Relationships between knowledge inertia, organizational learning and organization innovation

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Abstract

Both as power and a resource, knowledge is a significant asset both for individuals and organizations. Thus, knowledge management has become one of the important issues for enterprises. However, when facing problems, people generally resort to their prior knowledge and experience for solutions. Such routine problem-solving strategy is termed "knowledge inertia". This study aims to establish the constructs of knowledge inertia and examine the relationships between knowledge inertia, organizational learning and organizational innovation. Structural equation modeling is employed to discuss the degree of influence each construct has on each other and whether their relationships vary in different organization types. A questionnaire survey was conducted to collect data from government organizations as well as state-run and private enterprises. A total of 485 valid responses were collected. Our results reveal that knowledge inertia comprises both learning inertia and experience inertia. The relationships between the three variables are as follows. First, knowledge inertia exerts a mediating effect on organizational innovation through organizational learning. Second, when a firm's members have either less learning inertia or more experience inertia, the performance of the organizational learning will be better.
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Keywords: Knowledge inertia; Organizational learning; Organizational innovation; Principal analysis; Structural equation modeling

1. Introduction

Both as power and a resource, knowledge is strategically important for individuals and enterprises. The third industrial revolution is based on knowledge which changes the way an individual, an enterprise or even a nation can create wealth and prosperity. Thus, successful knowledge management can be the chief determinant for the survival of an enterprise in a knowledge-based economy.

Since the 1990s, there has been much interest in the exploration of knowledge management and the development of knowledge management theories. Nonaka (1994) proposed a theory of organizational knowledge creation where enterprises are encouraged to adopt novel ideas while reforming old operational procedures and creating new ones. Innovations are the prerequisite of knowledge creation and the essence of knowledge management. Faced with an ever-changing environment, innovations provide an enterprise with flexibility for changes, which is the key to its survival and success. Drucker (1985) considers knowledge the only source of an enterprise's competitive advantage. Hence, to meet current challenges, enterprises should seek ways to strengthen the research and development of knowledge, to manage it efficiently and to utilize it effectively.

Nevertheless, hurdles to efficient and effective knowledge management are many. Using the principles of inertia in physics to knowledge management, Liao (2002) states that knowledge inertia may inhibit an organization's capability to learn and solve problems. Often routine problem-solving procedures are adopted to save time and effort as well as to avoid risks. Stagnant knowledge sources and obsolete prior experience result in the same solutions and approaches being employed to deal with problems. Such predictability in management behavior may make an enterprise more risk in a highly vulnerable competitive environment. Inertia not only has negative impact on knowledge utilization, but may also disclose an enterprise's commercial secrets and strategies. In other words, organizations showing inertia in

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thinking and policy-making may suffer loss and failure. This further highlights the importance of innovations in knowledge management and that enterprises should devote efforts to avoid inertia.

The theory of knowledge inertia proposed by Liao (2002) has not been tested empirically. Therefore, this research attempts to establish the constructs of knowledge inertia using principal analysis and examines the relationships between knowledge inertia, organizational learning and organizational innovation with structural equation modeling approach. The sample of organizations studied includes government organizations (officials on central and regional government) as well as state-run and private enterprises (manufacturing and services industry).

2. Theoretical framework

2.1. Knowledge inertia

In physics, the principle of inertia states that objects continue in a state of rest or uniform motion unless acted upon by forces. Unless interrupted, an object's motion is subject to physical constraints and objects will move in the predicted trajectory. That human(s) can track and reach moving objects by predicting where the objects are going. This phenomenon suggests that human cognition also has inertia (Hofsten et al., 1998; Kavcic et al., 1999). The overall procedure explains several things. Firstly, prediction is based on the understanding that there is a trajectory *if* objects move *then* we can track and reach them according to their inertia. Secondly, changes in moving trajectory only happen if objects are interrupted by outside forces. This means that any change of inertia is caused by outside forces. Thirdly, change does not spontaneously, but must be implemented.

In human cognition, there is an explanatory process, which derives understanding from a view that other things have already been done (Schank, 1986). For example, as we read a text or listen to a discussion, we use our knowledge about what has already been written or spoken to help us tie together the pieces of what we hear. Our past knowledge helps us predict what we will hear next, disambiguate words, resolve pronouns, and make connections between the various things being discussed. This implies that our past knowledge of what has happened in some situations allow us to infer similar things and to explain it (Kolonder, 1994). In system logic programs, there is a commonsense law of inertia, which states that things do not change unless they are made to change. The fact that revision programming is easily captured in logic programs using such inertia rules can help to clarify the nature of the revisions captured by programming. It also provides a crucial element of proposals for representing knowledge about actions in default logic and logic programming (Przymusinski and Turner, 1997). On the other hand, people are usually either right-handed or left-handed from infancy, which is a physical inertia that is used throughout life and is very difficult to change. We can also consider if there is evidence to show that a phenomenon similar to inertia, exists in knowledge use. In both individuals and organizations, a high degree of the solution of a problem is generated by the knowledge acquired from past experience and its extension to fit new situations (Sternberg, 1985). People use a memory of past experiences and knowledge as a guide to generate planning for new problems. Re-using past knowledge to solve a new problem becomes a law or principle that similar things will remain static or uniform until the situation is no longer feasible and then is changed by outside forces.

