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CRITICAL SUCCESS FACTORS IN DIGITAL PUBLISHING TECHNOLOGY USING AN ANP APPROACH

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Abstract. Digital publishing technology (DPT) has been recognized as one of the most important technologies for economic development. The purpose of the study is to develop an evaluation model based on analytic network process (ANP) approach to explore the critical success factors (CSFs) for the successful implementation of DPT. It can objectively identify related criteria of DPT, and then prioritize improvement criteria to the success of promoting DPT for government. To demonstrate the applicability of the proposed approach, the Taiwan's DPT is conducted. The results of this study could serve as a new method and offer insights to policy makers to indentify and prioritize CSFs for DPT implementations systematically.

Keywords: information and communication technologies, digital publishing technology, critical success factors, analytic network process.

JEL Classification: C61, L78, L74, L86.

Introduction

The digital technologies have undergone significant developments in recent years. In the digital age, the way knowledge is accessed, retrieved, transferred and preserved is rapidly changing from the manufacture of physical items to delivering high value intangibles. Technological developments have made it necessary for publishers to engage in digital publishing technology (DPT), that is, publication of information on digital media (Shen *et al.* 2012).

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By definition, DPT is the publication of any form of digital media. Moreover, supported by digital technology and carried by computer networks, DPT brings about a revolutionary transformation of traditional publishing forms and patterns (Willinsk 2000). DPT has the potential for generating tremendous new wealth, mostly through authors, publishers, technology providers, databases, web distributors and end-users. It is also transforming the rules of competition for established businesses in unprecedented ways.

Owing to the significance of DPT (Lee *et al.* 2005; Hu 2007; Lee, Kim 2007; Sandström 2011), it is really of great importance to figure out the elements or factors that affect implementation of DPT. Thus the government and decision-makers can focus on the priority factors to promote the development of DPT. Moreover, it is hard to promote all influencing factors simultaneously. If these factors could be identified, it would provide more insights for the government to make the appropriate strategies and action plans.

For this purpose, the concept of critical success factor (CSF) is adopted in this study. Identifying the CSFs of DPT, the factors having greatest impact on the development/implementation of DPT can be found out. So the government can pay more attention on these CSFs and implement them progressively to greatly promote the efficiency of the DPT.

With this motivation, this study aims to develop an evaluation model based on analytic network process (ANP) approach to explore the CSFs for successful development/implementation of DPT. It can objectively identify related criteria of DPT, and then prioritize improvement criteria to the success of promoting DPT for policy makers. To demonstrate the applicability of the proposed approach, the Taiwan's DPT is conducted.

The paper is organized as follows: The following section summarizes some important previous research regarding DPT is introduced, and CSFs is reviewed with the related literature. Next, the proposed evaluation framework for DPT by the ANP method is described. The third section displays our empirical example results along with some discussions relating to managerial implication. Finally, conclusions and further work are in the last section.

1. Literature review

1.1. Digital publishing technology

The concept of digital publishing technology (DPT) has developed from early stage electronic publishing, desktop publishing, web publishing and network publishing to today's internet publishing (Shen *et al.* 2012). The definition of DPT is as publishing dependent upon the World Wide Web as its communication channel, producing digital content based on either domestic or global platforms, published and distributed online, with provision for the establishment of digital database facilities for future re-use. The process allows for links to e-commerce, for example, facilitating online payment, with all procedures in the process digitized. Based on customer requirements, the product (information) can be produced and provided in various formats, such as online, web, TV, CD Rom and if necessary, paper (Liu, Rao 2005). Additionally, Print-on-Demand (PoD) and Video-on-Demand (VoD) are elements of DPT. Therefore, the DPT industry is composed of various sub-sectors incorporates authors, publishers, technology providers, databases, web distributors and end-users.

DPT has received increasing attention; most studies have focused on aspects of the publishing trends and the impact of digital technology on the publishing industry. Moreover, few studies and methods are capable of demonstrating the factors that might affect implementation of DPT. Especially, relatively little progress has been made in developing a systematic decision-making approach to identify the CSFs specific to the development of DPT.

