



## A profile of information systems research published in expert systems with applications from 1995 to 2008

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### ABSTRACT

Expert systems with applications (ESWA) has been regarded as one of the highly qualified journals in the information system. This paper profiles research published in ESWA from 1995 to 2008. Based on the multidimensional analysis, we identified the most productive author and universities, research paper numbers per geographic region, and the most employed issues and methodologies used by the most highly published authors. Our results indicate that (1) ESWA is clearly an internationalized journal, (2) the most employed methodologies are fuzzy ESs and knowledge-based systems, and (3) the leading highly published authors always have diverse methodologies and applications. Furthermore, the implications for researchers, journal editors, universities, and research institution are presented.

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### 1. Introduction

Expert system is a kind of information system, a subfield of artificial intelligence, and a software that is used to reproduce the performance of one or more human experts. The simulation of performance of the expert is to help human workers solve real world problems by expertise, a specific domain of knowledge. There are diverse problems which need to be solved in the real world. Thus, the use of expert system becomes prolific in many fields (Liao, 2005). ESWA is regarded as one of the distinguished international journals which focus on expert and intelligent systems applied to real world problems globally. As a journal of expert and intelligent systems, it addresses many problems, methods, and performance. Therefore, it is useful for IS researchers to examine the major research issues in expert and intelligent systems and their trends in order to continuously progress the research.

This paper profiles the types of research that have been published in ESWA from 1995 to 2008. The overview of research published in the journal provides a broader understanding of IS for authors, reviewers, and journal editors, universities, and research institutions (Avison, Dwivedi, Fitzgerald & Powell, 2008). It is worthwhile to classify, categorize, and profile this paper into various dimensions, such as research issue (Alavi & Carlson, 1992; Claver, Gonzalez, & Llopis, 2000; Culnan & Swanson, 1986; Farhoomand & Drury, 1999; Vessey, Ramesh, & Glass, 2002), research methodology (Chen & Hirschheim, 2004; Grover, Lee, &

Durand, 1993; Ives, Hamilton, & Davis, 1980; Palvia, 2004; Palvia, Mao, Salam & Soliman, 2003), productive authors and university (Athey & Plotnicki, 2000; Im, Kim, & Kim, 1998; Nath & Jackson, 1991), because the results could provide some frequently called for guidelines and suggestions on how to publish in highly rated journals. Thus, this paper analyzes publication trends in ESWA to realize those objectives as follows:

1. To identify the most productive authors.
2. To identify the universities associated with the most research publications.
3. To identify the research impact of the most productive authors and geographic location based on the AIS classification.
4. To determine the issues and methodologies most investigated and analyze their trends.
5. To discuss the issues and methodologies of the most productive authors.

To achieve these objectives, a systematic and comprehensive review is needed. This review is constructed as follows. The next section describes the research methodology used in this paper. The third section presents the results of data analysis. The final section is the conclusion and implications of this research.

### 2. Research method

Expert system with applications published their first issue in 1990 and had full online information from this journal and was opened to general users in 1995. Thus this paper surveys the development of ESWA from 1995 to 2008. To focus on research articles,

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we follow Gallivan and Benbunan-Fich's suggestions to exclude editorials, guest editorials and book reviews from the analysis (Gallivan & Benbunan-Fich, 2007). Research articles between 1995 and 2008 totaled 1836 articles.

For a detailed analysis, each article was carefully examined to capture the relevant data. Relevant data include title, author, subject terms, abstract, affiliation, publication, year, and citations. Various items were counted and recorded for each article including the productivity of authors, geographic regions, author's background, research issues, and the impact of the research by the most productive authors. We used self citation within ESWA, ISI citation counts, and Google's scholar citation counts to assess the number of contributions per author. Institutional productivity was assessed by using each publication counted as one for all authors regardless of the number of co-authors from the same university (Avison et al., 2008; Yogesh & Jasna, 2008). The geographic location variables were counted and categories were based on the AIS guidelines. The profile of methodologies employed in this research is from a review of expert system methodologies and applications (Liao, 2005). Liao (2005) collects 166 articles from 78 journals from the year 1995–2004, surveys and classifies ES methodologies using 11 categories: rule-based systems, knowledge-based systems, neural network, fuzzy ESs, object-oriented methodology, case-based reasoning (CBR), system architecture development, intelligent agent (IA) systems, modeling, ontology, and database methodology. We collected relevant subjects of 11 categories. Then those subjects were used to classify the title, keywords, and abstract of the articles. The issues and methodologies of the most productive authors were also counted.

