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Benchmarking technology transfer in the Philippines Food processing industry

Abstract

Purpose: This paper tried to measure and benchmark the technology transfer in the food processing industry in the Republic of the Philippines.

Design/methodology/approach: In achieving the above-mentioned purpose, the researcher solicited the food processing industry input using survey questionnaires. Collection of data for this research carried out with the Philippine food processing industry professionals. The survey questionnaires distributed randomly in different regions in the Philippines. Statistical analysis techniques, including, exploratory factor analysis, and were used to exploit the survey data in order to address the research objective.

Research limitations: The scope of the study was limited only to target the respondents from the Philippine food processing industry.

Data analysis: Analysis of the results was based on a quantitative analysis. Factor analysis was applied. Principal axis factor analysis with VARIMAX rotation was conducted to assess the underlying structure for twenty nine (29) items of the survey instrument used. The constructed factors were used to measure the baseline of the benchmark of the technology transfer in the food processing industry in the Republic of the Philippines.

Findings: Five constructed factors perspective was utilized as a framework to present a benchmark of the current effectiveness of the international technology transfer in the Philippines food processing industry. A benchmark score of 79 per cent was determined. Philippine food processing industry has been operating at moderate to high effectiveness. Results, also, was shown that, the highest performing perspectives were transferee characteristics (80.22%) and Relation building (83.87%) indicating that the Filipino food processing professionals had satisfied and trust their suppliers.

The lowest perspective was the technology transfer value added (67.28%), highlighting that food processing companies could indicate that it needs more improvement in knowledge & working practices; and financial & schedule performance to advance the quality standards for better competitiveness.

Originality/Value: The paper benchmarked the Technology Transfer in the food processing industry in the Republic of the Philippines.

Keywords: benchmarking, technology transfer, food processing industry, factor analysis, philippines

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Sami Kyath
Negros Oriental State University, Philippines

Correspondence: Sami Kyath, Main Campus I, Negros Oriental State University, Dumaguete City, Negros Oriental 6200, Philippines, Email dr.samikhayat@yahoo.com

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Introduction

Technology transfer plays an important role in the development of every country. The same is true in every developing nation's Food Processing Industry. With the expected acceleration of economic growth in Asian countries as the ASEAN region gears itself into a single market and production base through the ASEAN Economic Integration, reforms in technologies, its policies and adoption are expected to occur to facilitate the projected growth and ensure investor protection.[1]

The Republic of the Philippines is a developing country and is touted as Asia's next Tiger economy.[2] The most dominant manufacturing sector of the country is the food processing industry that largely fuelled its economy. This accounts for forty per cent (40%) of its total manufacturing output and contributes twenty per cent (20%) of the Philippines Gross Domestic Product while employing at least 37% of the total Filipino workforce.[3–5]

It is expected to grow further since the Philippines is fast becoming a regional staging area for food manufacturers seeking to penetrate the lucrative East and South Asian market for processed products.[6] However, leaders of ASEAN member countries announced the establishment of an ASEAN Economic Community in 2015 to facilitate free movement of goods, services, investment, skilled labour, and capital across ASEAN members in order to compete with the global market. Under the ASEAN Investment Area, all industries, including agriculture, fisheries, forestry and extractive industries "shall be open and national treatment granted to investors" both at the pre and post-establishment stages, although with some exceptions, according to the ASEAN Economic Blueprint.[7]

The Philippines' rapidly expanding production of processed foods and beverages (f & b) presents robust opportunities for foreign exporters of agricultural raw materials and high value ingredients. About 65 per cent of U.S. agricultural exports to the Philippines

flow through the food processing industry.[8] Also, the Philippines is New Zealand's 7th largest food and beverage export destination, with exports totalling US$436 million in 2010.[5] Efforts are also being made by the Philippine Government to "assimilate into the global mainstream culture Filipino dishes".[9] The first quarter of 2012 alone showed a major increase of the export of processed food to the USA, Japan, Singapore, Malaysia, Indonesia, Thailand and China.

