

Relationships among organizational culture, knowledge sharing, and innovation capability: a case of the automobile industry in Taiwan

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Abstract The advancement of automobiles (*thereinafter auto*) during these decades has not only made great contributions to the economic development, but also significantly changed people's life. Apparently, the auto industry has entered an innovation race. Among extant literature, organizational culture (OC) has positive impact on innovation capability (INC), whereas little research concerns about how OC influences organization's capabilities through knowledge management (KM) activities, especially for knowledge sharing (KS) taken in a firm. This study aims to explore the effect of OC and KS on INC in the knowledge-intensive auto industry. Questionnaires are given to 6 whole-car manufacturers, 49 parts suppliers, and 7 car dealers in Taiwan. 449 valid questionnaires are returned, and an empirical analysis through structural equation modeling (SEM) is performed. The result shows that KS is the mediating variable of OC and INC, and OC has a significant positive effect on KS.

Keywords Organizational culture · Knowledge sharing · Innovation capability · Structural equation modeling (SEM) · Automobile

Introduction

Undoubtedly the advancement of automobiles (*thereinafter auto*) during these decades has directly influenced society in many ways and radically changed the way people live all over the world (Shatouri et al. 2012). It provides jobs for millions of people, generates billions of dollars in worldwide revenues, and provides the basis for a multitude of related service and support industries. The auto has enabled people to travel and transport goods farther and faster, and has opened wider market areas for business and commerce (Sirajudeen et al. 2012). Therefore, the auto now has become the most popular conveyance in people's daily living, such as shopping, traveling, and working. Importantly, it also shortens the distance between cities, thereby providing people more convenience. Moreover, no matter in a developing country or a developed country, the auto industry represents the level of a country's industrial skill and is often seen as the chief industry which could push forward the development of related industries. "Respect perfect & Pursue excellence" is the belief of the auto industry. From strategic management perspective, an organization today needs to be equipped with responsiveness and adaptability. An organization of good performance mostly results from its responsiveness and adaptability to the environment while a competitive environment requires an organization to pursue more complex dimensions of performance, most notably quality and innovation (Bolwijn and Kumpe 1990). Based on the ESP (i.e., *environment–strategy–performance*) model, Prajogo

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and Sohal (2001, 2006a, b) highlight the vital role of TQM for creating an innovative environment while a successful implementation of TQM depends on the prevailing culture of the organization. Ooi et al. (2012) suggested that implementing TQM practices successfully can build competitive knowledge sharing (*thereinafter* KS) competencies. Capacity for innovation of employees can be considered an invaluable resource to organization. Most importantly, in an organizational culture (*thereinafter* OC) all values, beliefs, and norms guiding the human resources and financial and technological ones are intended to achieve the objectives set (Isac and Tomescu 2013). OC is a main element for promoting an innovative environment. The OC represents the process the way things are done (Joseph and Dai 2009, p. 243).

Apparently, the auto industry has entered an innovation race. Uncertain technological trends, long development cycles, highly capital-intensive product development, saturated markets, and environmental and safety regulations have subjected the sector to major transformations (PRO-SESC 2012). Though under the pressures of the worldwide overcapacity and customer's diverse needs, globalization in the auto industry has seen the widespread diffusion of the adoption of the practice of global vehicle platform, which has been driving product design and auto-parts sourcing (Quadros and Consoni 2009). In addition, the increasing awareness of the 'green auto,' such as *environment protection*, *energy conservation*, and *intelligence*, has led to the 'green auto technology.' Therefore, the strategy of auto industry has globally become both demand-pull and technology-push as a whole. Trice and Beyer (1993) propose that influence of industry comes to the organization first of all through industry ideology which serves as a ground for OC. From strategic management perspective, the nature of strategic management characterizes adaptability and sustained competitive advantage, while adaptability shows an interdependent relationship between industry environment and organization. OC has been defined as a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (Schein 2004, p. 17). To effectively adapt and respond these environmental changes, an organization today with high mutual learning and close interactions among its partners is supposed to be a market-driven, innovative, and learning-oriented (Chang et al. 2008). Among extant researches, most scholars supported that OC is positively related to market orientation (e.g., Deshpande and Farley 2004; Papadimitriou and Kargas 2012) and innovation (e.g., Hassan et al. 2012).

For a long time, top executives of auto industry are always concerned with how to maximize their productions

and/or minimize their costs effectively. However, the rapid changes of information technology, the shortened product lifecycle, and the increased diverse needs of customers have reminded these executives the importance of knowledge management (*thereinafter* KM), thereby beginning to implement KM activities into their organizations thoroughly (*cf.* Yelden and Alber 2004; Jelenic 2011). According to Mason and Pauleen (2003), "sharing" is the single most important factor in KM implementation, while KS enables employees to share their insight and experiences to allow faster and cost-effective project completion (Geraint 1998). Therefore, the employee willingness to both donate and collect knowledge will enable the firm to improve INC (Lin 2007). However, problems with KM and KS often result from lack of applicability of available knowledge (Hidding and Shireen 1998; Raghu and Vinze 2007). OC is believed to be the most significant input to effective KM and organizational learning which determines values, beliefs, and work systems that could encourage or impede learning as well as KS (Leonard 1995; Slater and Narver 1995; Alavi and Leidner 2001; Gold et al. 2001).

The openness of the OC and the organizational learning capability has a significant impact on the enterprise sustainable competitive advantage. Chang et al. (2008) claim that learning organization is the best solution for the knowledge-intensive industry to bridge the gap between organization's capability and OC. While most studies have supported that OC influences KM and, in particular, KS, there is little research on the way how OC influences organization's capabilities (e.g., innovation capability; INC) through KM activities taken in a firm. Especially, the market of Taiwan's auto industry is much smaller than that in other countries/areas, thereby easily hindering its development. Therefore, auto manufacturers need to examine their abundant resources within an organization, utilize professional knowledge and technology sharing, and revitalize OC to enhance the INC, which is holding the key to firm's survival and growth today. That is, the auto industry that characterizes shortened product lifecycle, rapid improvement of high technology, and diverse demands of customers really needs an innovative OC to effectively incubate the KS. Accordingly, the main purpose of this paper is to explore the relationships among OC, KS, and INC, and we conclude with discussions, implications, and conclusions in the following sections.

Literature review

ESCAPE model: a revised model of ESP

Facing such a fast-changing environment, an organization should be more market-driven and learning-oriented. It is

believed that a learning organization is apt to develop and maintain its own competitiveness rather than that without learning ability (Liao et al. 2010). Chang et al. (2008) and Liao et al. (2010) all claimed that a learning organization will be the best solution for knowledge-intensive industry to bridge the gap. Based on the concept of *ESCAPE* model, Chang et al. (2008) proposed that there probably existed a missing linkage in the so-called ESP in which an open/or a positive culture can develop an organization's own capabilities/competences. Some researches (e.g., Senge 1990, 1997; Argyris and Schon 1996; Brown 1999) believe that successful organizations that forge ahead in a rapidly changing business environment will do so through the new knowledge creating and sharing. According to Alasoini et al. (2007), an organization's competitiveness will be even more dependent on its ability to produce innovations in the future. Akhavan et al. (2014) showed that OC has a positive and significant relationship with environmental responsiveness capability, both directly and indirectly through the mediation of KM. Throughout the world, innovation lies at the heart of economic growth and development for countries and firms in advanced as well as developing countries (Kale 2012). For example, innovation is essential to the ability of U.S. automakers and their suppliers to build and sell their products in a highly competitive and global industry, especially at a time of heightened technological uncertainty (Klier & Sand, 2010).

