The mediating role of organizational learning and knowledge integration on the relationship between knowledge characteristics and organizational innovation  
(Case Study: Iran Marine Industrial Company)

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Abstract. The purpose of this study was to investigate the relationship between knowledge characteristics and organizational innovation with mediating role of organizational learning and knowledge integration. In this regard, staff and managers of Sadra (Iran Marine Industrial Company) as the selected population and 250 of them were selected for sample. Questionnaire was used for data collection using confirmatory factor analysis for assessing validity, and Structural Equation Models (SEM), with Partial Least Squares (PLS) model was used to test the hypotheses. The results showed that there is a significant positive relationship between all variables. It can be said that knowledge characteristics has significant and positive effect on organizational learning, innovation and knowledge integration. Also significant effect of organizational learning on innovation is confirmed. In the other word, organizational learning and knowledge integration mediate the relationship between knowledge characteristics and organizational innovation.

Keywords: Knowledge management, Knowledge characteristics, Knowledge integration, Organizational learning, Innovation

1. INTRODUCTION

In today’s competitive world, knowledge has become a strategic resource in many organizations. Nonaka believes that (1995) in today’s unstable status, the only reliable resource to gain sustainable competitive advantage is knowledge. It is presented individually and collective. Collective knowledge is obtained from merging and integrating knowledge. In fact, this kind of knowledge is a combination of coordinated attempts of different people who are having different viewpoints but their skills are completing each other (Grant, 1995). Bunche et al (2001) believe that theories by knowledge which is focusing on integrating and characteristics of knowledge shall be utilized extensively by organizations, moreover, Hong (2003) and Grant (1995) are explaining that firms are requiring advantages for merging different kinds of knowledge in an efficient and effective model, they can change the individual knowledge to applicable knowledge through integration process to be in relation with knowledge ability of the organization directly and indirectly. In other words, regarding knowledge features, firms can increase their knowledge management abilities by the processes of knowledge merging. Regarding that innovation reinforces competitive advantage of companies; knowledge is a key that combines organizational learning and innovative activities. Firms shall be confident about continuous organizational learning and keeping a premier internal knowledge management system (Molen et al, 1993). Nowadays, knowledge management has become a very important concept within the world of business. In many firms, knowledge management is one of investment priorities. The thing that is clear is that the performance of knowledge management is significantly in connection with intellectual capital of the organization which is impacting on growth, innovation and financial success (Wang, 2005). Hall
and Mayors have insisted on the significance of knowledge management and its relation with innovation (Hall et al., 2006). Effective knowledge management simplifies knowledge relations and changes innovative flow and in addition to it, it increases innovative performances through developing visions and new abilities (Wang et al., 2005; Nonaka et al., 1995; Brockman and Morgan, 2003). Also Young (2005) has concluded that knowledge innovation and integration increase performance about new products. Regarding what is mentioned above, now firms are in need of continuous innovations in order to penetrate in world markets and avoid losing competition scene. Unfortunately, we are witnessing that they are not that successful. In this regard, Iran Marine industrial company with its long time experience has not achieved its main position within international markets. Therefore, in this study, we are trying to answer this question how we it can achieve its innovations by relying on knowledge management abilities and organizational learning. Therefore, the main purpose of his study is to review the impact of knowledge characteristics on organization innovation and also review this impact through organizational learning and knowledge integration on Iran Marine industrial company innovation.

