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Cross-Domain Employability Related to E-Business in Printing Industry

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Abstract

The study aims at introducing the cross-domain employability of Electronic Business (E-Business) that the printing industry professionals should have in Taiwan. The pilot study aims at confirming and developing a questionnaire based on indicator of employability on E-Business in Printing Industry. Secondly, designing Analytical Hierarchy Process (AHP) questionnaire and builds its weight. The study presents the cross-domain employability indicators related to E-Business. The contribution can benefit the printing industry when recruiting human resources, and to serve as reference for the printing related departments in higher education.

Keywords: Employability, E-Business, Printing industry, AHP

Introduction

The success of a country's economic development depends on whether it can successfully integrate into corporate production systems its labor force with knowledge and ability [1], and it is even more so for Taiwan's printing industry. Human resource quality is an important factor in determining a company's competitiveness, and Levin [2] believes that fierce competition in dynamic environments, budget reduction and heavy price pressure make business operation highly dependent on high-quality human resources. High-quality labor force is required to have cross-domain employability, which is what a mature industry relies on for enterprise transformation and development [3]. Crossan & Berdrov [4] pointed out that one of the consequences of intense competition, globalization and the advanced development of science and technology is that organisational learning, knowledge creation and innovation capability have combined to form a major benefit supporting corporate competitiveness. It is therefore quite natural that, out of necessity arising from competition, companies have adopted the competence-based perspective and require the employees they recruit to possess cross-domain multiple competences instead of one single specialized skill. Enterprises tend more and more to require their employees to possess what is needed for business operation in terms of cross-domain competences and the corresponding performance requirements [5] in order for them to remain employed on a long-term basis in the enterprise and to subsequently develop their individual professional careers.

Education is the main means of enhancing Taiwan college students' employability [6]. Hillage and Pollard [7] defined the term "employability" as the capability to move self-sufficiently within the labor market to realize potential through sustainable employment, and considered that if an employee has self-perceived employability, he will be able to deploy employability frequently both within and outside of the enterprise. Rothwell & Arnold [8] started from the perspective of personal employment and career development to consider that employability is about people's ability to possess skills, find work, and maintain work of the kind they want. For an enterprise, employability means possessing human resources with long-term working ability. The concept of employability can be considered by a corporate organisation as employees' long-term working ability, as in the idea of "work for the sake of life" [9-10]. Sanders & de Grip [11] stated that training participation and task flexibility of low-skill workers in an enterprise are positive and beneficial to their employability within the enterprise and the possibility of their deploying lifetime employability outside of the enterprise. All these studies focused on employability are based on the competence-based theory [12]. The need to enhance employees' possession of the kind of employability their enterprise demands sustains the inevitability for the enterprise to plan and implement education and training programs. In view of all the above and for the purpose of our study, we can define employability, in the labor market related to the printing industry, as the ability to execute the requirements of the related professional technology cluster and to remain employed on a long-term basis, particularly in Electronic Business.

It would be highly meaningful to identify the requirements of Taiwan's printing businesses in terms of employees' employability in Electronic Business and to use the findings as a basis for talent cultivation in higher education. Therefore, based on the research background described above, this study aims at introducing, from a competence-based perspective, a set of indicators for the kind of cross-domain employability required for Taiwan's printing industry professionals. These indicators can then be used as assessment tools by printing businesses in the

development of their talent recruitment strategy including the field of E-Business and as a basis for the curriculum planning of related departments in science and technology universities.

Cross-domain employability from a competence-based perspective

Printing is one of the industries with a high cluster effect. The production chain going from the upstream supply of raw materials like paper, ink or plastic material, to the actual printing process with pre-press, on-press and post-press technologies, via the various tasks of image process, network transmission, color control and management, printing skill process, gravure printing process and binding process, forms an industry displaying a cluster effect [13]. Taiwan's printing industry, like in other countries, is characterized by its status as both an industry and a service; its technical content covers knowledge and applications of a broad range of fields, including electronics, mechanics, materials, mathematics, physics, chemistry, optics,

