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1 **Learning about knowledge management for improving environmental impact**
2 **assessment in a government agency: The Western Australian experience**

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15
16 **Abstract**

17
18 How does knowledge management (KM) by a government agency responsible for
19 environmental impact assessment (EIA) potentially contribute to better environmental
20 assessment and management practice? Staff members at government agencies in charge
21 of the EIA process are knowledge workers who perform judgement-oriented tasks
22 highly reliant on individual expertise, but also grounded on the agency's knowledge
23 accumulated over the years. Part of an agency's knowledge can be codified and stored
24 in an organizational memory, but is subject to decay or loss if not properly managed.

25 The EIA agency operating in Western Australia was used as a case study. Its KM
26 initiatives were reviewed, knowledge repositories were identified and staff surveyed to
27 gauge the utilisation and effectiveness of such repositories in enabling them to perform
28 EIA tasks.

29

30 Key elements of KM are the preparation of substantive guidance and spatial information
31 management. It was found that treatment of cumulative impacts on the environment is
32 very limited and information derived from project follow-up is not properly captured
33 and stored, thus not used to create new knowledge and to improve practice and
34 effectiveness. Other opportunities for improving organizational learning include the use
35 of after-action reviews. The learning about knowledge management in EIA practice
36 gained from Western Australian experience should be of value to agencies worldwide
37 seeking to understand where best to direct their resources for their own knowledge
38 repositories and environmental management practice.

39

40

41 Key-words: environmental impact assessment, knowledge management, organizational
42 learning, decision-making, environmental agencies.

43

44

45 Abbreviations:

46

47 DEC – Department of Environment and Conservation (Western Australia)

48 EIA – Environmental Impact Assessment

- 49 EIS – Environmental Impact Study or Statement
- 50 EPA – Environmental Protection Authority (Western Australia)
- 51 EAct – Environmental Protection Act 1986 (Western Australia)
- 52 GIS – Geographical Information System
- 53 KM – Knowledge management
- 54 NGO – Nongovernmental Organization
- 55 OEPA – Office of the Environmental Protection Authority (Western Australia)
- 56 US – United States
- 57 WA - Western Australia
- 58

59 **1. Introduction**

60

61 Environmental impact assessment (EIA) is a legal requirement in most countries
62 worldwide for the appraisal of development projects that can significantly affect the
63 environment. It is an important tool for managing human uses of the environment
64 through a systematic and public process for identifying and designing environmentally
65 sustainable development projects, plans and programs. Wherever practiced, the EIA
66 process is implemented and managed by one or more government agency. Each year,
67 dozens, hundreds or even thousands of EIAs may be carried out in a particular
68 jurisdiction.

69

70 Our interest is in how the responsible government agencies (hereafter EIA agency)
71 manage the considerable volume of knowledge generated through EIA and how it is
72 used to improve future EIA and environmental management practice. Knowledge
73 management (KM) aims at stimulating and enhancing collective organizational skills
74 and competencies (Standards Australia, 2005). Studies of KM and organisational
75 learning by private and government organisations are well documented in the
76 international literature but to date relatively little pertains specifically to EIA agencies.

77

78 Key roles of EIA agencies include managing the EIA process in a particular jurisdiction,
79 including enforcement of legal requirements for assessing proposals and designing and
80 implementing a series of procedures to guide operations. They perform the crucial task
81 of quality control by reviewing EIA documents, in particular the environmental impact
82 study or statement (EIS) prepared by the proponent of the activity being assessed. In

83 performing their work, EIA agencies can (i) accumulate information and knowledge; (ii)
84 learn from experience; and (iii) establish new procedures or policies aimed at improving
85 EIA efficiency or effectiveness. Thus EIA agencies can be framed as learning
86 organisations (Argyris and Schön, 1996).

87

88 Our focus is where there is a centralised EIA agency responsible for managing the
89 process and for carrying out all or most EIA tasks. This model is used in countries such
90 as Australia, Brazil and Mexico, where an environmental agency or Ministry has
91 statutory power to approve, refuse or to impose conditions on actions that can
92 significantly harm the environment. An alternative approach based on having a
93 responsible competent decision-making authority for each development sector which
94 must observe EIA requirements and demonstrate that they have been fulfilled when
95 delivering the appropriate permits (as used in most of the European Union) is not
96 addressed here.

97

98 A central EIA agency can facilitate the appraisal of the real outcomes of EIA in one
99 particular jurisdiction, as well as provide essential data for evaluating process
100 effectiveness. In his comparative review of EIA in selected countries Wood (2003, p.
101 312) noted that: 'it is probably no coincidence that the EIA systems which are monitored
102 all possess a single body with overall responsibilities for EIA'. Thus KM by centralized
103 agencies offers huge potential for organizational learning (OL) for EIA enhancement, as
104 they deal with a larger variety and number of proposals than competent authorities.
105 Experience gained can be useful for future assessments, i.e. EIA can be seen as a
106 learning process (Saarikoski, 2000; Sadler, 1996, p. iii).

107

108 Our interest concerns management of knowledge by EIA agencies to facilitate this
109 learning process. Specifically our research had the following aims:

- 110 • identify and evaluate knowledge repositories established by a centralised EIA
111 agency to understand both how they evolved and how they are used to
112 improve ongoing EIA; and
- 113 • derive possible lessons that could be applied to or adapted by similar agencies
114 in other jurisdictions.

115

116 We selected the Office of the Environmental Protection Authority (OEPA) of Western
117 Australia (WA) as the centralised EIA agency case study for this research. There has
118 been a long tradition of reporting on innovations in EIA practice in WA which
119 demonstrate elements of organisational learning directed at improving processes (e.g.
120 Hollick, 1981; Bailey and Saunders, 1988; Glasson, 1999; Middle and Middle 2010).
121 When comparing EIA systems in different countries, Wood (1999) concluded that:
122 ‘Widely perceived as a comprehensive and effective EIA system, Western Australia’s
123 EIA process is of particularly comparative interest’. Thus, by analyzing the KM
124 approach of the OEPA, there is a potential to derive lessons for international practice in
125 EIA. As EIA is a universal tool, lessons drawn from one jurisdiction may be relevant to
126 improve practice elsewhere (Wood, 1994).

127

128 In large part our research was guided by interviews with senior staff from the OEPA
129 and key results based on a survey of all staff who make use of the OEPA's knowledge
130 repositories in their work. Before presenting details of the survey methodology and

131 results, we summarise the principles of KM and organisational learning based on key
132 findings from the international literature. We then relate this to the role of EIA agencies
133 and the potential of KM to influence ongoing and future EIA practice. This background
134 provided a foundation for our detailed investigation of the KM initiatives utilised by the
135 OEPA in Western Australia. In order to contextualize our findings, we provide an
136 overview of the EIA arrangements in the State. Following presentation of our
137 methodology and results, we conclude with a discussion of the implications of our
138 findings with respect to foreseeable improvements in Western Australian practice as
139 well as possible implications for international EIA practice.

140

141 **2. Knowledge management perspectives**

142

143 The need for knowledge management in the public administration and the formulation
144 of public policies received early recognition by authors such as Henry (1974), in the
145 face of the then emerging information technologies and the rise of “information-based
146 governmental agencies”, such as, in the United States, the Environmental Protection
147 Agency and the President’s Council on Environmental Quality together with the
148 ‘extremely far-reaching National Environmental Policy Act’ (p. 190), the law approved
149 by the US Congress in 1969 which first institutionalized EIA, a policy tool later adopted
150 worldwide.

151

152 Today, KM is an acknowledged facet of organizational development and management.

153 Possible advantages of KM include: (i) reducing the costs of repeatedly developing

154 solutions (Szulanski, 1996); (ii) identifying and replicating best practices (Olivera,

155 2000); (iii) buffering an organization from the disruptive effect of staff turnover (Argote
156 et al., 1990). The notion of organizational learning (Argote, 1999; Argyris and Schön,
157 1996), formulated in the 1970s, tries to explain why and how knowledge can be used to
158 achieve an organization's goals.

