

Research Trend of Public-Private Partnership in Construction Journals

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Abstract: An impressive series of content analyses of Public-Private Partnership (PPP) publications between 1998 and 2003 from four internationally renowned construction journals (including the *International Journal of Project Management*, the *Journal of Construction Engineering and Management*, the *Construction Management and Economics*, and the *Engineering Construction and Architectural Management*) was reported. Their work inspired the writers of this paper to continue from where they left it. Based on a two-stage literature review, PPP articles from 1998 to 2008 were analyzed in terms of the annual number of PPP articles published, the writers' contribution, and the research focus in their studies. From the analysis it was found that the number of PPP publications in these journals has been increasing. This finding might imply that PPPs are becoming more important to the construction industry at large. In addition, this study also found that the U.K. researchers have published the largest number of PPP articles, followed by those from the United States, Singapore, Hong Kong, Australia, China, and Germany. Although the build-operate-transfer scheme was the most frequently investigated form of PPP in earlier research, the diverse concept of PPP has attracted a lot of research interest and has become the focus of most recent PPP publications. Research topics published in these journals on investment environment, governance issues, and other supported areas tend to receive more attention from researchers. Moreover, complicated and vigorous analysis techniques such as game theory and fuzzy set theory have also been applied in this field of study.

DOI: 10.1061/(ASCE)0733-9364(2009)135:10(1076)

CE Database subject headings: Infrastructure; Partnerships; Publications; Construction industry; Reviews; Research.

Introduction

The increasing importance of private participation in public infrastructure development has meant that research papers published with regard to Public-Private Partnership (PPP) is important both to researchers and practitioners in this field (Al-Sharif and Kaka 2004). Through this publication process, researchers worldwide can share and gain access to these important research findings and make further advancement in the subject area. Also researchers need not to repeat what has already been done, and instead can continue to build from the work of others.

Academic journals are useful to the research community in general, but important to new researchers in particular. It helps them to gain a wider perspective of the field quickly with ease. Therefore, a systematic analysis of articles published in academic journals would assist researchers to explore the current status and future trends of the chosen topic (Tsai and Wen 2005). In the field

of PPP, Al-Sharif and Kaka (2004) conducted a comprehensive analysis which reviewed PPP-related publications in four selected construction journals from 1998 to 2003. Their review illustrated the coverage of PPP during this period, the gaps to be addressed by the academic community, and also assessed the impact of the research on the construction industry. The results showed that the number of published papers during 1998–2003 in this area did not reflect the importance of PPP and the actual level of activities associated.

In recent years PPP has been adopted more extensively by governments around the globe, and as a result an increasing number of problems have been reported in the implementation of PPP projects. Therefore a continuous content analysis of professional papers from 1998 to 2008 is believed to be useful in identifying the research trend of this important topic. This study continued to review the research trend in PPP but extended the literature search to other related journals and aimed to address the following questions:

1. What was the coverage of PPP topics during the period of 1998–2008?
2. What did the writers contribute to the PPP publications during the period of 1998–2008?
3. How did the theme/focus/interest of these PPP publications change during the period of 1998–2008?

Background of PPPs

PPP is defined by the Canadian Council for PPP as follows (Canadian Council for PPP 2007):

“A cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards.”

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Note. This manuscript was submitted on September 21, 2007; approved on May 27, 2009; published online on September 15, 2009. Discussion period open until March 1, 2010; separate discussions must be submitted for individual papers. This paper is part of the *Journal of Construction Engineering and Management*, Vol. 135, No. 10, October 1, 2009. ©ASCE, ISSN 0733-9364/2009/10-1076–1086/\$25.00.

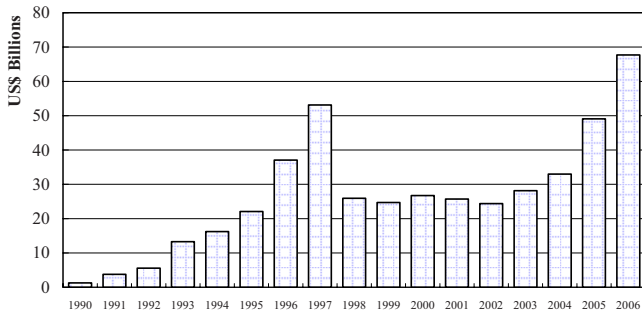


Fig. 1. Annual investment of infrastructure projects with private participation in developing countries between 1990 and 2006 (World Bank 2008)

Since PPPs were first introduced in the U.K. back in 1997, it has been recognized as an effective way of delivering value for money public infrastructure and services. PPP now accounts for about 15 and 8% of infrastructure spend in the U.K. and Australia respectively (Banks 2005). On the other hand, PPP also plays a significant role in the infrastructure development of developing countries. Fig. 1 presents the annual private investment between 1990 and 2006 in the public services of developing countries (World Bank 2008).

In general the level of private involvement ranges from simple service provisions without recourse to public facilities to service provisions based on public facility usage. This can go as far as full private ownership and operation of public facilities and their associate services (Li et al. 2005a). With private involvement increasing, PPP modes may include service contract, leasing, joint ventures, concession, and privatization (Li et al. 2005a).

Similarly, there are various other spectrums of PPP modes defined by researchers and practitioners. For instance, the Canadian Council for PPP provides a framework where PPPs can be categorized based on the extent of public and private sector involvement, and the degree of risk allocation. In order of increasing degree of private sector risk and involvement, the categories include operation and maintenance (O&M), build-finance, build-finance-maintain, lease-develop-operate, design-build-operate, design-build-finance-maintain, design-build-finance-operate, design-build-finance-operate-maintain, build-own-operate, concession, etc. (Canadian Council for PPP 2007).

It is worth highlighting that PPP is not a panacea or a quick fix solution to deliver project financing and realization. Each PPP type has inherent strengths and weaknesses which need to be recognized and integrated into project arrangement to deliver clear advantages and benefits (European Commission 2003).

However, various problems have been encountered in international PPP projects in many countries, such as high costs in tendering, complex negotiation, cost restraints on innovation, and differing or conflicting objectives among project stakeholders (Akintoye et al. 2001). Curnow et al. (2005) also drew attention to the fact that as governments continued to reduce the amount of private sector involvement in core activities, the scope for private sector participants to recover sufficient financial reward is limited and has reached an unsustainable level. The worldwide practices and problems encountered make it necessary to carry out a careful analysis of the research topics currently published by major construction journals, which may be beneficial to researchers by enabling them to identify contemporary research issues.

