

RESEARCH BRIEF

An Analysis of the Effects of Innovative Climate, External Work Contacts, and Stimulating Innovative Leadership on Thailand's Animal Feed Industry Innovative Behavior

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Thailand's food industry is a significant contributor to the Kingdom's economy, with 2015 data indicating the sector contributed approximately 23% to the nation's gross domestic production (Thailand Board of Investment, 2016). Often referred to as "kitchen of the world" or the "food basket of Asia," Thailand's animal feed production is a crucial element in food exports, which have reached \$27 billion per year (Thailand Board of Investment, 2016; Wipatayotin, 2017). Currently, Thailand ranks 13th in the world among food exporters, but within the present 20-year plan, expects to reach the top 10 in food exports within a decade, with a projected export value of \$63 billion (Royal Thai Embassy, 2016).

Innovation and technology play critical roles in these plans and projections, as animal feed accounts for 95% of the total production within the animal feed industry, with aquafeed making up the remaining 5% (Roembke, 2014). The Thai Feed Mill Association estimated that Thailand would produce 19.7 million metric tons of compound feed, and this is expected to increase by 100% within 20 years (Mordor Intelligence, 2018). However, to get there, a shift in Thai agriculture will need to take place.

Although the Thai Feed Mill Association has reported annual growth rates of 5% over the past

five years for feed production (Figure 1), it appears in 2018 that trend will come to an end (Mordor Intelligence, 2018). Contributing factors to this have been stated in the new Thai governmental regulations related to the purchase of domestic corn by feed mills, before importing feed wheat, which has significantly reduced Thai feed wheat imports. However, the Thai government has also introduced rice as a substitute for feed wheat (Byrne, 2017; Einstein-Curtis, 2017).

Higher raw material prices for feed production also affect company profitability and survival (Langemeier, Schroeder, & Mintert, 1992). Many factors contribute to corn and soybean price increases in recent years, including expanding world economies and decreases in the value of the U.S. dollar. However, a significant contributor to this price increase has been the expansion of the corn-ethanol industry. Without this, corn and soybean prices would have been near the same levels before the ethanol expansion (Wisner, 2008). These factors, therefore, have an impact on the daily lives of the people in Thailand and hurt the competitiveness of Thailand's food export business due to the higher cost. Combined with the Thai government's measures to control the price of animal feed, feed companies have to find measures to reduce

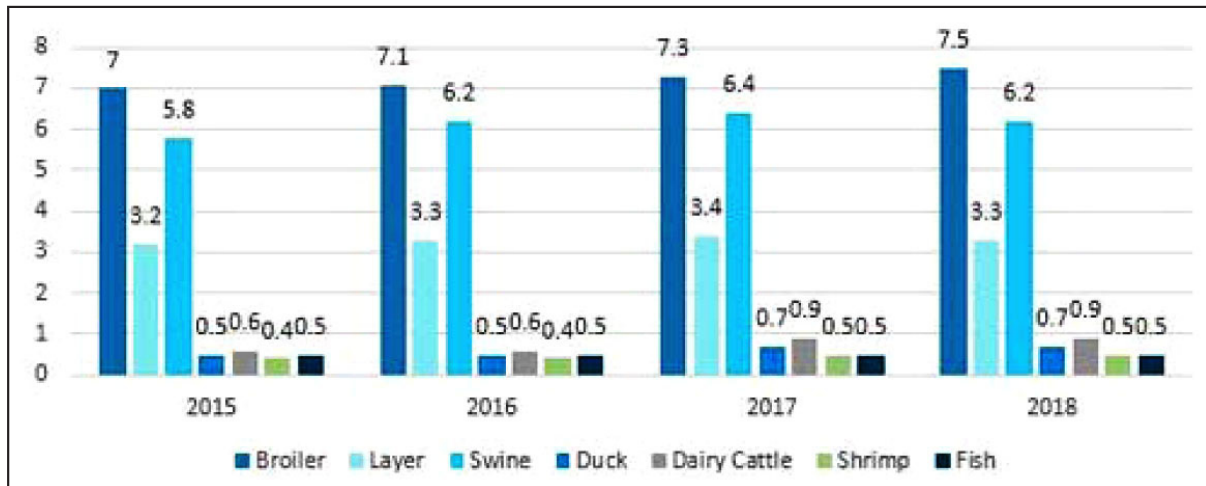


Figure 1. Thailand’s feed additives market: Feed demand by sector from 2015–2018 (in a million metric tons). Source: Mordor Intelligence (2018)

production costs in line with rising raw material prices.