159

160 Approaches to KM discussed in the international literature broadly revolve around
161 systems for identification, creation, storage, retention, use, sharing and transfer of
162 knowledge (e.g. Davenport and Prusak, 1998; Argote et al. 2003; European Standard
163 CWA 14924: 2004; Rashman et al., 2009) and are applicable to private and public
164 organizations alike. In short, KM systems comprise the set of dispersed knowledge
165 (held by individuals and stored in documents) and the mechanisms to make that
166 knowledge accessible; which Olivera (2000, p. 813) refers to as organisational memory.

167

168 The location of organizational memory is multiple and includes individual staff,
169 technical systems (e.g. electronic databases) and paper records, organizational routines
170 and procedures, as well as social networks and the routines and values of the
171 organizational culture (Argote, 1999; Nakano and Fleury 2005; Pollitti, 2009). Thus two
172 broad approaches are generally recognized as necessary to enable implementation of
173 KM strategies: technology-based (such as databases, intranet) and human resources or
174 the knowledge that resides within individuals. As noted by Handzic (2005) information
175 technology has become essential for: (i) building knowledge repositories, (ii) facilitating
176 knowledge searching and discovery, and (iii) promoting socialization and collaboration,
177 so that apart from the personal knowledge of staff it is virtually impossible to
178 implement KM initiatives without technological support. An organisation cannot solely

179 rely on the knowledge embedded in individuals, as ‘the contents of social networks are
180 subject to decay as a consequence of turnover’ (Argote, 1999).

181

182 The importance of memory for organizations is widely recognized. Functions of
183 organizational memory include: (i) support to problem-solving; (ii) support to decision-
184 making and (iii) maintenance of routine behaviours, norms and shared interpretations
185 (Olivera, 2000). Walsh and Ungson (1991) remark that decisions are likely to be more
186 effective when considered in terms of organization’s history than when made in a
187 historical vacuum. Thus retention of an organisation's knowledge is vital; Argote et al
188 (2003, p. 572) define this as ‘embedding knowledge in a repository so that it exhibits
189 some persistence over time’. Pollitt (2009) warns about the risks of memory loss,
190 Othman and Hashim (2004) of organizational amnesia and Argote (1999) of
191 organizational forgetting.

192

193 Other desirable features of knowledge repositories beyond the issue of retention include
194 their accessibility and availability, relevance and specificity of contents, effectiveness of
195 indexing (easiness to find contents), frequency and importance of use, response time
196 and the extent to which the knowledge content has been filtered and is updated (Olivera
197 2000, p. 826; Cheung et al. 2007, p. 151).

198

199 Although a broader review of organizational learning is not possible here, it is
200 convenient, for the purposes of this paper, to note two central concepts: (i)
201 a distinction should be made between organization learning and adaptation, as change
202 does not necessarily imply learning (Fiol and Lyles, 1985); (ii) the distinction, made by

203 Argyris and Schön (1996), between single- and double-loop learning, which is often
204 used to explain learning in organizations; single loop learning is understood as that
205 which modifies strategies of action as a result of perceived mismatch of outcomes to
206 expectations; double loop learning arises from questioning the values and norms that
207 guide action and can lead to deeper and higher level changes.

208

209 So far our discussion of KM has largely been drawn from the managerial literature.
210 Studies about knowledge management and learning by organizations involved in the
211 EIA process are scarce. There have been a number of studies focussing on learning and
212 change by EIA agencies, but these have principally documented examples of
213 collaborative social learning arising from the public participation component of EIA
214 exerting external influence on agency knowledge, behaviour and operations. Pioneering
215 studies by Hill and Ortolano (1976) and Brendecke and Ortolano (1981) based on
216 interviews with 350 staff from two government agencies involved in the EIA process in
217 the US found evidence that external input did influence decision-making in those
218 agencies, which then reflected information generated as a result of the interagency and
219 public review of draft environmental impact statements (EISs). More recent examples
220 can be found in Webler et al., 1995; Saarikoski 2000; Chávez and Bernal, 2008;
221 Sánchez-Triana and Ortolano, 2001; Sinclair et al., 2008) while social learning in the
222 context of natural resource management is also receiving growing attention in the
223 literature (e.g. a review by Blackmore, 2007).

224

225 A more explicit focus on internal learning by EIA agencies with a KM related element
226 is evident in Fitzpatrick (2006) who explored organizational learning associated with

227 the EIA process in the case of two projects (a dam and a mine) submitted to different
228 Canadian jurisdictions, which involved 41 organizations, both governmental and non
229 governmental. She found that ‘all organizations’ (p. 177) experienced learning
230 outcomes. Government actors emphasized single-loop learning, or activities designed to
231 improve performance within the existing process; on the other hand, non government
232 actors, identified a wider range of outcomes centred on changing process that can
233 contribute to future assessments, i.e. double-loop learning. Four government
234 organizations directly involved in the cases reviewed by Fitzpatrick (2006) used formal
235 ‘post hoc reviews’ of the environmental assessment activities as a mechanism to derive
236 lessons learned. Knowledge repositories used by these government organizations
237 included assessment reports (a publicly available document summarizing the assessment
238 findings and recommendations) and reports of post hoc studies and records of
239 assessment activities (files containing documents pertaining to the EIA process).

240

241 It is clear from the literature that knowledge management and organisational learning by
242 government agencies makes an important contribution to the achievement of their
243 functions. In this research we set out to document how KM initiatives by a leading EIA
244 agency have contributed to improvements in environmental protection and management.

245

246 **3. Objectives and methods**

247

248 The research sought to identify key elements of KM undertaken by the OEPA for
249 improving EIA practice, especially with regard to the responsibilities of that agency,
250 and then determine to what extent KM initiatives could contribute to enhance EIA

251 effectiveness in Western Australia more generally. By adopting a case study approach
252 (i.e. with OEPA as the case study unit) we wished to derive possible lessons that could
253 be applied to or adapted by similar agencies in other jurisdictions. As Yin (2003) points
254 out, case study research allows for making inferences and reaching valid conclusions
255 that can be generalized to theoretical propositions (p.10), as well as developing
256 propositions for further enquiry (p. 6).

257

258 The data collection methods were document review, participant observations, interviews
259 and questionnaires. Document review included a thorough search of the OEPA website
260 (i.e. the principal public interface of the agency: www.epa.wa.gov.au/) and the selective
261 review of key present and past documents. One of the authors has been analyzing EIA
262 practice in Western Australia for a number of years and has recently participated in a
263 number of ad hoc committees responsible for reviewing EIA procedures and practice in
264 this jurisdiction; some insights arose from these committee meetings. Open semi-
265 structured interviews were conducted with four senior OEPA staff members (including
266 the current and one past Director) as well as one of the technical staff. Finally, a
267 questionnaire was applied to OEPA staff.

268

269 The purposes of document review, participant observations and interviews were:

- 270 • to identify milestones of EIA in Western Australia that could reflect
271 improvements resulting from “learning from experience”;
- 272 • to identify the knowledge repositories currently used at OEPA;
- 273 • to capture how they evolved and how they relate to EIA practice; and
- 274 • to identify currently perceived gaps and foreseen improvements.

275

276 This combination of data collection approaches enabled important internal OEPA tasks
277 and operations to be identified with respect to how EIA is carried out internally.

278

279 The interviews were conducted with 7-10 days intervals between them, thus allowing
280 time for gaining some familiarity with documents or events mentioned by the
281 interviewees and to consider the appropriateness of modifying the questions to be
282 formulated to the next interviewee. The interviews were carried out in an evolving and
283 opportunistic, although structured, manner designed to maximise researcher
284 understanding and depth of knowledge, as opposed to posing an identical suite of
285 questions to a range of interviewees; such approaches being common in qualitative
286 social science research (e.g. Neuman, 2000). A key outcome of the interview sequence
287 was fine-tuning of the questionnaire for OEPA staff, a draft version of which had been
288 prepared on the basis of document reviews and participant observations. Prior to
289 questionnaire application, two pilot tests were conducted with senior staff members who
290 were asked to carefully scrutinize the wording used in each question, in order to
291 minimize ambiguities.