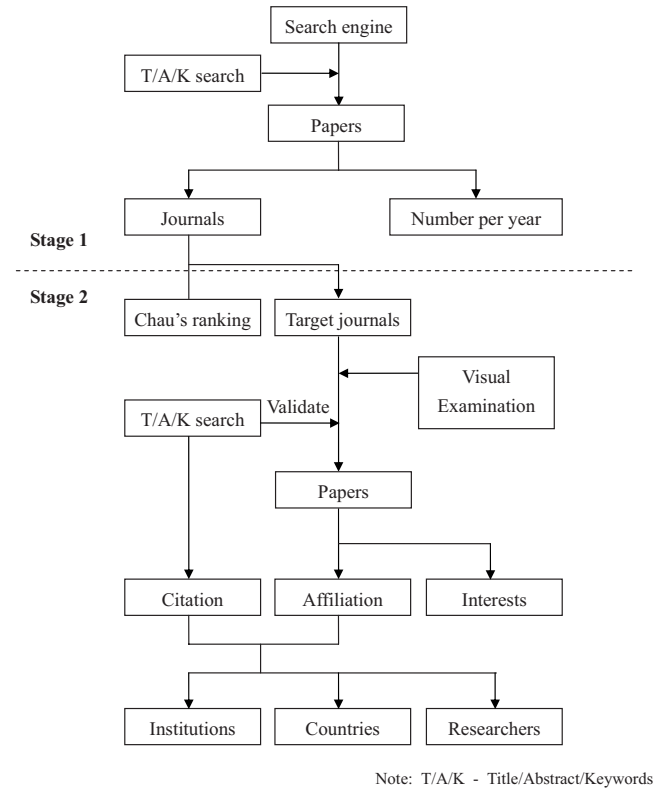


Fig. 2. Research framework for this study

Research Methodology

Al-Sharif and Kaka (2004) reviewed papers published by four construction journals from 1998 to 2003, namely the Journal of Construction Engineering and Management (JCEM), the Construction Management and Economics (CME), the International Journal of Project Management (IJPM), and the Engineering Construction and Architectural Management (ECAM). These four selected journals are among the top-10 construction journals in the ranking of Chau (1997), which are highly recognized as well as frequently accessed. Since the literature search in the study of Al-Sharif and Kaka (2004) was only limited to four selected construction journals, useful literature published in other journals and conference proceedings might not have been included.

A research team may probably submit its findings to a higher journal in its area or a journal with similar topics. Based on this assumption, the writers first chose a search engine to identify journals which published the most PPP articles. The search was further refined by making reference with the journal ranking list of Chau (1997) in the construction engineering and management area. To acquire a more elaborated understanding of PPP research, this study carried out a two-stage literature review to conduct a content analysis of PPP papers from 1998 to 2008, which is presented in Fig. 2.

In Stage 1, a comprehensive search was conducted under the "title/abstract/keyword" field of the search engine "Scopus." Search keywords included public-private partnership, private-finance initiative, build operate transfer, privatized infrastructure, privately financed, etc. Papers with these specific terms in the title, abstract, or keywords were considered to meet the requirements of this study. The search was further limited in the subject areas such as "business, management, and accounting," "decision sciences," "economics, econometrics, and finance," "energy,"

“engineering,” “environmental science,” and “social sciences” with the document type of “article or review.” The full search code is as follows:

TITLE-ABS-KEY(“public private partnership” OR “public private partnerships” OR “build operate transfer” OR “build-operate-transfer” OR “build/operate/transfer” OR “private finance initiative” OR “public-private” OR “privately financed” OR “private finance” OR “public/private” OR “private infrastructure” OR “privatized infrastructure” OR pfi OR bot OR “PPP/PFI” OR “PFI/PPP”) AND DOCTYPE(ar OR re) AND SUBJAREA(ener OR engi OR envi OR busi OR deci OR econ OR soci) AND PUBYEAR AFT 1997 AND PUBYEAR BEF 2009 AND (LIMIT-TO(LANGUAGE, “English”)) AND (LIMIT-TO(SRCTYPE, “j”))

Despite these search specifications, the results may still include some unwanted publications, which happened to meet the search keywords but do not really discuss about private participation in the infrastructure development. However, it was hard to exclude these unwanted results totally. Therefore, these search results were only analyzed in terms of top ranked journals and number of PPP papers published annually.

The results in Stage 1 indicated that JCEM, CME, IJPM, and *Public Money and Management* (PMM) have published the most PPP-related papers (detailed information is provided in the “Discussion” section), and thus were selected as target journals in Stage 2. As the major focus of this study is to examine the research trend of PPP in construction journals, the other three of top-six journals identified in the ranking of Chau (1997), ECAM, Journal of Management in Engineering (JME), and Proceedings of Institution of Civil Engineers—Civil Engineering (PICE-CE), were included in the second stage too. It is found that the top three journals (JCEM, CME, and IJPM) identified in Stage 1 were also ranked high in the ranking of Chau (1997). These two selection processes reinforce each other.

In Stage 2, a visual and more comprehensive search of all target journals was carried out instead of via the search engine. In the search, articles which were published under the broad categories of “editorial,” “book review,” “discussions and closures,” “letter to the editor,” and “articles in press” were excluded from the analysis. Compared to the analysis in Stage 1, a closer look at the content of selected papers was conducted to identify the changes of research techniques adopted and research interests, and then explore the research trend of PPP.

The research contribution from each country, institution, and researcher was analyzed and ranked quantitatively in a similar fashion as Al-Sharif and Kaka (2004) did. In their earlier work it was assumed that the contribution of each writer in a multi-authored paper is indiscriminately the same as if the paper is written by a single writer. However, Howard et al. (1987) advocated that a more accurate approach should be adopted to reflect the actual contribution of each individual writer in a multi-authored paper, assuming that the first writer has contributed more than the second writer, and the second more than the third, and so on and so forth. Howard et al. (1987) produced the following formula to differentiate the contribution of each individual writer in a multi-authored paper and this formula was adopted by Tsai and Wen (2005) to identify the research trend of science education

Table 1. Score Matrix for Multiauthor Papers

Number of writers	Order of specific writer				
	1	2	3	4	5
1	1.00				
2	0.60	0.40			
3	0.47	0.32	0.21		
4	0.42	0.28	0.18	0.12	
5	0.38	0.26	0.17	0.11	0.08

$$\text{Score} = \frac{1.5^{n-i}}{\sum_{i=1}^n 1.5^{n-i}}$$

where n =number of writers of the paper and i =order of the specific writer. Given that each paper has a score of one point, a detailed score matrix for writers is shown in Table 1. It should be noted that the order of authorship may not always reflect the actual contribution difference. For instance, the principal investigator would take the last position and leave previous positions to other researchers. Thus, this study considered both the contribution score and the number of times that the writer’s name occurred.