In the research of "*The U.S. automobile manufacturing industry*," Fine et al. 1996, p. 84) claimed that the auto industry will continue as a knowledge-intensive industry, as opposed to just cutting, forming, and joining metal. Consequently, intellectual asset development—in manufacturing, marketing, engineering, etc.—will increase as a key competence for all firms. The auto industry is a typical assembling industry because vast numbers of parts are necessary for production. Liu and Zhao (2006) further declared that auto industry is a technology-intensive and knowledge-intensive industry, because it demands high performance and quality parts. From these statements mentioned above, auto industry is kind of knowledge-intensive industry with no doubt and the best solution to maintain competitiveness is acting as a learning organization.

Senge (1990) defines a learning organization as an organization "*where people continually expand by their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together.*" OC that supports learning and KS supports organizations for such an approach and also helps them obtain performance and enjoy success in their environment (Madge 2012). Learning organization possesses certain characteristics to meet

the ever-changing needs of the environment. A culture of learning organization has direct effects on organizational performance and organizational innovativeness (Hussein et al. 2014). Therefore, OC, KS, and INC are related to learning organization.

Organizational culture (OC)

Barney (1986) has argued that high-performing organizations share many common traits of OC, but each organization benefits from those traits in a different manner. OC is a key component in the achievement of an organization's mission and strategies, the improvement of organizational effectiveness, and the management of change (Adeyoyin 2006). OC is defined in many ways by various authors and researchers. OC is viewed as a set of beliefs, values, and assumptions shared by members of an organization (Schein 1985) or a set of values, beliefs, and behavior patterns that form the core identity of organizations, and help shaping the employees' behavior (Deal and Kennedy 1982). Therefore, OC is expected to have an important bearing on behavior (Cooke and Szumal 2000; Chatman and Barsade 1995; Martin and Siehl 1983; Schein 1985) and enhance the effectiveness/efficiency, competitiveness, and achieving organizational goals as well.

Due to its vague and intangible concept, there are innumerable ways to describe the content of OC (Cooke and Rousseau 1988). Therefore, few writers have attempted to classify or label types of culture (Hood and Koberg 1989). For instance, Wallach (1983) identifies OC as three types, including bureaucratic culture, innovative culture, and supportive culture. Petrock (1990) proposes a typology of four cultural types: (1) clan culture, (2) adhocracy culture, (3) hierarchy culture, and (4) market culture. Quinn and McGrath (1985) classify OC into rational culture, developmental culture, consensual culture, and hierarchical culture. In a word, it seems that there is more than one type of OC in the business world while these different types of OC are defined by these values, assumptions, and interpretations (Jaynes 1976; Mitroff 1983; Neumann 1955, 1970).

Knowledge sharing (KS)

Knowledge is an important resource and serves as a basic source of competitive advantage (Conner and Prahalad 1996; Gold et al. 2001; Grant 1996b; Jaworski and Kohli 1993; Liao et al. 2004; Danskin et al. 2005; Meiami and Meihami 2014). Without knowledge, no organization will survive. A good implementation of KM system can effectively improve the adaptability, creativity, and external competition capabilities within an organization. van den Hooff and van Weenen (2004) and de Vries et al. (2006)

found that KS practices can be separated into two processes: knowledge donating (KD) and knowledge collecting (KC). KS is the process where individuals mutually exchange their explicit or implicit knowledge and jointly create new knowledge (van den Hooff and de Ridder 2004) and can be viewed as an organizational innovation that has the potential to generate new ideas and develop new business opportunities through socialization and learning process of knowledge workers (Lin 2006).

Look to the global trend of auto industry, a manufacturer with cross-country integration capability will not only have its own production locations worldwide but will integrate global R&D resources, will constantly develop the component products required for the new models, and finally will become an important strategic R&D partner among manufactures so as to obtain the competitive market position in the future. Such an integration capability, however, really needs KS to acquire and share the new knowledge within an organization, thereby transforming it into organization's resource.

Innovation capability (INC)

Innovation is also defined as "implementing new ideas that create value" (Linder et al. 2003). Accompanied with rapid environmental changes, the issues on INC have already attracted much attention recently. In fact, all competitors in the market will have the same levels of management capabilities, such as human resource, marketing, and strategies. Therefore, many firms begin to treat innovation as the key to competitive advantage (Harrison and Samaon 2002). Zahra and George (2002) argued that potential absorptive capacity should be more critical in turbulent environments for it provides firms with the strategic flexibility, performance, and innovation. It is no doubt that innovation has become the requisite capability for firm's survival, and the market would eliminate a firm with less INC gradually.

Since Schumpeter (1934) proposed the two concepts of innovation and invention, the term "*innovation*" has received much attention from the academy. Some scholars define INC from product perspective (e.g., Blau and Mckinley 1979; Dougherty and Bowman 1995) and some focus on process perspective (e.g., Drucker 1985; Amabile 1988; Scott and Bruce 1994). Innovation is becoming exceedingly complex; INC therefore should be defined in wide dispersed scopes and levels to accord with the requirements of firm strategy and accommodate to special conditions and competition environment (Guan and Ma 2003). For instance, innovation is divided into four dimensions: production innovation, process innovation, position innovation, and paradigm innovation. Wang and Ahmed (2004) defined innovation as an organization's

overall capability of introducing new product to market, or opening up new markets, through combining strategic orientation with innovative behavior and process. They divided INC into four dimensions, including product innovation (PROD), process innovation (PROC), marketing innovation (MART), and strategic innovation (STRG).

Hypotheses development

OC and KS

Martin (2000) argues that OC holds the key to successful KM. In the last few years, the key role of cultural values is highlighted on the way KM processes are developed and applied in organizations (Donate-Manzanares & Guadamillas-Gómez, 2009). These two concepts are highly related and the existing research suggests in the main that OC underpins KM activities (Gray and Densten 2005). Jarvenpaa and Staples (2003) showed that organizational shared values have an important influence on the willingness of knowledge owners to share knowledge with other organizational members. OC is said to be an important factor to create, share, and use knowledge in that it establishes norms regarding KS (De Long and Fahey 2000) and creates an environment in which individuals are motivated to share their knowledge with others (Cabrera and Cabrera 2002).

