

1 **Effective risk governance for environmental policy making: A knowledge management**
2 **perspective**

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11 **Abstract**

12 Effective risk management within environmental policy making requires knowledge on
13 natural, economic and social systems to be integrated; knowledge characterised by
14 complexity, uncertainty and ambiguity. We describe a case study in a (UK) central
15 government department exploring how risk governance supports and hinders this challenging
16 integration of knowledge. Forty-five semi-structured interviews were completed over a two
17 year period. We found that lateral knowledge transfer between teams working on different
18 policy areas was widely viewed as a key source of knowledge. However, the process of
19 lateral knowledge transfer was predominantly informal and unsupported by risk governance
20 structures. We argue this made decision quality vulnerable to a loss of knowledge through
21 staff turnover, and time and resource pressures. Our conclusion is that the predominant form
22 of risk governance framework, with its focus on centralised decision-making and vertical
23 knowledge transfer is insufficient to support risk-based, environmental policy making. We
24 discuss how risk governance can better support environmental policy makers through
25 systematic knowledge management practices.

26

27 **Keywords:** environmental policy; risk; enterprise risk management; knowledge management.

28

29 **1. Introduction**

30 Environmental policy-making is increasingly risk- and evidence -informed across the
31 European Union’s Member States and in Canada, Australia and the US (Holmes and Clark,
32 2008; Likens, 2010). Further, the move towards participatory policy-making that involves a
33 wider range of stakeholders from an early stage is building momentum (Klinke and Renn,
34 2012; Stern and Fineberg, 1996). In the UK policy context, it is explicitly stated that risk
35 relevant knowledge not only resides in scientific data, but in the “*in the minds of front line*
36 *staff in departments, agencies and local authorities and those to whom the policy is directed*”
37 (Cabinet Office, 1999). As a result, environmental policy making increasingly involves
38 integration of knowledge (Figure 1) of a wide range of types (Alavi and Leidner, 2001) and
39 from a wide range of sources (Prpich et al., 2011) that may be highly technical, value laden,
40 ambiguous and/or contradictory (Gregory et al. 2006; Klinke and Renn, 2002; Tribbia and
41 Moser, 2008).

42

43 [Please insert Figure 1 here]

44

45 For example, developing policy to manage flood risk requires knowledge of the effect
46 of anthropogenic climate change and land use developments on river discharge, economic
47 and demographic developments in river corridors and changing societal views on safety and
48 the importance of natural and cultural landscape values (Collins et al., 2007; Hooijer et al.,
49 2004). This required integration of knowledge from multiple disciplines, experts,
50 organisations, industry groups and actors within civil society is not a one off exercise but
51 rather part of a continuous knowledge acquisition process (Strutt et al., 2006) to manage
52 dynamic and emerging risks (Walker et al., 2003; Wahlin and Grimvall, 2008).

53 The challenge for environmental risk governance is the daunting task of acquiring,
54 coordinating, analysing and utilising this knowledge base to inform risk management and
55 support organisational learning (Figure 1). This requires appropriate risk governance
56 structures and practices (Klinke and Renn, 2010). Risk governance is defined as the
57 organisational components (such as processes and policies) that support and sustain risk
58 management activities (such as risk identification and assessment) (ISO 3100). Many risk
59 governance framework used in the public sector are based on Enterprise risk management
60 (ERM) frameworks (for example, COSO, 2004). ERM principles underpin public sector risk
61 governance in Canada, Australia, the US (Victorian Auditor-General's Office, 2007; AON,
62 2011; Province of British Columbia, 2012; Hardy, 2010) and the UK (HM Treasury, 2004).
63 Key features of ERM are its emphasis on strategic decisions (Figure 2) and internal control
64 (Arena et al., 2010).

