



Clustering Organizational Learning Capability Indices for Knowledge Sharing in Different Segments of the Firm

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Since maximization of learning and organizational learning capabilities is the most important element for the success of knowledge management in each organization, this paper focuses on the dimensions of organizational learning capability. We suggest a mathematical clustering structure of dimensions according to their effect on the learning capability for different parts of the organization in order to obtain the highest level of learning capability in an organization. The proposed mathematical clustering aims to relate the needs of different sections of a firm to the corresponding learning capabilities.

Keywords: organizational learning capability; knowledge management; clustering

Introduction

Organizational learning is a process through which an organization will learn more items. Such learning means any changes in the organizational models, which may lead to recovery or maintenance of an organizational function (Alegre & Chiva, 2008). Jerez Gómez, Céspedes-Lorente, and Valle Cabrera (2004) also defined organizational learning as the creation, procurement, knowledge transfer and integration capability, and modification of organizational behavior for reflection of a new position with the improvement viewpoint of organizational function. Templeton, Lewis, and Snyder (2002) believed that organizational learning is a collection of organizational functions, such as learning knowledge, distribution and interpretation of information and memory consciously and/or non-consciously with positive effects on organizational changes. Learning capability is an important factor for further growth and innovation of an organization (Aad et al., 2011). Organizational learning capability is a collection of resources and/or tangible and intan-

gible skills for which it is necessary to also use competitive advantages. An organizational learning capability is a sign of creation capacity and combination of ideas in an effective way in contact with various organizational borders and through special managerial methods and innovations (Rashidi, Habibi, & Jafari Farsani, 2010). Ulrich, Von Glinow, and Jick (1993) also considered organizational learning capabilities as the capacity of managers in an organization for further production and combination of important and effective ideas. There are different studies for measuring the organizational learning capabilities at industrial and nonindustrial places among which are also Aydin, Zaim, and Ceylan (2009) and Hsu and Fang (2009). Aghdasi and Bafraei (2009) studied the organizational learning levels at different hospitals. In Aghdasi and Bafraei's (2009) research, knowledge transfer and integration capability had the highest mean followed by the systems perspective, openness and experimentation, and managerial obligation capabilities. Furthermore, a study was performed in India by Bhatnagar, which focused on the measuring of the organizational learning capability of managers. According to the results, IT managers and multinational companies had the highest rate of organizational learning capability, while engineering managers had the lowest rate (Bhatnagar, 2006). Based on the reviewed literature on organizational learning capability (OLC), learning capability includes following ten dimensions: Risk taking, Interaction with the external environment, Dialogue, Participative decision making, Managerial commitment, Systems perspective, Openness and experimentation, Knowledge transfer and integration, Teamwork, Demonstration of mission and goals. OLC is defined as the organizational and managerial characteristics or factors that facilitate the organizational learning process or allow an organization to learn (Di-bella, Nevis, & Gould, 1996; Goh & Richards, 1997; Hult & Ferrell, 1997). Additionally, organizational learning is seen as a dynamic process based on knowledge, which implies moving among different levels of action, going from the individual to the group level, and then to the organizational level and back again (Huber, 1991). This process stems from the knowledge acquisition of the individual, and progresses with the exchange and integration of this knowledge until a corpus of collective knowledge is created (Hedberg, 1981) and embedded in the organizational processes and culture. This collective knowledge, which is stored in the so-called organizational memory (Walsh & Ungson, 1991), has an impact on the type of knowledge acquired and the way in which it is interpreted and shared. What an individual learns in an organization greatly depends on what is already known by other members of the organization-in other words, on the common knowledge base (Simon, 1991). In this paper, we focused on the dimensions of organizational learning capability for obtaining the highest level of learning capability. Increasing learning capability facilitates the knowledge

sharing process in different parts of an organization. We should allow the transfer, interpretation, and integration of knowledge in an organization. In order to obtain the maximum level of learning capability in an organization, we should implement each dimension of learning capability that has the greatest effect on learning capability when compared with other dimension parts. For this, we cluster the dimensions of learning capability in different segments based on the effect of particular dimensions.

