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MEASUREMENT MODEL OF KNOWLEDGE BASED RESOURCES FOR COMPETITIVENESS OF TECHNICAL AND VOCATIONAL COLLEGES IN UNDEVELOPED AREAS OF CHINA

Yong Zhang[1], Amirmudin Udin[2], Yusri Kamin[3] and Noriadah Abdul Karim[4]

Competitiveness is one of the most important and valuable advantage that ensures technical and vocational colleges to achieve success and long-term viability. In order to improve competitiveness of technical and vocational colleges in undeveloped areas of China, this paper proposed a new perspective which drew knowledge-base and dynamic capability view into evaluating vocational colleges' key resources and capabilities, specifically for the intangible resources and dynamic capabilities. This paper presents a new viewpoint of researching competitiveness via measuring specific knowledge based intangible resources and dynamic capabilities for vocational colleges in undeveloped areas of China. Integrated theories of knowledge-based resources and dynamic capability view, and based on the findings of experimental study in selected five vocational colleges in undeveloped areas of China, eventually, the paper reoriented and identified the key components of intangible resources and dynamic capabilities for vocational colleges, also shed light on the measurement model of intangible resources, the measurement model of dynamic capabilities, which effected on enhancing competitive advantage of vocational colleges in undeveloped areas of China. Accordingly, the outcomes of this study would contribute for managers of vocational college to improve competitiveness of technical and vocational colleges.

Keywords: Competitiveness, Knowledge based resources, Technical and vocational colleges, Measurement model.

1. INTRODUCTION

Dating back to the 1980s, colleges and universities began to notice the importance of resources and capacities as rational sources for gaining competitiveness (Akonkwa, 2009). Interestingly, today's technical and vocational colleges (TVC) increasingly apply the knowledge based resources view to explore intangible resources which guarantees them success in competitive education market, and more rely on their dynamic capabilities (Wu, 2009; Grant, 2011; UNESCO, 2012). According to Porter (1998), organisation's resources as a source of competitiveness have rested upon two basic premises: first, resources provide the basic direction for an organisation's competitive strategy; second, resources are the primary sources

[1] Guizhou University of Finance and Economics (GUFE), China; Universiti Teknologi Malaysia, *E-mail: billzhangy@gmiail.com*

[2] Universiti Teknologi Malaysia, *E-mail: p-amir@utm.my*

[3] Universiti Teknologi Malaysia, *E-mail: p-yusri@utm.my*

[4] Universiti Teknologi Malaysia, *E-mail: rohinjunior@gmail.com*

of profit for the institutions or value for stakeholders. The causal links and interaction of resources and competitiveness indicated that an organisation's capabilities are supported by relevant resources, and unique capabilities which mostly bundle with valuable resources to influence strategic planning and implementation, and ultimately effect on an organisation's competitiveness (Penrose, 1959; Barney, 1991; Gamble, 2009).

Porter (1998) and Mintzberg (2003) have documented that tangible resources (TR) alone would not be able to maintain competitiveness because they could be easily imitated by rivals. Conversely, intangible resources (IR) included brands, trade knowledge, human capital, new technology, culture, policy etc., as vital and strategic factors in business success (Barney and Arikan, 2001). IR were more difficult to imitate but are more likely to produce competitiveness. Moreover, an organisation's capabilities are popular concepts that are related to managerial abilities (Begley and Boyd, 2013). In strategic management field, many research findings have confirmed the importance of those abilities involved in collaboration capability (Priem, 2007), knowledge management capability (Martina *et al.*, 2007), and creativity and innovation (Spender, 2008). According to the dynamic capabilities view (Teece, *et al.*, 1997; Nielsen, 2012), such knowledge-based abilities were most important for achieving and sustaining competitiveness as they could increase the value, and underscore the distinctive features of a vocational college.

Many types of research showed that the characteristics of vocational colleges were different from traditional business organisations, for example, some distinctive resources have included government funds and policies; training facilities; campus culture; academic human capital; information technology (Ma, 2009; Wu *et al.*, 2013; Liu and Zhang, 2014) as well as knowledge management capability (Billet, 1997). Specifically, vocational colleges as a knowledge provider should be pay more attention on knowledge management capability inclusive knowledge acquisition, knowledge conversion, and knowledge application (Ondari-Okemwa, 2006). In addition, the vocational colleges have combined both the school-based vocational education and industrial enterprise partnership. In particular, vocational colleges need to be tightly linked to enterprises in society. Industrial enterprise partnership capability can provide vocational students with an opportunity to obtain up-to-date specific skills before graduate. Therefore, it is apparent that the vocational colleges/industrial enterprise partnership merits further attention (Iannelli and Raffe, 2010; Liu and Zhang, 2014).

