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An Empirical Classification of Employability Skills for Entry Level IS/IT Professionals

Paul Golding
University of Technology, Jamaica, cashmere@flowja.com

Vanesa Tennant
University of Technology, Jamaica

Opal Donaldson
University of Technology, Jamaica

AN EMPIRICAL CLASSIFICATION OF EMPLOYABILITTY SKILLS FOR ENTRY LEVEL IS/IT PROFESSIONALS AIS SIG-ED IAIM 2008 CONFERENCE PROCEEDINGS

Paul Golding
University of Technology, Jamaica
cashmere@flowja.com

Vanesa Tennant
University of Technology, Jamaica

Opal Donaldson
University of Technology, Jamaica

ABSTRACT

Over the years, a number of studies have suggested various classifications of IS/IT skills for sustainable employment of IS/IT professionals. However there exists variations in findings on IS/IT skills requirement which may be due to different classification schemes applied to categorize skills. To address this problem, this paper applied factor analysis to explore the taxonomy/classification put forward by Fang, Lee and Koh [2005]. Data was collected from three main constituents: industry (job recruiters), academics and students in Jamaica. The factor analysis results created four categories, which we labeled as (1) Technical Proficiencies, (2) Application Technologies, (3) System Development and (4) Organizational and Personal Skills. These classifications were somewhat different from that proposed by Fang et al (2005). This study confirmed that "soft skills" are more important than technical skills for entry level IS/IT professionals. For future studies, we suggest comparative studies at other universities/industries on a national and international level.

Keywords: IS/IT skills, IS/IT professionals, Jamaica

I. INTRODUCTION

The authors of the Joint Task Force for Computing Curricula 2005 alluded to a paradigm shift accruing in the computing discipline. They argued that the discipline has grown in many dimensions and no single view of the field seems adequate. Indeed, these changes affect the employability of graduates as students who succeed in this ever changing environment will be the ones who combine and effectively synthesize technology mastery with core knowledge of business skills and practice. DEST [2002] have used the term "employability skills" to identify the required skills that will produce graduates who are responsive to economic, social, cultural, technical and environmental changes and can work flexibly and intelligently across business context. These are skills that are not only required to gain employment but also to progress within the enterprise so as to achieve one's potential and contribute successfully to the enterprise strategic direction. In order to produce these skills, academia/universities must be willing to re-engineer curricula and investigate how to incorporate significant updates to produce technically competent students who have the hard and soft skills to succeed in the business world [Brookshire, Yin, Hunt, and Crews 2007].

Several research papers have indicated that the IS/IT profession still faces the dilemma of properly identifying the skills required for a variety of industry positions. Granger, Dick, Jacobson and Van Slyke [2007] have queried whether the IS curricula reflects the evolving demands of today's and tomorrow's IS professional and have argued that the face of IS has changed and that our curricula must change with it. The question these authors posed is "what are the appropriate learning outcomes and objectives for IS entry level professional?"

Fang, Lee and Koh [2005] have argued that the graduate of an IS program should possess the required skills and training to perform well at entry level position and have a basis for continued growth as a professional. Gill and Lashine [2003] although not writing about IS graduates stated that the required skills must be market oriented. They argued that in the absence of market

orientation it may become a frustrating experience for both learners as well as knowledge providers because they fail to see the relevance between what is being taught and what the job market requires. Fang et al. [2005] have suggested that misunderstanding or ignoring recruiters perceptions will result in outdated curricula design, poor job placement and weak student advising.