However, the two-stage literature review carried out in this study may provide biases to the results. Therefore, it is worth noting that the analyses in the following only base on the data collected by the specific sampling approach. This study does not aim to the complete population of PPP articles, but only look at the trend of PPP research in the construction engineering and management area.

Discussion

Number of PPP Papers Published Annually

The total number of PPP-related papers identified by the search engine was 1,952, with an increasing trend from 95 in 1998 to 266 in 2008. The total number of papers published in the seven selected journals during 1998–2008 was 4,106. Among these 170 (4.14%) addressed PPP subjects. This trend reinforced that there is increasing attention in the topic from 9 papers found in 1998 to 22 in 2008. Table 2 shows the number of PPP publications annually and a full publication list selected in the study is presented in the Appendix.

As presented in Table 2, 910 different journals were found to have published 1,952 PPP-related papers during 1998–2008. It can be seen that more and more academic journals have published PPP papers. The journals JCEM, CME, IJPM, and PMM have published the most PPP papers within the study period, and the respective numbers of PPP publications for each were 41, 39, 28, and 26. Therefore, these four journals were selected as the target journals for the data collection in Stage 2, as described in the “Research Methodology” section. Among the seven selected target journals, JCEM published 40, about 24%, of all the PPP-related papers, followed by 32 in CME, 30 in IJPM, and 27 in PMM. It is worth noting that IJPM published a special issue (2006, Volume 24, Issue 7) on PPPs, and so did Volume 23, Issue 7, 2003 in PMM and Volume 156, Issue 5, 2003 in PICE-CE. Combining all the papers from 1998 to 2008, it was found that the PPP interest among the seven journals was similar with a cover-

Table 2. PPP Papers Published from 1998 to 2008

		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Search engine	PPP	95	137	122	146	150	171	161	223	238	243	266	1,952
	Journals	85	101	97	121	116	136	123	177	181	191	193	910
Selected journals	Total	306	302	329	311	321	344	406	447	462	453	425	4,106
	PPP	9	11	9	8	12	23	11	17	28	20	22	170
	Ratio (%)	2.94	3.64	2.74	2.57	3.74	6.69	2.71	3.80	6.06	4.42	5.18	4.14
JCEM	Total	61	56	62	61	60	80	101	139	132	102	103	957
	PPP	1	1	2	4	4	3	3	8	4	7	3	40
	Ratio (%)	1.64	1.79	3.23	6.56	6.67	3.75	2.97	5.76	3.03	6.86	2.91	4.18
CME	Total	65	72	87	74	60	72	89	86	105	101	94	905
	PPP	0	2	3	0	1	4	3	5	6	2	6	32
	Ratio (%)	0.00	2.78	3.45	0.00	1.67	5.56	3.37	5.81	5.71	1.98	6.38	3.54
IJPM	Total	42	47	45	45	68	66	66	69	72	85	85	690
	PPP	1	2	2	1	2	0	2	1	12	4	3	30
	Ratio (%)	2.38	4.26	4.44	2.22	2.94	0.00	3.03	1.45	16.67	4.71	3.53	4.35
PMM	Total	33	36	37	33	32	30	37	45	41	52	45	421
	PPP	0	2	0	2	1	6	1	1	2	5	7	27
	Ratio (%)	0.00	5.56	0.00	6.06	3.13	20.00	2.70	2.22	4.88	9.62	15.56	6.41
PICE-CE	Total	21	17	28	36	38	37	52	50	52	52	34	417
	PPP	3	1	1	1	1	10	1	0	1	0	0	19
	Ratio (%)	14.29	5.88	3.57	2.78	2.63	27.03	1.92	0.00	1.92	0.00	0.00	4.56
ECAM	Total	38	35	37	37	38	36	39	35	36	37	36	404
	PPP	3	1	1	0	1	0	1	2	3	2	1	15
	Ratio (%)	7.89	2.86	2.70	0.00	2.63	0.00	2.56	5.71	8.33	5.41	2.78	3.71
JME	Total	46	39	33	25	25	23	22	23	24	24	28	312
	PPP	1	2	0	0	2	0	0	0	0	0	2	7
	Ratio (%)	2.17	5.13	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	7.14	2.24

age ratio of 4%, except for JME. These findings may indicate that PPP is increasingly important to the construction industry and the research community.

Writer's Contribution to the Papers

As previously mentioned, by applying the score matrix as delineated in Table 1, the score of a specific writer in a multiauthored paper can be calculated. For instance, Edwards from Australia published three papers jointly with Li, Akintoye, and Hardcastle from the U.K., but a score of 0.54 was awarded to Australia according to the new calculation method. The country origin, affiliation, and contribution of writers to the PPP research are provided in the following paragraphs.

The country origins of PPP publication as shown in Table 3 are listed along with the number of institute/university, researchers, papers involved, and score for each country; among these the U.K. researchers were involved in 59 papers and scored top with 55.38. This is understandable because the U.K. has been recognized to be the major originator of the PPP concept. It is also worth noting that the country origins of most published papers in Table 3 are developed countries/jurisdictions, such as the U.K., United States, Singapore, Hong Kong, Australia, and Germany. These six developed countries together with China have a very high coverage of the whole publication, which was about 79%. This was believed to be a research limitation to the study as the perspective from developing countries was not covered in these publications. Besides, the construction education, national economics, or low English literacy may also be potential reasons why developing countries appear to be less active in publishing PPP

Table 3. Research Origin of PPP Papers Published

	Institute/University	Researchers	Papers	Score
U.K.	42	82	59	55.38
United States	15	28	25	14.77
Singapore	3	17	22	18.57
Hong Kong	5	15	18	14.69
Australia	13	24	17	12.91
China	7	9	14	10.26
Germany	3	11	8	7.60
Taiwan	7	9	5	4.42
India	3	6	4	4.00
Netherlands	5	10	4	3.14
Turkey	4	7	4	2.79
Canada	2	7	3	3.00
Greece	4	6	3	3.00
Egypt	2	6	3	2.68
Thailand	2	5	3	2.60
Denmark	2	3	2	2.00
Ireland	2	2	2	2.00
Brazil	2	2	1	1.00
Indonesia	1	1	1	1.00
Italy	1	3	1	1.00
Malaysia	1	1	1	1.00
Spain	1	1	1	1.00
Saudi Arabia	1	1	1	0.47
Japan	1	1	1	0.40
South Africa	1	1	1	0.32