Nowadays, globalization has led to the changing of the traditional key resources related to competitiveness. Consequently, re-exploring crucial factors, and investigating the interaction of variables has become a complex but significant discipline in the study of vocational colleges' competitiveness (Liu and Zhang,

2014). However, the importance of intangible resources and such dynamic capabilities has yet to be looked at in depth in China's vocational colleges in most undeveloped areas (Wu, *et al.*, 2013). This presents opportunities for researchers to embark on studies of reorienting key intangible resources and dynamic capabilities. It will also contribute to enhancing the competitiveness of vocational colleges in Chinese undeveloped areas.

2. STATEMENT OF THE PROBLEM

Records from the Education Development Report of China (2013) indicated that in recent years, more and more government funding, facilities and infrastructure invested in TVC in order to improve competitiveness, especially, in undeveloped areas (MOE, 2013). However, the competitiveness level of TVCs in undeveloped areas still ranked low (MOE, 2013). Compared to TVCs in developed provinces in China, most TVC in undeveloped areas were lower in terms of funds from manufactory, instructional facilities, human capital, culture, knowledge management, and innovation (Ma, 2009; MOE, 2013; Wu, *et al.* 2013). But this was not the result of a lack of government or financial support. Previous studies by Tsang (2009), Ma and Zhang (2012), Zhuang (2012), Wu *et al.* (2013), showed that for most TVC in undeveloped areas, their tangible resources such as government funds, tuition fee income, and fixed asset valuation did not translate into CA effectively; likewise, the potential of the intangible resources such as human capital, college's culture, policy, and information technology skills was underestimated; and top managers lacked a deep understanding of TVC's dynamic capabilities in term of knowledge management capability, collaboration capability, and innovation.

Moreover, in undeveloped areas, the top leaders of TVC were generally contented with local government funds and traditional methods of college administration. They concentrated acquiring more on tangible resources such as government funds, tuition income, instruction facilities, campus infrastructures, and traditional training capabilities, but paid little attention to developing intangible resources such as campus culture, new technology, knowledge management capability, industrial partnerships, and innovation capacity. Meanwhile, managers in TVC are still unclear or confused about what are their specific important valuable intangible resources and dynamic capabilities which can be used to effectively achieve competitiveness. Zhang (2011) stated that there were the huge gaps between TVC in developed and undeveloped areas in terms of competencies of exploring intangible resources; using knowledge management capability; industrial enterprise cooperation; and innovation.

In view of the foregoing, it can be assumed that the success of attaining a high level of competitiveness among TVC in undeveloped areas depends largely on the clarity of understanding of key intangible resources and dynamic capabilities among TVC's managers and lecturers.

3. RESEARCH OBJECTIVES

In order to enhancing the competitiveness of TVC, this paper aims to:

(i) Determine the measuremnt model of intangible resources which deemed important for enhancing competitiveness of technical and vocational colleges in undeveloped areas of China.

(ii) Determine the measuremnt model of dynamic capaiblies which deemed important for enhancing competitiveness of technical and vocational colleges in undeveloped areas of China.

4. LITERATURE REVIEW

Knowledge-based resources are important intangible resources with characteristics of originality, inimitability, uniqueness, and irreplaceability (Grant, 2011). Borrowing from Porter's Five-Force Model (1998), even if a competitor could not perfectly imitate a vocational college's resource, it could still obtain competitive advantage of its own by obtaining resource substitutes. But knowledge based resources avoid this happen. Spender (2008) pointed that any development of the organisation needs to be supported by knowledge, and the organisation's knowledge-based resources contribute value in ways which rivals cannot imitate or obtained on the open market. Moreover, the dynamic capability might guide the organisations attempt to create and develop those capabilities with dynamic characters that lead to securing competitiveness (Barney, 2001; Zahra *et al.*, 2006). Dynamic capabilities, by contrast, refer to

> "the capacity of an organisation to purposefully create, extend, or modify its resource base" (Helfat, 1997).