292

293 The final version of the questionnaire was distributed to the 40 potential respondents
294 (i.e. OEPA project officers and their branch managers) following an oral presentation
295 addressing the research purposes and the objectives of the questionnaire; this was
296 scheduled to take place at a relatively informal weekly staff meeting to which external
297 speakers are occasionally invited. Purposes of the questionnaire were:

298

- to collect evidence of knowledge management actual practices; and

- 299 • to survey how the organization's knowledge repositories are perceived in
300 terms of effectiveness and usefulness to internal users.

301

302 The questionnaire was structured around the following topics: (1) sources and
303 repositories, (2) usefulness and access, (3) knowledge creation and learning
304 environment, (4) identifying gaps and improvements and (5) context (respondent
305 contextual data about professional experience within OEPA). Respondents remained
306 anonymous. The questionnaire was designed having in mind its possible application to
307 other EIA agencies, thus enabling comparative studies. The questionnaire is at one time
308 part of the research method and a product of the research, as it was tailor-made to reflect
309 surveyed knowledge repositories operated by the OEPA.

310

311 Insights for designing the questionnaire were gained from several sources, in particular:
312 CEN (2004), Cheung et al. (2007), Olivera (2000), Standards Australia (2005). A
313 number of questions were formulated using a Likert scale, where an item is presented as
314 a declarative sentence, followed by response options that indicate varying degrees of
315 agreement with or endorsement of the statement (DeVellis, 1991, p. 68). Questions on
316 access to knowledge repositories and their usefulness for performing EIA tasks were
317 formulated using a four-level scale indicating frequency of access. Two open questions
318 sought the respondents' opinion about gaps in the current repositories and opportunities
319 for improvement.

320

321 Three weeks were allowed for reply and a total of eighteen questionnaires were
322 returned. Given that a number of potential respondents were on extended leave over the

323 whole period allowed for reply, this represented a roughly 50% return rate. Answers
324 were organized in tables and analyzed descriptively by grouping frequencies.

325

326 Before presenting the results obtained it is useful to set the scene for our analysis by
327 outlining the context in which the OEPA operates.

328

329 **4. The EIA process in Western Australia and its management**

330

331 The state of Western Australia has had EIA processes in operation since 1974. Since
332 then there have been progressive modifications to the guiding legislation, supporting
333 administrative procedures and other comprehensive guidance, in response to growing
334 maturity in practice and especially the move towards more strategic approaches to EIA.
335 Legal responsibility for the EIA process rests with the Environmental Protection
336 Authority (EPA) in accordance with the provisions of the *Environmental Protection Act*
337 1986 (WA) (hereafter EPAct). While the EPAct specifies some of the procedures for
338 EIA, including responsibilities and functions of the EPA and of the Minister for the
339 Environment and appeal processes, separate Administrative Procedures, prepared by the
340 EPA in accordance with the EPAct and published in the Government Gazette in 2002,
341 outline the objectives of and procedures for EIA in the State.

342

343 The EPA is a statutorily independent panel of five people that provides advice to the
344 Environment Minister on environmental matters including all proposals subject to EIA.
345 Four of the EPA members undertake this role on a part-time basis and the panel meets
346 on one day each fortnight. While the EPA is the legal entity responsible for undertaking

347 EIA (e.g. author of all EIA guidance documents and reports to Minister) the day to day
348 EIA work is carried out by (full-time) public servant staff within the OEPA on behalf of
349 the panel; hence, it is the workings of the OEPA that is our focus in this research. More
350 specifically it is the project officers and branch managers who actually perform the key
351 EIA tasks and who are main users of knowledge repositories and organizational
352 memory within OEPA.

353

354 While the EIA component of the EPAct is administered by the OEPA, other aspects of
355 environmental management (e.g. natural areas management, licensing and pollution
356 control) covered by the Act are the responsibility of the Department of Environment and
357 Conservation (DEC). As might be expected, there is some inter-relationship between the
358 activities of DEC and those of the OEPA (e.g. environmental expertise within DEC is
359 often utilised as an input to individual assessments). For the remainder of this paper our
360 focus is exclusively on the EIA-related activities within the OEPA.

361

362 Figure 1 shows the current EIA process in WA, the local terms for the main steps of the
363 process and the main input and output documents. The "steps of the EIA process"
364 column depicts in bold types the terminology usually employed internationally or in
365 textbooks. It can be observed that the WA process comprises all the major steps,
366 including scoping and follow-up, which are absent in a number of EIA systems (Bond
367 and Wathern, 1999). The figure also depicts the main tasks performed by OEPA officers
368 in order to comply with legal requirements and internal procedures. The "internal
369 procedures" and "outputs" columns indicate the main tasks and are expressed in the
370 local terminology.

371

372

Figure 1

373

374 Five levels of environmental assessment were in use in WA at the time of research. The
375 term “referral” means the submission of information about a proposal (project or land
376 use plan) for screening, i.e. decision on the need to assess and the level of assessment
377 required. The main types of EIS are known as Public Environmental Report (PER) and
378 the Environmental Review and Management Programme (ERMP). Unlike other
379 jurisdictions, public hearings are not part of the process. Public consultation is formally
380 provided for via public announcements of new proposals and by a period of public
381 comment when written submissions are received by the OEPA. However, project
382 proponents are expected to consult with the public and relevant government agencies as
383 part of project planning and clear evidence of consultation activities must be given
384 alongside the environmental impact study. There are also a number of third party appeal
385 rights for several steps in the process.

386

387 An indicator of the volume of the staff workload is provided by the numbers of
388 proposals received and assessments performed, available from the EPA annual reports.
389 Between 1998-2009, OEPA performed on average 535 reviews of development
390 proposals and planning schemes each year, out of which formal assessments were
391 required for 46 proposals (or 8.6% of total referrals). For those proposals not subject to
392 formal assessments, specific advice to decision-making authorities was provided on
393 average to 227 proposals (42% of total referrals). In each year, the number of formal
394 assessments actually completed averaged 39. Figure 2 shows the yearly number of main

395 documents received and processed by EPA in the period. In addition to these
396 documents, staff also review changes to approved proposals requests, whose figures are
397 not provided by the EPA annual reports.

398

399 **Figure 2**

400

401 The most common types of projects for which a full assessment has been required are
402 mining, oil and gas development, and harbour and railway infrastructure, often
403 associated with major resource development projects. Referrals, however, bring a range
404 of proposals, including local zoning schemes, water supply projects, road construction
405 and improvements. Screening does not utilise lists of types of proposals, as in many
406 jurisdictions, but is determined on a case-by-case basis with respect to the likelihood
407 that a proposal would have a significant effect on the environment.

408

409 **5. Results and Findings**

410

411 **5.1 OEPA staff profile**

412

413 The main users of knowledge repositories and organizational memory are project
414 officers and branch managers who actually perform the tasks featured in Figure 1. In
415 2009, OEPA staff was composed of 37 project officers, three branch managers, two
416 assistant directors and one director, totalling 43 technical staff directly involved in the
417 core tasks. In addition, the OEPA is staffed with five administrative officers and five
418 specialists in geographical information systems.

419
420 The OEPA staff come from a range of backgrounds and professional experience. As of
421 October 2009, 30% of the staff had been working at OEPA for less than two years, 17%
422 between two and five years, 25% between five and ten years and 28% for more than ten
423 years. Staff turnover was seen as a problem in the period 2002-2008, coinciding with an
424 economic boom in the State due to a thriving natural resource sector, especially mining
425 and gas. In that period, about 20% of the staff left every year, obliging the organization
426 to hire new graduates and to provide on-the-job training.

427

428 **5.2 Mapping knowledge repositories**

429

430 The knowledge repositories utilised by the OEPA staff in carrying out their EIA duties
431 are summarised in Table 1. Some are available only for internal use, such as the
432 geographical information system (GIS) and the Officers Manual, but most are publicly
433 accessible items. Table 2 provides a summary explanation of the contents of each type
434 of repository. Inevitably, overlapping exists. Some repositories were prepared for the
435 benefit of the OEPA's clients, i.e. project proponents, decision-making authorities,
436 environmental consultants and the public. These documents aim at clarifying EPA
437 understanding on a particular subject or to provide specific guidance on contents of
438 documents to be presented or methods for collecting or analyzing environmental
439 information. Other repositories are primarily intended for internal use, as they set out
440 internal procedures.