Table 4. Researchers Involved in at Least Four Papers

Researchers	Papers	Score	Affiliation
Tiong, R. L. K.	16	5.22	Nanyang Technological University, Singapore
Zhang, X. Q.	13	11.02	The Ministry of Water Resources of China, The University of Hong Kong, and The Hong Kong University of Science and Technology
Wang, S. Q.	7	2.92	Nanyang Technological University and National University of Singapore
Ye, S. D.	6	3.60	Nanyang Technological University, Singapore, and Beijing Jiaotong University, China
Kumaraswamy, M. M.	6	2.70	The University of Hong Kong
Akintoye, A.	6	2.29	Glasgow Caledonian University, U.K.
Ting, S. K.	6	1.00	Nanyang Technological University, Singapore
Ashley, D.	6	0.64	Ohio State University, United States
Wibowo, A.	4	3.60	Technische Universität Berlin, Germany and Ministry of Public Works of Indonesia
Shaoul, J.	4	3.47	University of Manchester, U.K.
Shen, L. Y.	4	1.96	The Hong Kong Polytechnic University
Pollock, A. M.	4	1.87	University of Edinburgh, U.K.
Hardcastle, C.	4	0.62	Glasgow Caledonian University, U.K.

papers in these journals and little or no publications were written by writers from Malaysia, Thailand, Indonesia, Philippines, etc., where an active PPP market has been seen.

Recent statistics show that there has been an increase of writers from different countries researching into the topic of PPP, as presented in Table 3. Similarly, more evidence to support this assertion can be seen in Tables 4 and 5. The analysis shows that 13 researchers contributed in at least four papers and 12 research centers were involved in at least four papers. Among them, R. L. K. Tiong from Nanyang Technological University, Singapore has published 16 papers, and X. Q. Zhang from The Ministry of Water Resources of China (formerly at The University of Hong Kong and currently at the Hong Kong University of Science and Technology) contributed 13 papers. Due to the efforts of these two researchers, their respective research centers also obtained high scores. Nanyang Technological University, Singapore has contributed 18 papers, followed by 11 of The University of Hong Kong, 9 in the National University of Singapore, and 7 in the Ministry of Water Resources of China and Glasgow Caledonian University, U.K. respectively.

The writers are recommended to cite a reference to its source when referring to all factual material that is not original. Also, a suitable reference can act as an evidence of the findings. Therefore, the citation analysis of selected papers could be considered

highly important for evaluating the contributions of the writers and the journals. Tables 6–8 list the most frequently cited papers, journals, and writers (all self-citations were already excluded). Among them, the paper of Grimsey and Lewis (2002) has been cited most. The research team of Wang, Tiong, Ting, and Ashley in Singapore contributed enormous efforts too, and four papers from this research team (Wang et al. 1998; Wang et al. 1999; Wang et al. 2000a; Wang et al. 2000b) were included in the most frequently cited papers. JCEM has been cited most for 189 times, followed by 135 in IJPM, and 118 in CME. From the viewpoint of times cited per PPP paper, JCEM, IJPM, and CME ranged from 4.73 to 3.69.

Research Interests in PPPs

As mentioned previously in this paper, diverse types of PPPs have been adopted in worldwide infrastructure development. Among these different types, build-operate-transfer (BOT) has been the most popular vehicle in the early years of PPP usage and development. However, through a closer look at the title of PPP papers in recent years, it could be seen that the variety of terms has appeared, which may indicate the evolution of partnerships be-

Table 5. Research Centers Involved in at Least Four Papers

Institution/University	Country	Researchers	Papers	Score
Nanyang Technological University	Singapore	12	18	12.67
The University of Hong Kong	Hong Kong	10	11	9.29
National University of Singapore	Singapore	5	9	4.54
The Ministry of Water Resources of China	China	1	7	7.00
Glasgow Caledonian University	U.K.	7	7	5.92
Ohio State University	United States	1	6	0.64
Loughborough University	U.K.	10	5	3.22
University of Melbourne	Australia	6	4	4.00
University College London	U.K.	5	4	4.00
University of Manchester	U.K.	2	4	4.00
Bauhaus-University Weimar	Germany	7	4	3.60
The Hong Kong Polytechnic University	Hong Kong	3	4	2.40

Table 6. Most Frequently Cited Papers

Writer/year	Document title	Times
Grimsey and Lewis (2002)	Evaluating the risks of public private partnerships for infrastructure projects	29
Wang et al. (1999)	Political risks: Analysis of key contract clauses in China's BOT project	19
Li et al. (2005c)	The allocation of risk in PPP/PFI construction projects in the U.K.	17
Ye and Tiong (2000)	NPV-at-risk method in infrastructure project investment evaluation	17
Wang et al. (2000a)	Evaluation and management of political risks in China's BOT projects	16
Akintoye et al. (2003)	Achieving best value in private finance initiative project procurement	15
Wang et al. (1998)	Evaluation and competitive tendering of BOT power plant project in China	14
Kumaraswamy and Zhang (2001)	Governmental role in BOT-led infrastructure development	14
Zhang (2005a)	Critical success factors for public-private partnerships in infrastructure development	14
Klijin and Teisman (2003)	Institutional and strategic barriers to public-private partnership: An analysis of Dutch cases	14
Wang et al. (2000b)	Evaluation and management of foreign exchange and revenue risks in China's BOT projects	13
Tam (1999)	Build-operate-transfer model for infrastructure developments in Asia: Reasons for successes and failures	13
Ho and Liu (2002)	An option pricing-based model for evaluating the financial viability of privatized infrastructure projects	13
Lam (1999)	A sectoral review of risks associated with major infrastructure projects	12

tween the public and private sectors. It was noticed that the concept and terms PPP or PFI were only more widely adopted since 2003.