Applying the concept of inertia to human behavior shows that individuals often resort to constant methods for dealing with problems. Routine problem-solving approaches and similar reasoning will be adopted to save time and effort and also avoid risks. In the context of strategic change, Huff et al. (1992) describe inertia as an "overarching concept that encompasses personal commitments, financial investment sand institutional mechanisms supporting the current ways of doing things…inertia describes the tendency to remain with the *status quo* and the resistance to strategic renewal outside the frame of current strategy" (p. 55). This definition leads us to the concept of *mental inertia*, which originates in cognitive and learning approaches, thus linking the firm's difficulties to change to cognitive structures, perception and interpretation. On the other hand, everything stemming from past experience and knowledge without revision and updating would imply predictable management behavior and problem-solving strategy of an enterprise (Liao, 2002). That is to say, inertia would result in lack of innovation and expected behavior, which may jeopardize the survival or undermine the advantage of an enterprise in a highly competitive environment. Hence, it is important for an organization or enterprise to avoid the negative impact of inertia on its capability to learn and it should utilize knowledge efficiently and effectively.

2.2. Organizational learning

All humans are born with the ability to learn and it is through learning that they adapt to the changing and evolving environment. Learning leads to new insights and concepts. It often occurs when we take effective actions and when we detect and correct our own mistakes (Argyris and Schon, 1978). As to the learning of an organization, Morgan and Ramirez (1983) suggest that organizational learning occurs when members use learning to solve a common problem they are facing. Every organization will develop the most suitable learning method taking into consideration the needs and characteristics of the organization itself (Helleloid and Simonin, 1994).

There are two types of organizational learning commonly discussed in the literature. Firstly, exploitative learning (March, 1991) is the acquisition of new behavioral capacities framed within existing insights. Exploitative

learning is described in the literature as "single-loop" (Argyris and Schon, 1978, 1996), "operational" (Coopey, 1996), "first-order" (Fox-Wolfgramm et al., 1998), "evolutional", "frame-taking", "reactive" (Weick and Westley, 1996) and "incremental" (Miner and Mezias, 1996). Secondly, explorative learning (March, 1991) occurs when organizations acquire behavioral capacities that differ fundamentally from existing insights. Exploration is about discovery, variation, effectiveness, flexibility and innovation (March, 1991; Weick and Westley, 1996). This type of organizational learning is referred to as "double-loop" (Argyris and Schon, 1978, 1996), "strategic" (Coopey, 1996), "second-order" (Fox-Wolfgramm et al., 1998), "revolutionary", "frame-breaking", "proactive" (Weick and Westley, 1996) and "radical' (Miner and Mezias, 1996). Different organizational structures are conducive to different types of learning. Mechanistic structures with tightly coupled relationships between actors foster exploitative learning in stable contexts, while organic structures with loosely coupled relationships are favorable to the occurrence of explorative learning in changing contexts (Burns and Stalker, 1961; Weick and Westley, 1996; Rowley et al., 2000; Hansen et al., 2001). In addition, Clegg et al. (2005) propose a perspective that sees learning not as something that is done to organizations, or as something that an organization does; rather, learning and organizing are seen as mutually constitutive and unstable, yet pragmatic, constructs that might enable a dynamic appreciation of organizational life. Therefore, in a long-term development, organizational learning may contain both natures of exploitative and exploration learning on different organization types and development stages in order to keep organization constantly growth.

On the other hand, Kim (1993) and Morgan (1997) describe the learning process as the acquisition, interpretation and implementation of new knowledge; and similarly Huber (1991) identifies it as the acquisition, dissemination, interpretation and storage of new knowledge. Argote (1999) view that organizational learning involves three stages: acquisition, sharing and storage. Interpretation is not seen as a discrete stage but more as an activity arising throughout the learning process. Furthermore, implementation is not a necessary element of the process since as learning refers to the evolution of cognitive capacities, which may or may not lead to action. Therefore, a learning organization has the ability to continuously adjust to new situations and to renew itself according to the demands of the environment (Jaw and Liu, 2003). To enhance its capability to learn, an organization should establish a system where individual learning can be shared among members (Tsang, 1997). Learning by an individual forms the basis of organizational learning; it is through individual learning that an organization will also learn as a whole (Grant, 1996).

However, Adams et al. (1998) identify inertia as a barrier that hinders an organization's capabilities for learning about markets for new product development. In addition,

knowledge inertia may inhibit the learning ability of an individual (Liao, 2002). This may in turn affect organizational learning. Thus, our first hypothesis is stated as follows.

H1. *Knowledge inertia is negatively related to organizational learning.*

2.3. Organizational innovation

Most of the literature on innovation has focused on technological innovation (Abernathy and Clark, 1985; Freeman and Soete, 2000), and the restricted view resulting from that bias has been criticized in studies of organizational innovation (Easingwood, 1986; Barras, 1990; Gallouj and Weinstein, 1997; Avlonitis et al., 2001). However, the concepts 'innovation' and 'organization' are central to organizational theory. The most common distinction with respect to types of innovation is between product and process innovation. Organizational innovation is often added to these two basic types. Business organizations attempt to create value and thereby achieve competitive success. Ever since Schumpeter (1934) pointed out that innovation plays an important in economic development, it has received much attention and has been widely studied for its organizational innovation issues (Daft and Becker, 1978; Hage and Aiken, 1970; Damanpour, 1991; Tang, 1998; Stjernberg and Philips, 1993; Kickul and Gundry, 2001; Wijnberg, 2004).

