

# International Paper Presentations (Break out room 1)

## The Measurement of Business Operational Efficiency of Thai-Danish Dairy Cooperatives (Lampaya Klang) Limited, Saraburi Province, Thailand

Anucha Wittayakorn-Puripunpinyoo<sup>1</sup>

### Abstract

The dairy industry in Thailand has been developed after the King of Denmark gave some dairy cows to King Bhumibol Adulyadej of Thailand in 1960. At the same time, dairy cooperatives have been established to help farmers in Thailand for higher income. Thai-Danish dairy (Lampaya Klang) cooperatives Ltd. was established to help farmers in Saraburi province that is one of the main raw cow milk production areas in Thailand. The research objectives were: 1) to analyze the business operation of Thai-Danish dairy (Lampaya Klang) cooperatives Ltd, and 2) to measure the business operational efficiency of Thai-Danish dairy (Lampaya Klang) cooperatives Ltd. Saraburi Province. Time-series data were collected from Thai-Danish dairy cooperatives Ltd. and the Database of the Cooperatives Auditing Department, Ministry of Agriculture and Cooperatives, The Royal Thai Government. The data were analyzed with multiple linear regression to estimate the parameters of factors that influenced the revenue of Thai-Danish dairy (Lampaya Klang) cooperatives Ltd. The findings showed that 1) revenue, debts, expenditure, loans of Thai-Danish dairy cooperatives Ltd had significantly increased and 2) the business operational efficiency of Thai-Danish dairy (Lampaya Klang) cooperatives Ltd, Saraburi province performed with 18 years of business operational efficiency and 14 years of business operational inefficiency. Overall, The cooperatives performed its own business operational efficiency with the good sharp with an average score of business operational efficiency was equal to 1.00, which expressed the high efficiency of business operation.

**Keywords:** Business Operational Efficiency, Dairy Cooperatives

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## Introduction

The problem of heteroscedasticity is one of the assumptions for regression analysis, which is caused by the error that may vary according to the value of the dependent variable, independent variable, or sample size. Heteroscedasticity is common for time series data and for cross-sectional data, which is found mainly with economic data such as individual or family consumer data (Greene, 2009). When there is a problem of heteroscedasticity, it will cause errors in the standard error estimator of the regression coefficients. As a result, the regression coefficient estimator does not have the lowest variance. It lacks the BLUE (Best Linear Unbiased Estimator) property, which means it is not an estimator with the best unbiased linear estimator property, effecting hypothesis testing, t-test and F-test. This results in erroneous hypothesis testing and leads to the incorrect conclusion of the analysis. Therefore, the heteroscedasticity hypothesis must be tested before the estimation of regression coefficient.

The Goldfeld-Quant test is a popular test for heteroscedasticity problem used in cases where it is assumed that the variance increases or decreases with one of the independent variables, using the ratio of Sum of Squared Errors (SSE) obtained by least squares analysis of the data that are divided into two independent groups, one with high variance and one with low variance sorted according to independent variables compared with the F-test statistic. The test power is highest when the midpoint was cut off (Goldfeld and Quandt, 1965). There were researches on the efficiency and development of statistics from Goldfeld-Quant test as follows. Daow Kongsiriwattana (1989) found that the Goldfeld-Quant test has higher test power than the Szroeter's test when the sample is small ( $n = 20$ ) and when  $r$  and  $\lambda$  are very high or very low, with the errors variances in the form  $\sigma^2_t = kXr_t$  and  $\sigma^2_t = k^2(1 + \lambda X_t)^2$ . Carapeto and Holt (2003) proposed a new test, called the C-H test, based on the Goldfeld-Quant test in combination with the Neural Network Models for examining the problem of heteroscedasticity in the additive form,  $v(\epsilon_i) = \sigma^2_i = \alpha^2(1 + \lambda X_i)^2$ , where  $\lambda = 0.03, 0.04,$  and  $500$  and the multiplicative form,  $v(\epsilon_i) = \sigma^2_i = kX^\gamma_i$ , where  $\gamma = 1.25, 1.35,$  and  $2$ . The results showed that the C-H test has the highest test power and provides higher testing power than all Goldfeld-Quant testing methods. For the Budka et al. (2008), they presented the comparison of the efficiency of dividing the data for Goldfeld-Quant test and found that the method of dividing the data from the median absolute deviation gave the test power higher than in the case of eliminating the center observation. The study by Rana et al. (2008)

presented the testing of heteroscedasticity problem when there is abnormality in dataset based on the Goldfeld-Quant test method. The results showed that the proposed method gave higher test power than the Goldfeld-Quant test. When the sample size was small ( $n = 20$ ) and the outliers were low (5%), the test power of the proposed method tends to increase as the sample size increases. A study by Alabi et al. (2020) discusses the selection of appropriate test statistics for testing the heteroscedasticity when there is a problem of multicollinearity and Alabi et al. (2020) study when there is no multicollinearity problem. A total of 9 tests were presented and a several heteroscedasticity forms were studied, including heteroscedasticity based on multiple independent variables and heteroscedasticity of exponential function. The results showed that the heteroscedasticity test was not stable when there was no multicollinearity problem. The Goldfeld-Quant test had the highest test power of all sample sizes studied ( $n = 15, 20, 30, 40, 50, 100, \text{ and } 250$ ) at significance levels 0.01, 0.05 and 0.1.

To construct the test statistics of the Goldfeld-Quant test, it was necessary to arrange the data according to the independent variables influencing the heteroscedasticity. Most of the past researches studied only one independent variable. However, if there is more than one independent variable studied, the researcher may find it difficult to determine the independent variable that has influence. In some studies, the data was sorted based on the approximate values of the variables obtained from the regression analysis instead. This research proposes an idea for testing the heteroscedasticity under the test statistics of Goldfeld-Quant that will divide the data into 2 groups from the cluster analysis, which is a technique of grouping the observation values that are quantitative data with distance measurements and the group in which the sample is the least distant from the center of the group is selected. This concept does not necessarily have to know which independent variables influence the variance of the error as a guideline for choosing the hypothesis test about heteroscedasticity problem, if it is unknown which independent variable has an influence on variance form.

## Method

This research presents the modified Goldfeld-Quant test. The null hypothesis in the test is H0: The data does not have heteroscedasticity against H1: The data have heteroscedasticity. The process of testing the modified Goldfeld-Quant test starts from dividing observation values into 2 groups by using cluster analysis using K-means method when K = 2. Then regression analysis was performed in each group and calculate the test statistics under the F distribution as follows:

$$F_{GQ\_M} = \frac{SSE_2 / df_2}{SSE_1 / df_1}$$

Where SSE1 and SSE2 are the sum of squares of the error values of Group 1 and Group 2.

df<sub>1</sub> and df<sub>2</sub> are the degrees of freedom of Groups 1 and 2, respectively.

The degrees of freedom are calculated as df<sub>1</sub> = n<sub>1</sub> - k and df<sub>2</sub> = n<sub>2</sub> - k.

Where n<sub>1</sub>, n<sub>2</sub> are the sample sizes in Groups 1 and 2 after the K-means clustering analysis, k is the number of independent variables.

The null hypothesis (H<sub>0</sub>) is rejected when F<sub>GQ\_M</sub> is greater than F<sub>α,(df<sub>2</sub>,df<sub>1</sub>)</sub> or p-value is less than significance level (α).

The study was conducted under a multiple linear regression model with 3 independent (X) variables, with this format:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon_i$$

where Y<sub>i</sub> is the dependent variable in the observation, where i = 1, 2, ..., n; X<sub>j</sub> is the independent variable, where j = 1, 2, 3; β<sub>0</sub> is the constant or the Y-intercept; β<sub>j</sub> is the regression coefficient; and ε<sub>i</sub> is the errors term. The uniform distribution has a value between 20 and 100, X<sub>j</sub> ~ U(20, 100), where j = 1, 2, 3 produces an error with a normal distribution, ε<sub>i</sub> ~ N<sub>(0,σ<sup>2</sup>(ε<sub>i</sub>))</sub> by specifying format of the heteroscedasticity in 2 formats, 1) Multiplicative Heteroscedasticity v(ε<sub>i</sub>) = σ<sup>2</sup>x<sup>δ</sup><sub>i</sub>; δ = -4, -3.6, ..., 0, 0.4, ..., 4 and σ<sup>2</sup> = 1 and 2) Groupwise Heteroscedasticity

v(ε<sub>i</sub>)  $\begin{cases} 0.1 \text{ if } i \leq n/2 \\ 0.9 \text{ if } i > n/2 \end{cases}$  and v(ε<sub>i</sub>)  $\begin{cases} 0.3 \text{ if } i \leq n/2 \\ 0.7 \text{ if } i > n/2 \end{cases}$  The parameters or the regression coefficients

were specified as  $\beta_0 = 10$ ,  $\beta_1 = \beta_2 = \beta_3 = 1$ . The sample sizes ( $n$ ) in the studies were 20, 30, 60, 120, and 250, and the significance levels for hypothesis testing were 0.01 and 0.05.

Control estimates for type I error by simulating the data for the variance with fixed error. Calculate the test statistics of the modified Goldfeld-Quant test ( $F_{GQ\_M}$ ) and the Goldfeld-Quant test ( $F_{GQ}$ ). The calculated test statistic was compared against the critical value to conclude that it would reject or accept the null hypothesis at the significance level 0.01 and 0.05. Count the number of times the null hypothesis was rejected when the null hypothesis was true. It was repeated 1000 times for each situation by comparing Type I error estimates of the test statistic with Brandley's criteria (1978). If the Type I error estimate ranges from 0.005 to 0.015 at the 0.01 significance level and between 0.025 and 0.075 at the 0.05 significance level, it is concluded that the test statistic can control the Type I error estimate. For comparison of estimated power of the test, it was considered only for the test statistics that can control Type I error by simulating the data to have the heteroscedasticity. Calculate test statistics of the modified Goldfeld-Quant test ( $F_{GQ\_M}$ ) and the Goldfeld-Quant test ( $F_{GQ}$ ). Compare the calculated test statistics against critical values to conclude whether to reject or accept the null hypothesis at the significance level 0.01 and 0.05. Count the number of times that the null hypothesis was rejected when the alternative hypothesis was true. Repeat 1000 times for each situation and compare the test power estimates obtained in each situation.

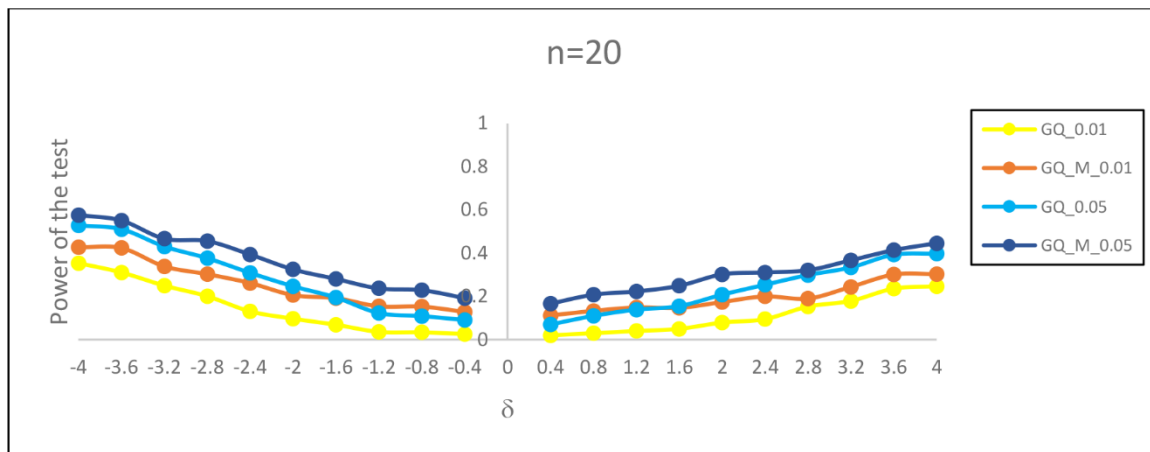
## Results

Comparison of estimated power of the test between the modified Goldfeld-Quant test and the Goldfeld-Quant test under the heteroscedasticity pattern of the multiplicative non-constant aberration variance, it was found that the modified Goldfeld-Quant test cannot control Type I error estimates when sample sizes were 20 and 30 and the Goldfeld-Quant test when the sample size was 20 at the significance level 0.01 and 0.05. It was found that the modified Goldfeld-Quant test and the Goldfeld-Quant test provided similar test power at all sample size of the study and all levels of significance. In addition, the power of the test of the modified Goldfeld-Quant test and the Goldfeld-Quant test tend to increase as the sample size increases. The degree of variance of the error increased ( $\delta = 0.4, 0.8, \dots, 4.0$ ) and the degree of variance of errors reduced ( $\delta = -0.4, -0.8, \dots, -4.0$ ), the test power of both methods is also increased. For heteroscedasticity pattern of the groupwise, it was found that the modified Goldfeld-Quant test cannot control Type I error estimate when the sample sizes

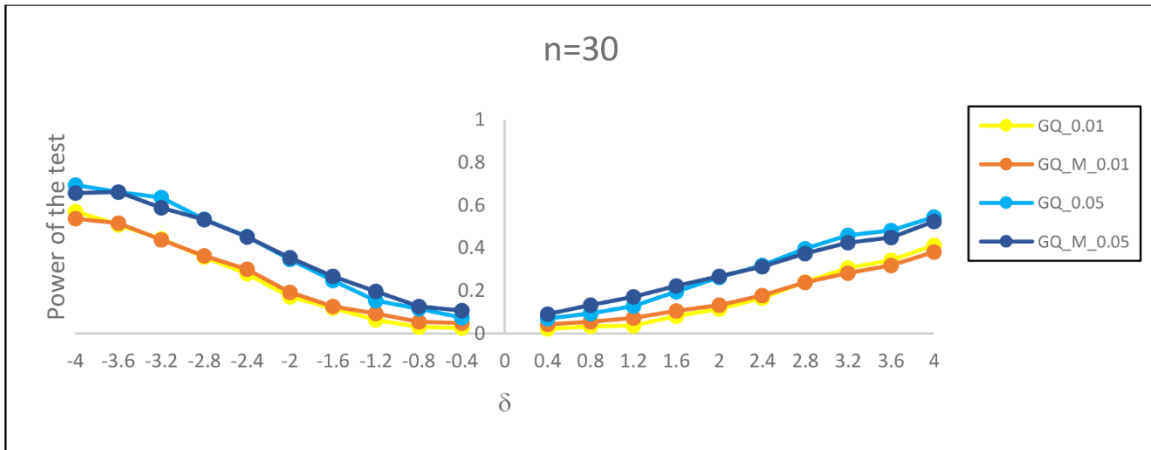
were 20, 30, and 60 at the significance level 0.01 and when the sample sizes were 20 and 30 at the 0.05 significance level and the Goldfeld-Quant test cannot control Type I error estimates when the sample size was 20 at all significance levels. As for the test power estimates, it was found that the modified Goldfeld-Quant test and the Goldfeld-Quant test gave similar test powers across all sample size levels and the modified Goldfeld-Quant test also gave higher test power than the Goldfeld-Quant test when the sample size was 120 at the 0.01 significance level and when the sample size was 60 and 120 at 0.05 significance level.

The test power estimates obtained by simulating data in various situations when specifying the heteroscedasticity in the multiplication pattern and the groupwise pattern are shown in Figure 1 (1.A – 1.E) and Figure 2 (2.A – 2.B), respectively, when the symbols are as follows.

- GQ\_0.01 means the Goldfeld-Quant test at a significance level 0.01
- GQ\_M\_0.01 means the modified Goldfeld-Quant test at a significance level 0.01
- GQ\_0.05 means the Goldfeld-Quant test at a significance level 0.05
- GQ\_M\_0.05 means the modified Goldfeld-Quant test at a significance level 0.05
- n means the sample size of the study
- $\delta$  means the degree of variance of the error in multiplicative pattern
- Power of the test means the test power estimate

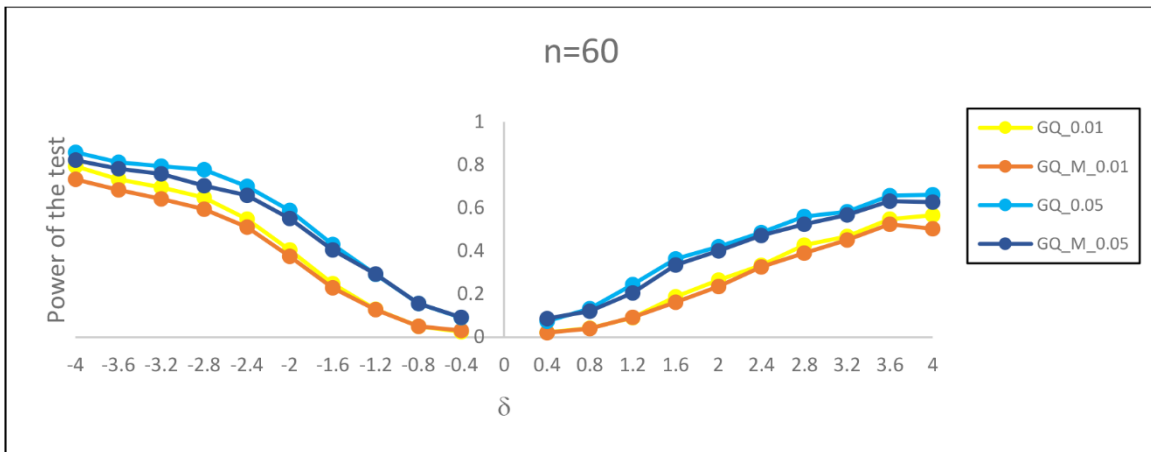


**Note:** Sample size = 20, Type I error estimates cannot be controlled for the GQ\_M test and for the GQ test at significance levels 0.01 and 0.05. (1.A) The sample size is 20.

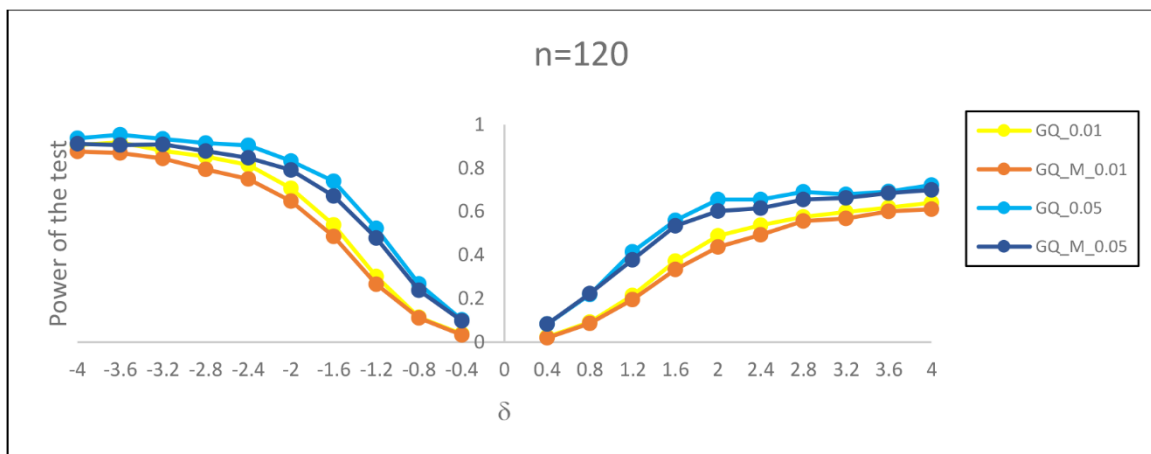


Note: Sample size is 30, The GQ\_M test cannot control estimates of type 1 error.

(1.B) The sample size is 30.

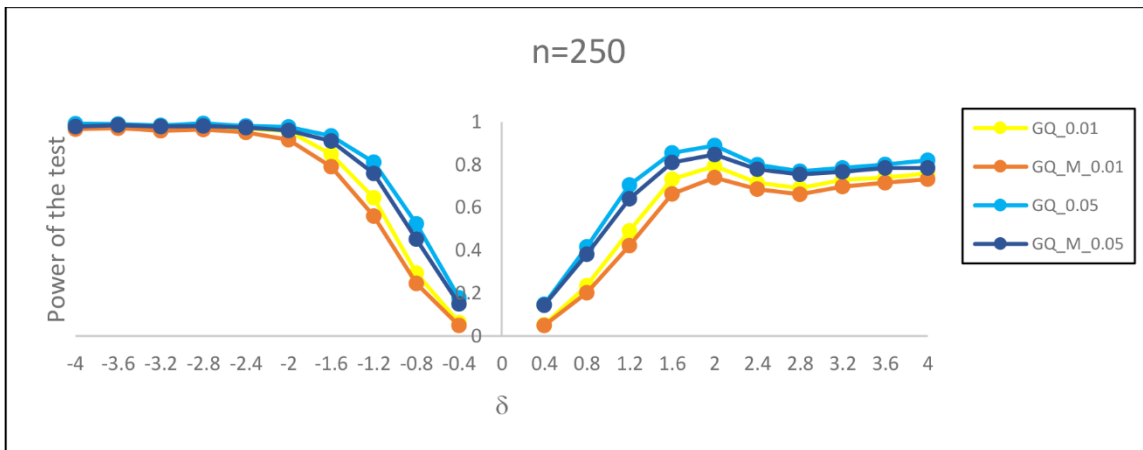


(1.C) The sample size is 60.



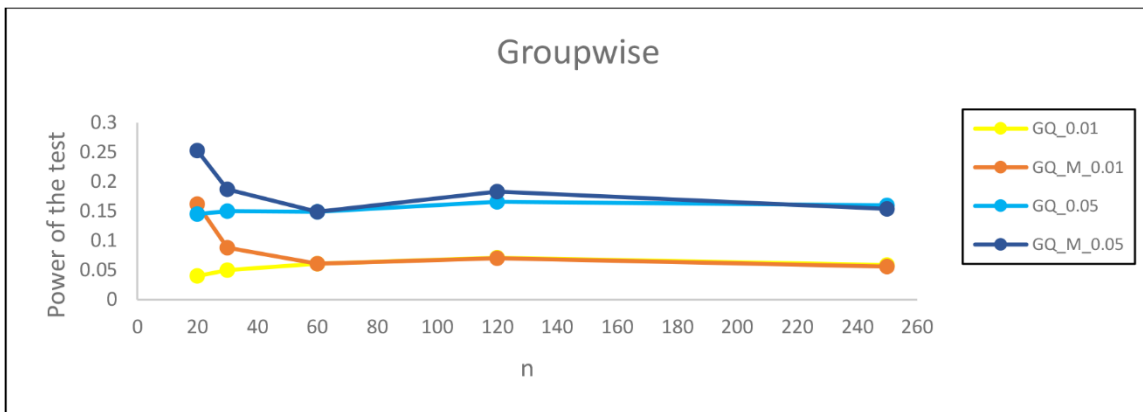
(1.D) The sample size is 120.



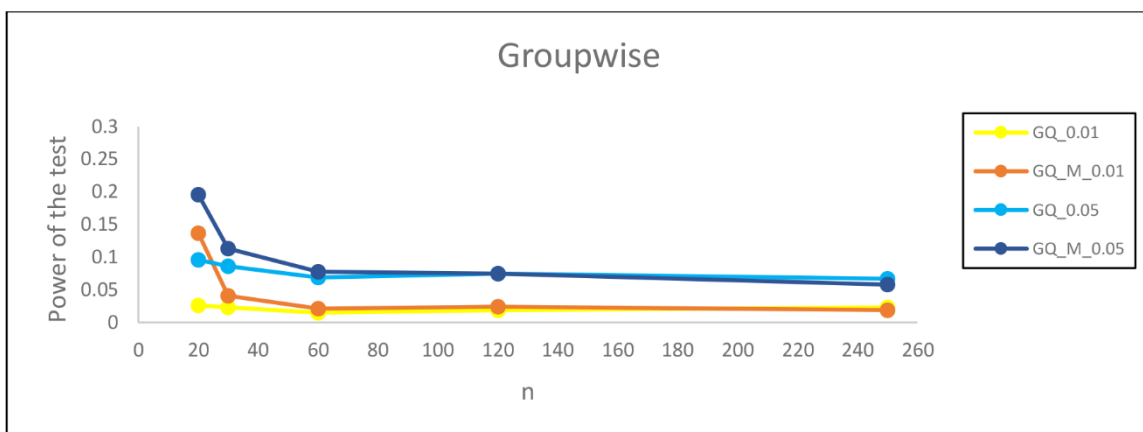


(1.E) The sample size is 250.

Figure1: Test estimated power of the test of the heteroscedasticity in multiplicative pattern.



(2.A) Groupwise Pattern Form 1



(2.B) Groupwise Pattern Form 2

Figure2: The estimated power of the test of the heteroscedasticity in groupwise pattern.

**Note:** Both of groupwise forms cannot control the Type I error estimate at the significance level 0.01 when the sample sizes were 20, 30 and 60 and at the significance level 0.05 when the sample sizes were 20 and 30 for the GQ\_M test and at the significance level 0.01 and 0.05 when the sample size was 20 for the GQ test.