Theoretical background and review of literature

Knowledge characteristics

Features and complications within knowledge cause different definitions of it. One of complicating factors of knowledge is causing from its vague and intangible nature (Hosseini, 2010). Downport and Prusak define knowledge as a flowing combination of experiences, values, significant information and viewpoints of experts that are presenting a framework for assessment and collecting information and new experiences (Downport et al., 1998). Also, Nonaka and Takeuchi consider the creation of knowledge as the reason of combining receiving information and individuals’ concept creating. Such attitude indicates that knowledge can be found only in field of human and beliefs and their experiences (Nonaka et al., 1995). From other approaches, we can introduce the approach of Polani that put knowledge by splitting it into implicit and explicit at a level upper than data and information and lower than vision and wisdom (Polani, 1969). About division of knowledge kinds, Nonaka has divided knowledge into two groups of explicit and implicit one according to Polani. Explicit knowledge is defined as a knowledge that can be coded and it can be shared through dialect, and tacit knowledge is abstract and it is not easily in access and tacit knowledge is what in the mind of individuals and their experiences and it is not publishable through articles explicitly (Nonaka, 1994). El Joe et al have introduced three features of being modular, explicitness and also complexity. Modularity means knowledge is revising and formatting in knowledge tank that is understandable by all of the users and individuals independent from the knowledge owner through standard and clear procedures within work processes (Gride and Kumarasovammi, 1995). In other words, modularity breaks down knowledge in specific procedures which helps employees to implement their practical activities and then to improve their organization knowledge management abilities. By using knowledge modularity, merging new developed concepts with current knowledge system is easier. It seems this feature of knowledge is for more efficient and flexible merger of knowledge management with helping organization. In addition, explicit knowledge can be a good help for knowledge merger. Explicitness is the second feature of knowledge management. In other words, knowledge by having such feature can be easily classified and analyzed, and it will be clearly defined and codified and can be shared through information technologies and coded processes (Mc Oiley and Chakeravarsi, 2002). Ultimately, complexity is defined as difficulty of perception and understanding roles and organizational processes. Implicitness is the nature of knowledge and in fact it is the inability of explaining the principles impacting on performance (El Joe, 2006). Organizational learning means all the methods, procedures and processes utilized within organization to learn. Organizational learning is done through sharing visions, knowledge, experience and conceptual models of organization members.
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Organizational learning

Organizational learning is based upon knowledge and experience that is existed in organization memory and it is relying on mechanisms like policies, strategies and models on knowledge storing (Rahnavard, 1999). People and groups are the factors that organizational learning is done through. Argris (1999) defined organizational learning subject to sharing knowledge, beliefs, and assumptions among people and teams. Also, organizational learning can be defined as the ability of an organization as a total in exploring errors and modifying them and also changing knowledge and organization values in a way to establish new skills and new capacities as solutions. Based upon such definition, the features of organizational learning process is: change in organizational knowledge, increasing possible areas and changing people’s mind (Probst and Bochel, 1997). Bob Guns defines organizational learning as gaining knowledge, skills, values, beliefs and improving visions for maintenance, growth and developing the organization. Some of fundamental notes of organizational learning are: 1. Structures: structures shall be defined that the knowledge and learning must be shared at all levels of organization based on it. To do so, matrix organization can be helpful. This note is important that the responsibility of a senior and respectful person as a Chief Learning Officer is having a fundamental role. 2. Adaptability with changes and 3. Benchmarking: specifically in field of best methods, according to previous researches, some of important strategies of organizational learning are: strategic planning, teleconference, benchmarking, meetings, learning through practice, collective software, practical workshops, company assessment card, parallel learning structures and multi-functional teams of Zomorodian (2004) Clute (1997) define organizational learning as a process for finding problems and finding their solutions, Wijnhoven (2001) explains that organizational learning assist people for cooperating in establishing organization knowledge. Through organizational learning, employees are having more chance to be in relation with each other in a way that such connection provides access, distribution and knowledge conversion by utilizing knowledge management ability. Gnyawali and Stewart (2003) believe that practical learning in organization reinforces existing knowledge and its role in organization (Gnyawali and Stewart 2003). In addition, Drucker (1993) believes that organizational learning can increase the quality and quantity of information transfer and knowledge storing within a dynamic environment (Drucker, 1993). Cohen and Levinthal (1990) declare that organization learning ability, improves utilization and creation of knowledge (Cohen and Levinthal, 1990).