65

66 [Please insert Figure 2 here]

67

68 The risk governance of ERM frameworks are characterised by formal and vertical knowledge
69 transfer and aggregations that we are concerned may be inadequate for the scope and
70 complexity of knowledge required to develop effective environmental policy. Enterprise Risk
71 Management frameworks require that risk knowledge is made explicit through systematic
72 risk assessment and aggregated through formal risk reporting (COSO, 2004). Aggregated
73 risk knowledge, typically presented as qualitative or semi-qualitative information in risk
74 registers and matrixes, informs debates about risk appetite and risk management strategy at
75 Board and senior management levels which are then disseminated through the chain of
76 command (COSO, 2004). This emphasis on vertical transfer and aggregation of risk

77 knowledge and the top-down communication of risk appetite and risk ownership appears to
78 ignore the flow of knowledge at tactical, project and operational levels (Figure 2).

79 Given our research interest in how knowledge is utilised in the development of
80 environmental policy relating to environmental risks, we conducted this study to examine the
81 relationships between risk knowledge and policy design in the context of an environmental
82 risk governance framework. Our research aim was to examine the efficacy of knowledge
83 management practices supporting the integration of risk knowledge into environmental policy
84 and identify opportunities for improvement. Here integration is defined as the processes and
85 practices used to coordinate decision making involving multiple actors and groups that may
86 have different knowledge, expertise and perceptions relevant to the decision (Tsai, 2002).
87 Our objectives were to (i) access policy teams taking these decisions; (ii) describe sources of
88 knowledge used to inform their decisions; (iii) reference our findings to risk governance
89 systems and theoretical understandings of risk and knowledge management capability.

90 *1.1 Case description*

91 The case study was selected as a good example of a government department developing
92 policy to manage complex environmental risks in the context of significant stakeholder
93 participation, top-down targets and state role back (Goldsmith and Eggers 2004; Klinke and
94 Renn 2010). These challenges are not unique to the UK or this case study department. They
95 have wide international significance for environment ministries that manage complex policy
96 portfolios and risks of widely diverging character (Prpich et al., 2011) with a need to share
97 costs and risk management accountabilities with a broader range of regulatees and civil
98 society (Bevir et al., 2003). Among the responsibilities of the case study department is
99 developing policy relating to risks to the natural environment. This includes risks to
100 biodiversity and ecosystem health caused by hazards such as exotic animal disease, industrial
101 pollution, anthropogenic climate change and emerging risks such as nanotechnology. The

102 case study department has implemented a risk governance system adopting official UK
103 guidelines based on ERM principles (HM Treasury, 2004).

104

105 **2. Methods**

106 We employed a qualitative case study methodology (Locke, 2001; Yin, 2008) well suited to
107 in-depth, inductive investigation of the factors informing decisions in organisations, including
108 relevant institutional and cultural factors (Yanow, 2000; Lounsbury, 2008). The risk-based
109 decisions of policy teams within the case study department formed the unit of analysis (Yin,
110 2008).

111 Semi structured interviews (n = 45) were conducted between August 2009 and March
112 2011. Interviews lasted one hour, were conducted one-to-one in private, with participants'
113 identities kept anonymous in data analysis and use. Interviews were in two tranches to obtain
114 an overview of risk and knowledge management across the department (tranche one) and
115 then a detailed analysis of the sources of knowledge used by policy makers at a project and
116 operational level (tranche two). Tranche one interviews (n = 23) captured a sample of
117 individuals across a range of functional groups and hierarchical levels, including specialist
118 advisors to policy teams. Tranche two interviews (n = 22) focused on eight policy teams that
119 had not been involved in tranche one. Recognising the constraints of the small sample size
120 (Denscombe, 2007) policy teams were selected to be as representative of the department as
121 possible. They included small and large teams; teams working on new and extant policy
122 areas; and teams working on high and lesser profile policies. Each policy team leader and
123 one to three subordinates (depending on team size which ranged from three to over ten) were
124 interviewed. Interview questions were developed through analysis of the departments risk
125 policy and governance documents in coordination with the department's chief risk officer.