## Conclusion

The Goldfeld-Quant test was able to control Type I errors better than the modified test. In other words, the Goldfeld-Quant test was able to control Type I errors when sample sizes were 30, 60, 120, and 250 in both multiplicative heteroscedasticity and groupwise heteroscedasticity. In case of the multiplicative heteroscedasticity, the modified Goldfeld-Quant test can control Type I errors where the sample sizes are large are such as 60, 120, and 250 at all significant levels and in the case of groupwise heteroscedasticity where the sample sizes were 120 and 250 at the significance level 0.01, and the sample sizes were 60, 120, and 250 at the 0.05 significance level. When considering the comparison of test power estimates in situations where Type I error can be controlled, it was found that the two tests gave approximately the same test power estimates. The modified Goldfeld-Quant test for multiplication pattern provides better test power estimates than the Goldfeld-Quant test when the degree of variance of error was low ( $\delta = -0.8, -0.4, 0.4,$  and  $0.8$ ). As for the groupwise heteroscedasticity, the modified Goldfeld-Quant test had test power estimate higher than the Goldfeld-Quant test especially when the sample size was 60 and 120 at the 0.05 level of significance.

## Reference

- Alabi, O.O., Ayinde, K., Babalola, O.E., Bello, A.H., & Okon, E.C. (2020). Effects of Multicollinearity on Type I Error of Some Methods of Detecting Heteroscedasticity in Linear Regression Model. *Open Journal of Statistics*, 10(1), 664-677.
- Alabi, O.O., Babalola, O.E., Ayinde, K., & Bello, H.A. (2020). Monte Carlos Study on Power Rates of Some Heteroscedasticity Detection Methods in Linear Regression Model Without Multicollinearity Problem. *Computer Science Series*, 18(2), 128-134.
- Bradley, J.V. (1978). Robustness. *British Journal of Mathematics and Statistical Psychology*, 31(2), 144- 151.
- Budka, A., Kachlicka, D., & Kozłowska, M. (2008). Notes on the Use of the Goldfeld-Quandt Test for Heteroscedasticity in Environment Research. *Biometrical Letters*, 45(2), 43-55.
- Carapeto, M., & Holt, W. (2003). Testing for Heteroscedasticity in Regression Models. *Journal of Applied Statistics*, 30(1), 13-20.
- Goldfeld, S.M., & Quandt, R.E. (1965). Some Tests for Homoscedasticity. *Journal of The American Statistical Association*, 60(310), 539-547.
- Greene, W.H. (2009). *Econometric Analysis*. (5<sup>th</sup> ed.). Upper Saddle River, New Jersey, 07458: Prentice Hall.
- Kongsiriwattana, D., (1989). *A comparison of the power of the test statistics for heteroscedasticity in linear regression analysis*. [Master's thesis, Chulalongkorn University]. Chulalongkorn University Intellectual Repository (CUIR) Retrieved from <http://cuir.car.chula.ac.th/handle/123456789/33552>.
- Rana, Md.S., Midi, H., & Imon, A.H.M.R. (2008). A Robust Modification of the Goldfeld-Quandt Test for the Detection of Heteroscedasticity in the Presence of Outliers. *Journal of Mathematics and Statistics*, 4(4), 277-283.

## The Cooperatives Members Demand for Business Credit Service of Kuchinarai Agricultural Cooperatives Limited: The Structural Equation Model Approach

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### Abstract

The research objectives were to study: 1) the causal factors of business operations that influenced the credit service member demand of Kuchinarai Agricultural Cooperatives Ltd., Kalasin province, and 2) the influences of causal factors of the credit service member demand. The study population was the members of the agricultural cooperatives who had long-term and short-term loans from cooperatives and utilized the credit business from the cooperatives, which was composed of 2,450 individuals in the accounting year of 2020. The sample size was calculated by the Taro Yamane formula. It turned out 345 samples. The questionnaire was applied as a data collection tool. Part analysis and Structural Equation Model (SEM) were utilized as the data analysis tools. The research findings expressed as 1) 4 casual factors influenced member credit business service demand which comprised of the serviced cooperatives officers, the procedure of credit operations, place, appliance, office instruments, financial technology, and the provided information to cooperatives members, 2) there were 4 casual factors had both direct and indirect influences on member credit business service demand. The casual factors which had the most influence on member credit business service demand were the factor of place, appliance, office instruments, and financial technology. Kuchinarai Agricultural Cooperatives Limited would make their considerations to apply the financial technology for member credit business service demand to generate the

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efficiency and quality of member credit business service demand and meet the member credit business service demand correctly.

**Keywords:** Credit Business, Kuchinarai Agricultural Cooperatives Ltd.

## Introduction

Kuchinarai Agricultural Cooperative Limited was established on April 20, 1976, located at 94 Moo 15, Kuchinarai Road, Buakhao Subdistrict, Kuchinarai District. Kalasin Province. The cooperatives have a total of 3,473 cooperative members with a total of 5,568,880 shares, representing a total share value. 55,688,800.00 baht. It operates the business with a chair of the Board of Directors which is composed of 15 directors and 13 staff members. Its main businesses are as follows: 1) counting deposits from members, 2) giving credit to members, 3) collecting products from members, 4) procurement of products to sell to members, and 5) processing agricultural products. ([www.cpd.go.th/profile/report](http://www.cpd.go.th/profile/report)). Giving credit to members of agricultural cooperatives is considered a type of business operation at Kuchinarai Agricultural Cooperatives Ltd., focused on credit business by providing credit to cooperative members since the cooperative's inception until now. It is regarded that the credit business is one of the businesses that are important to cooperatives members in terms of taking loans received from credits are used for occupational investments, and agricultural cooperatives earn income from the interest on loans from their members.

**Table 1:** Amount of short-term and long-term loans to members of Kuchinarai Agricultural Cooperatives Limited (Unit: Thai Baht)

Year	Short Term Loan	Long Term Loan	Total
2016	267,727,754.56	3,067,400.00	270,795,154.56
2017	239,367,784.90	3,956,300.00	243,324,084.90
2018	283,258,592.90	3,600,200.00	286,858,792.90
2019	290,112,478.05	1,482,700.00	291,595,178.05
2020	266,023,720.00	3,400,500.00	269,424,220.00
2021	296,023,720.00	3,890,500.00	299,914,220.00

**Source:** Cooperative Auditing Department, Ministry of Agriculture and Cooperatives, 2022

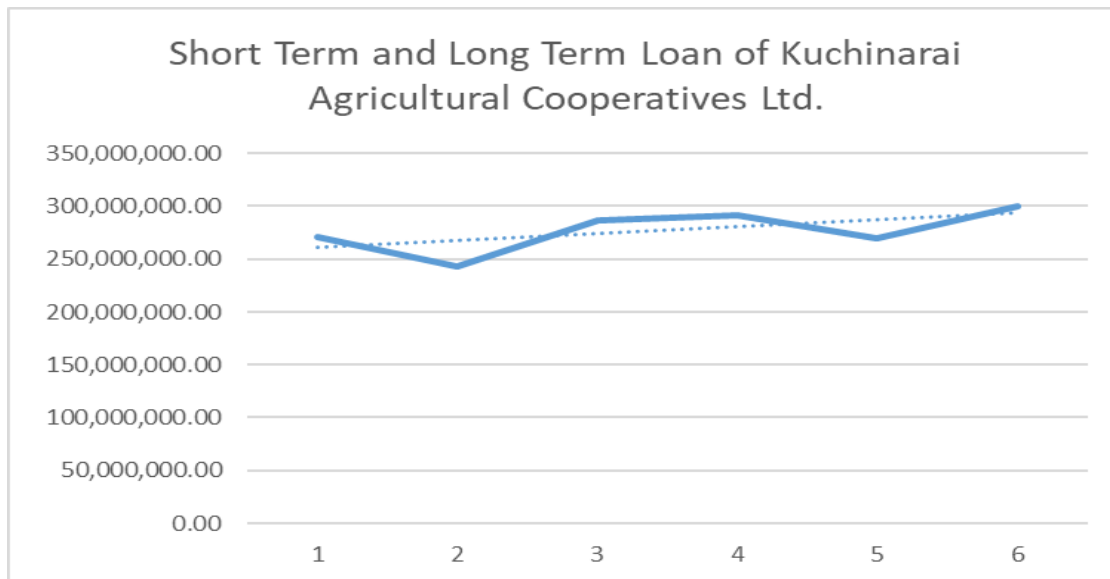


Figure 1 Short-term and a long-term loan amount of members of Kuchinarai Agricultural Cooperative Limited

Table 1 and Figure 1, it showed the amount of short-term and long-term loans to members of the cooperatives from 2016-2021 tends to increase over the past 6 years. Therefore, the use of credit services by members of cooperatives is necessary for members to have their business services loans for both short-term and long-term loans from cooperatives members of the agricultural cooperative as the owner of the cooperative. Cooperatives members are shareholders and customers of the cooperative. They also are service users of credit businesses from agricultural cooperatives. Cooperatives is an organization that provides credit to its members for both short-term and long-term loans as mentioned above. The Cooperatives would like to know which causal factors in business operations influence the credit business services of cooperatives members. In the past, there was no research study conducted on this subject. From the review of the researcher's literature, it was found that no researcher has given importance to studying the causal factors influencing the use of credit services by cooperatives. Therefore, it is interesting for researchers who study research to develop a Structural Equation Model (SEM) as the research tool and to improve the operation development of Kuchinarai Agricultural Cooperatives Ltd. to meet the needs of the members' credit services properly. The SEM research methodology supports the acquisition of reliable findings and is ultimately beneficial to agricultural cooperatives.

## Research Objectives

1. To study the causal factors of business operations that influence the demand for credit business services of members of Kuchinarai Agricultural Cooperatives Ltd., Kalasin Province
2. To study the influence of causal factors of business operations on the demand for credit business services of members of Kuchinarai Agricultural Cooperatives Ltd., Kalasin Province

## Research Methodology

The population was members of the Kuchinarai Agricultural Cooperatives Ltd. which borrowed money from the cooperatives and used the credit business of the Cooperatives in the fiscal year 2019, both short-term and long-term borrowing, totaling 2,450 cooperatives members. The sample size from the population was determined by the Taro Yamane formula to maintain a 95 % confidence level, which can be expressed as follows:

$$n = \frac{N}{1 + N * (e)^2}$$

where n = sample size

N = total number of population

e = error term

$$n = \frac{2,450}{1 + (2,450) * (.0025)} = 345 \text{ people, the sample size was 345 people.}$$

In this research, the researcher used a questionnaire to collect primary data from cooperatives members. The assessment form was a rating scale based on the Likert scale method, which gave a 5-point scale, which was the weight of the opinions of the members of Kuchinarai Agricultural Cooperative Limited as follows:

- 5 = the most
- 4 = a lot
- 3 = medium
- 2 = little
- 1 = minimal



There was a definition of interpretation criteria for rating the average score of opinions of cooperatives members. The score ranges are as follows (Kalaya Wanichbuncha, 2011: 226 - 228).

Average rating	Opinion level
4.50-5.00	at most
3.50-4.49	very much
2.50-3.49	Moderate
1.50-2.49	less
1.00-1.49	minimal

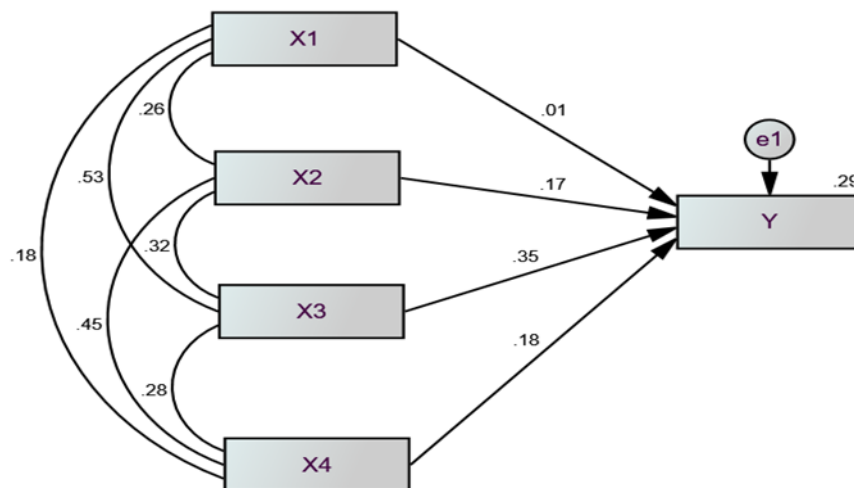
The opinion level from the questionnaire consisted of the 4 factors of Kuchinarai Agricultural Cooperatives business that were causal factors, namely: 1) the staff of the credit business service providers, 2) the process of operating the credit business, 3) factors in terms of location, materials, equipment, the technology of agricultural cooperatives to provide services to members, and 4) information of cooperatives to members of agricultural cooperatives, and the resulting factors were the demand for credit business services of cooperative members.

For the content validity testing of the questionnaire, it was considered as a property of questions that can be measured according to the properties of questions following the research objectives. The correspondence index between the question and the research objectives (Item-Objective Congruence Index: IOC) was identified by 3 experts who considered scoring the IOC value of 0.90 which met the standard score. (Boonchom Srisaard, 2010: 103). For the reliability test of the questionnaire, which was a feature of a confidence measurement tool. The researcher applied 30 pre-tested questionnaires with members of Khao Wong Agricultural Cooperatives Ltd., Kalasin Province. The cronbach's alpha expressed as 0.96 indicating that the questionnaire created by the researcher is reliable. (Kalaya Vanichbuncha, 2012: 440 - 446).

Data were analyzed by Path Analysis to examine the relationship between variables and determine the causal relationship between the variables and the Structural Equation Model (SEM) (Arbuckle, J.L, & W. Wothke, 1999). (Cunningham, E, 2008) applying the Analysis of Moment Structure (AMOS) program to analyze the causal factors influencing the use of business credit services of cooperatives members, and the influence of causal factors of business operations influencing the use of business credit services following the research objectives 1 and 2, respectively.

## Research Results

The research results according to the 1st research objective, the causal factors influencing the use of business credit services of members of Kuchinarai Agricultural Cooperatives Ltd. could be explained by figure 2 as follow:



**Figure 2** Path analysis of the causal factors of business operations that influence the member's credit business service, Kuchinarai Agricultural Cooperative Limited, Kalasin Province

Chi-square ( $p > .05$ ) Root Mean Square Error Approximation (RMSEA) = .075 Goodness of Fit Index (GFI) = .97 Incremental of Fit Index (IFI) = .98 Comparative Fit Index (CFI) = .92

Figure 2. Path analysis of the causal factors of business operations that influence the member's credit business service, Kuchinarai Agricultural Cooperative Limited, Kalasin Province (Standardized Estimates in AMOS Program)

From figure 2, the causal variables were:

X1 = Credit business service officer factor

X2 = Credit business operation procedure

X3 = Factors on location, materials, equipment, and technology of agricultural cooperatives in providing services to members.

X4 = Cooperative Information factors for Agricultural Cooperative Members, and

Y = Demand for Business Credit Services of Kuchinarai Agricultural Cooperatives Members Ltd, based on the causal path analysis of business operations influencing business Credit services of members. It showed that all 4 causal factors directly affected the demand for

business credit services of members, and positively affected the demand for business credit services. There were 4 variables of X1-X4 as exogenous variables, and Y as an endogenous variable, in which the 4 exogenous variables directly affected the endogenous variable (Arbuckle, J.L, & W. Wothke, 1999) (Cunningham, et al. E, 2008) Arbuckle, J.L, & W. Wothke (1999) explained that path analysis was statistical significance expressed that: 1) the relationship between variables in the model must be linear and rational, and 2) the causal path must be a unidirectional system. The relationship between each pair of variables in the schematic must be in the same direction from cause to effect with a path coefficient representing the degree of correlation (Cunningham, E, 2008), which can be seen in Table 2.

**Table 2:** Causal factor variable path coefficients in the model.

Factors in Structural Equation Model	Coefficients of Path Analysis
X1 = staff factor of credit service providers	.01
X2 = credit Business Process Factor	.17
X3 = factors of location, materials, equipment, and technology of agricultural cooperatives in providing services to members	.35
X4 = cooperative information factor for agricultural cooperative members	.18

**Source:** Calculation

**Table 3:** Causal factor covariance in the model.

Causal factor variables in the model	Covariance, causal factor in the model.
X1, X2	.26
X1,X3	.53
X1,X4	.18
X2,X3	.32
X2,X4	.45
X3,X4	.28

**Source:** Calculation

Table 2, it showed that the causal factor variable path coefficient in the model, X3 = factors of location, materials, equipment, and technology of agricultural cooperatives

providing services to members affecting the demand for business credit services of members where the route coefficient was .35, followed by X4 = cooperative information factor for members whose route coefficient was .18, X2 = credit business process factor. The route coefficient was .17, and X1 = credit business service officer factor affected the demand for business credit services of members. Therefore, from the 1st research objective, it could be concluded that the causal variables in the models affected the demand for business credit of members. Also table 2, the results showed that the covariance of the 4 causal factors in the models expressed a positive covariance, indicating that the 4 causal factors had a change in the same direction.

The research results according to the 2<sup>nd</sup> research objective, the influence of causal factors of business operations influencing the use of business credit services of members expressed in table 4 as follows:

**Table 4:** The influence of causal factors of business operations influencing the demand for credit business services among members of Kuchinarai Agricultural Cooperatives Ltd., Kalasin Province

Causal factor variable			Indirect Influence				Sum of Influence	
Causal factor variables in the model	Coefficient	Direct influence	X1	X2	X3	X4	Sum of indirect influence	The Sum of influences included
X1	0.01	0.0001		0.000476	0.001908	0.000324	0.002708	0.002808
X2	0.17	0.0289	0.000476		0.019584	0.01377	0.03383	0.06273
X3	0.35	0.1225	0.001908	0.019584		0.01764	0.039132	0.161632
X4	0.18	0.0324	0.000324	0.01377	0.01764		0.031734	0.064134
<b>Total</b>								<b>0.291304</b>

**Source:** Calculation

From table 4, the results showed that the 4 causal factors influencing the demand for business credit services among members, and applied the analysis results to calculate the direct and indirect effect of the 4 causal factors influencing the demand for business credit business services among members of Kuchinarai Agricultural Cooperatives Ltd. , Kalasin Province. According to the principles of Arbuckle, J.L., & W. Wothke, (1999) and Cunningham, E. (2008), the direct influences of the 4 causal factors were 0.0001, 0.0289, 0.1225, and 0.0324, respectively. The research outcomes also showed that the indirect influence of causal factor

X1 = credit business service officer factor on credit business demand of members and X2 = credit business process factor was 0.000476. The indirect influence of causal factor X1 = credit business process officer factor on members' demand for business credit services and X3 = factors of location, materials, equipment, and technology of agricultural cooperatives providing to members was 0.001908. The indirect influence of causal factors X1 = service staff factor and X4 = cooperative information factor was 0.000324.

Indirect influence of causal factors X2= credit business procedural factor transmitted through causal factors in the model and X1 = credit business service officers factor on credit business demand, equal to 0.000476. Indirect influence of causal factors X2 = credit business procedural factor transmitted through causal factors in the model and X3 = place, material, equipment, technology factor of agricultural cooperatives in providing services to members was 0.019584, and indirect influence of causal factors X2 = credit business procedural factor transmitted through causal factor model X4 = cooperative information input factor to agricultural cooperative members was 0.01377.

The indirect influence of causal factors X3 = factors of location, materials, equipment, and technology of agricultural cooperatives providing services to members through causal factors in the model X1 = factors of credit business service officers was 0.001908. In addition, indirect influence of causal factors X3 = Factors of location, materials, equipment, technology of agricultural cooperatives in providing services to members through causal factors in the model X2 = procedural factors Influence of causal factors X3 = Factors on location, materials, equipment, the technology of agricultural cooperatives in providing services to members through causal factors in the model X4 = Factors in credit business operations. Providing information on cooperatives to members of agricultural cooperatives was 0.01764.

The indirect influence of causal factors X4 = cooperative information factor to agricultural cooperative members and X1 = Credit business service officers factor to the credit business demand of members was 0.000324. The indirect influence of causal factors X4 = cooperative information factor to agricultural cooperative members and X2 = credit business procedural factor was 0.01377, and the indirect influence of the causal factor X4 = cooperative information factor to agricultural cooperative members and X3 = factor of location, material, equipment and technology of agricultural cooperatives in providing services to members was 0.01764.

## Discussion

The research results according to the 1st research objective, analyze the causal factors influencing the use of business credit services of members of Kuchinarai Agricultural Cooperatives Ltd., Kalasin Province. It was found that the 4 causal factors in the model were: X1 = credit business operator staff factor to the demand for credit business services of cooperative members, X2 = credit business process factor, X3 = factors related to place, materials, equipment, the technology of agricultural cooperatives to provide services to members, and X4 = factors of cooperative information to members of agricultural cooperatives. All of them directly affected the demand for business credit services of members. The findings were consistent with research by Shahzad, U., Liu, j., Mahmood, F. and Luo, F. (2021), Silong, A.K, and Gadanakis, Y. (2019). Boon and Patcharee Suriya (2016).

The research results according to 2nd research objective, are the influence of causal factors of business operations influencing the demand for business credit services of members. The results showed that 4 causal factors influenced the demand for business credit services among members. For the causal factor, X3 = factors of location, materials, equipment, and technology of agricultural cooperatives in providing services to members as causal factors influencing the demand for business credit services of members. The results showed that Kuchinarai Agricultural Cooperatives Ltd. should pay attention to all causal factors. In addition, highly influential factors should also be considered, such as location, materials, equipment, technology, and the location of services must be convenient for providing facilitating credit services to cooperative members who were the credit services users. Materials and equipment that are up-to-date and consistent with the services provided to members. The application of financial technology to provide credit services to members. Financial technology application is to develop financial products, services, and innovations with the main target to increase efficiency, convenience, fast, safe, reduce the cost incurred, and meet the demand of agricultural cooperative members as service users and agricultural cooperatives as better service providers. This is consistent with research by Wattanapa Himarat (2016), and Thanaphon Sangchot (2018). Puschmann, T. (2017), and Goldstein. I and Jiang, W. (2019).

## Recommendation

This research analyzes the causal factors of business operations influencing the demand for business credit services of members of Kuchinarai Agricultural Cooperatives Ltd., and the influence of causal factors of business operations influencing the demand for business credit services. Business credit services for members reflected the causal factors influencing the demand for business credit service members. There were 4 causal factors: X1= credit business operator staff factor to the demand for credit business of cooperative members, X2 = credit business operating process factor, X3 = location factor materials, equipment, the technology of agricultural cooperatives providing services to members, and X4 = cooperative information factors for members of agricultural cooperatives. To create the quality of providing business credit services of agricultural cooperatives, which were considered one of the main businesses of Kunarai Agricultural Cooperatives Ltd. In addition, providing short-term and long-term credit services to cooperative members However, agricultural cooperatives had special characteristics that were different from other businesses. That was to say, cooperative members were both owners of the cooperative, members, shareholders, and customers of agricultural cooperatives. Credit and credit services are therefore important businesses that the cooperatives focused on to meet the demand of members. In addition, the service of cooperative members or customers was fully considered important. Providing good services and meeting the member demand was to create satisfaction for cooperative members and customers who received services from the beginning to the end of the service process. Therefore, agricultural cooperatives, which was necessary to impress every part of the service in the credit business for members.

## Suggestions for Future Research

Due to the research outcomes, the researcher focused on applying a causal model to analyze the factors influencing the demand for credit businesses of cooperative members. Subsequently, further research work should include qualitative data such as interviews and forums with stakeholders such as cooperative chairmen, cooperatives members, officers, and management staff so that the further research outcome has more complete.

## Reference

- Anucha Wittayakorn-Puriphanpinyo. (2020). Analysis of Operations and Efficiency of Dairy Cooperative Operations in Nakhon Ratchasima Province. *Sukhothai Thammathirat Journal*, 33(2), 52-68.
- Arbuckle, J.L., & W. Wothke. (1999). *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. New Jersey: Lawrence Erlbaum Association Inc.
- Boonchom Srisaard. (2010). *Preliminary research*. 8<sup>th</sup> edition, Bangkok: Suwiriyasan.
- C Shahzad, U., Liu, j., Mahmood, F. and Luo, F. (2021). Corporate Innovation and Trade Credit Demand: Evidence from China. *Manage Decision Econ*, 12(10), 1–16.
- Cooperative Auditing Department Ministry of Agriculture and Cooperatives. (2561). *Cooperative Financial Information*. Retrieved from [https://www.cad.go.th/main.php?filename=coop\\_situation2](https://www.cad.go.th/main.php?filename=coop_situation2)
- Cooperative Promotion Department Ministry of Agriculture and Cooperatives. (2021). Profile Coop. Retrieved from [www.cpd.go.th/profile/report](http://www.cpd.go.th/profile/report)
- Cunningham, E, (2008). *Structural Equation Modeling using AMOS*. Victoria: Statsline.
- Goldstein. I and Jiang, W. (2019). To FinTech and Beyond. *The Review of Financial Studies*, 32(5), 1647-1661.
- Kalaya Wanichbancha. (2012). *Use of SPSS for Windows in data analysis*. 20<sup>th</sup> edition, Bangkok: Chulalongkorn University Printing House.
- Kanlaya Wanichbuncha. (2011). *Statistical Analysis: Statistics for Administration and Research*. 13<sup>th</sup> printing, Bangkok: Chulalongkorn University Printing House.
- Kuchinarai Agricultural Cooperatives Limited. (2019). Annual Report Kuchinarai Agricultural Cooperatives Limited. Retrieved from [www.kuchinaraicoop.com](http://www.kuchinaraicoop.com)
- La-ong Mantakarn Lae Phichayada Thuanpha. (2018). Factors related to the decision to choose financial services for credit. Thai commercial bank of SMEs entrepreneurs in Ubon Ratchathani Province. *Journal of Management Ubon Ratchathani University*, 7(13), 45-54.
- Patcharin Maboon and Patcharee Suriya. (2016). Factors Affecting Debt Payments of Members of Phu Wiang Agricultural Cooperative Limited, Khon Kaen Province. *Kasetsart Journal*, 44(4), 605-614.
- Pushmann, T. (2017). FinTech. *Business Information System Engineering*, 59(1), 69–76.
- Rural Livestock Farmers in Nigeria. *Agricultural Finance Review*, 80(1), 68-90.