For an organization, innovation would denote the generation or adoption of novel ideas or behavior. Hence, to an enterprise, an innovation can be a new product or service, a new production technology, a new operation procedure or a new management strategy. Most successful innovations are the result of gradual changes in concepts and methodology implemented continually over time (Tushman and Nadler, 1986). Accumulation of organizational resources relies on the creation, search, acquisition and sharing of knowledge; and effective organizational innovation is the key to maintain competitive advantage in a constantly changing environment (Lemon and Sahota, 2004). In the literature on organizational innovation, there are many models. In view of the varied nature of organizational innovation, this study adopts the dual-core model (Damanpour, 1991), which is based on the distinction between administrative and technical innovations. While it is recognized that organizational innovation is the key determinant of an enterprise's success or failure, the question of whether knowledge inertia would affect the implementation of organizational innovation remains to be explored.

In addition, Liao et al. (2007) investigate the relationships between knowledge sharing, absorptive capacity, and innovation capability in Taiwan's knowledge-intensive industries. They find that absorptive capacity is the intervening factor between knowledge sharing and innovation capability. Research findings also show that knowledge

sharing has a positive effect on absorptive capacity, and that a completely mediating model exhibits both model generalization and extension characteristics through multiple model comparison in different industry population samples. Hence, our second hypothesis is as follows.

H2. *Knowledge inertia is negatively related to organizational innovation.*

2.4. Relationship between organizational learning and organizational innovation

Argyris and Schon (1978) suggest that organizational learning would enhance the innovative capacity of an organization. Stata (1989) regards innovation as a result of individual and organizational learning and as the only source of lasting competitive advantage in a knowledge-intensive industry. Foster (1986) proposes the S-shaped learning curve for innovative products. According to this curve, under a constant technology, increased production will only bring diminishing returns. Only continual innovations can prevent this decrease and ensure increasing profits. Moreover, different organizational learning styles will result in different innovation activities (McKee, 1992). Single-loop learning will lead only to a quantitative increase in innovations, and a qualitative increase in innovations can be achieved only by double-loop learning. Meta-learning, which comprises both single- and double-loop learning, contributes to innovations, thus enhancing learning of the whole organization. Gerybadze and Reger (1999) find that organizational learning has a positive relationship with organization innovation on globalization of R&D. In addition, Greve (2005) describes how organizations can learn from the innovations made or adopted by other organizations. In doing so, he presents a framework for inter-organizational learning that allows study of how learning is affected by the characteristics of the origin and destination organizations, as well as their relationships. The findings of these studies reveal that organizational learning and organizational innovation are related. Hence, our third hypothesis is as follows. In addition, examines the effects of organizational learning and teamwork cohesion on organizations' capacity to use innovation (technical and administrative) to meet the changing needs of their environment. This paper verifies how certain characteristics of the firm (support leadership and teamwork cohesion) significantly affect both learning and innovation, as well as showing the implications of these in organizational performance. On the other hand, Jay et al. (2006) present a study of SME's and suggest that market focused learning, relative to other learning capabilities plays a key role in the relationships between industry structure, innovation and brand performance. The findings also show that market focused learning and internally focused learning influence innovation and that innovation influences a brand's performance. In addition, Alberto et al. (2007) propose a research finding that
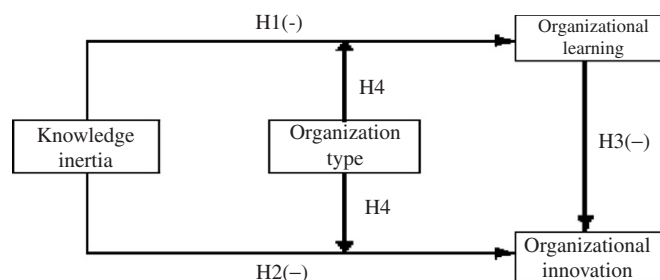

Fig. 1. Theoretical framework.

leadership style, an individual feature, and organizational learning, a collective process, simultaneously and positively affect firm innovation. A structural equation model and data from 408 large firms in four sectors supported their hypotheses. Organizational learning had a stronger direct influence on innovation than CEO transformational leadership; however, leadership had a strong, significant influence on organizational learning, indirectly affecting firm innovation. Thus, our third hypothesis is as follows.

H3. *Organization learning is positively related to organizational innovation.*

2.5. Moderating effect of organization type

Different types of organizations have different organization cultures, which in turn influence organizational learning (Chou, 2003). Hult et al. (2003) examine four organization types with different combinations of scale and history, and find that a larger organization with a longer history has better performance in organizational learning. Above literature reviews have shown that different organization types have different cultures, which may in turn influence organizational learning. Hence, our fourth hypothesis probes the influence of organization type on organizational learning and organizational innovation.

H4. *Organization type has a moderating effect on the impact of knowledge inertia on organizational learning and innovation.*

Fig. 1 displays the theoretical framework of this research which summarizes our four hypotheses.