Several studies have attempted to identify the necessary skills required for IS/IT professional including McMurtrey, Downey, Zeltmann and Friedman [2008], Fang et al [2005], Tang, Lee and Koh [2001], Scott, Alger, Pequeno and Sessions [2002], Young and Lee [1996], and Todd, McKeen and Gallupe [1995]. However the findings on the importance of skills and knowledge for IS/IT professionals differs which may be due to the variation in classifications schemes used. This paper will expand on the work of Fang et al [2005] and empirically determine the most important skills for entry level IT/IS professional. This study also seeks to address the absence of a universally accepted classification of knowledge, skills, and abilities by doing the following:

- Data will be collected from the three main constituent's: recruiters, educators and students.
- Fang et al [2005] taxonomy will be evaluated to statistically determine the classifications and what skills should be included in each classification. Their classification included core IS knowledge, organizational skills, interpersonal skills and personal skills.
- Unlike Fang et al [2005], our study will apply factor analysis to determine the statistical accuracy of the classifications.
- Data will be collected from a Jamaican perspective to provide professional comparison with countries outside of the developed world.

This paper is structured as follows, the next section discuss the extant literature highlighting the categories of skills and knowledge deemed necessary for an entry level IS/IT graduate. This will be followed by the methodology that

was applied to collect the data from the three constituents; next on the analysis and discussion of the findings, and we will end with a conclusion and provide recommendations for future studies.

II. LITERATURE REVIEW

The findings in the most recent studies have indicated that personal characteristics or soft skills are more important than technical skills for less experienced personnel [McMurtery et al. 2008, Fang et al. 2005]. An Australian study by Precision Consultancy [2007] reported that broadly speaking that the IT/IS industry is satisfied with the technical or discipline specific skills of graduates but other employability skills are underdeveloped. This finding may account for the recent tendency towards soft skills. Despite this tendency towards soft skills McMurtery et al [2008] found that technical skills continue to be very important for entry level graduates. Studies done by Koong, Liu & Liu [2002] and Lee et al [2001] have found that technical skills are more important than soft skills.

VARIATION IN IS/IT CLASSIFICATION SKILLS

McMurtrey et al [2008] in their study argued that there are variations in findings among IS/IT studies in the skills required for the IS/IT professional. They suggested that these variations may be due to two factors. Firstly, it is proposed that the data collection techniques by various researchers have been diverse, and include examination of newspaper advertisement [Todd et al 1995], job postings on company web site [Lee and Lee 2006], surveys from employers and or educators [McMurtery et al, 2008; Wu, Chen, Chang, 2006 and Fang et al, 2005]. Of the recent surveys we have identified, only Scott et al [2002] has elicited student's response in their study. In addition most of these studies were conducted in the USA and there is parse data from a developing country's perspective for comparative purposes. Secondly, the studies have also used different classification schemes to examine the importance of the skills and knowledge areas of the IT/IS professional.

We see the absence of a classification scheme as an issue that the IS/IT community should resolve. Table 1 below provides a summary of the various classifications used since 1972. Lee, Yen, Havelka and Kohn [2001] included IT activities knowledge areas and proficiencies) and professional skills (business skills, and interpersonal skills and traits). On the other hand, Cappel [2001/2002] included programming languages, technical knowledge areas, proficiencies, and personal qualities. Similarly, Fang et al. [2005] used personal skills and traits, core IT skills (technical knowledge and proficiencies), and organizational knowledge. McMurtery et al [2008] included business expertise, personal attributes, and proficiencies.

Table 1. Classification of IS Abilities/Knowledge/Skills

Authors	Categories
Ashenhurst [1972]	People, models, systems, computers, organizations, society
Leitheiser [1992]	Developer Skills: Interpersonal, analysis & design, programming, business, environment, programming language, specific application Specialist skills: Database &data communication, software, hardware, advanced application
Nelson [1992]	Organizational knowledge, organization skills, organizational unit, general IS knowledge, technical skills, IS product
Todd et al. [1995]	Hardware, software, business, management, social, problem solving, development methodology
Lee, Trauth and Harwell [1995]	Business functional knowledge, interpersonal and management skills, technology management knowledge, technical specialty knowledge
Young & Lee [1996]	Interpersonal skills, programming languages, development & management of applications, operating systems, network and communications, personal computer tools
Kohn, Lee, Yen, and Havelka [2001]	Personal traits, interpersonal/IS Core (IS Management and IS technology and development), Organization and Society
Cappel [2001]	Programming languages, technical knowledge areas, and non-