1.2. Critical success factors

Critical success factors (CSFs) are those few things that must go well for an individual or an organization to ensure success in a business undertaking (Rockart 1979; Chung 1987). CSFs are the few key areas where "things must go right" for the business to flourish and for the manager's goals to be attained. They represent the managerial or individual activities that an organization must pay particular and continuous attention to in order to achieve the level of performance essential to achieve desired goals (Hackney, Dunn 2000).

Moreover, CSFs are the conditions, characteristics or variables that must go right to have a significant impact on the success of an institution or its endeavor. Thierauf (1982) also states that if the results in these areas are not adequate, the organization's efforts for the period will be less than desired. When CSFs are adequately implemented, they will promote and guarantee the development of an organization. Otherwise, they may also lead to the decline of the organization.

CSFs are widely applied to various contexts such as organization's efforts in developing strategic plans (Munro, Wheeler 1980), establish guidelines for monitoring a corporation's activities (Dickinson *et al.* 1985), identify critical issues associated with implementing a strategic plan (Boynton, Zmud 1984), and can be used by manager and organizations to help achieve high technological performance (Chen, Karami 2010). It is clear from the above literature that CSFs can be analysed and studied at the company level, industry level, and even the wider economic and socio-political level.

CSFs in DPT are vital elements for government. They are indispensable for a successful relief activity, and they directly contribute to obtain the success. That is, they are the key determinants of success or failure of a specific DPT activity. If these CSFs are not satisfactory, the government will fail to adopt appropriate strategies and action plans. Moreover, identification of CSFs is pretty important, enabling government can just pay more attention on these CSFs and implement them progressively to greatly improve the action plans of the DPT.

However, it is important to recognize that very little previous research has sought to identify the CSFs specific to the DPT area in a scientific and systematic manner. Thus, after summarizing relevant studies, this study extrapolates elements and factors influencing DPT, and introduces the ANP method. In doing so, we can simultaneously take into account both the relationships of feedback and dependence among factors; then, the ANP approach is applied to obtain the weight of construct and CSFs, ranking all of factors for successful development of DPT. The related ANP method is reviewed in the next section.

2. Methodologies

The purpose of this study is to identify the CSFs for the development of DPT as a reference for government. It is typical of such an approach to have decision-making problems with multi-criteria decision making (MCDM). One of the optimal approaches to solve such a problem is using ANP (Saaty 1996). The analytical method, ANP and proposed procedures of the evaluation model for DPT and, are delineated in this section.

2.1. Analytic network process

The ANP is a generalization of the analytic hierarchy process (AHP) (Saaty 1996). The AHP, also developed by Saaty (1980), is one of the most widely used MCDM methods. The AHP decomposes a problem into several levels making up a hierarchy in which each decision element is considered to be independent. However, many actual problems of policies do not purely contain linear relation of upper and lower class structure. On the contrary, it produces mutual dependent or mutual influential relation. In consequence, in the year of 1996, the traditional linear structured AHP was further developed into ANP so AHP is considered a special condition of ANP because every perspective, basis or substitutive plan might produce interdependence and feedback relations (Saaty 2009). An extensive review about the limitations of AHP is given in Sipahi and Timor (2010).

When applying ANP for decision making, three phases should be considered: (Lee *et al.* 2012; Hu 2010; Saaty 1996):

Phase 1. Building a network framework. In the beginning, the character of problems which is to be solved have to be defined and all the criteria that affect the decision as well as setting up networked level structure of problems have to be determined.

Phase 2. Calculating the relative weight for each criterion.

Step 1. Calculating the maximum eigenvalue and eigenvector of the pairwise comparison matrix.

The elements are compared pairwisely with respect to their impacts on other elements. The way of conducting pairwise comparisons and obtaining priority vectors is the same as in the AHP. The relative importance values are determined on a scale of 1–9, where a score of 1 indicates equal importance between the two elements and 9 represents the extreme importance of one element compared with the other one. A reciprocal value is assigned to the inverse comparison; that is, $a_{ji} = 1/a_{ij}$ where a_{ij} denotes the importance of the i^{th} element compared with the j^{th} element. Also, $a_{ii} = 1$ is preserved in the pairwise comparison matrix. Then, the eigenvector method is employed to obtain the local priority vectors for each pairwise comparison matrix.