Other hurdles inhibiting growth within the Thai food industry is the range of changes in society, which has necessitated a response to far-reaching technical and economic changes in the production and processing of food (CPG Official Channel, 2012). However, the reality is anything but good.

According to a recent study from the University of the Thai Chamber of Commerce, of the 1,219 small and medium-sized enterprises (SMEs) surveyed in late 2018, only 2.87% of the agricultural and food processing industry’s 15 million farmers is considered part of the digitally and innovation-focused, technology-enabled Industry 4.0 era (Chantanusornsiri, 2018; Deloitte, 2015; Wipatayotin, 2017; Yaklai, Suwunnamek, & Srinuan, 2018). Most of the Thai SMEs today were found to be still considered 2.0 (72.3%) or 1.0 (22.8%) based on their lack of adoption and use of modern technologies, with a mere 1.97% judged to be in the 3.0 era, using machinery for production. Furthermore, quality and food safety are also issues within the Thai poultry sector, as it is not yet fully automated and leads to compromises (Mordor Intelligence, 2018).

However, research has suggested that global manufacturers are increasingly adapting to their suppliers’ operations by using their external work contacts in acquiring innovative ideas (Gumusluoglu & Ilsev, 2009). Innovation is a critical strategy that gives organizations a pathway to competitive

advantage (Skroupa, 2017), with leadership being the best predictor of innovation performance (Barsh, Capozzi, & Davidson, 2008). Additionally, to achieve organizational change, executives and managers must lead in innovation. Leaders must also support employees who differ in thought processes, background, culture, and beliefs, which is paramount to developing innovative ideas (Skroupa, 2017). If the leaders do not embrace and adapt to rapid change, they will be left behind by their competitors and the developments within their sector (Deloitte, 2015).

Innovative leadership is a style that allows subordinates to initiate a brainstorming process that creates new ideas, possibilities, and projects/products for the organization. It also includes the creation of new units for innovation and the promotion of teamwork that drives innovation (De Jong, 2006; Deloitte, 2015).

Problem Statement

In 2018, out of 15 million individuals involved in Thai agriculture, only 2.87% were determined to be part of the Thai government’s digitally, and innovation-focused technology-enabled Industry 4.0 era. However, numerous studies have determined that innovation is the key to competitive sustainability and international trade. Therefore, this study sought to determine how Thailand’s animal feed industry is affected by the firm’s innovative climate, innovative behavior, stimulating innovative leadership, and external work contacts.

Conceptual Model

From the review of the literature, the following latent and observed variables and their related hypotheses were identified from the research. Supporting theory can be found in Table 1.

Possible influences on innovative climate (IC) included support for innovation (SUIN), participative safety (PASA), and striving for excellence (STEX), which led to the creation of the following two hypotheses:

- H1: Innovative climate (IC) has a direct influence on innovative behavior (IB).
- H2: Innovative climate (IC) has a direct influence on stimulating innovative leadership (IL).

Possible influences on external work contacts (WC) included the customer (CO), supplier (SUPP), knowledge institutes (KNIN), and competitors (COMP), which led to the creation of the following two hypotheses:

- H3: External work contacts (WC) has a direct influence on innovative leadership (IL).
- H4: External work contacts (WC) has a direct influence on innovative behavior (IB).

Possible influences on stimulating innovative leadership (IL) included providing resources (PRRE), consulting (CONS), and recognizing

behaviors (RECO), which led to the study's final hypothesis:

- H5: Stimulating innovative leadership (IL) has a direct influence on innovative behavior (IB).

Therefore, Figure 2 shows the proposed model and the related five hypotheses.

Methods

Sample and Data Collection

The targeted population for the study was individuals with five or more years' experience involved in the production and operations management within the Thai animal feed industry. Initially, the sample size was determined from a population of firms operating in the six major regions of Thailand, wherein the data was obtained from the Thai Department of Livestock and Fisheries Department in 2015. From this, the sample size was divided using the proportion method, where a comparison of each group's population in each province within each region was made. Afterward, a sampling frame was obtained using a raffle process, which was used to conduct the simple random sampling of the individuals identified within each group (Ott & Longnecker, 2010, p. 25). After that, we divided the sample size by using the method of comparing the proportions with the population of each province in each region until the 382 surveys