- Silong, A.K, and Gadanakis, Y. (2019). Credit Sources, Access and Factors Influencing Credit Demand among Rural Livestock Farmers in Nigeria. *Agricultural Finance Review*, 80(1), 68-90.
- Thanaphon Saengchot. (2018). *Acceptance of Financial Technology MyMo Mobile Banking Technology Case Study Context of Government Savings Bank*. Master's Thesis, Department of Technology Administration, College of Innovation Thammasat University.
- Wattanapha Himarat. (2016). *Factors Affecting Acceptance of Financial Technology in the Context of Commercial Banks*. Master's Thesis, Technology Administration, College of Innovation, Thammasat University.

## Characteristics and Factors Affecting Learning Organization Personal of The Agricultural Cooperatives Federation of Thailand Limited

Anucha Wittayakorn-Puripunpinyoo<sup>1</sup>

### Abstract

The research objectives were to: 1) study personnel characteristics of learning organization (LO) of the Agricultural Cooperative Federation of Thailand Ltd. (ACFT) following Peter Senge's concept, 2) study factors affected LO of AC following Peter Senge's concept. The population was 1,850 personnel who work in ACFT. Sample size determination was applied Taro Yamane with the statistical significance of 95 percent. It turned out of 400 samples. Primary data were collected by questionnaires. Data analysis was applied to descriptive statistics and multiple regression. The findings were 1) personnel characteristics of LO of the ACFT following Peter Senge's concept found that personal mastery, mental models, and systems thinking had the high level while shared vision and team learning had the moderate level, 2) factors affected Peter Senge's LO of ACFT in terms of operating cost reduction were personal mastery, mental models, shared vision, team learning, and systems thinking prospectively. The ACFT and AC should have the guidelines to encourage, support and develop both organization and every level of personnel to develop towards concrete learning organization emphasized on the 5 elements of LO of Senge's concepts and take the LO concept associated with the organizational strategic plan.

**Keywords:** Learning Organization, The Agricultural Cooperative Federation of Thailand Limited

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## Introduction

The starting point for the learning organization concept, from the writings of Chris Argyris (1957), presented the concepts of organizational behavior and people working in an organization by introducing the Learning Organization concept, which described the learning of those who had their own function as a learning organization originated from Peter Senge's book of the fifth disciplines. The art and practice of the Learning Organization (1990) which discusses 5 disciplines that will lead to a theoretical learning organization.

The learning organization concepts explains that is an organization that has created a channel for knowledge transfer between personnel within acquiring knowledge from outside. The key goal is to provide opportunities for the pursuit of best practices that lead to the development and creation of a concrete organizational knowledge base and to foster learning in the organization.

In the development of the organization to keep up with the changes in society at all levels that occur all the time by emphasizing on the learning that arises from upgrading the ability of personnel or human resources within the organization. The need to learn within the organization at all levels and learning as a team is beneficial to the organization both at the individual, team and organization levels. The development and learning in the organization are also the development of the attitudes of the personnel in the organization and the values, philosophy, vision and organizational culture that are important factors that will facilitate the formation of a learning organization to lead the development of the organization in all dimensions.

The concept of a learning organization is a new paradigm of organizational design to meet the changing economic conditions both nationally and globally. The concept of a learning organization focuses on the development of individuals at both individual and organizational levels by learning to be able to learn from both inside and outside the organization in order to conform to changes in the economy and changing society.

The result of changes in the economic and social system will affect working conditions and working environment and bring society into a knowledge-based society. The use of knowledge of individuals and organizations as tools in work is therefore necessary to achieve work efficiency and competition. It is in the line with changes in economy, society, politics, technology, culture and new innovations that happens all the time. Therefore, both public

and private organizations need to adjust to make survive be consistent and support changes and can compete with competitors. It is one way to adjust the organization and to use information technology in decision making in work to create value and maximum organization benefits.

In this research, the researcher studied the learning organization of the Agricultural Cooperative Federation of Thailand Limited (ACFT), applying the principles and concepts of the learning organization according to the concept of Senge to be applied to the organization of the Agricultural Cooperatives Federation of Thailand Limited by giving importance to being a learning organization of the Agricultural Cooperatives Federation of Thailand Limited.

According to the learning organization concept of Peter Senge (Peter Senge, 1990: 36) in 5 aspects: 1) self-knowledge 2) conceptualism 3) shared vision 4) team learning and 5) systematic thinking from the concept of the 5 principles of the learning organization following the concept of Senge. This will affect the work of the organization that emphasized on the results of work in the aspects of cost reduction in practice as well as factors affecting the organization of learning according to the conceptual framework that the researcher has shown. In this regard, the concepts according to the principles of learning organization in all 5 areas are causal variables. In addition, the other two performance results were variables. According to the conceptual framework that the researcher obtained from the literature review. In this study, the researcher had chosen to conduct a research study with the Agricultural Cooperatives Federation of Thailand Limited because the Agricultural Cooperatives Federation of Thailand Limited is regarded as the leading organization in the operation of Agricultural Cooperatives in Thailand. It was also an organization formed by the gathering of provincial cooperatives across the country whose members are agricultural cooperatives and farmers.

According to the Cooperative Act 1999, the Agricultural Cooperatives Federation of Thailand Limited registered and established on May 30, 1952, has the status of a juristic person under the name Wholesale Cooperative of Thailand Limited Sin Chai and requested to register the name change to The Agricultural Cooperatives Federation of Thailand Limited on October 1, 1975. With members being, the Agricultural Cooperatives Federation of Thailand Limited has approximately 3,900 agricultural cooperatives with a total membership of more than 6,000,000 households, it was established on May 30, 1952, which is 66 years of operation of the Agricultural Cooperatives Federation of Thailand Limited.

The main objective of the establishment of the Agricultural Cooperatives Federation of Thailand Limited under item: 1) providing academic assistance to members and item, and 2)

requesting or receiving academic assistance from the government foreign agencies or any other persons.

It started with the Agricultural Cooperatives Federation of Thailand Limited itself that are ready to be a learning organization to be a model of organizational development and becoming a learning organization among the cooperative's member, which is the basis of becoming a learning organization of the Agricultural Cooperatives Federation of Thailand Limited that the researcher studied are rooted in knowledge management.

This is a management approach within the organization to create the knowledge definitions of the organization and collecting, creating and distributing the organization's knowledge throughout the organization to achieve the continuation of knowledge and apply the knowledge to be useful in the preparation of the strategic plan of the Agricultural Cooperatives Federation of Thailand Limited.

The Agricultural Cooperatives Federation of Thailand Limited has concerned in terms of knowledge management and organization by applying the learning organization principles and concepts as the main idea in formulating the organization's strategy and ultimately affecting the results of operations. In addition, the learning organization concept of the Agricultural Cooperatives Federation of Thailand Limited also included the creation of a learning culture within the organization. This is a collection of existing knowledge which was scattered in the person, or document to develop into a system so that everyone in the organization can access knowledge and develop themselves to be knowledgeable apply the knowledge gained in practice to create efficiency and effectiveness for the Agricultural Cooperatives Federation of Thailand Limited.

## Research Objectives

The researcher has defined 2 research objectives as follows:

1. To study the characteristics of learning organization personnel of the Agricultural Cooperatives Federation of Thailand Limited according to Peter Senge's concept
2. To study factors affecting the learning organization of agricultural cooperatives' member according to the concept Peter Senge's concept

## Conceptual Framework

The researcher developed the research concepts as follows:

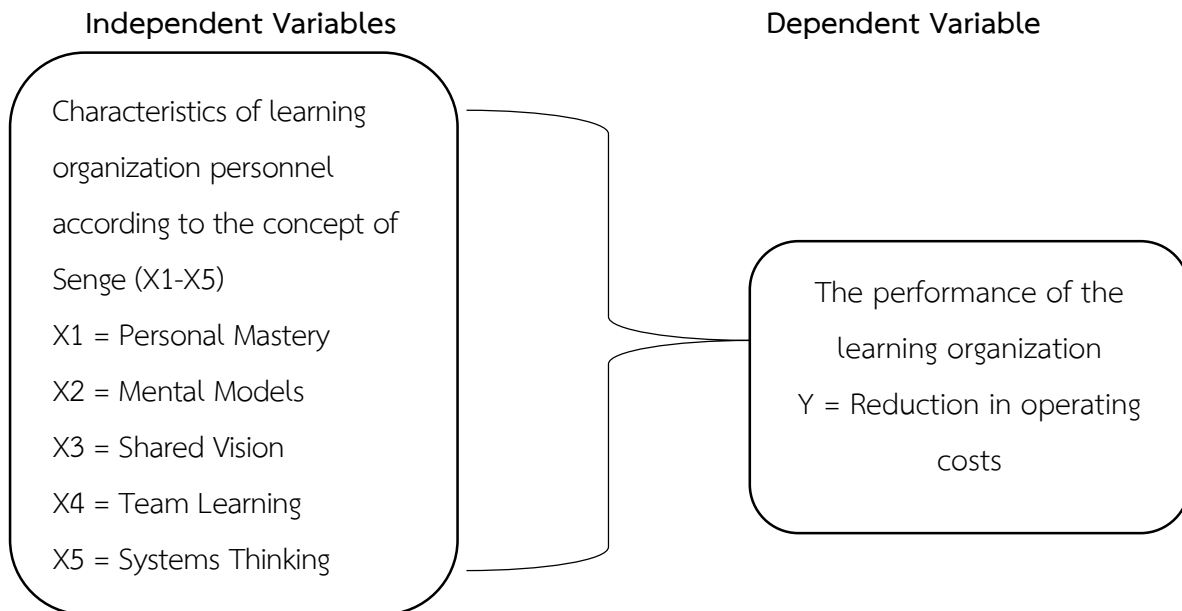


Figure 1 Conceptual Framework

## Research Methodology

### Determination of population and samples

1. Population determination used in this research consisted of members in the Agricultural Cooperative Federation of Thailand Limited which composed of 27,186 people
2. Determining the sample size, the researcher applied Taro Yamane formula to maintain a 95% of confident level from respondents above the sample size of 400 samples will be used.

### Data Collection

The primary data were collected from 400 samples as mentioned before by questionnaire from June to August of 2021.

## Research Tools

The researcher created a research tool by designing a questionnaire. By creating tools and finding, the quality of the tools as follows:

Step 1. Study and research related documents, textbooks and research results to use as a guideline for creating questionnaires to be effective and consistent with the research objectives.

Step 2. Determine the scope and issues of the questions according to the research objectives.

Step 3. Proceed to create a questionnaire by questionnaire consisting of 4 parts:

Part 1: questionnaire on the characteristics of the respondents' personal data.

Part 2: a questionnaire style to choose to answer using a rating scale according to the Likert method which was a factor that affected personnel of a learning organization according to Peter Senge's learning organization concept which were: 1) personal mastery, 2) mental models, 3) shared vision, 4) team learning, and 5) systems thinking.

Part 3: a questionnaire type that chooses to answer the rating scale according to the Likert method which asked about the performance of personnel in the organization in the cost reduction in operations.

According to the quality measurement of data collection tool, Reliability and validity were applied with the concepts used to evaluate the quality of research. They indicated how well a method, technique or test measure of questionnaire. Reliability test was about the consistency of a measure while validity was focused on the accuracy of a measure. Moreover, it was important to consider reliability and validity when the researcher was creating the research design, planning methods, and writing up the results. For reliability test, the researcher applied Cronbach's alpha statistics, it turned out with 0.95 of Cronbach's alpha value which clarified that the questionnaire built was significantly reliability. For the evaluation of content validity, the most important validity was the content validity. This meant that the extent to which the instrument was measured. The expert judgment was the practical approach to estimating the content validity. By doing that the researcher requested 5 experts to judge each item whether it really measured the expected attribute. The Item Objective Congruence (IOC) index was used as the basis for screening the item quality. In each item, the experts were asked to determine the content validity score. It finally turned out of 0.90 of IOC, which statistically clarified the content validity.

## Data Analysis

According to the 1st research objective, the researcher applied arithmetic mean and standard deviation for data analysis. Inferential Statistics by using multiple linear regression equation to estimate the regression coefficient with the ordinary least square method of parameters estimation to answer the 2nd research objective. Linear regression equation can be represented by equations (3.1) as follows:

$$\hat{Y}_1 = \hat{\beta}_0 + \hat{\beta}_1 * X_1 + \hat{\beta}_2 * X_2 + \hat{\beta}_3 * X_3 + \hat{\beta}_4 * X_4 + \hat{\beta}_5 * X_5 + \text{error term} \dots\dots(3.1)$$

Where:

The independent variables consisted of:

X1 = Personal Mastery

X2 = Mental Models

X3 = Shared Vision

X4 = Team Learning

X5 = Systems Thinking

The dependent variable consisted of:

Y = The reduction in operating costs

## Results

Part 1: Characteristics of learning organization personnel of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Sange explained in Table 1.1 – 1.5, which can be described as follows:

**Table 1.1:** Characteristics of personnel organizations of self-knowledge learning organizations of the Agricultural Cooperatives Federation of Thailand Limited

n. = 400			
Personal Mastery	Mean	Standard Deviation	Interpretation
1. Commitment to lead the organization towards the excellence	4.33	0.60	The Most
2. Commitment to continuous creativity and development	4.53	0.50	The Most



**Table 1.1:** Continued

Personal Mastery	Mean	Standard Deviation	Interpretation
3. Personnel have a sense of responsibility to work towards success every time	4.60	0.49	The Most
4. Having the learning about the job, including studying, researching, learning from the study of things for progress	4.19	0.60	A Lot
5. There is pursuing knowledge to increase the potential of work to achieve the goals set	3.42	0.47	A Lot
6. Having the learning or following new knowledge to cause development and timely	3.42	0.49	A Lot
7. Using data for analysis and decision making in work	4.01	0.50	A Lot
8. Accepting the reasons or opinions of colleagues	4.00	0.49	A Lot
9. Ability to analyze events from multiple perspectives	3.40	0.67	Moderate
10. Having the skills in analyzing problems to be a model for the next development	3.94	0.71	A Lot
11. There is extensive synthesis of information obtained from learning sources.	2.59	0.92	Little
12. There is a way of thinking that can lead to a structured operation.	3.19	0.56	Moderate
13. There is consultation in planning the work.	2.97	0.69	Moderate
<b>Total average</b>	<b>3.74</b>	<b>0.59</b>	<b>A Lot</b>

**Source:** Calculation

From Table 1.1, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of their personal mastery at a high level. ( $\bar{X} = 3.74$ ). Characteristics of personnel in the Agricultural Cooperative Federation of Thailand Limited with the highest average level were personnel who had a sense of responsibility to work towards success every time. ( $\bar{X} = 4.60$ )

**Table 1.2:** Characteristics of personnel of learning organizations on the Agricultural Cooperative Federation of Thailand Limited

n. = 400

Mental Models	Mean	Standard Deviation	interpretation
1. Bringing various problems that occur during work to analyze and find better alternatives	3.37	0.49	Moderate
2. Various problems that occur during the operation are analyzed and find better alternatives	3.28	0.88	Moderate
3. There is an exchange of knowledge and work experience with colleagues.	3.37	0.39	Moderate
4. Always try to find the best way to apply to work	3.96	0.37	A Lot
5. Able to adjust the way of thinking and working according to the situation	3.63	0.23	A Lot
<b>Total average</b>	<b>3.52</b>	<b>0.47</b>	<b>A Lot</b>

Source: calculation

From Table 1.2, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of the mental models at a high level. ( $\bar{X} = 3.52$ ) Characteristics of personnel in the Agricultural Cooperatives Association of Thailand Limited that had a high average level which composed of personnel who were always trying to find the best way to apply to their work. ( $\bar{X} = 3.96$ ).

**Table 1.3:** Personnel characteristics of learning organizations in relation to the joint vision of the Agricultural Cooperative Federation of Thailand Limited

n. = 400

Shared Vision	Mean	Standard Deviation	Interpretation
1. The organization analyzes the environment to find strengths, weaknesses are opportunities to develop into the vision of the organization.	4.63	0.48	The Most
2. Having the opportunity to participate in setting the vision of the organization	3.65	0.6	A Lot

Table 1.3: Continued

Shared Vision	Mean	Standard Deviation	Interpretation
3. The organization has a clear image that makes you want to integrate to achieve goals for the future of the organization.	4.11	0.89	A Lot
4. To be encouraged to work together to realize the goals of the organization	4.14	0.68	A Lot
5. Understand the mission of the organization	4.11	0.36	A Lot
6. Expression of common corporate values	3.26	0.36	Moderate
7. The opportunity to participate in the creation of activities for the reputation of the organization	2.66	0.59	Moderate
8. Development and creation of new works with others on a regular basis	3.26	0.39	Moderate
<b>Total average</b>	<b>3.37</b>	<b>0.52</b>	<b>Moderate</b>

Source: calculation

From Table 1.3, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of common vision at a moderate level. ( $\bar{X} = 3.37$ ) The characteristics of personnel in the Agricultural Cooperatives Association of Thailand Limited had the highest average level. Weaknesses are opportunities to develop into the vision of the organization. ( $\bar{X} = 4.63$ )

Table 1.4: Characteristics of learning organization personnel in teamwork of the Agricultural Cooperatives Federation of Thailand Limited

n. = 400

Team Learning	Mean	Standard Deviation	Interpretation
1. Acquiring knowledge from the organization to encourage teamwork or group work.	4.43	0.50	The Most
2. Team members are learning at the same time. each other and exchange ideas with each other	4.17	0.67	A Lot
3. Members in the team always have innovative ideas.	3.53	0.68	A Lot

Table 1.4: Continued

Team Learning	Mean	Standard Deviation	Interpretation
4. Employees and fellow team members understand the work process of the organization the same as everyone.	3.24	0.73	Moderate
5. Personnel and fellow team members have a good relationship with each other in the organization.	3.86	0.68	A Lot
6. Employees and fellow team members have set the criteria for the success of the work together.	2.81	0.94	Moderate
7. Personnel and fellow team members learn information to discuss and summarize the best approach of the team.	3.16	0.90	Moderate
8. Staff and fellow team members have follow-up together.	2.68	0.69	Moderate
9. Employees and fellow team members evaluated together.	2.94	0.39	Moderate
10. Your personnel and cooperatives systematically managed.	3.26	0.80	Moderate
11. Personnel and colleagues or fellow members understand the infrastructure of the organization	4.07	0.77	A Lot
12. Personnel and colleagues or fellow members have a clear and systematic division of responsibilities.	3.40	0.98	Moderate
<b>Total average</b>	<b>3.14</b>	<b>0.59</b>	<b>Moderate</b>

Source: calculation

From Table 1.4, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of team learning at a moderate level. ( $\bar{X}$  = 3.14) The characteristics of personnel with the highest average level were personnel in the Agricultural Cooperative Federation of Thailand Limited, who received knowledge from the organization to promote working as a team or group. ( $\bar{X}$  = 4.43)

**Table 1.5:** Characteristics of systematic thinking learning organization personnel of the Agricultural Cooperatives Federation of Thailand Limited

n. = 400

Systems Thinking	Mean	Standard Deviation	Interpretation
1. Having an understanding that oneself is an important part of the organization as other parts of the organization	4.43	0.80	The Most
2. The vision of the organization has been integrated into the operation systematically.	4.11	0.87	A Lot
3. There is a link to the work that is involved in the development of the present and future work.	4.30	0.78	A Lot
4. Having creativity in various works considering the current reality in a stepwise manner	3.30	0.73	Moderate
5. Having the ability to develop their own learning systematically	3.24	0.98	Moderate
<b>Total average</b>	<b>3.97</b>	<b>0.67</b>	<b>A Lot</b>

**Source:** Calculation

From Table 1.5, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of team learning at a high level. ( $\bar{X}$  = 3.97) The characteristics of personnel in the Agricultural Cooperatives Federation of Thailand Limited had the highest average level, namely, the personnel had the perception that they were part of the same importance as other parts of the organization. ( $\bar{X}$  = 4.43)

Part 2: Factors affecting the learning organization of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Senge explain by Table 1. 6 as follows:

**Table 1.6:** Factors affecting the learning organization of organization of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Senge

Independent variable (X)	Dependent variable (Y)
Characteristics of learning organization personnel	Reducing operating costs (Y1)
Personal Mastery (X1)	0.17***
Mental Models (X2)	0.47***
Shared Vision (X3)	0.59***
Team Learning (X4)	1.52***
Systems Thinking (X5)	0.60***
F	365.09
$\chi^2$	0.98

**Source:** Calculation

\*\*\*Statistically significant at 0.01 level

\*\* statistically significant at the 0.05 level

\*. statistically significant at the 0.10 level

From Table 4. 16, the learning organization factors of the member agricultural cooperatives according to Peter Senge's concept of reducing operating costs (Y1) consisted of five factors: 1) Personal Mastery (X1), 2) Mental Models (X2), 3) Shared Vision (X3), 4) Team Learning (X4), and 5) Systems Thinking (X5). The learning organization of the member agricultural cooperatives according to Peter Senge's concept of cost reduction (Y1), all five factors were statistically significant at the 0.01 level. The researchers were able to describe each learning organization factor of the member agricultural cooperatives according to Peter Senge's concept of reducing operating costs (Y1) in each factor are as follows:

1) The Personal Mastery of the personnel of the member agricultural cooperatives according to the concept of Peter Senge had a positive effect on the cost reduction in operations, that was, the increase in the self-knowledge of the personnel of the member agricultural cooperatives by 1 unit will result in The reduction in operating costs of member agricultural cooperatives by 0.17 units meant that when personnel in member agricultural cooperatives It was determined to lead the organization to excellence and continually develop its work.

2) The concept of Peter Senge member agricultural cooperative personnel had a positive effect on cost reduction in operations. That was to say, the concept of personnel in member agricultural cooperatives increases by one unit, resulting in an increase in innovation capacity by

0.47 units that occurred while working to analyze and found the better alternatives in the next operation and exchange knowledge including the experience of working with colleagues in member agricultural cooperatives. In addition, personnel in member agricultural cooperatives are always trying to find the best way to adapt to their work and to adjust their thinking. Furthermore, how to work in accordance with the situation and bring new ideas used to develop the work to be better always.

3) The shared vision of Peter Senge's member agricultural cooperative personnel had a positive effect on reducing operating costs. In other words, the increase of personnel in member agricultural cooperatives by one unit resulted in a reduction in operating costs by 0.59 units. The personnel in the organization analyzed the environment in the organization to find strengths. Weaknesses were opportunities to develop into the vision of the organization. In addition, members of agricultural cooperative personnel had the opportunity to participate in setting the vision of the organization such as brainstorming sessions. Suggesting guidelines that were beneficial to member agricultural cooperatives, etc., including the organization having a clear image that makes personnel wanted to integrate together to achieve goals for the future of the organization such characteristics would be affected the cost reduction in the operation of member agricultural cooperatives.

4) Team learning by Peter Senge member agricultural cooperative personnel positively affected operational cost reduction. The research result expressed that the reduction of operating costs increased by 1.52 units, such as the fact that personnel in member agricultural cooperatives received knowledge from the organization to promote teamwork or group work. Also personnel in the team were learning at the same time and exchanging opinions with each other. Including the personnel in the team always have the initiative to create new things. Employees understand the work process of the organization the same as everyone. In addition, staff members have a good relationship with each other in the organization and work as a team in which the success criteria of the work are set together. The information is learned in the work to discuss and summarize the best approach of the team. Team members are monitored and evaluated working together. Personnel have an understanding of the organization's infrastructure. In addition, at work every time Personnel have a clear and systematic division of duties and responsibilities in their work. The team-based learning of the members of the agricultural cooperatives will result in a reduction in operating costs. Especially the reduction of losses or mistakes that occur in the operational processes of member agricultural cooperatives.

5) The systematic thinking of the personnel of the member agricultural cooperatives according to Peter Senge's concept has a positive effect on the cost reduction in operations. Work 0.60 units, for example, agricultural cooperative personnel members have integrated the vision of the organization in systematic operations and linking past performance to current and future work development. In addition, there are agricultural cooperative personnel members who have initiatives to create various works. Taking into account the current reality in a stepwise manner this will cause a reduction in operating costs of member agricultural cooperatives.

