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Assessing the Effect of Intellectual Capital on New Product Development (Case Study: Pharmaceutical Industry of Isfahan Province)

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Abstract

Among the intangible assets, intellectual capital is the crucial capital for business performance and product development in companies. The purpose of this study is to determine to what extent, new product development influence by intellectual capital (IC) in Isfahan pharmaceutical firms. IC is a concept that comprises of three elements: human capital, structural capital and customer capital. Sample population of this study is among the product managers, research and development and laboratory employees of pharmaceutical firms of Isfahan that comprises of 91 persons sample populations. Method used in this study is survey-descriptive and for data collecting, Bontis standard questionnaire was used. Then data analyzed with PLS software (Next generation of Structural Equation Modeling). Finding shows that structural capital of Isfahan pharmaceutical firms has the most effect on new product development. Human capital has the most effect on structural capital. Human capital doesn't have the meaningful effect on new product development. This study suggests the managers of these firms to reinforce innovative behavior of their employees. R^2 statistic of whole model shows that generally new product development derives from IC about 34.8% in pharmaceutical firms of Isfahan.

Key words: Intellectual capital; New product development; Partial least square method

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INTRODUCTION

Despite the role of intellectual capital as a source of competitive advantage, its significance has not been yet fully appreciated by most companies and organizations (Collis, 1996). An increased awareness among corporate managers and industry leaders regarding significance of intellectual capital and building new capacities for promotion of intellectual capital within organizations the key to superior performance and continuous improvement of product and process in the respective industry. Pharmaceuticals, an industry primarily dealing with health issues and saving lives, requires intensive knowledge work on a continuous basis in order to meet diverse consumer needs. Researchers maintain that the industry is especially characterized by its heavy dependence on intellectual capital for capital renewal (Zucker, Darby, & Brewer, 1994). It is a highly knowledge-intensive operation because producing drug from raw substances requires much knowledge and extensive R&D activities. According to Hsu and Fang (2009), and Chen, James Lin and Chang (2006), among the intangible assets, intellectual capital is the most crucial one for business performance and product development in companies.

This paper investigates the effect of intellectual capitals (i.e. human capital, structural capital, and customer capital) on development of new product in pharmaceuticals companies of Isfahan province. In particular, this study explains the degree to which the

dependent variable *new product development* is influenced by the independent variable intellectual capitals in the mentioned firms. However, special emphasis is placed on human resources in these companies. According to De Jong and Hertzog (2007), one way to increase innovation in organizations is investment on their employees. Chen, et al. (2006) classify critical success factors (CSFs) in new product development as human capital, structural capital and relational capital. Studies by Griffin (1997) indicate 32.4 percent of corporate sales were realized from development of new products.

Visiting the rare diseases treatment centers, such as cancer and MS, in Isfahan, would leave no doubt about the urgent need of the patients for the medications which for the most part are procured from foreign sources, and the rise in their price or their unavailability every now and then have been giving the patients a really hard time. At this time, pharmaceutical companies are expected by relying on intellectual capacity of their specialized workforce and domestic resources, as well as profiting from the latest technology to successfully carry out the momentous mission of independence from foreign sources for production of strategic and critical pharmaceutical products, while satisfying the patients' needs by providing them with internationally competitive, quality drugs. Human resource experts and scholars almost univocally point to intellectual capital as the key factor which significantly contribute to development and prosperity of nations and businesses (Bounfour & Edvinsson, 2005; Lin & Edvinsson, 2011; Chou & Bontis, 2002).