As the Philippines is expected to remain the fastest growing economy in South East Asia, prospects for 2015 and beyond are excellent for most foods and beverages products particularly those that can be classified as "healthy," "gourmet" or "convenient." Traders expect the U.S. will retain its longstanding position as the Philippines' number one supplier, and forecast export sales will reach $2 billion in 2020 due to the popularity of U.S. f & b products and its reputation for excellent quality.[10] As quality and efficiency continue to improve, the Philippines will be in a position to exploit export opportunities due to its strategic location and membership in various free trade agreements.[8]

The Philippine Food Processing Industry is composed of the following major sectors: fruits and vegetables, fish and marine products, meat and poultry products, flour and bakery products, beverages, confectioneries, dairy products, food condiments and seasonings, food supplements, bottled water, snack foods and fats & oils.[3]

In recognizance to the key role Technology Transfer has in this industry, the Philippine Government in 2010 passed Republic Act 10055, otherwise known as the "Philippine Technology Transfer Act of 2009" that aims to promote and facilitate technology transfer among others[11] and to empower the food industry, Philippine Government strengthen the food safety regulatory system through passing Republic act 10611 known as "Food Safety Act 0f 2013".[12]

However, several factors stand in the way for the majority of food industry players in the Philippines for them to fully enjoy the benefits of technology transfer.[13] This study benchmarked said factors to set the baseline data of Technology Transfer in the food processing industry in the Philippines.

Research method

Since this research is concerned with the technology transfer process within the local food processing industry in the Philippines, the decision and judgment was made to only solicit responses from this sector. One hundred and fifty seven (157) respondents from the Philippines food processing industry responded to the survey questionnaires. The respondents' gender were fairly distributed between 77male (49 percent) and 80 female (51 percent). The majority of the respondents (128 (82%)) were aged less than 50 years old.

The target respondents in this research included the Philippine food processing sector and its associated professionals involved in product development, factory design, unit design, quality systems & auditing, packaging, marketing, sourcing equipment, legislation and labelling, hygiene, management, processing and R&D professionals from food processing industry involving technology transfer initiatives. Some of the respondents have more than one role in the company. The evaluation of the position held by respondents was necessary to confirm the validity and reliability of their response. The respondents included president, director, manufacturing director, unit & plant manager, engineer, chemist, supervisor, account developer & finance officer, science research specialist, nutritionist, etc. Almost 50 percent of the respondents were in administration or unit management. These respondents will have an informed perspective of all daily operations and hence will be able to seriously evaluate all issues concerning the enablers and the outcome.

The survey questionnaire contained two separate sections. The first section solicited the respondents' personal information to establish their demographic profiles. Here they were also asked to rate the success of technology transfer in the Philippine food processing industry. Section two (questionnaire survey) contained two parts with 29 questions (items) in total. Part one examined the Technology Transfer Process Enablers and their associated sub-factors, including: Transfer Environment, Learning Environment, Transferor Characteristics, and Transferee Characteristics. Part two focused on measuring the Outcome of the Technology Transfer strategy in the following categories: Economic Advancement, Knowledge Advancement, and Project Performance.

Respondents were requested to rate these variables in two separate columns (A,B) in terms of Importance (Column A) and, Effectiveness (Column B) using a Five-Point Likert Scale. Column A asked respondents for their opinion about statements related to Technology Transfer, ranging from 1=strongly disagree to 5=strongly agree. These results were used to determine the importance/significance of each variable.

Column B required determining respondents' perception of the impact of Technology Transfer factors in the food processing industry environment, based on their experience. Column B has two parts. The first part is for rating the Enabler Factors with 1=strongly negative to 5=strongly positive as the range of selection available to the respondents. The second part of column B was for rating the Outcome, with the values rating from 1=very low to 5=very high. These results were essential for determining the effectiveness of Technology Transfer in the food processing industry in the Philippines. They enabled connecting links between variables to be established.

