THE EFFECT OF ABSORPTIVE CAPACITY ON THE TECHNOLOGICAL TRANSFER EFFECTIVENESS, AN EMPERICAL STUDY OF VACCINE COMPANY IN BANDUNG, INDONESIA

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Abstract

Absorption capacity is a variable that influences the effectiveness of transfer technology in previous studies. Few of these studies examined this variable in the vaccine industry sector. This research is an empirical study to see the effect of absorption and each of its constituent dimensions (the ability to recognize, the ability to acquire, the ability to assimilate, and the ability to apply) to technology transfer effectiveness carried out in vaccine companies. The research approach is proportional stratified random sampling, where the data is processed statistically quantitatively. The questionnaires that contained 43 questions were used to collect data from 114 respondents from employees with strategic position levels in the vaccine companies studied. Quantitative statistical methods with SPSS software were used to analyze the research data, including regression analysis, Pearson Product Moment correlation analysis, and impact analysis. The results showed that the level of absorption capacity of the vaccine companies studied had a statistically significant positive effect on the technology transfer effectiveness. Each dimension of absorptive capacity is separately proven to have a statistically significant positive impact on the technology transfer effectiveness in the order from which it gives the most potent influence, namely the ability to apply, the ability to assimilate, the ability to recognize, and the ability to acquire. The findings in this study can be used as a reference by company stakeholders as a basis for maintaining and increasing their absorption capacity based on the order of magnitude of influence from each dimension studied to increase the effectiveness of technology transfer in the future.

Keywords: Technology Transfer, Absorption Capacity, Vaccine Companies

Introduction

Vaccines are pharmaceutical preparations that prevent the occurrence of certain diseases in individuals who receive these vaccines, which indirectly play a role in reducing community morbidity so that the level of public health can be better. Not all countries can make a vaccine industry because of several limitations and complications in the vaccine manufacturing process. It takes about five to eighteen years to bring a vaccine product from research to the international market (Plotkin et al., 2017). Therefore, innovation related to vaccine production is expensive and very complex (Hayman et al., 2021), involving significant investments, technological gaps, lack of knowledge, and unpreparedness of human resources (Fu et al., 2022). The production process of vaccines is a multi-step process requiring extensive collaboration (Fu et al., 2022; Medeiros et al., 2022).

The technology transfer strategy accelerates the availability of new vaccine products on the market by accelerating the development stages, simplifying vaccine technology and production processes, and providing financial support and licensing of new vaccine products (Aars et al., 2021; Kumraj et al., 2022; Medeiros et al., 2022). Implementing a technology transfer strategy is only sometimes effective and on target; many factors influence its success. One factor affecting the effectiveness of a technology transfer process is the readiness factor of the recipient, described as Absorptive Capacity. In general, absorptive capacity is the ability of a company/party to accept, explore, and implement technology in supporting the development and increasing the competitiveness of the company (Zahra & George, 2002). The higher the level of absorption capacity of a company, the company can receive technology transfers from external parties to be implemented and used in business processes (Farhadikhah & Husseini, 2015).

PT. XXX is a vaccine company in Indonesia producing vaccines and life science products globally. Many products from this company have been used nationally and widely by several countries worldwide. Guaranteed quality, efficacy, and high safety are the reasons these products can compete nationally and globally. PT XXX developed some of these products by implementing a technology transfer strategy from external parties either in whole or only in part. Thus, practically in the field, this company already has experience implementing technology transfer strategies in its business processes, especially in developing and commercializing its products. However, there has yet to be an actual measurement of the effectiveness of the technology transfer process and no measurement of the absorptive capacity of PT. XXX itself and its influence on the effectiveness of the technology transfer. It is necessary to do this resaerch, considering the company faces rapidly changing market developments and demands for providing quality vaccines and other life science products quickly and on time.

In this research, an empirical study will be carried out to measure the level of absorptive capacity and its effect on the effectiveness of technology transfer at PT. XXX is a company in the vaccine industry in Bandung, Indonesia. Understanding the level of absorptive capacity and its influence on the effectiveness of technology transfer will assist companies in evaluating and improving the aspects involved in implementing technology transfer strategies in the future.

