

RESEARCH BRIEF

Thai Research and Development Organization Performance: A Structural Equation Model Analysis of Organizational Culture and Learning Organizations

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Given the rapid changes in the global economy, every country must increase its competitiveness and seek a first-mover advantage to maximize its own resources (Nakata & Sivakumar, 1997). Executives from nearly every kind of firm maintain, almost without exception, that early entry into a new industry or product category gives any organization an almost insuperable head start (Suarez & Lanzolla, 2005). However, realizing the potential of new technologies requires major economic and social transformations, which entails the overthrow of old patterns, of entrenched expectations, and accepted “common sense” notions—not to mention established management theories and hardened political realities (Organisation for Economic Co-operation and Development, 1999).

At the core of change is research and development (R&D), with the evidence generated by R&D projects a critical influence on policy formulation, funding, and implementation (Hermansyah, Sainsbury, & Krass, 2017). Many countries, therefore, rely on R&D processes, and they have identified R&D as a key factor in their long-term stability and sustainable growth (Hlaváček & Siviček, 2017).

In Thailand, the National Economic and Social Development Plan (NESDP) serves as the roadmap for economic development with the 12th Plan (2017–2021) aiming to transform, upgrade, and increase the R&D focus of 10 key domestic industries, including automotive, agriculture, food manufacturing, tourism, and hospitality (Kraisuth & Panjakajornsak, 2017; Kumpa, 2016; Tan & Tang, 2016)

These formal ideas have been re-packaged and re-labeled “Thailand 4.0,” which has become the mantra for a new digital economy, based on innovative R&D (Jones & Pimdee, 2017). Under Thailand 4.0, the reward potential is huge if hurdles are overcome and programs executed properly, as retail e-commerce alone in 2022 is estimated to represent 2.1 trillion baht (US\$64 billion), or three times higher than 2016, thanks to the popularity of social commerce, intense competition, and the availability of wireless technology and smartphones (Leesa-nguansuk, 2017b; Pumim, Srinuan, & Panjakajornsak, 2017).

However, challenges are everywhere as Thailand ranked 40th out of 60 in the global Digital Evolution Index 2017 (Leesa-nguansuk, 2017a), and was placed on the Watch Out list, which indicates a country is

constrained by low levels of digital advancement and slow growth. In Thailand's case, this rank was due to low levels of digitization, slow momentum in terms of filling infrastructural gaps, institutional constraints, and low sophistication of consumer demand.

This is consistent with the IMD World Digital Competitiveness Ranking ("New competitive global elite," 2017) in which it was also stated that there is a relation between the lack of talent and training with a lack of business agility, with education and knowledge production being the key at unlocking the door to success (Reeve, 2016). On this list, Thailand also ranked near the bottom with a score of 41 out of 63 countries (Singapore ranked #1). Stated another way, World Bank research has stated that leading countries in innovation and IT had up to 8,000 highly qualified people working in R&D per million of the population, whereas the current ratio in Thailand is 1,000 per million (Lathapipat & Sondergaard, 2015).

One recent bright star, however, came from the Global Innovation Index 2017 in which Thailand's strengths included creative goods exports and gross domestic expenditure on R&D (GERD) financed by business, where it placed fifth and sixth globally (Dahad, 2017; Organisation for Economic Co-operation and Development, 2017). A shining star of such a program is the US\$3 billion Thai community-based enterprise entrepreneur export program known globally as "OTOP" [One-Tambon, One-Product].

As with OTO, R&D is coming from the private sector, and not the government. This is consistent with the vision for Thailand 4.0 and other Asian countries, which actively expands R&D activities by private sector funding (more than 70%).