441

442

Table 1

Table 2

443

444

445 5.3 Initiatives related to knowledge management and organizational learning

446

447 Notwithstanding that OEPA has not implemented any formal KM program, several
448 internal management initiatives relevant as enablersⁱ of organizational learning have
449 been developed over time: (1) quality assurance, (2) spatial information management,
450 (3) records management, (4) mentoring, (5) training, (6) preparing and publishing
451 guidance, and (7) the “back-catalogue” or library archive of all EPA documents from
452 1974 onwards. These are briefly described followed by one further initiative that
453 commenced during our research.

454

455 A quality assurance program for EIA started in the mid-1990s leading to improved
456 efficiency through elimination of ‘unnecessary steps and duplication’ and possibly
457 enhancing effectiveness by means of a ‘more systematic methodology’ for
458 environmental acceptability criteria.ⁱⁱ An internal manual was issued, containing, among
459 other elements, detailed procedures for EIA tasks, a template for internal procedures, a
460 document control protocol, and standardization of terminology.

461

462 The building of a GIS started in the late 1980s as part of a WA government-wide
463 initiative. Initially, the OEPA staff used spatial information essentially to check
464 presence or absence of environmental values when a proposal was received. Published
465 EPA guidance provides a series of specific requirements about a range of
466 “environmental values”, also known in the EIA literature as “valued ecosystem

467 components”. Western Australia examples of such environmental values include
468 “declared rare flora” and “threatened ecological communities”.

469

470 Currently, OEPA has a dedicated GIS group staffed by five specialists who not only
471 maintain and update information on environmental values but also perform a “proximity
472 analysis” for every proposal referred to the EPA. Such an analysis means producing a
473 map featuring the new proposal, former proposals and environmental values at distances
474 of 200 m, 500 m and 2 km from the proposed development, thus providing project
475 officers with a quick overview of the spatial context of matters that might represent a
476 significant effect on the environment associated with the proposal. The group also
477 systematically captures the boundaries of all proposals referred to EPA in a spatial
478 dataset.

479

480 OEPA has adopted a records management system to ensure file and document tracking,
481 as well as a database of ongoing and past assessments including proponent details,
482 decisions made and timelines. Both systems are on the OEPA's internal Intranet and
483 subject to improvements and upgrades. However, the organization also maintains files
484 containing a hard copy of all relevant documents for every assessment which are
485 updated and consulted by project officers.

486

487 The effects of staff turnover are dealt with by adopting an array of measures. New staff
488 are informed by several ways. There is a half-day introductory course, an active
489 mentoring program and ad hoc provision of short-courses. All new staff have an
490 experienced staff member assigned as mentor, who, like in traditional apprenticeship,

491 ‘impart their tacit knowledge, as well as demonstrate their skill and exemplar
492 behaviours’ (Agimo, 2004, p. 9).

493

494 Since 2006, the OEPA in partnership with the Environmental Consultants Association
495 (WA) Inc. has provided bi-annual offerings of a two-day residential training course
496 entitled “Environmental Assessment for Practitioners”, especially targeted towards
497 environmental consultants and newer staff members within the OEPA. A vital aspect of
498 each course offering has been the attendance of at least one senior OEPA member of
499 staff who can answer specific and detailed questions regarding procedures within the
500 unit. The training course is perceived as being valuable in developing professional
501 relationships between EIA practitioners in WA (Morrison-Saunders and Bailey, 2009).

502

503 Publishing guidance intended for stakeholders has been used by the EPA since the State
504 EIA system was formalized. These documents are available to OEPA staff and external
505 EIA practitioners alike. Between 1999 and 2006, nine EPA *Position Statements* were
506 produced; these provide the overarching principles and information which the EPA
507 would use when giving advice to the Minister, the public, proponents and decision-
508 makers to clarify their responsibilities for managing a particular environmental matter.

509 Between 1998 and 2009, four draft and 25 final EPA *Guidance Statements* were
510 produced; these provide the EPA's understanding about a particular issue against which
511 proponents can develop their proposals.ⁱⁱⁱ Guidance documents have been updated or
512 expanded on several occasions, typically following amendment to the legislation. More
513 importantly, a new kind of guidance started being published in the late 1990s focusing
514 on recommendations for consultants and proponents to undertake their EIA tasks.

515 Guidance has been issued on numerous aspects of EIA practice, such as conducting
516 terrestrial flora surveys, designing environmental offsets for proposals that impact on
517 biodiversity, sampling of short range endemic invertebrates, criteria for protection of
518 benthic habitat. We call this type of guidance “substantive”, as it is essentially different
519 from procedural guidance intended at explaining details of a particular EIA system,
520 such as “how to make submissions” or how many days an EIS is available for public
521 comment.

522

523 One strong point of the EPA's approach to EIA is the formal publication of its
524 recommendations to the Minister for the Environment for each individual assessment
525 carried out. This series known as the EPA Reports extend from the first published in
526 March 1974 to the present day (currently numbering more than 1300). These reports,
527 systematically available via the Internet since 1989, document the history of EPA
528 advice, recommendations and policies. The EPA has always hosted a publicly
529 accessible library containing hard copy of the entire suite of EPA Reports (and other
530 EIA documentation). While the EPA Reports are readily accessible, EIS and other
531 environmental review documents are not held in any central repository and typically do
532 not remain available on the Internet after the public review period closes; such
533 documents must be obtained from the proponent's website and are usually available
534 only for a limited period. Hard copies may be available in the EPA's library, but the
535 collection is incomplete.

536

537 Coincidentally with the timing of the research, in May 2009, the Minister for the
538 Environment established a “Shared Environmental Assessment Knowledge” (SEAK)

539 Taskforce comprising proponent, consultant, NGO and government agency
540 representatives and chaired by the EPA Chairman. The purpose of the taskforce is to
541 develop a shared environmental knowledge system for collecting, reporting and
542 accessing environmental information and knowledge generated through the
543 environmental assessment process (EPA 2009a, p. 51). More specifically the taskforce
544 has been examining the creation, collection, organisation, storage, analysis, governance
545 and communication of digital environmental knowledge in WA. The taskforce will
546 make recommendations on a model for delivering improved environmental data
547 management and knowledge building that enhances assessment and approvals
548 processes. Their recommendations, however, were not publicly available at the time this
549 paper was concluded.

550

551 **5.4 Use of knowledge stored in organizational memory**

552

553 Findings related to access and use of collective knowledge for performing the EIA tasks
554 at the OEPA were obtained from the questionnaire. Out of 16 knowledge repositories
555 (Table 1), respondents most often access previous EPA reports and the organization's
556 hard files, alongside the sources which provide personal interaction (i.e. repositories 14
557 to 16). The least accessed sources are the GIS Viewer and the State of the Environment
558 Report. It appears that sources that feature real cases or solutions are used most often
559 relative to those that provide generic guidance. No additional internal knowledge source
560 was mentioned, although space was provided in the questionnaire. A few external
561 knowledge repositories were however identified, with non specified Internet sites most
562 often mentioned, followed by scientific literature and external professional networks.

563

564 The five main EIA tasks (from Figure 1) of OEPA staff - (1) recommending the level of
565 assessment; (2) reviewing scoping documents; (3) reviewing the draft environmental
566 impact document; (4) preparing the draft EPA report and (5) preparing an appeal report
567 - were listed and survey respondents were directed to indicate ease of access to
568 knowledge repositories for performing those tasks. Several staff reported that tasks (3)
569 and (2) require slightly more frequent access to the repositories, but no significant
570 difference appeared, suggesting that no particular EIA tasks is viewed as more complex
571 than others by OEPA staff.