	technical skills (personal qualities)
Scott, Alger, Pequeno, and Sessions [2002]	Technical Skills (Programming, Databases, System Design), Business Skills(System Analysis, Business Processing Re-engineering), Soft Skills (Communication)
Fang et al [2005]	Core IS Knowledge, Organizational, Interpersonal (Group) Skills, Personal skills
McMurtrey, Downey, Zeltmann, Friedman [2008]	IS Core Knowledge, Proficiencies, Business Expertise, and Personal Attributes

An examination of the literature reveals that several of the studies use similar areas and skills in their research instrument. The two most recent studies McMurtey et al [2008] and Fang et al [2005] each had a total of forty two (42) skill areas with eighty percent (80%) of the questions being identical. The differences related to more recent technologies like GIS and wireless networks and the changes in business focus towards more global trends like e-commerce, ethics and privacy.

This paper applies an empirical statistical technique to substantiate the classification of skills proposed by Fang et al [2005]. The findings will be compared to those of Fang et al [2005] and a more recent research, McMurtey et al [2008].

APPLICATION OF CLASSIFICATION SCHEME FOR THIS PAPER

This paper will use Fang et al [2005] taxonomy as the basis for further discussion and evaluation. Fang et al [2005], using prior studies of Lee, Trauth and Harwell [1995], Young and Lee [1996], and Tang, Lee and Koh [2001], classified critical IS requirement into four categories: core IS knowledge (managerial and technical), organizational (knowledge about organizational/industrial entities), interpersonal skills and personal skills (See Table 2)

Table 2: Core IS Knowledge/Skills

Category	Items
Core IS Knowledge	Managerial: Vision about IS/IT competitive advantage and Awareness of IS technology trends Technical: Hardware concepts, Cs/Server/Routers/Network), Operating System, Packaged software, Database design, web development programming languages, object-oriented methodologies, Network/communication system/program languages, System development methodologies, and Programming languages
Organizational	Specific business functional areas (finance, marketing, etc.), specific business organizations, specific industries, and general business environment (economic, legal, etc)
Interpersonal(Group) Skills	Team skills and communication skills (oral and written)
Personal Skills	Creative thinking skills, Critical thinking skills, and Personal motivation

Source: Fang et al [2005]

Core IS knowledge is broken down into two areas: managerial and technical. Technical competence, understanding of the broad conceptual and theoretical elements of IS/IT specialisation is crucial to the industry. However, the importance of IS/IT professionals possessing more than technical skills has been recognized since the early days of IS as an academic field [Bassellier and Benbasat, 2004]. Managerial skills for IS/IT professionals is important, and as noted by Papulova and Mokros [2007], while knowledge of IS/IT is excellent, application of the knowledge to convey the change of thinking and creation of value in modern approaches to business and management should be emphasized. The authors further argued that enterprises can gain competitive advantage with IT professionals implementing continual and on-going innovations, with managerial skills and knowledge in the centre of the innovation process.

Bassellier and Benbasat [2004], in their paper, referred to the second category as ‘organization-specific knowledge”. The authors defined organizational skills as the “understanding by IT professionals of the specific organizational context in which information technologies are deployed and of the connection between IT and business (pp. 679)”. They further noted that it tantamount to be cognizant of the organization’s goals, objectives, environment and the constraints imposed on or by its suppliers, buyers, government and competitors. A lack of such is seen in a study by Wu, Chen, Chang [2006], which reported that the greatest knowledge gap existed for topics such as “Information Security”, “Supply chain management”, ‘Innovative Management”, and “Accounting Information Systems.”