Step 2. Consistency test.

The consistency test of ANP is designed to ensure the consistency of judgments by decision makers throughout the decision making process. Based on the suggestions by Saaty (1980), a consistency ratio (CR) of less than 0.1 indicates that the consistency level of the pairwise comparison matrix is acceptable while a CR of greater than 0.1 indicates that the

results of the decision process are not consistent. In this case, Saaty (1980) suggested that the decision maker performs the pairwise comparison again.

Step 3. Computation of supermatrix.

If the matrix does not conform to the principle of random fields, the decision maker can assess weights to adjust the matrix into a supermatrix to fulfill such a requirement or even transform it into a weighted supermatrix M. Then, according to Eq. (1), the weighted supermatrix multiplies itself several times and then converges into a limiting supermatrix with constant value to get the relative weight:

$$M^* = \lim_{k\to\infty} M^k. \tag{1}$$

Phase 3. *Determining* the weight for each criterion and obtaining final priorities.

After obtaining the relative weights of all criteria, integrating the evaluations of each dimension with the experts and multiplying the scores of each criterion by the total relative weights, a higher score would indicate that the dimension is more important and should be made for obtaining final priorities.

Recently, ANP was originally applied to the problems with multiple criteria, and has been widely used in solving problems of ranking, selection, and evaluation decisions (Lee 2013, 2015; Tsai, Chang 2013; Keršulienė, Turskis 2011; Fouladgar *et al.* 2012; Liou 2013; Peng, Tzeng 2013; Lin *et al.* 2015; Horng *et al.* 2015; Šimelytė *et al.* 2015). For more detailed information on the applications of the ANP, see the book by Saaty (2009) and Sipahi and Timor (2010). In this paper, the evaluation model for DPT, some criteria may have some interdependencies and cannot be captured by the AHP method. Therefore, we use the ANP method instead of the popular AHP approach to evaluate the DPT.

2.2. Proposed procedures

The proposed steps are as follows.

1) Defining problem. The first step is to define the SLT evaluation problem. Moreover, in this step, an expert team is formed that not only not only helped us to classify the various dimensions of decision making and construct the network structure for SLT evaluation but also replies to the questionnaires.
2) Building up a network framework. In the step, the dimensions and criteria for success associated with SLT policy are selected.
3) Calculating the relative weights for each dimension and criterion. In this step, the weighting of each dimension and criterion is found and the priority of the criteria in the evaluation model determining. The ANP is then utilized to derive the weightings based on the network structure.
4) Limiting the weighted supermatrix for the weigh. The unweighted supermatrix contains the priorities derived from the pairwise comparisons of the elements. In an unweighted supermatrix, its columns may not be column stochastic. To obtain a stochastic matrix (i.e., each column sums to one), multiply the blocks of the unweighted

supermatrix by the corresponding cluster priority. The supermatrix must satisfy the principle of column stochastic, which means every column should add up to 1.

5) *Determining* the weights of all criteria. After obtaining the relative weights of all dimensions, integrating the evaluation by multiplying the score of each dimension with the relative criterion weight. Eventually, the criteria weight of hierarchical structure can be generated based on the scores.

3. Empirical studies

The application of the ANP model presented in this study is assessed for the case of the Taiwan DPT.

3.1. Development of DPT in Taiwan

The global digital publishing industry is vigorously developing, this is most obvious with the developments in the United States, where e-books accounted for about 3% of the overall market at the end of 2009 and will account for 7% in 2010. And this is only the beginning: Driven by the improvement of reading devices with integrated online stores, an extensive range of electronic books, and an aggressive price policy of online retailers such as Amazon, eBook revenue continues to expand. The market is being further stimulated by multifunction devices such as Apple's iPad, and it has already proved lucrative for publishers, whose initial investments are paying off because of higher margins for eBooks (Coopers 2012).