Knowledge integration

Despite many articles of theoretical principles about knowledge orientation within productive activities and also the role of organizations in knowledge integration, still there are a few theories about such integration (Brown and Duguid, 2001). Its definition is limited to only one concept and there are less operational definition represented about it (Haddad, Bozgan, 2009). Grant (1996) defined knowledge integration as a process for coordinating people’s specific knowledge and also he insisted that such coordination shall be based upon the tendency of people within different sections of organization. Haddad and Bozgan (2009) conceptually defined knowledge integration as bringing diverse knowledge from different resources for doing the tasks properly or to tolerate complicated problems. In other words, according to them, knowledge integration includes sub-processes that are considering transfer, sharing and utilizing knowledge for problem solving. Also they have provided operational definition of knowledge integration and they defined it as the process of knowledge transfer (both explicit and tacit) within organization border and sharing it with people and groups and also using obtained knowledge for problem solving.

Organizational innovation

“Innovation is highly significant for organizations and companies since it can provide sustainable competitive advantage for them” (Weerawardena, 2006). Many organizations are facing with many problems in its environment in terms of competition and such problems are due to high speed of changes in environment and specifically technological changes. In this regard, managers and employees shall utilize the power, creativity and innovation for matching and coordinating with quick changes,
production line, managerial methods and production processes and … (Parnabi, 1995). There are different definitions of it in the literature of innovation. Bitz et al have defined innovation as the acceptance and utilization of methods and new knowledge including the ability of an organization for accepting or creating new beliefs and using such beliefs in developing and modifying products, services, procedures and new working processes, also, innovation is considered as an intangible resource that is also non-imitative (Bates and Khasawneh, 2005). Regarding to theoretical and operational definitions of main concepts of present study, there are different studies about principles of this field which we will review some of them briefly. In literature related to innovation, knowledge is called as one of the most important elements of innovation creation process (Galonic, 2005). Then, the ability of knowledge management is a crucial role in supporting and growing innovations. Trin (2002) also explains that when a company is able to gain knowledge and merge the existing knowledge with the new one, the company shall have innovation in production process or the product. He according to Grant states that the ability of a company for reforming to a new knowledge is a way for progressive improvement of innovation. Different knowledge entities and different strategies in developing knowledge are the result of different performances in the company. However, when companies diagnose the importance of creation, management and transfer of knowledge, most of them are not able to convert knowledge to an effective knowledge management strategy. Therefore, this is a big challenge for companies that creates an appropriate knowledge strategy that can improve organizational learning and in addition to it, creation of knowledge management ability in company (Trin, 2002). According to Trin, companies are utilizing the activities of organizational learning for achieving and using knowledge management processes in order to grow innovation. Organizational learning is focusing on developing expertise, decentralizing and decreasing bureaucracy for supporting creativity. For this reason, innovation is the secondary product of organizational learning. Therefore, organizational learning impacts on company’s innovation. A company with better organizational learning has more ability to develop innovation in products or its processes (Trin, 2002). Long and Fahi (2000) and Kraq (1998) explained companies that have human resources with tendency to knowledge management strategy can establish learning and innovation within their organizations better, since it increases the senses of trust and cooperation within organization that can encourage employees to continue their cooperation in a better form. On the other hand, Hong and Novel also stated that company’s competitiveness depends on its capacity for knowledge merger according to the effective model (Hong and Novel, 2003). Badii and Sharif declared that company requires more time and more resources for managing and maintaining information without effective knowledge merging. A wider domain of knowledge that is integrated will involve more diversity of people. The diversity resulted from knowledge and information helps people to make more relation with each other and as a result more ideas will be popped within organization that can encourage employees to continue their cooperation in a better form. On the other hand, Sanchez et al believe that explicitness and modularity increase the levels of organizational learning. Modularity follows a new model for knowledge management that focuses on the learning activities in company (Sanchez and Mahoni, 1996). Nito et al, stated that transferring complicated knowledge is done gradually therefore, utilization and conversion is tougher (Nito and Prezkano, 2004). Also, Mc Elroy in his researches has concluded that knowledge complexity toughen knowledge perception. Modularity maintains knowledge and creates a new knowledge and improves the spoiled sections. Likewise, higher level of tac knowledge in company decreases the relations among employees (Mc Elroy, 2000). According to the theoretical principles and the purposes of the research, the following hypothesis will be analyzed in this study.