It is essential to emphasize that the findings of this study including the most productive authors and universities should be regarded as 'indicative and not an authoritative statement' (Palvia, Pinjani, & Sibley, 2007). This is because such profiling analysis was applied only within ESWA. Some important researchers and universities might not have published in ESWA. They may have expertise and skills to publish in other important outlets. Therefore, similar to previous profiling studies (Claver et al., 2000; Palvia et al., 2007), it is best to interpret these results cautiously.

### 3. Results

#### 3.1. Productive authors

For assessing research productivity, an analysis is made of the authors who have published the most during the period 1995–2008 in the expert system with applications. All publications naming the researcher are counted equally (Palvia, Pinjani, et al., 2007; Yogesh & Jasna, 2008). For example, an article with two co-authors would provide one count for each. This approach results in the combined count of all authors being greater than the total number of articles. The findings of this study only include authors who have published 10 or more articles during the period 1995–2008 for reporting purposes. Table 1 lists the 11 most productive authors, sorted by the number of publications, along with the association for information systems (AIS) region and current affiliation. The top 11 authors with 10 or more publications are: Ingoo Han, Tzung-Pei Hong, Elif Derya Ubeyli, Dirk Van den Poel, Salih Gune, So Young Sohn, Shyi-Ming Chen, Kemal Polat, Yueh-Min Huang, Sang Chan Park, and Inan Guler. The geographical regions suggested by AIS are region 1 (America), region 2 (Europe, the Middle East and African), and region 3 (the Asia and Pacific). It is quite obvious that the most productive authors came from region 2 and region 3. This is because ESWA has attracted non-American authors and has become an internationalized IS journal.

**Table 1**  
Top 11 productive authors.

Name	Affiliation	AIS region	Count
Ingoo Han	Korea Advanced Institute of Science and Technology	3	26
Tzung-Pei Hong	National University of Kaohsiung	3	13
Elif Derya Ubeyli	TOBB Ekonomi ve Teknoloji Üniversitesi	2	13
Dirk Van den Poel	Ghent University	2	13
Salih Gune	Selcuk University	2	12
So Young Sohn	Yonsei University	3	11
Shyi-Ming Chen	National Taiwan University of Science and Technology	3	11
Kemal Polat	Selcuk University	2	11
Yueh-Min Huang	National Cheng Kung University	3	10
Sang Chan Park	Korea Advanced Institute of Science and Technology	3	10
Inan Guler	Gazi University	2	10

#### 3.2. Leading research university

To assess the contribution of institutions and or universities, an analysis is made of institutions and or universities which have published the most during the period 1995–2008. As stated previously, the results should be regarded as indicative and not as an authority's statement of university research. It was misleading to have several researchers from the same university co-authoring an article (Palvia, Pinjani, et al., 2007). Therefore a university was counted only once when it had two or more authors on a single publication. Table 2 lists the top 10 universities having 23 or more articles published in ESWA during the period 1995–2008. A total of 12 are listed as the top 10 universities because there are three universities having the same counts. The top place in the lists is Korea Advanced Institute of Science and Technology, with 90 contributions. The next 11 universities are National Chiao-Tung University, National Cheng-Kung University, Yonsei University, National Yunlin University of Science and Technology, Hong Kong Polytechnic University, Yuan-Ze University, National Taiwan University of Science and Technology, National Central University, Firat University, National Kaohsiung First University of Science and Technology, and Nanyang Technological University. It may show that Asian universities and researchers are more likely to prefer this internationalized journal focusing on expert and knowledge domain.