Organizational Learning Capability

Niece and his colleagues were the first to use the concept of capability; namely, they used it as a concept of recourses and abilities. Ashkenas (1995) introduced the organizational learning capability as follows: 'The ability of an organization to learn from its experiences and taking them through times and borders.' An organization incapable of learning tends to make adjustments to its own solution, instead of investing and devoting time in changes and improvements. The learning organization or prescriptive literature mainly focuses on the development of normative models for the creation of a learning organization. Jerez Gómez, Céspedes-Lorente, and Valle Cabrera (2005) suggested three basic concepts: (1) Knowledge, its acquisition, use, distribution and integration in an organization become one of the critical strategic resources and the base of learning in an organization. Acquiring and distributing knowledge is due to the internal changes that may be the result of both conceptual, as well as behavioral levels. (2) Learning capability is based on the existence of a collective ego that helps us to see the organization as a system whose every member should to try and cooperate to reach the desirable results. (3) Because this type of learning is mostly based on time and resources, the value and stability of competitive advantage is higher. This learning needs open atmosphere for ideas and high levels of experience. One way of preparing for an open atmosphere is to devote a room to new ideas, together with improvement, and renovation of individual knowledge. Learning capability is a complex multidimensional construct. Although various studies have identified different dimensions or components (Senge, 1990; Slater & Narver, 1995; Lei, Slocum, & Pitts, 2000), most do so from a theoretical point of view, consequently only few actually design a measurement scale based on the identified dimensions. Goh and Richard's study (1997) identified five dimensions (clarity of purpose and mission, leadership commitment and empowerment, experimentation and rewards, transfer of knowledge, teamwork, and group problem solving) and established a learning scale made up of 21 items. The questionnaire was sent to the employees of four organizations, namely two public and two private. The results enabled the authors to establish the differences among the firms with regard to their learning ability, concluding that the pri-

vate companies, operating in less-regulated environments, score highest in different dimensions. Hult and Ferrell's study (1997) is more extensive with regard to the validation of the scale they designed. The scale was formed of 23 items that attempted to measure the four dimensions they considered a part of organizational learning capability (team orientation, systems orientation, learning orientation, and memory orientation). As opposed to Goh and Richards's work (1997), Jerez Gómez et al. (2005) used a large sample of firms and paid particular attention to verifying the reliability, the content validity, and the convergent and discriminate validity of the scale, describing the whole process in detail. They developed a measurement scale for organizational learning capability supported by the results of a validation study, which included a sample of 111 Spanish firms from the chemical industry. They extracted four factors of organizational learning, which they called organizational learning capability. These four dimensions are: Managerial commitment, Systems perspective, Openness and experimentation, Knowledge transfer and integration. Chiva (2004) analyzed both mentioned works (Goh & Richards; Jerez Gómez et al., 2005) in order to determine the facilitating factors of organizational learning. Based on this comprehensive analysis, Chiva, Alegre, and Lapiedra (2007) developed an OLC measurement instrument that perceives OLC as a multidimensional concept, the dimensions of which are: experimentation, risk taking, interaction with the external environment, dialogue and participative decision making. On one hand, these five dimensions are essential enablers of the organizational learning process, while on the other hand, they represent the OLC of a particular firm.

Organizational Learning Capability Dimensions

Risk taking Risk taking is understood as the tolerance of ambiguity, uncertainty, and errors. Hedberg (1981) proposes a range of activities to facilitate organizational learning, amongst which the design of environments that assume risk taking and accept mistakes is emphasized. Accepting or taking risks involves the possibility of mistakes and failure occurrences. Sitkin (1996) goes as far as to state that failure is an essential requirement for effective organizational learning and to this end examines the advantages and disadvantages of success and errors. If the organization aims to promote short-term stability and performance, then success is recommended, since it tends to encourage the maintenance of status quo. According to Sitkin (1996), the benefits brought about by error or risk tolerance, prompting of attention to problems and the search for solutions, ease of problem recognition and interpretation, and a variety of organizational responses. Since the appearance of this work, many authors have underlined the importance of risk taking and accepting mistakes in order for organizations to learn (Popper & Lipshitz, 2000).