Literature Review

Technology Transfer Effectiveness

Transfer of technology in the vaccine production process not only accelerates the availability of vaccine products on the market but can also be a strategy for equitable distribution of readiness and ability to produce vaccines globally (Medeiros et al., 2022). In addition, technology transfer can increase access to vaccines while reducing the price of the vaccine itself (Kumraj et al., 2022). A technology transfer can only be declared successful when the transfer recipient successfully utilizes the transferred technology and can ultimately integrate it into their business processes (Farhadikhah & Husseini, 2015). The success and effectiveness of a technology transfer are the added value obtained by the company receiving the technology (Bozeman et al., 2015). An empirical study of the technology transfer process at a petroleum company in Libya concluded that the success of a technology transfer depends on the correct selection of the appropriate technology from the right vendor and the level of absorption from the company (A. Mohamed et al., 2014). The effectiveness of technology transfer is measured using the parameter of an increase in six output aspects of the company as a reference for the measurement, namely overall performance, industry knowledge, fundamental skills, scheduling performance, competitiveness, and company financial performance. Other measurement parameters of the effectiveness of technology transfer are the availability of products from technology transfer (out-the-door), market impact, impact on regional economic development, political impact, the use of alternative resources, increased human resource capacity, and benefits to society (Bozeman et al., 2015; Spann et al., 1995). Another measurement dimension for the effectiveness of technology transfer is to evaluate Product and Process Performance, Business Performance, and Human Resources Capability (Whangthomkum et al., 2006).

Product and Process Performance is the measurement dimension for the effectiveness of a company implementing the transfer of new technology from other parties to produce new products/services and to apply new process technology needed to optimize routine production processes (Whangthomkum et al., 2006). It includes output in the form of tangible objects resulting from technology transfer, such as new products or modified technology (Bozeman et al., 2015). It is also part of the overall performance evaluation of a company (A.S. Mohamed et al., 2012).
Business Performance measures technology transfer effectiveness related to a new product, service, or process acquired to accelerate the company's business performance in launching new products or processes that lead to increased business opportunities and profits (Whangthomkum et al., 2006). It includes the company's financial performance, business competitiveness (A. Mohamed et al., 2014), and market expansion opportunities (Bozeman et al., 2015). In another study, business performance is also influenced by the level of product and process innovation as one measure of the success of technology transfer (Sancho-Zamora et al., 2021).

Human Resources Capability is at the core of any technology transfer process because training and development of these human resources lead to the operation of the technology transferred and the ability to communicate back the technology acquired in the future (Bozeman et al., 2015; Whangthomkum et al., 2006). This dimension is measured based on how much the company can

manage the technology developed, increase the ability to handle future technology transfers, receive outside training, and improve management capabilities (Whangthomkum et al., 2006).

Absorptive Capacity

Absorptive capacity is a series of organizational routines and processes to acquire, assimilate, transform, and explore knowledge to enhance managerial skills that impact resilience and increased competitiveness (Zahra & George, 2002). Another definition is the company's ability to appreciate, assimilate, and apply new knowledge (Wesley M. Cohen & Daniel A. Levinthal, 1990). The dimension of measuring the absorptive capacity was reconceptualized by Zahra & George (2002) from the model made by Cohen & Levinthal (1990), resulting in four measurement dimensions, namely the ability to acquire, assimilate, transform, and exploit. These four dimensions are also used in several studies involving absorptive capacity and its influence on innovation, company performance, and the effectiveness of transferring new technology (Avila et al., 2018; Flatten et al., 2011; Müller et al., 2021). Lin & Chang, (2002) use adaptability, production capability, and application capability as dimensions to measure a company's absorptive capacity level. Whangthomkum et al. (2006) use the ability to recognize, acquire, assimilate, and apply to measure absorptive capacity.

The ability to recognize is the level of a company's ability to recognize the value and benefits of technology for company progress (Whangthomkum et al., 2006). The ability to recognize in several studies is combined with the ability to acquire dimensions (Avila et al., 2018; Flatten et al., 2011; Zahra & George, 2002).

Acquisition capability is a company's ability to identify and acquire externally generated knowledge critical to its operations (Müller et al., 2021; Zahra & George, 2002). The acquisition process determines which technology the company needs, which vendors have the technology it wants, and what resources must be prepared before getting the new technology (Whangthomkum et al., 2006). This acquisition stage is an important stage of absorptive capacity because if this stage does not exist, the next step cannot occur (Popescu et al., 2020).

The ability to assimilate is a routine company activity that enables it to analyze, process, interpret, and understand information obtained from external sources (Flatten et al., 2011; Zahra & George, 2002). This stage involves knowledge processing systems and new technology acquired for sharing, communication, coordination in planning and implementation, and problem-solving while using new technology (Whangthomkum et al., 2006). Assimilating external knowledge can accelerate the problem-solving rate and shorten the development cycle of new products/services (Popescu et al., 2020).

The ability to apply includes the ability to transform and exploit the company's ability to develop and improve its routine processes in facilitating the integration of existing knowledge with newly acquired and assimilated knowledge (Flatten et al., 2011; Zahra & George, 2002). Then the new technology is developed or combined with existing technology to produce a new process or technology (Avila et al., 2018; Müller et al., 2021). Dimensions This can be measured by looking at the output resulting from the application of this new technology, such as the number of new products, number of patents, process efficiency, number of publications, alternative technologies, or a combination of old and new technologies (Whangthomkum et al., 2006).