Hypothesis 1: Knowledge characteristics has a significant and positive effect on organizational learning.
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Hypothesis 2: Knowledge characteristics has a significant and positive effect on innovation in organization.
Hypothesis 3: Knowledge characteristics has a significant and positive effect on knowledge integration in organization.
Hypothesis 4: Organizational learning has a significant and positive effect on innovation in organization.
Hypothesis 5: Knowledge integration has a significant and positive effect on innovation in organization.

![Conceptual model](image)

**METHODOLOGY**

This research in terms of its nature and purpose is the applied one and the method of data collection is descriptive and correlational. Structural equation has been used to integrated investigation of proposed model. Population of this study includes 700 directors and staff of Sadra Company. According to sampling from the finite population and using Morgan table, number of case Study is equal to 250. Questionnaire is the data collection tool which was derived from (Joe .lee and Lee, 2006). Questionnaires were distributed among 250 people of which just an incomplete and unusable questionnaire was diagnosed. At the end, analysis was performed on 249 completed questionnaire. The following table presented number of measures designed to assess each variable, Cronbach's alpha coefficient and combined reliability of variables.

**Table 1.** Cronbach's alpha coefficient and combined reliability of variable.

<table>
<thead>
<tr>
<th>Number of items</th>
<th>Combined reliability</th>
<th>Cronbach’s alpha</th>
<th>code</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>0.859</td>
<td>0.755</td>
<td>KC</td>
<td>Knowledge characteristics</td>
</tr>
<tr>
<td>6</td>
<td>0.846</td>
<td>0.648</td>
<td>OL</td>
<td>Organizational learning</td>
</tr>
<tr>
<td>7</td>
<td>0.895</td>
<td>0.765</td>
<td>KI</td>
<td>Knowledge integration</td>
</tr>
<tr>
<td>6</td>
<td>0.815</td>
<td>0.699</td>
<td>INO</td>
<td>Innovation</td>
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</table>

As can be observed, Cronbach's alpha coefficient of all variables is more than minimum amount of 6.0 (Nanaly, 1978), 65/0 (Lee and Kim, 1999). Structural Equation Modeling (SEM )and partial least squares (PLS) method were used to test hypothesis and fitness in this study. That kind of approach is based on variance that requires less conditions compared to similar techniques of structural equation
like LISREL and Amos (Lynjandr et al., 2009). For example, PLS path modeling is more suitable for real-world applications, unlike the LISREL. Using this approach would be more appropriate, especially when models are more sophisticated (Wen Wu, 2010). Of course main advantage of PLS modeling in comparison to LISREL, is that it requires a smaller number of samples (Wixom, & Watson, 2001). However, relatively high sample size is used in this research. PLS examine two model simultaneously. External model (measurement model) which examine the relationship between reveal and hidden variables and internal model (structural model), that measures the relationship between Hidden variables and other hidden variables (Wen Wu, 2010).

**Research findings**

Initially, convergent validity in PLS model has been analyzed by Average variance extracted (AVE). This index shows the levels of variance, which a structure acquires from its indicators. Farnl and Locker (1981) propose higher values than 5.0 for this criterion. Since this amount grantees that at least 50 percent of variance of one structures define through its indicator. As it is observed in following table, all mean of derived variance was more than 0.5, therefore, measurement model has appropriate convergent validity.

Table 2. Convergent validity of the constructs of variables.