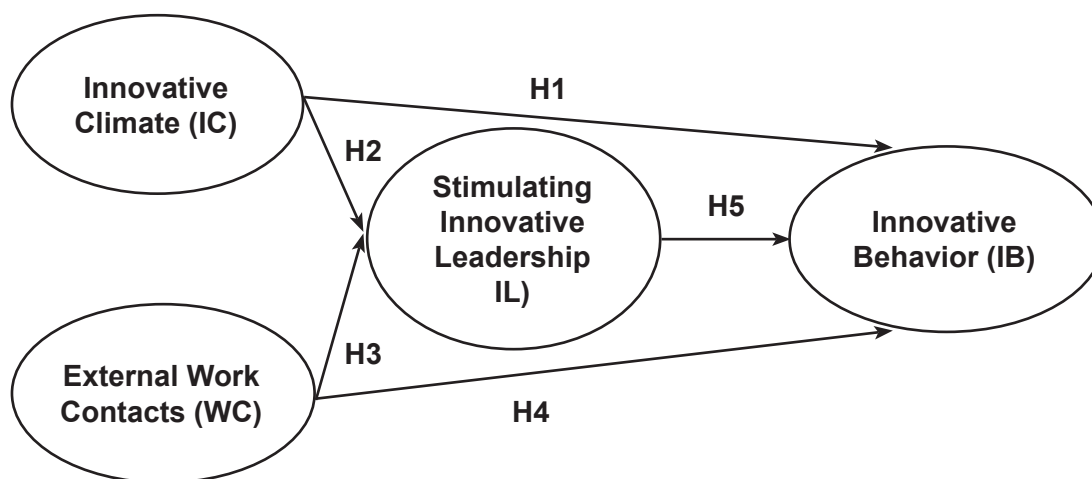


Figure 2. Conceptual model.

were obtained. Upon obtaining each individual’s agreement to take the survey, e-mail or post was used to send the questionnaire. The distribution of the study’s questionnaire began in September 2015 and continued until March 2016. As there are often response rate challenges posed by mail surveys (Chumney, 2013), two graduate student teams were employed to make follow-up inquiries. From this process, 382 questionnaires were eventually found acceptable and used for the study’s analysis of the four latent variables and their 13 observed variables (Table 1).

The Survey Instrument

Questionnaires were used to measure concept definition and practice concerning Thai animal feed innovation practices from six major Thai regions. Five experts in their fields were used to determine the questionnaire’s concepts. These included one academic

and four senior-level executives/managers working within the Thai animal feed sector.

From a pre-test of 30 production and 30 factory managers (60 total), Cronbach’s alpha was used to evaluate the 7-level Likert type agreement scale questionnaire from individuals who were not included in the final survey (Table 2). The values of alpha (α) that are considered acceptable are 0.70 or higher. As the study’s average value was found to be 0.946, the survey’s items were deemed to be reliable.

Furthermore, to determine the target sample size, various scholars’ suggestions were evaluated. Kline (2011) has suggested using sample sizes of at least 200. Another widely accepted rule of thumb is 10 cases/observations per indicator variable (Nunnally, 1967). This, however, is a lower bound of an adequate sample size. Therefore, a ratio of 20:1 was initially set as a target for the study’s structural equation model (SEM) analysis.

Measurement

Table 1

Summary of Latent Variables and Observed Variables along with Supporting Literature and Theory

Latent Variables	Observed variables (13 items)	Supporting Literature and Theory
Innovative climate (IC)	support for innovation (SUIN) participative safety (PASA) striving for excellence (STEX)	Açıkgöz & Günsel, 2011; Anderson & West, 1998; De Jong, 2006; Gumusluoğlu & Ilsev, 2009; Hartjes, 2010; Isaksen & Akkermans, 2011; Izzati, 2018; Organisation for Economic Co-operation and Development, 2007; Sarros, Cooper, & Santora, 2008; Schneider, Macey, & Ehrhart, 2013; Skroupa, 2017; West, 1990; West & Farr, 1989; Yukl, 2013
External work contacts (WC)	customer (CO) supplier (SUPP) knowledge institutes (KNIN) competitors (COMP)	Adams & Lamont, 2003; Gumusluoğlu & Ilsev, 2009; Huggins et al., 2010; Isidoro & Martínez-Román, 2012; Kimberly & Evanisko, 1981; Lincoln & Miller, 1979; Marquardt, 1996; Porter, 1980
Stimulating Innovative leadership (IL)	providing resources (PRRE) consulting (CONS) recognizing behaviors (RECO)	Basadur, 2004; Bass, 1985; Barsh et al., 2008; De Jong & Den Hartog, 2010; Dubrin, 2013; Gumusluoğlu & Ilsev, 2009; House & Shamir, 1993; Horth & Buchner, 2015; Huggins et al., 2010; De Jong, 2006, 2008; Scott & Bruce, 1994, 1998
Innovative behavior (IB)	opportunity exploration (OE) idea generation (IG) championing and application (CA)	Amabile, 1996; De Jong, 2006, 2008; De Jong & Den Hartog, 2008; Duvergerm, 2012; Hartjes, 2010; Kleysen & Street, 2001; Krause, 2004; McAdam & McClelland, 2002; Parker, Williams, & Turner, 2006; Rogers, 1959; Shane, 1994