Interaction with the external environment We define this dimension as the scope of relationships with the external environment. The external environment of an organization is defined as the factors beyond the organization's direct control of influence. It consists of industrial agents, such as competitors, and the economic, social, monetary, and political/legal systems. Environmental characteristics play an important role in learning and their influence on organizational learning has been studied by a number of researchers (Bapuji & Crossan, 2004)]. Relations and connections with the environment are very important, since the organization attempts to evolve simultaneously with its changing environment. Hedberg (1981) considers the environment as the prime mover behind organizational learning. More turbulent environments generate organizations with greater needs and desires to learn (Popper & Lipshitz, 2000). According to Nevis, Dibella, and Gould (1995), researchers have in recent years stressed the importance of observing, opening up to and interacting with the environment.

Dialogue In particular, authors from the social perspective highlighted the importance of dialogue and communication for organizational learning (Brown & Duguid, 1991). Dialogue is defined as sustained collective inquiry into the processes, assumptions, and certainties that make up everyday experience (Isaacs, 1993). Schein (1993) considers dialogue as the basic process for building common understanding in that it allows one to see the hidden meanings of words by revealing these hidden meanings in our own communication. The vision of organizational learning, as a social construction, implies the development of a common understanding, starting from the social base and relationships between individuals (Brown & Duguid, 1991). Nevis et al. (1995) argue that learning is a function of spontaneous daily interactions between individuals. The chance to meet people from other areas and groups increases learning. Similarly, Goh and Richards (1997) advocate teamwork and problem solving in groups with particular emphasis on multi-functional teams.

By working in a team, knowledge can be shared and developed amongst its members. Easterby-Smith, Crossan, and Nicolini (2000) hold that recent literature is moving away from the vision of an integrating dialogue in which consensus is sought towards one that seeks pluralism and even conflict. Oswick, Anthony, Keenoy, and Mangham (2000) claim that authentic dialogue fosters organizational learning, since it creates plural perceptions rather than suppresses them. Individuals or groups with different visions who meet to solve a problem or work together create a dialogue community.

Participative decision making Participative decision making refers to the level of influence employees have in the decision-making process (Cotton, Vollrath, Foggat, Lengnick-Hall, & Jennings, 1988). Organizations implement

participative decision making to benefit from the motivational effects of increased employee involvement, job satisfaction, and organizational commitment (Scott-Ladd & Chan, 2004). Scott-Ladd and Chan (2004) provide evidence to suggest that participative decision making enables better access to information and improves the quality and ownership of decision outcomes. Parnell and Crandall (2000) also maintain that divulging information is a requirement for participative decision making. Subordinates are assumed to be informed in order to participate efficiently. The above reviewed literatures considered participative decision making as one of the aspects that can facilitate learning.

Managerial commitment Management should recognize the relevance of learning, thus developing a culture that promotes the acquisition, creation, and transfer of knowledge as fundamental values (Stata & Almond, 1989). Management should articulate a strategic view of learning, making it a central visible element and a valuable tool with an influence on long term results (Slocum, McGill, & Lei, 1994). Likewise, management should ensure that the firm's employees understand the importance of learning and become involved in its achievement, considering it an active part of the firm's success. Finally, management should drive the process of change, taking the responsibility for creating an organization that is able to regenerate itself and face up to new challenges (Williams, 2001).

Systems perspective Systems perspective entails uniting the organization's members around a common identity. Various individuals, departments, and areas of the firm should have a clear view of the organization's objectives and understand how they can help in their development. The organization should be considered as a system that is made up of different parts, each with its own function, that act in a coordinated manner. Viewing the firm as a system implicitly involves recognizing the importance of relationships based on the exchange of information and services and infers the development of shared mental models. Inasmuch as organizational learning implies shared knowledge, perceptions, and beliefs, it will be enhanced by the existence of a common language and joint action by all individuals involved in the process. Thus, the presence of a common language favors knowledge integration—a crucial aspect in the development of organizational learning (Grant, 1996). In this way, organizational learning goes beyond the employees' individual learning and takes on a collective nature (McGill, Slocum, & Lei, 1992).