3. Research methodology

3.1. Sample

After pre-test and modifications, questionnaires were sent out to selected respondents. According to the maximum likelihood estimation (MLE), in order for the sample to be effective, the number of respondents should be between 100 and 150 (Ding et al., 1995). The sample comprises three organization types, namely government organizations, state-run and private enterprises. A total of

1200 questionnaires were sent out, 400 to each organization type. To ensure that the sample is representative, equal numbers of government organizations at both central and regional levels were included. State-run and private enterprises were randomly chosen from 1000 and 500 of these enterprises, respectively, listed under the manufacturing and servicing sectors of Taiwan (Li and Chen, 2003). A total of 1200 questionnaires were sent out, there were a total of 485 valid responses, for an effective response rate of 40.42% (Table 1).

3.2. Establishing the constructs of knowledge inertia

According to Liao (2002), knowledge inertia occurs when people use routine problem-solving procedures, resort to stagnant sources for new knowledge, and continue to follow past knowledge or experience. In the light of Liao's definition, this study proposes constructs for measuring knowledge inertia using the Likert five-point scale. Table 2 displays the questions used to investigate the three definitions of knowledge inertia.

After establishing the measuring constructs according to the original definition of knowledge inertia, exploratory factor analysis—principal analysis, is conducted to find if there are other hidden factors. Table 3 displays the loading of the two factors obtained by exploratory factor analysis.

As can be seen in Table 2, there are only two factors with eigenvalue λ greater than 1. In view of the discrepancy between the distribution of questions and the three original definitions of knowledge inertia, Question 3–1 of Factor I

was deleted. The questions for measuring knowledge inertia were then reclassified under two constructs: learning inertia and experience inertia as shown in Table 4.

As seen in the above reliability analysis, the Cronbach's α of the two constructs are both above 0.7, revealing that the modified questionnaire can be a valid measure for knowledge inertia.

3.3. Operational definition and measures of research variables

Table 5 lists the operational definitions of the three variables, namely knowledge inertia, organizational learning and organizational innovation.

3.4. Questionnaire development

3.4.1. Reliability analysis

Reliability of a construct refers to the consistency and stability of the questions. Table 6 lists the Cronbach's α of the constructs. As can be seen, with the exception of the construct of experience inertia (Cronbach's $\alpha = 0.602$), all other constructs have Cronbach's α above 0.7, which indicates high reliability (Nunnally, 1978).

3.4.2. Validity analysis

(1) *Convergent validity*: Table 7 displays the parameter estimates of the constructs and their T-values. As can be seen, all constructs have T-values greater than 2, revealing good convergent validity.

Table 1
Sample group statistics

Units	Organizational name/types (government organizations, state-run and private enterprises)	Sampling no.	Valid no.	Response rate (%)
1	Department of Ministry of Economic Affairs, (government organizations)	50	24	48
2	Ministry of Finance, (government organizations)	50	20	40
3	Ministry of Education, (government organizations)	50	18	36
4	Ministry of the Interior, (government organizations)	50	13	26
5	Taipei city government, (government organizations)	50	18	36
6	Taipei county government, (government organizations)	50	22	44
7	Taichung city government, (government organizations)	50	18	36
8	Kaohsiung city government, (government organizations)	50	17	34
9	China petroleum corporation, (state-run enterprises)	50	13	26
10	China shipbuilding corporation, (state-run enterprises)	50	22	44
11	China steel corporation, (state-run enterprises)	50	19	38
12	Taiwan sugar corporation, (state-run enterprises)	50	21	42
13	Taiwan salt corporation, (state-run enterprises)	50	23	46
14	China telecom corporation, (state-run enterprises)	50	25	50
15	Taiwan electronic corporation, (state-run enterprises)	50	20	40
16	Aerospace Industrial Development Corporation, (state-run enterprises)	50	24	48
17	Chi Mei Optoelectronics (private enterprises)	50	19	38
18	Macronix Corporation (private enterprises)	50	20	40
19	Unified manufacturing corporation, (private enterprises)	50	17	34
20	Excellent chain manufacturing corporation, (private enterprises)	50	24	48
21	Hun-whu Technology Corporation (private enterprises)	50	25	50
22	Nanya Technology Corporation (private enterprises)	50	18	36
23	Advanced Semiconductor Engineering Inc. (private enterprises)	50	24	48
24	Taiwan semiconductor manufacturing corporation, (private enterprises)	50	21	42
Total		1200	485	40.42

Table 2
Questions for measuring knowledge inertia

Original definition of knowledge inertia	Questions	Measurement scale
Definition 1: Use routine problem-solving procedures	1. Other people can know and predict my problem-solving strategy. 2. I often take the initiative to change my problem-solving approach. 3. I will change my problem-solving approach according to others' suggestions or demands. 4. I will use new approaches to solve new problems. 5. My unit/company has rigid operational procedures and lacks flexibility and innovation. 6. I often use different approaches to solve problems. 7. The regulations and practices of my unit/enterprise are restrictive to me. 8. I will use the same approach to solve the same problem.	
Definition 2: Resort to stagnant sources for new knowledge	1. I generally resort to the same source for new knowledge. 2. My unit/enterprise offers me opportunities to learn new concepts and methods. 3. I will try to learn new ideas to change my old thinking and behavior. 4. I am able to observe how other people solve problems. 5. I will take the initiative to seek new sources of knowledge. 6. I am scared of new knowledge and ideas that I do not understand.	Likert five-point scale
Definition 3: Keep following past knowledge or experience	1. I will use past knowledge and experience to solve new problems. 2. I rely greatly on past knowledge or experience in my work and living. 3. My past knowledge and experience will influence my acceptance of new knowledge. 4. My past knowledge and experience are not sufficient for solving all my problems at work. 5. I often learn from past experience. 6. My past knowledge and experience can enhance my working efficiency. 7. I need to learn new knowledge and have new experiences in my work.	