chromatics, business estimating, cost analysis, industrial management, production management, art and culture, creative design, multimedia technology, etc. The production process is highly oriented toward client needs, and the fact that the products tend to be small in quantity but highly diverse and customized means that professionals need to have cross-domain capabilities consisting in streamlined technical operation applications like estimating, design & editing, image process, color management, remote transmission via the Internet, computer application, job scheduling, printing production, logistics, etc. Due to the technology cluster of the industry, it is necessary for printing professionals to possess specialized skills whose content is constituted by cross-domain competences, so that they can meet competence-based requirements and achieve the kind of work performance required by business owners. The technology cluster involved in such professional employability is schematized in the following Figure 1.
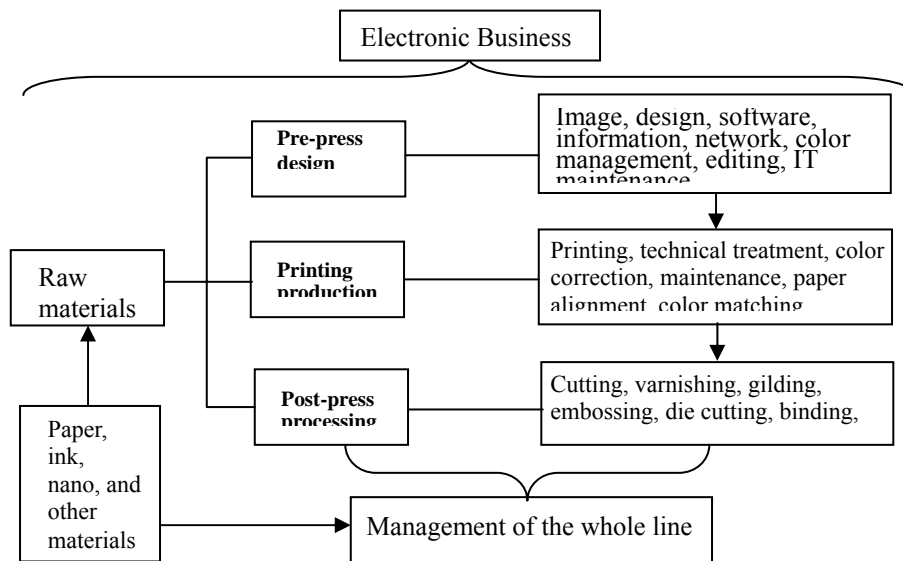

Figure 1 – The technology cluster involved in employability for the printing profession

According to the classification of Lei & Slocum [14], cross-domain competencies involve core competences, professional competencies, management competences, as well as general competences; among them, performance in professional competences is a key factor in corporate competitiveness. As to the cultivation of cross-domain employability, Shahin & Mahbod [5] considered, from the perspective of organisational performance, that requirements of organisational operation performance can be prioritized in terms of long-term SMART (Specific, Measurable, Attainable, Realistic, Time-sensitive) goal setting.

Therefore, cross-domain professional competence implies, for an individual, the possession of the knowledge and skills represented in the technology cluster. In the printing domain, characterized by a technology cluster, the technologies used cover three major areas, and professional knowledge can be divided into three broad domains [15]: generic areas of knowledge, generic skills (process knowledge), and generic professional competencies. Mentkowski *et al.* [16] considered competence as a concept and process involving a complex combination of motivation, personality, attitude, values, strategy, behavior,

self-perception and knowledge, and believed that such complex competence cannot be directly observed, but must be deducted from assumed performance. In our study, the concept of competence-based employability is considered as the professional competences required of the professionals employed in the printing industry for the execution of certain professional tasks, and the ability to deploy these competences in their work positions of E-Business, thereby developing their professional careers.

Methodology

In this study, a pilot research was first conducted, followed by expert consulting and a formal survey investigation. The purpose of the pilot research was to identify the research issues and the cross-domain employability indicators for professional talent in the printing industry, while the survey investigation aimed to establish weight values for the cross-domain employability indicators related to E-Business. In order to avoid Common Method Variance (CMV) [17], the formal survey by questionnaire was not conducted until one month after the pilot research, the survey questions were randomly sequenced, and respondent identity was concealed.