Data analysis and results

Varimax R-type factor exploratory principal factor analysis method was conducted to assess the underlying structure for the original 29items of the questionnaire into small set of factors, with minimum loss of information.[14] The data sample was considered sufficient for factor analysis, exceeding the observation to variable ratio (i.e. 5.4:1) recommended by Hair et al.[14] Moreover, the value of Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test was (0.888), exceeding the recommended threshold level 0.5 recommended by Hair et al.,[14] Coakes.[15] and level 0.7 recommended by Leech et al.[16]

The exploratory principal factor analysis retained twenty-one (21) variable solutions, removing eight (8) variables. Five construct factors best represented the data in terms of variance explained (73.6%) and grouping of variables. These constructed factors named (1) Technology Transfer Value Added (AV), (2) Relation Building (RB), (3) Transferee Characteristics (TE), (4) Government Influence (GI), and (5) Technology Characteristics (TC) (Table 1). Details the factor loadings, explained variance, Eigenvalues, communalities and Cronbach's alpha α for the five-factor solution.[13]

As rule of thumb, factor loadings of ±0.3 to ±0.4 are minimally acceptable, value greater than ±0.5 are generally considered necessary for practical significance.[14] All factor loadings (or coefficients) which

gave the correlations between the variables and the factors exceeded the 0.5 threshold level with loading ranging from 0.647-0.819.

Moreover, Cronbach's alpha α results exceeded the recommended value of 0.7 and ranged from 0.795-0.934 indicating that the scale used was reliable.[16–19] Argue that if Cronbach's alpha α is high (0.80 or higher), then this suggests that all of the items are reliable and the entire test is internally consistent. If alpha is low, then at least one of the items is unreliable, and should be identified via item analysis procedure. The communalities results ranged from 0.656-0.827 represent the relation between the variable and all other variables.[16]

(Table 1) show that the technology transfer value added factor (VA) explained 47.4 percent of the total variance (73.6). As well as, the result highlight that, the relation-building (RB) factor is the key player among the enablers explaining almost 10 percent of the total variance in the data set 73.6 percent. Combined explained variance for the enablers (i.e. relation building, transferee characteristics, government influence and technology characteristics) associate to 26.2 percent.

(Table 2) display the mean and standard deviation of the construct factors and their variables for column A and column B. The respondents strongly agreed that the technology transfer value added (VA) and the relation building (RB) are very important in the technology transfer process in food processing industry. As well as, they score the relation building (RB) constructed factor is the most important with mean of (4.42).

Table 1 VARIMAX rotated factor loading and communalities for the five-factor solution

Factor		Item code	Description	Factor loading	Communalities
1	Technology Transfer Value Added (VA) Variance= 47.36% Eigenvalue= 9.945 Cronbach's Alpha a=0.934	O 1.1		0.7	0.668
		O 1.2	Performance	0.721	0.698
		O 2.1	Improved knowledge	0.754	0.656
		O 2.2	Improved working practices	0.789	0.743
		O 2.3	Long-term adoption	0.795	0.714
		O 3.1	Financial performance	0.756	0.691
		O 3.2	Schedule performance	0.797	0.722
		O 3.3	Quality standards	0.783	0.763
2	Relation Building (RB) Variance=9.83% Eigenvalue=2.065 Cronbach's Alpha a=0.894	E 2.2	Trust	0.647	0.647
		E 2.3	Understanding	0.819	0.768
		E 2.4	Communication	0.789	0.797
		E 2.6	Teamwork	0.652	0.681
		E 2.7	Training	0.722	0.731
3	Transferee Characteristics (TE) Variance=5.93% Eigenvalue=1.245 Cronbach's Alpha a=0.862	E 4.1	Willingness to learn	0.758	0.74
		E 4.2	Degree of experience	0.804	0.766
		E 4.3	Transferee management	0.679	0.77
		E 4.4	Knowledge base	0.665	0.673
4	Government Influence (GI) Variance=5.33% Eigenvalue=1.120 Cronbach's Alpha a=0.795	E 1.3	Government policy	0.807	0.787
		E 1.4	Government enforcement	0.8	0.781
5	Technology Characteristics (TC) Variance=5.10% Eigenvalue=1.070 Cronbach's Alpha a=0.791	E 1.1	Complexity level	0.843	0.822
		E 1.2	Mode of Transfer	0.835	0.827

Extraction Method, principal component analysis. Rotation Method, varimax with kaiser normalization.