Through the comprehensive review of these published papers, some similarities are observed especially in the research methodologies. A common research methodology adopted by researchers comprises of four key stages, namely, (1) topic identification; (2) data collection; (3) knowledge processing; and (4) validation process (Fig. 3). The first stage of the research methodology is normally achieved via a comprehensive literature review search from journals, conference proceedings, books, reports, articles, etc. Also, a postresearch study would be conducted to investigate the need for the research. Responses from the industry would be achieved and communication with other researchers would be carried out in order to consolidate the worthiness of the research study. After the "topic identification" the second stage of the study would typically be "data collection." This stage is often carried out via recognized techniques, such as literature review (Li et al. 2005b), case studies (Wang and Tiong 2000), interviews (Akintoye and Chinyio 2005), and questionnaire (Wang et al. 1999). The third stage of the methodology typically considers "knowledge processing." After the data collection the information is normally studied via techniques including statistical analysis (Zhang, 2006a), scenario analysis (Shen and Wu, 2005), simulation (Ye and Tiong 2000), and theoretical analysis (Shen et al. 2007). This stage will deliver the initial findings of the research study. The final stage of the methodology is normally the "validation process" which will deliver the research conclusions via focus group meetings, pilot studies as used by Ye and Tiong (2000) and Ho (2006), and further interviews. Considering the studies of Zhang (2006a,b) he first determined the objective, which was to seek a concession selection method to achieve "public clients' best value." Next the best value contributing factors were explored through case studies of international PPP practices, literature review, interviews, and correspondence with worldwide bureaucrats. Also, a structured questionnaire survey of the opinions from international PPP experts and researchers was conducted to identify the relative significance and rankings of previously identified factors. Using agreement analysis, factor

analysis, and other related statistical analyses, the writer determined the major common parameters that affected the public clients' best value objectives in infrastructure development.

In the study of Al-Sharif and Kaka (2004) they summarized that the PPP papers published during 1998–2003 of the selected construction journals could be categorized into three groups, namely, "risk," "procurement," and "financial." The proportions of papers within each of these groups are 44, 35 and 21% respectively. However, in the current study which collected papers published from 1998 to 2008, the results clearly indicated that new ideas and topics have been introduced. For instance, Li et al. (2005a), Vazquez and Allen (2004), Jefferies (2006), and Zhang (2005a,b) explored critical success factors for PPP in order to derive a best practice. In recent years, researchers such as Carrillo et al. (2006) and Leiringer (2006) also made investigations on knowledge transfer and innovations in PPPs. Therefore the three categories defined by Al-Sharif and Kaka (2004) might not be adequate for the continuous analysis of the publications from 1998 to 2008.

In this paper, seven categories are identified for the research interests of PPP papers including (1) investment environment; (2) procurement; (3) economics viability; (4) financial package; (5)

Table 7. Most Frequently Cited Journals

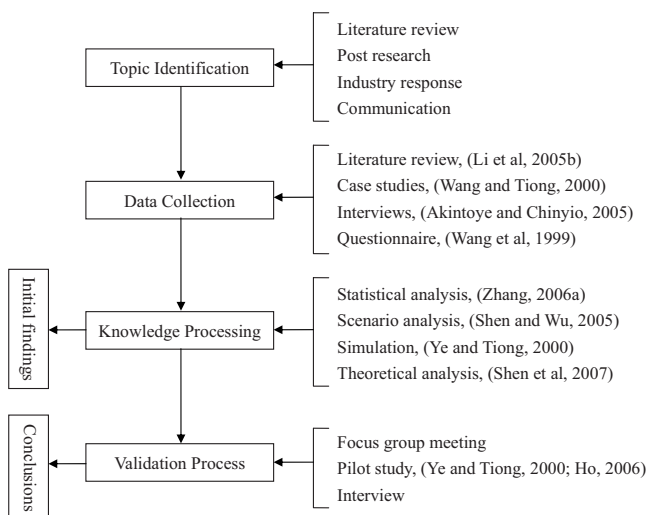
Journal	Total times	Times per paper
<i>Journal of Construction Engineering and Management</i>	189	4.73
<i>International Journal of Project Management</i>	135	4.50
<i>Construction Management and Economics</i>	118	3.69
<i>Journal of Management in Engineering</i>	19	2.71
<i>Public Money and Management</i>	72	2.67
<i>Proceedings of the ICE: Civil Engineering</i>	39	2.05
<i>Engineering, Construction and Architectural Management</i>	30	2.00

Table 8. Most Frequently Cited Writers

Researchers	Affiliation	Times cited
Tiong, R. L. K	Nanyang Technological University, Singapore	121
Wang, S. Q.	Nanyang Technological University and National University of Singapore	78
Zhang, X. Q.	The Ministry of Water Resources of China, The University of Hong Kong, and The Hong Kong University of Science and Technology	74
Ashley, D.	Ohio State University, United States	68
Ting, S. K.	Nanyang Technological University, Singapore	68
Akintoye, A.	Glasgow Caledonian University, U.K.	53
Kumaraswamy, M. M.	The University of Hong Kong	45
Hardcastle, C.	Glasgow Caledonian University, U.K.	43
Ye, S. D.	Nanyang Technological University, Singapore and Beijing Jiaotong University	29
Grimsey, D.	PricewaterhouseCoopers, Australia	29
Lewis, M. K.	University of South Australia	29
Li, B.	Glasgow Caledonian University, U.K.	28
Edwards, P. J.	RMIT University, Australia	28

risk management; (6) governance issue; and (7) integration research. Each of these categories of research interests includes the following topics:

1. **Investment environment:** government support, PPP guidelines, workable legal and regulatory framework, government's attitude, and public perspective;
2. **Procurement:** project identification, tendering, contract negotiations, concession period, and concessionaire selection;
3. **Economics viability:** financial feasibility, minimum revenue, minimum feasible tariff, evaluation techniques, and financial capability;
4. **Financial package:** capital structure, financing source, capital investment, payment mechanism, and debt interest;
5. **Risk management:** risk identification, risk evaluation, risk allocation, risk management, financial risk, political risk, and market risk;
6. **Governance issue:** relationship management, stakeholder management, PPP task forces, consortia management, and interface management; and
7. **Integration research:** critical success factors, best practice, positive and negative factors, knowledge innovations, and any other issues excluded from the above categories.

**Fig. 3.** General research methodology and common techniques

It may be considered uncertain and subjective to decide which topic research interest represents the scope of each paper (Themistocleous and Wearne 2000) but the analysis was undertaken by the same group of researchers: hence any variations in views could be eliminated. Also, this study was conducted merely for comparison purposes; hence the approach adopted is believed to be appropriate. Each paper was grouped under one main research interest. Even if the paper covered more than one research interest, the best-fit one was chosen. Based on this approach, the major research interests in PPP from 1998 to 2008 from the selected construction journals are shown in Table 9.