The basic assumption of the dynamic capabilities framework is that core competencies should be used to modify short-term competitive positions that can be used to build longer-term competitive advantage (Teece, *et al.*, 1997).

Intangible resources (IR) are defined as identifiable, non-monetary assets without physical substances, such as reputation, brand-name, and intellectual property (Barney, 2001). Intangible assets are the long-term resources of an entity which have no physical existence. Although, intangible resources partly reflect difficulties of valuation, it has been argued that intangible assets are more important and likely to produce competitiveness because they often are unobservable, truly rare and can be more difficult for competitors to imitate (Jackson *et al.*, 2003). In applying strategies from the knowledge based resources and the dynamic capabilities, a major handicap in identifying and appraising IR of TVC was that the traditional valuation techniques of resources were not able to capture the importance of intangible resources to educational institutions (Mintzberg, 2003).

In order to measure IR effectively this study combines broad literature and experts' perceptions of IR for TVC in undeveloped areas, and categorizes IR into four dimensions including human capital, college's culture, policies, and information technology (IT) skills, as shown in Table 1.

TABLE 1: SUMMARY OF KEY DIMENSIONS OF INTANGIBLE RESOURCES

Researcher	*Key dimensions of intangible resources*
Gold *et al.* (2001)	Technology; Structure; Culture
Ryan and Prybutok (2001)	Organisational culture; Top management leadership and commitment; Employee involvement; Measurement Information systems infrastructure
Chuang (2011)	Information technical skills; Human capital; Structure and Cultural resources
Chin (2009)	Organisational cultures, co-workers support, rewards, organisational structures, Information technology
Wang and Zhang (2010)	Organisational culture; Information technology skills; Measurement; Resources; Organisational structure; Training and education
Meliha (2011)	T-shaped skills; culture, policies; knowledge measurement; IT technology
Eshlaghy and Yusefvand (2011)	T-shaped skills; IT; Policy; Human capital
Lee and Sharmila, (2012)	Organisation Culture (knowledge sharing culture); Organisation Structure; Information Communication Technology; Human Capital; Organisation policies
Developed for this paper	Human capital (structure and T-shaped skills)CultureInformation technology

According to Bowman and Ambrosini (2003), dynamic capabilities (DC) have been defined as the capacity for reconfiguration, building, learning and integration attributes so as to achieve competitiveness in the changing social environment. Considered the reconfiguration, building, learning and integration attributes, many researchers strongly proposed knowledge management capability as one of the most important dynamic capabilities for knowledge organisations, specifically for educational institutions (Eraut, 1994; Barad, 2007). Other researchers, *e.g.* Ryan (2009), Ma (2009), Wu *et al.* (2013), Liu and Zhang (2014), found that the capability of college/enterprise collaboration or partnership was a distinctive aspect of gaining competitiveness among TVC compared to general universities. Recently, innovation was identified as an additional important dynamic capability for vocational colleges (Fathi and Wilson, 2009).

5. METHODOLOGY

The quantitative research (empirical study) portion, involved top managers (*e.g.* chancellors or vice chancellors), middle-level managers (*e.g.* deans or deputy deans of faculty, deans of administration), entry-level managers (head or director of

department), and lecturers (*e.g.* professor, associate professor, senior lecturer) selected from five high-ranking state vocational colleges in undeveloped areas of China. Stratified simple random sampling was used to identify the respondents for the quantitative phase of this research. Simple random sampling was used to draw the required samples for each strata of population. This sampling procedure works on the principle of randomization. Confirmatory Factor Analysis (CFA) was used to determine measurement model. Convergent validity and discriminant validity were evaluated. 458 samples were used for CFA testing.

Due to time and financial constraints, only 5 higher ranking vocational colleges (MOE, 2013) in undeveloped areas were selected for empirical study, and the results have only been interpreted for these undeveloped areas of China.