These data points are backed up by the 2014 Thailand Science Technology and Innovation Profile (2014), in which it was concluded that low investment of science, technology, and innovation (STI) in Thailand, especially research and development, has resulted in the low, global STI rankings. Specifically, Thailand from 2000–2014 only allocated 3.2% of the annual government budget for R&D, which proportion of the gross domestic expenditure on R&D (GERD) per Thai GDP was significantly low, at 0.25% of total GDP. As a comparison, South Korea during the same period had the highest GERD/GDP in East Asia at

3.7%, while Singapore has a GERD/GDP at 2.2%. The Thai government's rationale was to prioritize its budget allocation in response to fundamental needs, which means focusing mainly on health issues and security.

From the above reports, we decided to conduct a quantitative and qualitative study using structural equation modeling to examine the relationships between organizational culture and organizational learning on two R&D organizations under the Thai Ministry of Science and Technology. They are the Thailand Institute of Scientific and Technological Research (TISTR) and the National Science and Technology Development Agency (NSTDA).

Literature Review

Learning Organization

A learning organization is "an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights" (Garvin, 1993, p. 80). A learning organization is also an organization with the ideological and spiritual aim of accumulating knowledge for problem-solving and eliminating conflict from within the organization. Teamwork allows for the exchange of ideas, and the organizational culture enhances learning and development in ways that are consistent with organizational strategies and goals. Both aspects integrate information to enhance adjustment to changing external factors.

This study concerning Thai R&D organization performance analyzed the dimensions of the learning organization as discussed in the meta-analysis by Watkins and Dirani (2013). Inherent to the framing of the Dimensions of the Learning Organization Questionnaire, is the multidimensionality of the seven constructs, including 1) leadership for learning, 2) system connection, 3) embedded system, 4) continuous learning, 5) dialogue and inquiry, 6) empowerment, and 7) team learning (Kim, Egan, & Tolson, 2015).

Yergler (2015) and Kirwan (2013) also discussed learning organization dimensions which included (and adopted for this study): 1) continuous learning (LO1), 2) inquiry and dialogue (LO2), 3) team learning and collaboration (LO3), 4) employee empowerment (LO4), 5) embedded systems (LO5), 6) system

connection (LO6), and 7) strategic leadership (LO7). The learning organization is therefore viewed as once that has the capacity to integrate people and structures in order to move towards continuous learning and change (Kirwan, 2013).

After a review of the literature and development from the above concepts, the following hypotheses were created (Figure 1):

H1: *Learning organization (LO) directly and positively affects organizational performance (OP).*

H2: *Learning organization (LO) directly and positively affects organizational culture (OC).*

Organizational Culture

Organizational culture refers to the organization's beliefs and shared values over an extended period, as well as the beliefs and perceptions of the staff and the work which influences their attitudes and behavior (Robbins & Coulter, 2018; Tsai, 2011). This is consistent with Barbera (2014) who defined organizational culture as the shared assumptions, values, and beliefs that guide behavior and are difficult if not impossible to imitate. These shared values are typically the mechanism used to maintain people's performance given a shared understanding of economic gains, vision, and norms, with this shared understanding occurring through the linkage of effective performance and leadership status.

Organizational culture refers to fundamental characteristics based on mutual values and beliefs, as well as the management process of behaviors which cannot be copied. Organizational culture also means rational behavior mechanisms which can properly show benefits of economy, vision, and consistencies by connecting to effectiveness of working and leadership (Denison, 1990). Additionally, it involved the following:

Involvement (OC1) is concerned with the relationships among the aims of the organizations, which the organizations plan and set personnel in positions by seriously emphasizing on participation or on the missions of the organizations, as well as, on the team working. Besides, information distribution for wide and equal perception is included in this notion (Block, 2017; Buckingham & Coffman, 1999;

Katzenbach & Smith, 2015; Lawler, 1996; Spreitzer & Quinn, 1996).

Consistency (OC2) is a process in which goals are set and investments made to build capability and skilled personnel. Core values must be determined so that managers can make the best decisions. Also, organizations must articulate and document their objectives, indicating the correct and wrong way of accomplishing objectives (Schein, 1993).

Adaptability (OC3) involves organizations building strength and acceptance by establishing the same goals. Organizations must also build a culture in which they can operate through changing and difficult circumstances, as well as build a process in which there is continuous improvement of personnel (Denison & Mishra, 1995).

