Sys Rev Pharm 2020; 11 (1):139-148
A multifaceted review journal in the field of pharmacy

The Impact of Artificial Intelligence Outcomes on the Performance of Pharmacy Business in Thailand

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Article History: *Submitted: 17.10.2019* *Revised: 21.12.2019* *Accepted: 09.01.2020*

ABSTRACT
The current paper aims to examine the impact of outcomes of artificial intelligence such as saving of human capital, the accuracy of work, time efficiency, and work quality on the performance of the pharmacy business in Thailand. The primary data was collected from the managers of pharmacy who deals with machine intelligence in the institutions. PLS-SEM was used to analyze the data that are gathered from the respondent through questionnaires. The results indicated that the outcomes of artificial intelligence such as saving of human capital, the accuracy of work, time efficiency and work quality have positive nexus with the performance of the pharmacy business in Thailand. This study also suggested to the regulators that they develop and implement the policies that enhance the quality of the outcomes of artificial intelligence which improved the performance of the pharmacy business.
Key words: Artificial intelligence, Firm performance, Time efficiency, Work quality, Human capital
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DOI: 10.5530/srp.2020.1.19

INTRODUCTION

The concept of artificial intelligence (AI) was originally generated with the generation of robots around the globe. The robot word is spelled as 'robota' in Czech that was introduced by the Karel Capek in literature in 1921 (Agrawal & Srikant, 2000). The word 'robota' immortalized into the word robot in the center of the previous century. The humanoid automation firstly introduced by China in the third century when Yan Shi that was a mechanical engineer introduced a figure of human-shaped made with mechanical handiwork that is the combination of artificial organs, wood and leather (Garbassi, Morra, Occhiello, & Garbassi, 1998). Moreover, a Muslim inventor, scholar and engineer who's named al-jazari also invented a human-robot that is able to stick the cymbals in the 12th century. In addition, Leonardo made a very comprehensive study on the topic of human anatomy to create his human robot. His robot was a cavalier robot that has the ability to sit down, stand up, move head and wave arms and jaw. It was working with the help of cables and pulleys (Asaro, 2008). Most importantly, there is motivation and inspiration for Leonardo's sketchbooks in the accomplishment of the robot and also in the generation of research on the robot (Boden et al., 2011).

In the medical field, the American company was made the surgical system that is known as intuitive surgical and Leonardo was the inspirational factor for the invention of such vital research in the field of medicine. The approval of this surgical system was given by the "Food and Drug Administration (FDA)" in 2000 and now there is more than 5000 such type of surgical system operated around the globe (Bostrom, 2012). The system developed by Leonardo is currently facilitating the complex surgery by using the "minimally invasive approach and also able to control the surgeon from the console. This effective system is now commonly operated for gynecologic and prostatectomies procedures (Hussain, Mosa, & Omran, 2017). It is also now using in the repair of cardiac value. The invention of the robot and its evolution made the comprehensive changes in the direction especially the invention of the first robot that recognized as revolutionary in the conception of mechanical realistic and it also conceived by the French inventor in the 18th century. In addition, Leonardo made a very comprehensive study on the topic of human anatomy to create a human-robot. His robot was a cavalier robot that has the ability to sit down, stand up, move the head and wave arms and jaw. It was working with the help of cables and pulleys. In addition, William Gray was also famous on the basis of his invention regarding the fabrication by preparing the first electronic robot that was named as Machina Speculatrix. The primary function of this robot is to determine how the brain is functioned. It indicated that the connections of numbers of small brain cells lead the complex behavior (Hussain et al., 2012).

In addition, the term artificial intelligence is invented by John McCarthy in 1955 and defined that "the science and engineering of making intelligent machines." Johan was very frequent in the invention and development of artificial intelligence; that was the reason he invented the field of artificial intelligence with his colleagues in 1956 in the conference of Dartmouth College on the topic of artificial intelligence. This conference was the big initiative of artificial intelligence and research on artificial intelligence (Hussain, Musa, & Omran, 2019). This conference also provides the framework for all the research on the development and computer. Later on, many of the operations done with the help of computer such as a solution to mathematic problems that was the reason to get the interest of the "Department of Defense" of the USA (Steels & Brooks, 2018). After that, there was slowdown observed in the field of artificial intelligence but

after the '80s, a golden era began with the increase in the use of mining and logistic data and medical diagnosis. In this era, the instruments were developed that have extensive power of computation. Currently, artificial intelligence is considered as a branch of very important field engineering that implemented the new concepts and new solutions for complex issues and challenges (McCarthy & Hayes, 1981).