Furthermore, evidence suggests that OC has an impact on approaches to KM (Friesl et al. 2011). While an organization creates a learning-encouraged culture, its members will be willing to share their own knowledge and experiences with others easily. OC has presently become a knowledge-sharing culture of customer orientation in contrast to that of product orientation in the past while knowledge-sharing culture requires an organizational environment full of openness and trusts. Based on the sample drawn from 1200 employees working in international tourist hotels in Taiwan, Yang (2007) indicated that there was a strong and positive relationship between a collaborative culture and the effectiveness of KS. Al-Alawi et al. (2007) in their research investigating the role of certain factors in OC in the success of KS find that trust, communication, information systems, rewards, and organization structure are positively related to KS in organizations. Therefore, this study proposes.

H1 OC affects KS positively

KS and INC

American Productivity & Quality Center (APQC) defines KM as the conscious strategy of putting tacit and explicit knowledge into action by creating context, an

infrastructure, and learning cycles that enable people to find and use the collective knowledge of the enterprise (Leavitt 2002). West and Anderson (1996) identified the cross fertilization of information as integral to the creative and innovative process. By means of KS, an organization can benefit from collective knowledge and enhance its adaptability and INC. According to Lee (2001), in a study of the relationship between KS and information system outsourcing, the empirical result indicates that KS is the determinant predictor to outsourcing success as well as is positively related to it as well, while outsourcing actually is seen as one of the innovation activities. Many scholars strongly believe KS is the principal process to INC. For instance, Caloghirou et al. (2004) argue that the firm's internal capabilities and openness towards KS are critical to a firm's innovative performance. Karthikeyan and Muralidharan (2010) suggest that KM is a coordinating mechanism. Empirical evidence supports the view that a firm with a KM capability will use resources more efficiently and so will be more innovative and perform better. The results of Saney et al. (2009) indicate that KS is a key issue to enhance the INC of firms. Hong et al. (2004) point out that KS has a significantly positive impact on new product development. In an empirical study to explore the effects of two forms of KS on innovation, Kamasak and Bulutlar (2010) find that knowledge collecting had a significant effect on all types of innovation and ambidexterity, whereas knowledge donating, involving donating inside and outside the group, did not have any effect on exploratory innovation. Therefore, this study proposes.

H2 KS affects INC positively.

OC and INC

Literature on OC constantly reinforces the notion that OC is necessary for effective functioning and performance of the organizations (Yesil and Kaya 2013). It is generally agreed that OC is a significant influence on the propensity of an organization towards innovation (Tidd et al. 2001). OC has been recognized as a primary determinant within innovation, which is holistic in nature and inseparable from the culture that facilitates or constrains the ability to "add value" (Lemon and Sahota 2004). Kenny and Reedy (2006) emphasize that OC affects the extent to which creative solutions are encouraged, supported, and implemented. OC is considered to be one of the key elements in both enhancing and inhibiting innovation (Valencia et al. 2010). Different kinds of innovation are supposed to require different kinds of OC. Among extent studies related to the exploration on the types of OC, we find that most of them are associated with innovation. For instance, Kotter and Heskett (1992) identified an adaptive learning culture

or a culture that fosters and nurtures innovation as the optimal one for organizations pursuing long-term innovation and performance in dynamic environment. Claver et al. (1998) highlighted the most important conditions for the generation of an OC based on technological innovation. Lau and Ngo (2004) indicate that OC acts as a mediator between a firm's HR system and product innovation. Chang and Lee (2007) pointed out that both innovative culture and supportive culture had significantly positive effect on administrative innovation and technical innovation. Therefore, this study proposes.

H3 OC affects INC positively.

OC, KS, and INC

OC will affect an organization's learning and capabilities, and will guide it to change and innovate (Lynn 1999). Daft (2001) argues that a culture encouraging organization to change, especially under such a rapidly changing environment, is an important characteristic to OL. Hurley and Hult (1998) suggest that higher levels of innovativeness in the firms' culture are associated with a greater capacity for adaptation and innovation. Therefore, a strongly adaptive culture to encourage members within an organization to mutually learn and cooperate is required. OC is considered to be a key element of managing organizational change and renewal (Pettigrew 1990). Hu et al. (2009) find that if firms expect to achieve high-service innovation performance, they first need to develop KS behaviors plus a better team culture. Zheng et al. (2010) suggest that KM fully mediates the impact of OC on organizational effectiveness. Based on the study of Cao and Long (2009), the results support that OC has a positive indirect impact on innovation by affecting KS. Therefore, this study proposes.

H4 The relationship between OC and INC is mediated by KS.

This study explores the relationship among OC, KS, and INC. According to the literature review, the research framework and hypotheses were developed and are depicted in Fig. 1.

Research methodology

Sampling

Using a convenient sampling method, a total of 650 questionnaires were sent to 62 sample companies of Taiwan's auto industry, including 6 motor manufacturers, 49 parts suppliers, and 7 retailers. The information about the sampling companies or industries is as follows. First, the

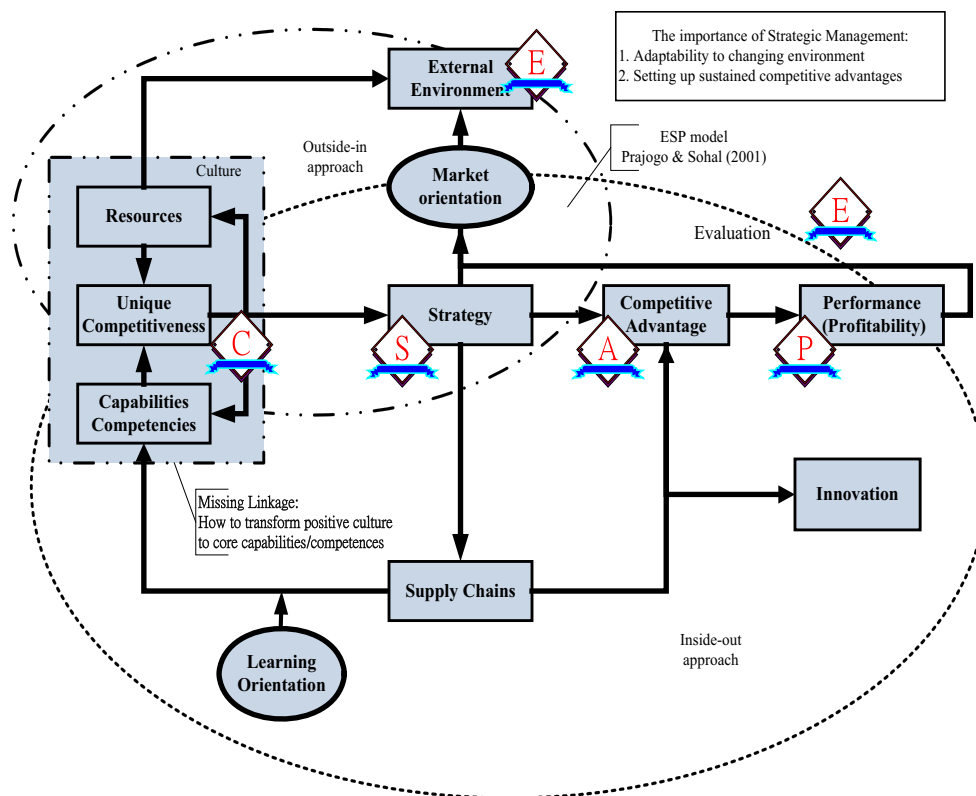


Fig. 1 ESCAPE model

market share of these 6 auto manufactures today, such as Kuozui, China, Ford, Yulon, Haitec, and Sanyang is more than 90%. Second, 49 parts suppliers were scattered across these 6 manufacturers with their different supports. Third, the present distributed channels of these 7 retailers, such as Shung-Ye, Fortune, Hotai, Esine, Hyun-Dai, Luxgen, and Ford Lio Ho, have completely covered this island. 449 valid responses were returned (the valid response rate was 69.07%) and used for the following analysis.