Mission (OC4) is comprised of the cooperative culture; sharing vision and perspectives; knowledge based on determining of vision, planning, goals, and mission (both short, middle, and long term), so that the organization and their staffs can achieve the goals together by realizing the demand of being stakeholders.

From the literature review, the following four variables were adopted from Daft (2008) and Denison and Mishra (1995): 1) the relationship between individual tasks and organizational goals (involvement = OC1), 2) a balance between organizational performance and goals and objectives (consistency – OC2), 3) organizational adjustment (adaptability – OC3), and 4) the organizational mission (mission – OC4). After a review of the literature and development of the above concepts, the following hypothesis was created:

H3: *Organizational culture (OC) directly and positively affects organizational performance (OP).*

Organizational Performance

Organizational performance (OP) refers to the outcomes of activities as determined or expected by the organization from the production process, and in particular, to the added value of the finished outputs from effectively fulfilling and resolving social problems using scarce resources. It also reflects the ability to complete missions, satisfy customer needs, sustainably gain market share, and contribute to organizational growth.

Gates (2010) reported on strategic planning and stated that an organization’s targets include its goals, objectives, and quantitative performance measures. Also, according to Ekpe, Eneh, and Inyang (2015), the most commonly identified components of what constitute a sound mission statement include having a concern for employees, defining clearly who are the customers and focus on survival, growth, and profitability of the business.

In Malaysia, Kamaruddin and Abeysekera (2013) selected efficiency, effectiveness, and reputation as components of OP for non-financial organizations. Lawler (1996) examined case studies and determined that an open-book approach that shares financial information with the entire workforce is effective. Additionally, increasing financial knowledge along with innovative courses are stated as a measure of OP success.

Salim and Sulaiman (2011) studied 115 Malaysian ICT SMEs and confirmed that organizational innovation has a significant influence on an organization’s performance. Additionally, Demers (2009) indicated that firms that demonstrate above-average financial performance possess the seven dimensions of a learning organization to a greater extent than firms that demonstrate below-average financial performance. Therefore, from the above and other research, the following observed variables were included in the study. These were identified as: 1) mission performance (OP1), 2) financial performance (OP2), 3) knowledge performance (OP3), and 4) innovation performance (OP4).

Conceptual Framework

Based on the above hypotheses and review of the literature, we have developed Figure 1’s conceptual framework which includes the causal relationships between a learning organization, organizational culture, and Thai R&D organization performance.

Methods

Sample and Data Collection

Quantitative research was conducted by using a 111-question survey, which was compiled from the related concepts, theories, and literature. For primary information, a 7-level Likert type agreement close-ended questionnaire was constructed to gather information from samples, ranging from strongly disagree (1) to strongly agree (7) (Likert, 1972). SPSS version 16 and AMOS 21 were used to interpret and assess the causal influences. Schumacker and Lomax (2004) are commonly cited for the suggested use of setting appropriate representative sample sizes. From their suggestion, 10–20 samples per observed variable is recommended, depending on the complexity of the model. In this study, there were two dependent variables and one independent variable, which were the learning organization (LO), organizational culture (OC), and organization performance (OP). The factor variables consisted of a total of 15 observed variables as shown in Figure 1 and further defined in Table 1. Stratified sampling was used to access