The organization or grouping of the items was confirmed using the Statistical Package for the Social Sciences (SPSS) version 15 to conduct the study's path analysis and the goodness of fit index (GFI) statistics. Validity was measured using convergent validity (AVE), construct validity (GFI, CFI, RMSEA, Chi-square/df), and discriminant validity (square root of the AVE). Established criteria for these statistics was $p > 0.05$, the $\chi^2 / df < 2.00$, root mean square error of approximation (RMSEA) < 0.05 , CFI > 0.90 , GFI > 0.90 , adjusted goodness of fit (AGFI) > 0.90 , and root mean square residual (RMR) < 0.05 .

Results

Demographics of Respondents

The demographics of the respondents are shown in Table 3. One very striking piece of data from the survey was the overwhelming participation of men only within the animal feed sector (99.5%). As to be expected, the majority of the management were between 41–50 years of age (40.8), and 100% indicated they had a college degree or graduate education.

The respondents' survey information results are shown in Table 4.

Table 2

Survey's Likert Scale Level of Agreement

Rank	Level of Agreement	Mean Range
1	Strongly Disagree	1.00 – 1.85
2	Disagree	1.86 – 2.70
3	Somewhat Disagree	2.71 – 3.55
4	Neither Agree or Disagree	3.56 – 4.40
5	Somewhat Agree	4.41 – 5.25
6	Agree	5.26 – 6.10
7	Strongly Agree	6.11 – 7.00

Table 3

Demographics of Respondents (n = 382)

Characteristic	Number	Percentage
Position		
Production Manager	174	45.5
Operation Manager	208	54.5
Sex		
Male	380	99.5
Female	2	0.5
Age range		
Under 40 years	132	34.6
41–50 years	156	40.8
Over 51 years	94	24.6
Experience		
Under 10 years	211	55.2
11–20 years	168	44.0
Over 21 years	3	0.8
Education		
Bachelor degree	273	71.5
Master's degree	109	28.5

Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Table 5 shows the results of Kaiser-Meyer-Olkin’s test, which determines whether the model is suitable for factor analysis. The Kaiser-Meyer-Olkin’s index was found to be 0.961, and Bartlett’s test of sphericity had a significance level of 0.00. Hence, this research was suitable for testing the hypotheses between factors.

Hypotheses Testing

Table 6 shows the testing results of the multiple regression analysis. To identify the relationships between the preceding variables, a path analysis was conducted using standardized coefficients (Beta).

Hypotheses test results are presented in Table 6, which show that innovative climate and CO affected IL at a significance level of < 0.05. Also, IA, WC, and IL all affected IB at a significance level of < 0.05.

Table 4

Latent and Observed Variables Respondents’ Survey Results

Variable	Items	Mean	S.D.	Skewness	Kurtosis
OE - opportunity exploration (OE)	4	5.073	.842	-.615	.938
IG – idea generation	5	4.866	.896	-.548	.618
CA- championing and application	4	4.562	.901	-.315	.406
IB – innovative behavior	14	4.834	.783	-.520	.690
PRRE - providing resources	4	4.974	1.129	-.577	.209
CONS - consulting	4	5.355	1.003	-.639	.586
RECO - recognizing behaviors	3	5.553	1.045	-.695	.710
IL - stimulating innovative leadership	11	5.294	.955	-.589	.592
SUIN - support for innovation	4	5.066	1.120	-.457	.398
STEX - striving for excellence	3	5.109	1.111	-.495	.317
PASA - participative safety	3	4.835	1.091	-.439	.299
IC – innovative climate	10	5.0034	1.010	-.345	.243
CUST - customer	3	5.136	.932	-.515	1.112
SUPP - supplier	3	4.9232	.92054	-.565	1.120
KNIN - knowledge institutes	3	4.8935	.96044	-.422	.544
COMP - competitors	3	4.9511	1.03339	-.451	.873
WC – external work contacts	12	4.9760	.84647	-.526	1.075

Note. S.D. = standard deviation.