Correlation of Absorptive Capacity and Technology Transfer Effectiveness

The effectiveness of a technology transfer can only succeed if there is a balanced relationship in capacity between the technology provider and the technology recipient. The technology provider's ability is measured using the disseminative capacity variable, while the recipient's ability is measured using absorptive capacity (Fredriksson et al., 2019).

Absorptive capacity has become one of the most common research areas within business management (Sancho-Zamora et al., 2021). Absorptive capacity is essential and is a factor influencing the effectiveness of the transformation process carried out by a company to increase competitiveness through changes in business models (Müller et al., 2021), innovation performance (Avila et al., 2018), product innovation (Min et al., 2017), financial performance (Kostopoulos et al., 2011), including the effectiveness of technology transfer (A.S. Mohamed et al., 2012; Whangthomkum et al., 2006).

Absorptive capacity positively influences either directly or using moderation on the effectiveness of technology transfer (Hafeez et al., 2020; Whangthomkum et al., 2006). Each dimension of absorptive capacity (recognition, acquisition, assimilation, application) also positively influences the effectiveness of technology transfer as a whole as well as on each dimension of technology transfer (performance products and processes, business performance, and HR performance) separately (Whangthomkum et al., 2006).

Research Methodology

Cenceptual Framework

The effectiveness of technology transfer (TTE) is measured by product and process performance (PPP), business performance (BP), and human resources capability (HRC). While absorptive capacity (ACAP) will be measured using the dimensions of ability to recognize (RECOG), ability to acquire (ACQUIRE), ability to assimilate (ASSIM), and ability to apply (APPLY). Figure 1 shows the influence relationship between absorptive capacity and its dimension on the effectiveness of technology transfer.

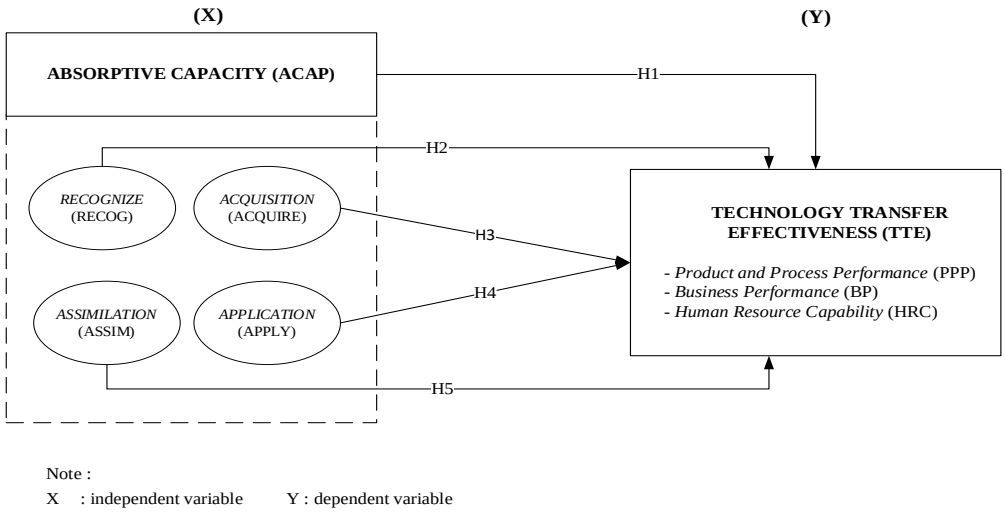

Figure 1. Research conceptual framework

Research Question and Hypothesis

According to the literature review and problems, the research questions of this study are : (i) how does absorptive capacity affect the effectiveness of technology transfer within the scope of new vaccine product development; (ii) how does each dimension of absorptive capacity, namely the ability to recognize, acquire, assimilate, and apply, affect the effectiveness of technology transfer within the scope of developing new vaccine products. The aim of this research is: (i) to evaluate the effect of absorptive capacity on the effectiveness of technology transfer within the scope of new vaccine product development; (ii) to evaluate the effect of each dimension of absorptive capacity, namely the ability to recognize, the ability to acquire, the ability to assimilate, and the ability to apply on the effectiveness of technology transfer within the scope of developing new vaccine products. The hypothesis proposed from this research are:

H1: Absorptive capacity (ACAP) has a significant positive effect on the technology transfer effectiveness (TTE).

H2: The ability to recognize (RECOG) has a significant positive effect on the technology transfer effectiveness (TTE)

H3: The ability to acquisition (ACQUIRE) has a significant positive effect on the technology transfer effectiveness (TTE)

H4: The ability to assimilation (ASSIM) has a significant positive effect on the technology transfer effectiveness (TTE)

H5: The ability to application (ASSIM) has a significant positive effect on the technology transfer effectiveness (TTE)

Data and Variables

This research uses a quantitative approach by conducting an empirical study at a vaccine company in Bandung, Indonesia, carried out in 2023. The research instrument in a questionnaire is used to obtain data. The questionnaire was prepared based on the measurement parameters for each dimension of the variables used in this research. We tested the questionnaire before use to collect data using validity and reliability tests. Respondents should answer each statement in the questionnaire using a scale based on the closeness of conditions in reality to those mentioned in the questionnaire statements. Questionnaire scoring is using 5 (five) Likert scale, namely (1) Strongly disagree, (2) Disagree, (3) Undecided/neutral, (4) Agree, and (5) Strongly agree with questions or statements in the questionnaire (Nicholls, 2010). The results of empirical measurements from primary data were verified using secondary data owned by the company.