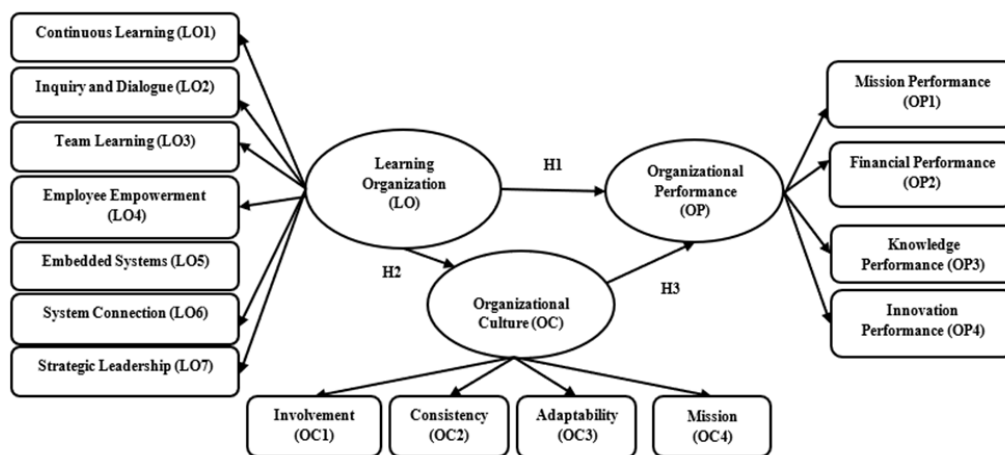


Figure 1. Conceptual framework.

all information. The closed-ended questionnaire was divided into four sections: 1) general information with 5 items, 2) the learning organization consisted of 36 items, 3) organizational culture with 29 items, and 4) organizational performance with 26 items.

The population of the study included 3,317 full-time scientific and technology R&D personnel from both the Thailand Institute of Scientific and Technological Research (TISTR) and the National Science and Technology Development Agency (NSTDA), which are agencies under the Thai Ministry of Science and Technology.

Assessment of Research Tools

Five experts in learning organizations and R&D strategies reviewed the questionnaire for content validity. The questionnaire was then adjusted based on their comments before being distributed. Thirty pre-tests were administered and analyzed for reliability and internal consistency using Cronbach’s alpha (Tavakol & Dennick, 2011), which based on an acceptable value of ≥ 0.7 , the results for reliability were 0.703–0.916 for OP, 0.725–0.918 for the LO, and 0.854–0.948 for OC.

Data Analysis

There were two parts to the data analysis, which included: 1) an analysis of general information for the representative samples through frequency distribution and percentage, and 2) an analysis of the seven observed variables for the LC, the four observed variables for OC, and the four observed variables for OP (Figure 1 and Table 1). Hypothesis testing was conducted using confirmatory factor analysis (CFA) to measure the model fit to the empirical data. The hypothesis model and empirical data were developed using a structural equation model (SEM), which lead to the path analysis to test the model and hypothesis (George & Mallery, 2010).

Results

General Data Analysis

Data were collected from 361 R&D personnel. Table 2 shows the respondents’ characteristics which included a heavy concentration of female personnel (63.4%), compared to male (36.6%). Regarding education, 62.6% had a master’s degree or higher, with 72.9% classified as “officers and staff,” and 57.6% having worked 10 years or less. There were also a significant number of temporary staff (10.8%).

Table 1
Summary of Latent and Observed Variables and Their Associated Theory

Latent Variables	Observed variables (15 items)	Literature Review & Theory
Learning Organization (LO)	continuous learning (LO1) inquiry and dialogue (LO2) team learning and collaboration (LO3) employee empowerment (LO4) embedded systems (LO5) system connection (LO6) strategic leadership (LO7)	Alipour, Idris, Ismail, Uli, & Karimi, 2011; Davenport & Prusak, 2000; Farooq, 2012; Hirsch-Kreinsen & Schwinge, 2014; Hung, Lien, Fang, & McLean, 2010; Laeeque, Babar, & Ahmad, 2017; Marquart, 2002; Naot, Lipshitz, & Popper, 2004; Senge, 1990; Senge, Scharmer, Joworski, & Flowers, 2004; Slaviček, 2011; Watkins & Marsick, 1993, 1996.
Organizational Culture (OC)	involvement (OC1) consistency (OC2) adaptability (OC3) mission (OC4)	Barbera, 2014; Daft, 2008; Denison, 1990; Denison & Mishra, 1995; Robbins & Coulter, 2018; Tsai, 2011.
Organization Performance (OP)	mission performance (OP1) knowledge performance (OP2) financial performance (OP3) innovation performance (OP4)	Demers, 2009; Gates, 2010; Ekpe et al., 2015; Kamaruddin & Abeysekera, 2013; Lawler, 1996; Paziuk, 2009; Salim & Sulaiman, 2011.