1. RESEARCH BASIC CONCEPTS AND BACKGROUND

The notion of intellectual capital in 1990 made its entry into the business as a brand new concept, and within a decade, from a quite novel idea turns into a well established and frequently used term in business lexicon. Human resource mangers view intellectual capital as the sum of employee's skills, knowledge, and aptitude. Marketing managers think of intellectual capital in terms of commercial concepts involving such instances as recognition of trade mark and customer satisfaction crucial to business success, whereas in view of IT managers, intangible key assets are identified as software applications and network capabilities (Marr, 2005). Intellectual capital, in fact, is a multidimensional concept made up of human, structural, and customer capital (Stewart, 1997). Human capital includes all the economically valuable assets imbedded in employees of an organization but the organization is not an owner thereof and remains at disposal of the employee (Hsu & Fang, 2009). Structural capital is the knowledge which remains in organization outside the employee's working hours when they leave for home (Ordonez de Pablo's, 2009). Customer capital refers to the value created for the organization through relationship with stockholders, customers, and suppliers (Hsu & Fang, 2009). Studies conducted in regard to intellectual capital and its effect on the firm performance (both in public and private sector) suggest an association between intellectual capital and high profitability and performance in these firms. Study by Ahmad Sharabati, NajiJawad, and Bontis (2010) on the effect of intellectual capital determinants on business performance in Jordanian pharmaceutical companies report strong and significant role of these determinants in business performance of these companies. In study of the relationship between intellectual capital efficiency and market value of Iranian pharmaceutical companies by Mehralian, et al. (2012), such effect was not found. In addition, Rostami, et al. (2010) examined the effect of intellectual capital on financial performance in the Iranian pharmaceutical industry and concluded that there was no evidence based on which the changes in market value of the companies could be ascribed to performance of intellectual capital and it seemed that the Iranian pharmaceutical market to be still more sensitive to tangible capitals rather than to intellectual capitals.

1.1 New Product Development

CSFs of new product development are the largely explored managerial topics which due to their mostly applied aspects have inspired a multitude of research works all around the globe. As a result, a large variety of factors and conditions have been introduced as CSF sin new product development. In one approach, CSFs of new product development are outlined in 5 general categories: (1) New product development should be aligned with customer wishes; (2) The firm should adequately define its target market, its position in that market and its market value, as well as the product concept, functions and features before embarking on new product development; (3) Managers should actively pursue employee empowerment, allowing them to apply new ideas and to establish interdepartmental collaboration in development of new product; (4) The company should have gathered sufficient in-house potentials for innovations; and (5) Highly motivated employees strongly committed to quality control and business performance. In addition, a lofty innovative culture has been shown to be positively related to new product development operation (Chen, James, & Chang, 2006). CSFs of new product development, in view of researchers, can be brought under three generic types of capitals, namely human capitals, structural capitals, and customer capital (Cooper & Kleinschmidt, 1996).

1.2 The Conceptual Model

Based on the findings of Hsu and Fang (2009), Alegre and Chiva (2009) on intellectual capital and new product development, and review of the literature, the following conceptual model's constructed (Figure 1), which displays contribution of intellectual capitals to the process of new product development.

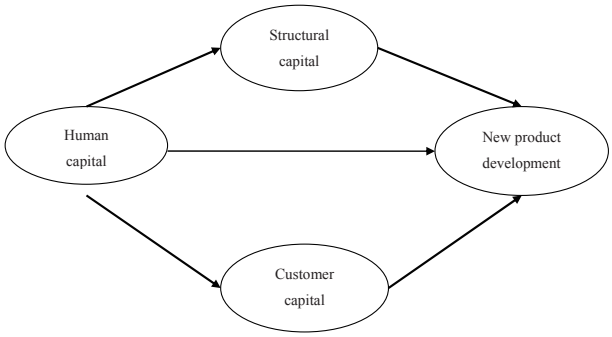

Figure 1
Research Conceptual Model

1.3 Research Hypotheses

(1) Human capital has a positive and significant effect on structural capital in pharmaceutical companies.

(2) Human capital has a positive and significant effect on customer in pharmaceutical companies.

(3) Human capital has a positive and significant effect on new product development in pharmaceutical companies.

(4) Structural capital has a positive and significant effect on new product development in pharmaceutical companies.

(5) Customer capital has a positive and significant effect on new product development in pharmaceutical companies.