Interpersonal skills involve oral and written communications, as well as, displaying overall professionalism on the job. Although, Pham [1997] examined traditional computing science courses, the findings revealed that there is a tendency for universities to focus less on writing, communication and presentation. Universities should practice otherwise as IS/IT professionals should be able to effectively communicate with individuals in the workplace without the use of specialized vocabulary/jargons [Reich and Benbasat, 2000]. Lee et al [1995] noted that IS/IT professionals should possess the ability to communicate, manage projects, and work cooperatively in groups, hence developing a social network.

With regards to personal traits, Fang et al [2005] highlighted that IS/IT professionals should be able to creatively and critically apply technical and managerial skills to the design and use of IT in solving business problems. Personal motivation was also noted as an important personal trait valuable to IS practitioners.

This paper will investigate the knowledge, skills and abilities measured in Fang et al [2005] in order to suggest classification for IS/IT skills. It will investigate the importance of these skills.

III. METHODOLOGY

Fang et al [2005] questionnaire has 57 questions, excluding demographic question. This paper modified the Fang et al [2005] questionnaire with the following changes:

- Demographic information was changed depending on the constituents; industry, educators, students.
- Examples that were not appropriate for the local industry were removed
- Questions that related to monitories were removed as this is not an issue in Jamaica.
- The internship question was also removed as this practice is scarcely done in Jamaica.
- In the body of the questionnaire MIS was changed to IS/IT
- In the test of knowledge skills, Analysis of Algorithm (AoA) and Theory of Computation (ToC) were added

A total of 43 questions was tested, and respondents were instructed to indicate the importance of the skill on a five-point Likert scale ranging from 1 (Not Important) to 5 (Very Important).

Separate research instruments were created to target each of the three constituents. The questions were the same except for the demographics. Paper based survey was used for all the target groups. None of the groups were given incentives to complete the survey. Convenience sampling was used to collect data from all three constituents. Convenience sampling has been shown to be an effective means of obtaining survey respondents with a desired background or points of view [McMurtery et al 2008].

Surveys instruments were distributed to third year and final year students from the School of Computing and Information Technology in a prominent Jamaican

university during the final week of their final exams. Two hundred survey instruments were distributed and one hundred and seventy were returned

The academic staff consists of 30 full and part time personnel. The instrument was issued to each persons explaining the purpose of the survey.

Industry was targeted based on companies that hired students from the School of Computing and Information Technology based on tracer studies done on our graduates. The companies represent a cross-section of the major and minor industries in the economic and industrial capital city in Jamaica. Students from the evening and part time cohort were asked to have their section supervisor complete the survey. The completed surveys were returned over a two week period.

IV. DATA ANALYSIS

The sample included 183 respondents of which 18 were academic, 26 companies and 139 IS/IT students from a university in Jamaica. Table 3 reports the results of the Kaiser-Mayer-Olin measure of sampling with a coefficient of .815 suggest that the sample is meritorious or very good. The Bartlett's Test of Sphericity with a significance of .000 indicates that the data does not produce an identity matrix and are therefore approximately multivariate normal and acceptable for factor analysis.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.815
Bartlett's Test of Sphericity	Approx. Chi-Square	4017.996
	df	946
	Sig.	.000

The data was examined using Bagozzi [1981] rules for convergence and discrimination in measurement. These rules dictate that items representing a distinct dimension should correlate highly with each other in a uniform pattern and should not correlate as strongly with other items representing another dimension.

A confirmatory factor analysis of the proposed four dimensions was conducted. The Principal Component Analysis extraction method was applied, while the rotation method used was Varimax with Kaiser Normalization. For purposes of ease and clarity, factors/items with low loadings (<.3) was suppressed. Table 4 presents the factor loadings for the four dimensions. Dimension one (1) had 13 factors with very good loadings ranging from .412 to .763 with all except one factor below .5. There was only one cross loading. Dimension two had nine factors, also with very good loading and two cross loading. Dimension three has 11 factors with very good loading. Although there are cross loading these are not very strong. Dimension four also had cross loading however the loadings were strong with only two of the ten factors having loading below .5. Generally within each dimension the items or factors converge by exhibiting uniformly high correlations and discriminate by exhibiting low correlations with items in other dimensions.