Due to continuing progress in the field of software programming, capacity and speed of electronic output in the field of medicine and other areas might be artificial intelligence as intelligent as the human (Dieguez-Santana, M Rivera-Borroto, Puris, Le-Thi-Thu, & M Casanola-Martin, 2017). No one neglect the vital contribution of cybernetics in the development of artificial intelligence. Cybernetics aims to control every system by using the technology that has the ability to explore the regulation of the system, constraints, and structure of the system, most importantly biological, physical, social and mechanical (Spiro, Bruce, & Brewer, 2017). Norbert Wiener was the inventor of the cybernetics who formalized the feedback notion with the implication in the field of computer science, engineering, neuroscience and biology (Dande & Samant, 2018). Fields that are most influenced by the artificial intelligence (cybernetics) are psychology, systems theory, cognitive psychology sociology, neuropsychology, and biology (Chen, Challita, Saad, Yin, & Debbah, 2017). Thus, the artificial intelligence is now playing a vital role in the field of pharmacy as well and current study aims to investigate the impact of outcomes of artificial intelligence such as saving of human capital, accuracy of work, time efficiency and work quality on the performance of pharmacy business in Thailand. The use of artificial intelligence is increasing around the globe and organizations generate comprehensive revenue from it. Figure 1 given below shows the increasing trend in the revenue of the worldwide companies from 2016 to 2025. The statistics highlighted that the revenue from artificial intelligence earned by the enterprises was only USD 357.89 million in 2016. In addition, this revenue increase and reached USD 841.31 million in 2017. Moreover, the revenue from artificial intelligence earned by the enterprises was increased and reached USD 1622.4 million in 2018. Furthermore, this revenue increase and reached USD 2867.54 million in 2019. Additionally, the revenue from artificial intelligence earned by the enterprises will increase and reach USD 4806.3 million in 2020. Similarly, this revenue will increase and reach USD 7714.18 million in 2021. Likewise, the revenue from artificial intelligence earned by the enterprises will increase and reach USD 11840.54 million in 2022. In addition, this revenue will increase and reach USD 17284.19 million in 2023. Moreover, the revenue from artificial intelligence earned by the enterprises will increase and reach USD 23886.76 million in 2024. Finally, the revenue from artificial intelligence earned by the enterprises will increase and reach USD 31236.92 million in 2025.