Table 3
Exploratory factor analysis of knowledge inertia

Factor I			Factor II		
No.	Question	Factor loading	No.	Question	Factor loading
1	1–4	0.743	1	1–3	0.648
2	1–6	0.556	2	1–8	0.584
3	2–2	0.681	3	2–1	0.542
4	2–3	0.635	4	3–2	0.600
5	2–4	0.646	5	3–3	0.667
6	2–5	0.544	6	3–5	0.616
7	3–1	0.543	7	3–6	0.595
8	3–7	0.557	–		
Eigenvalue		4.037	Eigenvalue		2.770

Note 1: Questions 1–4 denote Question no. 4 of Definition 1 of knowledge inertia.
Note 2: Using varimax normalized rotation.

(2) *Discriminant validity*: Anderson and Gerbing (1988) suggest the following procedure to test the discriminant validity of a variable: first, the constructs of a variable are set to be correlated and be termed the unconstrained model. Second, the unconstrained model is modified with one of correlations set to be 1.0 and then to be call constrained model. If the Chi-square difference between the two models is significant, this implies that the two constructs of the variable are different significantly and

should not be merged as one construct. It can be noted that all the Chi-square differences between two constructs in Table 8 are significant; therefore, the discriminant validities are verified.

3.4.3. Correlation analysis

Table 9 displays the means, standard deviations of constructs and their correlations. As can be seen, the following relationships exist between the research variables.

(1) *Relationship between knowledge inertia and organizational learning*: Experience inertia is positively related to organizational learning, meaning that members with more experience inertia show higher capability in enhancing organizational learning. On the contrary, learning inertia is negatively related to organization learning, which implies that more learning inertia among members will reduce the capacity for organizational learning.

(2) *Relationship between knowledge inertia and organizational innovation*: Experience inertia is positively related to organizational innovation. In other words, there is greater efficiency in enhancing organizational innovation. Nevertheless, learning inertia is negatively related to organizational innovation. That is to say, the greater the learning inertia among members, the less efficient they are in promoting organizational innovation.

(3) *Relationship between organizational learning and organizational innovation*: Commitment to learning, shared vision and open-mindedness all show positive correlation with both administration and technical innovation.

Table 4
New operational definitions and questions of knowledge inertia constructs

Research variable	Constructs and operational definition	Questions	Cronbach's α
Knowledge inertia	*Learning inertia*: Members of my organization are influenced by inertia in knowledge learning	1. My unit/enterprise does not offer me any opportunity to learn new concepts and methods. 2. I will not use new approaches to solve new problems. 3. I will not try to learn new ideas to change my old thinking and behavior. 4. I am not able to observe how other people solve problems. 5. I seldom use different approaches to solve problems. 6. I will not take the initiative to seek new sources of knowledge. 7. I do not need to learn new knowledge and experience in my work.	0.754
	Experience inertia: Members of my organization are influenced by inertia in solving problems with past knowledge and experience	1. I am used to resorting to the same source for new knowledge. 2. I rely much on past knowledge or experience in my work and living. 3. I will change my problem-solving approach according to others' suggestions or demands. 4. My past knowledge and experience will influence my acceptance of new knowledge. 5. I often learn from past experience. 6. My past knowledge and experience can enhance my working efficiency. 7. I will use the same approach to solve the same problem.	0.720

Note: The constructs of knowledge inertia is measured using a Likert five-point scale.

Table 5
Operational definitions of variables

Variable	Operational definition of construct	No. of questions	Source
Knowledge inertia	*Learning inertia*: Members of organization are influenced by inertia in knowledge learning. *Experience inertia*: Members of organization are influenced by inertia in solving problems with past knowledge and experience.	7 7	This study
Organizational learning	*Commitment to learning*: Organization regards learning as its most important basic value. *Shared vision*: Organization chiefs share future vision with its members. *Open-mindedness*: Organization does not stick to its old way of thinking but embrace innovative ideas.	6 6 5	Baker and Sinkula (1999) and Lin (2001)
Organizational innovation	*Administrative innovation*: Innovative operations with respect to planning, organization, personnel, leadership, management and service. *Technical innovation*: Innovations with respect to products, manufacturing and facilities.	9 7	Daft (1982) and Tsai (1997)

Note 1: The questions for measuring each constructs are the same as listed in Table 1.
Note 2: The constructs are measured using a Likert five-point scale.

This implies that high organizational learning can foster organizational innovation.

Correlations can only reveal the degree of relationship between constructs. To further understand the direct and indirect effects, as well as the moderating and mediating effects among the constructs, further analysis by structural equation model is required.

3.4.4. Structural equation model

(1) *Partially mediating model* (*theoretical model*): This examines the impact of knowledge inertia on organizational learning and organizational innovation and explores the direct influence of organizational learning on organizational innovation.