## Conclusion

Characteristics of learning organization personnel of the Agricultural Cooperative Society of Thailand Limited and member agricultural cooperatives based on the concept of Peter Senge. It consists of 5 disciplines of being a learning organization. Characteristics of learning organization personnel of the Agricultural Cooperatives Association of Thailand Limited, by personnel characteristics of the learning organization in 5 aspects, in descending order as follows: 1) Systems Thinking 2) Personal Mastery 3) Mental Models 4) shared vision and team learning, respectively.

Factors affecting the learning organization of agricultural cooperatives according to the concept of Peter Senge affecting the reduction of operating costs (Y1) consists of 5 factors: 1) Personal Mastery (X1), 2.) Mental Models (X2), 3) Shared Vision (X3), 4) Team Learning (X4), and 5) Systems Thinking (X5), with a statistical significance of 0.01, these 5 factors contributed to becoming a learning organization in reducing operating costs.

The factors influencing the effect of Peter Senge's conceptualized learning organization on the innovation capacity of member agricultural cooperatives are listed in the following order: team learning common vision systematic thinking Thought patterns and self-knowledge, respectively. The results of this research are consistent with the research of Kusol Thongwan (2010), Watjanarat Krai. (2010). Somchai Ratanakot and others (2015), Anan Boonsanong (2016). Supannikar Jitchu (2017) and Patcharakan Methaakkarakiat and Prasopchai Phasunon (2018) Chow., C. K W, and Tsui., w. H. k. (2017). that factors in the use of technology will influence the results of being a learning organization in both aspects of member agricultural cooperatives, namely reducing operating costs and creating innovations in member agricultural cooperatives.



## Reference

- Agricultural Cooperative Association of Thailand Limited Retrieved on January 13, 2018 from [www.co-opthai.com](http://www.co-opthai.com).
- Altinay, F. Dagli, G., and Altinay, Z. (2016). The role of information technology in becoming learning organization. *Procedia Computer Science*. 26(102), 663 – 667.
- Argyris, Chris and Donald A. Schon. (1978). *Organization Learning: a Theory of Action Perspective*. Massachusetts: Addison-Wesley.
- Barnard, c.l. (1972). *The Function of the Executive*. Massachusetts: Harvard University Press.
- Bodin Vikram. (2005). *Development of a learning organization*. Bangkok: Expernet. Retrieved from Marquardt M.J.2002. Building the Learning Organization: Mastering the five Elements for Corporate Learning. California: Davies Black Publishing.
- Buppha Phuangmalee. (1999). Perception of a learning organization in the nursing department of government hospitals in Bangkok. Thesis, MBA (Marketing). Bangkok: Graduate School. Chulalongkorn University. Photocopy.
- Chamnan Nimnuan. (2017). Knowledge Management of Military Organizations: A Case Study of the Air Force, *Sripatum Academic Journal*, 10(1), 69-79.
- Chamrieng Waiwat; and Benjamas Amphan. (1997). *The Five Principles of Organizational Discipline for Learning*. (2<sup>nd</sup> Edition). Bangkok: Competitors.
- Chantana Muangchan. (1999). *Vision of Educational Institution Administrators*. Bangkok: Chanthip.
- Chow., C. K W, and Tsui., w. H. k. (2017). Organizational learning, operating costs and airline consolidation policy in the Chinese airline industry. *Journal of Air Transport Management*. 16(63), 108-118.
- Critic Panich. (2004). *School of Quality and Creativity*. Bangkok: Office of the Education Council Secretariat.
- Department of Academic Affairs. (2001). *Quality Assurance in Educational Institutions at Level 3 Education Level 3: School Quality Management Guidelines*. Bangkok: Teachers Council of Thailand Printing House. Ladprao.
- Donyawan Leelasuphaphong. (2011). *Characteristics of employees and organizational performance according to the concept of learning organization*. Case study of a fast food company. Master of Business Administration Thesis Department of Management. Srinakharinwirot University.

- Egan T.M. (2014). Measuring the Impact of Learning Organization on Job Satisfaction and Individual Performance in Greek Advertising Sector *Procedia . Social and Behavioral Sciences*, 43(175), 367 – 375.
- H, Bahar Asci, Fatma. Z.T., and Altinas, F. (2016). A Strategic Approach for learning Organizations: A Mental Models. *Social and Behavioral Science*, 58(235), 2-11.
- Harell., F. E., (2019). *Regression Modeling Strategies with Applications to Linear Models, Logistic Regression, and Survival Analysis*. New York City: Springer.
- Husseina H., Omara, S. Noordina, F, Ishaka, N.A. (2016). Learning Organization Culture, Organizational Performance and Organizational Innovativeness in a Public Institution of Higher Education in Malaysia: A Preliminary Study. *Procedia Economics and Finance*. 7(37), 512 – 519.
- Kalaya Wanichbancha. (1999). *Data Analysis with SPSS for Windows*. Bangkok: Chulalongkorn University Printing House.
- Kalaya Wanichbancha. (2003). *Statistical Analysis: Statistics for Decision Making*. 6<sup>th</sup> printing Bangkok: Chulalongkorn University Printing House.
- Khunsoonthornkit, A.and Panjakajornsak, V. (2018). Structural equation model to assess the impact of learning organization and commitment on the performance of research organizations. *Kasetsart Journal of Social Sciences*. 39(3), 457-462.
- Kiatkong Khumpairrote (1994). Performance Assessment, *Khon Journal*, (January-March).
- Kidanon Malithong. (1997). *Educational technology and innovation*. Bangkok: Chuan Pim.
- Kittikhun Thitsomkul. (2017). *Organization of learning that affects the performance of personnel of the Royal Thai Air Force Command Development Squadron*. Royal Thai Armed Forces Headquarters (Master of Public Administration Thesis). Rajabhat Rajabhat University, Chachoengsao.
- Kusol Thongwan. (2010). The relationship of factors promoting being a learning organization to the level of learning organization birth. and the level of being an innovative organization: a case study of the National Science and Technology Development Agency. *Journal of Payap University*. 21(1), 222-247.
- Luan Saiyot and Angkana Saiyot (1995). *Educational research techniques*. Bangkok: Suwiriyasas.
- Luan Saiyot and Angkana Saiyot. (1997). *Research Statistics*. Bangkok : Suwiriyasas.
- Luechai Phancharoenkit. (1997). *Organization development based on the concept of learning organization: a case study of The Siam Commercial Bank Public Company Limited*. Bangkok: Graduate School of Chulalongkorn University. Photocopy.

- M.Murat Yaşlıoğlu, Ömer Şapb, and Duygu Topluca. (2014). An Investigation of the Characteristics of Learning Organizations in Turkish Companies, *Scale Validation*. 37(150), 726 – 734.
- Manida Luesaiwong. (2008). *Opinions of employees with factors that support the creation of a learning organization: a case study of Kasikorn Bank Public Company Limited*. Management). Bangkok: Graduate School Srinakharinwirot University. Photocopy.
- Marquardt, M.J and Reynolds, A. (1994). *The Global Learning Organization*. New York: Irwin.
- Nittaya Duangprasert. (2007). *Employees' Opinions towards Being a Learning Organization: A Case Study of Siam Commercial Bank Public Company Limited, Watchyothin Branch*. Thesis material M.Ed. (Educational Administration). Bangkok: Graduate School Kasetsart University. Photocopy.
- Nutthaphan Ketchonan. (2005). Learning Organization. Retrieved on December 8, 2009 from [www.wasant.org/knowledge/tutor/km18.php](http://www.wasant.org/knowledge/tutor/km18.php).
- Pananan Kosinanon. (2017). *Research report on the development of Rajapruek College as a learning organization Bangkok*. Ratchaphruek College.
- Pansri Srichantuk. (2011). *Factors affecting being a learning organization of support personnel: a case study of Rajamangala University of Technology Isan*. Independent study and research, Master of Business Administration. Rajamangala University of Technology Isan.
- Parichat Sangkanan. (2004). Smart Organization: Learning Organization. Retrieved on June 15, 2008 from <http://www.cdd.go.th/morchorchor/learnmorchor.doc>.
- Patcharakan Methaakkarakiat and Prasopchai Phasunon. (2018). *Factors affecting being a learning organization of the Office of the Board*. Basic education. *Veridian E-Journal, Silpakorn University, Thai version, Humanities, Social Sciences and Arts*, 11(1), 44-60.
- Payom Wongsarsri (1987). *Personnel Management*. Bangkok : Phranakorn Panich Printing House.
- Pedler, M., Burgoyne, J. and Boydell, T. (1991). *The Learning Company: A strategy for Sustainable Development*. Berkshire: McGraw-Hill.
- Peerawat Jarudul. (1998). *Implementing the concept of learning organization in the Government Savings Bank*. Research papers R.P.M. (Public Administration). Bangkok: Graduate School Chulalongkorn University. Photocopy.
- Praphan Surihan. (1999). *Management theory*. Bangkok: Srinakharinwirot University.
- Puangrat Kasetphaet. (2000). *Strategic planning of educators*. Bangkok: Suwiriyaarn.

- Senge, Peter M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday Currency.
- Su Chao Chang and Ming Shing Lee (2007). A study on relationship among leadership, organizational culture, the operation of learning organization and employees' job satisfaction, *The Learning Organization*, 14(2), 155-185.
- Teerasak Akaravorn. (2001). *Being a Thai teacher*. Bangkok: Kor Phon Phim (1996).
- Thiphawan Lorsuwanrat. (2006). *Modern Organization*. Bangkok: National Institute of Development Administration.
- Thitiporn Phiboonwong. (2016). *Guidelines for developing a learning organization of the Government Savings Bank Region 14*. Master of Business Administration Thesis Department of Public Management. College of Commerce Burapha University, Chonburi.
- Watjanarat Krai. (2010). *Factors Affecting Being a Learning Organization: A Comparative Study Between Government Organizations and Private Organizations*. Graduate School. Department of Public Administration. Faculty of Management Science (Public Administration). Prince of Songkla University.
- Wichai Wongyai. (1999). Learning Organization. *Education*, (September-December, 1999), 9-11.
- Zeynep Kabadayı Kuşcu, Müjdelen Yenerb, F. and Gülruh Gürbüzc. (2015). Learning Organization and its Cultural Manifestations: Evidence from a Global White Goods Manufacturer. *Social and Behavioral Sciences*, 52(210), 154 – 163.

## Why don't Thais Watch Thai Films? A Study of Possible Factors and Solutions

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### Abstract

In the last decade, there has been a declining popularity in Thai films, as indicated by the downward trend of the total revenues of the national film industry. This study aims to investigate the influence of three potential factors, including movie genre, plot, and actor list. Twelve movies were randomly selected to be samples for this study. Thirty-nine participants

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were asked to rate their satisfaction with each factor of the samples. Pearson' s correlation analysis was then employed to examine the interrelationship between each factor and the movie's total gross. Time series plots were also drawn to show the change of the three factors over time. The results indicate that the satisfaction ratings of the three factors considerably dropped during the years of 2011 to 2016, but that the three factors do not significantly correlate with income. To gain the popularity of Thai films, as suggested by some experts in this industry, modernizing all factors related to film production, lowering the content restrictions on movies, cracking down on film piracy, and raising financial support could be possible solutions.

**Keywords:** Thai Films, Popularity, Genre, Plot, Actor

## Introduction

Thai films were once very popular, and Thai film producers profited handsomely from them (Angkulanon, 2018). Some Thais love watching Thai films since they depict Thai customs and cultures and reflect Thai common practice. However, during the past decade, there has been a downward trend in the popularity of Thai films. The total amount of income from Thai films has been lower than other foreign films (Angkulanon, 2018; Lopattananont et al., 2020). According to Lopattananont et al. (2020), the total revenue of this movie industry gradually dropped from 1,260 million baht in 2011 to around 600 million baht in 2016. Angkulanon (2018) also revealed that Thai films accounted for only 11 per cent of the market share in 2017. Unfortunately, the literature review finds a deficiency in the research that primarily investigates the factors influencing this downward trend.

There might be a number of factors that influence the decline in popularity of Thai films. For instance, Thai films have been viewed by many Thais that their production is shoddy, their plots are boring, their climaxes and turning points are predictable, and Thai film viewers have become bored of the same old style (Komchadluek, 2017; Lappanich, 2020). Filmmakers tend to produce only a few movie genres, such as romance, comedy, and horror. These lead to a decline in interest in domestic films (Thairath, 2015). Nevertheless, it is still unclear what factors Thai movie viewers consider while selecting a film at a cinema.

This study, therefore, aims to investigate the effects of some potential factors (genre, plot, and list of actors) on the popularity of Thai films based on the perspectives of Thai moviegoers. This could provide insight into Thai filmmakers to attract more audiences and enhance the competitiveness of the domestic film industry. This paper is organised as follows. After the introduction, Section 2 presents a review of relevant literature to identify some potential factors. This is followed by the methodology in Section 3. Results and discussions are given in Section 4, and conclusions are drawn in Section 5.

## Literature Review

Movie genre, such as adventure, action, sci-fi, comedy, and horror, is one of the factors that moviegoers apply at a cinema. As confirmed by Tselysh (2021), the most popular movies in Russia are those of the entertaining genre. Kanyapong (2020) stated that from 1997 to 2012, the majority of Thai movie genres were comedy, horror, and ladyboys, as these genres were likely to generate the most revenue.

The development of a movie plot is one of the significant problems that Thai filmmakers have faced (Lopattananont et al., 2020). This is confirmed by an interview of a successful acting coach, Warissara Bunrungwach, who has been working in the Thai movie and series industry for many years. She stated on "The Thaiger" Channel on YouTube (published on May 3, 2022) that a major flaw in Thai film quality is the repetition of traditional story lines in Thai films (Thaiger, 2022). The Korean government acknowledged that the movie plot is an important factor in a successful movie. As a result, in 1997, the Ministry of Tourism and Sports in Korea invited experienced screenwriters from around the world and established a research and development (R & D) team to intensively develop international plots that attract the majority of moviegoers (Ruangrong, 2021). Chen and Yang (2021) confirmed that not only the actors' acting skills but also the content and plot of a film were key factors in its success. They studied the ten most popular Chinese films in 2019, viewed on the Douban website. The results showed that 86% and 84% of the respondents preferred the films' plots promoting inspiration and relating to social ethics, respectively.

Another important factor affecting Thai moviegoers' satisfaction is the leading actors. Suwunpukdee and Choompolsathien (2019) investigated Thai viewers' media exposure, viewing habits, attitudes, expectations, and behavioural trends regarding Thai films. The finding showed that the movie genre and major actors have a significant impact on their decisions. Chanrungrameekul (2020) stated that Thai viewers usually choose a film the leading actors of which are famous and are shipped as an imaginary couple on and off the screen. This is added by Kanyapong (2020), stating that although some Thai films lacked advanced computer graphics or were produced on a low budget, the main actors and the creativity of the movies' plots played an important role in attracting Thai viewers.

From the review, the propositions here are that movie genre, plot, and list of actors are likely to be some of the factors affecting the movie selection of Thai audiences. The next section describes the methodology employed to validate such propositions.



## Methods

Twelve Thai movies with a wide range of total revenues, movie genres, and show times were randomly selected and used as case studies. Their total income was set as the response variable, which might be influenced by the three potential factors (movie genre, plot, and list of actors). Purposive sampling, also known as a selective sampling technique, was adopted to select the participants for this study. It is a type of non-probability sampling in which researchers choose samples with specific characteristics or experiences to participate in the survey. Samples are chosen with a view to addressing certain issues raised by a research study (Teddlie and Yu, 2007). The researchers searched the participants, from the lists of their own friends, who had seen all of the twelve movies selected. Finally, 39 participants who met this condition agreed to take part in this study. A Google Form was created to explore their perspectives towards the genre, plot, and list of actors of the chosen Thai films, using a 1–5 Likert scale; (1) = Very dissatisfied, (2) = Dissatisfied, (3) = Neutral, (4) = Satisfied, and (5) = Very satisfied. The questionnaire was distributed through Facebook and Line groups.

In terms of data analysis, mean scores of the respondents' satisfaction ratings when considering movie genre, plot, and list of actors of the twelve movies were calculated. Then, Pearson's correlation analysis was conducted to test the interrelationship between each of the three factors and the response variable. The correlation coefficients and the P-values were calculated using Minitab software, at the 0.05 level of significance. Time series plot was also drawn to further examine the changes of the three factors over time.

## Results and Discussion

There were 39 questionnaires returned, with 21 females (53.8%) and 18 males (46.2%). With regards to the age range, the majority of the respondents are between the ages of 10–20 and between the ages of 21–30, accounting for 15 respondents (38.5%) and 16 respondents (41%), respectively. The number of middle-aged respondents (between 31 and 40 years old) is 5, constituting 12.8%, and the minor group is the respondents who are over 40, recorded as 3 (7.7%). The respondents are also from different regions in Thailand. The results show that 9 (23.1%) of the participants are from the north-eastern region, 9 (23.1%) from the central

region, 8 (20.5%) from the southern region, 7 (17.9%) from the western region, and 6 (15.4%) from the northern region.

The mean scores of the three factors were calculated, and the income of each movie was collected from public websites as shown in Table 1. The results of the correlation analysis between the income and each factor are shown in Table 2.

**Table 1:** The mean scores of the three factors (movie genre, plot, and list of actors) and the income of each movie

Movie name (Year)	Genre	Plot	Actors	Income (Million Baht)
Fan Chan (2003)	4.18	4.03	3.92	137.3
The Letter (2004)	4.36	4.25	4.30	43.7
Art of the Devil (2004)	4.29	4.23	4.43	20.0
2508 Siamese Outlaws (2004)	4.34	4.13	4.26	5.8
The Overture (2004)	4.31	4.10	4.26	52.7
At the Gate of the Ghost (2011)	4.04	4.31	4.29	27.0
One Day (2016)	2.10	1.85	1.90	111.2
The Promise (2017)	2.49	2.18	2.08	34.7
Slumboy Soi Teeed (2017)	2.05	1.85	2.03	18.0
Zombie Fighter (2017)	1.75	1.90	1.82	1.3
Dew (2019)	2.06	1.98	1.95	9.3
Cracked (2022)	2.44	2.20	2.39	5.4

**Table 2:** Pearson's correlation analysis results

Factors	Correlation coefficient	P-value
Movie genre	0.208	0.516
Plot	0.163	0.613
Actors	0.127	0.694

From Table 2, the correlation coefficients of the three factors are very close to zero, and the P-values are all over the level of significance (0.05). These indicate weak linear relationships between the film's income and the three factors. Generally speaking, movie genre, plot, and list of actors do not significantly influence the popularity of Thai films. This suggests that there could be other factors for Thai films' decreasing tendency.

When considering the Time series plots of the three factors, as shown in Figure 1, the line graphs dramatically drop during the years of 2011 to 2016 for all factors. The results are confirmed by Lopattananont et al. (2020) who stated that the Thai film industry's overall revenue steadily decreased by approximately 660 million baht over the same period. This presupposes that in those six years, there could be a major disruption or shift in the domestic film industry. This may be due to the increasing accessibility of the Internet and smartphones to the Thai population since 2010. In 2020, 55% of Thai people were mobile Internet users, and they spent an average of 3 hours and 44 minutes watching entertainment content via online streaming (Lopattananont et al., 2020). The assumption is also supported by Muang-ngam (2020) stating that the movie industry has been disrupted by digital technology. The increasing accessibility of smartphones among Thai people, as well as the emergence of digital platforms that allow people to effortlessly watch movies online, may change the perspectives of Thai movie viewers regarding their satisfaction with Thai films. During the past decade, foreign entertainment media has drastically dominated Thai people, particularly series and movies from Korea, China, and America. For Thais, foreign films have recently established a new benchmark of film quality, notably in terms of plots and production. This might cause Thai audiences to have higher expectations and be dissatisfied with the current level of Thai film quality.

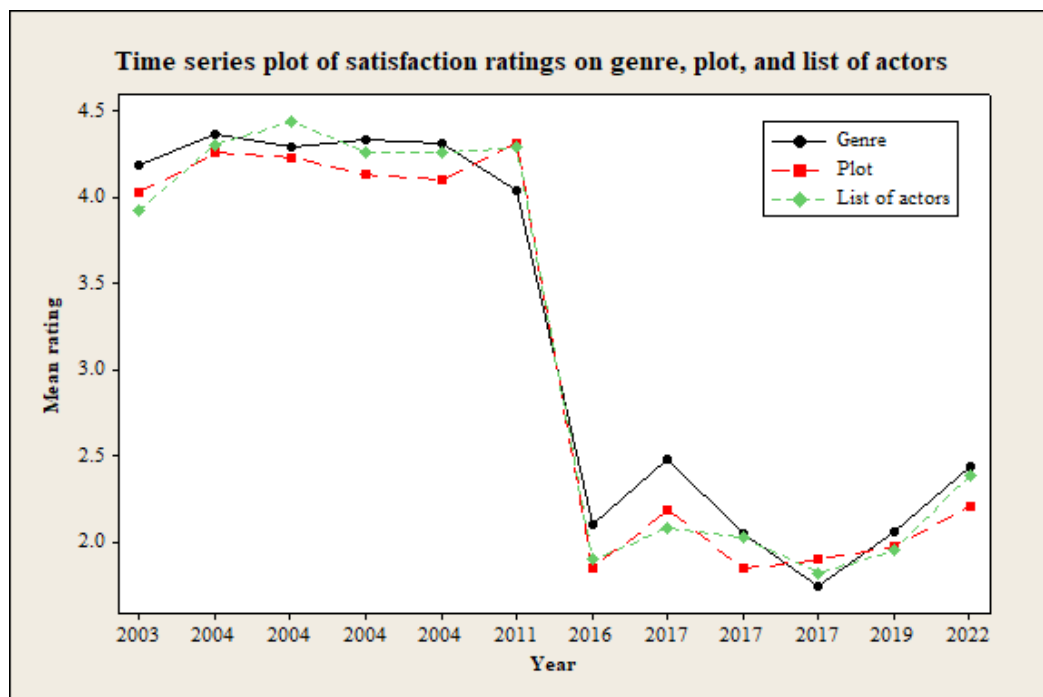


Figure 1: Time series plots of satisfaction ratings for movie genre, plot, and actor choices

There might be some solutions that Thai filmmakers could learn from other countries. Chinese filmmakers, for example, mainly focused on historical (period) dramas, have gradually overcome this downward trend by adding more sophisticated computer graphics, modernizing story lines, and revising their plots to become more globalized. This is implied by ‘The Untamed’, a Chinese television series first shown in 2019. The series had adopted those solutions, and it then became the talk of the town with a million Tweets about it (Petvirojchai, 2020). This suggests that if the domestic film industry aims to gain market share, the filmmakers should not maintain the same level of quality. They should utilize computer technology, develop various stories, and highlight the uniqueness of Thai films. Furthermore, a few experts in the Thai film industry were interviewed on the YouTube channel "UnPuwanart", suggest that sensor regulations in Thailand hinder the creativity of Thai filmmakers. Stories about monks, for example, are banned and harshly criticized. This restriction should be withdrawn so that the film producers are able to freely express their ideas and get the freedom to present alternative plots. Additionally, Banjong Pisanthanakun, a Thai film director of many Thai blockbuster movies, such as ‘The Medium’, emphasizes in the same interview that the government has not continuously put their efforts to combat film piracy. This is as opposed to the Korean officers who have successfully suppressed illegal copies of films on the Internet. As a result, Korean moviegoers are terrified of the repercussions of breaching the law, and so they cease visiting those unauthorized websites (Kunpalin, 2022). If counterfeiting and piracy continued to be unacceptably high in the Thai film business, the profitability of Thai films would steadily decline, and Thai filmmakers' motivation and inventiveness would dwindle.

A lack of funding and budget could be another reason why Thai filmmakers are unable to produce high-quality films. Warissara Bunrungwach, a successful acting coach, who was interviewed on the YouTube Channel "The Thaiger", added that when funds are limited, Thai film makers are unable to devote a significant portion of their budget to conducting research in order to produce a more realistic and innovative film. This budget constraint also contributes to the hasty and cheap production of a film. Thai filmmakers have to reduce the shooting and editing time to get the best shot. For example, in a Thai series, they have to hasten the film shooting to reach about 12–20 scenes per day; however, compared to a Korean series, there are only 6 scenes. Although a scene may not have worked yet, they must go on to the next scene in order to keep production costs down (Thaiger, 2022). If the Thai government provides financial assistance and makes greater efforts to promote collaboration

between domestic producers and international partners, it is possible that the domestic film industry will grow and Thai films will become more popular.

## Conclusion

Due to the declining popularity of Thai films, this study aims to investigate the potential factors leading to the decline so that some viable solutions can be addressed. The suspected factors (genre, plot, and list of actors), however, do not correlate with the films' total gross. The analysis clearly shows that Thai moviegoers were generally dissatisfied with Thai films launched during the past decade. The emergence of digital platforms allowing viewers to effortlessly watch domestic and international movies online could be a cause. The foreign films may give Thai viewers new perspectives on film plots and production, as well as set a new benchmark for cinematic quality. To reverse this trend, as suggested by some experts in this industry, modernizing all factors related to film production, lowering the content restrictions on movies, cracking down on film piracy, and raising financial support might be some solutions.

This study did not calculate a reliable sample size in statistics, and the validity and reliability of the survey items were not confirmed since it was only a pilot study to screen for significant factors that influence the movie's popularity. Future studies may consider the appropriate number of samples and confirm the quality of the measurement instrument before a survey is conducted.