Openness and experimentation Our unit of analysis is generative or double-loop learning, which requires a climate of openness that welcomes the arrival of new ideas and points of view, both internal and external, allowing individual knowledge to be constantly renewed, widened, and improved. To

create a climate of openness, there needs to be a previous commitment to the cultural and functional diversity, as well as a readiness to accept all types of opinions and experiences and to learn from them, avoiding the ego-centric attitude of considering one's own values, beliefs, and experiences to be better than the rest (McGill et al., 1992). Openness to new ideas, coming from within the organization or from outside of it, favors experimentation, an essential aspect of generative learning, inasmuch as it implies the search for innovative flexible solutions to current and future problems, based on the possible use of different methods and procedures. Experimentation requires a culture that promotes creativity, an enterprising ability, and readiness to take controlled risks, supporting the idea that one can learn from one's mistakes.

Knowledge transfer and integration This dimension refers to two closely linked processes, which occur simultaneously rather than successively: internal transfer and integration of knowledge. The efficacy of these two processes rests on the previous existence of absorptive capacity (Cohen & Levinthal, 1990), implying the lack of internal barriers that impedes the transfer of best practices within the firm (Szulanski, 1996). Transfer implies internal spreading of knowledge acquired at an individual level, mainly through conversations and interaction among individuals. Fluid communication relies mainly on the existence of agile information systems that guarantee the accuracy and availability of the information. With regard to dialogue and debate, work teams and personnel meetings can be ideal forums in which to openly share ideas. The main role of work teams in developing organizational learning is frequently pointed out in the literature, with particular emphasis placed on multidisciplinary and multifunction teams. Team learning places the group above the individual, allowing the transfer, interpretation, and integration of the knowledge acquired individually. This integration leads to the creation of a collective corpus of knowledge rooted in organizational culture, work processes, and the remaining elements that form the 'organizational memory.' Thus, knowledge can be subsequently recovered and applied to different situations, guaranteeing the firm's constant learning in spite of the natural rotation of its members (Simon, 1991).

Teamwork In today's complex world, individuals need to help each other accomplish the organizational objectives. Structures and systems in an organization need to encourage teamwork and group problem solving by employees and reduce the dependency on upper management. Furthermore, teams need to have the ability to work cross-functionally. By working in teams, knowledge can be shared among organizational members, consequently contributing to better understanding of other individuals, their

Table 1 Items Composing the OLC Scale

Dimension/measurement items	Literature source
<i>Risk taking</i>	
People are encouraged to take risks in this organization	Amabile (1996)
People here often venture into unknown territory.	Isaksen, Lauer, & Ekvall (1999)
<i>Interaction with the external environment</i>	
It is part of the work of all staff to collect, bring back, and report information about what is going on outside the company.	Pedler, Burgoyne, & Boydell (1997)
There are systems and procedures for receiving, collating, and sharing information from outside the company.	Pedler et al. (1997)
People are encouraged to interact with the environment: competitors, customers, technological institutes, universities, suppliers etc.	Pedler et al. (1997)
<i>Dialogue</i>	
Employees are encouraged to communicate.	Templeton et al. (2002)
There is a free and open communication within my work group	Amabile (1996)
Managers facilitate communication	Pedler et al. (1997)
Cross-functional teamwork is a common practice here.	Hult and Ferrell (1997)
<i>Participative decision making</i>	
Managers in this organization frequently involve employees in important decisions	Goh and Richards (1997)
Policies are significantly influenced by the view of the employees	Pedler et al. (1997)
People feel involved in main company decisions	Pedler et al. (1997)

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needs, and how they work in different parts of the organization, thus encouraging knowledge transfer.

Demonstration of mission and goals The organization, as a whole and each unit within it, needs to have a clearly articulated purpose. Employees need to understand this purpose and the contribution of their work toward the attainment of the organization's mission. In addition, the organization needs to promote employee commitment to these goals. If the employees understand the gap between the vision and the current state, they can strive to overcome that gap (Mohrman, Mohrman, & Cohen, 1995).