(2) *Direct model*: This examines the direct impact of knowledge inertia and organizational learning on organizational innovation.

(3) *Completely mediating model*: This model assumes that the organizational learning is the mediating variable between knowledge inertia and organizational innovation (Fig. 2).

As shown in Table 10, the completely mediating model has the smallest χ^2 value 3.545 and is the only model that χ^2 value and degree of freedom are close to each other. The completely mediating model also possesses the largest overall model fit index GFI, NFI, CFI and the smallest RMSR (0.998, 0.998, 1.000, 0.007, respectively). Therefore, the completely mediating model has the best-fitted model

Table 6
No. of questions for each construct and its Cronbach's α

Variable	Construct	No. of questions	Cronbach's α
Knowledge inertia	Learning inertia	7	0.755
	Experience inertia	7	0.602
Organizational learning	Commitment to learning	6	0.861
	Shared vision	6	0.882
	Open-mindedness	5	0.823
Organizational innovation	Administrative innovation	9	0.907
	Technical innovation	6	0.870

Table 7
Convergent validity of constructs

Variable	Construct	No. of questions	Estimate (λ)	T-value
Knowledge inertia	Learning inertia	7	0.304–0.444	9.431–13.440
	Experience inertia	7	0.230–0.402	6.187–9.296
Organizational learning	Commitment to learning	6	0.484–0.682	13.332–18.881
	Shared vision	6	0.596–0.754	16.143–22.541
	Open-mindedness	5	0.422–0.727	11.044–21.366
Organizational innovation	Administrative innovation	9	0.524–0.710	15.593–20.660
	Technical innovation	6	0.372–0.661	11.948–21.755

Table 8
Discriminant validity of constructs

Variable	Model	χ^2	df	$\Delta\chi^2$
Knowledge inertia	1. Unconstrained model	299.54	76	–
	2. Learning inertia–experience inertia	373.81	77	74.27**
Organizational learning	1. Unconstrained model	614.408	116	–
	2. Commitment to learning–shared vision	690.655	117	76.247**
	3. Commitment to learning–open-mindedness	641.388	117	26.98**
	4. Shared vision–open-mindedness	620.109	117	5.701**
Organizational innovation	1. Unconstrained model	308.664	89	–
	2. Administrative innovation–technical innovation	348.803	90	40.139**

Note 1: $\Delta\chi^2 = \chi^2$ (unconstrained model)$-\chi^2$ (constrained model).
Note 2: *p*-value <0.05, **p*-value <0.01 level.
Note 3: A–B implies that constructs A and B are set to be completely correlated.

Table 9
Descriptive statistics and correlation matrix of constructs

Constructs	Means	S.D.	1	2	3	4	5	6	7
1. Learning inertia	2.048	0.647	(0.75)						
2. Experience inertia	3.702	0.784	−0.30*	(0.60)					
3. Commitment to learning	3.698	0.817	−0.43*	0.22*	(0.86)				
4. Shared vision	3.586	0.877	−0.35*	0.19*	0.78*	(0.88)			
5. Open-mindedness	3.493	0.874	−0.35*	0.22*	0.78*	0.84*	(0.82)		
6. Administrative innovation	3.536	0.851	−0.30*	0.16*	0.72*	0.78*	0.80*	(0.91)	
7. Technical innovation	3.656	0.781	−0.34*	0.19*	0.72*	0.75*	0.79*	0.85*	(0.87)

Note 1: *p*-value <0.05, N = 485.
Note 2: Numbers in parentheses indicate the Cronbach's α of constructs.
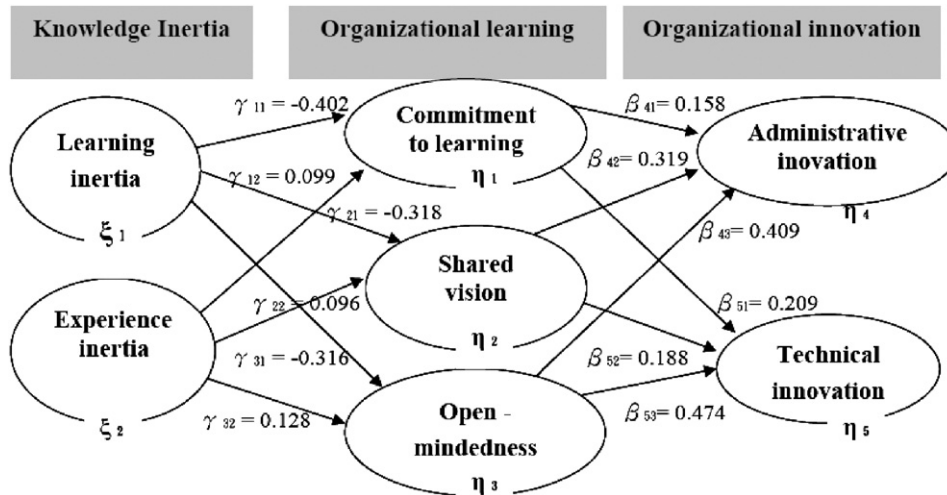
Fig. 2. Path diagram of the completely mediating model.