572

573 **5.5 Usefulness and accessibility of knowledge stored in organizational memory**

574

575 Nine statements related to usefulness and accessibility of knowledge repositories
576 derived from internal tasks and operations within OEPA were included in the
577 questionnaire (Table 3). Respondents were asked to declare their agreement with these
578 statements using a five level scale. The results show that:

- 579 ▪ There is an ample agreement (72%) that Guidance Statements usefully condense
580 the organization's knowledge for use in EIA.
- 581 ▪ There was some disagreement on the level of detail provided by Guidance
582 Statements, probably due to some being outdated, as noted by a few respondents,
583 and to some being detailed whereas others provide only general guidance.
- 584 ▪ Most respondents disagreed with the statements that they may prefer to obtain
585 information from other people rather than from documents; this may suggest that
586 the initiative of writing guidance and making it available to staff is welcome. It

587 may also possibly reflect a preference by OEPA staff for being able to “defend”
588 or be accountable for knowledge and views put forward in EPA documents; i.e.
589 having a published source by way of back up. When these results were viewed in
590 light of the number of years of employment within the OEPA (i.e. the respective
591 groups of staff with less than 2 years in OEPA (n=8) and those with more than
592 10 years (n=6) of service) it was found that the less experienced staff were more
593 likely to rely on documents rather than people and vice versa for the more
594 experienced staff.

595 ■ All staff respondents indicated that they consult with people in the DEC, which
596 is consistent with the notion of EIA as a multidisciplinary and multi-institutional
597 activity.

598 ■ The level of disagreement with the statement that issues addressed by OEPA
599 staff are typically so specific such that internal knowledge sources are not useful
600 (72%) reinforces the finding that knowledge repositories are perceived as useful
601 by staff.

602

603

Table 3

604

605 Respondents were also asked to rank the effectiveness of each knowledge repository in
606 providing access to the organization’s stored knowledge. A notion of effectiveness was
607 advanced for the respondents as “the ease of access – in terms of time and effort – to
608 OEPA collective experience and knowledge”. Ranking utilised a five-level Likert scale.
609 Fourteen out of the sixteen repositories were ranked as effective or very effective, with

610 only two ranked as ineffective or not used (GIS Viewer and the State of the
611 Environment Report).

612

613 The low ranking obtained by GIS Viewer is explained by the fact that it is the interface
614 available to project officers, while spatial data analysis is performed exclusively by GIS
615 specialized staff. The results of the 'proximity analysis' are printed and included within
616 a folder containing other project-related information. If a project officer needs more
617 spatial information than is usually provided, he or she asks for assistance from the GIS
618 team. This explains why GIS is an important tool, but the Viewer interface is not
619 considered as an effective source by project officers.

620

621 The answers are consistent with those provided for the first question. Senior staff is the
622 source that returned the most "very effective" ratings (65%). The sources that hit the
623 higher percentages of "very effective" or "effective" combined were the EPA Reports
624 and the internal meetings (both at 100%), followed by senior staff (94%) and the
625 Officers Manual and templates (89%).

626

627 The reasons advanced for rating a source as effective or very effective are the ability to
628 find information and possibility of obtaining insights to perform the tasks (89%). This
629 explains why State of the Environment Reporting was considered to be ineffective; its
630 scale of focus covering the entire land and coastal environment of Western Australia is
631 too broad for application to specific projects. It is clear that the utility of the information
632 obtained (i.e. meeting needs, enabling task performance and finding examples or

633 solutions) are the predominant benefits to nearly all respondents. Less than half of the
634 respondents indicated speed of access as a reason for ratings of effectiveness.

635

636 The reason most cited for rating a source as ineffective or very ineffective is that “the
637 information that can be found is outdated” (61% of respondents), whereas the response
638 that “it is very time consuming to retrieve information from those sources” was cited by
639 50% of respondents. A number of reasons associated with information technology were
640 also advanced.

641

642 Answers to open questions (i.e. a space in the questionnaire provided for free answers)
643 included in the questionnaire frequently mentioned the need to update knowledge
644 sources and to upgrade technology-based systems. In particular it appears that although
645 the usefulness of the GIS is acknowledged, users feel the need to introduce
646 improvements in terms of (i) compatibility with other government spatial information
647 systems, especially DEC’s and (ii) accuracy of information.

648

649 **5.6 Knowledge creation**

650

651 The research intended to capture staff perceptions about creating knowledge in their
652 work. Six statements were provided and the respondents asked to rate their agreement
653 (Table 4). Taken collectively, responses to each statement are overwhelmingly positive.
654 This suggests that OEPA staff are proud of what they do and are generally positive
655 about the experience both personally and in terms of what they achieve. When these
656 results were viewed in light of the number of years of employment within the OEPA

657 (i.e. the respective groups of staff with less than 2 years in OEPA (n=8) and those with
658 more than 10 years (n=6) of service) it was found that less experienced staff are:

- 659 • more enthusiastic about personal learning [statement A] and a belief in the value
660 of well-informed EPA reports protecting the environment for present and future
661 generations [statement F];
- 662 • not so sure that mistakes can/should be viewed as learning opportunities
663 [statement C] or that new knowledge can be used in the future [statement D];
664 and
- 665 • more frequently negative about their personal contribution to providing new
666 information that will be used in the future [statement E] relative to the more
667 experienced OEPA staff members.

668

669 Table 4

670

671 **6. Discussion**

672

673 For the analysis intended in this paper, OEPA is viewed as an organization that
674 processes information and delivers analysis in the form of advice and recommendations
675 to the Minister for the Environment, to other decision-making authorities and to
676 proponents. Information is supported by input documents provided by external
677 organizations and concentrated in output documents (both depicted in Figure 1). Here
678 we discuss the research findings under two perspectives: (1) the usefulness and
679 effectiveness of knowledge repositories and (2) the array of KM initiatives employed

680 (or not) by the OEPA. The section closes with a discussion of knowledge issues not
681 currently dealt with by the OEPA.

682

683 **6.1 Coverage, usefulness and access to knowledge repositories**

684

685 The ‘capture and dissemination of socially constructed knowledge’ is one particular
686 aspect of KM in the public sector (Riege and Lindsay, 2006, p. 27). Undoubtedly the
687 OEPA has been fulfilling this task and contributing to capturing and disseminating
688 relevant knowledge for decision-making in Western Australia from 1974 onwards.

689

690 Knowledge contained in the repositories, in particular Guidance Statements, has been
691 filtered by the organization, i.e. their content has been selected by groups of people in
692 the organization and validated through consultation with staff within the OEPA, other
693 government departments and different stakeholders. Hence, there is a profound
694 difference between this kind of repository maintained by a government organization and
695 private companies’ knowledge repositories. Another characteristic of such public
696 repositories is that individuals cannot make direct contributions to them, in contrast with
697 some kinds of repositories used by private companies such as consultancies (Olivera,
698 2000).

699

700 The finding that OEPA staff prefer obtaining information from documents over other
701 people corresponds with the findings of Morrison-Saunders and Bailey (2009) in a
702 study of EIA consultants (especially) and also OEPA staff previously. They reported
703 that inexperienced staff were more likely to rely on published documentation to guide

704 their EIA activities relative to experienced staff who would draw more on their own
705 experience and be comfortable making their own judgments accordingly.

706

707 Particularly important is the preparation of substantive guidance to EIA. The perception
708 of OEPA staff that Guidance Statements usefully condense knowledge for use in EIA is
709 comparable with similar comments provided by environmental consultants in Western
710 Australia previously (Waldeck et al., 2003). New substantive guidance is being
711 developed by EPA as a consequence of a new internal policy derived from a multi-
712 stakeholder review of the WA EIA process concluded in March 2009 (EPA, 2009b).

713 The review identified a number of ‘opportunities to deliver better environmental
714 protection and to improve the efficiency and transparency’ (EPA, 2009a, p. 7),
715 including ways to streamline the scoping process, formalising timelines in EIA, and
716 clearly specifying environmental outcomes to be met by proponents in conditions of
717 approval issued by the Minister. Draft guidelines for these initiatives have since been
718 published on the EPA website and represent new opportunities for organizational
719 learning.