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Table 2 Construct factors and variables mean and standard deviation

Code	Description	Column A		Column B	
		Mean	Std. Dev.	Mean	Std. Dev
VA	TT Value Added	4.32	0.69	3.92	0.76
VA1	Competitiveness	4.37	0.69	4	0.71
VA2	Performance	4.34	0.7	3.97	0.78
VA3	Improved knowledge	4.34	0.7	3.92	0.77
VA4	Improved working practices	4.35	0.71	3.9	0.79
VA5	Long-term adoption	4.22	0.74	3.87	0.74
VA6	Financial performance	4.25	0.69	3.83	0.77
VA7	Schedule performance	4.24	0.67	3.87	0.74
VA8	Quality standards	4.48	0.63	3.99	0.8
RB	Relation Building	4.42	0.73	4.19	0.77
RB1	Trust	4.27	0.77	4.03	0.78
RB2	Understanding	4.43	0.7	4.22	0.76
RB3	Communication	4.43	0.82	4.21	0.8
RB4	Teamwork	4.44	0.71	4.22	0.75
RB5	Training	4.52	0.68	4.27	0.74
TE	Transferee Characteristics	4.18	0.76	4	0.75
TE1	Willingness to learn	4.17	0.85	4	0.84
TE2	Degree of experience	4.03	0.78	3.83	0.75
TE3	Transferee management	4.18	0.71	4.04	0.71
TE4	Knowledge base	4.32	0.69	4.13	0.72
GI	Government Influence	4.05	0.92	3.89	0.86
GI1	Government policy	4.08	0.92	3.91	0.83
GI2	Government enforcement	4.03	0.91	3.87	0.89
TC	Technology Characteristics	3.97	0.72	3.75	0.73
TC1	Complexity level	3.93	0.75	3.67	0.75
TC2	Mode of Transfer	4.01	0.68	3.83	0.71

Benchmarking the technology transfer performance in Philippines food processing industry

The five constructed factors perspective had utilized as a framework to present a benchmark of the current effectiveness of the international technology transfer in the Philippines food processing industry. The mean importance values for each indicator (Table 2 Column A) had used to create relative and global weight for each indicator in the framework. The mean impact rating for each indicator (Table 2 column B) had then multiplied by relative and global weights to create individual perspective scores and an overall score, respectively.[20] The details for each indicators relative and global weight, resultant performance scores for each perspective and the overall technology transfer index for the food processing industry in the Philippines had shown in Table 3. The methodology of technology transfer index had developed by Waroonkun.[20]

The perspective global relative weight had determined by finding the percentage of each perspective (factor) weighted contributed to the overall technology transfer index. For example, from (Table 2: column A). The relative weight of the TT value added factor had scored (20.66%) [i.e. 4.32/(4.32+4.42+4.18+4.05+3.97)*100=20.65%]. Relative weight (r_i) of each indicator had determined by multiplying the frequency distribution of mean value by a different scale [-2, -1, 0, 1, 2] and then normalized, thus removing neutral rating.

For example, indicator Complexity level (TC1) had a mean importance frequency distribution of [SD=0, D=4, N=38, A= 80, SA=35]. Multiplying this distribution by the scale resulted in a value of 146 [0x-2+4x-1+38x0+80x1+35x2=146]. Similarly, for indicator Mode of Transfer (TC2) the calculated value was 158. Normalizing these two values [e.g. rTC1=146/(146+158)=0.4803] provides the relative weight for the two indicators from the technology characteristics perspective (Table 3) details the relative weights for

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all the twenty-one (21) indicators. Global weight (k_i) had obtained by multiplying the relative weight of the technology transfer indicator by the relative weight of its parent perspective. For example, the global weight for indicator TC1 had calculated as 0.0910 (i.e. kTC1=0.1895x0.4803=0.0910). Thus, this indicator contributes nine percent to the overall technology transfer index. In summary, relative weights had used to calculate scores for the five perspectives and global weights for calculating the technology transfer index.