In recent years it has been obvious that the research interests in PPPs have been increasing. These include governance issues, investment environment, and other supported researches in order to find solutions and overcome problems of PPP projects. Taking “governance issues” for instance, researches such as interface management of China’s BOT projects (Chan et al. 2005), relationship management in PPP projects (Smyth and Edkinsa 2007), and stakeholder management for PPP projects (El-Gohary et al. 2006) were reported in these academic journals, as these papers are of value and interest to the industry. An increase in research interests as time goes by was also predicted in the conclusions of Al-Sharif and Kaka (2004). Research interests in PPP have continued to develop: for example in “risk management” researchers have been adopting more complicated and vigorous methods, such as the fuzzy set theory (Thomas et al. 2006), the game theory (Medda 2007), etc. instead of qualitative analyses that were used in earlier research work. More attention for this research interest has also been drawn on risk allocation of PPP projects (Li et al. 2005c; Abednego and Ogunlana 2006; Ng and Loosemore 2007)

Conclusions

PPP is becoming an increasingly important vehicle to deliver public infrastructure development and public service. At the same time, researchers are also active to review international PPP practices and explore valuable strategies for better implementation. This paper conducted a two-stage review of related articles published using the search engine “Scopus” in the first stage and then a visual examination of all related papers in the seven selected construction journals, namely, CME, IJPM, ECAM, JCEM, JME,

Table 9. Major Research Interests of PPP Papers

Topic	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total	%
Risk management	2	2	5	0	2	5	1	4	5	2	7	35	20.6
Integration research	4	3	0	0	6	1	2	5	6	4	3	34	20.0
Governance issue	0	1	1	3	0	7	1	1	6	4	7	31	18.2
Investment environment	0	1	2	2	0	5	2	1	4	2	2	21	12.4
Procurement	2	1	0	1	2	0	3	2	2	5	1	19	11.2
Economics viability	0	3	1	0	2	1	2	3	3	2	2	19	11.2
Financial package	1	0	0	2	0	4	0	1	2	1	0	11	6.5

PICE-CE, and PMM, in order to identify the research trends in the field of PPP from 1998 to 2008.

Between 1998 and 2008, 170 papers relating to PPP were published in these journals. The range of research interests in PPP shown in these journals has been increasing steadily. From the content analysis reported in this paper, the importance of PPPs is obvious. This study has identified profound evidence to show the increasing impact of PPP to the construction industry. The U.K. researchers were found to be the originators of most PPP papers, followed by the United States, Singapore, Hong Kong, Australia, China, and Germany. The potential reasons why these countries produce more PPP papers than other countries could be due to construction education, national economics, mother language, or the limitation of journals surveyed. In the academic community, Nanyang Technological University in Singapore, The University of Hong Kong, National University of Singapore, and Glasgow Caledonian University in the U.K. have been identified as active institutions in pursuing PPP research.

It was also found that various modes of PPP have been applied in different parts of the world, and the diverse concept of PPP has been publicly accepted instead of the more traditional BOT scheme alone. A general research framework and common techniques for conducting PPP studies have been identified. There has been an increase in research interests in PPP. The three traditional topics risk, procurement, and financial have been expanded to a spectrum of seven categories including (1) investment environment; (2) procurement; (3) economics viability; (4) financial package; (5) risk management; (6) governance issue; and (7) integration research. For the three traditional research interests, the techniques adopted vary from qualitative to quantitative analyses, and some have included more vigorous techniques/theories in researching in this field.

This study has provided a general overview of the development of PPPs in the academic field and has hence formed a solid platform for scholars and the academe to continue to build from. A better understanding of the research trend in PPP may enable the practitioners to appreciate the key issues in PPP development and hence better able to drive PPP projects which are seen as global trend in delivering major infrastructure projects. The analyses of writers' contribution to PPP research also provide great potential for both scholars and practitioners to seek for a cooperation opportunity. A list of the most-cited papers on PPP could also benefit the profession by suggesting additional readings on PPP-related topics.

Acknowledgments

The writers gratefully acknowledge the Research Grants Council of the Hong Kong Special Administrative Region, China (RGC Project Nos. PolyU 511405 and N_PolyU514/07) and the National

Natural Science Foundation of China (Project No. 70731160634) for providing funding to support this research effort.

Appendix

PPP papers identified in the selected construction journals from 1998 to 2008:

Number	Journal	Year	Issue	Writers	Topic
1	CME	2008	11	Brandao, L. E. T., Saraiva, E.	Inv.
2	CME	2008	11	Raisbeck, P.	Ris.
3	CME	2008	9	Chiara, N., Garvin, M. J.	Ris.
4	CME	2008	7	Roumboutsos, A., Anagnostopoulos, K. P.	Ris.
5	CME	2008	7	Jin, X. H., Doloi, H.	Ris.
6	CME	2008	6	Smyth, H.	Gov.
7	CME	2007	9	Ng, S. T., Wong, Y. M. W.	Gov.
8	CME	2007	5	Aziz, A. M. A.	Fin.
9	CME	2006	10	Carrillo, P. M., Robinson, H. S., Anumba, C. J., Bouchlaghem, N. M.	Int.
10	CME	2006	5	Cheah, C. Y. J., Liu, J. C.	Inv.
11	CME	2006	4	Thomas, A. V., Kalidindi, S. N., Ganesh, L. S.,	Ris.
12	CME	2006	4	Huang, Y. L., Chou, S. P.	Eco.
13	CME	2006	3	El-Diraby, T. A., Gill, S. M.	Ris.
14	CME	2006	3	Leiringer, R.	Int.
15	CME	2005	9	Chen, C., Messner, J. I.	Int.
16	CME	2005	6	Wibowo, A.	Eco.
17	CME	2005	5	Li, B., Akintoye, A., Edwards, P. J., Hardcastle, C.	Int.
18	CME	2005	4	Xenidis, Y., Angelides, D.	Ris.
19	CME	2005	3	Cheng, L. Y., Tiong, R. L. K.	Eco.
20	CME	2004	9	Ahadzi, M., Bowles, G.	Pro.
21	CME	2004	7	Vazquez, F., Allen, S.	Int.
22	CME	2004	4	Garvin, M. J., Cheah, C. Y. J.	Eco.
23	CME	2003	5	Akintoye, A., Hardcastle, C., Beck, M., Chinyio, E.	Gov.
24	CME	2003	5	Ye, S. D., Tiong, R. L. K.	Ris.
25	CME	2003	4	Thomas, A. V., Kalidindi, S. N., Ananthanarayanan, K.	Ris.
26	CME	2003	4	Ye, S. D., Tiong, R. L. K.	Eco.
27	CME	2002	2	Ho, S. P., Liu, L. Y.	Eco.
28	CME	2000	3	Wang, S. Q., Tiong, R. L. K., Ting, S. K., Ashley, D.	Ris.
29	CME	2000	3	Ozdoganm, I. D., Birgonul, M. T.	Ris.
30	CME	2000	2	Wang, S. Q., Tiong, R. L. K., Ting, S. K., Ashley, D.	Ris.