#### 3.3. Research numbers by AIS region

The association of information system (AIS) suggests that the geographical regions are region 1 (America), region 2 (Europe,

**Table 2**  
Top 10 productive universities.

Rank	School	Counts
1	Korea Advanced Institute of Science and Technology	90
2	National Chiao-Tung University	59
3	National Cheng-Kung University	55
4	Yonsei University	32
5	National Yunlin University of Science and Technology	31
6	Hong Kong Polytechnic University	29
7	Yuan-Ze University	28
8	National Taiwan University of Science and Technology	27
9	National Central University	24
10	Firat University	23
10	National Kaohsiung First University of Science and Technology	23
10	Nanyang Technological University	23

the Middle East and African), and region 3 (the Asia and Pacific). An analysis is made of the regions. Fig. 1 lists the total number of contributions by AIS regions during the period 1995–2008. Before the year 2000, the total number of articles of region 1 (America) reached its highest in 1998. After the year 2001 region 2 (Europe, the Middle East and African) and region 3 (the Asia and Pacific) grew consistently. After the year 2006 all regions grew quickly because the journal received more and more articles and also has more capacity to publish more articles.

3.4. Research methodologies

The profile of methodologies employed in this research follows Liao's (2005) 11 categories: rule-based systems, knowledge-based systems, neural network, fuzzy ESs, object-oriented methodology, case-based reasoning (CBR), system architecture development, intelligent agent (IA) systems, modeling, ontology, and database methodology (Liao, 2005). We collected the keywords from the Liao's relevant 11 categories and listed them in Appendix A.

We used the keywords in three stages to attribute a total of 1836 articles to 11 categories. The first stage was to compare the collected keywords to each title of research article. There are 757 identified articles and 1079 articles are unidentified. The second stage was to analyze the 1079 articles by comparing the collected keywords to each keyword of each research article. There are 392 identified leaving 687 articles unidentified. The third stage was to analyze the 687 articles by comparing the collected keywords to each abstract of each research article. There are 354 identified articles and 333 articles are unidentified. After three stage analysis

the totals are 1503 articles identified and 333 articles unidentified. The identified rate is 81.86%. Fig. 2 lists the number of 11 categories published during the period 1995–2008. The most popular methodology is fuzzy ESs, followed by knowledge-based systems and neural network. From 1990, fuzzy became more and more an important issue worldwide because of the uncertainty in problem solving. It is not surprising that the fuzzy systems were of most concern to the expert and intelligence research community.

3.4.1. Trends in research methodologies

To see the trends in research methodologies, we display 11 categories year by year during the period 1995–2008. Fig. 3 lists the trends in research methodologies. The results show that fuzzy ESs started high in the mid 1990s, went down in 2001 and reached the top in 2008. The neural network started to grow quickly from 2003 and reached second in 2008. The knowledge-based systems are constantly in the high rate of publications and rise up to rank third in 2008. The rank fourth is rule-based systems. Other methodologies always show a low rate in the trend analysis.

3.5. Leading research profiles

The profile of leading research provides important information for researchers to realize what leading authors researched. Junior researchers learn much from publications of leading authors and find some niches to continue their careers. Two analyses were made of issues and methodologies researched by leading authors. Table 3 lists the researched issues by top 11 authors. Table 4 presents the preferred research methodologies by the top 11 authors.

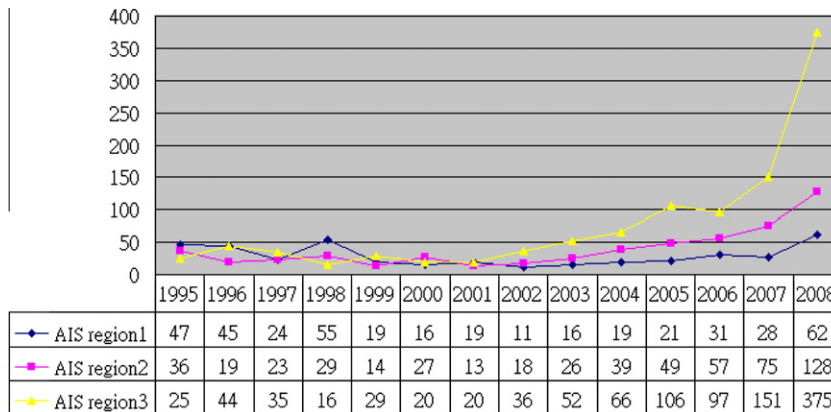


Fig. 1. Research numbers by AIS region.