At present the digital publishing commodities circulating in Taiwan market are generally in the forms of CD, electronic databases, e-books and e-magazines, electronic newspapers, mobile contents and so on. Taiwan's digital publishing and archives industry output value achieved around 2.39 billion USD in 2011, a growth rate of 45.2% over 2010 (1.64 billion USD). The digital publishing output value was around 2.29 billion USD, an impressive growth of 46.68%. Most of the growth was spurred by the Amazon Kindle, which boasts low priced promotional methods that have already spurred enormous demand in Europe. In turn, this trend sparked the growth of Taiwan's e-book industry and related supply chains (Industrial Development Bureau 2012).

The E-Taiwan Plan is to improve its competitive position through the infrastructure of electronics (e-Infrastructure). The government needs to build up sufficient bandwidth for attracting users, and this is the first step toward increased market penetration (Tsai *et al.* 2008). With the progress of Taiwan's digital publishing technology, at present, many manufacturers have already made research and development of the technologies of e-books and e-book readers. To encourage the book publishers to transform paper books into e-books, in 2005, the Industrial Development Bureau (IBD), Ministry of Economic Affairs started to subsidize publishers to promote the "digital copyright authentication and turnover platform" together, and planned an integral digital publishing supply chain ranging from the establishment of integration standardization of desktop publishing text and graphics, issuance of information content, value-added multimedia contents and so on to digital asset management, establishment and operation of digital copyright management technology (Wang, Ho 2010).

At this time, digital publishing industry, an important development project of the cultural and creative industry and digital content industry, is crucial for the transformation and development of Taiwan's publishing industry. In December, 2008, entity publishers began to promote the digital publishing alliance and align network, hardware and telecom practitioners to join together so as to hopefully create a new situation for digital publication in Taiwan.

3.2. The results

Step 1. Defining problem.

Taiwan's DPT industry output value achieved around 2.39 billion USD in 2011, a growth rate of 45.2% over 2010 (1.64 billion USD). Most of the growth was spurred by the Amazon Kindle, which boasts low priced promotional methods that have already spurred enormous demand in Europe. In turn, this trend sparked the growth of Taiwan's e-book industry and related supply chains.

Taiwan's DPT industry still relies heavily on domestic sales. However, exports to regions such as China, Europe, America, and Japan have been steadily growing over the past few years. This is especially true of China, whose population strongly identifies with and adores archives from Taiwan. Enticed by a large market and strong buying power, many businesses are eager to expand into the China market.

Regarding the DPT is an emerging area of ICT development and relatively new technologies, the identifying the CSFs specific to the DPT are deficient and lack proper evaluation guidelines. The model is developed and then validated using data from the expert team, which contained 12 experts with extensive experience consulting in this study. The 12 experts, including two senior staffs from in the IDB in Taiwan who are in charge of DPT departments in Taiwan, eight project mangers from Institute for information industry, and two professors of management of school.

Step 2. Building up a network framework.

Due to lack of previous research about CSFs in DP, the possible factors were developed based on the literature review (Shen *et al.* 2012; Wang 2009; Tsai *et al.* 2008; Wang, Ho 2010; Industrial Development Bureau 2012) and a series of discussions with experts. This discussion with the experts helped us to organize the various critical factors in the DC into four dimensions and six alternatives as evaluation factors. The four dimensions; they are "(A) Expanding the publishing content", "(B) Expanding the markets", "(C) Upgrading digital technological capability", and "(D) Diffusion of digital knowledge" with 15 criteria. These dimensions and criteria are presented in Table 1 with a short description. Moreover, according to the suggestions of twelve experts, Figure 1 shows the interdependence among dimensions based on the hierarchical structure.

Step 3. Calculating the relative weights for each dimension and criterion.

Based on the network structure, aiming the criteria belongs to each dimension designing ANP questionnaire, as well as using geometric mean (Dyer, Forman 1992) from the experts' opinions to construct a pairwise comparison matrix. Then, we are going to begin a series of pairwise comparison in each dimension and criteria, and then the calculation of the eigenvalue and eigenvector are based on the third section.