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Knowledge integration</th>
<th>Organizational learning</th>
<th>Knowledge characteristics</th>
<th>Variable Convergent validity</th>
</tr>
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<tbody>
<tr>
<td>0.526</td>
<td>0.810</td>
<td>0.734</td>
<td>0.671</td>
<td>Mean of variance extracted (AVE)</td>
</tr>
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</table>

Also, the amount of load factor of each indicator is determined in PLS model to assess the reliability of each hidden variable’s indicators. Value of each factorial load of relevant hidden variable’s indicator must be greater of equal to 0.3 (Falk and Miller, 1992). Factorial loads value of research’s hidden variables indicator are visible.

Table 3. The value of load factor indicators of hidden variables.

<table>
<thead>
<tr>
<th>P values</th>
<th>Innovation</th>
<th>Knowledge integration</th>
<th>Organizational learning</th>
<th>Knowledge characteristic</th>
<th>Hidden variable indicators</th>
<th>row</th>
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<tbody>
<tr>
<td>&gt;0.05</td>
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</table>

As it can be observed in the above table, all amounts of measures related to the hidden variable which were identified in shaded houses are higher than 0.4. Therefore, it can be said that measurement model has sufficient reliability about indicators of hidden variables. Probability values of the indicators has been shown in the table above. These values are usually introduced as reliability parameters related to
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confirmatory factor analysis, since the relationship between indicators and hidden variables have been predetermined. As it is observed, all amounts of probability is less than 05/0 and research’s instruments has appropriate reliability. Results related to hypothesis and the relationship between variables are shown in the below table.

Table 4. Results from the study of variables.

<table>
<thead>
<tr>
<th>Result</th>
<th>The level of significance</th>
<th>Path coefficient</th>
<th>Relationships between variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive and significant</td>
<td>Less than 0.05</td>
<td>0.293</td>
<td>knowledge characteristics and organizational innovation</td>
</tr>
<tr>
<td>Positive and significant</td>
<td>Less than 0.05</td>
<td>0.414</td>
<td>knowledge characteristics and organizational learning</td>
</tr>
<tr>
<td>Positive and significant</td>
<td>Less than 0.05</td>
<td>0.624</td>
<td>knowledge characteristics and knowledge integration</td>
</tr>
<tr>
<td>Positive and significant</td>
<td>Less than 0.05</td>
<td>0.344</td>
<td>Organizational learning and innovation</td>
</tr>
<tr>
<td>Positive and significant</td>
<td>Less than 0.05</td>
<td>0.391</td>
<td>knowledge integration and innovation</td>
</tr>
</tbody>
</table>

According to table 2 and figure 2 it is observed that, all hypothesis are confirmed and it means that knowledge attributes has positive and significant effect on organizational learning, Innovation and integration of knowledge in Iran Marine Industrial Co. And organizational learning and integration of knowledge has positive and significant effect on organizational innovation as well. Calculated path coefficient shows that when the feature of knowledge affect innovation organizational learning and knowledge integration, this impact is more than its direct impact on organizational innovation and this issue indicates intermediary role between the two variables. Though their effect is not perfect due to the presence of a significant direct relationship between the characteristics of knowledge and innovation and is interpreting part by part, while it indicates more and greater path coefficient.

Figure 2. Research model in the standard estimation.
Figure 3. Research model in significant mood of parameters.

Model fitting Indices investigating

Cross-validation that includes CV-Communality and CV-Redundancy has been used to check the quality or validity of the model. Subscribe index, measures the quality of measurement model of each block. Redundancy index which is also called Q2 Stone-Gis measures the quality of the structural model for each endogenous block with respect to the measurement model. The positive values of these indicators indicate appropriate and acceptable quality of measurement and structural models. Table 4 shows the values of each of the indicators related to independent variables, mediators and dependent variables. As can be observed indicators are positive and greater than zero.

Table 5. Subscription index (CV Com) and redundant index (CV Red).