Pilot study
In the recent decade, the technological content of

Taiwan's printing industry has undergone quantitative and qualitative change, with a high degree of high-tech application in the production flow and a high concentration of knowledge and technology in its products. However, there had been very little research related to the professional competences professionals in the industry are required to have, making it difficult to rely on literature analysis to establish cross-domain employability indicators of E-B business for the printing industry. Therefore, we conducted a pilot research to survey professionals of printing businesses, confirming the importance of the research issues and the feasibility and necessity of the indicators and sub-indicators of cross-domain employability in the printing industry. Following literature review and consulting sessions with experts, the main issues related to the cross-domain employability of E-B business of printing industry professionals were identified, and a draft project for employability indicators was established; based on these elements, a pilot questionnaire was constructed as the research tool for the pilot study. The questionnaire was structured according to the three main dimensions of printing industry, professional personnel, and cross-domain employability. The sampling targeted Taiwan's 1000 largest printing businesses and 272 questionnaires were randomly sent out, out of which 187 valid ones were recovered, with a recovery rate of 85%.

Table 1 Statistical analysis of recovered questionnaires in the pilot research

Printing departments	N=187
Pre-press: design, business, manufacturing, layout/adjustment	Design personnel 24% Business personnel 35% Manufacturing personnel 29% Layout/adjustment personnel 21%
On-press: press machine operators	9.4%
Post-press: post-processing and binding personnel	17%

Questionnaire survey
(1) **Questionnaire construction:** Based on the employability indicators of E-Business expected by printing businesses as shown by the results of the pilot research, an Analytical Hierarchy Process (AHP) survey questionnaire was compiled and then confirmed after discussion with experts, before being used as the tool for the survey investigation.

(2) **Administration and recovery:** Targeting Taiwan's 500 largest printing businesses, a random sampling was carried out and on-line questionnaires were sent to selected businesses; printed questionnaires were sent as a complimentary measure to facilitate recovery. A total of 150 questionnaires were thus administered, with 76 valid returned questionnaires and a recovery rate of 50.67%.

(3) **Statistical analysis by AHP:** The purpose of the AHP is to analyze the weights of the various indicators of cross-domain employability related to E-Business in order to obtain the weight values for the indicators. Elaborated by Satty [18], AHP is mainly applied in situations of uncertainty and to decision issues involving multiple evaluation criteria. Applied to this study, the AHP used the system's decomposed indicators to make a pairwise comparison of the employability indicators obtained from the pilot research, thereby finding the ratios of relative importance (*i.e.* weight values) among the indicators. Three steps of AHP methodology for calculating the weights among indicators of different levels is as follows:
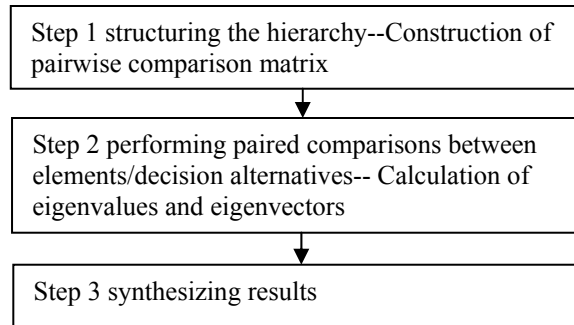
Figure 2 Three steps of Analytic Hierarchy Process

Consistency test: After establishing the pairwise comparison matrix and the whole hierarchy structure, a consistency test must be carried out in order to calculate the Consistency Index (C.I.) and the Consistency Ratio (C.R.). The closer lamda-max is to n, the more consistent it is. C.I. **=** (lamda-max – n)/(n-1). If C.I. = 0, it implies that the questionnaire respondent's earlier and later judgments regarding decision factors are consistent. Saaty [18] suggested using Consistency Index and Consistence Ratio to test the consistency of pairwise comparison matrices. When C.R.$\leqq$ 0.1, there is consistency.