2. METHODOLOGY

This is an applied research which is conducted based on a descriptive survey design. Further, in present work, human capital is measured as a formative construct, while the other two elements of intellectual capital (i.e. structural capital and customer capital), and new product development are held as reflective constructs. The information gathering tool is a questionnaire derived from Standard Questionnaire Intellectual Capital Bontis (1998) which is a widely applied index for an inventory of intellectual capital in organizations and enterprises (Bontis, 1998; Bontis, et al., 2000; Angstrom, et al., 2003; Hsu & Fang, 2009; Ahmad Sharabati, et al., 2010). To evaluate the three elements of intellectual capitals, 20 questions were selected, and for assessment of the criterion variable, new product development, 5 other questions were composed based on the literature of new product development. The respondent answer to the items in this questionnaire was measured in Likert 5-point scale, ranging from 1 = fully disagree to 5 = fully agree. According to our inquiry from the Internet site of the Iranian Ministry of Industries and Mines, in total 16 pharmaceutical companies were registered in Isfahan province, of this number, 6 units were reported as active all of which were included in the study and received the questionnaire. In general, the most complex regression model occurs in two instances: the one concerns dimensions of the most complex construct and the other is the regression model for the largest number of constructs whose path towards the construct is endogenous. The required sample size in partial least square (PLS) model is at least 10 times the number of predictor variables in either of the above two cases (of which the greater one will be taken into account) (Martinez-Torres, 2006). In our study, there are 3 constructs whose path towards the construct is endogenous (these being structural, customer, and human capitals), and there are 7 indicators of the formative construct (i.e. human capital). Given the greater number of the latter one, the sample size is set 10 times the number of these indicators, which implies a minimum required sample size of 70 respondents. After explaining the nature of our study to managing director of the companies and letting them know that participation of active people in new product development and marketing is needed, 91 employees in total were selected as the respondents of whom 80 people answered the questionnaire and returned it. Having checked the received questionnaires, 72 of them were regarded usable which indicated a satisfactory response rate of 79.1 percent.

Test of hypotheses and model analysis was performed using partial least square (PLS) method.

2.1 Findings

2.1.1 Descriptive Statistics, the Model Reliability and Validity

Table 1
Mean, Standard Deviation, Correlation, and Cronbach's Alpha of the Construct

Construct	Mean	St. Dev.	Human capital	Structural capital	Customer capital	Alpha coefficient
Human cap.	3.49	0.93				0.78
Structural cap.	3.46	1.02	0.67			0.74
Customer cap.	3.85	0.84	0.56	0.52		0.72
New product development	3.79	1.03	0.39	0.44	0.54	0.63

2.1.2 Reliability

In table 1, Cronbach's alpha of each variable is given. As is seen, alpha-value of new product development is smaller than 0.7, suggesting lack of reliability in this variable. However, there is still another and more accurate reliability measure proposed by Fornell and Larcker (1981)

termed composite reliability. The composite reliability for each variable is provided in table 2. The advantage of this method relative to Cronbach's alpha lies in its use of real load factor (winze, et al., 2010). In this method, reliability threshold is set at 0.7. Composite reliability of new product development shown in table 2 is higher than 0.7, which confirms reliability of this variable.

Table 2
Validity and Reliability Values of Variables

Hidden variables	Average variance extracted	Composite reliability
Human cap.		
Structural cap.	0.500	0.819
Customer cap.	0.551	0.830
New product development	0.555	0.783

2.1.3 Convergent Validity Versus Discriminate Validity

In test of the model by Smart PLS software, to see if subscales of each construct do measure what we expected from them or not, convergent and discriminate validity test is used (winze, et al., 2010). According to Fornell and Larcker (1981), if average variance extracted (AVE) becomes greater than 50%, there is convergent validity, the values of which are presented in table 2. However, if AVE of each variable be greater than correlation of the variable with other variables, there is discriminate validity (Fornell & Larcker, 1981). AVE square root of 3 variables structural capital, customer capital, and new product development is 0.707, 0.742, and 0.744, respectively, which is greater than the greatest correlation between these variables which are 0.650, 0.571, and 0.524, respectively. Thus, the research model has discriminate validity. The results on convergent and composite validity are provided in table 2.

As is seen in table 2, AVE of all three variables is either greater than or equal to the threshold of 0.5, implying the model fitness for the purpose of this research. The state of the research variables in the understudy firms is summarized in table 3.

2.1.4 Analysis of Structural Model

In PLS method, the structural model and its associated hypotheses is tested based on the calculated values of path coefficients (βs) and significance level (t-values), and the model goodness of fit is determined by R^2 for each dependent variable.