Problem definition and modeling

Organizational learning capability has many dimensions. Here we have involved ten dimensions of OLC dimensions for better explanation. We can choose each set of OLC dimensions. In order to obtain the maximum level

Table 1 Continued from the previous page

Dimension/measurement items	Literature source
<i>Team work and group problem solving</i>	
The current approach of the organization encourages the personnel to solve problems cooperatively, before discussing them with managers	Goh and Richards (1997)
We often cannot form unofficial groups to solve the problems of the organization	Goh and Richards (1997)
Majority of problem solving groups are members of different operating environments	Goh and Richards (1997)
<i>Demonstration of mission and goals</i>	
There is a widespread support and acceptance of the Organization's mission statement.	Goh and Richards (1997)
I do not understand how the mission of the organization is to be achieved (r).	Goh and Richards (1997)
The organization's mission statement identifies the values to which all employees must conform	Goh and Richards (1997)
We have opportunities for self -assessment with respect to goal attainment.	Goh and Richards (1997)
<i>Managerial commitment</i>	
The managers frequently involve their staff in important decision making processes.	Jerez Gómez et al. (2004)
Employee learning is considered more of an expense than an investment.	
The firm's management looks favorably on carrying out changes in any area to adapt to and/or keep ahead of new environmental situations.	
Employee learning capability is considered a key factor in this firm	
In this firm, innovative ideas that work are rewarded.	
<i>Systems perspective</i>	
All employees have generalized knowledge regarding this firm's objectives.	Jerez Gómez et al. (2004)
All parts that make up this firm (departments, sections, work teams, and individuals) are well aware of how they contribute to achieving the overall objectives.	
All parts that make up this firm are interconnected, working together in a coordinated fashion.	

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of learning capability and facilitating knowledge sharing process in different segments of an organization, we should implement each dimension of OLC in its fitting part. At first, we should calculate the Weight of each dimension in each part, to do this; we use k measuring items that exist in OLC literature. Finally, the dimensions are clustered in different parts of the organiza-

Table 1 *Continued from the previous page*

Dimension/measurement items	Literature source
<i>Openness and experimentation</i>	
This firm promotes experimentation and innovation as a way of improving the work processes.	Jerez Gómez et al. (2004)
This firm follows up what other firms in the sector are doing; adopting practices and techniques it believes to be useful and interesting.	
Experiences and ideas provided by external sources (advisors, customers, training firms, etc.) are considered a useful instrument for this firm's learning.	
Part of this firm's culture is that employees can express their opinions and make suggestions regarding the procedures and methods in place for carrying out tasks.	
<i>Knowledge transfer and integration</i>	
Errors and failures are always discussed and analyzed in this firm, on all levels.	Jerez Gómez et al. (2004)
Employees have the chance to talk among themselves about new ideas, programs, and activities that might be of use to the firm.	
In this firm, teamwork is not the usual way to work.	
The firm has instruments (manuals, databases, files, organizational routines, etc.) that allow what has been learnt in past situations to remain valid, although the employees are no longer the same.	

tion according to their effects and the cost of implementing the aspects and presented formulas. Then we have considered k implementing methods for implementing each dimension in each part of the organization. Implementing methods for each dimension are different in different organizations. As people learn in different ways, there are different styles of organizational learning; therefore organizations select different implementing methods for implementing OLC dimensions in different parts according to the features of industrial environment, adopted strategies, business culture, technology, available resources and history of the Company. Implementation methods are determined by the organization's knowledge management. The organization limits total budget, which is considered to have increased the learning capability of the organization to a maximum value.

Our proposed formulas for clustering are described in four steps:

Step 1: Determining $n_{ijkk'}$

We should measure the weight of implementation item k of dimension i in part j by measure item k . $n_{ijkk'}$ gives a number between 0 and 100 which is determined by Knowledge Management Team.