A review of the application of the above methodology shows that the execution of the pilot research made it possible for cross-domain employability issues on E-Business investigated in our study to closely match the actual needs of Taiwan's printing industry. The cross-domain employability indicators of E-Business thus obtained were used as the basis for the compilation of the formal survey questionnaire, adding to the objectivity of the content of the questionnaire. Furthermore, in order for the retrieved data to match the needs of the study, after the

pilot research was compiled, experts were invited to examine, regarding its content, the correlation between the indicators and the survey questions, so as to make sure the questions truly reflect the content of what was to be investigated. In terms of data analysis, statistics by percentage description was used for the pilot questionnaire, while for the AHP questionnaire, analysis of weight values was carried out by means of the softwares Excel and Expert Choice 2001.

Results and Discussions

Results of pilot research

(1) The reliability and validity of questionnaire: the overall reliability of the questionnaire was good, with a Cronbach's Alpha coefficient of .914; the validity was acceptable, with a Kaiser-Meyer-Olkin measure of sampling adequacy of .795; and the Bartlett test of sphericity showed significance, meaning the questionnaire was good in both reliability and validity.

Table 2 KMO and Bartlett test

Kaiser-Meyer-Olkin measure of sampling adequacy		.795
Bartlett test of sphericity	close to chi-square distribution	1164.988
	degree of freedom	276
	significance	.000

(2) The identification and cultivation of professionals' cross-domain employability related to E-Business is an important research issue for the printing industry in present-day Taiwan. The cross-domain

employability of printing industry professionals has been obtained by induction and expressed in terms of eight main indicators and 24 sub-indicators, as shown in Table 3.

Table 3 Analysis of survey results of pilot study

	Analysis of opinions
Regarding the printing industry	• 90.9% considered the printing industry as a high-tech industry; • 64.2% considered it impossible for the printing industry to be replaced by multimedia and disappear; • 63.6% believed the printing technology must gradually upgrade and transform itself; •38.8% considered the development of professional certification for printing to be of substantial use for production; • 90% believed R&D ability ought to be strengthened; • 83.6% believed that Taiwan's printing technology industry is too small to reach economy of scale for cost reduction.
Regarding the professionals	• 96% believed that the reason printing professionals are not easily available is that school teaching does not match industry needs; • 94.6% found that schools and universities offer too few professional courses in printing related to E-Business, resulting in graduates having difficulties getting connected to the real work and having much less professional know-how than expected by employers; • 76.3% considered the professional skills required for the printing industry are excessively complex and that professionals need to have cross-domain employability; • 92.8% considered the working environment not good enough to attract professionals.
Cross-domain employability (indicators and sub-indicators)	• Image-processing ability (color correction skill, color management, software application); • Innovation ability (innovative design, innovation/R&D, creative application); • Pre-press network integration ability (E-Business, network application, remote transmission, computer maintenance/repair); •Business operation ability (business planning, printing-related foreign language skill, commercial estimating); • Editing/design ability (type/typesetting, multimedia production, aesthetic drawing); • Production/manufacturing ability (printing press machine operation, CTP plate operation, job scheduling); • Work attitude (dedication to work, professional ethics, enthusiasm for learning); • Teamwork (problem-solving ability, communication/coordination ability, ability to react instantly to emergency).

(3) In response to the needs of the future development of the printing industry, the professional work areas in which cross-domain employability related to E-Business is required for printing professionals are, by order of importance: screen printing, fast printing, package printing, industrial printing, special printing, cultural printing, and electronic printing. An examination of the requirements of cross-domain employability for these areas shows the predominance of professional competences, which implies that the respondents still place great importance on the cultivation of professional capabilities, and that they value employees' professional performance, using it as a measure of the value represented by them within corporate organisations. This shows that the competence-based concept is concretely realized in the production activities of printing businesses.

(4) The survey results obtained at the level of science and technology universities shows that the courses that may serve to cultivate students' cross-domain employability related to E-Business are, by order of degree of need: general introduction to printing integration, color management, design printing, remote network application, image process, printing production management, innovation/R&D, printing cost estimation and planning, mechanical application, materials application, and information equipment maintenance and repair. It can be observed that courses related to professional areas like planning, design, production, management, application, maintenance/repair, and innovation/R&D are of concrete needs to Taiwan's printing industry. However, "education for all" does not equal "employment for all" [19], and the issue of how to further match classroom courses with the competences required for cross-domain employability so as to optimize course planning and design will be another important research area.