126 Qualitative codes (Bazeley, 2007) were developed using a grounded theory approach
127 (Locke, 2001) and computer-assisted qualitative data analysis (CAQDAS) software (NVivo
128 9TM; Figure 3). Interview transcripts were analysed using the following questions ‘what
129 knowledge is being used to inform risk behaviour?’; ‘In what context is the knowledge
130 informing risk behaviour?’ and ‘what factors are affecting use of knowledge to inform risk
131 behaviour? Codes were interpreted employing relevant theory (Kelle, 2005). Credibility of
132 data was established by triangulation between data sources, peer review and member
133 checking (Yin, 2008; O’Leary, 2010). Following triangulation logic, only codes supported
134 by multiple sources were used in the final analysis. To enable peer review, researchers FS,
135 CM and MS coded the data independently before comparing and establishing final codes.
136 Codes and results were refined through critical reflection by the case study department’s
137 chief risk officer and all interviewees given the chance to review the results.

138

139 [Please insert Figure 3 here]

140

141 **3. Results**

142 **3.1 *Risk-based decisions observed***

143 Policy teams were responsible for risk-based decisions at project and operational levels and
144 for informing risk-based decisions at programme and strategic levels (Figure 2). Policy
145 teams typically comprise two to ten individuals led by a middle-ranking civil servant not
146 reporting directly to the board. Each team was responsible for one stream of work within a
147 policy area overseen by a senior civil servant (senior responsible owner) reporting directly to
148 the board. Integration of risk into policy development at all levels was codified in the

149 department's 'policy cycle' (Figure 4) which identified the appropriate risk management
150 activities at each stage of policy-making.

151

152 [Please insert Figure 4 here]

153

154 The following risk management activities were delegated to policy teams: identifying
155 and assessing environmental risks associated with policies; developing and presenting options
156 to manage policy risks to senior decision makers; identifying and managing delivery risks
157 and evaluating the efficacy of the risk management of delivered policies. Examples of
158 hazards causing environmental risk assessed by policy teams interviewed include: exotic
159 animal disease; nitrates (impacting water quality) and greenhouse gas emissions. Delivery
160 risks are defined as risks to the successful implementation of chosen policy options; for
161 example, risks relating to the ability to deliver project goals; delivery bodies' (e.g.
162 regulators') capabilities to implement policy; and secondary risks such as public and media
163 responses to policies.

164 **3.2 *Lateral knowledge transfer and culture of collaboration***

165 Common across the majority of policy teams interviewed, colleagues working in other policy
166 teams were viewed as an important source of knowledge. This manifested as a pervasive
167 'culture of collaboration' that placed normative pressure on policy makers to utilise the
168 knowledge of peers and stakeholders in policy-making (Table 1, code: Culture of
169 collaboration). This lateral knowledge transfer between policy teams did not take place
170 through formal mechanisms but was informally encouraged through the widely held espoused
171 value (Schein, 1986) portraying an inclusive, collaborative approach to risk management as
172 desirable:

173 *“There is expertise and you know if you don’t use it then it’s silly. And you are required to*
174 *bring the experts on board. Even to the extent where you’re encouraged if someone else has*
175 *done something very similar to you go and have a chat with them, see what problems arose.”*

176

177 [Please insert Table 1 here]

178

179 In addition to this culture of collaboration, and serving their designed purpose of aggregating
180 knowledge for senior decision makers, we observed that risk registers and the process of
181 maintaining them also facilitated knowledge transfer within policy teams (Table 1, code: risk
182 registers and team communication). Risk registers achieved this by requiring policy makers
183 to make their knowledge of risks explicit and visible to others. Participants described
184 increased participation within teams due to risk knowledge being made more explicit:

185 *“We have a nice up to date risk register. So we’ve got the benefit of the entire team being*
186 *aware of these risks, being able to update from their various areas, and to keep an eye on*
187 *these risks. Whereas if you have a less well organised system you’re essentially relying on*
188 *possibly just the one individual, presumably a bit higher up, who’ll be aware of it and is*
189 *keeping an eye on things.”*

190 However, only seven of the twelve teams interviewed used a risk register.

191 **3.3 Observed use of knowledge**

192 The most widely used source of knowledge informing the risk-based decisions of policy team
193 members was individual experience (Table 2, code: individual experience).