6. FINDINGS AND DATA ANALYSIS

Confirmatory factor analysis (CFA) was used to test measurement model, which included specifying the indicators for each latent variable, enabling an assessment of construct validity and reliability (Hair *et al.*, 2006). In this paper, cited from Hair *et al.* (2006), the indicators of average variance extracted (AVE) and the component reliability (CR) were calculated by the following formula.

$$AVE = \frac{\sum \lambda^2}{\sum \lambda^2 + \sum (1 - R^2)} \quad CR = \frac{(\sum \lambda)^2}{\sum \lambda^2 + \sum (1 - R^2)}$$

The inspection of measurement model of Intangible Resources (IR) indicated that the level of model fit was satisfied. The results of standardised estimates (Figure 1) showed that the value of Chi-square was 239.25 with 87 degrees of freedom. Although the p value associated with this result was significant at $p = .000$, and the sample size in this study for CFA was quite large ($N = 458$), a significant p-value could be expected (Hair *et al.*, 2006). In addition, the normed Chi-square (2.750) was accepted (between 1 and 3). In this case, a good value of normal Chi-square (less than 3) was enough to indicate a good model fit (Hair *et al.*, 2010). The GFI (0.935) and AGFI (0.910) were both greater than 0.9; the CFI (0.964) was greater than 0.9; the PNFI (0.783) was greater than 0.5; and specifically the RMSEA was 0.062 (*i.e.*, a measure of less than 0.08 fails the goodness-of-fit analysis). These results suggest that the measurement model of intangible resources provided a reasonably good fit. The values of all factor loadings were acceptable (all items over 0.7). In addition, the average variance extracted (AVE) of IR1 was 0.58 and the component reliability (CR) of IR1 was 0.85; the AVE of IR2 was 0.64; CR of IR2 was 0.83, and the AVE of IR3 was 0.61; CR of IR3 was 0.90. All values of AVE were greater than 0.5 and values of CR were greater than 0.7. Hence, these results showed that IR1, IR2 and IR3 had acceptable

convergent validity. Moreover, the second-order construct of IR was also found to have a good reliability (0.931). An examination of inter-correlations between the three dimensions (IR1, IR2, IR3) of intangible resources showed the estimates (0.62, 0.71, 0.69) were significantly below the cutoff value of 0.90 (Figure 2), implying distinctness in construct content or discriminant validity. The congeneric measurement model with all unidimensional constructs did not contain any cross-loadings either among the measured variables or among the error terms. Taken together, these results supported the measurement model validity and, as such, the proposition that IR could be a second-order latent construct composed of IR1, IR2, and IR3 was confirmed. Figure 3 also shows the simplified dimensions of IR.

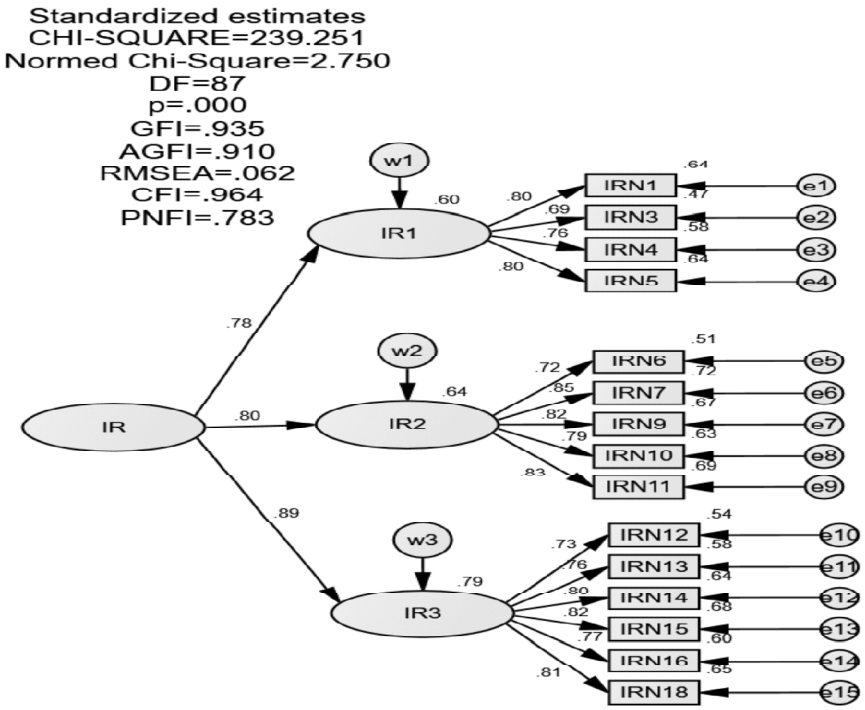


Figure 1: Measurement Model of Intangible Resources

After running CFA, the inspection of measurement model of Dynamic Capabilities (DC) indicated that the level of model fit was satisfied. The results of standardised estimates (Figure 5) showed that the value of Chi-square was 115.79 with 74 degrees of freedom. Although the *p* value associated with this result was significant at $p = .000$, the sample size in this study for CFA was quite large ($N = 458$), and a significant *p*-value could be expected (Hair *et al.*, 2006). In addition, the normed Chi-square (2.105) was accepted (between 1 and 3). In this case, a

