will of participants to reduce the difference between one's own outcome and the
219 opponent's one. The initial state of management or the lack of proper infrastructure may thus
220 imply some pressure on stakeholders to engage in a dialogue. Another factor may also be the

221 distribution of bargaining power or influence across agents engaged in negotiation, which
222 sometimes plays a more important role in the process than the difference between agents'
223 interests (Van Bommel et al., 2009).

224

225 The literature on collaborative bargaining has identified several other dimensions of
226 importance for analyzing participatory schemes beyond preferences, pressure to collaborate,
227 and bargaining power. These additional dimensions concern a) the role played by the
228 principal, e.g., environmental planner in our framework, and b) the type of relationships
229 between players in the bargaining game.

230

231 First, the principal's attitude is emphasized as a major determinant for agents to agree to
232 collaborate (Margerum, 2002; Petts, 2004; Ansell and Gash, 2007). Moreover, the position
233 granted to the principal and, more generally, whether the consultation takes place in a
234 centralized or decentralized setting, also matters (see, e.g., Bourdeaux, 2007). In this respect,
235 Suh and Wen (2009) link bargaining power with the way the game is structured. Second,
236 familiarity among stakeholders is likely to modify the outcome of a planned consultation,
237 mainly because of a more transparent bargaining environment instead of a conflict-driven one
238 (Wiedemann and Femers, 1993; Bouwen and Taillieu, 2004; Braun and Schultz, 2010).
239 However, the implementation of a more familiar interaction between agents does not prevent
240 interplay among basic factors, such as non-compatible interests or bargaining power (Lejano
241 and Ingram, 2009; Maguire and Lind, 2003), or the difficult context of a bargaining procedure
242 (Nicklin et al., 2011). Besides such other variables, familiarity between stakeholders will
243 eventually concern the volume and quality of the information shared by stakeholders (Reimer
244 and Hoffrage, 2006).

245

246 *A benchmark for relative performance of participatory schemes*

247

248 Building upon the discussion above, we consider the issue of assessing the performance of
249 participatory schemes in environmental planning, taking as observed outcome a series of
250 management decisions that has become acceptable to parties. Such outcome is based on the
251 new components of management project, upon which each group consents to at the end of the
252 dialogue, rather than obtaining at all costs decisions that are in line with their initial objective.

253 We suggest selecting as a first performance indicator the deviation from initial objectives to
254 final outcomes reached, which may be considered a form of convergence. The gap between
255 the initial objective and the outcome for each stakeholder group is an indicator of the
256 concessions made. Another indicator is the intensity of capital stock investment associated
257 with the final agreed-upon components of the management project. Performance in this case
258 is expressed as the ability for the participatory process to move away from a dead-end
259 situation (blocking in practice some components of new capital stock), precisely by reducing
260 the gap between the management provisions (or outcomes) accepted by each group. Biddle
261 and Koontz (2014) correlate the outputs from collaborative governance processes with
262 stakeholders' participation in the case of watershed-level water quality management. They
263 show that collaborative processes with stakeholder participation can provide intermediate
264 outputs of pollution reduction goals that serve as proxies of environmental outcomes.
265 Figure 1 presents the initial objectives, final outcomes and displacements for both players (B_1
266 and B_2). The gap between the final outcomes (A) defines the magnitude of unachieved
267 concessions between parties, and in a complementary way the investment in capital stock that
268 is ultimately achievable can be denoted the outcome of the process.

269

270 [FIGURE 1 ABOUT HERE]

271

272 Ultimately, these two performance indicators are originating from the need to upgrade
273 facilities in an initial situation of poor management performance. The final objective of the
274 environmental planner may be seen as the *performativity* (Callon, 2010) of a new
275 management system and its environmental rearrangement. We follow here Beierle (1999) and
276 Leach et al. (2002) who recommend as a benchmark for performance assessment the common
277 social objective arising from a critical situation (a bad initial management state). As noted
278 above, the participatory initiative may be considered a means to upgrade local management
279 capacities for solid waste. The initial issue shared by all concerns the improvement of the
280 proportion of waste taken care of (collection, diversion, treatment) by the community (within
281 a common waste management network), reducing its undesirable impacts.

282

283 We assume that the common social goal lies somewhere between extreme stakeholder
284 preferences, as some linear combination of stakeholder welfare objectives. Such social goal is

285 not identified however, because stakeholder preferences and the associated weights in the
286 social welfare function are not observed, and would require dedicated revealed or stated
287 preference elicitation procedures. Therefore, we can only consider that it is “socially
288 desirable” that stakeholder positions converge towards each other, even though the final
289 outcome may not reach a socially optimal position.

290

291 Consequently, a concerted management initiative can be considered successful not only
292 because it allows for a higher level of acceptable solutions to be possible (investment in
293 management renewal, A in Figure 1), but also because negotiation allows stakeholders to
294 partly converge towards the final outcome (stakeholder displacements B_1 and B_2 in Figure 1,
295 see Leach et al., 2002).

296

297 *The investigation method and study areas*

298

299 In order to explore the performance of consultation-based management procedures applied to
300 municipal solid waste management, it is necessary to conduct a thorough analysis of the
301 dimensions described above. Instead of considering a large sample of municipalities with cost
302 of data collection issues, we select a limited number of study areas (three sites), paying
303 attention to their differences in terms of management modes and intrinsic characteristics.
304 Some aspects of collaborative participation have to be distinct in order to identify sources of
305 management performance. However, at the same time, the study areas need to have some
306 features in common so that some homogeneity in model parameters (and/or assumptions) can
307 be expected. We first identified the list of all (26) on-going participation-based procedures for
308 municipal solid waste management in France in 2005 and 2006 (with the support of experts
309 from ADEME, the French Agency for Energy and Waste Management). Three areas were
310 selected out of this list, based on criteria such as the existence of a consultation-based
311 procedure involving several stakeholders who engage in this form of dialogue.