Table 2
Respondents' Characteristics (n = 361)

Description		Frequency	Percentage
Gender	Male	132	36.6
	Female	229	63.4
Age (Years)	20–25	9	2.5
	26–30	48	13.3
	31–35	67	18.6
	36–40	79	21.9
	41–45	71	19.7
	46–50	39	10.8
	51–55	25	6.9
	56–60	23	6.4
Academic Degree	Doctorate Degree	36	10.0
	Master's Degree	190	52.6
	Bachelor's Degree	120	33.2
	Lower than Bachelor's Degree	15	4.2
Position	Chief Executives	17	4.7
	Middle-Level Executives	42	11.6
	Officers and Staff	263	72.9
	Temporary Staff	39	10.8
Work Experience (Years)	1–5	104	28.8
	6–10	104	28.8
	11–15	48	13.3
	16–20	59	16.3
	30 +	46	12.7

For the research framework, the CFA model and the path diagram analysis of the SEM are shown in Figure 2 for learning organizations (LO) and organizational culture (OC) on R&D organizational performance (OP).

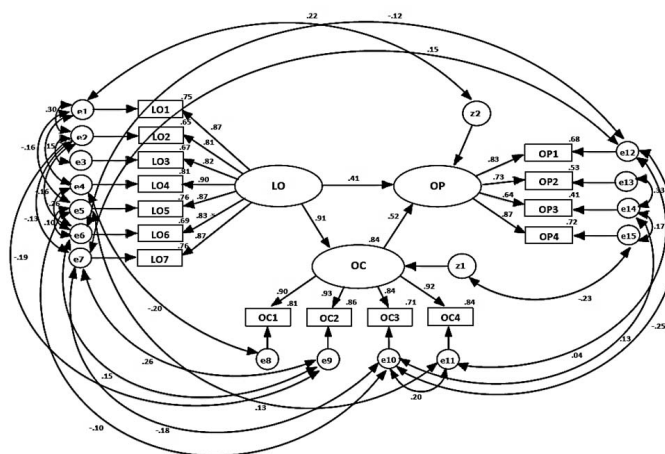


Figure 2. Path diagram for the model with standardized results shown.
Note. Quantities close to the variables are their squared multiple correlations.
 Quantities near paths are standardized loadings or correlations.

Table 2
Theory Consistency Validation Criteria for the Empirical Data.

Goodness of Fit Measurement	Recommended Value	SEM Results	Theory Support
Relative Chi-square: χ^2/df	3.00	1.235 ($p = 0.101$)	Bollen (1989)
GFI - Goodness of Fit Index	≥ 0.90	0.972	Jöreskog and Sörbom (1979)
AGFI - Adjusted Goodness of Fit Index	≥ 0.90	0.946	Schumacker and Lomax (2004)
CFI - Comparative Fit Index	≥ 0.90	0.997	Bentler (1990)
NFI - Normed Fit Index	≥ 0.90	0.986	Bollen (1989)
RMSEA - Root Mean Square Error of Approximation	≤ 0.08	0.026	Steiger (1990), Browne and Cudeck (1993)
SRMR - Standardized Root Mean Square Residual	< 0.05	0.020	Kenny, Kaniskan, and McCoach (2014)
TLI - Tucker Lewis index	≥ 0.90	0.995	Bentler (1990)

The results show that the culture fits with the empirical data at a rate within the expected level, as shown in Table 2.