194

195 [Please insert Table 2 here]

196

197 Other sources of knowledge included; external stakeholders, other policy teams, specialist
198 advisors (called evidence colleagues) and delivery bodies (Table 2). External stakeholders
199 included: civil society groups, regulated industries, NGOs, pressure groups, media and any
200 affected parties. Communication between policy teams was predominantly informal (Table
201 2, code: informal communication between policy teams). Communication with external
202 stakeholders was formal and informal (Table 2) and often complex, involving negotiation,
203 conflict resolution, and issue formulation, as illustrated:

204 *“We've been having two, three meetings in the past month and every month the [regulated*
205 *industry representative] don't agree, or somebody else doesn't agree with the findings that*
206 *the [delivery body] have come up with. So at the last meeting we invited an expert in [XXXX].*
207 *And [regulated industry representative] are perfectly happy because he suggested 'Let's go*
208 *back and let's find out if it's 1 milligram or 2 milligram'. So to find solutions we do involve*
209 *other people who need to be at the meeting. We call them in.”*

210 The importance of communication with stakeholders in this case study is illustrated by one
211 policy, developed by the department that arguably failed due to insufficient communication
212 with key stakeholders during the policy's development. The inadequacy of efforts to consult
213 with stakeholders during policy formulation was made apparent by the surprised response of
214 key stakeholders and the public when the policy was formally announced. Tellingly, the
215 consultation and impact assessment were published four months after the policy was
216 announced. Subsequent protest from non-governmental organisations, faith leaders and
217 newly founded single issue groups made effective use of social media to mobilise widespread
218 condemnation of the policy. Indicative of the lack of communication between those

219 developing the policy and stakeholders, government advisors reported being shocked at
220 stakeholders' negative response. As one senior government advisor was quoted as saying:

221 *"I were so enamoured of this idea across the board. I love that kind of thinking ... it blinded*
222 *us to the political implications."*

223 Following the negative stakeholder reaction, support for the policy, which had previously
224 been high among senior officials, dwindled and the policy was abandoned. The highly public
225 nature of the failed policy caused reputational damage to the department and those involved.

226 The department did have formal processes to facilitate knowledge transfer beyond
227 vertical risk reporting, such as monthly open discussions chaired by a senior civil servant
228 where risk issues could be raised outside of formal reporting channels, incorporating the
229 widespread availability of internal consultants specialising in economics, legal and social
230 affairs. The department had made considerable progress in defining how risk management
231 should contribute to its policy making cycle (Figure 4) and followed best practice in
232 providing risk management guidance on its intranet and training. However, training, best
233 practice and guidance did not appear to be widely used among participants (Table 2). In
234 particular, given the important of *lateral* knowledge transfer reported, it is significant that
235 formal mechanisms for lateral knowledge transfer between teams, such as written reports of
236 lessons learned, were viewed as important by only five (out of 45) interviewees (Table 2,
237 code: codified lessons learned).

238 **3.4 Factors limiting knowledge transfer**

239 The most widely reported factor limiting knowledge available for risk-based decisions was a
240 lack of formal processes and mechanisms to capture and disseminate knowledge, particularly
241 the knowledge of employees when they changed roles or left the organisations (Table 3,
242 codes: lack of knowledge retention).