Results of the AHP survey

(1) Description of samples: Among the valid recovered samples, males represented 69.7%, far above the female percentage of 30.3%. The 31- to 50-years old represented the largest age group. As to the category of printing services, those belonging to industries related to printing came

out at the top with a whopping 78.9%. The other most represented groups are: in terms of job titles, business owners and technical production staff; in terms of seniority, those who have worked for 16-20 years in the industry (the vast majority of all respondents having a seniority of over 3 years); and in terms of business size, those with 21-50 employees. The details are shown in Table 4.

Table 4 Description of samples   n=76

		No. of times	Percentage	Valid percentage	Accumulated percentage
Age distribution	21-30 years old	15	19.7	19.7	19.7
	31-40 years old	24	31.6	31.6	51.3
	41-50 years old	24	31.6	31.6	82.9
	51-60 years old	9	11.8	11.8	94.7
	Above 61 years old	4	5.3	5.3	100.0
Category of work	Printing-related industries	60	78.9	78.9	78.9
	Electronics-related industries	11	14.5	14.5	93.4
	Education-related industries	1	1.3	1.3	94.7
	Other industries	4	5.3	5.3	100.0
List of job titles	Person in charge	14	18.4	18.4	18.4
	(Vice) General manager	8	10.5	10.5	28.9
	(Vice) Manager	6	7.9	7.9	36.8
	(Vice) factory director	4	5.3	5.3	42.1
	Director (Section chief)	9	11.8	11.8	53.9
	Business personnel	8	10.5	10.5	64.5
	Technical production personnel	16	21.1	21.1	85.5
	General administrative personnel	1	1.3	1.3	86.8
	Technology colleges	1	1.3	1.3	88.2
	General universities	2	2.6	2.6	90.8
	Professional training institutions	6	7.9	7.9	98.7
	Others	1	1.3	1.3	100.0
Seniority distribution	Under 3 years	15	19.7	19.7	19.7
	3-5 years	8	10.5	10.5	30.3
	6-10 years	13	17.1	17.1	47.4
	11-15 years	11	14.5	14.5	61.8
	16-20 years	16	21.1	21.1	82.9
	Over 20 years	13	17.1	17.1	100.0

(2) Analysis of the results of the AHP
   •**Construction of an AHP pairwise matrix schema**
Based on the cross-domain employability indicators of E-Business obtained from the results of the pilot research, an AHP pairwise matrix was constructed (as in figure 2) to be used as the basis for the compilation of the AHP questionnaire.