312

313 Study area 1 is located in the central-east region and covers several geographical areas, of
314 which only one can be considered industrial in nature. The population covered is between
315 250,000 and 300,000 inhabitants. Study area 2 is located to the south-west and is also
316 heterogeneous in terms of geographical features, from a coastal urbanized zone to the west, a

317 rural landscape to the east, and a population between 200,000 and 250,000 individuals. Study
318 area 3 is a site located to the north-west of the country and includes only coastal local
319 communities, with a population a little over 50,000 individuals at the beginning, but the
320 planning reflection subsequently extends beyond 150,000 individuals.

321

322 To explore the heterogeneity of the population in the three study areas, we collected data from
323 INSEE (French Institute for Statistics and Economic Analysis) at the district level, to match
324 the corresponding geographical areas. The population characteristics in the three study areas
325 are remarkably homogeneous in terms of annual household median income (19,903 euros,
326 18,542 euros and 18,608 euros for study area 1, 2 and 3 respectively) and income interquartile
327 range (3.95, 3.96 and 3.87 in study area 1, 2 and 3 respectively). Concerning education, the
328 proportion of adult population with a higher education degree ranges from 21.62 in area 2 to
329 22.63 in area 3, and the proportion of adults without any degree is respectively 15.63 in area
330 1, 15.50 in area 2 and 10.86 in area 3. Only population density is fairly-different across those
331 study areas, with respectively 154.65, 141.00 and 182.47 inhabitants per square km for area 1,
332 2 and 3. Therefore, the requirement that study areas should be fairly homogeneous (for
333 parameters to be assumed common) seems to be satisfied.

334

335 Our field survey consisted of two waves: first, a 6-month exploratory survey at the end of
336 2006, with direct interviews on the three study areas with local managers, scientific and
337 technical experts; second, at the end of 2008, the main field survey was conducted. It included
338 about 50 semi-direct interviews, the visit of the major treatment facilities in operation, and a
339 collection of published material related to the municipal solid waste management project in
340 the local media, over the period of the dialogue (2000-2008). This information was
341 supplemented by numerous technical reports (public or for internal use), providing us with
342 data capturing the diversity of stakeholders and of their positions involved in each study area.

343

344 In all three sites, the stakeholder dialogue runs over 6 to 7 years and shares similar stages,
345 from the creation of a waste management agency between 2000 and 2002, to the provision of
346 substantial funding of new waste facilities between 2008 and 2012. In all cases, the dialogue
347 has been initiated by an elected administrator, playing most of the time the role of the
348 principal of the game. Thanks to this quasi-ethnographical survey, we were able to distinguish

349 between two stakeholder coalitions in each study area, each defending technical and political
350 objectives (Weible, 2006). Our results on these preference points are consistent with previous
351 results in Davoudi and Evans (2005), Davoudi (2000) and Saarikoski (2006). Although the
352 stages look similar across the study area, the actual negotiation processes were fairly different
353 because of heterogeneous contexts, participatory schemes, and positions taken by
354 stakeholders.

355

356 Field surveys revealed that stakeholders have different objectives regarding

- 357 a) spatial localization of management efforts and infrastructures,
- 358 b) comparative technical performance of the solid waste management solutions,
- 359 c) management system: internal complementarities in the logistic chain and
360 interdependencies, -even outside the management area,
- 361 d) manageability of health and environmental impacts,
- 362 e) quality aspects, and more broadly the motivation to go beyond standard
363 management practices,
- 364 f) information and relations between the solid waste management agency and the
365 public,
- 366 g) financial aspects.

367

368 3. The model

369

370 There are two groups of agents, $j=1, 2$, each with *message* m_j and associated *outcome* y_j ,
371 which we normalize according to the standard cheap talk literature: $m_j, y_j \in [-1,1]$. The
372 model represents a *dialogue* as a set of agents' interactions according to a three-stage game,
373 and we make the simplifying assumption that each group is homogeneous, so that each group
374 of agents is considered a *player*. In stage 1, each player identifies its initial objective denoted
375 θ_j . In stage 2, messages $\{m_1, m_2\}$ are sent by players, either directly to the principal in the
376 centralised case, or to each other in the decentralised case. In stage 3, outcomes y_1 and y_2 are
377 observed and the game ends. The main difference between both versions of the game is that,
378 in the centralized case, the principal determines the preferable outcome $\{y_1, y_2\}$ from

379 messages $\{m_1, m_2\}$ according to her own attitude, whereas in the decentralized case, the
 380 principal leaves the coordination task to the players. In the latter case, the principal expects
 381 players to look for outcomes that are more coordinated than their initial objective $\{\theta_1, \theta_2\}$
 382 because players are concerned about welfare improvement from negotiation. In each case, one
 383 can make behavioral assumptions on the principal and/or on the players.

384

385 We assume players' preferences depend on several aspects: their "selfish" interest in seeing
 386 the outcome as close as possible to their own objective, the need for the negotiation to
 387 succeed, and the consideration for the other player. The second aspect accounts for the loss
 388 each player would incur if an agreement is not reached and the negotiation fails. Presumably,
 389 the more serious the local environmental situation, the higher the probability that players will
 390 find it ultimately necessary to make a compromise. Therefore, each player is also seeking to
 391 reduce the difference between her own outcome and the opponent's one, which is driven only
 392 by the (selfish) need for negotiation to succeed.

393

394 From these assumptions, the payoff function of payer i , $i=1, 2$, is:

$$395 \quad \pi_i = -(y_i - \theta_i)^2 - \delta(y_i - y_{-i})^2, \quad (1)$$

396 where $\delta \geq 0$. The third aspect related to the consideration for the other player translates into a
 397 weighted function of payoffs from both players being maximized. While the second
 398 component of preferences could be considered intrinsic because it refers to the gain or loss for
 399 the player in case final claims are too far apart, the third component is directly associated with
 400 some form of openness typical of concerted (or participatory) setup. More precisely, the
 401 player can be interested in seeing the other player being acknowledged for what he claims as
 402 legitimate, and then receiving a minimum payoff from dialogue, even though this will not
 403 guarantee that her own payoff will not be lower (or higher). Let λ_i denote the weight put by
 404 player i on her own payoff, with $1 - \lambda_i$ the weight on the other player's payoff, which then
 405 represents their consideration for others. Each player would finally maximize
 406 $\lambda_i \pi_i + (1 - \lambda_i) \pi_{-i}$ with respect to message m_i .