This study uses absorptive capacity as the independent variable and technology transfer effectiveness as the dependent variable. Each variable is defined and measured using the dimensions used in previous research as references.

Table 1. Research Variables and Measurment Dimensions

Variables	Measurement dimensions	Reference
Absoprtive Capacity (ACAP)	The ability to recognize (RECOG) The ability to acquire (ACQUIRE)	(Avila et al., 2018; Flatten et al., 2011; Hafeez et al., 2020; Lin & Chang, 2002;

	The ability to assimilate (ASSIM) The ability to apply (APPLY)	A. Mohamed et al., 2014; Müller et al., 2021; Popescu et al., 2020; Wesley M. Cohen & Daniel A. Levinthal, 1990; Whangthomkum et al., 2006; Zahra & George, 2002)
Transfer Technology Efectiveness (TTE)	Product and Process Performance (PPP) Business Performance (BP) Human Resources Capability (HRC)	(Bozeman et al., 2015; Farhadikhah & Husseini, 2015; Hafeez et al., 2020; A. Mohamed et al., 2014; Sancho-Zamora et al., 2021; Spann et al., 1995; Whangthomkum et al., 2006)

The absorptive capacity (ACAP) uses 26 measurement questions from its four dimensions. The measurement questions from ACAP refer to Whangthomkum et al. (2006), Flatten et al., (2011), and Müller et al., (2021). The effectiveness of technology transfer (TTE) uses 18 measurement questions from its three dimensions. This TTE measurement questions refers to Whangthomkum et al. (2006) and Bozeman et al., (2015). Adjustments were made for ACAP and TTE parameter by combining several parameters with the same context without eliminating the initial purpose of these parameters.

Method of Data Analysis

Validity and reliability are tests to check the validity and reliability of the questionnaire as a research instrument. The Pearson Product Moment is the correlation technique used to test the validity of the statement items in this study. If the correlation coefficient value exceeds the critical value of 0.3, the item statement is a valid construct (Sugiyono, 2013). Instrument reliability was analyzed using the Alpha-Cronbach method to see the consistency of a study's results when it is conducted repeatedly. A questionnaire can be reliable if the reliability coefficient is more significant than 0.6 (Straub & Gefen, 2004).

This study's data processing and analysis technique combines descriptive and parametric inferential statistics through regression analysis. Regression statistical methods analyze the correlation and significance between the effect of the variable absorptive capacity (ACAP) and each dimension on the effectiveness of technology transfer (TTE). Quantitative statistical methods with SPSS software process and analyze the collected research data, including regression analysis, Pearson product-moment correlation analysis, and impact analysis.

The results of data analysis using regression will explain the relationship between variables in the study according to the research concept framework. The hypotheses will be tested by looking at the results of the sign analysis and the significant value (p-value) of the results of the regression analysis. If the significant *p-value* <0.05, the hypothesis is declared proven/accepted. The hypothesis is rejected if the significant *p-value* > 0.05 (Sugiyono, 2013).

Results And Discussion

Instrument validity and reliability test

Validity and reliability tested the total 43 statement points in the questionnaire construct. Validity Test Results using Pearson Product Moment shows that all statement items have a validity coefficient greater than the critical point ($r_{count} > 0.3$), so all statement items in the questionnaire are appropriate as measuring instruments in research for further analysis.

Questionnaire Reliability Test Results shows that the reliability value of the *alfa-Cronbac*h coefficient of statement items is greater than 0.6. These results indicate that the questionnaire's items are reliable in measuring the variables.

Statistical Description of Research Variables

This study used a questionnaire containing 43 statement items to collect response data from 114 respondents. Recapitulation of Descriptive Analysis of Absorptive Capacity Variables and Recapitulation of Descriptive Analysis of Technology Transfer Effectiveness (TTE) Variables summarize the responses from each stretching dimension used. In order to make it easier to interpret the variables, this study categorizes the collected responses from questionnaires. The principle of categorization of the total score of responses in this study uses the calculated average value as a reference for determining the classification of assessment categories.

$$P = \frac{X_{max} - X_{min}}{b} = \frac{R}{b}$$

Which is (P)= class length of each interval; (X_{max}) = maximum value`; (X_{min}) = minimum value; (R)= range; (b) = number of classes. In the questionnaire, the maximum value is 5 (five), and the minimum value is 1 (one), so if the value is substituted into the equation above, the interval value is 0.8. This table below presents the classification of the criteria for evaluating the average value.