## Reference

- Angkulanon, R. (2018). Thai movies revive, year 2018, revenue-market share growth 100%. Retrieved on May 10, 2022 from The Bangkok Insight Website: <https://www.thebangkokinsight.com/news/business/media/54500/>.
- Chanrungrmaneeikul, U. (2020). 120 years of Thai Film Business: Propositions for the Thai Government and Society. *Journal of Communication Arts Review*, 24(1), 103:120.
- Chen, D., & Yang, F. (2021). Innovation Strategy of Film and Television Creation under the Background of Big Data. *Journal of Physics: Conference Series*, 1852(2), 022048.
- Kanyapong, V. (2020). *Who said Thai movies suck! A collection of very good Thai movies from the past 20 years is now available on Netflix*. Retrieved on May 13, 2022 from Beartai Website: <https://www.beartai.com/lifestyle/movies/423782>.
- Komchadluek. (2017). *Many thoughts of Thai director - Solving the problem of sluggish Thai movies*. Retrieved on May 10, 2022 from <https://www.komchadluek.net/entertainment/276911>.
- Kunpalin, P. (2022). *Why can't the Thai film industry go as far as the Korean? | HIGHLIGHT sit and talk LIVE*. Retrieved on May 10, 2022 from YouTube Website: <https://www.youtube.com/watch?v=0l5Uugg8fw0>.
- Lappanich, J. (2020). *Why don't Thais watch Thai movies? Are they restricted in their ability to think freely or are they just boring?*. Retrieved on May 15, 2022 from Urban Creature Website: <https://urbancreature.co/city-why-dont-thais-watch-thai-films/>.
- Lopattananont, T., Kosalwat, B., Charuworn, P., & Otaivites, S. (2020). *Analysis of the Thai Film Industry in B.E. 2562*. Kasem Bundit Journal, 21(2), 100:117.
- Muang-ngam, R. (2020). *The end of the cinema business*. Retrieved on May 15, 2022 from Thai Franchise Center Website: <https://www.thaifranchisecenter.com/document/show.php?doculD=4971>.
- Petvirojchai, S. (2020). *When the Asian entertainment industry becomes the front runner and defeats Hollywood*. Retrieved on May 16, 2022 from The Matter Website: <https://thematter.co/brandedcontent/asian-entertainment-onlinetv01/103850>.
- Ruangrong, R. (2021). *How do Korean films have a management system? Why is it expanding so rapidly over the world?*. Retrieved May on 15, 2022 from Thairath Online Website: <https://www.thairath.co.th/entertain/inter/2127706>.

- Suwunpukdee, P., & Choompolsathien, A. (2019). Attitude, Expectation and Behavioural Trend of Thai Movie Viewing of Elderly People in Bangkok. *Journal of Journalism*, 12(1), 47:50.
- Teddle, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research*, 1(1), 77:100.
- Thaiger. (2022). *Why is Thai media so outdated and how can it be improved? | This is Thailand*. Retrieved on May 18, 2022 from The Thaiger Website: <https://thethaiger.com/news/national/why-is-thai-media-so-outdated-and-how-can-it-be-improved-this-is-thailand>
- Thairath. (2015). *The crisis of Thai films – film producers give up*. Retrieved on May 15, 2022 from <https://www.thairath.co.th/content/519593>.
- Tselysh, M. (2021). Foreign Leaders of Soviet Film Distribution: What Were They Like? *International Journal of Media and Information Literacy*, 6(2), 447:452.

## Heteroscedasticity Test with A Modified Goldfeld-Quandt Test

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Wannaporn Junthopas<sup>2</sup>

### Abstract

The purpose of this research is to present a method for hypothesis testing of heteroscedasticity; modified Goldfeld-Quandt test. The statistical test used in the proposed method was based on the concept of cluster analysis using K-means method. The study is specified under the multiple linear regression model with the variance pattern of error varied based on independent variable by comparing power of the test under conditions of multiplicative heteroscedasticity and the groupwise heteroscedasticity. The sample sizes ( $n$ ) in the study were 20, 30, 60, 120, and 250. The significance levels were specified at 0.01 and 0.05, repeating 1000 times in each situation. Comparison of the power of the test showed that the modified Goldfeld-Quant test and the Goldfeld-Quant test provided similar estimate of the power of the test in case of large sample size. In the multiplicative pattern, it was found that the modified Goldfeld-Quant test gave a higher estimated power of the test than that of the Goldfeld-Quant test when the sample size was 60 at the significance level 0.01 and when the sample sizes were 60 and 120 at the 0.05 level of significance, when degree of variance of errors was the low values. For the groupwise pattern, it was found that the modified Goldfeld-Quant test gave an estimate of the test power higher than that of the Goldfeld-

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Quant test when the sample size was 120 at the 0.01 significance level and when the sample sizes were 60 and 120 at a level of significance 0.05.

**Keywords:** Heteroscedasticity, Goldfeld-Quant test, K-means, Clustering

## Introduction

The problem of heteroscedasticity is one of the assumptions for regression analysis, which is caused by the error that may vary according to the value of the dependent variable, independent variable, or sample size. Heteroscedasticity is common for time series data and for cross-sectional data, which is found mainly with economic data such as individual or family consumer data (Greene, 2009). When there is a problem of heteroscedasticity, it will cause errors in the standard error estimator of the regression coefficients. As a result, the regression coefficient estimator does not have the lowest variance. It lacks the BLUE (Best Linear Unbiased Estimator) property, which means it is not an estimator with the best unbiased linear estimator property, effecting hypothesis testing, t-test and F-test. This results in erroneous hypothesis testing and leads to the incorrect conclusion of the analysis. Therefore, the heteroscedasticity hypothesis must be tested before the estimation of regression coefficient.

The Goldfeld-Quant test is a popular test for heteroscedasticity problem used in cases where it is assumed that the variance increases or decreases with one of the independent variables, using the ratio of Sum of Squared Errors (SSE) obtained by least squares analysis of the data that are divided into two independent groups, one with high variance and one with low variance sorted according to independent variables compared with the F-test statistic. The test power is highest when the midpoint was cut off (Goldfeld and Quandt, 1965). There were researches on the efficiency and development of statistics from Goldfeld-Quant test as follows. Daow Kongsiriwattana (1989) found that the Goldfeld-Quant test has higher test power than the Szroeter's test when the sample is small ( $n = 20$ ) and when  $r$  and  $\lambda$  are very high or very low, with the errors variances in the form  $\sigma^2_t = kXr_t$  and  $\sigma^2_t = k^2(1 + \lambda X_t)^2$ . Carapeto and Holt (2003) proposed a new test, called the C-H test, based on the Goldfeld-Quant test in combination with the Neural Network Models for examining the problem of heteroscedasticity in the additive form,  $v(\epsilon_i) = \sigma^2_i = \alpha^2(1 + \lambda X_i)^2$ , where  $\lambda = 0.03, 0.04,$  and  $500$  and the multiplicative form,  $v(\epsilon_i) = \sigma^2_i = kX^\gamma_i$ , where  $\gamma = 1.25, 1.35,$  and  $2$ . The results showed that the C-H test has the highest test power and provides higher testing power than all Goldfeld-Quant testing methods. For the Budka et al. (2008), they presented the comparison of the efficiency of dividing the data for Goldfeld-Quant test and found that the method of dividing the data from the median absolute deviation gave the test power higher than in the case of eliminating the center observation. The study by Rana et al. (2008)

presented the testing of heteroscedasticity problem when there is abnormality in dataset based on the Goldfeld-Quant test method. The results showed that the proposed method gave higher test power than the Goldfeld-Quant test. When the sample size was small ( $n = 20$ ) and the outliers were low (5%), the test power of the proposed method tends to increase as the sample size increases. A study by Alabi et al. (2020) discusses the selection of appropriate test statistics for testing the heteroscedasticity when there is a problem of multicollinearity and Alabi et al. (2020) study when there is no multicollinearity problem. A total of 9 tests were presented and a several heteroscedasticity forms were studied, including heteroscedasticity based on multiple independent variables and heteroscedasticity of exponential function. The results showed that the heteroscedasticity test was not stable when there was no multicollinearity problem. The Goldfeld-Quant test had the highest test power of all sample sizes studied ( $n = 15, 20, 30, 40, 50, 100, \text{ and } 250$ ) at significance levels 0.01, 0.05 and 0.1.

To construct the test statistics of the Goldfeld-Quant test, it was necessary to arrange the data according to the independent variables influencing the heteroscedasticity. Most of the past researches studied only one independent variable. However, if there is more than one independent variable studied, the researcher may find it difficult to determine the independent variable that has influence. In some studies, the data was sorted based on the approximate values of the variables obtained from the regression analysis instead. This research proposes an idea for testing the heteroscedasticity under the test statistics of Goldfeld-Quant that will divide the data into 2 groups from the cluster analysis, which is a technique of grouping the observation values that are quantitative data with distance measurements and the group in which the sample is the least distant from the center of the group is selected. This concept does not necessarily have to know which independent variables influence the variance of the error as a guideline for choosing the hypothesis test about heteroscedasticity problem, if it is unknown which independent variable has an influence on variance form.

## Method

This research presents the modified Goldfeld-Quant test. The null hypothesis in the test is H0: The data does not have heteroscedasticity against H1: The data have heteroscedasticity. The process of testing the modified Goldfeld-Quant test starts from dividing observation values into 2 groups by using cluster analysis using K-means method when K = 2. Then regression analysis was performed in each group and calculate the test statistics under the F distribution as follows:

$$F_{GQ\_M} = \frac{SSE_2 / df_2}{SSE_1 / df_1}$$

Where SSE1 and SSE2 are the sum of squares of the error values of Group 1 and Group 2.  $df_1$  and  $df_2$  are the degrees of freedom of Groups 1 and 2, respectively.

The degrees of freedom are calculated as  $df_1 = n_1 - k$  and  $df_2 = n_2 - k$ .

Where  $n_1, n_2$  are the sample sizes in Groups 1 and 2 after the K-means clustering analysis,  $k$  is the number of independent variables.

The null hypothesis ( $H_0$ ) is rejected when  $F_{GQ\_M}$  is greater than  $F_{\alpha, (df_2, df_1)}$  or p-value is less than significance level ( $\alpha$ ).

The study was conducted under a multiple linear regression model with 3 independent ( $X$ ) variables, with this format:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon_i$$

where  $Y_i$  is the dependent variable in the observation, where  $i = 1, 2, \dots, n$ ;  $X_j$  is the independent variable, where  $j = 1, 2, 3$ ;  $\beta_0$  is the constant or the Y-intercept;  $\beta_j$  is the regression coefficient; and  $\varepsilon_i$  is the errors term. The uniform distribution has a value between 20 and 100,  $X_j \sim U(20, 100)$ , where  $j = 1, 2, 3$  produces an error with a normal distribution,  $\varepsilon_i \sim N_{(0, \sigma^2)}$  by specifying format of the heteroscedasticity in 2 formats, 1) Multiplicative Heteroscedasticity  $v(\varepsilon_i) = \sigma^2 x_i^\delta$ ;  $\delta = -4, -3.6, \dots, 0, 0.4, \dots, 4$  and  $\sigma^2 = 1$  and 2) Groupwise Heteroscedasticity

$v(\varepsilon_i) \begin{cases} 0.1 \text{ if } i \leq n/2 \\ 0.9 \text{ if } i > n/2 \end{cases}$  and  $v(\varepsilon_i) \begin{cases} 0.3 \text{ if } i \leq n/2 \\ 0.7 \text{ if } i > n/2 \end{cases}$  The parameters or the regression coefficients

were specified as  $\beta_0 = 10$ ,  $\beta_1 = \beta_2 = \beta_3 = 1$ . The sample sizes ( $n$ ) in the studies were 20, 30, 60, 120, and 250, and the significance levels for hypothesis testing were 0.01 and 0.05.

Control estimates for type I error by simulating the data for the variance with fixed error. Calculate the test statistics of the modified Goldfeld-Quant test ( $F_{GQ\_M}$ ) and the Goldfeld-Quant test ( $F_{GQ}$ ). The calculated test statistic was compared against the critical value to conclude that it would reject or accept the null hypothesis at the significance level 0.01 and 0.05. Count the number of times the null hypothesis was rejected when the null hypothesis was true. It was repeated 1000 times for each situation by comparing Type I error estimates of the test statistic with Brandley's criteria (1978). If the Type I error estimate ranges from 0.005 to 0.015 at the 0.01 significance level and between 0.025 and 0.075 at the 0.05 significance level, it is concluded that the test statistic can control the Type I error estimate. For comparison of estimated power of the test, it was considered only for the test statistics that can control Type I error by simulating the data to have the heteroscedasticity. Calculate test statistics of the modified Goldfeld-Quant test ( $F_{GQ\_M}$ ) and the Goldfeld-Quant test ( $F_{GQ}$ ). Compare the calculated test statistics against critical values to conclude whether to reject or accept the null hypothesis at the significance level 0.01 and 0.05. Count the number of times that the null hypothesis was rejected when the alternative hypothesis was true. Repeat 1000 times for each situation and compare the test power estimates obtained in each situation.

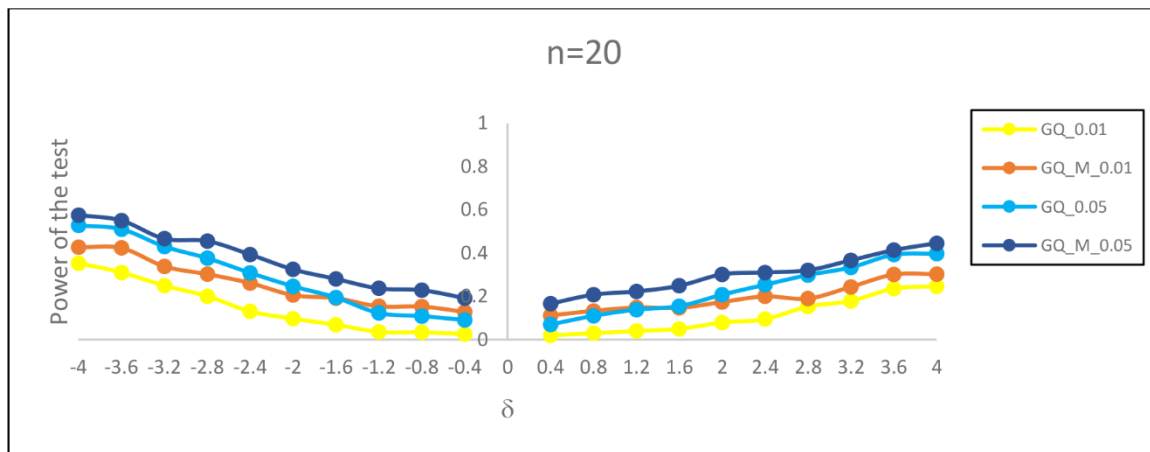
## Results

Comparison of estimated power of the test between the modified Goldfeld-Quant test and the Goldfeld-Quant test under the heteroscedasticity pattern of the multiplicative non-constant aberration variance, it was found that the modified Goldfeld-Quant test cannot control Type I error estimates when sample sizes were 20 and 30 and the Goldfeld-Quant test when the sample size was 20 at the significance level 0.01 and 0.05. It was found that the modified Goldfeld-Quant test and the Goldfeld-Quant test provided similar test power at all sample size of the study and all levels of significance. In addition, the power of the test of the modified Goldfeld-Quant test and the Goldfeld-Quant test tend to increase as the sample size increases. The degree of variance of the error increased ( $\delta = 0.4, 0.8, \dots, 4.0$ ) and the degree of variance of errors reduced ( $\delta = -0.4, -0.8, \dots, -4.0$ ), the test power of both methods is also increased. For heteroscedasticity pattern of the groupwise, it was found that the modified Goldfeld-Quant test cannot control Type I error estimate when the sample sizes

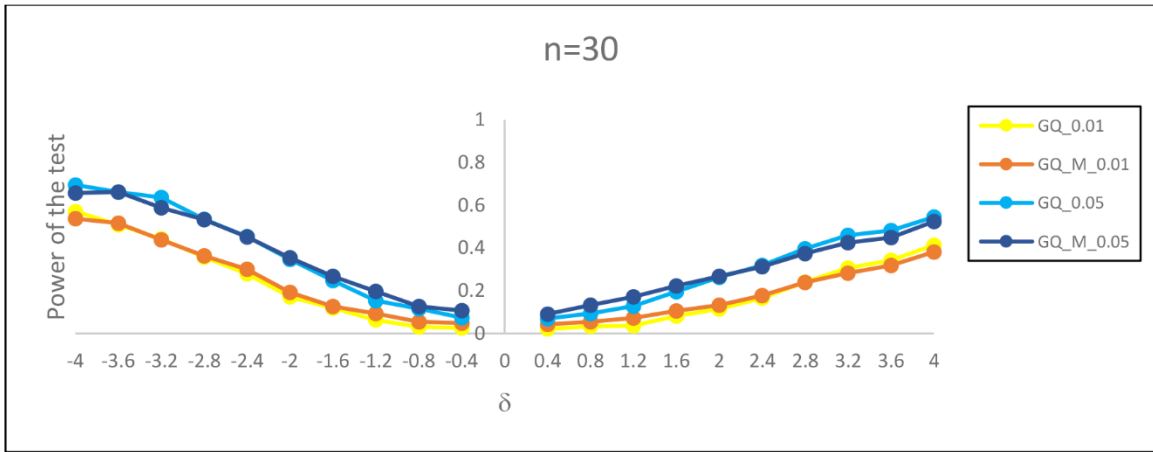
were 20, 30, and 60 at the significance level 0.01 and when the sample sizes were 20 and 30 at the 0.05 significance level and the Goldfeld-Quant test cannot control Type I error estimates when the sample size was 20 at all significance levels. As for the test power estimates, it was found that the modified Goldfeld-Quant test and the Goldfeld-Quant test gave similar test powers across all sample size levels and the modified Goldfeld-Quant test also gave higher test power than the Goldfeld-Quant test when the sample size was 120 at the 0.01 significance level and when the sample size was 60 and 120 at 0.05 significance level.

The test power estimates obtained by simulating data in various situations when specifying the heteroscedasticity in the multiplication pattern and the groupwise pattern are shown in Figure 1 (1.A – 1.E) and Figure 2 (2.A – 2.B), respectively, when the symbols are as follows.

- GQ\_0.01 means the Goldfeld-Quant test at a significance level 0.01
- GQ\_M\_0.01 means the modified Goldfeld-Quant test at a significance level 0.01
- GQ\_0.05 means the Goldfeld-Quant test at a significance level 0.05
- GQ\_M\_0.05 means the modified Goldfeld-Quant test at a significance level 0.05
- n means the sample size of the study
- $\delta$  means the degree of variance of the error in multiplicative pattern
- Power of the test means the test power estimate

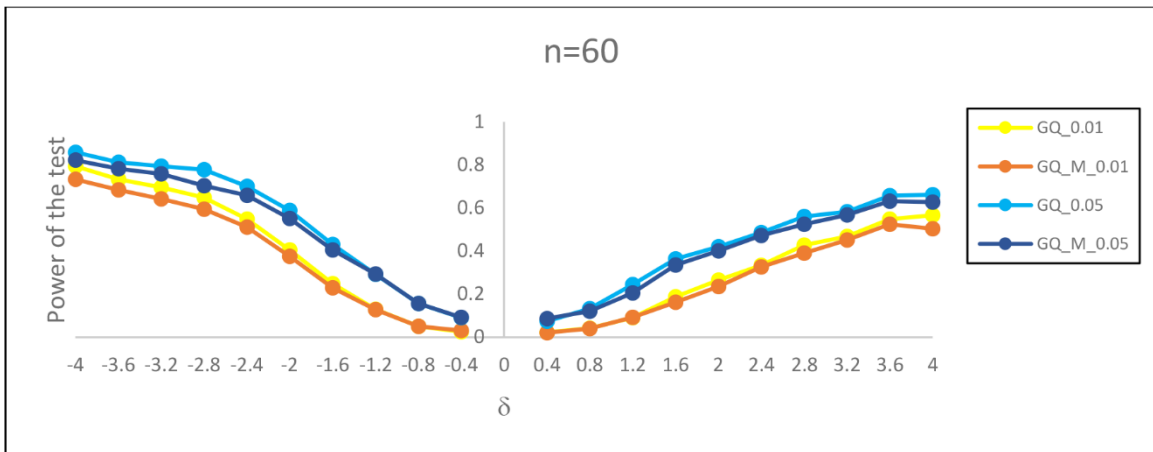


**Note:** Sample size = 20, Type I error estimates cannot be controlled for the GQ\_M test and for the GQ test at significance levels 0.01 and 0.05. (1.A) The sample size is 20.

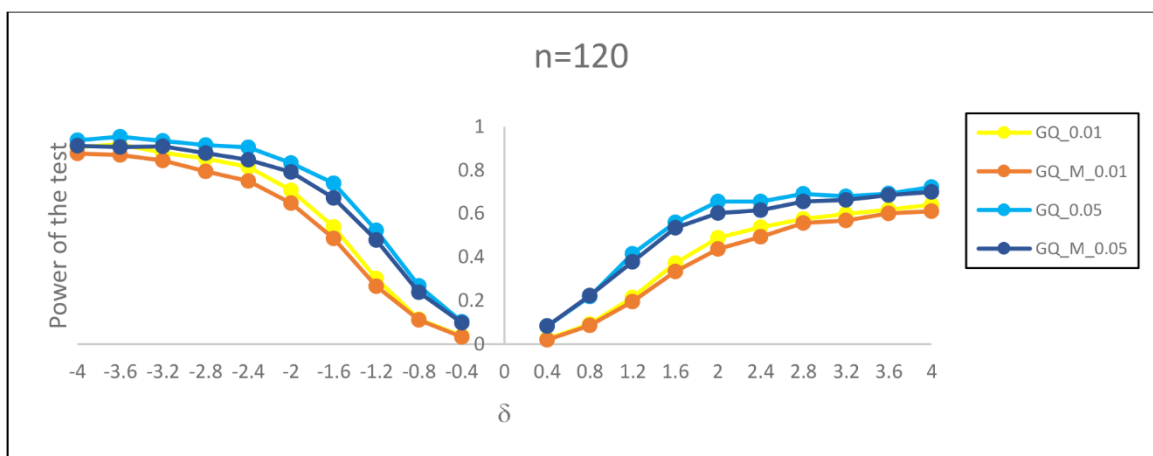


Note: Sample size is 30, The GQ\_M test cannot control estimates of type 1 error.

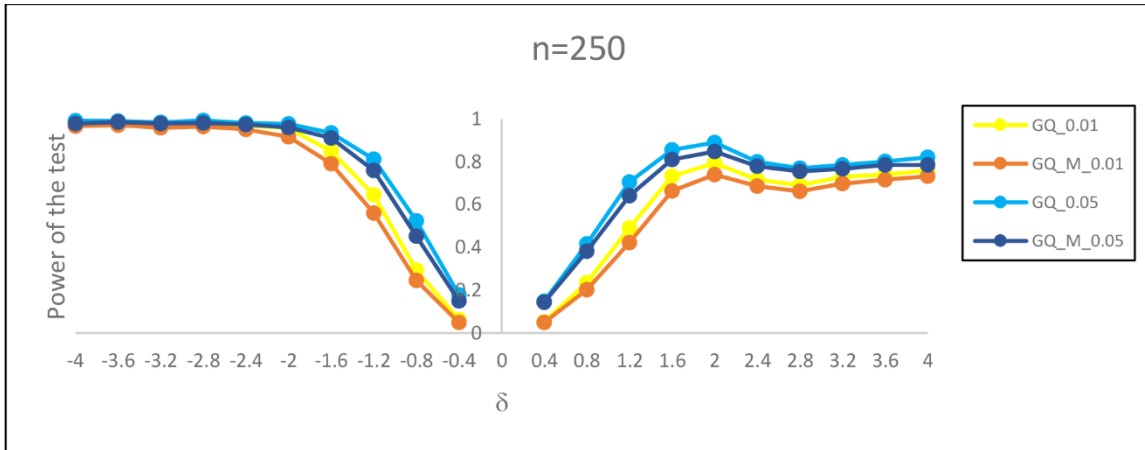
(1.B) The sample size is 30.



(1.C) The sample size is 60.

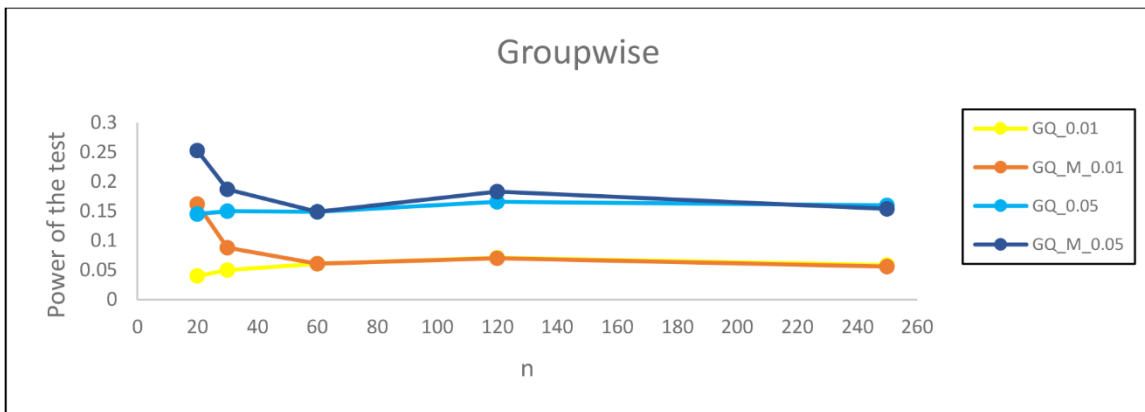


(1.D) The sample size is 120.