407

408 Consider now the preferences of the principal, who can be considered either neutral (in the
 409 same sense as the game-theory) or "soft", in a sense we define below. The neutral principal

410 puts equal weight on both players; he maximizes $E[\pi_1 + \pi_2 | m]$, with π_j the profit function
411 of player j and $m = \{m_1, m_2\}$. On the contrary, a “soft” principal leaves to each player the task
412 of expressing the weight or consideration the other player deserves, instead of forming an
413 objective function based on the principal’s equal consideration for both players. The soft
414 principal would then maximize $E[(1 - \lambda_2)\pi_1 + (1 - \lambda_1)\pi_2 | m]$, where $1 - \lambda_i$ is the weight or
415 consideration associated by player i with the other player case. We assume that
416 $\lambda_i > 0, i = 1, 2$, (i.e., each player has minimum consideration for the other one). It is important
417 in addition to note that it is not only the nature of the principal (neutral or not) that matters,
418 but the perception the players have on the nature of the principal regarding neutrality or not.
419 Then, there are four subcases of the centralized case to consider: i) the principal is neutral and
420 considered as such; ii) the principal is “soft” and considered as such; iii) the principal is
421 neutral but considered “soft” by both players; iv) the principal is “soft” but considered neutral
422 by both players². In each subcase, players 1 and 2 determine their best signal to send to the
423 principal, given the-perceived behavior of the principal.

424

425 Our definition of a “soft” principal contrasts with the framework of Calcott and Hutton
426 (2006), who examine the possibility that principals may be biased against projects (even
427 efficient ones), and analyze the relationship between environmental liability regime and the
428 possibility of harsher regulation in regulatory gatekeeping. They show that adopting a soft
429 liability regime does not compensate in general the regulator’s bias against projects. In
430 contrast, the principal in our framework may be neutral or soft, but only with respect to the
431 weights associated with players, as described above, and not with respect to regulation
432 enforcement as in Calcott and Hutton (2006). However, the possibility they consider of a
433 biased principal (towards some projects or stakeholders) could be an interesting extension of
434 our framework.

435

² In our model, we assume that the principal treats both players identically, even when he is “soft”, and that players perceive the principal as acting symmetrically over both players. It is also possible to consider the case of players perceiving differently the attitude of the principal (neutral or soft). Because dealing with all possible cases would complicate the analysis, we do not consider such additional case, although adapting the present model would be feasible. Instead, we deal only with the presumably more common cases, namely, that the principal is perceived identically by both players. Furthermore, as we will show below, differences in those dialogue sub-modes have a lower impact on performance as other parameters, so that it is likely that including this case would not significantly modify our results and conclusions.

436 Second, consider the decentralized case, where the nature of the principal does not matter. On
437 the contrary, it is the degree of familiarity of players regarding their opponent that matters.
438 Player j may believe that the other player has the same “perception” of the situation as himself
439 or not, depending on whether players are familiar with each other (through, e.g., previous
440 interactions and experience). If players 1 and 2 do not have reasonable knowledge of each
441 other, we assume that player 1 believes that player 2 shares with him the system of weights λ_1
442 for player 1 and $(1-\lambda_1)$ for himself. And similarly for player 2, who would believe player 1
443 to share his system of weights λ_2 and $(1-\lambda_2)$. If however, there is some degree of
444 knowledge between both players, then each player would use this information. For example,
445 player 1 would still apply weights λ_1 and $(1-\lambda_1)$, but would acknowledge the fact that player
446 2 uses the system of weights λ_2 and $(1-\lambda_2)$, and symmetrically for player 2.

447
448 Combining centralized and decentralized cases, we now deal with eight possible dialogue
449 modes: the principal is neutral/soft and perceived as neutral/soft by the players, there is
450 reciprocal familiarity/no familiarity across both players, and player 1(2) is familiar with
451 player 2(1) but player 2(1) is not with player 1(2). In all cases, player j will design his
452 message in such a way that the receiver will select the best possible outcome for player j . In
453 what follows, we will make the important (and in our opinion, realistic) assumption that each
454 player develops, in a symmetric way, an inference upon the inference the other player is
455 making. We proceed in three steps. First, we characterize the outcomes observed at the end of
456 the dialogue process, taking as given the inference adopted by players. Second, we
457 characterize the inference upon which players base their messaging strategy, i.e., the way they
458 use available information given their preferences and perceptions. Third, we solve the model
459 for optimal messages and outcomes by replacing inferences by their expression.

460

461 Details of the model solutions are presented in the Appendix.

462

463 4. Model calibration and simulation

464

465 We first discuss in this section the method used to calibrate our messaging model. Since the
466 model is based mostly on unobserved preferences, beliefs, bargaining power, willingness for
467 agreement, the way to proceed departs from usual structural econometric approaches. We use
468 in-depth qualitative surveys in the three study areas presented in Section 2, to construct proxy
469 variables for the components of the model, that is, the initial objective of player j , θ_j , the
470 weight placed by player j on himself, λ_j – thus the weight he assigns the other player $(1-\lambda_j)$ –
471 and the willingness or pressure for agreement, δ .

472

473 There are eight possible dialogue modes, depending on players' vision of the attitude of the
474 principal (centralized case) and on players' familiarity with each other (decentralized case).
475 This yields eight additional parameters if we consider the probability associated with each
476 case. In terms of outcomes, concessions $\{y_1, y_2\}$ reached at the end of the stakeholder
477 dialogue process can be considered dependent "observed variables".

478

479 The calibration of the above parameters is a major effort in the present work, which is
480 justified in our view by the complex nature of stakeholder dialogue, and by the lack of
481 empirical data from actual concerted experiences (cf. Kontoleon et al., 2002; Money and
482 Allred, 2009; French and Bayley, 2011). As pointed out by Thomson et al. (2007), the
483 performance of planning procedures can be assessed from a quantitative analysis of
484 components of the dialogue and its observed effects. The usual way of collecting information
485 on planning procedures is to conduct a direct qualitative survey of stakeholders and decision
486 makers (including possibly the public). On solid waste management issues, standard
487 techniques such as the Analytical Hierarchy Process (Strager and Rosenberger, 2006; Ananda
488 and Herath, 2008), Likert-scale questions (Thomson et al., 2007), or nonparametric test
489 procedures (Garmendia and Stagl, 2010), have been employed. Collecting information
490 directly from stakeholders can lead to strategic and cognitive biases (Watkin et al., 2012;
491 Paolisso, 2002) that can partly be controlled for by using post-survey validity-check
492 procedures (consistency ratio).