Descriptive Category Range

No.	Interval	Criteria
1	1,00 - 1,79	Very Not Good
2	1,80 – 2,59	Not good
3	2,60 – 3,39	Pretty good
4	3,40 – 4,19	Good
5	4,20 - 5,00	Very good

Recapitulation of Descriptive Analysis of Absorptive Capacity Variables, the percentage value of responses regarding the Absorptive Capacity (ACAP) variable is 77.87%, the standard deviation value is 0.75, and the average value of responses regarding the Absorptive Capacity (ACAP) variable is 3.89, which is categorized as a good one.

Recapitulation of Descriptive Analysis of Technology Transfer Effectiveness (TTE) Variables shows that the overall percentage value is 82.35%, the standard deviation value is 0.67, and the average response value is 4.12. It can be concluded that the responses regarding the variable Technology Transfer Effectiveness (TTE) are in a good category.

Data Analysis of the Effect of Absorptive Capacity (ACAP) on Technology Transfer Effectiveness (TTE)

Linear Regression Test

Table 2. Calculation of the Coefficient Value of the ACAP-TTE Regression Equation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	4.422	4.543		.973	.332
	ACAP	.647	.054	.748	11.938	.000

a. Dependent Variable: TTE

Based on Table 2, the regression equation can be formed as follows: TTE = 4.422 + 0.647 ACAP. The equation can be interpreted as follows: (a)= 4.422, meaning that if the absorptive capacity (ACAP) is zero (0), then the effectiveness of technology transfer (TTE) will be worth 4.422 units; (b) = 0.647 means that if the absorptive capacity (ACAP) increases by one unit, so the effectiveness of technology transfer (TTE) will increase by 0.647 units.

Pearson Product Moment Correlation Analysis

Table 3. ACAP-TTE Pearson Product Moment Correlation Coefficient Value

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.748[a]	.560	.556	7.93579

a. Predictors: (Constant), ACAP
b. Dependent Variable: TTE

Based on Table 3, it is known that the correlation coefficient (r) is 0.748. These values are then interpreted based on Guilford's criteria as follows : (0,00 - 0,199) = very low; (0,20 - 0,399) = low; (0,40 – 0,599) = moderate; (0,60 – 0,799) = strong; (0,80 – 1,000) = very strong (Sugiyono, 2013). So, a correlation coefficient of 0.748 indicates a strong relationship between the independent and dependent variables.

Coefficient of Determination Analysis

The coefficient of determination is the square of the correlation coefficient (Sugiyono, 2013). Once the value (r) is known to be 0.748, the coefficient of determination can be calculated using the following formula: $(r)^2 = (0.748)^2$ x 100% = 56,0%. Based on the coefficient of determination, absorptive capacity (ACAP) influences the effectiveness of technology trnsfer (TTE) by 56.0%, while other factors that influence the remaining 44.0% are not studied.

Data Analysis of the Effect of Recognizing Ability (RECOG) on Technology Transfer Effectiveness (TTE)

Table 4. RECOG-TTE Regression Equation Coefficient Value Calculation Results

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	26.807	5.713		4.692	.000
	RECOG	1.863	.337	.463	5.532	.000

a. Dependent Variable: TTE

Based on Table 4, the regression equation can be formed as follows: TTE =26.807 + 1.863 RECOG. The equation can be interpreted as follows: (a)= 26.807, meaning that if the ability to recognition (RECOG) is zero (0), then the effectiveness of technology transfer (TTE) will be worth 26.807 units; (b) = 1.863 means that if the ability to recognition (RECOG) increases by one unit, so the effectiveness of technology transfer (TTE) will increase by 1.863 units.

Table 10. RECOG-TTE Pearson Product Moment Correlation Coefficient Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.463[a]	.215	.208	10.60188

a. Predictors: (Constant), RECOG

Based on Table 5, it is known that the correlation coefficient (r) is 0.463. These values are then interpreted based on Guilford's criteria, which indicates a moderate relationship between the independent and dependent variables. The coefficient of determination is $(r)^2 = (0.436)^2$ x 100% = 21.5% . It indicates that RECOG influences the TTE by 21.5%, while other factors that influence the remaining 78.5% are not studied.

Data Analysis of the Effect of Acquisition Ability (ACQUIRE) on Technology Transfer Effectiveness (TTE)

Table 6. ACQUIRE-TTE Regression Equation Coefficient Value Calculation Results

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	38.484	4.808		8.004	.000

	ACQUIRE	1.177	.284	.365	4.143	.000

a. Dependent Variable: TTE

Based on Table 6, the regression equation can be formed as follows: TTE =36.484 + 1.177 ACQUIRE. The equation can be interpreted as follows: (a)= 38.484, meaning that if the ability to acquistion (ACQUIRE) is zero (0), then the effectiveness of technology transfer (TTE) will be worth 38.484 units; (b) = 1.177 means that if the ability to acquistion (ACQUIRE) increases by one unit, so the effectiveness of technology transfer (TTE) will increase by 1.177 units.