Table 1. The dimensions and criteria for DPT

Dimensions	Criteria	Descriptions
(A) Expanding the publishing content	(A1) Providing financing and digital product development subsidies	The level of providing financing and digital product development subsidies
	(A2)Usage and support of the digital learning application flagships	The level of usage and support of the digital learning application flagships
	(A3) Establishment of electronic and paper synchronous	The level of establishment electronic and paper synchronous
	(A4) Establishing the protection mechanism of digital copyright	The level of establishing protection mechanism of digital copyright
(B) Expanding the markets	(B1)Setting up the Chinese language content exchange center	The level of setting up the Chinese language content exchange center
	(B2) Encouraging join the international publishing alliance	The level of encouraging joining the international publishing alliance
	(B3) Integrating the software and hardware industries to enter the overseas markets	The level of integrating the software and hardware industries to enter the overseas markets
	(B4) Developing the own brands to the overseas markets	The level of developing the own brands to the overseas markets
(C) Upgrading digital technological capability	(C1) Enhancing R&D capability and industrial technological levels	The level of enhancing R&D capability and industrial technological levels
	(C2) Building the standardization of publishing	The degree of building standardization of publishing
	(C3) Developing the outstanding digitization publications	The degree of developing the outstanding digitization publications
	(C4) Enhancing the self-produce key components	The degree of enhancing the self-produce key components
(D) Diffusion of digital knowledge	(D1) Expanding the scope of digital learning applications	The level of expanding the scope of digital learning applications
	(D2) Expanding the demand for digital publication to the libraries	The level of expanding the demand for digital publication to the libraries
	(D3) Encouraging the digitization consumers for the localization	The level of encouraging digitization consumers for the localization

For the pairwise comparison matrix as shown in Table 2, the question asked to the participants is: "What is the importance degree between each dimension with respect to the decision goal?" It is observed that "(C) Upgrading digital technological capability" criterion was found to have the highest priority (0.40) in CSFs, followed by "(D) Diffusion of digital knowledge" (0.35), "(A) Expanding the publishing content" (0.16), and "(B) Expanding the markets" (0.08). Both "(C) Upgrading digital technological capability" and "(D) Diffusion of digital knowledge" are considered to be the most dimensions in CSFs in terms of DPT.

Moreover, according the interdependency of criteria, we apply pairwise comparisons again to establish the criteria relationships within each dimension. The eigenvector of the observable pairwise comparison matrix provide the criteria weights at this level, which will be used in the supermatrix. There are 15 such pairwise comparison matrices in the study.

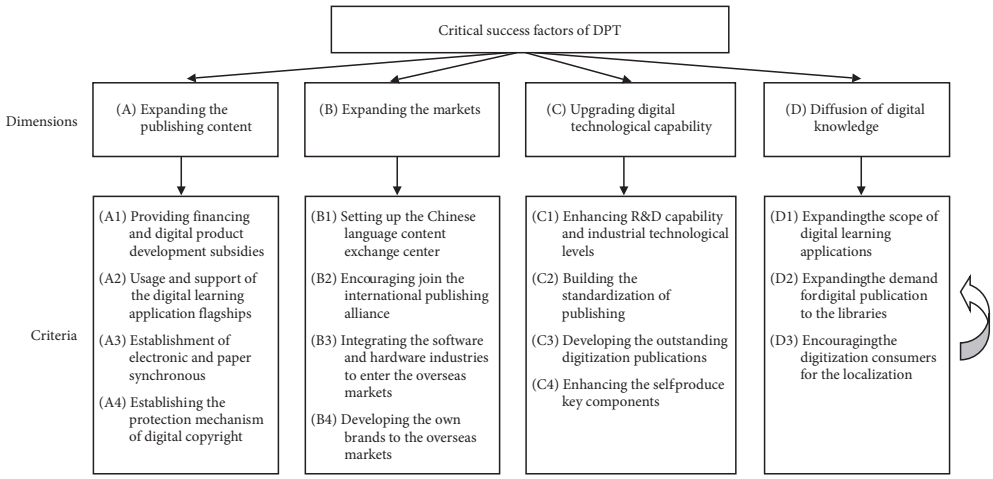

Fig. 1. ANP-based model for critical success factors of DPT

Table 2. The pair-wise comparison of dimensions

	(A)	(B)	(C)	(D)	e-vector
(A) Expanding the publishing content	0.079	0.108	0.047	0.404	0.16
(B) Expanding the markets	0.04	0.058	0.144	0.083	0.08
(C) Upgrading digital technological capability	0.244	0.455	0.611	0.319	0.40
(D) Diffusion of digital knowledge	0.618	0.378	0.198	0.194	0.35