Table 10
Model comparisons among direct, partially mediating, and completely mediating models

Model	χ^2	$\Delta\chi^2$	df	GFI	NFI	CFI	RMSR
Partially mediating model	170.92	–	1	0.922	0.932	0.932	0.033
Direct model	108.88	62.04**	6	0.945	0.957	0.959	0.174
Completely mediating model	3.545	167.37**	4	0.998	0.999	1.000	0.007

Note 1: *p-value <0.05 ($\Delta\chi^2 = 3.84$), **p-value <0.01 ($\Delta\chi2 = 6.63$).
Note 2: $\Delta\chi^2$ is based on partially mediating model.

compared to the partially mediating model and the direct model. This result indicates that the influence of the knowledge inertia on organizational innovation occurs by way of organizational learning.

The path parameters (γ and β) of the completely mediating model are estimated by the MLE method. The MLEs of the parameters are shown in Table 11. The T-values of these estimates are all significant (>2) under significant level 0.05.

The model estimation results reveal the following relationships among three research variables:

(1) *Relationship between knowledge inertia and organizational learning*: As seen in Table 11, parameter estimates of the hypothesized relationships between learning inertia and the three constructs of organizational learning are negative and significant, indicating negative impact of learning inertia on organizational learning. That is to say, organization members with substantial learning inertia will undermine the organization's commitment to learning, shared vision and open-mindedness. On the other hand, T-values of the hypothesized relationships between experience inertia and the three constructs of organizational learning are positive and significant, indicating positive impact of learning inertia on organizational learning. In other words, organization members with great experience inertia will enhance the performance of the organization on

commitment to learning, shared vision and open-mindedness. According to the above, learning inertia has negative effect on organizational learning while experience inertia has positive influence on organizational learning; hence H1 is partially supported.

(2) *Relationship between organizational learning and organizational innovation*: As seen in Table 11, parameter estimates of the hypothesized relationships between the three constructs of organizational learning and the two constructs of organizational innovation are positive and significant, indicating positive impact of organizational learning on organizational innovation. In other words, higher organizational learning ability will lead to better performance in administrative and technical innovation; hence H3 is supported.

3.4.5. Moderating effect of organization type

In order to further understand whether or not the path parameters will be influenced by the group variable (organization type), Jaccard and Wan's (1996) multi-group method is adopted to test the moderating effect of organization type. The hypothesized model assumes that the path parameters of the three organizations are the same. The alternative model assumes that path parameters of the three organizations are the same with the exception of only one path parameter. If the Chi-square difference

Table 11
MLEs of the path parameters

Paths/hypotheses		Parameter estimate	T-value	Hypothesized relationship	Results
Learning inertia → commitment to learning	(γ_{11})	−0.402*	−9.421	Negative	Supported
Experience inertia → commitment to learning	(γ_{12})	0.099*	2.323	Negative	Not supported
Learning inertia → shared vision	(γ_{21})	−0.318*	−7.166	Negative	Supported
Experience inertia → shared vision	(γ_{22})	0.096*	2.158	Negative	Not supported
Learning inertia → open-mindedness	(γ_{31})	−0.316*	−7.154	Negative	Supported
Experience inertia → open-mindedness	(γ_{32})	0.128*	2.894	Negative	Not supported
Commitment to learning → administrative innovation	(β_{41})	0.158*	3.653	Positive	Supported
Shared vision → administrative innovation	(β_{42})	0.319*	6.436	Positive	Supported
Open-mindedness → administrative innovation	(β_{43})	0.409*	8.221	Positive	Supported
Commitment to learning → technical innovation	(β_{51})	0.209*	4.683	Positive	Supported
Shared vision → technical innovation	(β_{52})	0.188*	3.672	Positive	Supported
Open-mindedness → technical innovation	(β_{53})	0.474*	9.225	Positive	Supported

Note 1: Completely mediating model, $\chi^2 = 3.545$, GFI = 0.998, CFI = 0.999, NFI = 1.000.
Note 2: *T-value > 1.96.

Table 12
Moderating effect of organization type

Paths/hypotheses		Organization type			χ^2	$\Delta\chi^2$
		1 Government organization $n = 150$	2 State-run enterprise $n = 167$	3 Private enterprise $n = 168$		
Learning inertia → commitment to learning	(γ_{11})	−0.384*	−0.356*	0.363*	114.60	0.18
Experience inertia → commitment to learning	(γ_{12})	0.096	0.067	0.138*	113.44	1.34
Learning inertia → shared vision	(γ_{21})	−0.330*	−0.185*	−0.267*	109.96	4.82
Experience inertia → shared vision	(γ_{22})	0.131*	0.126*	0.065	112.93	1.85
Learning inertia → open-mindedness	(γ_{31})	−0.209*	−0.309*	−0.299*	111.15	3.63
Experience inertia → open-mindedness	(γ_{32})	0.090	0.137*	0.163*	113.09	1.69

Note 1: Organization type column: *$|T| > 1.96$.
Note 2: Hypothesized model: $\chi^2 = 114.78$, df = 54.
Note 3: $\Delta\chi^2$ column: *p-value < 0.05 ($\Delta\chi^2 = 5.99$), **p-value < 0.01 ($\Delta\chi^2 = 9.21$).

between the hypothesized model and the alternative model is greater than the critical value $\chi^2_{1-\alpha}(2)$ (5.99 and 9.21 for $\alpha = 0.05$ and 0.01, respectively), this indicates that the moderating effect of the organization type is significant. Also, if the moderating effect does exist, there should be further discussion about the path parameters of the three types of organizations.