The CFA indicates that the LC is measured by seven observed variables: 1) continuous learning (LO1), 2) inquiry and dialogue (LO2), 3) team learning and collaboration (LO3), 4) employee empowerment (LO4), 5) embedded systems (LO5), 6) system connection (LO6), and 7) strategic leadership (LO7). The seven observed variables have standard factor loadings of 0.860, 0.764, 0.818, 0.884, 0.886, 0.837, and 0.867, respectively.

Organizational culture (OC) is measured by four observed variables: 1) involvement (OC1), 2) consistency (OC2), 3) adaptability (OC3), and 4) mission (OC4). The four observed variables have standard factor loadings of 0.903, 0.927, 0.844, and 0.917, respectively.

Last, the organizational performance of R&D organizations is measured by four observed variables: 1) mission performance (OP1), 2) knowledge performance (OP2), 3) financial performance (OP3), and 4) innovation performance (OP4). The four observed variables have standard factor loadings of 0.827, 0.730, 0.641, and 0.875, respectively. All of the latent and observed variables are significantly and statistically significant, with p -values less than 0.001.

In conclusion, the relationship model for how the learning organization model and culture influences the

performance of R&D organizations offers the expected outcomes.

Structural Equation Model (SEM) Analysis Results

Causal relationship analysis shows that LO has a statistically significant positive effect on OP, with a coefficient alpha equal to 0.411 and a p -value less than 0.001. The LO explains 83.1% ($R^2 = 0.831$) of the variation in the OP of R&D organizations and 83.5% ($R^2 = 0.835$) of the variation in OC. This study reveals that OC has a significant direct impact on OP. The overall path coefficient of the influence of LO and OC on the OP of R&D organizations is illustrated in Table 3.

The results from the LO analysis also shows that OC influences the performance of R&D organizations. Confirmation of this comes from $OC = (0.914 \times LO)$ $R^2 = 0.835$ and $OP = (0.887 \times LO) + (0.520 \times OC)$ $R^2 = 0.831$.

Discussion

The main objective of this study was to examine the effects OC and LO on Thai R&D organizational performance using a SEM. According to Watkins and Marsick (1996), adopting the LO model significantly and positively influences the performance of R&D organizations, a finding that is consistent with hypotheses H_1 and previous research from Alipour

Table 3
Direct, Indirect, and Total Effects of the Latent Variables

Dependent Variable	R ²	Effect	Independent Variables		
			LO	OC	OP
Organizational Culture	0.835	Direct Effect	0.914	0.000	0.000
		Indirect Effect	0.000	0.000	0.000
		Total Effect	0.914	0.000	0.000
Organizational Performance	0.831	Direct Effect	0.411	0.520	0.000
		Indirect Effect	0.476	0.000	0.000
		Total Effect	0.887	0.520	0.000

Note: LO = Learning Organization, OC = Organizational Culture, OP = Organizational Performance

et al. (2011), which also noted that being an LO has a direct impact on OP. This finding is additionally aligned with Martiez (2009), who found that the relationship between LOs and an organization's financial performance in the US is integrally positive and that the LO educates and reinforces OP by developing the people's ability to perform various tasks and generate strategic improvement. Demers (2009) established that a firm's adoption and implementation of LO characteristics or dimensions is a means of continuous improvement in performance. Therefore, this study adopted the seven dimensions of LO from Yergler (2015) and Kirwan (2013) in the following discussion:

Continuous learning (LO1) occurs when an organization creates an opportunity for learning in research and practical science development by encouraging people to recognize problems and consider feedback (Organisation for Economic Co-operation and Development, 2008). An R&D organization requires qualified personnel who are eager to learn new things. In particular, a workflow process that includes consultancy and a rigid follow-up system will enhance continuous learning as another aspect of the organizational culture that affects organizational effectiveness (Slaviček, 2011). Senge (1990) and Marquart (2002) noted that the organization should form a pooled knowledge system to help prioritize and plan each task that directly affects organizational performance.