Number	Journal	Year	Issue	Writers	Topic	Number	Journal	Year	Issue	Writers	Topic
31	CME	1999	5	Ranasinghe, M.	Eco.	71	IJPM	2002	2	Grimsey, D., Lewis, M. K.	Ris.
32	CME	1999	5	Miller, J. B., Evje, R. H.	Pro.	72	IJPM	2001	4	Kumaraswamy, M. M., Zhang, X. Q.	Inv.
33	ECAM	2008	2	Swaffield, L. M., McDonald, A. M.	Gov.	73	IJPM	2000	4	Yeo, K. T., Tiong, R. L. K.	Ris.
34	ECAM	2007	6	Kumaraswamy, M. M., Liu, Y. Y., Anvuur, A. M., Rahman, M. M.	Gov.	74	IJPM	2000	1	Wang, S. Q., Tiong, R. L. K.	Inv.
35	ECAM	2007	5	Hassanein, A. A. G., Khalifa, R. A.	Gov.	75	IJPM	1999	6	Tam, C. M.	Int.
36	ECAM	2006	5	Jefferies, M.	Int.	76	IJPM	1999	2	Lam, P. T. I.	Ris.
37	ECAM	2006	3	Arboleda, C. A., Abraham DM	Fin.	77	IJPM	1998	2	Gupta, J. P., Sravat, A. K.	Int.
38	ECAM	2006	2	Ng, S. T., Wong, Y. M. W.	Int.	78	JCEM	2008	11	Kong, D., Tiong, R. L. K., Cheah, C. Y. J., Permana, A., Ehrlich, M.	Ris.
39	ECAM	2005	6	Akintoye, A., Chinyio, E.	Ris.	79	JCEM	2008	2	Ye, S. D., Liu, Y. S.	Pro.
40	ECAM	2005	2	Li, B., Akintoye, A., Edwards, P. J., Hardcastle, C.	Int.	80	JCEM	2008	1	Liou, F. M., Huang, C. P.	Ris.
41	ECAM	2004	6	Wibowo, A.	Inv.	81	JCEM	2007	12	Aziz, A. M. A.	Int.
42	ECAM	2002	4	Jefferies, M., Gameson, R., Rowlinson, S.	Int.	82	JCEM	2007	10	Algarni, A. M., Arditi, D., Polat, G.,	Int.
43	ECAM	2000	4	Ye, S. D., Tiong, R. L. K.	Inv.	83	JCEM	2007	8	Vassallo, J. M.	Pro.
44	ECAM	1999	1	Zantke, G., Mangels, B.	Inv.	84	JCEM	2007	5	Shen, L. Y., Bao, H. J., Wu, Y. Z., Lu, W. S.	Pro.
45	ECAM	1998	4	Zhang, W. R., Wang, S. Q., Tiong, R. L. K., Ting, S. K.	Ris.	85	JCEM	2007	2	McCowan, A. K., Mohamed, S.	Pro.
46	ECAM	1998	1	Akintoye, A., Taylor, C., Fitzgerald, E.	Ris.	86	JCEM	2007	1	Subprasom, K., Chen, A.	Inv.
47	ECAM	1998	1	Saunders, A.	Fin.	87	JCEM	2007	1	Salman, A. F. M., Skibniewski, M. J., Basha, I.	Eco.
48	IJPM	2008	6	Marrewijk, A. V., Clegg, S. R., Pitsis, T. S., Veenswijk, M.	Gov.	88	JCEM	2006	9	Zhang, X. Q.	Pro.
49	IJPM	2008	4	Daube, D., Vollrath, S., Alfen, H. W.	Eco.	89	JCEM	2006	7	Ho, S. P.	Inv.
50	IJPM	2008	4	Chen, C., Doloi, H.	Int.	90	JCEM	2006	3	Wibowo, A.	Eco.
51	IJPM	2007	8	Ng, S. T., Xie, J. Z., Cheung, Y. K., Jefferies, M.	Pro.	91	JCEM	2006	2	Zhang, X. Q.	Pro.
52	IJPM	2007	3	Smyth, H., Edkinsa, A.	Gov.	92	JCEM	2005	10	Zhang, X. Q.	Eco.
53	IJPM	2007	3	Medda, F.	Ris.	93	JCEM	2005	9	Wibowo, A., Kochendörfer, B.	Ris.
54	IJPM	2007	1	Ng, A., Loosemore, M.	Ris.	94	JCEM	2005	6	Zhang, X. Q.	Fin.
55	IJPM	2006	7	Abednego, M. P., Ogunlana, S. O.	Ris.	95	JCEM	2005	6	Chan, W. T., Chen, C., Messner, J. I., Chua, D. K. H.	Gov.
56	IJPM	2006	7	Shen, L. Y., Platten, A., Deng, X. P.	Ris.	96	JCEM	2005	6	Zhang, X. Q.	Pro.
57	IJPM	2006	7	Holmes, J., Capper, G., Hudson, G.	Gov.	97	JCEM	2005	2	Shen, L. Y., Wu, Y. Z.	Pro.
58	IJPM	2006	7	Singh, L. B., Kalidindi, S. N.	Ris.	98	JCEM	2005	1	Zhang, X. Q.	Int.
59	IJPM	2006	7	Clifton, C., Duffield, C. F.	Gov.	99	JCEM	2005	1	Zhang, X. Q.	Int.
60	IJPM	2006	7	El-Gohary, N. M., Osman, H., El-Diraby, T. E.	Gov.	100	JCEM	2004	5	Zhang, X. Q.	Pro.
61	IJPM	2006	7	Koch, C., Buser, M.	Inv.	101	JCEM	2004	3	Sentuerk, H. A., Yazici, G., Kaplanoglu, S. B.	Gov.
62	IJPM	2006	7	Kleiss, T., Imura, H.	Inv.	102	JCEM	2004	2	Zhang, X. Q.	Pro.
63	IJPM	2006	7	Fischer, K., Jungbecker, A., Alfen, H. W.	Gov.	103	JCEM	2003	6	Ye, S. D., Tiong, R. L. K.	Ris.
64	IJPM	2006	7	Devapriya, K. A. K.	Fin.	104	JCEM	2003	2	Schaufelberger, J. E., Wipadapisut, I.	Fin.
65	IJPM	2006	3	Chen, M. S., Lu, H. F., Lin, H. W.	Int.	105	JCEM	2003	1	Bakatjan, S., Arikan, M., Tiong, R. L. K.	Fin.
66	IJPM	2006	1	Consoli, G. G. S.	Gov.	106	JCEM	2002	4	Shen, L. Y., Li, H., Li, Q. M.	Pro.
67	IJPM	2005	1	Li, B., Akintoye, A., Edwards, P. J., Hardcastle, C.	Ris.	107	JCEM	2002	2	Kumaraswamy, M. M., Morris, D. A.	Int.
68	IJPM	2004	5	Smith, N., Zhang, H., Zhu, Y. R.	Eco.	108	JCEM	2002	2	Kwak, Y. H.	Int.
69	IJPM	2004	1	Lemos, T., Eaton, D., Betts, M., Almeida, L. T.	Ris.	109	JCEM	2002	2	Zhang, X. Q., Kumaraswamy, M. M., Zheng, W., Palaneeswaran, E.	Pro.
70	IJPM	2002	8	Merrifield, A., Manchidi, T. E., Allen, S.	Int.	110	JCEM	2001	6	Aziz, A. R. A.	Inv.
						111	JCEM	2001	5	Zhang, X. Q., Kumaraswamy, M. M.	Pro.
						112	JCEM	2001	3	Chang, L. M., Chen, P. H.	Fin.
						113	JCEM	2001	2	Zhang, X. Q., Kumaraswamy, M. M.	Gov.
						114	JCEM	2000	3	Ye, S. D., Tiong, R. L. K.	Eco.