243

244 [Please insert Table 3 here]

245

246 Related to a lack of knowledge retention was a paucity of formal processes to transfer
247 knowledge between policy teams (Table 3, code: lack of formal knowledge sharing). As a
248 result, the context-specific knowledge of risks in a policy area, such as in-depth knowledge of
249 how best to engage with key stakeholders, was felt to be particularly prone to being lost
250 through staff turnover:

251 *“The corporate memory seems to consist of people working there currently and how long*
252 *they’ve been there, rather than actually, you know, further back, and learning from other*
253 *policy areas I wouldn’t say happens much at all, certainly not at my level.”*

254 This problem was seen to be accentuated by the relatively rapid rotation of staff between
255 roles:

256 *“We’re moving away from the situation where people got to know their subject areas and*
257 *were familiar with them, to a culture where we’re going to dip in and out of projects much*
258 *more frequently. So there’s a big risk as people move from one project to another, you don’t*
259 *actually capture the experience they gain, before they move on.”*

260 Participants reported that lack of resources limited their ability to transfer and utilise
261 knowledge. This included a lack of financial resources and of time (Table 3, codes: lack of
262 human capital; lack of time). For example, limited financial resources sometimes meant that
263 participants could not consult with stakeholders or scientific experts as much as they liked.
264 Five interviewees cited lack of time and resources as the main reason that evaluations of risk
265 management performance were not carried out:

266 “...because resource and money are always a problem, I suspect that when you get to that
267 part of the cycle, there are other things to be done...and doing a proper evaluation is going
268 to take time and money and often I think the pressure is to use that time and money to do
269 something new. And I think that’s a kind of institutional problem really.”

270

271 **4. Discussion**

272 This study has identified two aspects of how knowledge informs environmental policy-
273 making that have environmental risk governance implications.

- 274 • First, managing risks in environmental policy-making at a project and operational
275 level was informed by a complex network of informal communication encompassing
276 a wide range of internal and external stakeholders (Table 2).
- 277 • Second, while this informal communication was a valuable source of knowledge, it
278 was vulnerable to a loss of knowledge through staff turnover, and to time and
279 resources pressures (Table 3).

280 With regards the first aspect, while the importance of intellectual capital (the
281 knowledge and expertise of employees) to risk management capacity in the private sector has
282 been recognised (Neef, 2005), our study reveals that the intellectual capital required for
283 effective environmental policy making is particularly diverse. For example, in addition to
284 quantitative risk assessments provided by experts, policy teams must communicate with civil
285 society groups and regulated industries to gain knowledge of how stakeholders perceived
286 risks and how they might respond to policy options. Thus, the network of communication
287 critical to gaining the specific and contextual knowledge (Jensen and Meckling, 1995)
288 required to effectively manage risk within the environmental policy context is likely to be
289 relatively complex. Given that an organisation cannot manage its risks effectively if it cannot

290 manage its knowledge (Neef 2005), the implication for organisations responsible for
291 environmental risk and policy is that their risk governance framework must place significant
292 effort into managing and supporting this extensive network of lateral knowledge transfer.

293 Broadly, our results support the assertions of Vince (2000) that there is insufficient
294 focus on the communal aspects of learning in the public sector; and illustrate the value of a
295 broad, participatory approach to risk management by government bodies, reaffirming the
296 ‘analytic-deliberative process’ (Stern and Fineberg, 1996). However, our findings suggest
297 the importance and benefit on knowledge management goes beyond the analytic-deliberative
298 processes’ integrating technical assessment and social values to produce legitimate policy
299 design and outcomes (Klinke and Renn, 2012). Our results show that an internal knowledge
300 management across organisational silos (policy teams in our case) is also critical and that a
301 participatory approach that engages with external stakeholders does not necessary result in
302 better internal knowledge management. This is evidenced our observations that while
303 engagement with external stakeholders was prevalent in our case study (Table 2, code:
304 external stakeholders), engagement between policy teams was less prevalent (Table 2, code:
305 informal communication between policy teams). We offer evidence for promoting, perhaps
306 more firmly than has historically been the case, the knowledge management components of
307 environmental risk governance and policy-making (Stern and Fineberg, 1996, Figure 1-2,
308 p.28). With this in mind, below we address the question: how can the integration of risk-
309 relevant knowledge across multiple individuals and stakeholders be better supported by an
310 enterprise-wide risk governance framework?

