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Empirical Study on Enhancing Medical Service Performance with Intellectual Capital through Process Capability

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ABSTRACT

This study investigates the synergistic relationships among intellectual capital, process capability, and medical service performance. An empirical study was conducted by using a second-order research framework. Data were collected through a questionnaire survey, and structural equation modeling techniques were used to analyze the data. An empirical analysis revealed that intellectual capital is a major factor influencing final medical service performance. This major factor should be carefully improved to increase process capability in hospitals in the long term. Hospitals account for a substantial proportion of the intellectual capital in the health-care industry, and, thus, should improve their process capability to achieve high medical service performance.

KEYWORDS: Intellectual capital; health-care industry; process capability; medical service performance.

Introduction

To optimize medical service processes (MSP) for healthcare providers, medical organizations depend on professional knowledge to effectively integrate and analyze clinics, prescriptions, billing, supply chains, and patient relationships, in and across organizational boundaries (Wu & Hu, 2012). According to Nursing Intellectual Capital Theory (NICT) (Covell & Sidani, 2013a, 2013b), the health-care industry is a very complex and high knowledge-intensive industry that relies on the synergies of intellectual capital (IC), process capability (PC), and medical service performance (MSP). Many studies are exploring the relationship between IC and MSP, most of which focus on the impact of IC on medical professionals (Covell & Sidani, 2013a). However, few studies have examined the relationship between IC and MSP from a management and process perspective. Hence, we propose a research model that clarifies the relationships between IC and MSP with a management perspective of PC in a hospital. Since Taiwan's National Health Insurance system is very successful (Cheng, 2015; Wu et al., 2010), we target the medical institutions in Taiwan. The contribution of this research is not only to find out the relationship between IC and MSP but also to put forward the emphases of management PC, which can be used as a reference for the medical industry.

Research Model and Literature Review

We use graphical representations to explain the core issues of this study, then depicted the analytical research model as Figure 1. And this study proposes three hypotheses and verifies them if these three hypotheses are acceptable to understand the relationship between IC, PC, and MSP.

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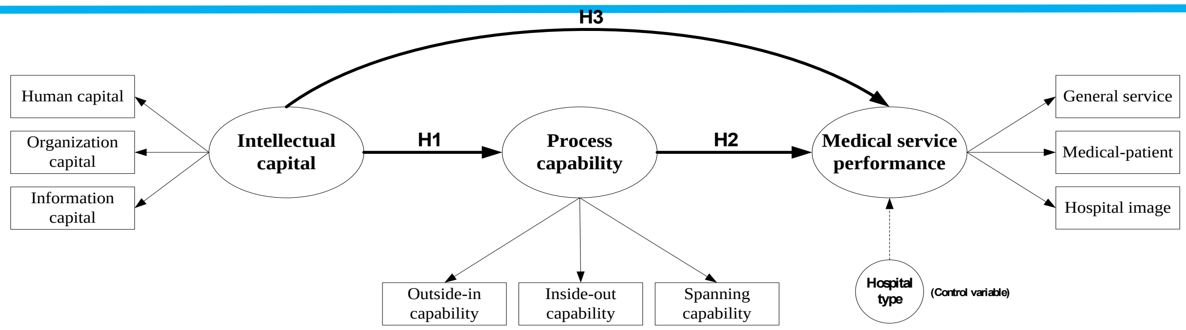

Fig 1. Research model

The three hypotheses and the subjects of this research are as follows:

H1: Intellectual capital is positively associated with process capability.
H2: Process capability is positively associated with medical service performance.
H3: Intellectual capital is positively associated with medical service performance directly.

***Intellectual capital (IC)*:** According to the definition of NICT (Covell & Sidani, 2013a), there are four elements of IC in the nursing and medical domain: (1) nursing human capital (NHC), (2) nursing structural capital (NSC), (3) nurse staffing (NS), and (4) employer support for nurse continuing professional development (CPD). Therefore, based on NICT and previous studies (Dumay & Garanina, 2013; Serenko & Bontis, 2013), we define the three subconstructs of IC as human capital, organization capital, and information capital. The contents for IC as table 1.