To clearly understand the capacity of innovation in the auto industry, we need to expand our research scope from an individual company to chain members. Besides, manufacturers, parts of suppliers, and retailers were often seen as the up/mid/downstream companies, respectively. Therefore, we used a convenient sampling method for the sample studied. All the questionnaires answered by the respondents from a company were rightly given a specific code number for distinguishing them from those from other companies (See Appendix 1, 2, 3). According to the analysis of sample structure, we found that (1) the ratio of the manufacturing sector to the service sector is 7.3; (2) the founded year of Taiwan's auto industry is mostly more than 40 years, meaning that the auto industry has an early start in this island; (3) approximately 71% of auto industry has capital amount less than 100 million dollars; (4) about 60% of the total has number of the employees not more

than 500, meaning that the great contribution to Taiwan's auto industry majorly comes from these medium-small enterprises (MSEs); (5) our respondents mostly come from department of marketing/business/service (33.2%); (6) 31.4% of the respondents come from the basic level; (7) the average tenure of the sample is more than 8 years while 40% of the total is over 10 years, meaning that the manpower structure of Taiwan's auto industry seems to be aging gradually. All the values of the sample structure analysis are shown in Table 1.

Operational definitions and measurement

A five-point Likert scale (1 = totally disagree, 5 = totally agree) was used to measure the constructs.

- (1) OC is the shared understanding or values of an organization's employees, which in turn will determine how things work in the organization (Wallach 1983). Based on Wallach's (1983) concept, we modified the measurement of OC with nine items, comprising innovative culture (IOC) and collaborative culture (COC) and the former refers to the culture that can encourage INC and strengthen organization's competences to completely adapt to environmental changes while the latter refers to the

Table 1 The analysis of sample structure

profile	Item	Supplier		Manufacturer		Retailer		Total	
		No.	%	No.	%	No.	%	No.	%
		313	69.7	81	18.0	55	12.2	449	100
Founded years	1–10 years	0	0	15	18.5	10	18.2	25	5.6
	11–20 years	20	6.4	0	0	0	0	20	4.5
	21–30 years	73	23.3	15	18.5	0	0	88	19.6
	31–40 years	104	33.2	26	32.1	11	20.0	141	31.4
	40 years+	116	37.1	25	30.9	34	61.8	175	39.0
Capital (NT\$ million)	100–1000	277	88.5	11	13.6	32	58.2	320	71.3
	1100–3000	9	2.9	0	0	0	0	9	2.0
	3100–5000	15	4.8	15	18.5	8	14.5	38	8.5
	5100–10,000	11	3.5	26	32.1	15	27.3	52	11.6
	10,000+	1	0.3	29	35.8	0	0	30	6.7
No. of employees	1–500	249	79.6	0	0	16	29.1	265	59.0
	501–1000	37	11.8	15	18.5	20	36.4	72	16.0
	1001–1500	7	2.2	25	30.9	5	9.1	37	8.2
	1501–2000	11	3.5	26	32.1	6	10.9	43	9.6
	2000+	9	2.9	15	18.5	8	14.5	32	7.1
Department	Marketing & sales	89	28.4	15	18.5	45	81.8	149	33.2
	R&D	56	17.9	22	27.2	0	0	78	17.4
	Purchase & quality control	68	21.7	21	25.9	0	0	89	19.8
	Production	46	14.7	11	13.6	0	0	57	12.7
	Administration	54	17.3	12	14.8	10	18.2	76	16.9
Position	General staff	105	33.5	13	16.0	23	41.8	141	31.4
	Engineers	90	28.8	30	37.0	9	16.4	129	28.7
	Basic level manager	74	23.6	12	14.8	15	27.3	101	22.5
	Mid-level manager	34	10.9	21	25.9	8	14.5	63	14.0
	High-level manager	10	3.2	5	6.2	0	0	15	3.3
Tenure	1–3 years	62	19.8	17	21.0	16	29.1	95	21.2
	4–6 years	71	22.7	18	22.2	4	7.3	93	20.7
	7–10 years	64	20.4	11	13.6	7	12.7	82	18.3
	11–15 years	50	16.0	11	13.6	12	21.8	73	16.3
	15 years+	66	21.1	24	29.6	16	29.1	106	23.6

culture that emphasizes the achievement of organizational performance is required by close team collaboration within an organization.

- (2) In the knowledge-based view of the firm, knowledge is considered to be the most strategically important resource (Conner and Prahalad 1996; Grant 1996a; Nahapiet and Ghoshal 1998; Pettigrew and Whipp 1993; Liao et al. 2004). KS is perceived as one of the indicators of social capital accumulation in organizations because knowledge possessed by one member of an organization can be shared easily and efficiently under the condition by which sufficient social capital resides (Collins and Hitt 2006). In this study, we adopted the concept of van den Hooff and

van Weenen (2004) and classified KS into two dimensions (i.e., KD and KC) with ten items. The former is the one to communicate with others what one's personal intellectual capital is, and the latter is the one to consult colleagues in order to get them to share their intellectual capital (van den Hooff and van Weenen 2004).

- (3) As to INC, this study adopted the concept of Wang and Ahmed (2004) which defined an organization's overall capability of introducing new product to market, or opening up new markets, through combining strategic orientation with innovative behavior and process. They divided INC into four dimensions (i.e., PROD, PROC, MART, and STRG) with 19 items.

Data analysis and results

Reliability and validity

According to the Cronbach's α value of each dimension in this study, we find that all the dimensions are of high reliability, except cooperative culture (Cronbach's $\alpha = 0.67$) and the reliability of constructs is ranging from 0.81 to 0.86, meaning the internal consistency of each variable/dimension in this study is acceptable (See Table 2). As to the confirmatory factor analysis, we found that the value of the *Goodness-of-Fit* (i.e., CFA, NNFI, SRMR, and RMSEA) among the OC, KS, and INC is acceptable (see Table 3). Based on Bollen (2003) and Churchill Jr. (1979), this study further verifies the convergent and discriminate validity of our constructs to ensure the construct validity. The results indicate that all the factor loadings in the measurement model are significant at a 0.01 level (the t-value of dimension is ranging from 11.3 to 20.15), meaning the convergent validity of each construct is acceptable. Besides, the range of χ^2 differences ($\Delta\chi^2$), according to Anderson and Gerbing (1988), is from 20.81 to 368.92. This result means that the discriminant validity of each construct in this study is acceptable.