Step 2: Calculating $w_{ijkk'}$

According to the amount of $n_{ijkk'}$, we can determine the numerical value of k by specifying the weight of implementation item k of dimension i in part j . Also the organization's knowledge management team determines the value of a , b , c , d , α , β , and γ in $w_{ijkk'}$:

$$w_{ijkk'} = \begin{cases} 0 & n_{ijkk'} < a \\ \alpha & a \leq n_{ijkk'} < a \\ \beta & b \leq n_{ijkk'} < c \\ \gamma & c \leq n_{ijkk'} < d \\ 100 & n_{ijkk'} \geq d \end{cases} \quad (1)$$

Step 3: Calculating w_{ijk}

Equation (2) shows the calculation of the Weight of implementation item k of dimension i in part j :

$$w_{ijk} = \sum_{k'} w_{ijkk'} \quad (2)$$

If the implementation item k of dimension i was j , $x_{ijk} = 1$ so x_{ijk} would be 0. For measuring the effect of each dimension on the learning capability of the organization in each part, we use the measurement items in literature of organizational learning capability in Table 1.

We have k measurement items and k implementation items for each dimension. Firstly, to achieve this goal we should examine the amount of measurement item k' . This value is shown in $n_{ijkk'}$, which is a number between 0 and 100 and is determined by organization's Knowledge Management Team. According to the amount of $n_{ijkk'}$, the organization would determine the numerical value of measurement item, k to measure the weight of implementation item k of dimension i in part j . The organization's knowledge management team determines the value of a , b , c , d , α , β , and γ in the function $w_{ijkk'}$.

Step 4: Mathematical Clustering Model

Equation (3) or objective function maximizes the total effects of dimensions that are implemented in different parts of an organization:

$$\max \sum_i \sum_j \sum_k w_{ijk} x_{ijk} \quad (3)$$

Because of capital limitation, each organization should invest in the dimensions of organizational learning capability, which have the greatest effect on learning capability of the organization to achieve the highest level of learning capability.

Table 2 Values of Fixed Variables

Part <i>j</i>	Max. cost of implementing dim. in part <i>j</i>	The minimize effect in part <i>j</i>
1	16000\$	70
2	14000\$	75
3	24000\$	70
4	14000\$	70
5	18000\$	80

Table 3 Values of Constant Coefficients

α	β	γ	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
27	45	67	13	38	53	79

$$\sum_i \sum_k c_{ijk} X_{ijk} \leq A_j \quad \forall j. \tag{4}$$

This equation certifies that the total implementation cost for activating dimensions in part *j* is limited to a maximum value.

$$\sum_i \sum_j \sum_k c_{ijk} X_{ijk} \leq B. \tag{5}$$

This equation ensures that the total budget of the organization, which is considered to have increased the learning capability of the organization, is limited to a maximum value.

$$\sum_i \sum_k w_{ijk} X_{ijk} \geq M_j \quad \forall j. \tag{6}$$

This equation indicates that the total effect of dimensions in each part is limited to a minimum value. When the amount of a measured item reduces, its effect will be reduced and thus the total effect on the learning capability of the organization will be reduced. Since we have limited the total effect to a minimum value in each part of the organization, more dimensions will be active and so the total cost will be increased.

Computational Results

We have considered an organization including 5 segments, 3 measurement items and 3 implementation items for each dimension. The total budget of the organization is allocated to increase the learning capability, the total implementation cost for implementing dimensions in part *j* and the total effects in each part are shown in Table 2. Constant coefficients, $\alpha, \beta, \gamma, a, b, c$ for calculation of w_{ijk} are displayed in Table 3. These coefficients are determined by the organization’s knowledge management team. We choose $n_{ijkk'}$ and c_{ijk} as follows: $10 \leq n_{ijkk'} \leq 87, 1800 \leq c_{ijk} \leq 4000$. We solved the presented model using lingo software. Implemented dimensions of organization’s different parts are displayed in Table 4.

Table 4 Output Result

<i>i</i>	<i>j</i> =	<i>k</i> =1					<i>k</i> =2					<i>k</i> =3					
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
1		0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2		1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
3		0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0
4		0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
5		0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
6		1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
7		0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
8		0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
9		1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0

Dimensions the organization should consider in each segment of the firm are displayed in Table 4 ($x_{ijk} = 1$). Implementing method of dimensions in each part is shown in Table 4. We have considered 3 implementing methods for each dimension ($k = 1, 2, 3$). Implementing methods for each dimension are different in different organizations.