Inquiry and Dialogue (LO2) occur when the organization encourages people to accept other

opinions without bias or fear of retribution from those in senior positions by giving members an opportunity to build mutual trust. Task performance within research and practical science development is well integrated and combines various fields. Inquiry and dialogue are fundamental practices that can be used to analyze and critique performance and to continually improve work systems. This focus on team inquiry and discussion is consistent with Senge and Joni (2005), as it facilitates decision-making in advance through effective problem-solving. Open sessions for generating new ideas and beliefs help people to innovate (Schein, 1993; Senge, 1990; Senge et. al, 2004).

Team learning and collaboration (LO3) occur when the organization supports learning and collaboration in R&D. The organization's objective is to effectively and efficiently adjust goal setting via appraisals of past performance and consultancy with equal consideration of the people's opinions. This corroborates Senge (1990), who identified the importance of a team to learn how to work together, accept different opinions to solve complicated problems, and follow a creative learning cycle in the organization. Moreover, learning how to manage people inside the organization is similar to fighting against an unexpected event external to the organization (Watkins & Marsick, 1993).

Employee empowerment (LO4) occurs when the organization helps personnel at all levels to participate in organizational management, that is, to determine the corporate vision, objectives, and goals, especially those that fit customers' needs and market demand. The performance of an R&D organization benefits

from a clear chain of command that allows people at various levels to participate and share opinions on a continual basis.

Embedded systems (LO5) is when the creation of learning occurs when the organization supports and encourages two-way communication and creates a culture that accepts those with innovative ideas (Senge et. al, 2004). R&D organizations should prepare a modernized database of core competencies and be able to use it easily. Learning within an organization cannot rely solely on employing new technology; people must collaborate to create systematic learning, new knowledge, and a good atmosphere to stimulate the learning process.

System connection (LO6) is the connection with the environment which occurs when the organization reacts to change, that is, technology environment, competition, customers, and shifts in market demand (Hirsch-Kreinsen & Schwinge, 2014). R&D organizations systematically create a fundamental structure and integrate how they work with society and communities. Watkins and Marsick (1993, 1996) mentioned that both internal and external environments cause organizational movement and adjustment. R&D organizations in Thailand are subsidized by a given governmental budget, and the government determines the criteria and key performance indicators to monitor them. The key success factors in performance assessment are continuous improvement, as evidenced by a change in technology level, and competition to ensure that R&D budgets are fully used in a measurable way.

Strategic leadership (LO7) occurs when the organization encourages leaders who can think and act strategically to support, improve, and share the learning culture and create a learning environment within the organization. In particular, leaders must communicate and disclose useful up-to-date information about organizational direction, business competitors, and marketing knowledge to ensure that employees are aware of current circumstances. Watkins and Marsick (1993, 1996) said that leaders play an important role in improving organizational learning, corroborating other studies (Davenport & Prusak, 2000; Naot et al. 2004; Watkins & Marsick, 1993). Leadership is the most important factor determining the quality of the

learning process within the organization.

OP research from this study revealed four critical components in the performance of R&D organizations. They included:

Mission performance (OP1) reflects the organization's effort to determine its objectives, missions, goals, and operational direction, including the development of infrastructure and a system to support organizational goals and pursue R&D to leverage the organization's capacity for sustainable development and competitiveness in the Asian market. The government should estimate mission performance in an R&D organization annually.

Knowledge performance (OP2) reflects learning, understanding, and knowledge management in the organization and among employees. Specifically, it reflects an increase in these competencies to enable the organization to produce unique products in response to customer demand in the market. The creation of a learning organization linking the organization to society and the nation is the principal mission of an R&D organization.

Financial performance (OP3) reflects the organization's effort to determine financial outcomes by comparing the current and long-term assets and considering cost reduction or effective budgeting. Most R&D organizations fulfill their mission in response to society and the national context. This makes them non-profit organizations; they evaluate organizational performance and use their research findings to address existing national problems.