Table 2 Reliability analysis

Construct	Dimension	Items	Cronbach's α	
			Dimension	Construct
Exogenous variable				
OC	IOC	6	0.84	0.81
	COC	3	0.67	
Endogenous variable				
KS	KD	5	0.78	0.85
	KC	5	0.79	
Endogenous variable				
INC	PROD	6	0.88	0.86
	PROC	4	0.79	
	MART	3	0.80	
	STRG	2	0.81	

Table 3 The CFA analysis

	OC	KS		INC	
	The initial/final	The initial	The final (cut 3 items)	The initial	The final (cut 4 items)
GFI	0.95	0.95	0.99	0.86	0.88
AGFI	0.91	0.92	0.97	0.82	0.83
SRMR	0.041	0.042	0.02	0.055	0.056
RMSEA	0.087	0.077	0.037	0.076	0.088
NNFI	0.96	0.97	0.99	0.96	0.95
CFI	0.97	0.98	1.00	0.97	0.96

Correlation analysis

Table 4 shows the means, standard deviations of variables, and their correlations. The results indicate that all the correlations between factors are significant. As can be seen, the relationships between research variables are as follows:

- (1) OC is positively related to KS, meaning that a higher level of OC within an organization will enhance individuals' intention to share knowledge.
- (2) KS is positively related to INC, meaning that an organization with great KS behaviors exhibits higher INC.
- (3) OC is positively related to INC, meaning that an organization with a higher level of OC is apt to improve the organizational innovation.

However, the value of correlation only reveals the degree of relationship between two constructs. To facilitate a good understanding of indirect/direct and mediated effects, this study therefore uses structural equation modeling (SEM) to validate the effects among the constructs.

Structural model

As shown in Fig. 2, the results of structural model analysis indicate an adequate fit, such as GFI = 0.88, NNFI = 0.95,

and CFI = 0.96. Besides, the path coefficient (γ_{11}) from OC-KS is 0.89 (t-value = 17.83, $P < 0.001$), meaning H1 is supported and the path coefficient (γ_{21}) from OC-INC is 0.78 (t value = 5.24, $P < 0.001$), meaning H3 is supported. However, the relationship between KS and INC is not significant and positive as expected ($\beta_{21} = -0.01$, t value = -0.08 , $P > 0.05$), meaning H2 is not supported.

Competitive model analysis

Since OC is categorized into IOC and COC, we would therefore take these two types of OC into account for examining which one is the optimal model in our study. The values of Table 5 indicate that the GFI of COC (0.95) is better than that of IOC, while the SRMR (0.046)

and RMSEA (0.087) of COC are each lower than that of IOC. From this, we conclude that COC is the optimal representative of OC. This finding is consistent with the concept of Awan et al. (2013) which highlights COC as a source of managing innovation. Considering the model of COC (Fig. 3) in contrast to our initial structural model (Fig. 3), we find that the path coefficient from COC-KS and COC-INC is 0.87 (t-value = 15.65, $P < 0.001$) and 0.43 (t-value = 2.85, $P < 0.001$), respectively, meaning COC would significantly and positively impacts KS and INC both. On the other hand, the path coefficient from KS-INC is 0.3 (t-value = 2.03, $P < 0.01$) and the significant value which is consistent with previous studies, means H2 is supported in COC model in which H4 is also supported.

Table 4 Correlation analysis

Dimensions	μ	σ	1	2	3	4	5	6	7	8
IOC (1)	3.801	0.563	1							
COC (2)	3.784	0.542	0.687**	1						
KD (3)	3.827	0.626	0.669**	0.586**	1					
KC (4)	3.864	0.542	0.661**	0.642**	0.746**	1				
PROD (5)	3.503	0.642	0.568**	0.459**	0.464**	0.417**	1			
PROC (6)	3.752	0.556	0.655**	0.539**	0.563**	0.586**	0.630**	1		
MART (7)	3.601	0.640	0.550**	0.451**	0.502**	0.452**	0.776**	0.638**	1	
STRG (8)	3.500	0.747	0.506**	0.433**	0.488**	0.439**	0.553**	0.519**	0.605**	1

** $P < 0.05$

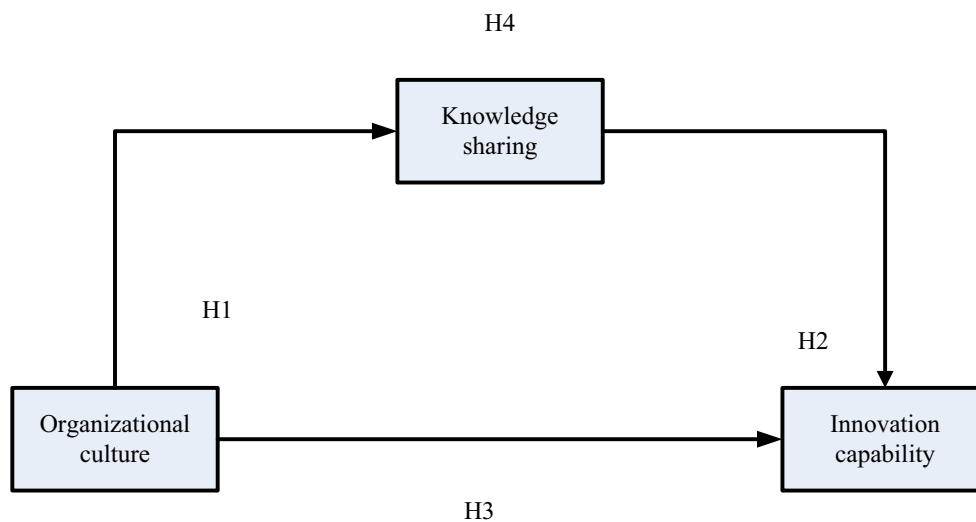
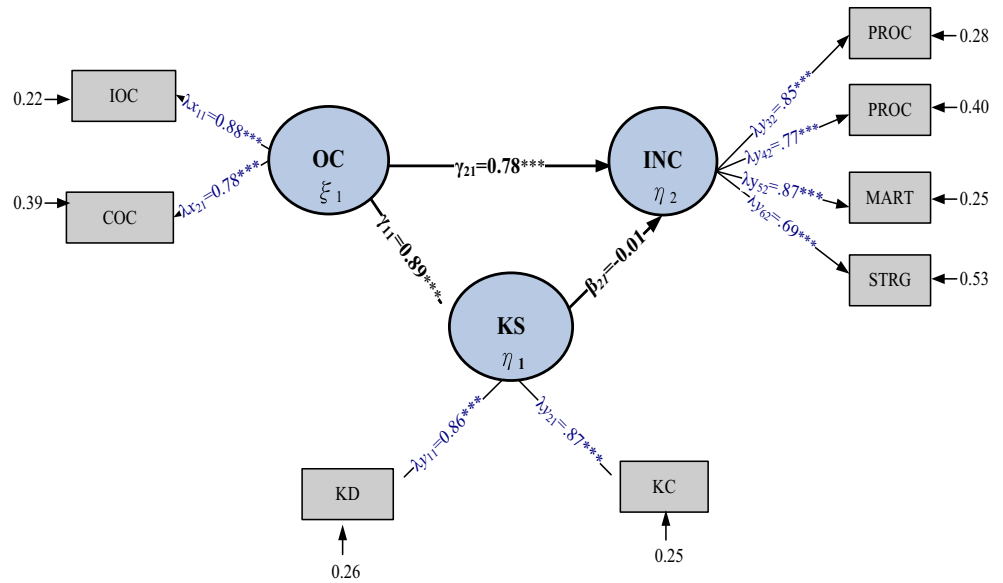