Number	Journal	Year	Issue	Writers	Topic	Number	Journal	Year	Issue	Writers	Topic
115	JCEM	2000	3	Wang, S. Q., Tiong, R. L. K., Ting, S. K., Ashley, D.	Ris.	160	PMM	2003	3	Klijn, E. H., Teisman, G. R.	Inv.
116	JCEM	1999	3	Wang, S. Q., Tiong, R. L. K., Ting, S. K., Ashley, D.	Ris.	161	PMM	2003	3	Reeves, E.	Inv.
117	JCEM	1998	4	Wang, S. Q., Tiong, R. L. K., Ting, S. K., Chew, D.	Pro.	162	PMM	2003	3	Fischbacher, M., Beaumont, P. B.	Gov.
118	JME	2008	3	Carrillo, P. M., Robinson, H. S., Foale, P., Anumba, C. J., Bouchlaghem, D.	Int.	163	PMM	2003	3	Grubnic, S., Hodges, R.	Gov.
119	JME	2008	3	Tawiah, P. A., Russell, A. D.	Int.	164	PMM	2003	3	Shaoul, J.	Fin.
120	JME	2002	4	Askar, M. M., Gab-Allah, A. A.	Int.	165	PMM	2003	3	Asenova, D., Beck, M.	Ris.
121	JME	2002	1	Zayed, T. M., Chang, L. M.	Ris.	166	PMM	2002	2	Shaoul, J.	Eco.
122	JME	1999	4	Malini, E.	Eco.	167	PMM	2001	4	Wakeford, J., Valentine, J.	Gov.
123	JME	1999	1	deMonsabert, S., Buede, D., Vasilakopoulou, E.	Gov.	168	PMM	2001	3	Kirk, R. J., Wall, A. P.	Gov.
124	JME	1998	3	Lo, W., Chao, C. H., Hadavi, A., Krizek, R. J.	Pro.	169	PMM	1999	3	Glaister, S.	Int.
125	PICE-CE2006		5	Sohail, M., Bateman, J., Cotton, A., Reed, B.	Int.	170	PMM	1999	1	Gaffney, D., Pollock, A. M.	Eco.
126	PICE-CE2004		4	Freer, R.	Int.						
127	PICE-CE2003		5	Gambrill, B.	Int.						
128	PICE-CE2003		5	Bayley, M.	Ris.						
129	PICE-CE2003		5	Cathcart, A.	Gov.						
130	PICE-CE2003		5	Standen, D.	Fin.						
131	PICE-CE2003		5	Kennerley, J. A.	Gov.						
132	PICE-CE2003		5	Gambrill, B.	Inv.						
133	PICE-CE2003		5	Gambrill, B.	Inv.						
134	PICE-CE2003		5	Bowman, S.	Inv.						
135	PICE-CE2003		5	Keeling, D.	Gov.						
136	PICE-CE2003		5	French, S.	Gov.						
137	PICE-CE2002		4	Hadjihambi, M., Deriziotis, A.	Int.						
138	PICE-CE2001		5	Maxwell, D. E.	Fin.						
139	PICE-CE2000		3	Gellatly, G. M., Burtwistle, P., Baldwin, A. N.	Gov.						
140	PICE-CE1999		4	Merna, A., Smith, N. J.	Int.						
141	PICE-CE1998		3	Grubb, S. R. T	Int.						
142	PICE-CE1998		1	Tiffin, M., Hall, P.	Int.						
143	PICE-CE1998		2pt2	Robertson, J. G.	Int.						
144	PMM	2008	3	Barretta, A., Busco, C., Ruggiero, P.	Gov.						
145	PMM	2008	3	Pollock, A. M., Price, D.	Ris.						
146	PMM	2008	3	Charles, M. B., Ryan, R., Castillo, C. P., Brown, K.	Gov.						
147	PMM	2008	3	Weihe, G.	Gov.						
148	PMM	2008	3	van Gestel, N., Koppenjan, J., Schrijver, I., van de Ven, A., Veeneman, W.	Inv.						
149	PMM	2008	2	Jones, R., Noble, G.	Gov.						
150	PMM	2008	2	Shaoul, J., Stafford, A., Stapleton, P.	Eco.						
151	PMM	2007	5	Reeves, E., Ryan, J.	Pro.						
152	PMM	2007	5	Hellowell, M., Pollock, A. M.	Int.						
153	PMM	2007	2	Pollock, A. M., Price, D., Player, S.	Eco.						
154	PMM	2007	1	McMurray, R.	Inv.						
155	PMM	2007	1	Jupe, R.	Int.						
156	PMM	2006	5	Boin, A., Smith, D.	Gov.						
157	PMM	2006	3	Shaoul, J.	Eco.						
158	PMM	2005	3	Jupe, R.	Inv.						
159	PMM	2004	3	Hodges, R., Mellett, H.	Inv.						

Note: Inv.=investment environment; Pro.=procurement; Eco.=economic viability; Fin.=financial package; Ris.=risk management; Gov.=governance issue; and Int.=integration research.

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