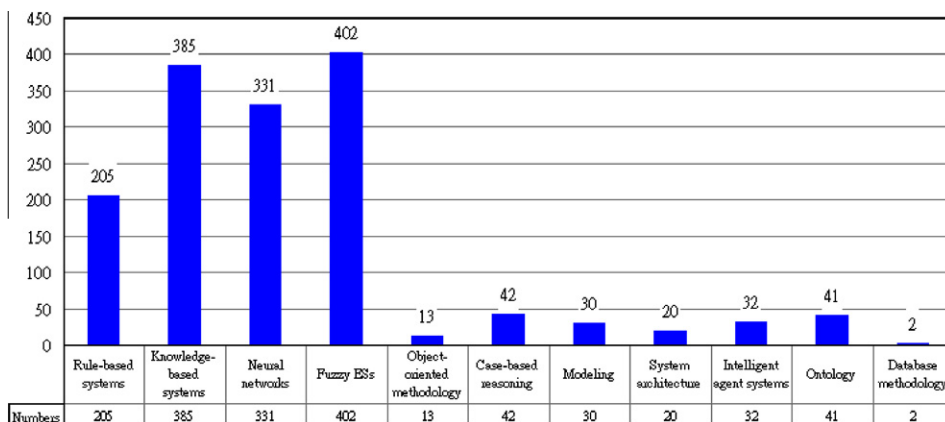


Fig. 2. The number of 11 categories.

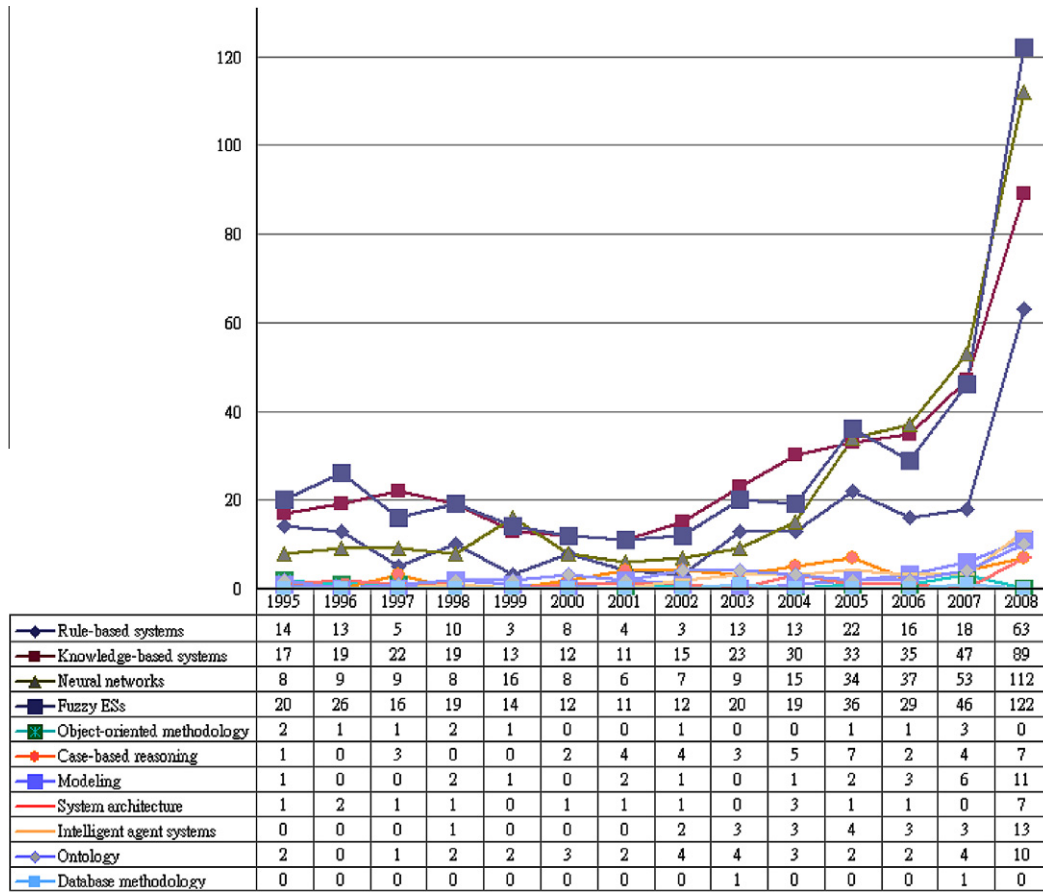


Fig. 3. Trends in research methodologies.