Table 12. ACQUIRE-TTE Pearson Product Moment Correlation Coefficient Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.365[a]	.133	.125	11.13965

a. Predictors: (Constant), ACQUIRE

Based on Table 7, it is known that the correlation coefficient (r) is 0.365. These values are then interpreted based on Guilford's criteria, which indicates a low relationship between the independent and dependent variables. The coefficient of determination is $(r)^2 = (0.365)^2$ x 100% = 13.3%. It indicates that ACQUIRE influences the TTE by 13.3%, while other factors that influence the remaining 86.7% are not studied.

Data Analysis of the Effect of Assimilation Ability (ASSIM) on Technology Transfer Effectiveness (TTE)

Table 8. ASSIM-TTE Regression Equation Coefficient Value Calculation Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	21.447	3.728		5.753	.000
	ASSIM	1.438	.143	.688	10.027	.000

a. Dependent Variable: TTE

Based on Table 8, the regression equation can be formed as follows: TTE =21.447 + 1.438 ASSIM. The equation can be interpreted as follows: (a)= 21.447, meaning that if the ability to assimilation (ASSIM) is zero (0), then the effectiveness of technology transfer (TTE) will be worth 21.447 units; (b) = 1.438 means that if the ability to assimilation (ASSIM) increases by one unit, so the effectiveness of technology transfer (TTE) will increase by 1.438 units.

Table 9. ASSIM-TTE Pearson Product Moment Correlation Coefficient Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.688[a]	.473	.468	8.68422

a. Predictors: (Constant), ASSIM

Based on Table 9, it is known that the correlation coefficient (r) is 0.688. These values are then interpreted based on Guilford's criteria, which indicates a strong relationship between the independent and dependent variables. The coefficient of determination is $(r)^2 = (0.688)^2$ x 100% = 47.3% . It indicates that ASSSIM influences the TTE by 47.3%, while other factors that influence the remaining 52.7% are not studied.

Data Analysis of the Effect of Application Ability (APPLY) on Technology Transfer Effectiveness (TTE)

Table 10. APPLY-TTE Regression Equation Coefficient Value Calculation Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	8.558	3.629		2.359	.020
	APPLY	2.043	.148	.795	13.852	.000

a. Dependent Variable: TTE

Based on Table 10, the regression equation can be formed as follows: TTE =8.558 + 2.043 APPLY. The equation can be interpreted as follows: (a)= 8.558, meaning that if the ability to application (APPLY) is zero (0), then the effectiveness of technology transfer (TTE) will be worth 8.558 units; (b) = 2.043 means that if the ability to aplication (APPLY) increases by one unit, so the effectiveness of technology transfer (TTE) will increase by 1.438 units.

Table 11. APPLY-TTE Pearson Product Moment Correlation Coefficient Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.795[a]	.631	.628	7.26266

a. Predictors: (Constant), APPLY

Based on Table 11, it is known that the correlation coefficient (r) is 0.795. These values are then interpreted based on Guilford's criteria, which indicates a strong relationship between the

independent and dependent variables. The coefficient of determination is $(r)^2 = (0.795)^2$ x 100% = 63.1% . It indicates that APPLY influences the TTE by 63.1%, while other factors that influence the remaining 36.9% are not studied.

Hypothesis Test and Discussion

Hypothesis testing is done by measuring each correlation's significance value, measured using the linear regression equation. The interpretation of testing this hypothesis is as follows: (H0) = Independent variable does not positively influence the dependent variable; (H1) = Independent variable has a positive influence on the dependent variable. The test criteria are as follows: Reject H0 and accept H1 if p-value < 0.05; or Accept H0 and reject H1 if p-value > 0.05.

Table 12. Summary Of The Results Of The Linear Regression Equation

Independent variable (X)	Dependent variable (Y)	Regression equation	Correlation coefficient (r)	Determination coefficient (%)	t-value	p-value (Sig.)
ACAP	TTE	Y = 4.422 + 0.647X	0.748	56.0	11.938	0.000
RECOG	TTE	Y = 26.807 + 1.863X	0.463	21.5	5.532	0.000
ACQUIRE	TTE	Y = 38.484 + 1.177X	0.365	13.3	4.143	0.000
ASSIM	TTE	Y = 21.447 + 1.438X	0.688	47.3	10.027	0.000
APPLY	TTE	Y = 8.558 + 2.043X	0.795	63.1	13.852	0.000

Discussion

The result of measuring the response rate of the questionnaire on the absorption capacity is 77.87% with an average point of 3.89 which showed within a good category. This result shows that this vaccine company already has an excellent absorptive capacity when assessed by the four dimensions used in this study. Likewise, the level of effectiveness of the technology transfer process carried out where taking studies on new vaccine products showed a percentage response value of 82.35% with an average point of 4.12 which is also in the good category. These results indicate the success of the technology transfer process when assessed by the three dimensions used in this study.