720

721 However, such improvements do not deal with a number of current shortcomings in
722 terms of KM that have been identified in the course of this research. The treatment of
723 cumulative impacts in EIA practice in WA is currently very limited, as the GIS only
724 keeps information on the location of previous proposals, but does not include data
725 generated by the respective environmental assessment. Thus, if an officer would like to
726 retrieve information on an existing proposal in order to better understand the cumulative
727 impacts, it would be necessary to review the files relative to that particular undertaking,

728 a time consuming task possibly incompatible with a project analysis timelines. These
729 timelines are a significant constraint on project officers, as EPA is committed to deliver
730 its recommendations in a relatively short period in order to respond to the constant
731 criticism from proponents that the EIA process takes too long (EPA, 2009b; Middle and
732 Middle, 2010).

733

734 The questionnaire findings also showed that OEPA has no clear policy or practice for
735 the revision of older knowledge stocks. Outdated sources were mentioned several times
736 by the respondents to the survey in the open discussion comments at the end of the
737 questionnaire. To develop and review their EIA guidance, the OEPA will normally
738 undertake several rounds of drafting and public review prior to their publication and
739 thus the availability of human resources and timelines become constraints to the ability
740 to quickly update knowledge repositories. Private organisations, in contrast, typically
741 would not be faced with this issue. Specific resourcing of knowledge management
742 activities may thus be an important element of an effective EIA practice.

743

744 **6.2 Knowledge management initiatives**

745

746 Although there has never been any formal knowledge management initiative in the
747 OEPA, several actions have contributed to organizational learning. This characteristic
748 has been identified by an Australian agency in charge of promoting good practices in
749 the public service: 'While many organizations may not use the term 'knowledge
750 management' to describe their activities in this area, many relevant activities are

751 undertaken to enhance organizational learning, improve service delivery, and build
752 capabilities and flexibility.’ (Agimo, 2004, p. 3).

753

754 Initiatives pertaining to both technology-based and human resources approaches to KM
755 have been implemented. The OEPA has been particularly active in producing guidance
756 and setting up different repositories, but ‘well-defined KM strategies (...) going beyond
757 knowledge repositories’ are used by the most advanced government organizations
758 (Riege and Lindsay, 2006, p. 25) were not identified in this survey, apart from the
759 mentoring program and the half-day introductory course (Section 5.3).

760

761 After-action reviews are not used as a learning mechanism for EIA. This activity is
762 defined as ‘a facilitated discussion, conducted immediately after a project or major
763 activity and using a semi-structured format’ that ‘draws on the participants experience
764 and perceptions to help identify lessons’ (Standards Australia, 2005). Fitzpatrick (2006,
765 p. 171) sees a post hoc analysis as a ‘method for generating shared meaning’ and
766 ‘debriefing and documenting lessons from specific experiences’. Interestingly, the
767 OEPA has identified after-action reviews as one means of improving EIA practice in
768 WA in their partnering agreement with the Environmental Consultants Association
769 (Morrison-Saunders and Bailey 2009) but these have not been employed to date.

770

771 In Canada, Fitzpatrick (2006, p. 168) mentioned the ‘post hoc review’ conducted by
772 government bodies after the assessment of two major projects as contributing to
773 enhancing the EIA processes in two jurisdictions. Findings led to ‘improved
774 performance’ (by modifying procedures for public information requests) and ‘changed

775 theories in use' (or double-loop learning), in this case, pointing to reducing the number
776 of issues debated in Canadian public hearings. In one case, a 'Lessons learned'
777 document is available on the Internet.

778

779 One questionnaire respondent, working at OEPA for more than ten years, mentioned the
780 need to update a report: 'written a long time ago which gathered all the relevant wisdom
781 in EPA reports into a summary, making it easier to access'. This person was referring to
782 EPA (1992), which, based on 'detailed research of the Authority's publications',
783 selected fundamental 'principles' and lessons learned that could be useful for future
784 assessments. This kind of after action review is also a further example of guidance
785 material not being updated by OEPA.

786

787 As a relatively small agency with a unique function, OEPA is in itself a community of
788 practice. Social networks do play a role in managing knowledge, notwithstanding the
789 popularity of printed sources noted previously, as many questionnaire respondents
790 stated they consult with people in the DEC or other government departments.

791

792 **6.3 Beyond performing internal tasks**

793

794 Despite achievements in KM, there are underexplored learning opportunities that could
795 enhance EIA practice by the OEPA, the most prominent being that data and information
796 gathered in the follow-up phase are not processed into meaningful knowledge for future
797 assessments. Audit and compliance reports are filed with the Inspections and
798 Compliance Branch (a DEC division) but then seemingly are forgotten. Consultants

799 who prepare such reports and the proponents can learn from them and potentially, such
800 learning can be reflected in upcoming environmental assessment documents prepared by
801 these consultants and proponents. However, there is no systematic or structured way of
802 conveying learning to the OEPA or sharing such learning with other stakeholders.

803

804 The organization and its stakeholders are aware of the huge opportunities for improving
805 knowledge management in the EIA process. Historically information generated in the
806 assessment process has been used to inform and support OEPA decision-making, but
807 only to a limited extent has it contributed to building a knowledge base. Through the
808 establishment of the SEAK Taskforce (discussed in Section 5.3), there is an expectation
809 that OEPA will find collaborative ways to build knowledge from the extensive
810 ecosystem information that is gathered in the EIA process. Harnessing this knowledge
811 would provide opportunities for double-loop learning (Argyris and Schön, 1996). At
812 present information derived from project follow-up in EIA practice in WA is not
813 properly captured and stored, thus not used to create new knowledge and to improve
814 practice and effectiveness.

815

816 **6.4 Going beyond conventional EIA practice**

817

818 KM by EIA agencies is key to a broader learning process that potentially extends
819 beyond immediate EIA stakeholders to influence environmental management activities
820 that lie well beyond the scope of normal EIA practice. Our study has not attempted to
821 measure such an influence but we believe that it is worthwhile flagging and it is an
822 increasing feature of the EIA literature. For example the international effectiveness

823 study of Sadler (1996, p. 227) was one of the first explicit attempts to map out how EIA
824 processes can be sharpened in order to become a 'tool for sustainability assurance'. One
825 way to do this could be achieved through EIA follow-up where the combined efforts of
826 project follow-up, EIA system review follow-up and meta-level evaluations of EIA
827 efficacy as a concept (Arts and Morrison-Saunders, 2004, p. 312) contribute to
828 'environmental sustainability'.

829

830 Weaver et al (2008) emphasize the role of individual EIA practitioners in personally
831 'pushing the vectors' of sustainability. This sentiment is shared by Gibson et al (2005,
832 p.188) who argue for a transition from project EIA to 'sustainability assessment' which
833 ultimately is about 'making the world better, one undertaking at a time'. Another
834 example comes from Downs (2008) who maps out how an enhanced EIA process could
835 contribute to sustainable development and poverty eradication through 'an adaptive
836 social learning process' and a 'trans-disciplinary, knowledge-partnership' approach
837 amongst others. Similarly, Bond et al. (2010, p. 6) argue that 'sustainability outcomes in
838 EIA' call for a 'learning organization approach', and Sheate and Partidario (2009, p.
839 287) call for 'strategic approaches' that facilitate the 'exchange and transfer of
840 knowledge already owned by stakeholders'.

841

842 Central to all of these thoughts – although not always acknowledged - is the key role of
843 EIA agencies.

844

845 **7. Conclusions**

846

847 In this research we set out to identify and evaluate knowledge repositories established
848 by the centralised EIA agency operating in Western Australia to understand their
849 evolution and how they are used to improve ongoing EIA by the OEPA with a broader
850 aim of deriving lessons that could be applicable to similar agencies in other
851 jurisdictions.

852

853 The OEPA experience shows that even in the absence of a formal or systematic KM
854 strategy, it is possible to adopt a number of initiatives conducive to manage an
855 organization's ability to learn, store and use collective knowledge in support of its core
856 activities. That a single agency has been responsible for EIA in WA for many years no
857 doubt has contributed to success in KM whether through formal or informal means; i.e.
858 an EIA system based around a single agency simply increases the opportunity for KM
859 to occur. This is an important learning point for those jurisdictions designing or re-
860 designing EIA systems and may have relevance for other environmental management
861 agencies too.