Table 1. Contents of IC

Subconstructs of IC	Contents	Source
Human capital (IC)	Knowledge, skill, capability, work-related competence, experience, expertise, and personality traits	Dzenopoljac et al., 2017; Dumay & Garanina, 2013; Serenko & Bontis, 2013
Organization capital (OC)	1. External attribute: customers, suppliers, and competitors. 2. Internal attribute: corporate culture, management processes, organizational structures,	Dumay & Garanina, 2013; Dzenopoljac et al., 2017; Serenko & Bontis, 2013; Dumay & Garanina, 2013; Serenko & Bontis, 2013
Information capital (IC)	Infrastructure and applications that support an organization's strategies	Devaraj et al., 2013; Komnenić & Pokrajčić, 2012; Dumay & Garanina, 2013; Serenko & Bontis, 2013; Westbrook et al., 2013

***Process capability (PC)*:** Based on past research (Brahma & Chakraborty, 2011; Bromiley & Rau, 2016; Coleman et al., 2013; Wu & Hu, 2012), we consider PC to consist of these three dimensions: outside-in capability, inside-out capability, and spanning capability. The contents for IC as table X

Table 2. Contents of PC

Subconstructs of PC	Contents	Source
Outside-in capability (OIC)	Industrial environment, long-term relationships with external stakeholders, respond to market changes quickly	Inauen & Schenker-Wicki, 2011; Inauen & Schenker-Wicki, 2011
Inside-out capability (IOC)	Operations in internal processes, service innovation, logistics, medical processes, customer service, technology	Ngo & O'cas, 2013; Hu et al., 2017
Spanning capability (SPC)	Integrate outside-in and inside-out capabilities, strategy development, organizational collaboration, information integration, information system planning	Bernroider, 2014; Coleman et al., 2013; Zhang et al., 2011

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Medical service performance (MSP): Regarding the definition of MSP, many scholars have put forward multiple views in the past (He, 2014WHO, 2015; Varagunam et al., 2013; Huang & Jerng, 2014; Lee et al. (2010; Gebicki et al., 2014; Alkhenizan & Shaw, 2011; Hung & Jerng, 2014; Francis et al., 2016). We adopted the views of all scholars that the measurement of MSP was at the organization level, and considering the perspectives from WHO and integrating past research, this study defined MSP as consisting of three subconstructs: general service level, medical-patient relationships, and hospital image. The contents for IC as table 3.

Table 3. Contents of MSP

Subconstructs of MSP	Contents	Source
General service level (GS)	Responsive governance, staff orientation, efficiency, healthcare quality	WHO, 2015; He, 2014; Varagunam et al., 2013; Huang & Jerng, 2014;
Medical-patient relationships (MP)	Clinical effectiveness, safety, patient centeredness, and doctor-patient relationship.	Alkhenizan & Shaw, 2011; Lee et al., 2010;
Hospital image (HI)	Reputation, hospital promote its rank in customer surveys	Wu & Hu, 2012; Hung & Jerng, 2014

Questionnaire design: The survey instrument consisted of a two-part questionnaire. The first part used a nominal scale to collect basic information on the hospital and the respondent. The second part of the questionnaire was prepared by considering previous research, and a 7-point Likert scale was used to evaluate the hospital's IC, PC, and MSP. Also, after discussion with five experts in the medical industry, we considered the hospital type as the control variable.

Sampling: We aimed at general hospitals in Taiwan, excluded primary clinics and specialist hospitals. The sample contained a total of 437 hospitals selected from the list of hospitals published by the Taiwan Joint Commission on Hospital Accreditation for the year 2017. A total valid sample size was 128 (overall response rate: 29.3%). The demographics of the samples are presented in Table 4.

Table 4. Demographics of the samples

	Frequency	Percent (%)
Hospital types		
Medical center	8	6.3
Regional hospital	63	49.2
District hospital	57	44.5
Annual revenue M: million, B: billion		
< 100 M	18	14.1
100 M~500 M	44	34.4
500 M~1 B	31	24.2
1 B~5 B	20	15.6
5 B~10 B	13	10.2
>10 B	2	1.6
Number of employees		
< 500	5	3.9
501~1000	41	32.0
1001~1500	42	32.8
1501~2000	33	25.8
>2000	7	5.5
Respondent's working experience		
< 5 years	20	15.6
5~10 years	61	47.7
10~20 years	37	28.9
20~30 years	8	6.2
> 30 years	2	1.6
Respondent's education level		