493

494 In our case however, we use interviews of individual stakeholders, but also an overview of
495 their real options and concessions in the course and at the end of negotiation (see Table 1 in

496 the Appendix for examples of data collected). As described in section 2, the calibration draws
497 on separate but related data sets (as in Masuda et al., 2008). The first data set consisted of
498 printed documents including exploitation and local planning reports, articles from local
499 newspapers, promotional material, etc., over the years 2000 to 2008. The second data set was
500 a group of interviews with all of the relevant participants, and the visit of the major solid-
501 waste treatment facilities. These data sets are then integrated into the same calibration
502 protocol, which ultimately yields the quantitative results presented in Table 2. We are
503 therefore in a position to revisit the consistency of stakeholders' engagement throughout the
504 negotiation phase. Therefore, for each variable or parameter to be quantified, we first proceed
505 to select (and order) relevant data to calibrate. We then construct a cardinal notation scale
506 which is specific to each variable or parameter, and we can assign at the end a score to each.

507

508 According to the existing literature, the discrepancy between groups' interests is a major
509 factor for explaining the success or failure of a negotiation. It is a particularly challenging to
510 quantify the collective objective of each group, and we have seen in Section 2 that this
511 variable is grounded on seven management aspects considered particularly important because
512 the most often cited in debates.

513 In Table 1 (Appendix), we illustrate the calibration method on the example of aspect c)
514 (Management system complementarities between processes, described in section 2). Table 1
515 is a significant reduction in size from the original collected data, as it only deals with a single
516 aspect (out of seven), a single study area (case 1) and only three stakeholders (out of 30) are
517 represented. A range indicator specific to aspect c) is constructed, by selecting the extreme
518 positions recorded during the negotiation phase (as in Biddle and Koontz, 2014), from one
519 extreme (a single process) to the other (multiple and simultaneous processes). These two
520 extreme indicators are then rescaled to lie between -1 and 1. It is used to locate each player on
521 the [-1, 1] scale according to his stated options during the negotiation compared to the lower
522 or upper bound of the range (column *Objective* in Table 1).

523

524 Since player objectives are expressed or observed several times and on multiple aspects (see
525 Awakul and Ogunlana, 2002), an aggregation procedure is required, based on the relative
526 importance of each of their positions. This is the purpose of column *Weight* in Table 1.
527 Weighting scales can be constructed for each stakeholder by using ordinal information from

528 the survey in order to state whether a particular aspect is equally, more or less important than
529 another for a given stakeholder (as in Li et al., 2012). For example, decisive and irreversible
530 votes have more weight than oral statements, even the more so when the latter are not
531 repeated or confirmed by subsequent actions.

532 Once preference indicators are computed for each stakeholder, we assign stakeholders to two
533 groups using a similarity procedure. We perform a parametric significance test on the
534 difference between the stated preference of a particular stakeholder and the average
535 preference indicator of his alleged group, to check for inconsistent assignment. In our three
536 study areas, solid waste industrialists and technical consultants always belong to the same
537 group (Group 1), and their location within this group is always strong. The public and elected
538 local authorities are distributed across both groups, and their location is almost never
539 “extreme”. On the other hand, environmental associations and public planning authorities turn
540 out to have a fairly “extreme” location when belonging to Group 2. Once groups are formed,
541 they are considered players in our game, as explained in Section 3.

542

543 The same way as for preferences, we also need to calibrate parameters λ_j representing the
544 considerations each player has for the other. They are quantified in a similar manner to the
545 procedure above, by constructing a range of values from salient features reported in our
546 dataset following the management process. We account for the negotiation power each player
547 is likely to have (and believes the other player has).

548

549 Another parameter to calibrate is δ , measuring the willingness of players to reach an
550 agreement. The value of this variable therefore depends on the management and policy habits
551 and arrangements prevailing on the particular site at the beginning of the dialogue. We are
552 actually calibrating exclusively the *external* pressure on players that makes them more
553 inclined to endorse the final outcome. This is the difference with the “social pressure to
554 collaborate” of Suzuki and Iwasa (2009), who include also *internal* factors (such as
555 interpersonal relationship between stakeholders). In economic terms, such pressure would be
556 interpreted as a way to offset the “coordination loss” between agents. Parameter values are
557 then discussed with and validated by communication experts who were involved in these
558 study areas (a consulting firm on cases 1 and 2 and an independent consultant on cases 1 and
559 3).

560

561 Concerning the dialogue modes, we have seen above that we can consider eight possibilities.
562 The qualitative surveys allow us to evaluate the relative frequency of every mode in the three
563 areas, each exhibiting a particular combination of these modes. The relative frequency
564 associated with each mode is distributed in a fairly homogeneous way across cases, between
565 0.07 and 0.2. From there, we can compute an expected outcome level, using as weights the
566 empirical relative frequency (rate of occurrence) of each mode. All modes may be
567 simultaneously present to form a final outcome matrix. In order to obtain a synthetic formula
568 for the final outcome, we assign to each dialogue mode $g, g=1, 2, \dots, 8$, its positive weight β_g

569 such that $\sum_{g=1}^{g=8} \beta_g = 1$. We then compute an average outcome – which corresponds to a
570 particular participatory scheme – as

$$571 \quad \sum_{g=1}^{g=8} \beta_g Y_g (\theta_1, \theta_2, \lambda_1, \lambda_2, \delta), \quad (2)$$

572 where $Y_g (\theta_1, \theta_2, \lambda_1, \lambda_2, \delta)$ denotes the theoretical solution depending on contextual
573 parameters and players' parameters in dialogue mode g .