Table 5

Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Indicators	Index	Results
Kaiser-Meyer-Olkin measure of sampling adequacy	0.000 – 1.000	0.961
Bartlett’s Test of Sphericity	Significance Level < 0.05	0.000

Table 6

Multiple Regression Analysis

Dependent Variables	Independent Variables	Standardized Coefficients (Beta)	Sig.
Innovation leadership stimulating (IL)	Innovative climate (IA)	0.668	0.000
	External Work Contacts (CO)	0.210	0.000
Innovative behavior (IB)	Innovation leadership stimulating (IL)	0.351	0.000
	Innovative climate (IA)	-0.149	0.018
	External Work Contact (CO)	0.577	0.000

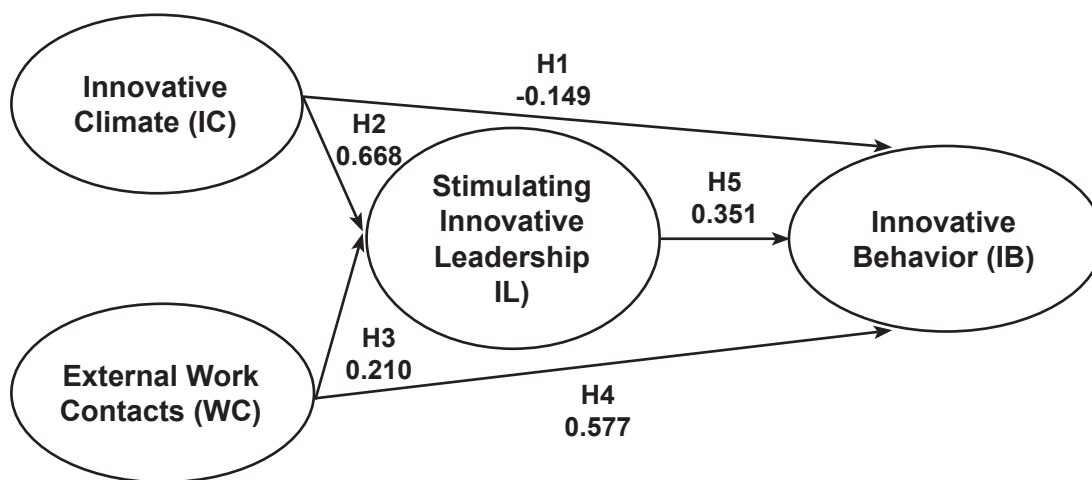


Figure 3. Final path analysis results.

Structural Equation Model (SEM) Analysis

A SEM, along with the associated variables that affect Thai animal feed industry innovation, is presented in Figure 3. The statistical data of the SEM model for animal feed industry innovation was the relative Chi-Square (χ^2/df), which was 1.143, RMR = 0.028, RMSEA = 0.019, CFI = 0.997, GFI = 0.982, and the AGFI=0.960, SRMR=0.02, and RMSEA=0.00.

Direct Effect, Indirect Effect, and Total Effect

The research found that the variable relationship with the strongest influence on IB was WC (DE = 0.577, TE = 0.787). This was followed by IC to IB (TE = 0.519). Table 7 and Table 8 show additional testing results.

Discussion

This study’s theoretical model of the relationships among IC, WC, IB, IL, and IB) was developed and tested. The findings of this research contribute to the understanding of the links between the theoretical constructs, and showed that IB is influenced both directly and indirectly by IC, WC, and IL. Additionally, WC had the highest TE with its relationship to IB. However, an IC was determined to have a direct but negative impact on IB, whereas IC had a positive effect through IL.

Furthermore, all five hypotheses were supported. The study also determined that there is a significant relationship between H1’s IC and IB, which is

Table 7

DE, IE, and TE of Influencing Variables

Hypotheses	Independent Variable	Dependent Variable	Direct Effect	Indirect Effect	Total Effect
H1	IC	IB	-0.149	0.668	0.519
H2	IC	IL	0.668	–	0.668
H3	WC	IL	0.210	–	0.210
H4	WC	IB	0.577	0.210	0.787
H5	IL	IB	0.351	-	0.351