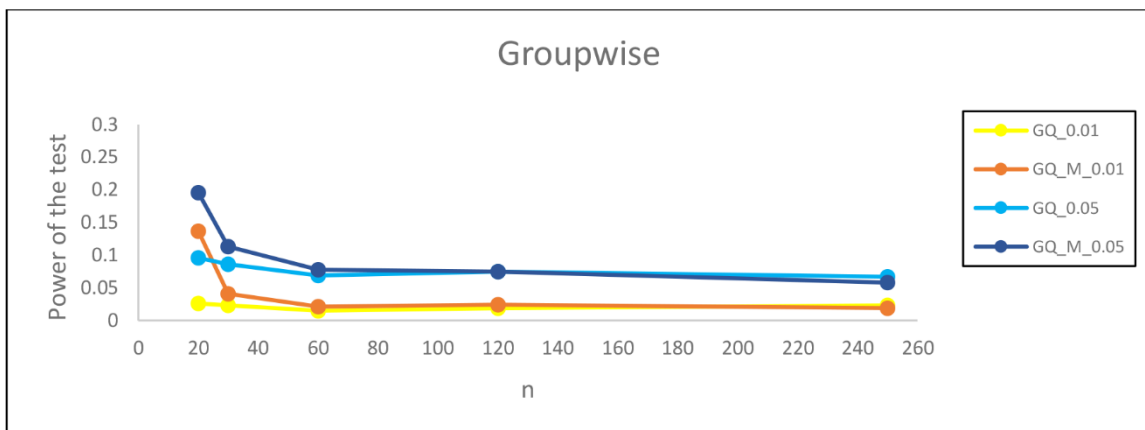


(1.E) The sample size is 250.

Figure1: Test estimated power of the test of the heteroscedasticity in multiplicative pattern.



(2.A) Groupwise Pattern Form 1



(2.B) Groupwise Pattern Form 2

Figure2: The estimated power of the test of the heteroscedasticity in groupwise pattern.



**Note:** Both of groupwise forms cannot control the Type I error estimate at the significance level 0.01 when the sample sizes were 20, 30 and 60 and at the significance level 0.05 when the sample sizes were 20 and 30 for the GQ\_M test and at the significance level 0.01 and 0.05 when the sample size was 20 for the GQ test.

## Conclusion

The Goldfeld-Quant test was able to control Type I errors better than the modified test. In other words, the Goldfeld-Quant test was able to control Type I errors when sample sizes were 30, 60, 120, and 250 in both multiplicative heteroscedasticity and groupwise heteroscedasticity. In case of the multiplicative heteroscedasticity, the modified Goldfeld-Quant test can control Type I errors where the sample sizes are large are such as 60, 120, and 250 at all significant levels and in the case of groupwise heteroscedasticity where the sample sizes were 120 and 250 at the significance level 0.01, and the sample sizes were 60, 120, and 250 at the 0.05 significance level. When considering the comparison of test power estimates in situations where Type I error can be controlled, it was found that the two tests gave approximately the same test power estimates. The modified Goldfeld-Quant test for multiplication pattern provides better test power estimates than the Goldfeld-Quant test when the degree of variance of error was low ( $\delta = -0.8, -0.4, 0.4,$  and  $0.8$ ). As for the groupwise heteroscedasticity, the modified Goldfeld-Quant test had test power estimate higher than the Goldfeld-Quant test especially when the sample size was 60 and 120 at the 0.05 level of significance.

## Reference

- Alabi, O.O., Ayinde, K., Babalola, O.E., Bello, A.H., & Okon, E.C. (2020). Effects of Multicollinearity on Type I Error of Some Methods of Detecting Heteroscedasticity in Linear Regression Model. *Open Journal of Statistics*, 10(1), 664-677.
- Alabi, O.O., Babalola, O.E., Ayinde, K., & Bello, H.A. (2020). Monte Carlos Study on Power Rates of Some Heteroscedasticity Detection Methods in Linear Regression Model Without Multicollinearity Problem. *Computer Science Series*, 18(2), 128-134.
- Bradley, J.V. (1978). Robustness. *British Journal of Mathematics and Statistical Psychology*, 31(2), 144- 151.
- Budka, A., Kachlicka, D., & Kozłowska, M. (2008). Notes on the Use of the Goldfeld-Quandt Test for Heteroscedasticity in Environment Research. *Biometrical Letters*, 45(2), 43-55.
- Carapeto, M., & Holt, W. (2003). Testing for Heteroscedasticity in Regression Models. *Journal of Applied Statistics*, 30(1), 13-20.
- Goldfeld, S.M., & Quandt, R.E. (1965). Some Tests for Homoscedasticity. *Journal of The American Statistical Association*, 60(310), 539-547.
- Greene, W.H. (2009). *Econometric Analysis*. (5<sup>th</sup> ed.). Upper Saddle River, New Jersey, 07458: Prentice Hall.
- Kongsiriwattana, D., (1989). *A comparison of the power of the test statistics for heteroscedasticity in linear regression analysis*. [Master's thesis, Chulalongkorn University]. Chulalongkorn University Intellectual Repository (CUIR) Retrieved from <http://cuir.car.chula.ac.th/handle/123456789/33552>.
- Rana, Md.S., Midi, H., & Imon, A.H.M.R. (2008). A Robust Modification of the Goldfeld-Quandt Test for the Detection of Heteroscedasticity in the Presence of Outliers. *Journal of Mathematics and Statistics*, 4(4), 277-283.

## The use of Statistics to Compare the Co-operative Education Students Abilities of Rajabhat Rajanagarindra University

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### Abstract

The research objectives were to: 1) study personnel characteristics of learning organization (LO) of the Agricultural Cooperative Federation of Thailand Ltd. (ACFT) following Peter Senge's concept, 2) study factors affected LO of AC following Peter Senge's concept. The population was 1,850 personnel who work in ACFT. Sample size determination was applied Taro Yamane with the statistical significance of 95 percent. It turned out of 400 samples. Primary data were collected by questionnaires. Data analysis was applied to descriptive statistics and multiple regression. The findings were 1) personnel characteristics of LO of the ACFT following Peter Senge's concept found that personal mastery, mental models, and systems thinking had the high level while shared vision and team learning had the moderate level, 2) factors affected Peter Senge's LO

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of ACFT in terms of operating cost reduction were personal mastery, mental models, shared vision, team learning, and systems thinking prospectively. The ACFT and AC should have the guidelines to encourage, support and develop both organization and every level of personnel to develop towards concrete learning organization emphasized on the 5 elements of LO of Senge's concepts and take the LO concept associated with the organizational strategic plan.

**Keywords:** Learning Organization, The Agricultural Cooperative Federation of Thailand Limited

## Introduction

The starting point for the learning organization concept, from the writings of Chris Argyris (1957), presented the concepts of organizational behavior and people working in an organization by introducing the Learning Organization concept, which described the learning of those who had their own function as a learning organization originated from Peter Senge's book of the fifth disciplines. The art and practice of the Learning Organization (1990) which discusses 5 disciplines that will lead to a theoretical learning organization.

The learning organization concepts explains that is an organization that has created a channel for knowledge transfer between personnel within acquiring knowledge from outside. The key goal is to provide opportunities for the pursuit of best practices that lead to the development and creation of a concrete organizational knowledge base and to foster learning in the organization.

In the development of the organization to keep up with the changes in society at all levels that occur all the time by emphasizing on the learning that arises from upgrading the ability of personnel or human resources within the organization. The need to learn within the organization at all levels and learning as a team is beneficial to the organization both at the individual, team and organization levels. The development and learning in the organization are also the development of the attitudes of the personnel in the organization and the values, philosophy, vision and organizational culture that are important factors that will facilitate the formation of a learning organization to lead the development of the organization in all dimensions.

The concept of a learning organization is a new paradigm of organizational design to meet the changing economic conditions both nationally and globally. The concept of a learning organization focuses on the development of individuals at both individual and organizational levels by learning to be able to learn from both inside and outside the organization in order to conform to changes in the economy and changing society.

The result of changes in the economic and social system will affect working conditions and working environment and bring society into a knowledge-based society. The use of knowledge of individuals and organizations as tools in work is therefore necessary to achieve work efficiency and competition. It is in the line with changes in economy, society, politics, technology, culture and new innovations that happens all the time. Therefore, both public and private organizations need to adjust to make survive be consistent and support changes and can compete with competitors. It is one way to adjust the organization and to use information technology in decision making in work to create value and maximum organization benefits.

In this research, the researcher studied the learning organization of the Agricultural Cooperative Federation of Thailand Limited (ACFT), applying the principles and concepts of the learning organization according to the concept of Senge to be applied to the organization of the Agricultural Cooperatives Federation of Thailand Limited by giving importance to being a learning organization of the Agricultural Cooperatives Federation of Thailand Limited.

According to the learning organization concept of Peter Senge (Peter Senge, 1990: 36) in 5 aspects: 1) self-knowledge 2) conceptualism 3) shared vision 4) team learning and 5) systematic thinking from the concept of the 5 principles of the learning organization following the concept of Senge. This will affect the work of the organization that emphasized on the results of work in the aspects of cost reduction in practice as well as factors affecting the organization of learning according to the conceptual framework that the researcher has shown. In this regard, the concepts according to the principles of learning organization in all 5 areas are causal variables. In addition, the other two performance results were variables. According to the conceptual framework that the researcher obtained from the literature review. In this study, the researcher had chosen to conduct a research study with the Agricultural Cooperatives Federation of Thailand Limited because the Agricultural Cooperatives Federation of Thailand Limited is regarded as the leading organization in the operation of Agricultural Cooperatives in Thailand. It was also an organization formed by the gathering of provincial cooperatives across the country whose members are agricultural cooperatives and farmers.

According to the Cooperative Act 1999, the Agricultural Cooperatives Federation of Thailand Limited registered and established on May 30, 1952, has the status of a juristic person under the name Wholesale Cooperative of Thailand Limited Sin Chai and requested to register the name change to The Agricultural Cooperatives Federation of Thailand Limited on October 1, 1975. With members being, the Agricultural Cooperatives Federation of Thailand Limited has approximately 3,900 agricultural cooperatives with a total membership of more than 6,000,000 households, it was established on May 30, 1952, which is 66 years of operation of the Agricultural Cooperatives Federation of Thailand Limited.

The main objective of the establishment of the Agricultural Cooperatives Federation of Thailand Limited under item: 1) providing academic assistance to members and item, and 2) requesting or receiving academic assistance from the government foreign agencies or any other persons.

It started with the Agricultural Cooperatives Federation of Thailand Limited itself that are ready to be a learning organization to be a model of organizational development and becoming a learning organization among the cooperative's member, which is the basis of becoming a learning organization of the Agricultural Cooperatives Federation of Thailand Limited that the researcher studied are rooted in knowledge management.

This is a management approach within the organization to create the knowledge definitions of the organization and collecting, creating and distributing the organization's knowledge throughout the organization to achieve the continuation of knowledge and apply the knowledge to be useful in the preparation of the strategic plan of the Agricultural Cooperatives Federation of Thailand Limited.

The Agricultural Cooperatives Federation of Thailand Limited has concerned in terms of knowledge management and organization by applying the learning organization principles and concepts as the main idea in formulating the organization's strategy and ultimately affecting the results of operations. In addition, the learning organization concept of the Agricultural Cooperatives Federation of Thailand Limited also included the creation of a learning culture within the organization. This is a collection of existing knowledge which was scattered in the person, or document to develop into a system so that everyone in the organization can access knowledge and develop themselves to be knowledgeable apply the knowledge gained in practice to create efficiency and effectiveness for the Agricultural Cooperatives Federation of Thailand Limited.

## Research Objectives

The researcher has defined 2 research objectives as follows:

1. To study the characteristics of learning organization personnel of the Agricultural Cooperatives Federation of Thailand Limited according to Peter Senge’s concept
2. To study factors affecting the learning organization of agricultural cooperatives’ member according to the concept Peter Senge’s concept

## Conceptual Framework

The researcher developed the research concepts as follows:

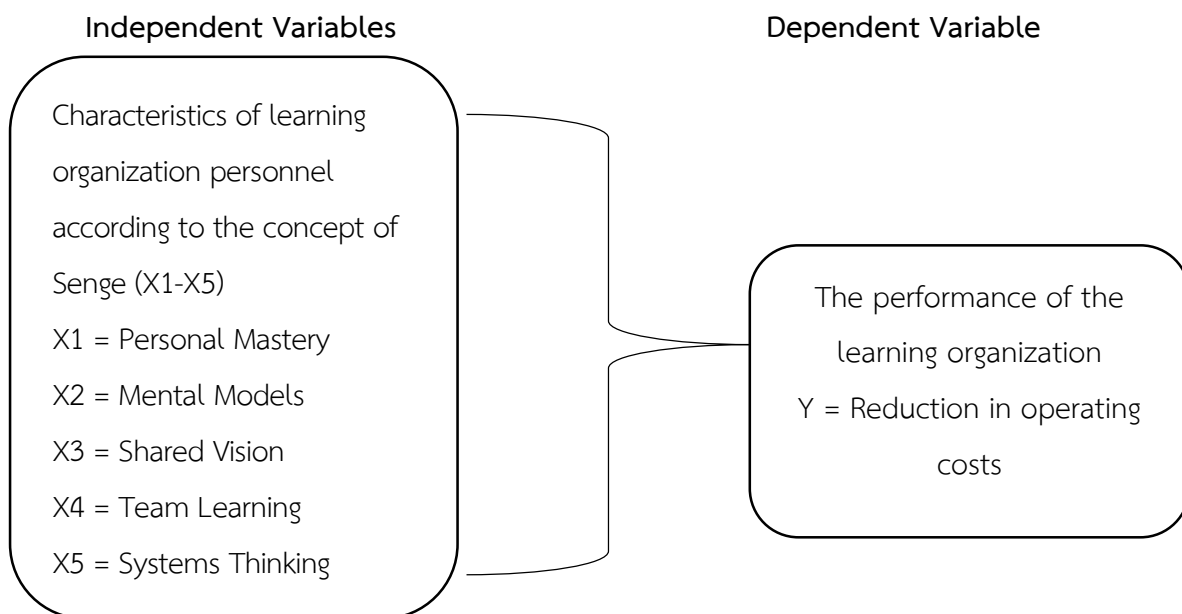


Figure 1 Conceptual Framework

## Research Methodology

### Determination of population and samples

1. Population determination used in this research consisted of members in the Agricultural Cooperative Federation of Thailand Limited which composed of 27,186 people

2. Determining the sample size, the researcher applied Taro Yamane formula to maintain a 95% of confident level from respondents above the sample size of 400 samples will be used.

### Data Collection

The primary data were collected from 400 samples as mentioned before by questionnaire from June to August of 2021.

### Research Tools

The researcher created a research tool by designing a questionnaire. By creating tools and finding, the quality of the tools as follows:

Step 1. Study and research related documents, textbooks and research results to use as a guideline for creating questionnaires to be effective and consistent with the research objectives.

Step 2. Determine the scope and issues of the questions according to the research objectives.

Step 3. Proceed to create a questionnaire by questionnaire consisting of 4 parts:

Part 1: questionnaire on the characteristics of the respondents' personal data.

Part 2: a questionnaire style to choose to answer using a rating scale according to the Likert method which was a factor that affected personnel of a learning organization according to Peter Senge's learning organization concept which were: 1) personal mastery, 2) mental models, 3) shared vision, 4) team learning, and 5) systems thinking.

Part 3: a questionnaire type that chooses to answer the rating scale according to the Likert method which asked about the performance of personnel in the organization in the cost reduction in operations.

According to the quality measurement of data collection tool, Reliability and validity were applied with the concepts used to evaluate the quality of research. They indicated how well a method, technique or test measure of questionnaire. Reliability test was about the consistency of a measure while validity was focused on the accuracy of a measure. Moreover, it was important to consider reliability and validity when the researcher was creating the research design, planning methods, and writing up the results. For reliability test, the researcher applied Cronbach's alpha statistics, it turned



out with 0.95 of Cronbach’s alpha value which clarified that the questionnaire built was significantly reliability. For the evaluation of content validity, the most important validity was the content validity. This meant that the extent to which the instrument was measured. The expert judgment was the practical approach to estimating the content validity. By doing that the researcher requested 5 experts to judge each item whether it really measured the expected attribute. The Item Objective Congruence (IOC) index was used as the basis for screening the item quality. In each item, the experts were asked to determine the content validity score. It finally turned out of 0.90 of IOC, which statistically clarified the content validity.

### Data Analysis

According to the 1st research objective, the researcher applied arithmetic mean and standard deviation for data analysis. Inferential Statistics by using multiple linear regression equation to estimate the regression coefficient with the ordinary least square method of parameters estimation to answer the 2nd research objective. Linear regression equation can be represented by equations (3.1) as follows:

$$\hat{Y}_1 = \hat{\beta}_0 + \hat{\beta}_1 * X_1 + \hat{\beta}_2 * X_2 + \hat{\beta}_3 * X_3 + \hat{\beta}_4 * X_4 + \hat{\beta}_5 * X_5 + \text{error term} \dots\dots(3.1)$$

Where:

The independent variables consisted of:

X1 = Personal Mastery

X2 = Mental Models

X3 = Shared Vision

X4 = Team Learning

X5 = Systems Thinking

The dependent variable consisted of:

Y = The reduction in operating costs

## Results

Part 1: Characteristics of learning organization personnel of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Sange explained in Table 1.1 – 1.5, which can be described as follows:

**Table 1.1:** Characteristics of personnel organizations of self-knowledge learning organizations of the Agricultural Cooperatives Federation of Thailand Limited

**n. = 400**

Personal Mastery	Mean	Standard Deviation	Interpretation
1. Commitment to lead the organization towards the excellence	4.33	0.60	The Most
2. Commitment to continuous creativity and development	4.53	0.50	The Most

**Table 1.1:** Continued

Personal Mastery	Mean	Standard Deviation	Interpretation
3. Personnel have a sense of responsibility to work towards success every time	4.60	0.49	The Most
4. Having the learning about the job, including studying, researching, learning from the study of things for progress	4.19	0.60	A Lot
5. There is pursuing knowledge to increase the potential of work to achieve the goals set	3.42	0.47	A Lot
6. Having the learning or following new knowledge to cause development and timely	3.42	0.49	A Lot
7. Using data for analysis and decision making in work	4.01	0.50	A Lot
8. Accepting the reasons or opinions of colleagues	4.00	0.49	A Lot
9. Ability to analyze events from multiple perspectives	3.40	0.67	Moderate
10. Having the skills in analyzing problems to be a model for the next development	3.94	0.71	A Lot
11. There is extensive synthesis of information obtained from learning sources.	2.59	0.92	Little
12. There is a way of thinking that can lead to a structured operation.	3.19	0.56	Moderate
13. There is consultation in planning the work.	2.97	0.69	Moderate
<b>Total average</b>	<b>3.74</b>	<b>0.59</b>	<b>A Lot</b>

**Source:** Calculation

From Table 1.1, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of their personal mastery at a high level. ( $\bar{X} = 3.74$ ). Characteristics of personnel in the Agricultural Cooperative Federation of Thailand Limited with the highest average level were personnel who had a sense of responsibility to work towards success every time. ( $\bar{X} = 4.60$ )

**Table 1.2:** Characteristics of personnel of learning organizations on the Agricultural Cooperative Federation of Thailand Limited

n. = 400

Mental Models	Mean	Standard Deviation	interpretation
1. Bringing various problems that occur during work to analyze and find better alternatives	3.37	0.49	Moderate
2. Various problems that occur during the operation are analyzed and find better alternatives	3.28	0.88	Moderate
3. There is an exchange of knowledge and work experience with colleagues.	3.37	0.39	Moderate
4. Always try to find the best way to apply to work	3.96	0.37	A Lot
5. Able to adjust the way of thinking and working according to the situation	3.63	0.23	A Lot
<b>Total average</b>	<b>3.52</b>	<b>0.47</b>	<b>A Lot</b>

Source: calculation

From Table 1.2, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of the mental models at a high level. ( $\bar{X} = 3.52$ ) Characteristics of personnel in the Agricultural Cooperatives Association of Thailand Limited that had a high average level which composed of personnel who were always trying to find the best way to apply to their work. ( $\bar{X} = 3.96$ ).

**Table 1.3:** Personnel characteristics of learning organizations in relation to the joint vision of the Agricultural Cooperative Federation of Thailand Limited

n. = 400

Shared Vision	Mean	Standard Deviation	Interpretation
1. The organization analyzes the environment to find strengths, weaknesses are opportunities to develop into the vision of the organization.	4.63	0.48	The Most
2. Having the opportunity to participate in setting the vision of the organization	3.65	0.6	A Lot

**Table 1.3:** Continued

Shared Vision	Mean	Standard Deviation	Interpretation
3. The organization has a clear image that makes you want to integrate to achieve goals for the future of the organization.	4.11	0.89	A Lot
4. To be encouraged to work together to realize the goals of the organization	4.14	0.68	A Lot
5. Understand the mission of the organization	4.11	0.36	A Lot
6. Expression of common corporate values	3.26	0.36	Moderate
7. The opportunity to participate in the creation of activities for the reputation of the organization	2.66	0.59	Moderate
8. Development and creation of new works with others on a regular basis	3.26	0.39	Moderate
<b>Total average</b>	<b>3.37</b>	<b>0.52</b>	<b>Moderate</b>

**Source:** calculation

From Table 1.3, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of common vision at a moderate level. ( $\bar{X} = 3.37$ ) The characteristics of personnel in the Agricultural Cooperatives Association of Thailand Limited had the highest average level. Weaknesses are opportunities to develop into the vision of the organization. ( $\bar{X} = 4.63$ )

**Table 1.4:** Characteristics of learning organization personnel in teamwork of the Agricultural Cooperatives Federation of Thailand Limited

n. = 400

Team Learning	Mean	Standard Deviation	Interpretation
1. Acquiring knowledge from the organization to encourage teamwork or group work.	4.43	0.50	The Most
2. Team members are learning at the same time. each other and exchange ideas with each other	4.17	0.67	A Lot
3. Members in the team always have innovative ideas.	3.53	0.68	A Lot

**Table 1.4:** Continued

Team Learning	Mean	Standard Deviation	Interpretation
4. Employees and fellow team members understand the work process of the organization the same as everyone.	3.24	0.73	Moderate
5. Personnel and fellow team members have a good relationship with each other in the organization.	3.86	0.68	A Lot
6. Employees and fellow team members have set the criteria for the success of the work together.	2.81	0.94	Moderate
7. Personnel and fellow team members learn information to discuss and summarize the best approach of the team.	3.16	0.90	Moderate
8. Staff and fellow team members have follow-up together.	2.68	0.69	Moderate
9. Employees and fellow team members evaluated together.	2.94	0.39	Moderate
10. Your personnel and cooperatives systematically managed.	3.26	0.80	Moderate
11. Personnel and colleagues or fellow members understand the infrastructure of the organization	4.07	0.77	A Lot

Team Learning	Mean	Standard Deviation	Interpretation
12. Personnel and colleagues or fellow members have a clear and systematic division of responsibilities.	3.40	0.98	Moderate
<b>Total average</b>	<b>3.14</b>	<b>0.59</b>	<b>Moderate</b>

Source: calculation

From Table 1.4, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of team learning at a moderate level. ( $\bar{X}$  = 3.14) The characteristics of personnel with the highest average level were personnel in the Agricultural Cooperative Federation of Thailand Limited, who received knowledge from the organization to promote working as a team or group. ( $\bar{X}$  = 4.43)

**Table 1.5:** Characteristics of systematic thinking learning organization personnel of the Agricultural Cooperatives Federation of Thailand Limited

n. = 400

Systems Thinking	Mean	Standard Deviation	Interpretation
1. Having an understanding that oneself is an important part of the organization as other parts of the organization	4.43	0.80	The Most
2. The vision of the organization has been integrated into the operation systematically.	4.11	0.87	A Lot
3. There is a link to the work that is involved in the development of the present and future work.	4.30	0.78	A Lot
4. Having creativity in various works considering the current reality in a stepwise manner	3.30	0.73	Moderate
5. Having the ability to develop their own learning systematically	3.24	0.98	Moderate
<b>Total average</b>	<b>3.97</b>	<b>0.67</b>	<b>A Lot</b>

Source: Calculation

From Table 1.5, it was found that the personnel in the Agricultural Cooperative Federation of Thailand Limited had all characteristics of team learning at a high level. ( $\bar{X}$  = 3.97) The characteristics of personnel in the Agricultural Cooperatives Federation of Thailand Limited had

the highest average level, namely, the personnel had the perception that they were part of the same importance as other parts of the organization. ( $\bar{X}$  = 4.43)

Part 2: Factors affecting the learning organization of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Senge explain by Table 1. 6 as follows:

**Table 1.6:** Factors affecting the learning organization of organization of the Agricultural Cooperative Federation of Thailand Limited according to the concept of Peter Senge

Independent variable (X)	Dependent variable (Y)
Characteristics of learning organization personnel	Reducing operating costs (Y1)
Personal Mastery (X1)	0.17***
Mental Models (X2)	0.47***
Shared Vision (X3)	0.59***
Team Learning (X4)	1.52***
Systems Thinking (X5)	0.60***
F	365.09
$\chi^2$	0.98

**Source:** Calculation

\*\*\*Statistically significant at 0.01 level

\*\* statistically significant at the 0.05 level

\*. statistically significant at the 0.10 level

From Table 4. 16, the learning organization factors of the member agricultural cooperatives according to Peter Senge's concept of reducing operating costs (Y1) consisted of five factors: 1) Personal Mastery (X1), 2) Mental Models (X2), 3) Shared Vision (X3), 4) Team Learning (X4), and 5) Systems Thinking (X5). The learning organization of the member agricultural cooperatives according to Peter Senge's concept of cost reduction (Y1), all five factors were statistically significant at the

0.01 level. The researchers were able to describe each learning organization factor of the member agricultural cooperatives according to Peter Senge's concept of reducing operating costs (Y1) in each factor are as follows:

1) The Personal Mastery of the personnel of the member agricultural cooperatives according to the concept of Peter Senge had a positive effect on the cost reduction in operations, that was, the increase in the self-knowledge of the personnel of the member agricultural cooperatives by 1 unit will result in The reduction in operating costs of member agricultural cooperatives by 0.17 units meant that when personnel in member agricultural cooperatives It was determined to lead the organization to excellence and continually develop its work.