The high success rate of technology transfer effectiveness for new vaccine products is associated with the high level of absorptive capacity of these companies to prove both correlations. The study's results proved a statistically strong positive effect with a correlation value of R=0.748 from the effect of the absorptive capacity on the effectiveness of technology transfer of the new vaccine product. The coefficient of determination of 56% indicates that the effect of absorptive capacity is dominant in determining the effectiveness of a technology transfer from this vaccine

company.

The magnitude of the positive influence of absorptive capacity on the effectiveness of technology transfer in this study is also proven statistically through the regression equation where there is an interpretation of the constant value b = 0.647, which means that if the absorption / absorptive capacity (ACAP) increases by one unit, then the effectiveness of technology transfer (TTE) carried out in the process of developing new vaccine products will increase by 0.647 units. Thus, if the vaccine companies under study can increase their absorptive capacity, it will directly affect the effectiveness of the technology transfer they are carrying out. The higher the level of absorptive capacity of a company will affect the increase in the effectiveness of technology transfer. In contrast, previous studies have shown that the low absorptive capacity of technology recipients will hinder knowledge transfer internally and between companies (Lane et al., 2001). The results of this study align with the notion of absorptive capacity itself, which is the ability of a company to acquire, assimilate, and apply the new knowledge they get (Wesley M. Cohen & Daniel A. Levinthal, 1990; Zahra & George, 2002). In research conducted by Lin & Chang (2002), a company will only successfully assimilate and apply external knowledge with a high absorptive capacity. Their research results prove a significant relationship between technology absorption capacity, interaction mechanisms, and R&D resources on the effectiveness of performance transfer (Lin & Chang, 2002). The results of this study are also in line with the results of other studies, which state that absorptive capacity as a whole has a positive influence both directly and using moderation on the effectiveness of technology transfer (Hafeez et al., 2020; Whangthomkum et al., 2006).

The results of an empirical study on vaccine companies in this study following similar previous study in other industrial fields: electronics & chemical industry (Lin & Chang, 2002), the packaging industry (Whangthomkum et al., 2006), the creative industry (Popescu et al., 2020), and the petroleum industry (A. S. Mohamed et al., 2012), there is a positive effect of absorptive capacity on the effectiveness of technology transfer and overall company performance through high levels of new product innovation (Ince et al., 2016).

The dimension of the ability to recognize (RECOG) has a statistically significant positive effect on the effectiveness of technology transfer, with a correlation coefficient of 0.463, indicating a moderate level of correlation with the magnitude of the effect is only 21.5%. Theoretically, because the RECOG is the earliest stage of all four dimensions of the absorptive capacity, further stages are still needed so that a transfer process technology can be effective and produce actual output for the company. This finding aligns with research conducted by Sancho-Zamora et al. (2021) classify the RECOG dimension as Potential Absorptive Capacity (PACAP), which focuses more on finding and analyzing the potential benefits of technology for improving company performance. However, this ability is a necessary condition for a technology transfer to run effectively (Whangthomkum et al., 2006) because if the ability to recognize is low, then there is a risk that the company chooses the wrong type of technology to adopt, so it can hinder the overall technology transfer process. Empirical evidence of the effect of the RECOG dimension on the TTE in vaccine manufacturing companies in this study is in line with previous studies, which stated the importance of companies having the essential ability to be able to understand a new technology before being able to adopt it (Sancho-Zamora et al., 2021). Other research states that

companies must first be able to recognize the existence, understand and recognize value, and adopt and accept new knowledge or technology before they can assimilate and apply it (Whangthomkum et al., 2006).

The ability to acquire (ACQUIRE) has a statistically significant positive effect on the TTE with a correlation coefficient value of 0.365, indicating a low level of correlation. The magnitude of influence from ACQUIRE is only 13.3% against TTE. Of the four dimensions comprising the absorptive capacity variable, the ACQUIRE dimension has the least influence on the TTE, although it is still statistically significant. Previous research conducted by Whangthomkum et al. (2006) in a packaging company showed the same result: ACQUIRE's influence is weak on the overall effectiveness of TTE. The explanation is that these capabilities already exist and are well developed at these companies as they focus on managing technology acquisition best to ensure they receive the right technology. (Whangthomkum et al., 2006.

As for the vaccine industry, which has a high level of process complexity and technology (Hayman et al., 2021; Plotkin et al., 2017), there are obstacles to the ability of a company, especially in developing countries, to obtain the vaccine production technology, especially with the existence of several patented technologies (Aars et al., 2021; Hayman et al., 2021; Kumraj et al., 2022).