Table 3
Mean, Standard Deviation, Loading, and T-Values for the Research Subscales

Variables	Questionnaire items	Mean	Standard Dev.	Loading	T-Value
Human capital	Company employee competence is at ideal level.	3.117	1.062	0.694	7.211
	For employee training and keeping them up-to-date, regular programs are prepared.	3.082	1.093	0.520	4.317
	Employee learning and training has effect on company profitability.	4.305	0.724	0.726	8.580
	Company employees are specialized in their professional areas.	3.423	1.004	0.690	6.904
	Company employees carry out their organizational tasks to the full.	3.376	0.987	0.574	4.488
	Employees feel proud of company efficiency.	3.717	0.825	0.506	4.171
	Employee work experience and specialization is has effect on company productivity and profitability.	4.305	0.707	0.627	5.544
Structural capital	Company selects and recruits the best and the most able applicants.	3.023	1.112	0.779	13.079
	Company properly rewards employee good performance.	2.705	1.163	0.613	6.700
	In company, employees have access to the Internet.	3.435	1.199	0.572	5.747
	Company supports R&D unit and ensures it.	3.917	0.941	0.791	22.097
	Company R&D affects its productivity and profitability.	4.070	0.910	0.749	14.901

To be continued

Continued

Variables	Questionnaire items	Mean	Standard Dev.	Loading	T-Value
Customer capital	Company maintains a long-term relationship with customers.	3.952	0.815	0.700	8.425
	The market in which the company operates has growth potentials.	4.023	0.801	0.810	17.961
	Company resolves customer problems in the least time.	3.388	1.012	0.691	9.940
	Relationship of company with customers and suppliers of raw materials influences its productivity and profitability.	4.058	0.745	0.761	16.369
New product development	Activities of R&D promote new product development.	3.776	1.050	0.862	21.649
	Creative solutions and ideas of specialized employees promote new product development.	3.552	1.180	0.600	3.990
	New product is an innovation and is not imitated.	3.247	1.290	0.649	5.542
	Company makes effort for new product development.	4.247	0.738	0.508	3.811
	Customers will positively react to new product launching.	4.141	0.927	0.505	3.411

2.1.5 Quality Evaluation of Structural Model

As was said earlier, this model contains a formative variable (human capital) which takes part in the formative model where all variance inflation factors (VIFs) ought to be smaller than 5, and in our study all of the VIFs are smaller than 5 ($1.529 < VIF < 2.175$). In addition, the obtained R^2 for three variables structural, customer, and new product development is 0.421, 0.329, and 0.348, respectively, all of which are higher than the threshold of 0.19. Considering R^2-value for endogenous constructs, it can be inferred that the model properly fits the data. The effect power (Quality of the structural model) is calculated based on f^2-statistic. Analysis of this measure serves as complementary to R^2-statistic in that it determines effect power of a hidden (latent) independent variable on a hidden (latent) dependent variable (Chin, 2010). The f^2-statistics (effect power factor) 0.02, 0.15, and 0.35 indicate a low, medium, and high effect size, respectively in analysis and prediction of variables (winze, 2010).

Table 4
Effect Power Factor (f^2) and the Structural Model Evaluation

Constructs	Effect power factor (f^2)	Effect size
Human capital	0.201	Medium
Structural capital	0.195	Medium
Customer capital	0.157	Medium
New product development	0.186	Medium

2.1.6 Test of Hypotheses

For test of hypotheses, significance of the path coefficients is put to test in the model. For this purpose, it is made use of self-adaptive method as it gives a more reasonable and more concrete standard error (Tenenhaus, et al., 2005). In this method, test result is expressed in two statistics: β and t-value. An absolute t-value higher than 1, 96 indicates path significance. Path coefficients of the research model are provided in Table 5 and the model path analysis is given in Figure 2.