One such comparison is shown in Table 3. It shows one such comparison which represents the result of the "(A) Expanding the publishing content" dimension with "(A1) Providing financing and digital product development subsidies" as the control criterion over other criteria. Table 3 also reveals that "(A3) Establishment of electronic and paper synchronous" has the strongest impact (0.493) on the "(A) Expanding the publishing content" dimension, with "(A1) Providing financing and digital product development subsidies" as the control criterion over others. Furthermore, "(A4) Establishing the protection mechanism of digital copyright" has the weakest impact (0.195). It shows that "(A3) Establishment of electronic and paper synchronous" has the most influence on the "(A1) Providing financing and digital product development subsidies" for the dimension of "(A) Expanding the publishing content". The e-vector from these matrices is thus used to form the supermatrix.

Table 3. The pair-wise comparison for requirement of "(A1) Providing financing and digital product development subsidies" under "(A) Expanding the publishing content" dimension

	(A2)	(A3)	(A4)	e-vector
(A2) Usage and support of the digital learning application flagships	1.00	2.00	2.00	0.311
(A3) Establishment of electronic and paper synchronous	0.50	1.00	2.00	0.493
(A4) Establishing the protection mechanism of digital copyright	0.50	0.50	1.00	0.195

Step 4. Limiting the weighted supermatrix for the weigh.

The supermatrix permits a resolution of the interdependencies that exist among the components of a system. It is a partitioned matrix where each sub-matrix is composed of a set of relationships between and within the levels, as represented by the decision maker model. The supermatrix, as shown in Table 4, presents the results of the relative importance measure for each of the criteria for each dimension. The components of supermatrix have been imported from the pairwise comparison matrices of interdependencies as shown in Table 3. As there are 15 such pairwise comparisons matrices, one for each interdependent criterion, therefore, there will be 15 non-zero columns in the supermatrix. Each of the non-zero values in a column which represents the relative importance weight associated with the interdependent pairwise comparison matrices.

Step 5. *Determining* the weights of all criteria.

Next, the supermatrix is made to converge to obtain a stable set of weights. For convergence to occur, the supermatrix needs to be column stochastic, which means the sum of each column of the supermatrix must be one. The converged supermatrix is shown in Table 5.

Finally, after convergence with the ANP application, are shown in Table 6. As illustrated in Table 6, all CR values are less than 0.1, indicating consistency (Saaty, 1980). In the "(A) Expanding the publishing content" category, the "(A1) Providing financing and digital product development subsidies" (0.314) was rated as the most important criterion; in "(B) Expanding the markets", "(B1) Setting up the Chinese language content exchange center" (0.330) was rated as the most important; in "(C) Upgrading digital technological capability", "(C1) Enhancing R&D capability and industrial technological levels" (0.302) was rated as the most important; and in "(D) Diffusion of digital knowledge", "(D1) Expanding the scope of digital learning applications" (0.411) was rated as the most important.