Table 3  
Researched issue by top 11 authors.

Name	Affiliation	Issue researched
Ingoo Han	Korea Advanced Institute of Science and Technology	Action mechanism, virtual community recommender, information noise CRM, bankruptcy prediction, stock price index credit risk, mobile, recommendation, IDS behavior of physicians, activity-based costing prediction of interest rate, maintaining system bond rating, exchange-rate forecasting impact of measurement scale
Tzung-Pei Hong	National University of Kaohsiung	Efficient sanitization, FP tree, bit-based feature selection, machine learning, data mining, parallelized indexing, classification, knowledge-integration, medical
Elif Derya Ubeyli	TOBB Ekonomi ve Teknoloji Üniversitesi	Medical
Dirk Van den Poel	Ghent University	CRM, marketing
Salih Gune	Selcuk University	Medical, medical DSS
So Young Sohn	Yonsei University	Mobile service, CRM, finance, dynamic scoring government fund, bipartite scorecard, selecting air force pilot trainee, commercialization, credit operations
Shyi-Ming Chen	National Taiwan University of Science and Technology	Students' evaluation, fuzzy system, adapting learning systems, fuzzy risk, temperature prediction, document retrieval, text categorization estimating null values
Kemal Polat	Selcuk University	Medical, medical DSS
Yueh-Min Huang	National Cheng Kung University	Net work, E-learning, adaptive learning, multiprocessor system, proportionate flow shop mining interesting patterns, intelligent, human-expert forum system, job-scheduling
Sang Chan Park	Korea Advanced Institute of Science and Technology	Minimizing information gap, visualization of patent analysis, personalization CRM, electronic commerce, process control system evaluation, integrated yield management in semiconductor manufacturing, database marketing
Inan Guler	Gazi University	Image restoration, medical

**Table 4**  
Preferred research methodology by top 11 authors.

Name	Affiliation	Employed research methodology
Ingoo Han	Korea Advanced Institute of Science and Technology	Rule-based Knowledge-based Neural network Fuzzy ESs Object-oriented Cased-based System architecture Intelligent agent system Modeling Ontology
Tzung-Pei Hong	National University of Kaohsiung	Rule-based Knowledge-based Neural network Fuzzy ESs Object-oriented Cased-based Intelligent agent system Ontology
Elif Derya Ubeyli	TOBB Ekonomi ve Teknoloji Üniversitesi	Rule-based Knowledge-based Neural network Fuzzy ESs Cased-based System architecture Intelligent agent system Database Modeling
Dirk Van den Poel	Ghent University	Knowledge-based Neural network Fuzzy ESs Ontology
Salih Gune	Selcuk University	Rule-based Knowledge-based Neural network Fuzzy ESs Cased-based System architecture Database Modeling
So Young Sohn	Yonsei University	Knowledge-based Neural network Fuzzy ESs Object-oriented
Shyi-Ming Chen	National Taiwan University of Science and Technology	Rule-based Fuzzy ESs System architecture Intelligent agent system
Kemal Polat	Selcuk University	Rule-based Knowledge-based Neural network Fuzzy ES Cased-based System architecture Database Modeling Ontology
Yueh-Min Huang	National Cheng Kung University	Rule-based Knowledge-based Neural network Fuzzy ESs Object-oriented Cased-based System architecture Modeling Intelligent agent system Ontology

**Table 4 (continued)**

Name	Affiliation	Employed research methodology
Sang Chan Park	Korea Advanced Institute of Science and Technology	Rule-based Knowledge-based Neural network Fuzzy ESs Object-oriented Cased-based Intelligent agent system Modeling Ontology
Inan Guler	Gazi University	Rule-based Knowledge-based Neural network Fuzzy ESs Cased-based System architecture Database Modeling Intelligent agent system

Most leading researchers have focused their attention on the industry or different methods. For example, professor Han focuses on financial field, professors Ubeyli and Gune focus on medical field, professor Poel focuses on marketing, and professors Hong and Chen use diverse methods to solve specific problems in a domain. Even though top leading researchers seem to be dealing with different issues, they still focus on a few domains. When they pay more attention to a specific research stream, they are able to solve more core problems in a domain.