Table 5
Model Path Coefficients

	Path		β	T-value (Bootstrapping)
Human capital	→	Structural cap.	0.649	8.685**
Human capital	→	Customer cap.	0.574	7.158**
Human capital	→	New product dev.	- 0.009	0.052
Structural cap.	→	New product dev.	0.277	2.407*
Customer cap.	→	New product dev.	0.409	3.311**

* Significant at 0.05 (two-tailed) ** Significant at 0.001 (two-tailed)

CONCLUSION AND SUGGESTIONS

The findings in this study suggest positive and significant effect of human capital on structural capital ($\beta = 0.649$, $p < 0.001$) and therefore hypothesis 1 is confirmed. Human capital is also found to be positively and significantly correlated to customer capital ($\beta = 0.574$, $p < 0.001$) and thereby the second hypothesis is validated and confirmed. However, our results do not indicate any association, let alone a significant association, between human capital and new product development ($\beta = -0.009$), hence hypothesis 3 cannot be confirmed. As regards structural capital, the results indicate a positive and relatively significant association between structural capital and new product development ($\beta = 0.277$, $p < 0.05$) and hypothesis 4 is confirmed. And finally, is the positive and significant effect of customer capital on new product development ($\beta = 0.409$, $p < 0.001$) which clearly justifies confirmation of hypothesis 5.

As the results of data analysis suggested, human capital in pharmaceutical companies of Isfahan province had no effect on new product development. This result is very remarkable, because according to the theory of intellectual capital, human capital as the most critical element plays a pivotal role. It is argued that in presence of a poor human capital, other organizational capitals are rendered ineffective and inefficient. Therefore, the pharmaceutical companies require focusing on development of their human capital if they truly wish to improve their new product development process. For promotion and development of human capital, in the first place, hones and strongly committed employees should be recruited, and subsequently the necessary investment (and reinvestment) should be made for promotion and enrichment of their professional knowledge and expertise on a continuous basis (Pasher & Ronen, 2011). The 1st and 2nd items of the subscale human capital which measure employee competence and training with standard deviation of 1.06 and 1.093, respectively, score higher than rest of the items in this category, signifying a considerable gap from the desirable state of task assignment in appointing right people to various jobs and positions, while continuously updating employee knowledge. In addition, the mean score (2.705) and standard deviation (1.163) of item 9in the questionnaire, evidently is suggestive of a disproportionate reward system, in the sense that employees do not receive the right reward for their good performance. And this has presumably undermined the impact of structural capital on new product development ($\beta = 0.277$) which relative to other variables, after human capital, shows the least effect on new product development. Therefore, to boost new product development, a shift in the current practice of managers in these firms towards a more effective employee reward system and better alignment of performance and reward is highly recommendable. Further, the responses to items 8 and 10 which concern possibility of Internet use in workplace and recruitment of best job applicants in the understudy firms with the highest measure of variability (1.199 and 1.112, respectively) on the one hand, refer to importance of Internet access for all the involved employees in the production process, and on the other hand, calls for adoption of more comprehensive recruitment procedures. In regard to item 15, resolving customer problems by the company in the shortest time, with a smaller mean (3.388) and greater standard deviation (1.012) relative to other items in the subscale customer capital, establishment of a stronger and more interactive relationship with customers, company employees, and business partners who themselves in a broader sense are regarded a customer to the company, as well as with knowledge production networks such as universities and research centers enable the company to learn from them and profit from their ideas on new product development. As for the subscale new product development, the responses to items 18 and 19 indicate that in these companies employees' ideas and creative solutions are not adequately made use of in new product development, and that the so called new product is rather an imitation than an innovation. One way to allow effective contribution of the employee ideas in new product development is interdepartmental collaboration. At any rate, these companies, in order to survive the competition and get competitive advantage over rivals, would need to transform their companies into learning organizations and upgrade their employees to knowledge workers, and would inevitably have to enter into active interaction and knowledge sharing arrangements with research and academic centers, as well as with other competitors. The interpretative ability of intellectual capital is also noteworthy. $R^2$for the model on the whole equals 0.348 which implies that intellectual capital accounts for 34.8 percent contribution to new product development in pharmaceutical companies. Future research in this area may further probe the causes of the missing human capital in the process of new product development in the understudy firms, since an elaboration on this issue would be insightful for managers of these companies and would greatly help approaching and resolving this issue. As the last point in this regard, it should be noted that given the broad sense of the concept intellectual capital which assumes a large variety of implications for almost every facet of the organization (including human resources, structure and organization, stakeholders and customers, and suppliers of raw materials), use of more extensive subscales comprising all these aspects can be instrumental to future problem solving attempts.

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