Table 4. The supermatrix before convergence

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	D4	E1	E2
A1	0.000	0.540	0.300	0.540	--	--	--	--	--	--	--	--	--	--	--
A2	0.311	0.000	0.540	0.300	--	--	--	--	--	--	--	--	--	--	--
A3	0.493	0.163	0.000	0.163	--	--	--	--	--	--	--	--	--	--	--
B1	0.195	0.300	0.163	0.000	--	--	--	--	--	--	--	--	--	--	--
B2	--	--	--	--	0.000	0.493	0.493	0.493	--	--	--	--	--	--	--
B3	--	--	--	--	0.121	0.000	0.196	0.196	--	--	--	--	--	--	--
C1	--	--	--	--	0.560	0.310	0.000	0.310	--	--	--	--	--	--	--
C2	--	--	--	--	0.320	0.196	0.310	0.000	--	--	--	--	--	--	--
C3	--	--	--	--	--	--	--	--	0.000	0.517	0.625	0.196	--	--	--
D1	--	--	--	--	--	--	--	--	0.540	0.000	0.137	0.493	--	--	--
D2	--	--	--	--	--	--	--	--	0.163	0.124	0.000	0.310	--	--	--
D3	--	--	--	--	--	--	--	--	0.300	0.360	0.238	0.000	--	--	--
D4	--	--	--	--	--	--	--	--	--	--	--	--	0.000	0.661	0.750
E1	--	--	--	--	--	--	--	--	--	--	--	--	0.750	0.000	0.250
E2	--	--	--	--	--	--	--	--	--	--	--	--	0.250	0.315	0.000

Table 5. The supermatrix after convergence

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	D4	E1	E2
A1	0.314	0.314	0.314	0.314	--	--	--	--	--	--	--	--	--	--	--
A2	0.275	0.275	0.275	0.275	--	--	--	--	--	--	--	--	--	--	--
A3	0.229	0.229	0.229	0.229	--	--	--	--	--	--	--	--	--	--	--
B1	0.180	0.180	0.180	0.180	--	--	--	--	--	--	--	--	--	--	--
B2	--	--	--	--	0.330	0.330	0.330	0.330	--	--	--	--	--	--	--
B3	--	--	--	--	0.143	0.143	0.143	0.143	--	--	--	--	--	--	--
C1	--	--	--	--	0.299	0.299	0.299	0.299	--	--	--	--	--	--	--
C2	--	--	--	--	0.226	0.226	0.226	0.226	--	--	--	--	--	--	--
C3	--	--	--	--	--	--	--	--	0.302	0.302	0.302	0.302	--	--	--
D1	--	--	--	--	--	--	--	--	0.301	0.301	0.301	0.301	--	--	--
D2	--	--	--	--	--	--	--	--	0.160	0.160	0.160	0.160	--	--	--
D3	--	--	--	--	--	--	--	--	0.236	0.236	0.236	0.236	--	--	--
D4	--	--	--	--	--	--	--	--	--	--	--	--	0.411	0.411	0.411
E1	--	--	--	--	--	--	--	--	--	--	--	--	0.364	0.364	0.364
E2	--	--	--	--	--	--	--	--	--	--	--	--	0.224	0.224	0.224

Table 6. Priorities and weights of critical success factors

Dimension / criteria	Relative weight (Ranking)	
(A) Expanding the publishing content (CR = 0.03)	0.16 (3)	
(A1)Providing financing and digital product development subsidies		0.314 (1)
(A2)Usage and support of the digital learning application flagships		0.275 (2)
(A3)Establishment of electronic and paper synchronous		0.229 (3)
(A4)Establishing the protection mechanism of digital copyright		0.180 (4)
(B) Expanding the markets (CR = 0.02)	0.08 (4)	
(B1)Setting up the Chinese language content exchange center		0.330 (1)
(B2)Encouraging join the international publishing alliance		0.143 (4)
(B3)Integrating the software and hardware industries to enter the overseas markets		0.299 (2)
(B4)Developing the own brands to the overseas markets		0.226 (3)
(C) Upgrading digital technological capability (CR = 0.01)	0.40 (1)	
(C1)Enhancing R&D capability and industrial technological levels		0.302 (1)
(C2)Building the standardization of publishing		0.301 (2)
(C3)Developing the outstanding digitization publications		0.160 (4)
(C4)Enhancing the self-produce key components		0.236 (3)
(D) Diffusion of digital knowledge (CR = 0.02)	0.35 (2)	
(D1)Expanding the scope of digital learning applications		0.411 (1)
(D2)Expanding the demand for digital publication to the libraries		0.364 (2)
(D3)Encouraging the digitization consumers for the localization		0.224 (3)

Note: CR = consistency ratio.