311 ***4.1 Supporting risk management through knowledge management***

312 We observed the important role the department’s culture of collaboration (Table 1, code:
313 culture of collaboration) played in supporting the extensive network of lateral communication
314 so important to informing risk-based decisions. While this cultural driver was important and

315 a credit to the department, our findings indicate that relying on culture alone for knowledge
316 management has its limitations (Table 3). Sole reliance on informal processes to support risk
317 knowledge management is neither a systematic nor a controlled form of risk governance
318 (MacGillivray et al., 2007). Here we discuss more formal mechanisms that could be used to
319 mitigate the weaknesses observed (Table3) in the case study department's predominantly
320 informal knowledge management.

321 Addressing the first weakness, loss of knowledge through staff turnover (Table 3, code:
322 Lack of knowledge retention), requires a systematic approach to managing the intellectual
323 capital residing with employees. Key steps towards achieving this include 'knowledge
324 mapping' and 'hard-tagging experts'. Knowledge mapping involves establishing 'who
325 knows what' in an organisation (Neef, 2005). Individuals with key knowledge, experience
326 and skills can then be made available throughout the company as a database sometimes
327 known as a 'knowledge yellow pages' (Davenport, 1998). Such an exercise would support
328 internal consultation beyond the current focus on economic and legal expertise evident in this
329 case study. Further, this would be valuable in guarding against knowledge loss if coupled
330 with an assessment of 'knowledge at risk': identifying critical knowledge held only by a
331 limited number of individuals and/or individual likely to leave the organisation (McBriar et
332 al., 2003). Hard tagging (McGee and Prusak, 1993) combines knowledge mapping with a
333 formal mentoring system. In addition to identifying (hard-tagged) experts available for
334 internal consultation, 'soft tagged' employees who are interested in building specialist
335 knowledge and skills are identified and partnered with hard-tagged experts for mentoring and
336 knowledge sharing (McGee and Prusak, 1993), thus ensuring key knowledge is not lost.

337 The second weakness, vulnerability to time and resource pressure (Table 3, codes: lack
338 of financial resources and lack of time), could be mitigated by making lateral knowledge
339 transfer easier and less time and resource intensive. Here, we offer insight into how this

340 might be achieved. The use of risk registers increased knowledge transfer within policy
341 teams (Table 1 code: ‘risk registers and team communication’). By requiring team members
342 to make risk management knowledge explicit as numbers or text, risk registers facilitated
343 knowledge transfer by a) creating a common language for risk knowledge (Grant, 1996); and
344 b) an accessible space where that knowledge could be aggregated and shared (Moynihan and
345 Landuyt, 2009). Not all the policy teams sampled (seven out of twelve) used risk registers.
346 A first step towards enriching communication in the case study department would be to
347 increase the use of risk registers. However, the greater challenge and one with wider benefit,
348 would be to develop tools that achieve the same effect between teams and the wide range of
349 experts and stakeholders they interact with. Such a tool would capture the risk relevant
350 knowledge of risk managers and stakeholders and make it widely accessible, both in the
351 language used and the format of the knowledge. Research in this area, for example, the
352 development of interactive models and ‘games’, might contribute to supporting the risk
353 management capability of public sector organisations by increasing the range of knowledge
354 that can be effectively used to develop risk management interventions, increasing the quality
355 and legitimacy of risk-based decisions therein. While research into risk communication has
356 explored the use of ‘games’ (McGill et al., 2011) this has been in the context of the dominant
357 risk communication paradigms of informing, persuading and supporting dialogue between
358 values and information (Demeritt and Nobert, 2011). In contrast, we suggest the use of risk
359 communication tools to facilitate knowledge transfer for the benefit of policy makers.