Table 8

Hypotheses Testing Results

Hypotheses	Estimate	S.E.	C.R.	p-value	Result
H1: Innovative climate (IC) has a direct influence on innovative behavior (IB)	-0.116	0.049	-2.381	$p < 0.05$	Supported
H2: Innovative climate (IC) has a direct influence on stimulating innovative leadership (IL)	0.631	0.038	16.796	$p < 0.001$	Supported
H3: External work contacts (WC) has a direct influence on stimulating innovative leadership (IL)	0.237	0.210	5.275	$p < 0.001$	Supported
H4: External work contacts (WC) has a direct influence on innovative behavior (IB)	0.534	0.577	11.723	$p < 0.001$	Supported
H5: stimulating innovative leadership (IL) has a direct influence on Innovative behavior (IB)	0.288	.351	5.725	$p < 0.001$	Supported

supported by other global studies. In Japan, secondary innovations have, therefore, become the main source of Japan’s competitiveness, with leadership vision a significant facet of transformational leadership and strongly associated with organizational culture (Antonakis & House, 2002).

Another salient component of a creative climate, which can lead to innovation, is the staff’s perception of support from top management (Mortara, Napp, Slacik, & Minshall, 2009). Klein and Sorra (1996) have suggested that in an open innovation environment, management needs to provide incentives for innovation,

the removal of obstacles in obtaining it while listening to staff complaints and concerns.

Concerning H2’s IC relationship to IL, support was there, but the relationship was weak. This is due to many studies showing that it is the leaders who create the climate for innovation (Ringle, Taylor, & Zablit, 2017). To borrow an expression from slang, “don’t get the cart before the horse,” as it is the leaders that pull the “cart.” However, a leader can inherit an environment in which an innovative climate already exists, thus the reason for some support for this hypothesis.

As stated, H3 and H4 were also supported, as it has often been said that the smartest people work for someone else (Ringle et al., 2017). Therefore, WC plays a crucial role in the ability to obtain innovative leadership and behavior, as organizations have long incorporated external innovation through a variety of mechanisms. These include acquisitions, partnerships, joint ventures, recruiting, and licensing. Additionally, WCs facilitate knowledge exchange with employees and provides new ideas to solve the same problems in innovative and different ways (Perry-Smith & Shalley, 2003; Porath, Spreitzer, Gibson, & Garnett, 2012). WCs also offer a solid knowledge base that can generate innovation.

Finally, H5's relationship between IL and IB was also supported in the study, with Gumusluoğlu and Ilsev (2009) stating that many studies have shown that transformational leadership positively influences organizational innovation, which was also the results from their study on Turkish micro- and small-sized companies. This has major implications for Thai agricultural SMEs as some have felt that innovation is size related, and that small firms are locked out from implementing it.

This is consistent with Deloitte's global survey of 600 executives in which the respondents pointed to leadership as the best indicator of innovation performance (Deloitte, 2015). As a whole, what matters in an organization is the creation of innovative behavior. External work contacts are also paramount in having a positive impact on the success of competitive organizations. Based on the findings, IB's observed variable of external work contacts, which featured the knowledge institutes, played a crucial role in new knowledge creation beyond the usual customer, supplier, and competitor within the Thai animal feed industry. Finally, creating new engagements can lead to innovation at the enterprise level.

Conclusion

Companies need to establish their teams around innovation and use appropriate processes and metrics to integrate innovation into the fabric of their corporate culture. Although it is clear that technology must be at the center of innovation, IT can be a barrier to innovation due to its complexity and related cost. In Thailand, the agribusiness sector is still predominantly

labor-intensive with limited to no mechanization still the reality to the vast majority of SMEs. Information technology, other than access to smartphones, is reserved for a tiny SME minority. Officials recognize these deficiencies and have laid out grand plans to overcome them, but even if the funding is obtained, it will take years, even decades, to achieve the desired results. Another issue is the resistance to ideas where it was "not invented here" is a cultural problem, with both national and corporate cultures can be difficult to change. Finally, Thailand has an aging population, and keeping new generations on the "farm" becomes ever more difficult. The question then becomes, "will time run out?"

The results show that creating innovative behaviors requires multiple components within the organization and outside the organization. In particular, leaders must behave in a more innovative way, in which workflows are created that inspires an atmosphere that fosters interoperability within the organization. Also, the external work contacts should be encouraged, but caution must also be taken in the exchange of information. This critical process requires a fine balance, but it must be undertaken if innovation is to be created and competitive advantage is sustained. Therefore, leadership grooming and selection is essential for an organization that needs to create innovative behavior.

Declaration of ownership

This report is our original work.

Conflict of interest

None.

Ethical clearance

This study was approved by the institution.

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