574

575 We mentioned in Section 2 that our performance indicators for participatory schemes are the
576 reduction of the gap (“displacement”) between initial player objectives, and the level of
577 investment observed in the final outcome. As for other variables, interviews and field survey
578 data are used to quantify these two performance indicators. For the “displacement” variable,
579 we account for three components: the range of the displacement, the stakeholders' awareness
580 or lack of information about what they are giving up, and the reversibility of the displacement.
581 As far as the level of investment in solid waste management is concerned, we consider four
582 components: technical, logistic and economic capacity building; organizational,
583 administrative and legal benefits; new infrastructures or management systems allowing better
584 outlets for solid waste to be found; new projects of infrastructure or management systems
585 allowing to reach the same objective. To measure more precisely the importance of these four
586 components, we use three variables for the calibration scale: the proportion of solid waste
587 tonnage or of local managers covered, the perennial nature of this capital (following Beierle,
588 1999), and the degree of consensual dissatisfaction with the way the issue of solid waste was
589 tackled (penalty for waste export and transportation).

590

591 Table 2 presents the calibrated values of the parameters of interest, including the outcome
592 variables and the relative frequency of each of the eight situations.

593

594

[TABLE 2 ABOUT HERE]

595

596 The model provides us with two types of indicators relative to the performance of the
597 consultation game: the difference between both players' outcome level, $y_1 - y_2$, and the
598 displacement from the initial objective to the final outcome, $y_i - \theta_i, i = 1, 2$. These two
599 indicators can be compared with the calibrated outcome variables, namely, the level of
600 investment in waste treatment and management, and the level of stated stakeholders'
601 displacement (in the survey). Such comparison is used as a means to assess the ex post
602 validity of the model, i.e., by computing a measure of distance between the calibrated variable
603 from the survey, and the corresponding simulated value from the model.

604

605 *Model Simulation and Validation*

606

607 In Table 3, we report the calibrated performance indicators, to be compared with our model
608 simulations. We normalize the outcomes and model simulations by taking area 3 as a
609 benchmark for results from areas 1 and 2. More precisely, we solve the model for areas 1 and
610 2, imposing calibrated displacement and investment to equal their normalized value for area
611 3. Therefore, model validation is only feasible for the first two study areas. The difference
612 between the stated performance level and the simulated performance level from the model is
613 expressed as a proportion of the stated performance. As can be seen from Table 3, the
614 average "error" of prediction is fairly limited (less than 5 percent in all cases).

615

616

[TABLE 3 ABOUT HERE]

617

618 Finally, to have a better evaluation of the relative contribution of each parameter or variable
619 of interest in the final performance of the stakeholder dialogue, we compute the elasticity of
620 the dialogue performance with respect to each parameter or variable. To do so, we compute an

621 average performance indicator from the displacement and the investment stated outcomes,
622 and run the model with a small change (typically, 1E-8) in the parameter or variable of
623 interest, to estimate the marginal effect. Table 4 reports computed elasticities at the calibrated
624 values for the three study areas.

625

626 [TABLE 4 ABOUT HERE]

627

628 Interestingly, elasticities with respect to parameters δ , θ and β are fairly different across
629 study areas, even though their calibrated values are roughly similar, as other parameters are
630 naturally different across study areas. The parameter δ for pressure to cooperate is associated
631 with the highest elasticity on average, although it is less than the objectives parameter for area
632 1. The probability associated with the eight dialogue modes does not seem to influence
633 performance much in relative terms.

634

635 5. Discussion and conclusion

636

637 We have proposed an original model based on messaging (“cheap talk”), to investigate the
638 performance of participatory procedures on environmental and land-use planning. The
639 application deals with three French study areas involved in municipal solid waste
640 management, where stakeholders’ attitudes and objectives have been quantified from
641 qualitative surveys. The novelty of the approach is to exploit these qualitative data for
642 constructing quantitative indicators (as proxies for negotiation background and outcomes) to
643 calibrate the theoretical model of negotiation. The performance of the dialogue is evaluated
644 by considering two dimensions: the resulting level of investment for waste collection,
645 diversion, treatment, and the displacement of stakeholders from their initial objectives to the
646 acceptance of the final outcome.

647 Comparing the observed outcomes from qualitative surveys with simulated outcomes from
648 our model, the latter performs well in terms of reproducing the negotiation outcomes. The
649 model could therefore be of interest for testing the performance of participatory schemes for
650 land use projects impacting the environment in other contexts. However, it should not be

651 considered a tool for predicting outcomes of future negotiation procedures, because of the
652 required ex post calibration of variables and parameters of interest.

653

654 In terms of the economics of public participation, this analysis is providing us with
655 interesting evidence. Concerning the performance of stakeholder dialogue in environmental
656 planning, it is not sufficient to rely on technical expertise or communication experts (policy
657 options regularly put forward in practice, see Braun et Schultz, 2010). Agents' perceptions
658 and their bargaining power are also factors to consider. The discrepancy between agents'
659 initial objectives remains a major critical factor, consistent with insight from the economic
660 literature. In contrast, with little emphasis in the economic literature, the willingness to reach
661 an agreement, related to local previous critical conditions, proves to be another major driver
662 of a successful negotiation.

663

664 A contribution of the present paper is to illustrate how economic modelling can contribute to
665 assess productivity of stakeholder dialogue and negotiation with numerous factors. We
666 believe it is an interesting complement to several papers dealing with noxious facility siting.
667 Feinerman et al. (2004) propose a framework for analyzing differences between political
668 siting and socially optimal locations for landfill. They test in particular whether NIMBY
669 conflicts can be resolved by democratic political processes where the principal's utility
670 depends on social welfare and political rewards. As our paper focuses on the performance of
671 stakeholder dialogue in participatory schemes with a calibration exercise that extends beyond
672 residential households as stakeholders, it could provide an interesting extension of Feinerman
673 et al. (2004). This is also true of Swallow et al. (1992), who propose a general and practical
674 approach (without empirical application) to the public-choice problem of noxious facility
675 siting, by decomposing the site selection process in three stages (minimum technical
676 standards, social selection criteria, and community acceptance). However, these authors are
677 interested in the role of observed criteria characterizing the three stages above and not in the
678 assessment of participatory schemes.