Fig. 2 Research framework

Table 5 The fit indexes of competitive model analysis

Model	Index						
	GFI	NNFI	CFI	SRMR	RMSEA	χ^2 (df)	Normed χ^2
IOC	0.90	0.96	0.97	0.058	0.11	303.33(51)	5.95
COC	0.95	0.97	0.98	0.046	0.087	105.78(24)	4.41

Fig. 3 Structural model (initial model)



Chi-Square=282.02, df=59, P-value=0.00000, RMSEA=0.092

To empirically validate whether KS plays a role of mediator in our model, we use SEM to explore the relationships among OC, KS, and INC. In this study, OC is an antecedent, KS is a mediator, and INC is an outcome. However, researchers need to propose different competitive models and make comparisons among them so as to get a rigorously mediated result (Hair et al. 1995). Therefore, competitive model analysis is expected. Model I (partial mediated model) explores the relationships among OC, KS, and INC; model II (complete mediated model) examines the direct relationships among OC, KS, and INC; model III (direct model) solely examines the direct influence of OC and KS on INC (See Table 6). From this table, we find that the difference of value of Chi-square between model II and model III/I is significant ($\Delta\chi^2 = 6.63, P < 0.01$), indicating the optimal model is model II (Fig. 4).

Discussions

This paper aims to explore the relationship among OC, KS, and INC in Taiwanese auto industry. Empirical findings of this study indicate that KS plays as a mediator in OC-INC

relationship, while OC has significant influence on INC. From the empirical finding of this study, we find that OC has significant impact on INC. This is consistent with most of extant studies (e.g., Valencia et al. 2010; Yesil and Kaya 2012, 2013; Hassan et al. 2012), meaning that OC, a certain norm of behavior, is a set of shared values and beliefs within an organization that will affect members' behavior and the implementation of change. Besides, our study indicates that OC has positive impact on KS. This outcome strongly supports the view of Hendriks (2004) and Al-Alawi et al. (2007), meaning that OC providing a system of behavioral patterns can influence the appreciation of processes such as KS, development, or retention. Finally, KS in this study positively influences INC. This finding is consistent with Lin (2007), Saney et al. (2009), and Hong et al. (2004), meaning that employee willingness to both donate and collect knowledge enables the firm to improve INC.

Knowledge-intensive industry characterizes large knowledge input, short product life cycles, high demand for customized products, and great quantities of production value (Liao et al. 2007). To some degrees, auto industry is both knowledge-intensive industry and labor-intensive

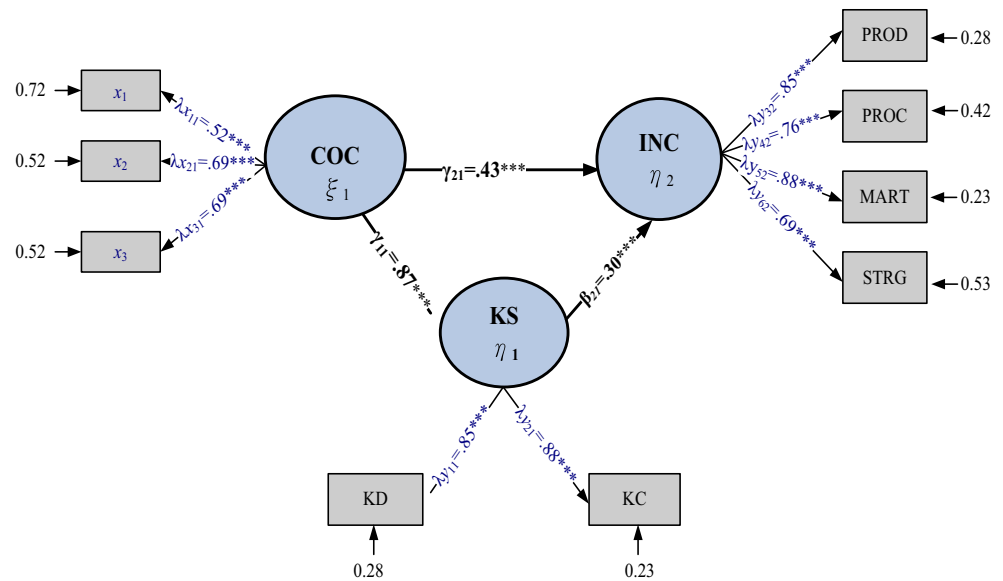
Table 6 Competitive model analysis

Model	Index									
	χ^2 (df)	$\Delta\chi^2$	GFI	AGFI	SRMR	RMSEA	NFI	NNFI	CFI	Normed χ^2
Model I	102.67 (24)	–	0.95	0.91	0.046	0.086	0.97	0.97	0.98	4.28*
Model II	109.3 (25)	6.63	0.95	0.91	0.051	0.087	0.97	0.97	0.98	4.37*
Model III	102.67 (24)	0	0.95	0.91	0.046	0.086	0.97	0.97	0.98	4.28*

$\Delta\chi^2$ = The difference between the χ^2 value of hypothetical model and that of other model

The symbol “*” means the value of $\Delta\chi^2 > 3.84$ ($\Delta df = 1$), $\Delta\chi^2 > 5.99$ ($\Delta df = 2$), or $\Delta\chi^2 > 7.81$ ($\Delta df = 3$) is significant at $\alpha = 0.05$

Fig. 4 Structural model (COC)



Chi-Square=102.67, df=24, P-value=0.00000, RMSEA=0.086

industry. Undoubtedly, the increasing growth of mobile communication technologies has made the needs of consumers today no longer limited to the traditional requirements, such as speed and safety, interior decorations, and exterior appearance. Therefore, each auto company in the market should prepare itself to be a market-driven and a learning-oriented organization to keep pace with diversity of customer's needs. To explore the relationship among culture, capability, and performance, we introduce the ESCAPE model proposed by Chang et al. (2008) from strategic management perspective. In their research, they suggested that there probably existed a missing linkage in so-called 'ESP' chain, especially the gap between the *culture* and the *capability* (C2C). Importantly, ESCAPE highlights the learning organization will be the best solution for knowledge-intensive industry to bridge the gap.