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High school	3	2.3
College	89	69.5
Graduate	33	25.8
Ph.D.	3	2.3
Respondent's gender		
Female	67	52.3
Male	61	47.7
Respondent's age		
<30	25	19.5
30~40	72	56.2
40~50	27	21.1
50~60	4	3.1
>60	0	0
Respondent's position		
Management	63	49.2
Medical	50	39.1
Other	15	11.7

Nonresponse bias: To ensure that no nonresponse bias existed, the respondents were divided into two groups: an early group containing 86 respondents and a late group comprising 42 respondents. The two groups were compared by considering various organizational characteristics that were determined by using the *t-test*. No significant differences were observed between the two groups at the .05 level (*t* value = 0.85, 0.31, and 0.41). This result indicated that no systematic nonresponse bias existed among the respondents.

Scale validation: The convergent validity was assessed using three criteria: (1) all item loadings (λ) should be statistically significant and exceed 0.70, (2) the composite construct reliability of each construct should exceed 0.80 and should be interpreted as Cronbach's α coefficient is interpreted, and (3) the average variance extracted (AVE) for each construct should be greater than 0.50 (Fornell & Larcker, 1981). The discriminant validity between constructs was assessed by determining whether the square root of the AVE for each construct exceeded the correlations between that construct and all other constructs (Fornell & Larcker, 1981; Chin, 1998). As shown in Table 5, the standardized item loadings ranged from 0.72 to 0.95, the composite reliability ranged from 0.89 to 0.96, and the AVE ranged from 0.67 to 0.90. Table 6 shows that the square root of the AVE for each construct was greater than the correlations between the construct and all other constructs. Thus, all constructs met the criterion for discriminant validity.

Table 5. Assessment of convergent validity

Construct	Items	Item loadings	Composite reliability	AVE	Cronbach's alpha	Weight
Human capital (**HC**)	3	.91 - .92	.94	.84	.90	0.49
Organization capital (**OC**)	4	.72 - .87	.89	.67	.83	0.44
Information capital (**IC**)	2	.93 - .93	.93	.87	.86	0.27
Outside-In capability (**OIC**)	3	.87 - .89	.91	.77	.85	0.55
Inside-Out capability (**IOC**)	3	.85 - .90	.90	.76	.84	0.33
Spanning capability (**SPC**)	3	.90 - .93	.94	.85	.91	0.24
General service (**GS**)	3	.92 - .95	.96	.89	.94	0.29
Medical-patient (**MP**)	3	.90 - .94	.94	.84	.91	0.52
Hospital image (**HI**)	2	.95 - .95	.95	.90	.89	0.59

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Table 6. Assessment of discriminant validity with cross-loading

Construct	HC	OC	IC	OIC	IOC	SPC	GS	MP	HI
HC	**.92**								
OC	.79	**.82**							
IC	.62	.73	**.93**						
OIC	.72	.74	.63	**.88**					
IOC	.68	.66	.59	.79	**.87**				
SPC	.55	.57	.54	.56	.68	**.92**			
GS	.62	.61	.48	.69	.69	.58	**.94**		
MP	.60	.62	.44	.67	.64	.53	.84	**.92**	
HI	.57	.53	.40	.55	.69	.54	.70	.75	**.95**
Mean	4.2746	4.0892	4.2441	4.2253	4.2126	4.0762	4.1311	4.4401	4.3961
STD	1.1472	1.1118	1.2538	1.2089	1.1271	1.1308	1.2113	1.2290	1.1686

* Diagonal values: Square root of the AVE for each construct.
* Non-diagonal value: Correlation

Results

Figure 2 shows the results. IC exerted a positive associated on PC (standardized path coefficient: 0.80, significant at .01) and explained 64% of the variance in PC (R2 = 0.64). Thus, *H1* was supported. PC exerted a positive associated with MSP (standardized path coefficient: 0.65, significant at .01), explained 60% of the variance in PC with IC (R2 = 0.60) together, and *H2* was supported. However, IC exerted a nonsignificant effect on MSP (standardized path coefficient: 0.15, nonsignificant at .01), and thus, *H3* was not supported.