679 Lejano and Davos (2002) propose a theoretical framework to incorporate equity principles
680 into the optimal siting decision process, with an application of bargaining games to an
681 incinerator siting. In their model, utility transfers are not feasible and the optima location is
682 entirely determined from estimates of (cancer) risk for various possible sites. Environmental

683 and health risk preferences and perceptions by stakeholders is in fact one (out of seven) aspect
684 that we consider in the present paper. The way Lejano and Davos (2002) address the risk and
685 utility issue is however more detailed than ours. Lami and Abastante (2014) focus also
686 exclusively on the choice of waste treatment technology (neither sorting nor prevention of
687 waste emission), and they explore more deeply the issue of benefits and costs for the
688 stakeholders. Finally, Santore (2014) examine in a theoretical paper the *ex ante* efficiency of
689 noxious facility siting when communities have heterogeneous preferences over income. They
690 show that simple lotteries (without host compensation) may be preferred to determine the
691 community where the noxious facility will be sited. Such analysis is at the community level
692 and does not include stakeholder dialogue and a participatory scheme, as it is more interested
693 in efficiency arguments for the decision maker, in a top-down decision perspective.

694

695 The set of papers above mostly consider top-down policies and centralized compensation
696 schemes, and as the present paper shows, there is room for stakeholder dialogue as a
697 complementary policy. This paper contributes to the literature on the economics of
698 stakeholder dialogue by confirming the usefulness of cheap talk models, which have been
699 recognized to be potentially useful for analyzing private negotiations and public policy
700 decision at a general level (Farrell and Rabin, 1996). They stand out as potentially promising
701 in an intermediary space: for analyzing the political economy of highlights in local
702 environmental planning.

703

704

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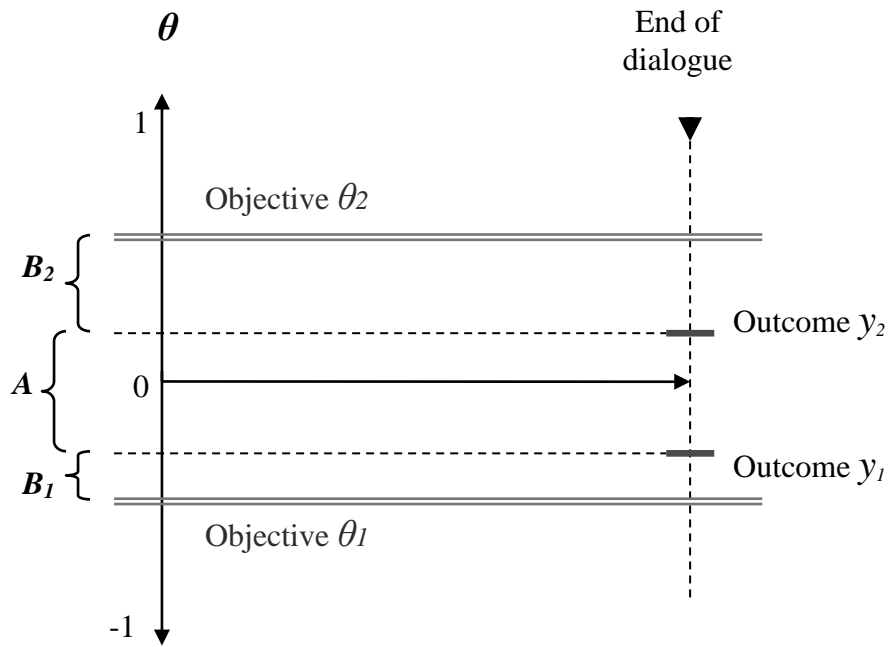
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930 Figure 1. Initial objectives, outcomes and displacements

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953 Table 2. Calibrated parameters – Cheap talk model

Parameter / Variable	Area 1	Area 2	Area 3
Pressure to co-operate (δ)	0.31	0.10	0.19
Objective of Player 1 (θ_1)	- 0.25	- 0.24	- 0.26
Objective of Player 2 (θ_2)	0.26	0.22	0.32
Weight associated with Player 1 by himself (λ_1)	0.64	0.72	0.59
Weight associated with Player 2 by himself (λ_2)	0.53	0.42	0.52
Outcome 2: Displacement with respect to initial objective	1.125	0.5875	1
Outcome 1: Level of new capital stock investments in solid waste management	1.375	0.833	1
Relative frequencies			
a. Principal neutral and perceived as such	0.13	0.217	0.166
b. Principal neutral but perceived as soft	0.115	0.102	0.104
c. Principal soft but perceived as neutral	0.085	0.104	0.095
d. Principal soft and perceived as such	0.18	0.137	0.125
Centralized case (a. to d.)	0.51	0.56	0.49
e. Familiar players	0.121	0.097	0.133
f. Non familiar players	0.142	0.158	0.13
g. Player 1 familiar with Player 2, but not the reverse	0.1	0.066	0.13
h. Player 2 familiar with Player 1, but not the reverse	0.127	0.119	0.117
Decentralized case (e. to h.)	0.49	0.44	0.51

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Table 3. Observed and Simulated Performance Indicators

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	Study area1	Study area 2	Study area 3
Calibrated displacement	1.125	0.5875	1
Calibrated investment	1.375	0.833	1
Calibrated displacement (area 3 as benchmark)	0.278	0.1265	0.253
Calibrated investment (area 3 as benchmark)	0.232	0.3335	0.327
Simulated displacement from model	0.274	0.1325	0.253
(prediction error in %)	(1.44 %)	(4.74 %)	(---)
Simulated investment from model	0.236	0.3275	0.327
(prediction error in %)	(1.7 %)	(1.8 %)	(---)

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963 Table 4. Elasticity of Dialogue Performance

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Parameter / Variable	Area 1	Area 2	Area 3
Pressure to co-operate (δ)	0.383	0.905	0.697
Objective of Player 1 (θ_1)	0.487	0.718	0.577
Objective of Player 2 (θ_2)	0.443	0.704	0.552
Weight associated with Player 1 (λ_1)	0.116	0.018	0.078
Weight associated with Player 2 (λ_2)	0.081	0.113	0.066
β_1 Principal neutral and perceived as such	0.019	0.013	0.018
β_2 Principal neutral but perceived as soft	0.016	0.017	0.018
β_3 Principal soft but perceived as neutral	0.016	0.002	0.016
β_4 Principal soft and perceived as such	0.036	0.004	0.046
β_5 Familiar players	0.050	0.036	0.031
β_6 Non familiar players	0.039	0.018	0.026
β_7 Only Player 1 familiar with Player 2	0.009	0.020	0.003
β_8 Only Player 2 familiar with Player 1	0.007	0.005	0.002