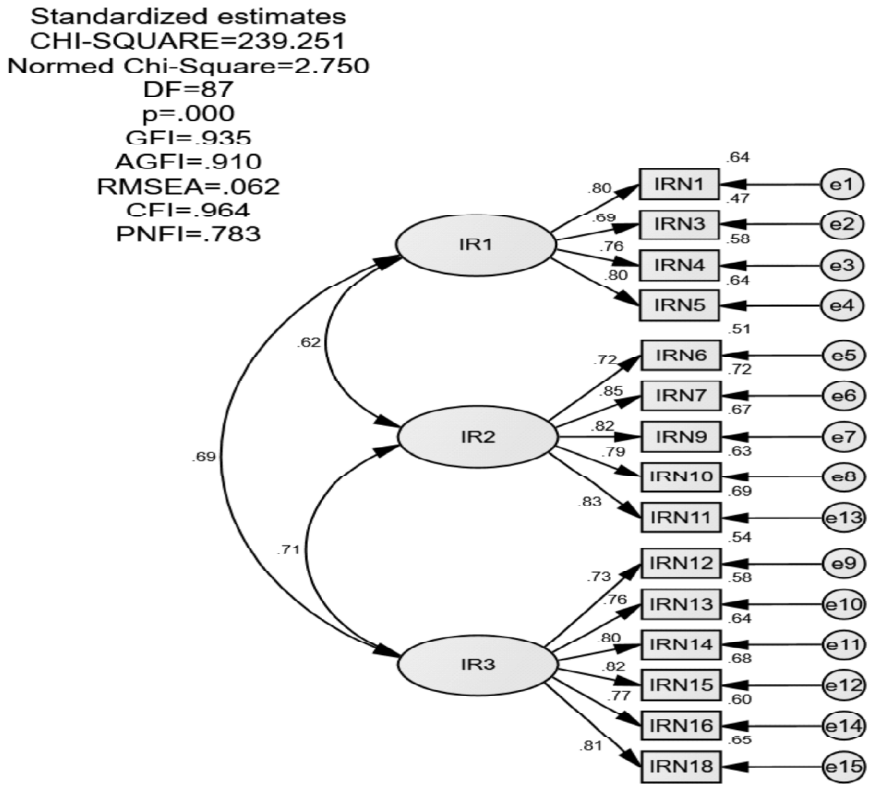
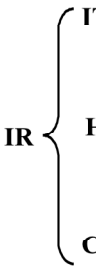


Figure 2: Construct Discriminant Validity for Intangible Resources.



Intangible Resources	
IT Skills	**Factor loading**
IRN1	0.8
IRN3	0.69
IRN4	0.76
IRN5	0.8
Human Capital	**Factor loading**
IRN6	0.72
IRN7	0.85
IRN9	0.83
IRN10	0.79
IRN11	0.83
Culture	**Factor loading**
IRN12	0.73
IRN13	0.76
IRN14	0.8
IRN15	0.82
IRN16	0.77
IRN18	0.81

Figure 3: The Dimensions of Intangible Resources

good value of normal Chi-square (less than 3) was enough to indicate a good model fit (Hair *et al.*, 2010). The GFI (0.955) and AGFI (0.936) were both greater than 0.9; the CFI (0.975) was greater than 0.9; the PNFI (0.775) was greater than 0.5; and specifically, the RMSEA was 0.049 (*i.e.*, a measure of less than 0.08 fails the goodness-of-fit analysis). These results suggest that the measurement model of tangible resources provided a reasonably good fit. The values of all factor loadings were acceptable (all items over 0.6). In addition, the average variance extracted (AVE) of DC1 was 0.57 and the component reliability (CR) of DC1 was 0.87; the AVE of DC2 was 0.67; CR of DC2 was 0.89; and the AVE of DC3 was 0.52; CR of DC3 was 0.84. All values of AVE were greater than 0.5 and values of CR were greater than 0.7. Hence, these results showed that DC1, DC2 and DC3 had acceptable convergent validity. Moreover, the second-order construct of DC was also found to have a good reliability (0.894). An examination of inter-correlations between the three dimensions of dynamic capabilities showed the estimates (0.37, 0.66, 0.52) were significantly below the cutoff value of 0.90, implying distinctness in construct content or discriminant validity (Figure 4). The congeneric measurement model with all unidimensional constructs did not contain any