The World Health Organization (WHO) encourages advanced companies holding patents to transfer technology to vaccine companies in developing countries, one of which is through partnerships or technology grants (Fu et al., 2022; Hayman et al., 2021; Kumraj et al., 2022). As is strategy, the ability level to obtain (ACQUIRE) companies will not significantly affect the effectiveness of a technology transfer because there is already a guarantee for their ACQUIRE level to obtain the latest technology. The same thing happened to the studied vaccine company as they got the technology for making a new vaccine from technology transfer results through partnerships and grants. It could explain why the influence of the ACQUIRE on the TTE has the weakest influence compared to the other ACAP dimensions.

The assimilation capacity (ASSIM) has a statistically significant positive effect on TTE with a correlation coefficient of 0.688, indicating a high level of correlation. The magnitude of the influence of ASSIM is 47.3% on TTE. The correlation between the ASSIM dimensions and TTE following expectations aligns with the literature, which states that this assimilation stage is essential in integrating new technology with existing technology to produce new processes and products (Whangthomkum et al., 2006). This assimilation stage involves incorporating external knowledge or technology into routine processes and procedures to analyze, process, interpret, and understand the information obtained from outside (Sancho-Zamora et al., 2021). In the technology transfer process for new vaccine products, the vaccine companies studied used the vaccine technology platforms they already owned and mastered previously as the basis for developing these new vaccine products. Armed with mastery of vaccine production technology they have had for a long time and supported by appropriate production facilities, the new technology's assimilation process can be easy. Thus it would be very appropriate if the vaccine company that studied had a high assimilation ability (ASSIM), which has a statistically significant effect on the TTE. This study's results align with previous research where the assimilation stage strongly influenced the effectiveness of technology transfer (Whangthomkum et al., 2006).

The application ability (APPLY) has a statistically significant positive effect on the effectiveness of technology transfer, with a correlation coefficient value of 0.795, indicating the highest level of correlation. The magnitude of the influence of APPLY is 63.1% on TTE, indicating the most dominant influence compared to the other dimensions. In the literature review, the ability to apply is a vital point to determine the success and level of effectiveness of a technology transfer where companies will be able to transform new technology received into a new process or product (Whangthomkum et al., 2006), innovation, and improving overall company performance (Bozeman et al., 2015; Sancho-Zamora et al., 2021).

The ability to apply is a realized absorptive capacity (RACAP) as a process of technological transformation and the company's ability to apply new external knowledge commercially to achieve organizational goals (Sancho-Zamora et al., 2021). In line with the literature, the research results show a high level of correlation and a significant influence of the ability to apply in the studied vaccine companies on their success and effectiveness in developing new vaccine products due to technology transfer commercially. The new vaccine product produced by this company has received Emergency Use List (EUL) certification, so the product can already be used in certain countries (Bandyopadhyay & Zipursky, 2023). In this case, the vaccine company under study already has a high ability to apply (APPLY) to convert the new technology obtained into a commercial product. The existence of commercial products is clear evidence of the success and effectiveness of the technology transfer in this company. It also explains the high correlation between APPLY and the TTE from vaccine companies.

Conclusion And Recommendation

Conclusion

Based on the findings in research regarding the effect of absorptive capacity on the effectiveness of technology transfer by taking empirical studies at a vaccine company in Bandung - Indonesia, It can be proven that absorptive capacity has a dominant influence of 56.0% on the technology transfer effectiveness where other factors influence the remaining 44%. The most significant influence of the absorptive capacity dimension on the technology transfer effectiveness is the ability to apply, which is equal to 63.1% because this dimension describes a company's ability to produce new products or processes due to technology transfer commercially. The minor effect of the absorptive capacity dimension on the technology transfer effectiveness is the ability to acquire, which is equal to 13.3% because the role of this dimension is relatively small due to the company getting technology transfer for the development of this new product from the partnership/grant program.

Recommendation

Referring to the conclusions of this study, the ability to acquire and recognize factors has a low to moderate correlation and influence on the technology transfer effectiveness. The results of this study serve as a recommendation for the company's stakeholders to further improve these two dimensions by increasing awareness of all elements of the company regarding technological developments that have the potential to be applied and beneficial for improving company

performance, increasing information capabilities relevant to the company's business fields, and openness to new technology. In addition, to further improve the ability to acquire new technology, the company's stakeholders need to increase interaction with other parties in similar industrial circles to acquire new knowledge, encourage employees to master information related to fields and outside the company's business fields, improve employee communication skills with external parties, and involve employees more in meetings with external parties regarding the latest technological developments. Within these two dimensions, company management must rely on more than the partnership or grant of global technology transfer program. Knowing the factors that make up the absorptive capacity and their influence on the technology transfer effectiveness, the companies can more precisely take steps related to the strategy and process of technology transfer that they carry out to improve the company's overall performance significantly.

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