As seen in Table 12, organization type does not have any moderating effect on the impact of knowledge inertia on organizational learning. That is to say, regardless of the type of organization, whether government organization, state-run or private enterprises, the effect of knowledge inertia on commitment to learning, shared vision and open-mindedness remain unchanged; hence, H4 is not supported.

4. Implications and contributions

(1) This research has established two constructs of knowledge inertia, namely learning and experience inertia,

which can serve as the basis for future studies. Although the questionnaire was pre-tested and modified, showing good reliability and validity, it may not be applicable to all research domains and there is still a room for improvement. In addition, different industries or businesses could use this measurement tool in order to modify the construct.

(2) Our findings reveal that knowledge inertia exerts a complete mediating effect on organizational innovation through organization learning. Hence, when assessing and formulating measures for promoting organizational innovation, organizations should consider the mediator variable of organizational learning to avoid misjudgment and achieve better performance. Also, these findings can provide a reference to other research investigate whether knowledge inertia could be a research variable in terms of exploring possible relationships on other research issues, such as organization behavior, human resource management, knowledge

management, education/learning, marketing, psychology, cognition, ergonomics, computer science, and technology management. Thus, this research considers that knowledge inertia is an interdisciplinary research topic. Different research theories can broaden our horizon on this research issue.

(3) Our results find evidence that learning inertia is negatively related to organizational learning, implying that knowledge inertia does affect the learning behavior both of individual members and the organization as a whole. While inertia often inhibits learning, experience inertia shows positive impact on organizational learning. To promote organizational learning and organizational innovations, organizations should reduce learning inertia by encouraging members to acquire new ideas and methods. In addition, organizations should help members improve working efficiency through experience inertia. The sharing of accumulated experience can also enhance organizational learning ability and foster better performance in organizational innovation.

(4) Our research findings show that experience inertia is positively related to organizational learning, meaning that members with more experience inertia show higher capability in enhancing organizational learning. From a cognitive or mental point of view, Huff and Huff (2000) argue that resistance to change at the level of individual cognitive processes is the primary source of inertia in organizations. They continue that inertia "results not from any external force but rather from properties inherent to the use of knowledge structures. The very properties that make schema useful sense making structures (i.e. efficiency, expectancy) also stand in the way of change" (p. 46). As a source of development, the changes due to internal and external reasons may enable individual and organizational learning. Therefore, to continue creating, sharing, learning, and storing knowledge may also become the source of organization innovation.

(5) Inertia exists not only in human cognition, but also in behavior. The problem is used to find a solution, and then the pattern of problem solving is used to fix the problem. This research considers that knowledge inertia could either enable or inhibit a knowledge manipulation activity on a specific problem solving or decision-making situation due to requirements relating to the problem domain. For example, knowledge inertia is suitable to some routine works under standard operational procedures and it could be an enabling factor for knowledge management. On the other hand, knowledge inertia is a negative factor to individual's and organizational learning and innovation. Thus, this research considers that knowledge inertia could implement more research on different problem domains in order to better understand its benefits and avoid its possible drawbacks.

(6) A literature review has shown that there have been few studies on the role of organization type as a moderator. Different organization types have different cultures, which may in turn influence organizational learning. Our study finds no evidence of organization type exerting moderating effect on the impact of knowledge inertia on organizational learning. In other words, organization type will not change the relationship between knowledge inertia and organizational learning. Although the hypothesis is not supported by this study, the relationship between organization type and organizational learning merits further exploration.

(7) On the other hand, cultural context is a critical factor not only on knowledge inertia, but also organizational learning, and organization innovation for investigating their relationships. However, the 'contextual' influence of a specific culture is not considered in the paper. Thus, authors might incorporate cultural context factor into the future study.

(8) In summary, when promoting organizational learning, care must be taken to avoid learning inertia, and efforts should be made to encourage acquisition of new knowledge and exploring new ideas and approaches. Sharing of experience and responsibility among members of the organization should be fostered to promote experience inertia in order to create a win-win situation for both the members and the organization.

5. Conclusion

This research examines the relationships between knowledge inertia, organizational learning and organizational innovation and the impact of knowledge inertia on organizational learning and organizational behavior. Our findings reveal that knowledge inertia exerts a complete mediating effect on organizational innovation through organization learning. In addition, this study shows that organization members with substantial learning inertia will undermine the organization's commitment to learning, shared vision and open-mindedness. On the other hand, organization members with great experience inertia will enhance the performance of the organization on commitment to learning, shared vision and open-mindedness. According to the above, learning inertia has negative effect on organizational learning while experience inertia has positive influence on organizational learning. Thus, this paper suggest that when assessing and formulating measures for promoting organizational innovation, organizations should consider the mediator variable of organizational learning to avoid misjudgment and achieve better performance. On the other hand, this study finds no evidence of organization type exerting moderating effect on the impact of knowledge inertia on organizational learning. However, the relationship between organization type and organizational learning could merit further exploration on

this research issue. The contributions of this study lie in offering new directions of exploration and widening the scope of knowledge management and organization studies.

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