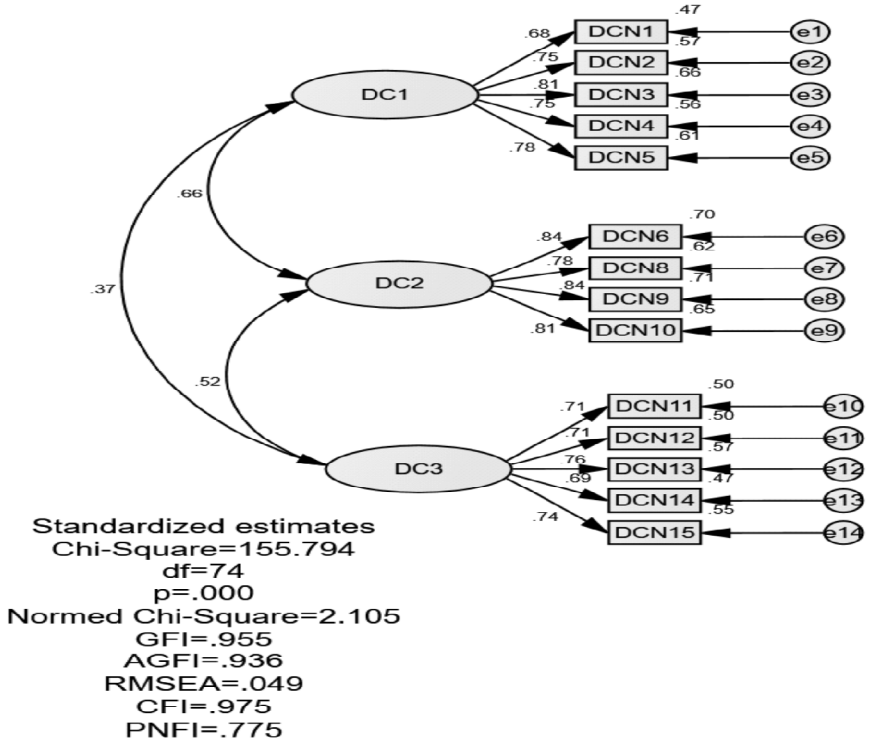


Figure 4: Construct Discriminant Validity for Dynamic Capabilities

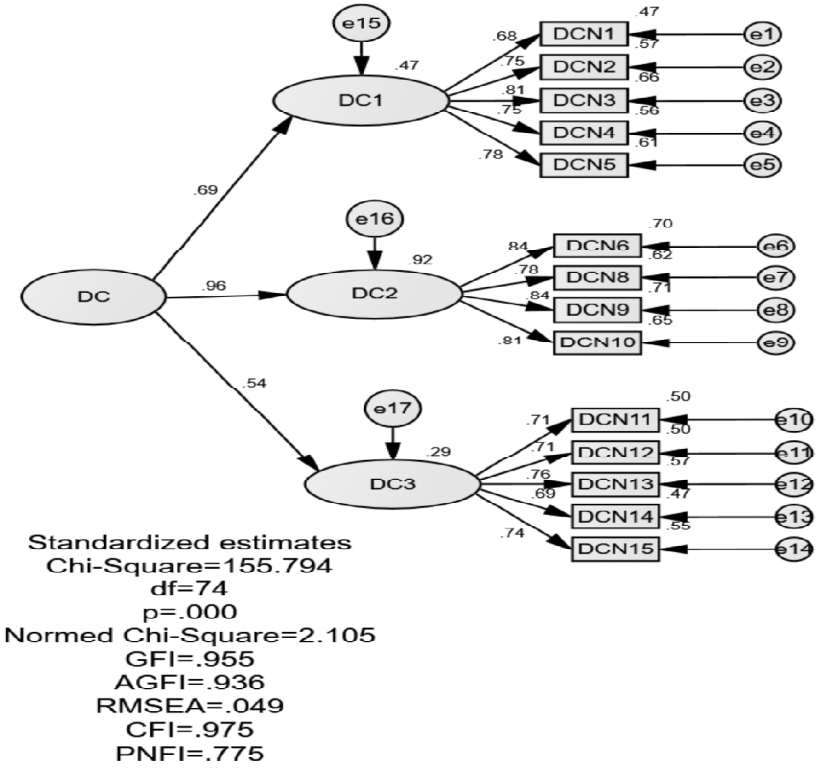
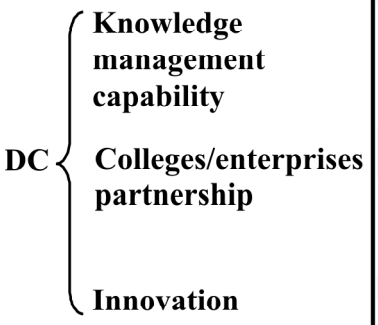