3.3. Discussion

The proposed evaluation framework has been effectively applied to identify and prioritize the CSFs for the development of DPT for the case Taiwan. As concerns analysis of this study, it is a favorable way to provided policy makers to implement DPT successfully by these four CSFs. These factors would provide more insights for the government to make the appropriate strategies and action plans. Further, these CSFs can provide decision maker with a mechanism to monitor and promote the DPT.

What factors provide policy makers should stress more in the Taiwan DPT should be understood so that more effort can be put on improving the performance of these factors? As shown in Table 6, the weights of the four dimensions, "(A) Expanding the publishing content", "(B) Expanding the markets", "(C) Upgrading digital technological capability", and "(D) Diffusion of digital knowledge", with respect to the goal, were 0.16, 0.08, 0.40, and 0.35, respectively. Among the four dimensions, "(C) Upgrading digital technological capability" had the largest priority with 0.40, followed by "(D) Diffusion of digital knowledge" with 0.35 is considered to be top two key factors by ANP. The results indicate that the government should provide technological resource to support and upgrade the industrial digital technological capability. Moreover, the government has to expanding the scope of digital applications for diffusion of digital knowledge to increase the success rate for the DPT.

The study also found that the importance of criteria in making the DPT decision. As shown in Table 6, the relative priorities of criteria under the four dimension. Under the "(A) Expanding the publishing content" dimension, the most important criterion, out of a total of four criteria, is "(A1) Providing financing and digital product development subsidies", with a priority of 0.314. This means that the major "(A) Expanding the publishing content" concern for implementing the DPT successfully is the "Providing financing and digital product development subsidies". The second and third criteria are "(A2) Usage and support of the digital learning application flagships" (0.275) and "(A3) Establishment of electronic and paper synchronous" (0.229). Moreover, under the "(B) Expanding the markets" dimension, "(B1) Setting up the Chinese language content exchange center" (0.330) is the most important criterion, and "(B3) Integrating the software and hardware industries to enter the overseas markets" (0.299) ranks the second. Next, under the "(C) Upgrading digital technological capability" dimension, "(C1) Enhancing R&D capability and industrial technological levels" (0.302) is the major concern, followed by "(C2) Building the standardization of publishing" (0.301). Finally, under the "(D) Diffusion of digital knowledge" dimension, "(D1) Expanding the scope of digital learning applications" 0.411) is what the decision-makers worries most about since it may affect the diffusion of the DPT.

As concerns analysis of this study, it is a favorable way to promote the performance of DPT by these four CSFs. Essential factors can be implemented and the DPT can be improved stepwise according to interdependence relationship among factors. Further, these CSFs can be regarded as critical criteria during the planning phase.

Conclusions and further work

The contribution of the study for the practical implementation the ANP is presented in this study as a valuable and efficient method to identify and prioritize the CSFs of DPT would be a useful and valuable reference for the policy makers for determining the appropriate strategies and action plans. Moreover, from the ANP implementation point of view, it supports the existing literature on ANP by the Taiwan's DPT that it provides more realistic results and applicable approach for the DPT evaluation problem. Therefore, ANP modeling can serve as a new method and offer insights to policy makers to indentify and prioritize CSFs for DPT implementations systematically. The results of this study could serve as a reference for the authorities.

However, this research has some limitations. First, since DPT includes different tasks and thus the criteria involved in DPT evaluation are complex; there may be additional dimensions and criteria that should be considered and added in future research. Second, a different group of decision-makers could also influence the results. Future research should examine the study results and focus on different groups of stakeholders (e.g., publishers, consumers), stakeholders in different contexts, as well as how the results might change over time. Based upon these differences, some managerial implications could be identified. Finally, the outcome of the ANP model conducted in this study is determined by expert team. However, due to problems such as incomplete information and subjective uncertainty, even experts find it difficult to quantify the precise ratio of weights for the different criteria for the DPT; the other analytical techniques (e.g., fuzzy sets theory, Decision Making Trial and Evaluation Laboratory) can be employed in order to gain more in-depth insights into the similar issues in the future research.

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