862

863 The key elements of KM adopted by OEPA are: (i) the provision (to proponents,
864 consultants and project officers alike) of substantive guidance on methods, approaches
865 and assessment criteria; (ii) development of a GIS-supported spatial information
866 database containing data on all proposals referred and significant environmental values
867 nearby every new proposal.

868

869 The main opportunities for improvement lie in (i) ensuring that EIA guidance material
870 is kept up-to-date; (ii) performing after-action reviews of selected assessments; (iii)

871 formalising a process for harnessing the extensive project performance and compliance
872 data generated in follow-up to create new knowledge to guide future practice.

873

874 In terms of the main functions of KM (knowledge creation, retention, and transfer or
875 share) OEPA appears to be particularly successful in retention and transfer to
876 knowledge users. Less significant results are evident with respect to knowledge
877 creation.

878

879 The OEPA case study clearly demonstrates that knowledge management initiatives can
880 be useful for EIA agencies and are perceived to contribute to more effective EIA. We
881 anticipate that equivalent enquiries conducted in other jurisdictions could identify other
882 initiatives appropriate to such agencies and relevant to international practice.

883

884 The key elements of KM that are potentially relevant for other EIA agencies (and by
885 extrapolation to other environmental management agencies more generally) are: (1)
886 establishing and maintaining a comprehensive and easily accessible spatial information
887 database; (2) preparation and periodic update, in consultation with major stakeholders,
888 of substantive guidance on methods and criteria for EIA tailored to the context of each
889 jurisdiction. An institutional arrangement to collect, filter and interpret information
890 generated in the follow-up of projects submitted to the EIA process is a third element
891 that potentially can enhance practice, but it remains untested in WA.

892

893 Ensuring environmental protection through EIA requires good management of the
894 organizations in charge of administering the EIA process. Knowledge management is a
895 key enabling process to accomplish this.

896

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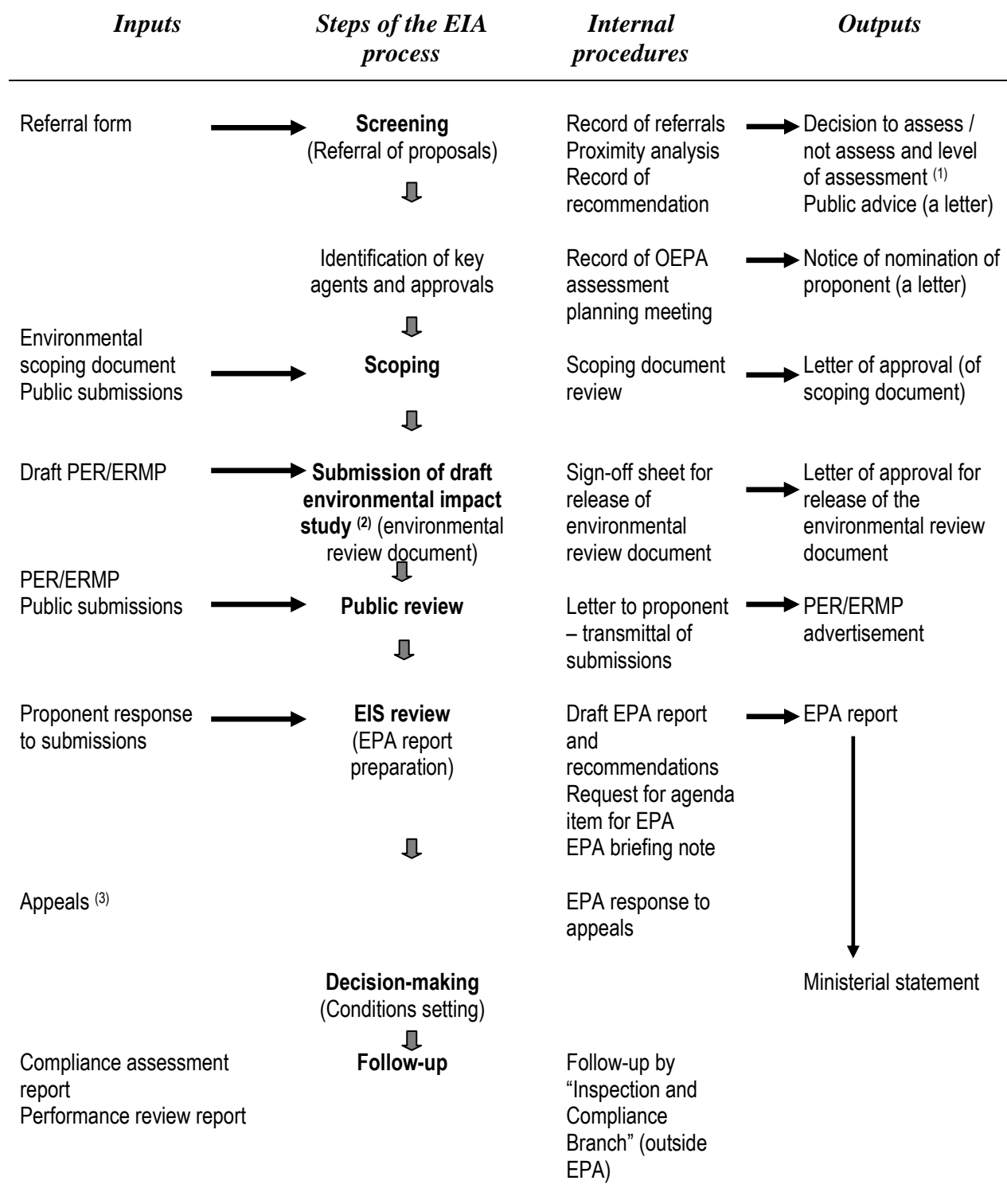
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ⁱ The concept of KM enablers is used here in accordance with Standards Australia (2005).

ⁱⁱ Quotations from an unpublished paper presented by Rob Sippe at the 16th Annual Meeting of the International Association for Impact Assessment, Estoril, Portugal, 1966.

ⁱⁱⁱ Following a review of the EPA's policy framework carried out in 2008, new nomenclature and types of guidance documents have begun to be utilised. In this paper we refer to them generically as Guidance Documents.

Figure 1



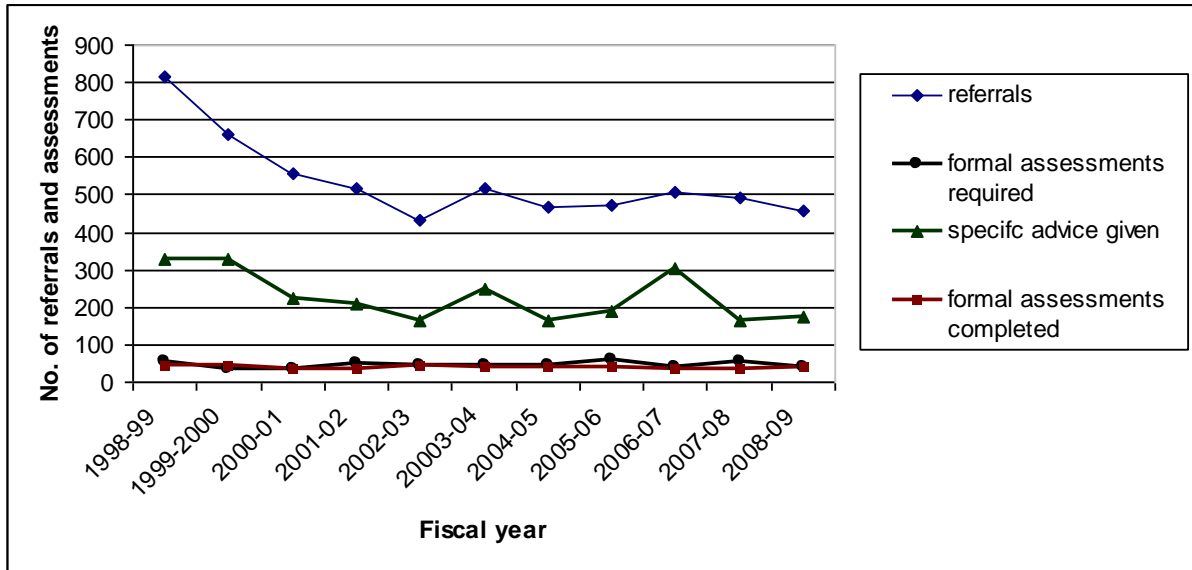
Notes:

(1) EPA decides on the level of assessment, such as environmental protection statement (EPS), public environmental review (PER) and environmental review and management plan (ERMP), the latter corresponding to the highest and more detailed level of assessment

(2) WA legislation does not use the term “environmental impact study”, which is employed here as a broad denomination for the sake of generalization; the term “environmental review document” encompasses the several types of studies under WA legislation

(3) the proponent and the public can appeal to an Appeals Convenor against any recommendation of EPA

Figure 2



**Figure 2: Annual variation of main documented inputs and outputs at OEPA.
Source: EPA Annual Reports from 1998-1999 to 2008-2009.**

Table 1
OEPA Internal Knowledge Repositories

TYPE / NAME	AVAILABILITY		FORM OF ACCESS		
	INTERNAL USE ONLY	PUBLICLY AVAILABLE	INTRANET	FILES / PRINTED ⁽¹⁾	PERSONAL CONTACT
1 Geographical information system	■		■	■	■
2 Record of proposals referred and proximity analysis	■		■	■	
3 Officers Manual and templates	■		■		
4 Key environmental factors		■	■		
5 Guidelines for environmental review documents		■	■		
6 Environmental Protection Policies		■	■		
7 EPA Position Statements		■	■		
8 Guidance Statements		■	■		
9 EPA Reports (formerly bulletins)		■	■		
10 EPACIS - EPA Central Information System	■			■	
11 Files	■			■	
12 TRIM – Total Records Information System	■		■		
13 State of the Environment Report		■	■	■	
14 Staff meetings	■				■
15 Informal talks	■				■
16 Senior staff	■				■

Note: (1) Limited numbers of publicly available reports authored by the EPA are available (at no cost) in hard-copy, but all can be downloaded (pdf format) from the EPA website. Files are printed documents held within OEPA for internal use only.

sources: compiled from the EPA website (www.epa.wa.gov.au), internal documents and interviews.

Table 2 - OEPA knowledge repositories and their main features

TYPE / NAME		DESCRIPTION
1	Geographical information system	contains several layers featuring “environmental values” (such as wetlands, threatened and priority ecological communities), zones covered by EPA environmental protection policies, position statements and guidance statements, public drinking water supply areas, a record of proposals referred to EPA and other spatial information; the EPA internal GIS started in 1994 and has been evolving since; an Intranet interface available to project officers is called GIS Viewer
2	Record of proposals referred and proximity analysis	every new proposal is received by GIS staff, its location and main features are entered into the system; a few proposals received prior to 2005 have been fed into the system; a project officer receives a “proximity analysis” document showing in a map or aerial photo the environmental values known at certain distances from the proposed site and all proposals previously referred to EPA
3	Officers Manual and templates	a compilation of internal procedures, templates and guidance; a first printed manual was released in 1991; currently it is composed of a series of electronic documents; templates are models of documents and letters relative to all aspects of the EIA process; several dozens templates are available in the Intranet
4	Key environmental factors	a comprehensive checklist of valued ecosystem components grouped under four categories (biophysical, pollution management and social surroundings); <i>critical environmental assets</i> is a term introduced in 2006 to describe factors of foremost importance, whereas <i>high value assets</i> designates other environmental assets that require a high level of protection
5	Guidelines for environmental review documents	guidance intended to proponents to assist the preparation of environmental impact documents (namely Public Environmental Review and Environmental Review and Management Programme); in performing the review task, project officers check the proponent’s document against these generic guidelines and the environmental scoping document
6	Environmental Protection Policies	guidance to protect the environmental values of certain areas or that addresses State-wide issues; starting in 1992, nine such documents have been enacted as of December 7 2009
7	EPA Position Statements	“set EPA views on some matters of environmental importance” ;starting in 1999, there are nine Position Statements as of August 15 2009
8	Guidance Statements	“Guidance Statements are issued by EPA to assist proponents, and the public generally, to understand the minimum requirements for protection of elements of the environment that the EPA expects to be met during the assessment process”; 56 have been issued as of December 7 2009, but some are no longer in use and have been withdrawn
9	EPA Reports (formerly bulletins)	the main output of the review process; feature recommendations of the EPA; bulletins have been numbered since the beginning of EIA in the State, in 1974; 1345 reports released as of December 7 2009
10	EPACIS - EPA Central Information System	a database of assessments, including proponent details, decisions made and timelines, from referrals (screening) to determination of appeals on EPA Reports and issue of Ministerial Statement (approval and conditions)
11	Files	physical files containing all documents relative to every referral received by EPA; active files are maintained at the office for quick retrieval
12	TRIM – Total Records Information System	a system for electronic document management, storing documents, e-mails and scanned documents received by OEPA
13	State of the Environment Report	a first report was published in 1992; the most recent (2007) edition covers 34 “environmental issues” featuring a description of current conditions (with indicators), pressures, current and suggested responses; maps feature the spatial extent of each issue; each issue is ranked in a five-level priority score
14	Staff meetings	formal meetings to deal with ongoing assessments or referrals
15	Informal talks	by definition, any exchange of views or information between staff members; this category also include social networks both inside and outside the organization

16 Senior staff	some officers have more than 30 years of EIA experience; senior staff can play a significant role in sharing knowledge as they are officially designated as mentors for new staff
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sources: compiled from the EPA website (www.epa.wa.gov.au), internal documents and interviews.

Table 3
Statements about internal knowledge repositories

<i>statement</i>	<i>disagree</i>	<i>agree</i>
A. Databases and knowledge sources at OEPA are easily accessible in terms of time and effort in retrieving information	7 (37%)	9 (50%)
B. Guidance Statements usefully condense EPA and DEC accumulated knowledge as applicable to EIA	2 (11%)	13 (72%)
C. Guidance Statements are not detailed enough to provide useful help	8 (42%)	6 (32%)
D. In my work, I have a preference for obtaining information from other people rather than from documents	61%	22%
E. I usually consult with people in other divisions of DEC	0	18 (100%)
F. I usually consult with people in other government departments	0	18 (100%)
G. I trust more the knowledge embedded in official sources than what I can directly obtain from people	7 (39%)	10 (56%)
H. The reports I prepare deal with such specific issues that I hardly ever find any useful knowledge in OEPA internal sources	13 (72%)	3 (17%)
I. The most accurate and reliable way of doing an internal task is to check how was it done last time	3 (17%)	14 (78%)

Note: results are presented in two broad groups; in the questionnaire, respondents were asked to mark “strongly disagree”, “partially disagree”, “unable to judge”, “partially agree”, and “strongly agree”; sums can be less than 100% where respondents indicated that they were “unable to judge”.

Table 4
Statements about internal knowledge creation

<i>statement</i>	<i>disagree</i>	<i>agree</i>
A. Working at OEPA provides meaningful opportunities to increase my personal knowledge		17 (100%)
B. Sharing information is part of my normal work activity		18 (100%)
C. At OEPA, mistakes are viewed as learning opportunities	2 (11%)	12 (67%)
D. In my work I generate new knowledge that can be used by OEPA in the future		14 (78%)
E. Significant parts of what I learn during my work is actually fed back into our future assessments	5 (28%)	12 (67%)
F. Preparation of well-informed EPA reports significantly contribute to decisions that protect the environment for present and future generations	3 (17%)	13 (72%)

Notes: (1) results are presented in two broad groups, as in Table 3; (2) one respondent did not rate statement A; for other sums smaller than 18, the balance is in the “unable to judge” category.