2) The concept of Peter Senge member agricultural cooperative personnel had a positive effect on cost reduction in operations. That was to say, the concept of personnel in member agricultural cooperatives increases by one unit, resulting in an increase in innovation capacity by 0.47 units that occurred while working to analyze and found the better alternatives in the next operation and exchange knowledge including the experience of working with colleagues in member agricultural cooperatives. In addition, personnel in member agricultural cooperatives are always trying to find the best way to adapt to their work and to adjust their thinking. Furthermore, how to work in accordance with the situation and bring new ideas used to develop the work to be better always.

3) The shared vision of Peter Senge's member agricultural cooperative personnel had a positive effect on reducing operating costs. In other words, the increase of personnel in member agricultural cooperatives by one unit resulted in a reduction in operating costs by 0.59 units. The personnel in the organization analyzed the environment in the organization to find strengths. Weaknesses were opportunities to develop into the vision of the organization. In addition, members of agricultural cooperative personnel had the opportunity to participate in setting the vision of the organization such as brainstorming sessions. Suggesting guidelines that were beneficial to member agricultural cooperatives, etc., including the organization having a clear image that makes personnel wanted to integrate together to achieve goals for the future of the organization such characteristics would be affected the cost reduction in the operation of member agricultural cooperatives.

4) Team learning by Peter Senge member agricultural cooperative personnel positively affected operational cost reduction. The research result expressed that the reduction of operating costs increased by 1.52 units, such as the fact that personnel in member agricultural cooperatives received knowledge from the organization to promote teamwork or group work. Also personnel



in the team were learning at the same time and exchanging opinions with each other. Including the personnel in the team always have the initiative to create new things. Employees understand the work process of the organization the same as everyone. In addition, staff members have a good relationship with each other in the organization and work as a team in which the success criteria of the work are set together. The information is learned in the work to discuss and summarize the best approach of the team. Team members are monitored and evaluated working together. Personnel have an understanding of the organization's infrastructure. In addition, at work every time Personnel have a clear and systematic division of duties and responsibilities in their work. The team-based learning of the members of the agricultural cooperatives will result in a reduction in operating costs. Especially the reduction of losses or mistakes that occur in the operational processes of member agricultural cooperatives.

5) The systematic thinking of the personnel of the member agricultural cooperatives according to Peter Senge's concept has a positive effect on the cost reduction in operations. Work 0.60 units, for example, agricultural cooperative personnel members have integrated the vision of the organization in systematic operations and linking past performance to current and future work development. In addition, there are agricultural cooperative personnel members who have initiatives to create various works. Taking into account the current reality in a stepwise manner this will cause a reduction in operating costs of member agricultural cooperatives.

## Conclusion

Characteristics of learning organization personnel of the Agricultural Cooperative Society of Thailand Limited and member agricultural cooperatives based on the concept of Peter Senge. It consists of 5 disciplines of being a learning organization. Characteristics of learning organization personnel of the Agricultural Cooperatives Association of Thailand Limited, by personnel characteristics of the learning organization in 5 aspects, in descending order as follows: 1) Systems Thinking 2) Personal Mastery 3) Mental Models 4) shared vision and team learning, respectively.

Factors affecting the learning organization of agricultural cooperatives according to the concept of Peter Senge affecting the reduction of operating costs (Y1) consists of 5 factors: 1) Personal Mastery (X1), 2.) Mental Models (X2), 3) Shared Vision (X3), 4) Team Learning (X4), and 5) Systems Thinking (X5), with a statistical significance of 0.01, these 5 factors contributed to becoming a learning organization in reducing operating costs.

The factors influencing the effect of Peter Senge's conceptualized learning organization on the innovation capacity of member agricultural cooperatives are listed in the following order: team learning common vision systematic thinking Thought patterns and self-knowledge, respectively. The results of this research are consistent with the research of Kusol Thongwan (2010), Watjanarat Krai. (2010). Somchai Ratanakot and others (2015), Anan Boonsanong (2016). Supannikar Jitchu (2017) and Patcharakan Methaakkarakiat and Prasopchai Phasunon (2018) Chow., C. K W, and Tsui., w. H. k. (2017). that factors in the use of technology will influence the results of being a learning organization in both aspects of member agricultural cooperatives, namely reducing operating costs and creating innovations in member agricultural cooperatives.

## Reference

- Agricultural Cooperative Association of Thailand Limited Retrieved on January 13, 2018 from [www.co-opthai.com](http://www.co-opthai.com).
- Altinay, F. Dagli, G., and Altinay, Z. (2016). The role of information technology in becoming learning organization. *Procedia Computer Science*. 26(102), 663 – 667.
- Argyris, Chris and Donald A. Schon. (1978). *Organization Learning: a Theory of Action Perspective*. Massachusetts: Addison-Wesley.
- Barnard, c.l. (1972). *The Function of the Executive*. Massachusetts: Harvard University Press.
- Bodin Vikram. (2005). *Development of a learning organization*. Bangkok: Expernet. Retrieved from Marquardt M.J.2002. Building the Learning Organization: Mastering the five Elements for Corporate Learning. California: Davies Black Publishing.
- Buppha Phuangmalee. (1999). Perception of a learning organization in the nursing department of government hospitals in Bangkok. Thesis, MBA (Marketing). Bangkok: Graduate School. Chulalongkorn University. Photocopy.
- Chamnan Nimnuan. (2017). Knowledge Management of Military Organizations: A Case Study of the Air Force, *Sripatum Academic Journal*, 10(1), 69-79.
- Chamrieng Waiwat; and Benjamas Amphan. (1997). *The Five Principles of Organizational Discipline for Learning*. (2<sup>nd</sup> Edition). Bangkok: Competitors.
- Chantana Muangchan. (1999). *Vision of Educational Institution Administrators*. Bangkok: Chanthip.

- Chow., C. K W, and Tsui., w. H. k. (2017). Organizational learning, operating costs and airline consolidation policy in the Chinese airline industry. *Journal of Air Transport Management*. 16(63), 108-118.
- Critic Panich. (2004). *School of Quality and Creativity*. Bangkok: Office of the Education Council Secretariat.
- Department of Academic Affairs. (2001). *Quality Assurance in Educational Institutions at Level 3 Education Level 3: School Quality Management Guidelines*. Bangkok: Teachers Council of Thailand Printing House. Ladprao.
- Donyawan Leelasuphaphong. (2011). *Characteristics of employees and organizational performance according to the concept of learning organization*. Case study of a fast food company. Master of Business Administration Thesis Department of Management. Srinakharinwirot University.
- Egan T.M. (2014). Measuring the Impact of Learning Organization on Job Satisfaction and Individual Performance in Greek Advertising Sector *Procedia . Social and Behavioral Sciences*, 43(175), 367 – 375.
- H, Bahar Asci, Fatma. Z.T., and Altinas, F. (2016). A Strategic Approach for learning Organizations: A Mental Models. *Social and Behavioral Science*, 58(235), 2-11.
- Harell., F. E., (2019). *Regression Modeling Strategies with Applications to Linear Models, Logistic Regression, and Survival Analysis*. New York City: Springer.
- Husseina H., Omara, S. Noordina, F, Ishaka, N.A. (2016). Learning Organization Culture, Organizational Performance and Organizational Innovativeness in a Public Institution of Higher Education in Malaysia: A Preliminary Study. *Procedia Economics and Finance*. 7(37), 512 – 519.
- Kalaya Wanichbancha. (1999). *Data Analysis with SPSS for Windows*. Bangkok: Chulalongkorn University Printing House.
- Kalaya Wanichbancha. (2003). *Statistical Analysis: Statistics for Decision Making*. 6<sup>th</sup> printing Bangkok: Chulalongkorn University Printing House.
- Khunsoonthornkit, A.and Panjakajornsak, V. (2018). Structural equation model to assess the impact of learning organization and commitment on the performance of research organizations. *Kasetsart Journal of Social Sciences*. 39(3), 457-462.
- Kiatkong Khumpairote (1994). Performance Assessment, *Khon Journal*, (January-March).
- Kidanon Malithong. (1997). *Educational technology and innovation*. Bangkok: Chuan Pim.
- Kittikhun Thitsomkul. (2017). *Organization of learning that affects the performance of personnel of the Royal Thai Air Force Command Development Squadron*. Royal Thai

- Armed Forces Headquarters (Master of Public Administration Thesis). Rajabhat Rajabhat University, Chachoengsao.
- Kusol Thongwan. (2010). The relationship of factors promoting being a learning organization to the level of learning organization birth. and the level of being an innovative organization: a case study of the National Science and Technology Development Agency. *Journal of Payap University*. 21(1), 222-247.
- Luan Saiyot and Angkana Saiyot (1995). *Educational research techniques*. Bangkok: Suwiriyasas.
- Luan Saiyot and Angkana Saiyot. (1997). *Research Statistics*. Bangkok : Suwiriyasas.
- Luechai Phancharoenkit. (1997). *Organization development based on the concept of learning organization: a case study of The Siam Commercial Bank Public Company Limited*. Bangkok: Graduate School of Chulalongkorn University. Photocopy.
- M.Murat Yaşlıoğlu , Ömer Şapb, and Duygu Topluca. (2014). An Investigation of the Characteristics of Learning Organizations in Turkish Companies, *Scale Validation*. 37(150), 726 – 734.
- Manida Luesaiwong. (2008). *Opinions of employees with factors that support the creation of a learning organization: a case study of Kasikorn Bank Public Company Limited*. (Management). Bangkok: Graduate School Srinakharinwirot University. Photocopy.
- Marquardt, M.J and Reynolds, A. (1994). *The Global Learning Organization*. New York: Irwin.
- Nittaya Duangprasert. (2007). *Employees' Opinions towards Being a Learning Organization: A Case Study of Siam Commercial Bank Public Company Limited, Watchyothin Branch*. Thesis material M.Ed. (Educational Administration). Bangkok: Graduate School Kasetsart University. Photocopy.
- Nutthaphan Ketchonan. (2005). Learning Organization. Retrieved on December 8, 2009 from [www.wasant.org/knowledge/tutor/km18.php](http://www.wasant.org/knowledge/tutor/km18.php).
- Pananan Kosinanon. (2017). *Research report on the development of Rajapruek College as a learning organization Bangkok*. Ratchaphruek College.
- Pansri Srichantuk. (2011). *Factors affecting being a learning organization of support personnel: a case study of Rajamangala University of Technology Isan*. Independent study and research, Master of Business Administration. Rajamangala University of Technology Isan.
- Parichat Sangkanan. (2004). Smart Organization: Learning Organization. Retrieved on June 15, 2008 from <http://www.cdd.go.th/morchorchor/learnmorchor.doc>.

- Patcharakan Methaakkarakiat and Prasopchai Phasunon. (2018). *Factors affecting being a learning organization of the Office of the Board*. Basic education. *Veridian E-Journal, Silpakorn University, Thai version, Humanities, Social Sciences and Arts*, 11(1), 44-60.
- Payom Wongsarsri (1987). *Personnel Management*. Bangkok : Phranakorn Panich Printing House.
- Pedler, M., Burgoyne, J. and Boydell, T. (1991). *The Learning Company: A strategy for Sustainable Development*. Berkshire: McGraw-Hill.
- Peerawat Jarudul. (1998). *Implementing the concept of learning organization in the Government Savings Bank*. Research papers R.P.M. (Public Administration). Bangkok: Graduate School Chulalongkorn University. Photocopy.
- Praphan Surihan. (1999). *Management theory*. Bangkok: Srinakharinwirot University.
- Puangrat Kasetphaet. (2000). *Strategic planning of educators*. Bangkok: Suwiryasarn.
- Senge, Peter M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday Currency.
- Su Chao Chang and Ming Shing Lee (2007). A study on relationship among leadership, organizational culture, the operation of learning organization and employees' job satisfaction, *The Learning Organization*, 14(2), 155-185.
- Teerasak Akaravorn. (2001). *Being a Thai teacher*. Bangkok: Kor Phon Phim (1996).
- Thiphawan Lorsuwanrat. (2006). *Modern Organization*. Bangkok: National Institute of Development Administration.
- Thitiporn Philboonwong. (2016). *Guidelines for developing a learning organization of the Government Savings Bank Region 14*. Master of Business Administration Thesis Department of Public Management. College of Commerce Burapha University, Chonburi.
- Watjanarat Krai. (2010). *Factors Affecting Being a Learning Organization: A Comparative Study Between Government Organizations and Private Organizations*. Graduate School. Department of Public Administration. Faculty of Management Science (Public Administration). Prince of Songkla University.
- Wichai Wongyai. (1999). Learning Organization. *Education*, (September-December, 1999), 9-11.
- Zeynep Kabadayı Kuşcu, Müjdelen Yenerb, F. and Gülruh Gürbüzc. (2015). Learning Organization and its Cultural Manifestations: Evidence from a Global White Goods Manufacturer. *Social and Behavioral Sciences*, 52(210), 154 – 163.

## Developing a Logistics and Supply Chain Performance Measurement Model by applying the COBIT2019 and SCOR framework

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### Abstract

There has been a development of SCOR DS to evaluate IT and digital use better. It combines the indicators possessing the economic flexibility, sustainability, and standard criteria that generate the change of processes for supporting every channel of business, enhancing strategic management, and originating a complete Supply chain. There was organizing the linear trading alliance to the network to emphasize the marketing drives by having the integration and digital transformation help evaluate the performance management process effectively (Borovkov et al., 2019). It enables the managers to control the quality of IT Governance which originates sustainable development. From this perspective (ITGI, 2018), the researcher is assessing the potential and possibility of the transportation business only as a case study. The base of the Indicator is from crucial SCOR DS on IT, and the COBIT2019 framework is for the Indicator according to the Balanced Scorecard to evaluate the quality. The research methodology depends on applying the CMMI concept, a method of maturity evaluation, and advice for improving

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the process to reach the utmost efficiency and effectiveness. The research result reveals that it could reduce the gap during the performance. Furthermore, the number of current theories regarding IT in Logistics and Supply chain is still limited in terms of academic study. Therefore, the objectives of this research were to create the integrative standard and quality assurance of the IT system used to create the maximum profits for the logistics organization and apply the results for future use.

**Keywords:** CMMI: Capability Maturity Model Integration, SCOR DS (Digital Standard),  
COBIT 2019 framework

## Introduction

Transportation service enterprises have a lot of competitiveness since there are several different service providers. Moreover, various environments impact transportation performances, such as laws, regulations, the uncertainty of transporting quantities, and competition between many types of transportation. Hence, transportation entrepreneurs must be capable of adjusting and developing the features of performance until they can respond to the customers' requirements in various aspects under changeable environments. Besides, transportation entrepreneurs should improve the process of operations within the organization to achieve effectiveness. The most important thing which can generate the efficiency of the transporting performance is the performance evaluation because it helps the transportation entrepreneurs realize which and how performing processes they have to improve. The assessment would take the information from the operating measurement to analyze and evaluate. Thus, it has to determine the indicators for visualizing the performance (Khairul et al., 2021). For this operational assessment, the study uses the SCOR DS Indicators and COBIT2019 Framework method implemented in the performance results of various types of businesses (ISACA, 2018). However, not every corporation will be successful with the CMMI method because it has to be consistent in assessment for improvement and relies on numerous sources of information to take into consideration (Keshta et al., 2018, CMMI, 2018). Unless the information is complete, it might cause errors in the evaluation. Therefore, the evaluators must perceive the assessment processes and many factors associated with the evaluation impact well, including bringing the results to improve and develop the organization for continuous effectiveness achievements.

Regarding the context of transforming the Logistics and Supply chain (APICS, 2017). to be digital, this research emphasizes the entire conceptual vision for the quality evaluation criteria focusing on transportation only. Then, the researcher determined the purposes of the study on quality assurance based on CMMI principles using the SCOR Digital Standard Indicator (ASCM, 2021). and COBIT2019 Framework on transportation business in Thailand. The research of true excellence in Logistics and Supply chain has to access the digital transformation process by IT and digital only (Tatiana et al., 2022). It is a change-based technology (Maydanova et al., 2019). Concerning the research hypotheses, the bringing of COBIT2019 (ISACA, 2018). and SCOR DS to be used as an IT Standard Framework considers that management is such an earlier crucial factor for all managers to manage their strategies. It is because they can monitor their corporates easier and integrate with the



novel software technologies variously, for example, developing the software system of the transportation business by considering the capability of such total logistics software system management (Karolina W., Natural, 2018). It affects the development process unexpectedly for all levels of the organization to provide services to the customers, both in the country and globally, generate value for the customers, and develop the service. Hence, this study is crucial to the mentioned purposes by bringing the SCOR DS Indicator to integrate with the COBIT2019 Framework. The results can take to apply to evaluate the IT governance standard (Bouayad et al., 2018). It is the bringing of the essential indicators to assess the quality for supervising the logistic industries and Supply chain. This research engages the case study with the transportation business of Thailand.

## Literature Review

The research focuses on the study of the CMMI evaluation using the SCOR Digital Standard Indicators and COBIT2019 Framework in the transportation business, which is crucial that managers in every position have to implement this evaluation as a controlling tool. The instrument is to assess the quality to manage the organization to meet the utmost effectiveness and efficiency according to the IT Governance standard, which is an ELMA standard criterion of Thailand (DITP, 2021). Furthermore, it describes according to the organizational theories at a high level and strategic management of BSC as follows:

### A. SCOR DS

The Association for Supply Chain Management (ASCM) is a universal leader in organizational alteration (ASCM, 2021), capability development, and supply chain innovation. It has launched the standardized digital citing the supply chain performance (SCOR DS) because this has been the most crucial improvement since the establishment of SCOR in 1996 (APICS, 2017). The new SCOR DS has adjusted the accessing frame to be open for contemporary, to include the indicators which have flexibility, economy, sustainability, and standard criteria of process change supporting the retail of every channel, strategic provision, and strategic coordination of supply chain. In addition, the new SCOR DS moves the thinking about the complete supply chain from determining the linear trading allies to the non-linear dynamic supply chain network focusing on the marketing drives, visualization, and cooperation. Our community gathers to adjust this SCOR compared to the energy in the room

when the SCOR 1.0 debuted for the first time. For the Indicator, our most successful is providing all stakeholders to see themselves, their organization, and the supply chain in their organization, including enhancing them to originate the foundation of the process for digital investment until 2030 (ASCM, 2021).

A group of experts has developed the new SCOR DS on varied contents. It updates the processes of indicators, skills, and guidelines to guarantee that it covers various industries. Furthermore, the experts have investigated the matrix of effectiveness and guidance, including adjustment to get the organization to have novel methods for measuring the results and improving the supply chain. "It is essential for us to provide the capability which is the most modernity to the supply chain professionals for developing their skills so that they can grow in this industry." Updating this new SCOR DS proposes the standardized industry, which has more coverage that enables the organization to use and support the supply chain to access the potentials fully. For the model, it realizes six main processes: Plan, Source, Make, Delivery, Return, and Order. The SCOR DS brings these processes additionally, as shown in Fig. 1.

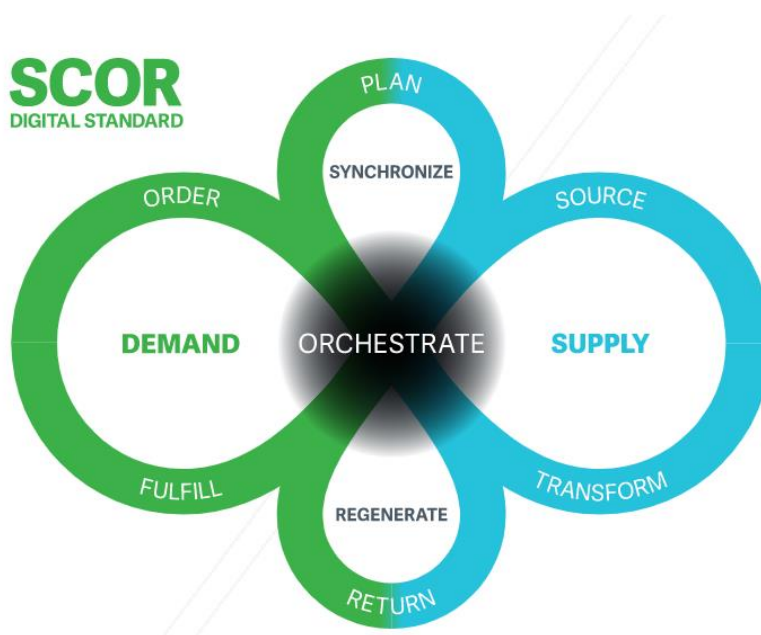


Figure 1 SCOR DS

Source: <https://www.ascm.org>

Fig. 1 indicates that the supply chain is always a set of activities moving without starting or stopping from a process to the SCOR DS process. Adding the Orchestrate is to be aware of the essence of the strategies, business regulations, technologies, and human resources with the covered orientation. It is to build a supply chain that has more effectiveness. Delivery divides into Fulfil and Order to provide details and focus on activities, direction, and those indicators. Make becomes Transform to expand the use for the service providers on production and other types (ASCM, 2021).

Hence, studying and searching the basic secondary information regarding the management and IT transportation business management are the fundamental data to compare with the criteria of COBIT2019 Framework performing pursuing the crucial strategies of the business has to possess the IT strategic system to support in every stage starting from the planning and supervising (ISACA, 2018), including operating more. It is such a strategic management.