To provide a baseline benchmark on the performance of food processing industry technology transfer in the Philippine score had calculated for each perspective of the framework and the overall technology transfer index (Table 3). Perspective scores had calculated by adding up the weighted result $r_i(x_i)$ for each indicator within the perspective (example: TC=1.7620+1.9896=3.7516 or (75.03%). The overall technology transfer index had calculated by adding up the weighted global result $k_i(x_i)$ for each indicator (i.e. technology transfer index= 0.1067+0.1041+0.1026+ … +0.3339+0.3770=3.9584 or (79.17%). A benchmark score of (79.17%) of the technology transfer in the Philippines in the food processing industry sector had been operating moderately to highly effectively. However, this result also demonstrates that there is much potential for improvement.

The above-mentioned method utilized to benchmark the performance of technology transfer of the food processing industry in the Philippines. It presented through Radar diagram (Figure 1) showing the performance score for each framework perspective. Results for each perspective ranged from 67.28 to 83.87 percent. Results was shown that, the highest performing perspectives were transferee characteristics (80.22%) and Relation building (83.87%) indicating that the Filipino food processing professionals had satisfied and trust their suppliers. The lowest perspective was the technology transfer value added (67.28%), highlighting that food processing companies could indicate that it needs more improvement in knowledge & working practices; and financial & schedule performance to advance the quality standards for better competitiveness.

Table 3 Evaluating technology transfer – baseline performance

Code	Perspective	Relative weight	Indicator relative weight r_i	Indicator global weight k_i	Indicator performance result x_i	Weighted indicator result $r_i(x_i)$	Weighted global result $k_i(x_i)$
VA	**TT Value Added**	**0.2065**					
VA1	Competitiveness		0.1292	0.0267	4	0.5168	0.1067
VA2	Performance		0.1268	0.0262	3.9745	0.504	0.1041
VA3	Improved knowledge		0.1268	0.0262	3.9172	0.4967	0.1026
VA4	Improved working practices		0.1274	0.0263	3.8981	0.4966	0.1026
VA5	Long-term adoption		0.1148	0.0237	3.8726	0.4445	0.0918
VA6	Financial performance		0.1178	0.0243	3.8344	0.4516	0.0933
VA7	Schedule performance		0.1172	0.0242	3.8726	0.4538	0.0937
VA8	Quality standards		0.14	0.0289	3.9873	0.5583	0.1153
						3.3641(67.28%)	
RB	**Relation Building**	**0.2109**					
RB1	Trust		0.179	0.0377	4.0255	0.7204	0.1519
RB2	Understanding		0.2014	0.0425	4.2229	0.8507	0.1794
RB3	Communication		0.2014	0.0425	4.2102	0.8481	0.1789
RB4	Teamwork		0.2032	0.0429	4.2166	0.857	0.1808
RB5	Training		0.2149	0.0453	4.2675	0.9172	0.1935
						4.1933(83.87%)	
TE	**Transferee Characteristics**	**0.1994**					
TE1	Willingness to learn		0.2493	0.0497	4	0.9973	0.1989
TE2	Degree of experience		0.2182	0.0435	3.8344	0.8365	0.1668
TE3	Transferee management		0.252	0.0503	4.0382	1.0178	0.2029
TE4	Knowledge base		0.2805	0.0559	4.1338	1.1595	0.2312
						4.0110(80.22%)	
GI	**Government Influence**	**0.19.36**					
GI1	Government policy		0.5136	0.0994	3.9108	2.0086	0.3889
GI2	Government enforcement		0.4864	0.0942	3.8662	1.8806	0.3641
						3.8891(77.78%)	
TC	**Technology Characteristics**	**0.1895**					
TC1	Complexity level		0.4803	0.091	3.6688	1.762	0.3339
TC2	Mode of Transfer		0.5197	0.0985	3.828	1.9896	0.377
						3.7516(75.03%)	
					TT index	**3.9584(79.17%)**	