An examination of the coefficient alpha values for the four dimensions indicates strong reliability values, all greater than the minimum value of .7 [Nunnally, 1978]. Dimension one had a Cronbach Alpha value of 0.919, dimension two: 0.864, dimension three: 0.830, and dimension four: 0.837 (see table 5).

Table 4: Rotated Component Matrix

	Component			
	1	2	3	4
Object-oriented Languages	.763			
High Level Procedural Languages	.763			
Database Query Language	.710			
Enterprise Resource Planning Tools	.705			
Simulation/Optimization Tools	.682			
Expert Systems/Shells	.678			
Data Warehouse	.650			
CASE Tools	.639			
Client-Server Database Tools	.616			
Statistics Tools	.568			
Project Management Tools	.544			
Interactive Web Programming Languages	.527		.349	
Mini/Mainframe Operating System	.412			
Word Processing Tools		.819		
Presentation Tools		.804		
Speadsheet Tools		.804		
Personal Database		.689		
Packaged Software		.686		
Internet/Navigation Browsers		.640		
Electronic Mail Tools		.472		.379
Web Publication Language	.345	.466		
PC Operating Systems	.302	.402		
Object-oriented Methodologies			.672	
Database Design	.465		.661	
(SDLC) Systems Development Programming Languages			.659	

Network/Communication Software	.352		.626	
Programming Language	.431		.605	
Web Development programming languages	.365		.554	
TOC,AOA	.407		.475	
Hardware Concepts			.420	
Awareness of IS			.395	.387
Operating Systems			.390	
Implementation			.376	
Knowledge of Business Environment				.739
Knowledge of Specific Business				.710
Knowledge of Specific Organizations				.612
Communication skills				.602
Knowledge of Specific Industries				.589
Creative thinking skills		.324	.338	.536
Personal Motivation			.321	.532
Visions about IS/IT			.328	.509
Critical thinking skills			.406	.445
Team Skills		.303		.345

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 8 iterations.

Table 5. Cronbach's Alpha

Component/Factor	Cronbach's Alpha	Number of items
1	.919	14
2	0.864	9
3	0.830	11
4	0.837	10

The following section will discuss the classification of the skills based on the results of the factor analysis**.**

V. DATA ANALYSIS AND DISCUSSION

Both Fang et al [2005], and McMurtrey et al [2008] used four dimensions though somewhat dissimilar. The four dimensions that Fang et al [2005] identified were (1) core IS knowledge, which was subdivided into managerial and technical, (2) organizational, (3) interpersonal or group skills and (4) personal skills. McMurtrey et al [2008] on the other hand identified (1) IS core knowledge, (2) Proficiencies, (3) Business Expertise, and (4) Personal Attributes.

The factor analysis created three categories to categorize those skills that Fang et al [2005] initially labeled as "Core IS skills: Technical'. A further comparison showed that our results combined organizational, Core IS Skills: Managerial, interpersonal and personal into one category. A similar comparison with McMurtrey et al [2008] indicated core IS and Proficiences were subdivided into three dimensions. In addition, both business expertise and personal attributes subsumed into one category. The section below will label the newly formed categories.

CATEGORY 1: TECHNICAL PROFICIENCIES

Category 1 appears to show a tendency towards technical proficiency (See table 4) with factors such as data query languages with a high mean of (3.85), programming languages (3.71), project management tools (3.71), high level procedural language (3.64) and object oriented languages (3.68**).** In comparing our results with McMurtrey et al (2008) four of the items assigned to proficiencies were placed in this new classification, and include expert systems, simulations/optimization tools, data warehouse, and statistical tools.

CATEGORY 2: APPLICATION TECHNOLOGIES

Category 2 shows a more uniform pattern towards application technologies with factors having high means such as word processing tools (4.02), presentation tools (4.02), internet browsers (4.07) and PC operating system (4.12). See table 4.