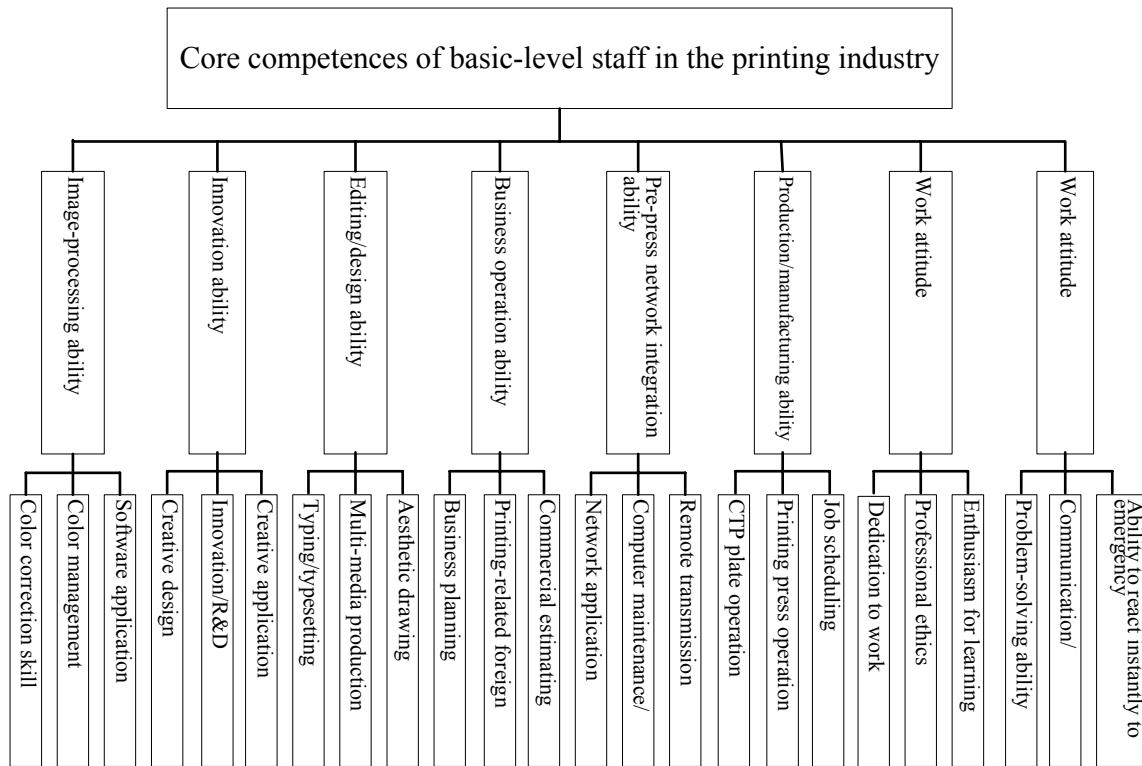Liang Yuan Hsiung,Dan-Pai Feng,Chi-Cheng Chang

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Figure 3 AHP pairwise matrix schema

• **Weights of cross-domain employability indicators related to E-Business**

The weights of the indicators are shown in Table 5. The ratio of image-processing ability to innovation ability is 1.02933, and that of innovation ability to image-processing ability is 1/1.02933 =0.97150. Using the formula of Satty [18], weights (eigenvalue) w can be calculated and turned into %, the values being as follows:

- Image-processing ability 9.690%
- Innovation ability 9.892%
- Pre-press network integration ability 10.357%
- Business operation ability 15.364%
- Editing/design ability 9.393%
- Production/manufacturing ability 12.860%
- Work attitude 16.286%
- Teamwork 16.157%

Table 5 - Weights of cross-domain employability indicators related to E-Business

	Image-processing ability	Innovation ability	Pre-press network integration ability	Business operation ability	Editing design ability	/ Production/ manufacturing ability	Work attitude	Teamwork	weight (eigen-value) w
Image-processing ability	1	1.02933	0.97551	0.63433	1.00427	0.70827	0.57606	0.65004	**0.09690**
Innovation ability	0.97150	1	0.76297	0.70160	1.28396	0.70132	0.61415	0.65884	**0.09892**
Pre-press network integration ability	1.02510	1.31066	1	0.54616	1.41260	0.65486	0.64127	0.59922	**0.10357**
Business operation ability	1.57648	1.42532	1.83098	1	1.95902	1.26704	0.76094	0.82464	**0.15364**

Table 5 - Weights of cross-domain employability indicators related to E-Business (cont.)

Editing / design ability	0.99575	0.77884	0.70791	0.51046	1	0.77412	0.73748	0.72465	**0.09393**
Production / manufacturing ability	1.41189	1.42589	1.52705	0.78924	1.29178	1	0.70243	0.72157	**0.12860**
Work attitude	1.73592	1.62826	1.55942	1.31416	1.35597	1.42363	1	0.92198	**0.16286**
Teamwork	1.53837	1.51782	1.66883	1.21265	1.37997	1.38587	1.08462	1	**0.16157**

Lamda Max=8.06606   C.I=0.00944   C.R=0.00674

- **Weights of cross-domain employability sub-indicators which related to E-Business**

The weight values of the sub-indicators can be calculated. For example:

Table 6 Weight values of image-processing ability

	Color correction skill	Color management	Software application	**Weight (eigenvalue)**
Color correction skill	1.00000	0.68009	1.22974	**0.30618**
Color management	1.47040	1.00000	1.66332	**0.43780**
Software application	0.81318	0.60121	1.00000	**0.25602**

Lamda Max= 3.00078   C.I=   0.00039   C.R=0.00075

Via a synthesis of the above AHP analyses, the eight main indicators are in the following order by importance: work attitude, teamwork, business operation ability, production/manufacturing ability, pre-press network integration ability, innovation ability, image-processing ability, and editing/design ability. When the total weight value is expressed as 100%, the weights of the various sub-indicators are as shown in Table 7.