360 ***4.2. Relevance and generalizability of findings***

361 Many governments, their departments and agencies globally are engaged in redefining how
362 they relate to business and society, and the structures and processes required by new models
363 of governance (Bevir et al., 2003; Rhodes, 1996). A significant element of this change is a
364 move away from being direct service providers to protecting public interests and values

365 through regulation and procurement of third party services (Goldsmith and Eggers, 2004). In
366 response to this change, there is an increasing use of private sector practices, for example
367 ERM, in the public sector (Edwards, 2002). While this offers many benefits, there are
368 questions as to whether private sector governance structures are appropriate for the
369 institutional and political realities of the public sector (Edwards, 2002)? We believe that this
370 study offers timely and relevant insight from a government department at the forefront of
371 global changes in public sector governance into some of the opportunities of applying
372 enterprise risk management to the governance of environmental policy making. While a
373 single case study offers rich insight into organisational behaviour it cannot be directly
374 generalized, our core finding ‘that lateral communication is a vital process supporting risk-
375 based decision making’ is of interest to other organisations seeking to employ risk
376 governance frameworks to support environmental policy and risk management. Our findings
377 also uncover some of the weaknesses of a predominantly informal and *ad hoc* approach to
378 lateral communication. Further research to explore how these weaknesses could be addressed
379 is critical.

380

381 **5. Conclusions**

382 Our core finding is that despite being widely accepted as important to developing effective
383 environmental policy (Table 1, code: culture of collaboration), lateral knowledge transfer
384 between policy teams was limited (Table 2, code: informal communication between policy
385 teams). Instead we found that environmental policy was largely informed by individual
386 expertise and through engagement with external stakeholders (Table 2, codes: individual
387 expertise; external stakeholders). The main factors explaining this observation were time and
388 resource pressures (Table 3, codes: lack of financial resources; lack of time) together with a
389 lack of mechanisms to support knowledge sharing (Table 3, code: of formal knowledge

390 sharing). The lateral knowledge transfer observed between policy teams was predominantly
391 informal and *ad hoc* (Table 2) making it vulnerable to loss of knowledge through staff
392 turnover (Table 3, code: lack of knowledge retention).

393 In light of this, we argue that the vertical knowledge transfer and aggregation prominent
394 in well-established risk governance frameworks (for example, COSO, 2004) are necessary
395 but insufficient to support the risk-based decision making informing development of
396 environmental policy. To overcome this shortcoming we propose that environmental risk
397 governance frameworks must engage in a wider range of knowledge management activities
398 that support and enable utilisation of the varied and dynamic body of knowledge, distributed
399 across employees and stakeholders, necessary to develop effective, risk informed,
400 environmental policy. As potential areas of future research we have identified a number of
401 means that could support such lateral knowledge transfer:

- 402 • Establish a culture that encourages communication and collaboration;
- 403 • Actively management risk management knowledge through knowledge mapping,
404 identifying critical knowledge at risk, succession planning and mentoring;
- 405 • Facilitate informal knowledge transfer through open forums or social media type
406 applications;
- 407 • Creation of a knowledge ‘yellow pages’ to support identification of internal experts
408 for consultation;
- 409 • Extend the elements of formal risk management processes that facilitate knowledge
410 sharing within teams, such as common terminologies and formats for risk knowledge,
411 to support inter-team communication and communication with external stakeholders.

412 The core contribution of our research is establishing an empirically grounded understanding
413 of the knowledge transfer processes underpinning effective environmental risk governance.

414 This in turn begins to establish the empirical and theoretical basis for developing knowledge
415 management tools and processes to benefit environmental risk governance. The strength of
416 our case study approach is that it facilitated an in-depth and rich investigation of an
417 organisation playing a key role in environmental risk governance in the UK. The
418 corresponding weakness of this methodology is a limited basis for generalizability (Yin,
419 2008). Case studies of other organisations will be required to provide the comparisons and
420 counterfactuals necessary to develop a robust understanding of what good environmental risk
421 governance entails. The time and effort required to conduct in-depth case studies, as well as
422 issues of access, will be challenges. However, we view this as necessary if environmental risk
423 governance is to move from merely borrowing risk governance structures developed in the
424 financial sectors (for example, COSO, 2004).

425

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431

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