<table>
<thead>
<tr>
<th>Variable</th>
<th>CV Red</th>
<th>CV Com</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge characteristics</td>
<td>0.256</td>
<td>0.256</td>
</tr>
<tr>
<td>Organizational learning</td>
<td>0.102</td>
<td>0.223</td>
</tr>
<tr>
<td>Knowledge integration</td>
<td>0.314</td>
<td>0.377</td>
</tr>
<tr>
<td>Innovation</td>
<td>0.297</td>
<td>0.214</td>
</tr>
</tbody>
</table>

Figure 4. Model fitting.
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DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS:

Here, it has been tried to examine the relationship between characteristics of knowledge, innovation, integrity of knowledge and learning organization. Five hypotheses were formulated according to this model, that all of them have been confirmed according to data analysis. Results of the research suggest that the characteristics of knowledge and organizational learning has significant and positive effect on innovation in the organization. These findings are aligned with previous studies, including the studies of Terin (2002) and Badii and Sharif (2003). Considering that organizational innovation is an important source of sustainable competitive advantage, its process consists of the acquisition, dissemination, and application of new knowledge. Innovation of an organization exactly is associated with its ability in using and applying its own related knowledge resources. Knowledge management is the vision of more effective applying of knowledge characteristics and expertise to create value and increase organizational effectiveness. Organizations that show higher levels of knowledge management capacity and greater features of knowledge experience the effect of learning that can improve their functionality, reducing duplication, rapid response to change, and the creation of new ideas and innovation. On the other hand, correct management of knowledge features improve organizational learning as well. In an organization where knowledge is properly managed and implicit knowledge change to explicit knowledge and become reliable, standardization happens and complexity of knowledge will be understood, it is possible to make all employees partner in knowledge sources and facilitate the relations between them. In this way it is possible to create a learning organization that can adapt itself with environmental changes and acts dynamic. Such an organization can guarantee the continuing activity and its conservation through multiple innovations in today's competitive world. On the other hand effective management of the characteristics of knowledge transmission and exchange of knowledge can lead to integration of the correct knowledge. Because if the characteristics of the knowledge properly manage, knowledge integration processes that includes organization’s internal knowledge with its external knowledge sources and also integration of available knowledge with new knowledge easily done and will have positive results for the organization and employees. Considering intermediary role of organizational learning and knowledge integration can be concluded that, the impact of knowledge characteristic on innovation in organization will be more effective using organizational learning and knowledge integration. As figure one shows, although the characteristics of knowledge has significant effect on innovation, if these features will be through the integration of organizational learning and knowledge, its effect on innovation in organization will be more and this is aligned with studies of Long et al. (1998) and Mc Oil and colleagues (2002). Knowledge acquisition from outside and inside workers provides opportunities for organizations to combine current knowledge and creating new knowledge. Interaction of new gained knowledge with current knowledge modify organizational knowledge store and increase current knowledge’s depth of organization. Therefore, it will increase potential of new innovative outcomes. Knowledge-based view suggests that the activities of the Knowledge acquisition increase, the ability of an organization to carry out its role effectively and efficiently, organizations reduce uncertainty to gain external and internal Knowledge acquisition through good abilities and earn more technological and managerial distinctions. So it can be said that that there is a positive correlation between Knowledge acquisition and innovation performance. Finally, it can say that the management and utilization of knowledge is a key component of the model this study. From knowledge-based approach, the value of individual and organizational knowledge is primarily lies in its application since knowledge is implicit. Innovation requires applications and a combination of specific knowledge and specific inputs from different areas. Deeper application of knowledge, enables organizations to continuously change their organizational expertise to products or services. People may have less mistakes or improve their performance through the effective application of knowledge and reduce reworking or additional work. Application of knowledge is subject to appropriate organizational learning which in turn leads to innovation in the organization. The organization should be able to take appropriate knowledge promptly, when innovation is the way to victory in today's world.

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