Table 7 Weight values of cross-domain employability indicators and sub-indicators related to E-Business

Main indicator	Weight value %	Sub-indicator	weight of sub-indicator %
(1). Image process ability	9.690%	Color correction skill	30.618%
		Color management	43.780%
		Software application	25.602%
(2). Innovation ability	9.892%	Innovative design	31.102%
		Innovation/R&D	27.741%
		Creative application	41.157%
(3). Pre-press network integration ability	10.357%	Network application	34.71%
		Remote transmission	30. 329%
		Computer maintenance/repair	34.96%
(4). Business operation ability	15.364%	Business planning	29.765%
		Printing-related foreign language skill	37.254%
		Commercial estimating	32.981%
(5). Editing & design ability	9.393%	Typing/typesetting	20.534%
		Multi-media production	28.881%
		Aesthetic drawing	50.585%

Table 7 Weight values of cross-domain employability indicators and sub-indicators related to E-Business

		Printing press operation	33.07%
(6). Production/ manufacturing ability	12.860%	CTP plating operation	26.53%
		Job scheduling	40.40%
		Dedication to work	35.765%
(7). Work attitude	16.286%	Professional ethics	35.810%
		Enthusiasm for learning	28.425%
		Problem-solving ability	32.961%
(8). Teamwork	16.157%	Communication/ coordination ability	33.392%
		Ability to react instantly to emergency	33.646%

Conclusions and suggestions

The investigation of cross-domain employability related to E-Business is highly important for the cultivation of talent for the printing industry in Taiwan. On this issue, this study offers fundamental research results obtained from a pilot research and a formal survey investigation, shedding meaningful light on what Taiwan's hi-tech printing industry needs in terms of professionals' competences in the process of its development. The conclusions of the study can be used for reference purposes by enterprises seeking to recruit new talent, and by science and technology universities in the examination, modification, planning and design of the courses offered in departments related to the printing field in E-Business. Therefore, this study can make contributions to both the industry and higher education in their talent cultivation endeavors. However, although the weights of the indicators and sub-indicators of cross-domain employability related to E-Business have been obtained, a gap remains to be bridged between professional competences and course design, and the issue of how to match them is more than relevant when it comes to talent cultivation. Particularly, over the last ten years the development of Taiwan's information technological industries has been accelerating, and the integration of computer technology in the hi-tech printing industry has been generalized, making cross-domain employability of E-Business especially important. It can be expected that, as the knowledge and technology related to the printing industry evolve rapidly, and Taiwan's printing businesses tend to be small in size, the only way for employees to deploy individual value within businesses is to have their cross-domain employability enhanced.

This study has not been able to cover such issues as the development of professional courses on E-Business in printing, or professional certification that guarantees work efficiency and quality. In view of the fact that the content of the professional technology involved in the printing industry is complex and the need for cross-domain employability related to E-Business is high, in future curriculum development emphasis can be placed on the elaboration, based on the indicators, of a modular curriculum for each area of professional work, so as to allow students to choose a curriculum centered on the technology cluster of a specific area of professional work determined in accordance with their individual needs and expectations in terms of career development. Moreover, the spirit of the competence-based approach lies in the fact that in the production activities of an enterprise, the professionals are required to seek production efficiency and quality; and professional certification remains an indispensable element in enhancing not only work efficiency and quality, but above all, personal employability of E-Business. Therefore, an important direction for future research consists in using the indicators analyzed in this study to: develop auxiliary tools for corporate talent recruiting, with a view to providing a basis for the objective recruitment of professionals with cross-domain employability of E-Business; examine and amend the assessment criteria for professional certification related to the hi-tech printing industry; and provide emerging countries as a reference for the elaboration and design of competence-based professional modular curricula.

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