Why learning organization is the best solution to bridge the gap between culture and capability? Based on the concept of McGill and Slocum (1994), OC can be distinguished into four types, such as the knowing culture, the thinking culture, the understanding culture, and the learning culture. It is apparent that OC is a culture equipped with knowledge-based and learning-oriented. In addition, Jo and Joo (2011) claimed that learning organization culture was significantly associated with KS intention. Suveatwatanakul (2013) strongly supported that KS has been identified as a key aspect in developing the learning organization. Therefore, this study refers KS to a continuous process creating an open/positive culture to developing its own capabilities/competences. On the other hand, a culture encouraging

change is a critical feature of organizational learning (Chang et al. 2008). Culture is alleged to have influence on the knowledge-related behaviors of individuals, teams, units, and also organizations as a whole because it influences the purpose of workers in terms of identifying which knowledge is appropriate to be shared, whom to share it with, and when is the right time to share it (King 2007). An organization can be viewed as a learning entity while it is made up of individuals. Individuals must learn first before organizational learning can occur. Without a learning organization, there can be no continuous improvement (Chang and Sun 2007).

Organizations are seen as learning through processes that create new knowledge or modify existing knowledge (Phang et al. 2008). Researchers and managers have realized that organizations good at learning will range ahead of the competition (Abell and Oxbrow 2002). Law and Ngai (2008) further suggest that managers should encourage KM and organizational learning activities within their firms, and give proper considerations to the strategies and implementation of programs supporting these activities to enhance firm performance. In addition, OL will enhance organization's capability (e.g., INC) in the future (Argyris & Schon, 1978) and this may be the only source of sustained competitive advantage (Stata 1989). Therefore, a firm's learning capabilities play a crucial role in generating innovation (Sinkula et al. 1997). As a whole, OC and KS can refer to the input/catalyst in LO while INC can refer to one of the output/performance of learning organization.

Theoretical contributions

This paper has three contributions. First, we make attempts to put OC, KS, and INC into a research framework and further empirically explore their interrelationships. Although most of extant literature (e.g., Hu et al. 2009; Huang et al. 2011) have supported that KS may act mediating role in the relationship between OC and INC, we find in this paper that KS only has its significant influence while OC is COC rather than IOC. Second, empirical analysis shows that OC in Taiwanese automobile companies has a significant impact on INC regardless of COC or IOC. This result is consistent with Bates and Khasawneh (2005), Valencia et al. (2010), Naranjo-Valencia et al. (2011), and Chang and Lee (2007). Naranjo-Valencia et al. (2011) claim that OC is a clear determinant of innovation strategy. Valencia et al. (2010) suggest that OC is considered to be one of the key elements in both enhancing and inhibiting innovation. Such an inference would keep those executives of motor companies bear in mind that a solid OC is conducive to INC. Finally, this paper would like to lay an emphasis on KS for its success within members would eventually lead to an excellent innovation performance in spite of that KS here has an indirect influence on INC.

Practical implications

Based on the research framework and empirical analyses, this study facilitates a better understanding of the causal relationships among OC, KS, and INC. This study thus has value as a reference for the auto industry in Taiwan for their establishment of OC, implementation of KS, and enhancement of INC. This study presents several managerial implications as follows:

Rethink and adjustment of OC

OC, a certain norm of behavior, is a set of shared values and beliefs within an organization and is shaped by the interactions between its members. Its existence within an organization will directly or indirectly affect members' behavior and the implementation of change (Liao et al. 2012). In this study, we find that KS has mediating effects on the relationship between COC and INC, meaning that the traditional innovative thinking existing within automobile manufacturers presently needs complete rethink and adjustment. Accompanied with the increasing market competition, every Taiwanese vehicle manufacturer devotes itself to R&D, product design, and process re-engineering to improve organizational effectiveness and

efficiencies to achieve organizational goal. Unfortunately, such efforts cannot afford to high cost pressure and meager profit worldwide and quickly force these manufacturers to focus on their parts suppliers to maintain good partnerships for pursuing maximum profit. On the other hand, today's parts suppliers are no longer in assembly production roles, but in R&D characters and system integrators, thereby becoming the most powerful recently among supply chain members. Therefore, it is apparent that the role transformation would inevitably impact their existent business strategies and the formation of OC in the future. The firm's ability in collaborating with its upstream and downstream partners determines its success in attaining better performance with supply chain collaboration (Kumar and Bharathi 2011). Human and Naude (2009) suggest higher levels of performance are possible for firms to achieve an increased integration of innovation and relationship orientation. According to Bates and Khasawneh (2005) and Chang and Lee (2007), suggesting that the type of OC an organization adopts will influence the organizational innovation, executives of motor companies have to take IOC (i.e., entrepreneurship) or other (e.g., supportive culture) into account in spite of that COC is better than IOC for KS to directly impact INC. That is, the relationship between COC and IOC should be compatible, instead of exclusive.

Strengthen R&D capability

As a matter of fact, KM activities (KS and knowledge transfer) have been proven as influence factors impacting the operations between new product development (NPD) teams (e.g., Frank et al. 2015; Frank and Ribeiro 2014). Nowadays, Taiwanese auto manufacturers have already entered the stage of strategic partners through licensing production from long-term cooperation with their technology manufacturer of original brand. To effectively enhance the overall value of global auto manufacturing system, Taiwanese manufacturer needs to devote itself to the enhancement of R&D, marketing innovation, and distribution channels management to improve its own corporate value. Employee willingness to both donate and collect knowledge enables the firm to improve INC (Lin 2007). According to Spencer (2003), firms designed strategies to share technological knowledge with competitors, and those firms that shared knowledge with their innovation system earned higher innovative performance than firms that did not share knowledge. In general, the advantage of product innovation for a firm can be maintained until its rivals have completely imitated (Koellinger 2008). In general, Taiwan's vehicle manufacturer is no more an OEM firm for its high quality of collaborative product design and

development. With such sound foundation, managers of motor companies, therefore, have to build up an optimal OC and adopt proper human resource practices to offer useful incentives to encourage KS among employees, thereby improving INC.

Utilize marketing innovation in the emergent market

While marketing refers to a capability of an organization to communicate with its external/internal customer, we can reasonably infer that the external/internal needs of customers may induce INC (Liao and Chang 2010). Innovation and marketing are both associated with organizational performance as well as competitive advantages. Marketing innovation capabilities could help market-oriented SMEs to develop and sustain competitive advantages, including differentiation and cost leadership strategies (Naidoo 2010). Weerawardena (2003) suggests that marketing capabilities would influence both the innovation intensity and sustained competitive advantage of the firm. Halpern (2010) further points out that innovation has a significant positive effect on airport marketing performance, irrespective of the strategic focus of the airport. Basically, multiple-brand marketing and niche-market management are the strength of Taiwanese automobile distribution channels, while their salesman training program is also better than other Asian countries so far. Focusing on global emerging market, Taiwanese vehicle manufacturers should more aggressively utilize their own competitive advantages (i.e., marketing and innovation) to quickly expand the Asian market boundaries (e.g., China). Therefore, this result can be used as a benchmark for development of other industries in Taiwan.

Future works

This paper aimed to verify the impact of KS on the relationship between OC and INC in Taiwan's auto industry. Therefore, the future works would focus on those factors that have been empirically found to affect OC and KS, thereby impacting INC.