Innovation performance (OP4) refers to an organization's performance in terms of creating innovative products and processes, the profits of which can be invested to develop new products and foster continual operational excellence. One indicator that the government uses as an assessment tool is the number of patents. The other form of outcome derived from R&D is the creation of solutions for society and the nation based on internal knowledge and wisdom. Paziuk (2009) also found that people who participate in learning organizations can improve both products and procedures in response to demand by allowing specialists and other interested persons to be part of the learning and career center network.

Hypothesis H₂ was also supported as LOs have a

direct and positive impact on OC. Numerous studies support this, including Laeeque et al. (2017) which determined that when implementing LO practices in firms, enhancing employee autonomy while inducing employees to learn new skills and new ways of doing things is extremely important. Additionally, LO practices were found to significantly uplift innovation performance (Farooq, 2012; Hung et al., 2010; Laeeque et al., 2017).

Denison (1990) and Denison and Mishra (1995) also supported the study's H₂ hypothesis. McAnally (1997) additionally revealed that OC is connected to OP in different ways. From the research of Daft (2008) and Denison and Mishra (1995), four OC components were identified. They are discussed as follows:

Involvement (OC1) is the relationship between individual tasks and organizational goals, in which the organization determines team members' and other employees' positions by determining the organizational goals or missions. According to Denison (1990), working as a team competitively with a shared information base that everyone can access will unite members in pursuit of a group project, unlike when employees pursue individual projects. These ideas are supported by other studies (Block, 2017; Buckingham & Coffman, 1999; Katzenbach & Smith, 2015; Lawler, 1996; Spreitzer & Quinn, 1996), which empowers people to act as entrepreneurs and have the organizational commitment to determine the direction of desired targets.

Consistency (OC2) represents stable organizational performance in terms of determined goals and objectives, in which the organization identifies goals, invests in people on a regular basis to strengthen their capabilities and competencies, and perceives organizational values. The R&D organization and its decision-making process should be founded on basic values and integrated to ensure that the organization can perform without suffering from barriers and limitations.

Organizational adjustment (OC3) is when the R&D organization demonstrates flexibility in responding to changes in science and technology or to anticipate and focus on innovation, with the understanding of the interplay between organizational change and innovation activities being the key to success in today's

pace of change in a dynamic business environment (Mäkimattila, Saunila, & Salminen, 2014).

Organizational mission (OC4) is when an organization forms a collaborative culture which increases innovation. As such, collaboration increases employee energy, creativity, and productivity, which generally leads to less stressed, happier, and more engaged workers (Tannenbaum, 2014). Further, it should consider the stakeholders' needs by consistently tracking the responsibility for operations and progress toward goals. Tsai (2011) found that an organization's mission can lead it to form behavioral traits based on the organizational goals and objectives.

An organization should be evaluated based on three indicators: strategic direction and clear objectives, an understanding of results expected from the goals and objectives to encourage people to work toward the organization's goals, and a linkage between the organization's mission and vision so that employees adhere to the common organizational values.

Conclusion

From this study, it can be concluded that adopting a learning organization model has a direct effect on the culture and performance of R&D organizations. In general, there is a broad consensus concerning innovation being the source of growth and competitive advantage for companies, regions, and states. The study also agrees with Cohen and Levinthal (1990), in which it was concluded that investment in an area of expertise early on may foreclose the future development of a technical capability in that area. Furthermore, the SEM revealed that the seven-dimension measuring LO directly and significantly influence OC and a Thai R&D OP. This was more recently confirmed by a report on Southeast Asia nations, in which Thailand was included, wherein the Organisation for Economic Co-operation and Development (2013) concluded that policymakers need to become better informed about the national importance of making a stronger commitment to research and innovation (R&I) by investing more heavily in capacity building and the expansion of opportunities for research in universities. These same individuals also need to develop a better understanding of researcher training

needs in universities and research institutes concerning the processes of commercialization. Fortunately, current Thai leaders have grasped these issues and are moving forward with their Thailand 4.0 vision of a new digitally enabled knowledge worker (Jones & Pimdee, 2017). The issues however of where these workers come from, who trains them, and how these programs are financed are the questions that many are asking and the topic for future research.

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