Conclusions

This paper proposed a mathematical clustering model to disseminate the organizational learning capability dimensions within the context of knowledge management in firms. The mathematical clustering technique has determined the allocation of indices, according to their effect on the learning capability, to different parts of the organization in order to obtain the highest level of learning capability in an organization. We developed an algorithm to imply the steps of the clustering method. Computational results confirmed the effectiveness of the model. The findings confirmed that learning capabilities producing more effects are in a cluster, related to one specific segment of the firm.

References

- Aad, G., Abbott, B., Abdallah, J., Abdelalim, A. A., Abdesselam, A., Abidinov, O., & Allport, P. P. (2011). Luminosity determination in pp collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector at the LHC. *The European Physical Journal C*, 71(4), 1–37.
- Aghdasi, M., & Bafraei, K. (2009). Measuring level of organisational learning capabilities in hospitals. *International Journal of Industrial Engineering & Production Management*, 19(4), 71–78.
- Alegre, J., & Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: An empirical test. *Technovation*, 28(6), 315–326.

- Amabile, T. M. (1996). *Creativity and innovation in organizations* (Harvard Business School Background Note 396–239). Harvard Business School, Cambridge, MA.
- Ashkenas, R. (1995). *The boundary less organization: Breaking the chains of organizational structure*. San Francisco, Ca: Jossey-Bass.
- Aydin, M. A., Zaim, A. H., and Ceylan, K. G. (2009). A hybrid intrusion detection system design for computer network security. *Computers & Electrical Engineering*, 35(3), 517–526.
- Bapuji, H., and Crossan, M. (2004). From raising questions to providing answers: Reviewing organizational learning research. *Management Learning*, 35(4), 397–417.
- Bhatnagar, J. (2006). Measuring organizational learning capability in Indian managers and establishing firm performance linkage: An empirical analysis. *The Learning Organization*, 13(5), 416–433.
- Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization Science*, 2(1), 40–57.
- Chiva, R. (2004). Repercussions of complex adaptive systems on product design management. *Technovation*, 24(9), 707–711.
- Chiva, R., Alegre, J., & Lapedra, R. (2007). Measuring organizational learning capability among the workforce. *International Journal of Manpower*, 28(3), 224–242.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128–152.
- Cotton, J. L., Vollrath, D. A., Foggat, K. L., Lengnick-Hall, M. L., & Jennings, K. R. (1988). Employee participation: Diverse forms and different outcomes. *Academy of Management*, 13(1), 8–22.
- Dibella, A. J., Nevis, E. C., & Gould, J. M. (1996). Understanding organizational learning capability. *Journal of Management Studies*, 33(3), 361–379.
- Easterby-Smith, M., Crossan, M., & Nicolini, D. (2000). Organizational learning: Debates past, present and future. *Journal of Management Studies*, 37(5), 783–796.
- Goh, S., & Richards, G. (1997). Benchmarking the learning capability of organizations. *European Management Journal*, 15(5), 575–583.
- Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, 7(4), 375–387.
- Hedberg, B. (1981). How organizations learn and unlearn. In P. C. Nystrom & W. Starbuck (Ed.), *Handbook of Organizational Design* (pp. 3–27). Oxford, England: Handbook of Organizational Design.
- Hsu, Y. H., & Fang, W. (2009). Intellectual capital and new product development performance: The mediating role of organizational learning capability. *Technological Forecasting and Social Change*, 76(5), 664–677.

- Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science*, 2(1), 88–115.
- Hult, G. T. M., & Ferrell, O. C. (1997). Global organizational learning capacity in purchasing: Construct and measurement. *Journal of Business Research*, 40(2), 97–111.
- Isaacs, W. (1993). Dialogue, collective thinking, and organizational learning. *Organizational Dynamics*, 22(2), 24–39.
- Isaksen, S. G., Lauer, K. J., & Ekvall, G. (1999). Situational outlook questionnaire: A measure of the climate for creativity and change. *Psychological Reports*, 85(2), 665–674.
- Jerez Gómez, P., Céspedes Lorente, J., & Valle Cabrera, R. (2004). Training practices and organisational learning capability: Relationship and implications. *Journal of European Industrial Training*, 28(2/4), 234–256.
- Jerez Gomez, P., Céspedes Lorente, J., & Valle Cabrera, R. (2005). Organizational learning capability: A proposal of measurement. *Journal of Business Research*, 58(6), 715–725.
- Lei, D., Slocum, J. W., & Pitts, R. A. (2000). Designing organizations for competitive advantage: The power of unlearning and learning. *Organizational Dynamics*, 27(3), 24–38.
- McGill, M. E., Slocum, J. W., & Lei, D. (1992). Management practices in learning organizations. *Organizational Dynamics*, 21(1), 5–17.
- Mohrman, S. A., Mohrman Jr., A. M., & Cohen, S. G. (1995). Organizing knowledge work systems. *Advances in Interdisciplinary Studies of Work Teams*, 2, 61–91.
- Nevis, E., Dibella, A. J., & Gould, J. M. (1995). Understanding organization learning systems. *Sloan Management Review*, 36(2), 73–85.
- Oswick, C., Anthony, P., Keenoy, T., & Mangham, I. L. (2000). A dialogic analysis of organizational learning. *Journal of Management Studies*, 37(6), 887–901.
- Parnell, J. A., & Crandall, W. (2000). Rethinking participative decision making: A refinement of the propensity for participative decision making scale. *Personnel Review*, 30(5), 523–535.
- Pedler, M., Burgoyne, J., & Boydell, T. (1997). *The learning company: A strategy for sustainable development*. London, England: McGraw-Hill.
- Popper, M., & Lipshitz, R. (2000). Organizational learning: Mechanism, culture and feasibility. *Management Learning*, 31(2), 181–196.
- Rashidi, M. M., Habibi, M., & Jafari Farsani, J. (2010). The relationship between intellectual assets organizational learning capability at the institute for international energy studies. *Management and Human Resources in the Oil Industry*, 11(4), 59–76.
- Schein, E. H. (1993). On dialogue, culture, and organizational learning. *Organizational Dynamics*, 22(2), 40–51.
- Scott-Ladd, B., & Chan, C. C. A. (2004). Emotional intelligence and participation indecision-making: Strategies for promoting organizational learning and change. *Strategic Change*, 13(2), 95–105.
- Senge, P. (1990). *The fifth discipline*. New York, NY: Doubleday.

- Simon, H. A. (1991). Bounded rationality and organizational learning. *Organization Science*, 2(1), 125–134.
- Sitkin, S. B. (1996). Learning through failure. In M. Cohen & L. Sproull (Eds.), *Organizational Learning* (pp. 541–578). Thousand Oaks, CA: Sage.
- Slater, S. F., & Narver, J. C. (1995). Market orientation and the learning organization. *The Journal of Marketing*, 59(3), 63–74.
- Slocum, J. W., McGill, M. E., & Lei, D. T. (1994). The new learning strategy: Anytime, anything, anywhere. *Organizational Dynamics*, 23(2), 33–47.
- Stata, R., & Almond, P. (1989). Organizational learning: The key to management innovation. *Sloan Management Review*, 30(3), 63–74.
- Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, 17, 27–43.
- Templeton, G. F., Lewis, B. R., & Snyder, C. A. (2002). Development of a measure for the organizational learning construct. *Journal of Management Information Systems*, 19(2), 175–218.
- Ulrich, D., Von Glinow, M. A., & Jick, T. D. (1993). High-impact learning: Building and diffusing learning capability. *Organizational Dynamics*, 22(2), 52–66.
- Walsh, J. P., & Ungson, G. R. (1991). Organizational memory. *Academy of Management Review*, 16(1), 57–91.
- Williams, A. P. (2001). A Belief-focused process model of organizational learning. *Journal of Management Studies*, 38(1), 67–85.

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