Certain factors of OC in the success of KS

Al-Alawi et al. (2007) found that trust, communication, information systems, rewards, and organization structure are positively related to KS in organizations. Another study indicated that trust and communication between staff and leadership have a positive and significant relationship with KS (Islam et al. 2011). Senior management

attitude is the key component of KM performance (Basu and Sengupta 2007), and top management support is leveraging KM as a tool for innovation (Kamath et al. 2011). On the other hand, transformational leadership and LMX may promote relational and organizational identification, thereby facilitating KS among employees (Carmeli et al. 2011). Oke et al. (2009) argue that different leadership styles are appropriate for distinct stages of the innovation process (creativity and implementation) as well as different innovation activities (exploratory and exploitative activities). Therefore, the effect of leadership and top management support on this measurement model is necessary.

Market orientation and collaboration

Facing today's ever-changing business environment, any organization needs long-term collaborative relationships with suppliers and channel members to exploit profitable new marketing opportunities (Liao et al. 2011). As firms can manifest their market orientation via the success of new innovation (Mavondo et al. 2005). Market orientation appears to be an aspect of OC (Oplatka and Hemsley-Brown 2007) and should work together with learning organization to generate competitive advantage, or could result in critical gaps in capabilities (Celuch et al. 2002). Hyvonen and Tuominen (2007) demonstrate the importance of channel collaboration and market orientation in contributing to a firm's competitive superiority. Therefore, the effect of market orientation and collaboration on this measurement model is required.

Employee's behavioral factors

Issa and Haddad (2008) claim that proper OC will enhance mutual trust in the organization. Ling (2011) finds that both culture and trust acts as elements that needs to co-exist in facilitating KS. Thus, to create a culture that shares, it is therefore essential to enhance trustworthiness among employees, making it as a part of the social norm that is being practiced on a daily basis (Tan et al. 2009). Besides, Jo and Joo (2011) argue that organizational citizenship behavior (OCB) turned out to fully mediate the relationship between organizational commitment and KS intention. Making an example of Taiwanese semiconductor industry, Chang et al. (2015) find that KS has a partial mediating effect on the organizational commitment-OCB relationship. Several quantitative reviews also have documented the negative relationships that role stressors have with task performance (Eatough et al. 2011). Therefore, the exploration of the role of employee's behavior in this measurement model is expected.

Human resource management

Liu and Liu (2011) find that human resource practices, incentive compensation plans, performance appraisal systems, and face-to-face communication foster KS. Chen and Cheng (2012) propose that internal marketing and organizational commitment influence KS attitudes and perceived behavioral control. In addition, a study of de Winne and Sels (2010) shows that both human capital and human resource management (HRM) are important determinants of innovation in start-ups. Shipton et al. (2005) provided evidence that combining training, appraisal, and induction influences different stages of the organizational learning cycle (i.e., creation, sharing, and implementation of knowledge). Therefore, an intensive research on the role of HRM in this measurement model is needed.

Level of OC

Among extant literature, OC can be identified into country level, industry level, and organizational level. In this paper, the level of OC we defined was organizational level while the auto industry was only the sampling target. To avoid misunderstandings of OC to happen in next research, a specific definition of OC level is necessary.

Challenges of emerging technology

To researchers and practitioners of great interests in the relative issues of the auto industry, some relevant challenges for the auto industry that comes with the

development of new emerging technologies, for example, 3D printing (3D printed cars) and robotics (autonomous cars), are expected. It is an important trend as we can see in the auto industry many ICT innovation and ICT companies that are not considered as direct competitors, bringing additional stress and new requirements for KS/ICT for auto companies.

Conclusions

The advancement of the auto during these decades has not only made great contributions to the economic development, but also significantly changed people's life. Apparently, the auto industry has entered an innovation race. Among extant literature, OC has positive impact on INC, whereas little research concerns about how OC influences organization's capabilities (e.g., INC) through KM activities, especially for KS taken in a firm. This paper is to explore the relationship among OC, KS, and INC. Collecting 449 valid questionnaires from 6 whole-car manufacturers, 49 parts suppliers, and 7 car dealers in Taiwan and the empirical result shows that KS is the mediator in OC–INC relationship while OC has a significant positive effect on KS.

Appendix 1

See Table 7.

Table 7 Proposal of sampling—auto manufacturing

No.	Questionnaire ID	Questionnaire returned	Questionnaire deleted	Valid questionnaire
1	M1–M15	15		15
2	M16–M30	15		15
3	M31–M45	15	M38	14
4	M46–M60	15	M52/56/59/60	11
5	M61–M75	15		15/0
6	M76–M90	15	M78/81/87/90	11

Appendix 2

See Table 8.

Table 8 Proposal of sampling—parts of suppliers

No.	Questionnaire ID	Questionnaire returned	Questionnaire deleted	Valid questionnaire
1	S91–S100	10	S91/95/96/100	6
2	S101–S110	10	S108	9
3	S111–S120	10	S117	9
4	S121–S128	8		8
5	S129–S137	9	S134	8
6	S138–S145	8	S143–S144	6
7	S146–S155	10		10
8	S156–S164	9	S156/158/160/164	5
9	S165–S174	10		10
10	S175–S184	10	S184	9
11	S185–S194	10	S188–S191	6
12	S195–S204	10	S197/204	8
13	S205–S214	10		10
14	S215–S224	10	S215–224	0
15	S225–S234	10		10
16	S235–S244	10	S239/240/241/243	6
17	S245–S254	10	S253	9
18	S255–S261	7	S256/257/259	4
19	S262–S271	10		10
20	S272–S281	10	S278/281	8
21	S282–S291	10	S282/286/289/291	6
22	S292–S301	10	S295/297/300	7
23	S302–S309	8	S304	7
24	S310–S319	10	S311 ~ S312	8
25	S320–S329	10	S324 ~ S325	8
26	S330–S339	10	S330/331/333/334/336/337	4
27	S340–S349	10	S340/342/343	7
28	S350–S359	10	S353/354/357/359	6
29	S360–369	10	S368/369	8
30	S370–S379	10		10
31	S380–S389	10		10
32	S390–S399	10		10
33	S400–S409	10		10
34	S410–S419	10		10
35	S420–S429	10		10
36	S430–S439	10		10
37	S440–S444	10	S440	9
38	S445–S446	2		2
39	S447	1	S447	0
40	S448–S449	2	S449	1
41	S450–S453	4		4
42	S454–S456	3		3
43	S457	1		1
44	S458–S460	3	S460	2
45	S461–S463	2		2

Table 8 continued

No.	Questionnaire ID	Questionnaire returned	Questionnaire deleted	Valid questionnaire
46	S464–S465	2		2
47	S466	1		1
48	S467	1		1
49	S468–S469	2	S469	1

Appendix 3

See Table 9.

Table 9 Proposal of sampling—retailers

No.	Questionnaire ID	Questionnaire returned	Questionnaire deleted	Valid questionnaire
1	R470–R479	10	R470	9
2	R480–R486	7	R484	6
3	R487–R494	8		8
4	R495–R504	10		10
5	R505–R514	10	R505/508/511	7
6	R515–R524	10		10
7	R525–R529	5		5

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