## B. COBIT 2019

IT management has to be concordant with the organization's management. Namely, the strategies of IT management have to be concordant with the organization management strategies to achieve the same goals. The principle usually brought to determine the organizational management strategy is the measurement dimension of the Balance Score Card: BSC (Kaplan et al., 2017), which has the organizing principle for the balance between the indicators. The styles of bringing the frame and method of ICT management are various principles and types, such as ISO, COSO (COSO, 2004), and COBIT, as the operational frame. COBIT has developed and improved until the 2019 generation. It combines efficient principles and operational frameworks of the standardized ones on IT, and digital management involved altogether, focusing on developing the standardized evaluation criteria from IT Governance standard by the COBIT2019 (ITGI, 2018). It can assess the status of project organizing on IT, which level it is and how it should improve, or whether it has a way to develop and extend the values to become higher. Hence, to follow Good Governance for purposes achievement, it has to use the COBIT2019 Framework for studying and developing this evaluation (ISACA, 2019). It divides the process into 40 processes into five domains: 1. Evaluate, Direct, and Monitor (EDM) 2. Align, Plan, and Organize (APO) 3. Build, Acquire, and Implement (BAI) 4. Deliver, Service, and Support (DSS), and 5. Monitor, Evaluate, and Assess (MEA) by studying the comparison shown in Fig.2 as follows:

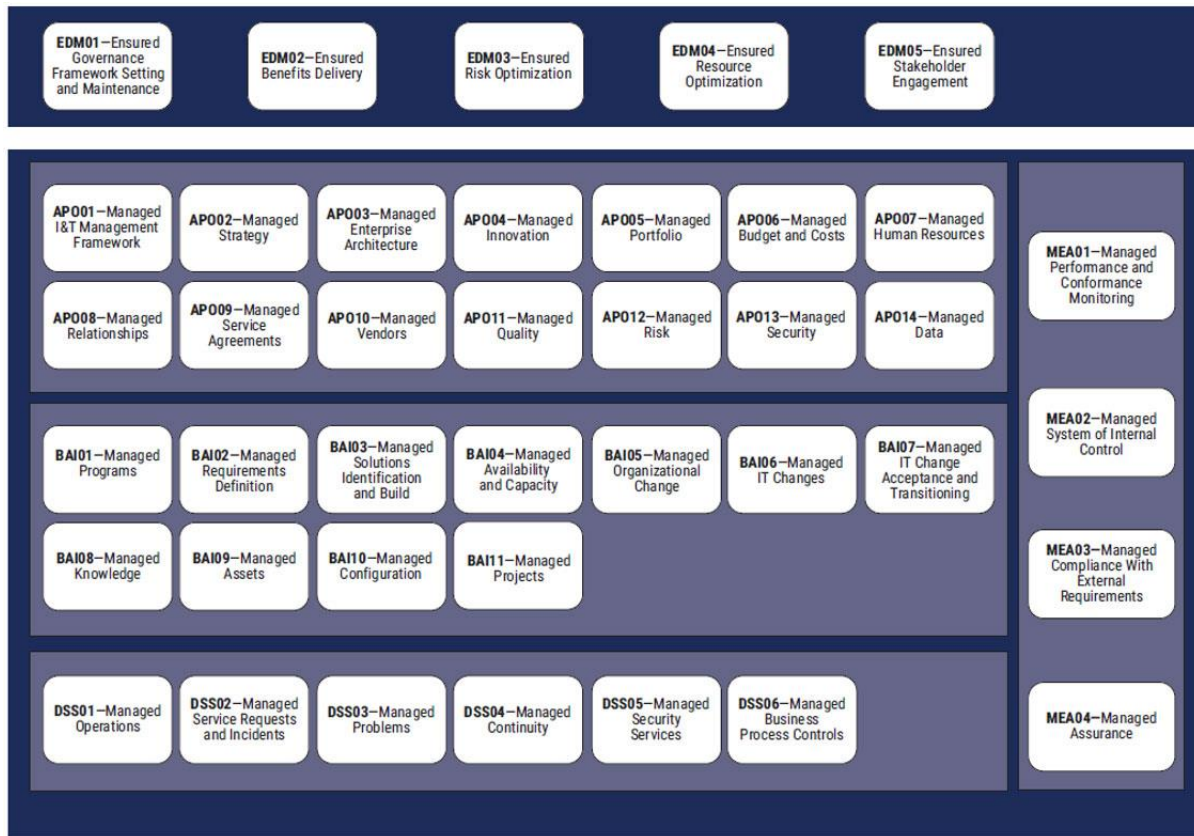


Figure 2 COBIT2019 Process Reference Model

Source: ISACA, COBIT 2019 Framework: Introduction and Methodology, USA, 2018

According to Figure 1, various Indicators evaluated the results of the process, which could help develop the performance process. The COBIT2019 framework was determined to enable the organization to manage, control, follow, and evaluate the IT system to reach the main goals of the business. Moreover, an application helped develop the instruments for the managers to link the gaps while monitoring the IT system management technique, including controlling the business risks by representing the relationship of the COBIT2019 framework for evaluating the quality according to the Indicators to express the quality of organization management compared with the global standard.

### C. Information Technology in Transportation

IT use has infiltrated almost everywhere, and the capability of managing the information helps improve resource management dramatically. However, the positive effect is a challenge for operating, supporting, and providing funds for these technologies in the transportation world. Besides, reducing the gap between novel technology and application, including

indicating the lost connecting points for technological use on transportation would become a challenge consistently. The up-to-date information system and transportation technology, as well as the IT development roles for the various technological challenge, such as the use of information systems and transportation technology, the use of Graphical User Interface (GUI), information management and sharing, technology use of the internet, intranet, extranet, and mobile application for transportation, information exchange and internet communication or extranet, a combination of transportation information resources across the platform, dynamic model creation, and transportation presentation on the internet, information publication, and management using the intranet of the organization, and integration between transportation database and internet, intranet, and extranet, prioritization of the research project, development, and demonstration to increase the operating contributions, enhance the use of ordinary information system. The meaning and standard of information technology on transportation can facilitate and follow the technology transfer as the Users' Supporters between transportation organizations and sellers (ISO, 2011). The evaluation of the effects of IT and digital technology on the transportation organization, the productivity increase, application of high technology for transportation involved the following issues: IT Management, Data Sharing and Interoperability, Transportation Applications and Information Dissemination and Transportation Applications of Web Technologies In applying web technologies, the focus in the Digital Transformation will be on advances in real-time technologies and push technologies (Tatiana et al., 2022).

#### **D. ELMA (Excellent Logistics Management Award)**

Department of International Trade Promotion, Ministry of Commerce, THAILAND, by the Office of Development and Promotion of Service Business, organized the committee's meeting to consider the ELMA Award contest (DITP, 2021). The purposes were to generate the standard for logistics and Supply chain in Thailand. The study brought the COBIT 2019 standard as the guideline for investigating the IT quality system. It emphasizes control as the main for supervision, focusing on the regulations and processes the IT organization has to follow for efficiency achievement through logistics and supply chain business. Hence, the researcher selected to study the Indicators and compared them with the ELMA criterion (Excellent Logistics Management Award), Transportation Branch The components include 1) strategy and vision on business and organization leading, 2) Plan and operation on logistics, 3) Significance of customers and marketing, 4) Use of information system and technology supporting the

logistics activity, 5) Significance of human resources, 6) Management of logistics process, and 7) Business capacity and result. When comparing with the principle of BSC, it was the criteria emphasizing the use of information systems and technology supporting the logistics activities, which is concordant with the COBIT2019 use, as shown in Table 1.

**Table 1:** Summary of comparison between ELMA and BSC

ELMA	BSC	COBIT2019
<ul style="list-style-type: none"> <li>• Every aspect has to rely on funds for management;</li> </ul>	<b>Financial</b>	-
<ul style="list-style-type: none"> <li>• Significance to the customers and marketing;</li> </ul>	<b>Customer</b>	-
<ul style="list-style-type: none"> <li>• Strategies, business visions, and organization leading;</li> <li>• Planning and operation on logistics;</li> <li>• Use of information systems and technologies supporting logistics activities;</li> <li>• Significance to human resources;</li> <li>• Management of logistics process;</li> </ul>	<b>Internal Process</b>	<ul style="list-style-type: none"> <li>• Information system use and technologies supporting the logistics activities</li> </ul>
<ul style="list-style-type: none"> <li>• Business capacity and results</li> </ul>	<b>Learning &amp; Growth</b>	-

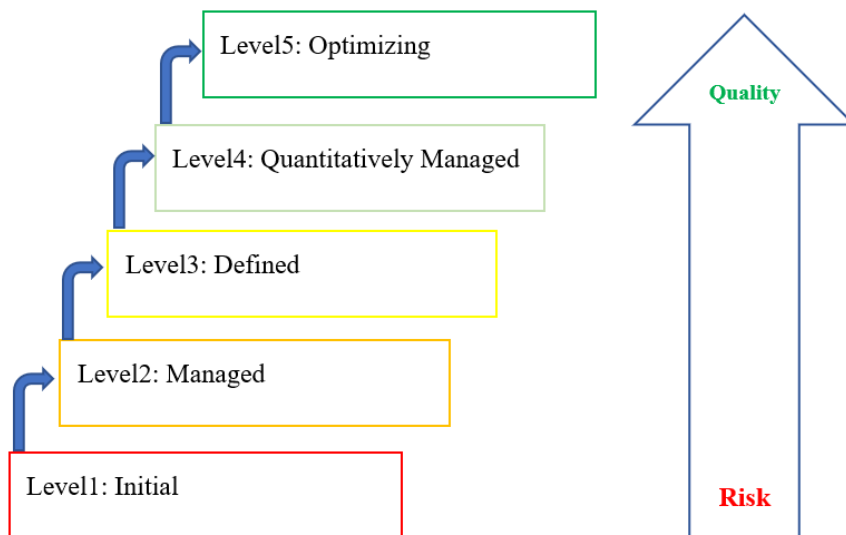
Table 1 is concordant with COBIT2019 in the ELMA criteria, information system use, and technologies supporting the logistic technologies, concordant with the internal process of the BSC, which is relevant and concordant to each other.

### E. BSC: Balanced Scorecard

A system or process of management, depending on the KPI determination, is a crucial mechanism. Kaplan and Norton gave the latest definition of the Balanced Scorecard that “it is a managerial tool which supports the bringing of strategies to the strategic implementation using the Measurement which enhances the organization to be concordant to each other, and emphasizes what is significant to the success of the organizational alignment, and focused on the Indicator in four Perspectives, which consisted of Financial Perspective, Customer Perspective, Internal Process Perspective, and Learning & Growth Perspective (Kaplan et al., 2017).

**F. Capability maturity model integration (CMMI)**

The model which increases the efficiency of the development process enhances the corporation to improve and support the cultures effectively and efficiently. It helps reduce risks when developing software, product, and service. The place for improving this work is at the Software Engineering Institute, Carnegie Mellon University, USA. CMMI is considered the standard for software improvement to be qualitative and famous (CMMI, 2018), with universal acceptability. If any organization gets the CMMI at a high level, between 4 and 5, such an organization has an effective development process, is reliable among the customers, and it guarantees that masterpiece. The CMMI Framework is a reference type consisting of the description for operational direction (Ismail, 2022), is best for the various engineering activities, covering the total life cycle of products from determining the requirements to delivering and maintaining. This model is successful from the systematic engineering capability model from the electronic industry allies group. It aims at preparing the mechanism for adjusting processes that supports the enterprise to avoid or eliminate obstacles. It works by mixing the models over the discipline as a descriptive form. CMMI is suitable for any organization which needs to discover the number of competencies within the scope of software, system, or product engineering, by participating in an evaluation. Furthermore, it is a device as guidance comprehensively the efforts to develop the process in each aspect of professionals in the CMMI Model, as shown in Fig. 3.



**Figure 3** CMMI’s Maturity Levels

Fig. 3 expresses the screen model, which consists of five maturity levels. Each stage of each foundation is for improving five processes continuously. The five processes of CMMI’s Maturity Levels show in Table 2 as follows:

**Table 2:** CMMI’s Maturity Levels

Maturity Level		Implication
1	<b>Initial</b>	This process views that it is unexpected and has the responsive reaction as “Work has finished, but it is delayed and uses over-budget.” It is such the worst stage that a business can realize that it is in an unexpected environment. It increases risks and lacks efficiency.
2	<b>Managed</b>	It reaches the level of successful management. The project has a "plan, operation, result measurement, and control" level. However, it still has numerous problems which have to resolve.
3	<b>Defined</b>	The organization works more proactively than reactively. It achieves the standard overall for recommending the project, program, and portfolio. All businesses perceive their defects, problems solving, and improvement goals.
4	<b>Quantitatively Managed</b>	It can measure and control better. The organization is managing with quantitative information to determine the predictable process concordant with the stakeholders' requirements. The business precedes the risks with in-depth data driving the data that involve how to adjust the faults of the process.
5	<b>Optimizing</b>	The process of the organization is flexible and stable. In this final stage, the organization is at a stability stage of improvement and response toward the changes.

According to Table 2, when an organization reaches Maturity Levels 4 and 5, it achieves a high maturity, which has to “develop, self-adjust, and grow continuously to respond to the needs of the stakeholders and customers.” It is the goal of CMMI: to generate credible environments. All products, services, and departments are proactive, effective, and efficient.



## Method

The study conducts CMMI evaluation specifically to the Transportation Business toward the Indicator of SCOR DS as a foundation for selecting and classifying a group according to the BSC principle (Kaplan et al., 2017)., consisting of four aspects: Finance, Customer, Internal Process, and Learning & Growth through the strategic management system using IT and digital COBIT2019 framework. The objectives are to supervise existing in the domain of Evaluate, Direct, and Monitor (EDM). In this domain, the supervision organization would assess the strategic alternation, monitor the executives about selected strategic alternatives, and follow the strategies achievement, with four managerial objectives. The Domain of Align, Plan, and Organize (APO) mention the overall organization, strategy, and supporting activities for IT information and technology. While the Domain of Build, Acquire and Implement (BAI) refer to the definition, acquirement, and IT adjustment including the mixture of the business process. Domain Deliver, Service, and Support (DSS) indicate the delivery of IT performance and service support, including the security, and the Domain of Monitor, Evaluate, and Assess (MEA) manage the investigation of effectiveness and IT concordance with the internal effectiveness goals, following the internal control objectives, and external determination. It is to recruit the criteria of quality assessment suitable for the Transportation Business as the case study, and the CMMI evaluation to use for assessing the quality of IT and digital management (De Haes et al., 2020), combining from Table 1, as shown in Fig. 4 and Table 3.

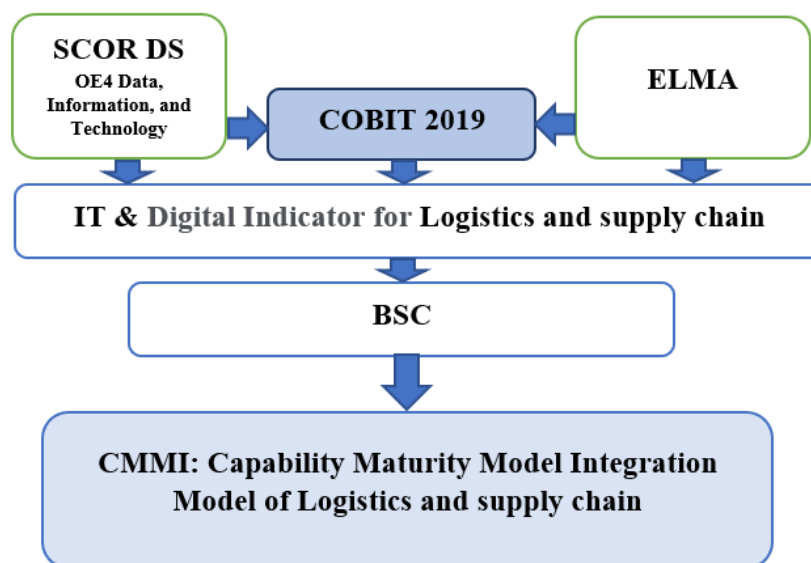


Figure 4 Methods of Research

Fig. 4 is a crucial stage of the research process. It brings all standardized criteria to integrate for assessing the IT and a digital standard, tries out, and evaluates the Transportation Business in Thailand.

**Table 3:** SCOR DS OE4 Comparison: Hierarchy Indicator and COBIT2019 Domains

SCOR Digital Standard OE4 Data, Information, and Technology	BSC				COBIT2019 Domains					
	Financial	Customer	Internal Process	Learning & Growth	← CMMI →					
					EDM	APO	BAI	DSS	MENU	
<b>Hierarchy</b>										
OE4.1 Define Supply Chain Data, Information and/or Technology Requirements			☑			☑				
OE4.2 Identify Technology Solution Alternatives			☑			☑				
OE4.3 Develop the Architecture Plan			☑					☑		
OE4.4 Select Preferred Technology Solution			☑			☑				
OE4.5 Plan and Approve an Implementation Roadmap			☑			☑				
OE4.6 Pilot and Deploy Technology Solution				☑				☑		
OE4.7 Maintain, Improve, or Retire Technology(ies)			☑						☑	
OE4.8 Govern Data Integrity and Accountability			☑			☑				☑

Table 1 is basic information on the operation situation in the organization as a guideline for research conduction. The researcher selected the evaluation and brought such criteria to analyze through the experts of Transportation Business, a total of 17 executives and personnel relating to this transportation operation according to the ELMA criterion (DITP, 2021). The operation is as follows: concluded the results from the objectives and the operations following the IT Logistics and Supply Chain from the interview. Then brought results to convert the mathematic values to find out the decision point within the criteria of weight value level of the scores by the CMMI method to meet the global standard criteria and evaluated in the industrial part of Logistics in the transportation business according to the case study.

Each sub-process calculated the related matrix relating to the total numbers of the matrix in the determined maturity, as developed in this study (Table 2). For the result, its ratio would show in percent, and the scores scale had a label of A-F (Table 4). The scores evaluation at the last stage for the success of attributes of all sub-processes used the IT in the Transportation Business to study the “Hierarchy” of all eight Indicators as the main to calculate the maturity index. It is the same as the maturity assessment calculated based on the proposed methods during the study, as shown in Table 2. It is because the ratio was the score between 1 and 100 per number of the maturity Level 1-5, expressed in percent according to the formula of arithmetic mean of the information in the distributed frequency.

The arithmetic of the information in the distributed frequency can calculate from the formula below:

The formula standing for as follows:

f = Frequency of information

$$\bar{X} = \frac{\sum fx}{n}$$

x = Values of information

n = Total frequency

**Table 4:** Conclusion of the evaluation of the operational result according to the SCOR DS per Score Range

Attributes	F	E	D	C	B	A
Score Range	0	1-19	20-39	40-59	60-79	80-100
Respondent	-	7	9	1	-	-
Indicator Sample						
Conclude	-	41.17	52.94	5.89	-	-

When Table 4 compared the criteria with Table 2, it reveals that the experiment results to answer the question of the development process from all 17 responders who replied to the questionnaire had the results during the operational beginning at the E level (41.17%). It is equal to Level 1 (Initial). The D level had a value of 52.94 %, the same as Level 2 (Managed), and C Level had a value of 5.89%, equal to Level 3 (Defined). No organization can develop up to a higher level than this. However, this is during the time of development that the system and mechanism reach a higher standard.

## Results

The study entitled A Quality Assurance based on CMMI Principles Using SCOR Digital Standard Indicator and COBIT2019 Framework on Transportation Business in Thailand is a guideline for IT internal audit, good supervision of IT Governance, arrangement of the internal control system of IT Control, including strategies and analysis processes for IT management. The research studied the basic information of the internal control system. Thus, the researcher selected the technique of Mixed Methods, Quantitative Data, and Qualitative Data, (Amy, 2021)., and then created the interview form from the data to interview the managers and personnel of the corporates. The researcher also compared the information and concluded the guidance to organize the standardized new paradigm from the standard framework of COBIT2019 and SCOR Digital Standard, which enhanced the measurement of the performance process effectiveness for IT management in the logistics and supply chain industry. Moreover, it helped adjust and improve, including developing the Indicator to be complete, and concluded the development result of the evaluation criteria for the IT Logistics and Supply chain organization, and reporting the research as the research methodology.

## Discussion

The expected benefits of this study are the capability of improving the SCOR DS Indicator focusing on the Orchestrate as the main, and selecting the Indicator OE4 Data, Information, and Technology to evaluate the transportation indicator. Besides, it is to operate, control, follow, and evaluate the quality of IT internal audit categorizing the group according to the BSC principle and COBIT2019 Framework, bringing the selection result of the indicator and related information of the transportation to evaluate through the CMMI method. For the logistics and supply chain management system in Table 1 mentioned above regarding the data analysis, the researcher analyzed by using the technique of contents analysis organizing the group of information per various issues, then analyzing the causes and effects by using the purposes and concepts in the research as a frame to analyze the type of IT management, and doing mapping according to the business strategy process of such logistics and supply chain management to create the new paradigm.

Furthermore, the research result reveals the qualitative and appropriate Indicators of the Transportation Business according to the IT governance standard to supervise the logistics and supply chain industry (ITGI, 2018). The result of using the Indicator principle enhances the potential of good management and increases the competitive capacity according to the universal standard changeable pursuing the innovation management, and brings the IT and digital to use to reach the utmost benefits, described as the BSC Principle as follows:

### **Financial Perspective**

According to the research result from the managers interviewed in their operation, every Indicator had to use budgets for performance fully.

### **Customer Perspective**

Regarding the research result of the managers interviewed through their operation, it focused on qualitative IT to respond to the services and requirements of the customers the most.

### **Internal Process Perspective**

Concerning the measurement of the operation by the Indicator, internal process according to the SCOR DS principle and COBIT2019 of the Transportation Business, both executive and operational departments emphasized the damaged products from transporting, the average time of conduction, transportation process, transporting management, by using the IT system as a crucial instrument to develop the organization.

### Learning & Growth Perspective

For CMMI, it is observable that although the organizational goals were high up to Level 5, such a model was applicable and beneficial for the organization reaching maturity at this level. This organization focuses on maintenance and improvement as the main. Moreover, it possesses flexibility toward innovation and responds to industrial change. It is concordant with the BSC on the Learning & Growth Perspective.

### Conclusion

The research article is only a basic part, and still has the advanced level for studying the SCOR DS, benefits of using the new model for IT Logistics according to the COBIT2019 Framework for the transportation business based on Thailand standard from the ELMA criterion, to manage the suitable materials, goals, and methods of the digital change. Such benefits include as follows:

1. Achieving the strategic goals of the transportation business service by IT system and realizing the business benefits;
2. Increasing the effectiveness from the evaluation of IT effective performance;
3. Planning the strategic alteration of IT and digital is a continuous process. Hence there is the assessment of capability and quality for improving the performance process appropriately so the business can grow. For a digital change, it has to alter the bases in every aspect of the organization, such as strategic management, suitable supervision, business style, capability, and cultures, or according to the development principles of the BSC to reach the utmost development until achieving learning and growth sustainability (Moh, 2022).

This research study specifically on the primary indicators as appropriate regarding the smart transportation business following the COBIT2019 and SCOR DS framework in the logistics and supply chain industries. Therefore, it can apply to other aspects of the research further.

### Research Limitation

This research has limitations because it is about the study of the transportation business only. Thus, the result might not be able to describe other industrial businesses thoroughly. It might have to take the methods to study for extending the new knowledge base.

## Reference

- APICS. (2017). *Supply chain operations reference model SCOR*. Version 0. APICS.
- ISACA. (2018). *IT Governance Institute, COBIT2019*. IT Governance Institute. USA.
- ISACA. (2018). *CobIT-4th Edition (Version 2019)*. 3<sup>ed</sup>. Information Systems Audit and Control Foundation, IT Governance Institute, Rolling Meadows. USA.
- ISACA. (2018). *ISACA Introducing COBIT® 2019 Executive summary* ISACA. USA.
- ISACA. (2019). *Control objectives for information and related technologies (COBIT)*. USA.
- ISACA. (2019). *COBIT2019 Framework: Introduction & Methodology*. USA.
- ISO. (2011). *ISO/IEC 17799 Information technology code of practice for information security management*. Switzerland: International Organization for Standardization (ISO). Switzerland.
- Kaplan, R. and Norton, D. (2017). *The Strategy Focused Company*. Harvard Business School Press. USA.
- ITGI, (2018). *It Governance Global Status Report*. IT Governance Institute, Rolling Meadows. USA.
- CMMI, (2018). *CMMI for Development Version 3 CMMI-DEV V1*. Retrieved on October 3, 2018 from <http://www.sei.cmu.edu/reports/10tr033.pdf>.
- Bouayad. H., Benabbou. L., Berrado. A. (2018). *An Analytic Hierarchy Process based approach for Information technology governance framework selection*. Proceedings of the 12<sup>th</sup> International Conference on Intelligent Systems: Theories and Applications. (pp. 1-6).
- Keshta, M. Niazi, M. Alshayeb. (2018). Towards implementation of process and product quality assurance process area for Saudi Arabian small and medium-sized software development organizations. *IEEE Access*, 6(2018), 41643-41675.
- Ervural B.C. (2018). Industry 4.0: Managing The Digital Transformation. *Springer Series in Advanced Manufacturing*, (2018), 267-284.
- Karolina W., Monika K. (2018). Logistics maturity model for service company – theoretical background. *Procedia Manufacturing*, 17(2018), 791-802.
- Borovkov, A., & Ryabov, Y. (2019). *Digital twins: Definition, approaches and methods of development*. In Proceedings of the international conference on digital transformation of the economy and manufacturing 2019 (pp. 234–245).
- ASCM. (2021). *SCOR Process and the Supply Chain*. Retrieved on January 20, 2022 from ASCM: Web site: <https://www.ascm.org>
- Maydanova, S., Ilin, I., Jahn. C., Lange. A., Korablev. V. (2019). *Balanced Scorecard for the Digital Transformation of Global Container Shipping Lines*. Conference: Proceedings of

- the International Conference on Digital Technologies in Logistics and Infrastructure (ICDTLI 2019). Retrieved on March 2022 from Web site: <https://www.atlantispress.com/proceedings/icdtli-19/125918543>
- De Haes, S., Van Grembergen, W., Joshi, A., & Huygh, T. (2020). *Enterprise Governance of Information Technology: Achieving Alignment and Value in Digital Organizations*. Cham, Switzerland: Springer Nature Switzerland AG. Switzerland.
- Amy Van Looy. (2021). A quantitative and qualitative study of the link between business process management and digital innovation. *Information & Management*, 58(2), 103413.
- DITP (2021). *Excellence Logistics Management Award (ELMA) criteria*. Retrieved on January 2022 from COSO: Web site: <https://www.tradelogistics.go.th/ELMA/>
- Khairul A., Zainol A., Hanif A., (2021). Indicators for maturity and readiness for digital forensic investigation in era of industrial revolution 4.0. *Computers & Security*, 105(June 2021), 102237.
- Ismail Keshta, (2022). A model for defining project lifecycle phases: Implementation of CMMI level 2 specific practice. *Journal of King Saud University - Computer and Information Sciences*, 34(2), 398-407.
- Tatiana L., Evgeniya C., Irina M., Tatiana S., Janna T., (2022)., An approach for increase of digital/IT innovation adoption for sustainable development of transportation system. *Transportation Research Procedia*, 63(2022), 564-574.
- Moh'dAnwer AL-Shboul, (2022). An investigation of transportation logistics strategy on manufacturing supply chain responsiveness in developing countries: the mediating role of delivery reliability and delivery speed, *Heliyon*, 8(11), e11283.