CATEGORY 3: SYSTEM DEVELOPMENT

Category 3 has a tendency towards system development with factors with high means: operating systems (4.02) network and communications software (3.87), implementation (3.67), hardware concepts (3.74) and database design (3.72). “Awareness of IS” is also in this category with a mean of (3.92), however this factor is considered inappropriate in this dimension and would be better placed in the Category four.

CATEGORY 4: ORGANIZATIONAL AND PERSONAL SKILLS

Category 4 is also relatively easy to classify, the theme is strongly towards organizational issues and personal and interpersonal skills with very high means such as critical thinking skills (4.57), creative thinking skills (4.47), personal motivation (4.42), and team skills (4.43). This category we will label as Personal and Organizational skills. This dimension had the highest overall mean score of 3.96 which suggest and confirms that non-technical skills are most important.

Visions of IS/IT competitive advantage which Fang et al [2005] had under managerial aspects of core IS knowledge was also reassigned to this dimension. A similar comparison with McMurtrey et al [2008] indicated that both business expertise and proficiencies were subsumed into this category.

It should be noted that this category, organizational and personal skills had the highest overall mean of 3.96, followed by System Development skills with a mean of 3.71, Technical Proficiencies with 3.55 and Application Technologies with 3.53 (See Table 6).

Table 6. Mean of Categories

	Minimum	Maximum	Mean
Organizational and Personal Skills	1.40	5.00	3.9612
System Development	1.36	4.82	3.7111
Technical Proficiences	1.38	5.00	3.5519
Application Technologies	1.00	4.50	3.5383

VI. CONCLUSION

Both Fang et al [2005] and McMurtrey et al [2008] created divergent classifications for IS/IT employability skills. This paper used the vast majority of the skills items from the aforementioned authors to conduct a confirmatory factor analysis to determine the classifications of the required IS/IT skills. Our findings suggest that there should be three dimensions for core IS/IT skills which we categorized as Technical Proficiencies, Applications Technologies and System Development. While all three core IS/IT categories had good factor loadings, technical proficiency had the highest reliability of .919. The fourth category created was classified as Organizational and Personal skills. This category combined the three categories of organizational, interpersonal and personal from Fang et al [2005] and also the personal attributes and business expertise from

McMurtrey et al [2008] into one dimension. This study confirmed that “soft skills” are more important than technical skills for entry level IS/IT professionals as related in studies such as Fang et al. [2005], Kovacs et al. [2005], McMurtrey et al [2008].

There is a need to create a universally accepted classification scheme to label the abilities, knowledge and skills which an IS/IT graduate should possess. This study is an initial step into arriving into a universally accepted classification scheme by applying factor analysis technique. We however note that this study has limitations. Firstly, a small sample was taken from academics (18) and industry (26). However, the academics of the IS/IT department as universities tend to be small. We believe that the sample size of the industry was relatively satisfactory as these were companies that operated locally and globally, however for future studies we will expand the number of companies. With a larger sample, we will also investigate IT/IS skills gaps between the three constituencies.

For future studies, we suggest comparative studies at other universities/industries on a national and international basis. This can provide valuable insight which could somewhat settle this issue. Furthermore, we suggest that as new technologies evolve, they can be added to the appropriate category and also be resampled to confirm placement.

VII. REFERENCES

Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
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ABOUT THE AUTHORS

Opal Donaldson is an Assistant Lecturer in the School of Computing & Information Technology at the University of Technology, Jamaica. She can be contacted at guccipalli@yahoo.com.

Paul Golding is a Lecturer in the School of Computing & Information Technology at the University of Technology, Jamaica. He is a member of the following organizations: IEEE, ACM, and AIS. His email address is cashmere@flowja.com.

Vanesa Tennant is an Assistant Lecturer in the School of Computing & Information Technology at the University of Technology, Jamaica. She is a member of the AIS and can be contacted at vtennant@cwjamaica.com.