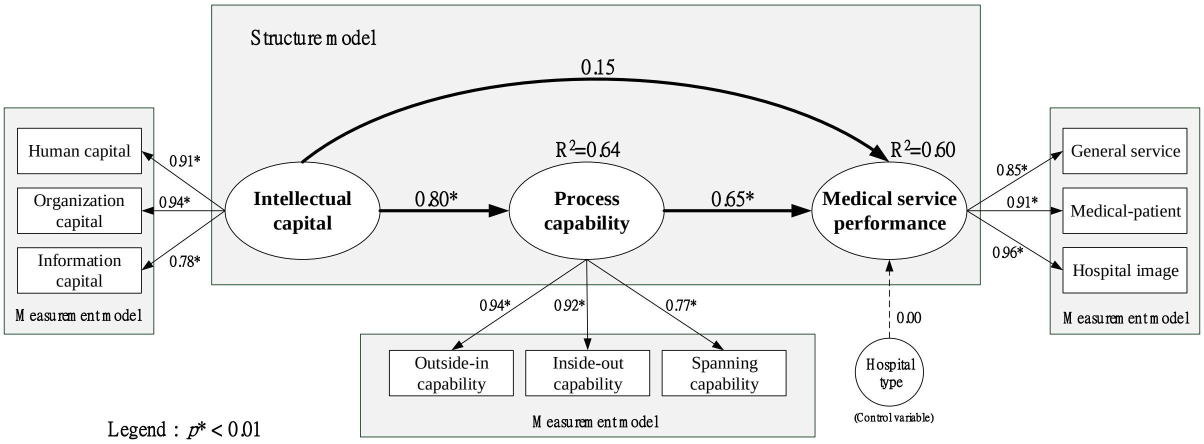

Fig 2. Result of analysis

Limitations

Although this study provided valuable results, it did have a limitation. The questionnaire was originally tailored for executives and IT managers at hospitals. However, only approximately 11.7% of the respondents were the senior staff. This may be because at large hospitals, senior managers are often busy and their surrogates complete the questionnaires. This response rate might lead to differences in perspectives regarding intellectual and knowledge-management practices, and it can increase the diversity of data sources and thereby raise the explanatory variance of the variables of interest.

Discussion

This observation indicated that IC can act as a principal antecedent of PC but not of MSP. The empirical data adequately supported the overall theoretical model. Consequently, IC played a vital role in determining the PC to MSP. Moreover, however, PC played a mediating role between IC and MSP.

As shown in Figure 2, human capital, organizational capital, and information capital are three major components that reflect IC in the health-care industry, and their respective weight scores (*W*) were 0.91, 0.94, and 0.78. However, human capital and organizational capital were more important than information capital. PC consists of outside-in, inside-out, and spanning capabilities, and these capabilities exhibited different levels of significance (*W* = 0.94, 0.92, and 0.77). Outside-in and inside-out capabilities are the two major components of PC. MSP consists of three indicators: general service, medical-patient relationships, and hospital image, and these indicators exhibited different levels of significance (*W* = 0.85, 0.91, and 0.96). Patient relationships and hospital images were more important than general service. In

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addition, we found that the specified control variable hospital type was not associated with MSP.

Conclusion

In general, IC is a major factor in determining the final MSP. MSP cannot be satisfied regardless of the size of IC investments. Specifically, hospitals that have abundant and valuable IC should focus on improving their process capability, which is necessary for achieving high medical service performance. Most studies on organizational performance have focused on the business sector, with few investigating the health-care sector. The most important contributions of this study are that we indicated the understanding of IC impact MSP through PC. Moreover, this study examined three indicators of MSP, general service, medical patient relationships, and hospital image, to prevent the findings from being inconsistent, which has often been the case in previous research on IT-enabled performance. In brief, we provided a new theoretical concept for clarifying MSP and also explained the relationship between IC, PC, and MSP. In addition, a second-order structure was used to analyze the relative importance of indicators informing the main constructs. This structure also provided vital information for effectively constructing the main constructs and conducting analyses in a more standard and systematic manner.

Hospitals should carefully sustain PC in the long term. In this process, the concept is relatively important for the health-care professional to acquire considerable IC. Hospitals are recognized as knowledge-intensive organizations with the responsibility to continually enhance the quality of care. Accordingly, IC-enhanced-MSP requires large investments in IC. Moreover, the senior management of hospitals should consider the time-lag effect on MSP. As to the indicators of MSP, all of them were significant and equally important. The results of this study are expected to provide insight into designing performance evaluation systems for hospital employees and for managing resources efficiently. Accordingly, we suggest that medical professionals must pay attention to the interaction between IC and PC in an evolutional process in order to further improve their expertise.

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