#### 4. Conclusions and implications

It is important for any field or any journal to do self-introspection in order to realize what happened inside of a journal or a field. This paper profiles the researches that have been published in ESWA from 1995 to 2008. Some interesting results emerge by analyzing the data during the period.

First, ESWA is really an internationalized journal from the viewpoint of geography. There are no significant differences in the number of publications between the three regions before the year 2001. After the year 2001 Asia and Pacific (region 3) published more articles, followed by region 2 (the Europe, Middle East and African) and region 1 (America). Second, the results of the leading research universities show that Asian universities and researchers contributed more to this journal, especially after the year 2001. Third, the more popular methodologies are fuzzy ESs, knowledge-based systems, and neural network. Finally, there are many researchers who develop mathematical models or specialize in analyzing problems that are seen in the real world. Most productive authors deal with diverse issues. Similarly most productive authors employed diverse methodologies to solve problems because they confront different difficulties.

There are several implications for researchers, journal editors, research institutions or universities. First, the analysis of this study shows that leading authors deal with different issues with diverse methods. But they still focus their interests and preferred methodologies on certain research streams. Second, leading authors also develop sophisticated mathematical models or specialize in solving problems that emerge in the real world. Upcoming researchers may apply the knowledge learned from these models to develop even better models. Third, the 11 categories of methodology in this paper are not complete. Other social science methodologies including expert system methodologies need to be taken into consideration, such as psychology and human behavior. Thus, prospects

from other social sciences methodologies are an important work in the near future. Finally, our recommendation to journal editors and research programs is to continue diverse research and to publish special issues in urgent problems, such as global recession and financial crisis, in order to meet the worldwide requirements of timely fashion.

**Appendix A**

Arranged keywords adapted from Liao (2005)

Categories	First keyword	Second keyword
Case_Based	Case-base Case Base Manufac Knowledge management Ultrasonic Medical Fault Knowledge e-Learning	Process      Appl Diagn Model
Database	Geograph Traditional Chinese medicin Medical	Expert
Fuzzy_ESs	Power load forecasting Scheduling Chemical Power Control sys Uncertain Knowledge Fault Power sys Fault detect Demand Wastewater treatment Data On-line Medical Job match Performance Secur Recognition Expert sys	Diagn Diagn  Reason Integ Diagn      Select Diagn Index
Intelligent_agent_systems	Intelligent agent Tutor Supply System anal System desig Knowledge represent Adaptive Air pollution Building Knowledge	Sys Chain      Sys  Design Internet

**Appendix A (continued)**

Categories	First keyword	Second keyword
Knowledge_base	Medical Financ Waste Production Decision DSS Knowledge KM Power Financial Tumor Business Agricult Steel composit Strateg Isokinetics Chemical Plant Concurrent Case Chip Power Urban Robot	Planning      Design      Process Control  Trans
Modeling	Process Medical Software Assembly Project allocation	Control  Estima Planning
Neural_networks	Neural network Fault Optimal Decision Inference Diagnostic sys Machine learning Power load forecasting Process control Knowledge Robot Parameter Waste Biomedical Crude oil distillation Neural network	Diagn Power Making          Learn  Treat
Objective_oriented	Object-orient Industr Knowledge Knowledge Knowledge Manufacturing information network Syntactic	Diagn Represent Learn Engineer



## Appendix A (continued)

Categories	First keyword	Second keyword
Ontology	Medical deci	Reuse
	Knowledge	
	Prevent	
Rule_based	Landscape assessment	Acquisition Model
	Knowledge	
	Knowledge	
	Transit	Product
	Plann	
	Psych	
	Teach	Devel
	Advis	
	Syst	
	Knowledge	Veri
	Knowledge	
	Knowledge	
Scheduli	Base	
Resource util		
Probab		
Sensor	Diagn	
Tutor		
Knowledge represent		
Rule base	Diagn	
Rule-base		
System_architecture	System architect	Evalu
	Material	
	Material	
	Computer aid	Decis
	Implement	
	Corpora	
	Military	
Ferryboat		

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