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967 **Appendix**

968 **Details of the cheap-talk model solutions**

969

970 *Final stage: outcomes*

971 In the centralized case, the principal receives the set of messages from players $m \equiv (m_1, m_2)$
 972 and makes decisions that depend on the principal's inference upon players' objectives θ_1 and
 973 θ_2 , given m . If the principal is neutral (denoted n), outcome is, for player $j, j= 1, 2$:

974
$$y_j^{cn} = \frac{1+2\delta}{1+4\delta} E[\theta_j | m] + \frac{2\delta}{1+4\delta} E[\theta_{-j} | m], \quad (\text{A1})$$

975 where $-j = 3-j$.

976 If the principal is soft (denoted b), we have:

977
$$y_j^{cb} = \frac{A + \delta B_1}{A + 4\delta C} E[\theta_j | m] + \frac{\delta B_2}{A + 4\delta C} E[\theta_{-j} | m], \quad j = 1, 2; -j = 3 - j, \quad (\text{A2})$$

978 where

979
$$A = (1 - \lambda_1 - \lambda_2 + \lambda_1 \lambda_2), B_1 = (2 - \lambda_1 - 3\lambda_2 + \lambda_1 \lambda_2 + \lambda_2^2), B_2 = (2 - \lambda_2 - 3\lambda_1 + \lambda_1 \lambda_2 + \lambda_1^2)$$

980 and
$$C = \left(1 - \lambda_1 - \lambda_2 + \frac{\lambda_1 \lambda_2}{2} + \frac{\lambda_1^2}{4} + \frac{\lambda_2^2}{4} \right).$$

981

982 In the decentralized case, each player designs his own message in such a way that negotiation
 983 can be ultimately to his advantage. Let y_j^D denote a just about acceptable outcome for player
 984 j from his point of view, adjusted with respect to all messages exchanged during the dialogue.
 985 However, y_j^D is not a beneficial public claim for player j during the cheap talk game. Each
 986 player j then opts to select another arguable claim or outcome, denoted y_j^{Prime} . We have

987
$$y_j^{\text{Prime}} = \frac{\lambda_j}{\lambda_j + \delta} \theta_j + \frac{\delta}{\lambda_j + \delta} E[y_{-j} | \theta_j, m], j = 1, 2; -j = 3 - j. \quad (\text{A3})$$

988

989 We can see that players account in their proposition $y_j^{\text{Prime}}, j=1,2$, for the possible
 990 proposition they think the other player can submit to the principal: $E[y_j | \theta_{-j}, m]$.

991 According to the assumption on symmetric inference discussed above, player 1 for example
 992 has to infer two components when considering $E[y_2 | \theta_1, m]$: $E[\theta_2 | \theta_1, m]$ and what player
 993 2 would infer for $E[y_1 | \theta_2, m]$. Using expressions above, player 1 selects

994

$$995 \quad y_j^D = \frac{\lambda_j}{\lambda_j + \delta} \theta_j + \frac{\delta}{(\lambda_j + \delta)(\lambda_1 \delta + \lambda_2 \delta + \lambda_1 \lambda_2)} \left[\delta \lambda_j E[\theta_j | \theta_{-j}, m] + (\lambda_j + \delta) \lambda_{-j} E[\theta_{-j} | \theta_j, m] \right],$$

$j = 1, 2; -j = 3 - j.$

996 (A4)

997 Such formulae are valid when players have a reasonable degree of familiarity with each other
 998 (case Φ). On the other hand, when a player does not account for the consideration perceived
 999 by the other player (case of no familiarity Γ), we have for player j , $\lambda_i \equiv (1 - \lambda_j)$. Player j then
 1000 uses this expression both in y_j^D and y_i^D , to obtain an outcome for himself noted $y_j^{D\Gamma}$, and
 1001 another for the other player noted $y_i^{\check{D}\Gamma}$.

1002

1003 *Intermediate stage: messages and inferences*

1004 Let us now characterize the way players determine the message they will use in the dialogue.
 1005 During the messaging with the principal or between players, expectations are formed on the
 1006 player's objective, conditioned on the messages (and in the decentralized case, on the value of
 1007 their own preference in addition).

1008

1009 In the centralized case, player 1 moves in such a way that the principal's inference regarding

1010 θ_1 ($E[\theta_1 | m] = \zeta_1$) is best for player 1:

$$1011 \quad \zeta_1^* = \arg \max_{\zeta_1} E \left[-\lambda_1 (y_1 - \theta_1)^2 - (1 - \lambda_1) (y_2 - \theta_2)^2 - \delta (y_1 - y_2)^2 \mid \theta_1 \right], \quad (A5)$$

1012 where $y_1 = y_1^C$ and $y_2 = y_2^C$. Player 2 acts in a symmetric way.

1013 If players believe the principal is neutral, player 1 will orient the principal towards an
 1014 inference ζ_1^n on $E[\theta_1 | m]$ such that:

1015
$$\zeta_1^{n*} = \frac{W_1^n}{1 - Z_1^n Z_2^n} \theta_1 + \frac{Z_1^n W_2^n}{1 - Z_1^n Z_2^n} \theta_2, \quad (\text{A6})$$

1016 and similarly for player 2, where

1017
$$W_j^n = \frac{\lambda_j(1 + 2\delta)}{(\lambda_j + \delta)} \text{ and } Z_j^n = \frac{\delta(1 - 2\lambda_j)}{(\lambda_j + \delta)} = 1 - W_j^n.$$

1018 When players believe the principal is soft, player j will drive the principal towards inference

1019 ζ_j^b on $E[\theta_j | m]$:

1020
$$\zeta_j^{b*} = \frac{W_j^b}{1 - Z_i^b Z_j^b} \theta_j + \frac{Z_j^b W_i^b}{1 - Z_i^b Z_j^b} \theta_i, \quad (\text{A7})$$