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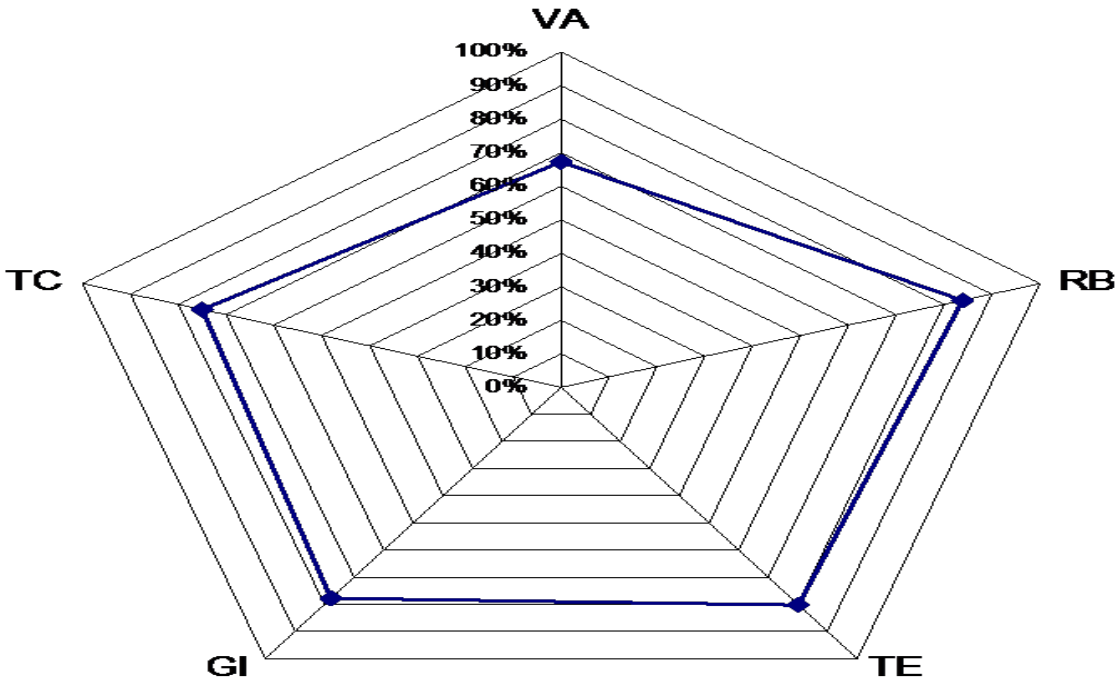

Figure 1 Radar Diagram Showing the Performance Score for Each Framework Perspective
GI, government influence 3.8891 (77.78%)
TC, technology characteristics3.7516 (75.03%)
TE, transferee characteristics4.0110 (80.22%)
RB, relation building 4.1933 (83.87%)
VA, technology transfer value adde3.3641 (67.28%)

Conclusion

Understanding the factors that affect technology transfer (TT) in the Philippines ultimately can help in benchmarking the technology transfer in food processing industry. It will be the first step before formulating the mathematical model to describe TT. Although there are numerous studies about Technology Transfer process, little are known about technology transfer in Philippine food processing industry.

A benchmark score of 79 per cent was determined, implying that to-date, Philippine food processing industry have been operating at moderate to high effectiveness. Results also show that the highest performing perspectives were transferee characteristics (80.22%) and Relation building (83.87%). Thus indicates that the Filipino food processing professionals are satisfied and trust their suppliers. The lowest perspective was the technology transfer value added (67.28%), highlighting that food processing companies could indicate that it needs more improvement in knowledge & working practices; and financial & schedule performance to advance the quality standards for better competitiveness.

As a final point, billions of Philippine Pesos had been directed into infrastructure projects or training for new technology. Most of these projects had financed by the host government and/or the international monetary fund under the sponsorship that not only provide infrastructure but transfer advanced technologies to the local workforce.

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Conflict of interest

The author declares no conflict of interest.

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