Figure 5: Measurement Model of Dynamic Capabilities



Dynamic Capabilities	
Knowledge management capability	**Factor loading**
DCN1	0.68
DCN2	0.75
DCN3	0.81
DCN4	0.75
DCN5	0.78
Colleges/enterprises partnership	**Factor loading**
DCN6	0.84
DCN8	0.78
DCN9	0.84
DCN10	0.81
Innovation	**Factor loading**
DCN11	0.71
DCN12	0.71
DCN13	0.76
DCN14	0.69
DCN15	0.74

Figure 6: The Dimensions of Dynamic Capabilities

cross-loadings either among the measured variables or among the error terms. Taken together, these results supported the measurement model validity and, as such, the position that dynamic capabilities could be a second-order latent construct composed of DC1, DC2, and DC3 was confirmed. Figure 6 also shows the simplified dimensions of DC.

7. CONCLUSION

The results of this study revealed IR as important factor for enhancing competitiveness related to three categories: human capital, culture, and information technology (IT) skills. Human capital development is becoming more and more important in TVCs. Culture was regarded as a critical successful factor for constructing dynamic capabilities in TVCs, and significantly affected strategy decisions and implementation. A culture of learning, cooperation, and innovation were more important to stimulate the development and application of knowledge within vocational colleges (Wu, 2009, Chuang, 2011). Currently, information technology (IT) skills have heavily influenced vocational education. Cumulatively, IT skills have become basic and essential skills required of everyone in higher vocational education. Porter (2003) also drew a similar conclusion stating that in this new information and knowledge era, competitiveness is more linked to IT skills. Hence, the twenty-first century workplace requires IT skills of its workforce to ensure global competitiveness.

The results of this study also indicated that:

(i) knowledge management capability could be identified as one important dynamic capability for vocational education institutions (Teece, 2007);

(ii) innovation needs to receive more attention as an important dynamic capability for vocational colleges in Guizhou;

(iii) collaboration also was validated as an important dynamic capability (Barad, 2007); including the college/enterprise collaboration or partnership as a distinctive aspect of developing competitiveness in comparison to universities generally in Guizhou (Ryan, 2009; Fahy, 2010; Wu *et al.*, 2013;).

In higher vocational education context, the knowledge management capability has been recognized as a key enabler for gaining and sustaining competitiveness. When vocational colleges efficiently implement and follow the process of knowledge acquisition, knowledge conversion, and knowledge application, they can improve operations with knowledge-rich and knowledge-managing, productive creativity. An important outcome of knowledge management is innovation. Successful innovation capability depended upon the extent to which the organisation created new knowledge, managed knowledge, and collaborated with outside institutions. Innovation can be seen as an institutional as well as an individual

competency. Innovation was the source of core competitiveness for educational institutions. This study further noted that innovation as a dynamic capability was crucial for vocational colleges' survival in educational markets (consistent with Li, 2013). Moreover, there were specific reasons to see the colleges and enterprise partnership as a crucial to the development of dynamic capability for gaining competitiveness. Much of the research and policy literature in Europe, America and China has illustrated that it is axiomatic to develop the vocational colleges-industry partnership, not only to make a profit but as a catalyst to further innovation, improve students' practical skills, develop the regional economy, and revive mature industries (CREST Expert Group, 2006; SSTI, 2006).

To sum up, the results of this study present the measurement model of intangible resources and dynamic capabilities will support managers to enhance competitiveness of TVC.

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