1021 with

1022
$$W_j^b = \frac{\lambda_j(A + \delta B)(A + 4\delta C)}{\delta[(A + \delta B) - (\delta D)]^2 + \lambda_j(A + \delta B)^2 + (1 - \lambda_j)(\delta D)^2} \quad (\text{A8})$$

1023 and

1024
$$Z_j^b = \frac{\delta[(A + \delta B) - (\delta D)]^2 + [(1 - \lambda_j)(A + 4\delta C) - (A + \delta B)](\delta D)}{\delta[(A + \delta B) - (\delta D)]^2 + \lambda_j(A + \delta B)^2 + (1 - \lambda_j)(\delta D)^2} = 1 - W_j^b. \quad (\text{A9})$$

1025 In the decentralized case, when player j is familiar with the other player i , he will send the
1026 following inference:

1027
$$\zeta_j^{\Phi*} = \frac{W_j^\Phi}{1 - Z_i^\Phi Z_j^\Phi} \theta_j + \frac{Z_j^\Phi W_i^\Phi}{1 - Z_i^\Phi Z_j^\Phi} \theta_i, \quad (\text{A10})$$

1028 where
$$W_j^\Phi = \frac{(\lambda_j \delta + \lambda_i \delta + \lambda_i \lambda_j)}{(\lambda_j - \lambda_j^2 + \delta)} \text{ and } Z_j^\Phi = 1 - \frac{(\lambda_j \delta + \lambda_i \delta + \lambda_i \lambda_j)}{(\lambda_j - \lambda_j^2 + \delta)} = 1 - W_j^\Phi.$$

1029

1030 On the other hand, when player j is not familiar with player i , we simply have $W_j^\Gamma = 1$ and

1031 $Z_j^\Gamma = 1 - W_j^\Gamma$. Finally, combining the formulae for outcomes y_j^* with those for inferences

1032 ζ_j^* , we can compute the final outcomes corresponding to the eight possible dialogue modes.

1033 **Appendix.**

1034 **Table 1. Example of objectives' calibration: study area 1, debate on aspect c),**
 1035 **stakeholders 1, 20 & 27.**

1036

Aspect under discussion	c) Management system: internal complementarities in the logistic chain and interdependencies	Values	
	<i>Extreme case. Reduce coordination and complementarity issues in the management system, thanks to a single direct process leading to a single final solid waste treatment</i>	Limit: -1	
Scale for positioning objectives	Single process Several processes: one is leading and the others are secondary Two processes or more, but several processes possibly to discard Two processes or more, but one process possibly to discard Combined but prioritized processes Combined but not prioritized processes Maximum diversification of processes	<i>Interval:</i> [-1, -0.75] [-0.75, -0.45] [-0.45, -0.15] [-0.15, 0.15] [0.15, 0.45] [0.45, 0.75] [0.75, 1]	
	<i>Extreme case. Invest in a deep diversification of waste treatment and reclamation processes, requiring a major effort on coordination and complementarity between the various waste volumes and facilities</i>	Limit: 1	
Stakeholders	<i>Major information in the data set</i>	<i>Objective</i>	<i>Weight</i>
#1	<p><i>November 2006.</i> For Mr. X., the plan at the end of year 2006, labeled “all incineration” remains satisfactory”, he votes in favor (Regional media, November 14, 2006).</p> <p><i>November 2006.</i> Mr. Y in local community Y (less involved than Mr. X in the intercommunal association) claims: “We need to find a site for waste incineration and I do not believe in agricultural spreading”, but he will vote in favor (Intercommunal association committee, November 2006).</p> <p><i>Over the whole negotiation period.</i> Mr X challenges the claim that every possible evaluation study has been conducted for the siting of an incinerator. He also repeatedly questions the quality of the compost obtained from mechanical biological treatment. <i>During the interview:</i> “This plan is definitely not better than the one before. I don’t think methanization will work”.</p>	-0.85 -0.7 -0.9 Weighted average -0.82	0.65 0.55 0.5 Total weight 1.70
#20	“The committee of inquiry issues a positive opinion, provided the future of site		

	<p>Z is mentioned in the plan, following the achievement of the objectives below: A single waste treatment and storage area for the intercommunal association of case 1”, or: “As many mechanical-biological waste treatment facilities as there are storage sites» (<i>Public Inquiry p. 220 and p. of Conclusions, September 14, 2007</i>).</p> <p><i>Public investigators mention an additional process: the “reversible storage of solid waste waiting to be treated” (Public Inquiry p. 7 of Conclusions, September 14, 2007).</i></p>	0	0.75
		0.2	0.1
		Weighted average 0.02	Total weight 0.85
#27	<p><i>Beginning of period.</i> The mere creation of the intercommunal waste agency in study area 1 would demonstrate, according to ecologist elected representatives [Mr A and Mrs. B], “the willingness to set up an incinerator (...), but since it would need to be fueled with solid waste, it will not be possible to sort them in order to reduce their volume”. Ecologist representatives ask for an “objective” study of the intercommunal waste agency in study area 1 that would explore thoroughly all solutions for solid waste treatment (<i>Regional press media, December 2, 2002</i>).</p> <p><i>Beginning of period.</i> « They propose as an alternative to waste incineration the development of waste sorting, methanization and landfills » (<i>Regional media, December 2, 2002</i>).</p> <p><i>July 2003.</i> Mrs. C is convinced by the methanization process: “Stabilisation is interesting because it reduces the volume of solid waste, but it does not allow for recycling, while there is a huge deficit of organic matters in the soil” (<i>Regional media, July 2003</i>).</p> <p><i>January 2007.</i> <i>Web page of the Green Party (ecologists) of the county:</i> the intended plan seems to diverge from the orientations of the intercommunal waste agency in study area 1. Mrs. B for the Green Party focuses her criticisms on the poor ambitions in terms of prevention and reduction of solid waste upstream, and on the fact that a recycling-based energy project is likely to be abandoned.</p>	0.35	0.45
		0.15	0.2
		0.2	0.35
		Weighted average 0.26	Total weight 1

1037