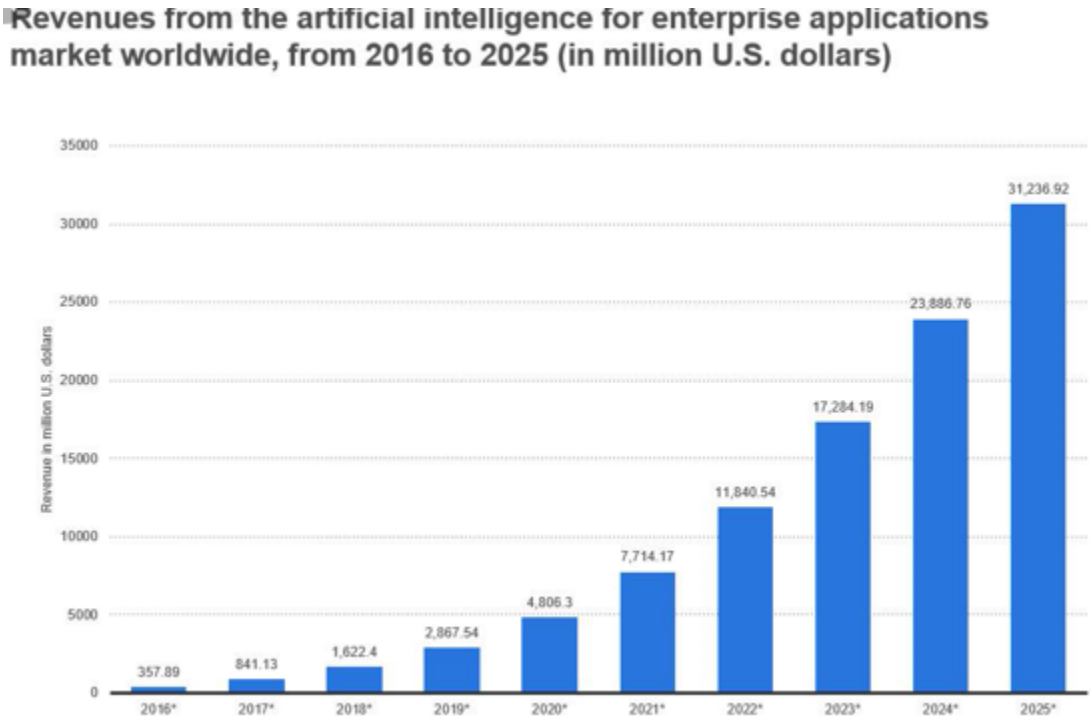

Figure 1: *Revenue Earned from Artificial Intelligence*

Literature Review

This section shows the literature of previous studies regarding the understudy constructs and their relationships as follow:

Performance of Pharmacy

The pharmacy performance refers to the improvement and development in the functions of the pharmacy. It also includes the accuracy and efficiency of the processes that enhance the overall performance of the company (Cor & Brocks, 2018). In

addition, the improvement in the accuracy of functions within the pharmacy and also financial improvement are included in the definition of pharmacy performance (Fernandes et al., 2015). Thus the performance of the pharmacy is an important element in the improvement of pharmacy business in the country and this study this topic under investigation and takes pharmacy performance as the main variable of the study.

Accuracy of Work

The accuracy of work defines as the quality of the work that was done by the institutions and that satisfy the client of the institution (Hooper et al., 2016). In addition, "accuracy is defined as the quality or state of being correct or precise (Bartram, Thewlis, Martin, & Norton, 2018). Another definition of accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard" (Ferencik et al., 2015). Thus, the accuracy of the work is important for the improvement in the reputation and income of the organization and this study takes this variable as an independent construct.

Saving of Human Capital

It refers to the involvement of machine work that reduces the efforts of mankind and saves the labor force within the organization (Shah & Steinberg, 2017). In addition, "human capital is an intangible asset not listed on a company's balance sheet and includes things like an employee's experience and skills. Since all labor is not considered equal, employers can improve human capital by investing in the training, education, and benefits of their employees" and saving of this intangible assets by employing the machine in the institution are said to be saving of human capital (Becker, Murphy, & Spenkuch, 2016). Thus, the saving of human capital is important for improvement in the processes, accuracy and income of the organization and this study takes it as an independent construct.

Time Efficiency

Time efficiency means to accomplish the task on or before the time that is important for the success of any business around the globe (Dong, Nelson, Indelman, Michael, & Dellaert, 2015). In addition, it refers to the efficiency of the organization to deal with its operation that they complete the task on or before the due date (Sharma, Dittrich, Yildirim-Yayilgan, & Van Gool, 2015). Moreover, it also refers to the organized functions of the organization in a way that they complete their tasks before time. Thus, time efficiency is essential for the improvement in the processes, accuracy and income of the organization and this study takes it as an independent variable.

Work Quality

Work quality refers to the ability of the work that satisfies the client of the institutions that enhance the performance of the institution. In addition, it also means that the quality of output of the institution that fulfills the demand of the customers (Vogt et al., 2017). Moreover, it also refers to the ability of the company's products that attract, retain and satisfy the client of the institution (Ragins, Ehrhardt, Lyness, Murphy, & Capman, 2017). Thus, the work quality is important for improvement element of the business that enhances the revenue of the business and this study take it as an independent variable.

Accuracy of Work and Performance of Pharmacy

The performance of the firm depends upon the accuracy of the work done by the organization. In addition, there is positive nexus among the accuracy of the work done and the performance of the pharmacy. Moreover, the accuracy of the work done is the foremost element that enhances the performance of the business specially pharmacy business around the globe (Woods et al., 2016). Furthermore, the performance of the pharmacy can be increase through the accuracy of work done by the institution (Liu et al., 2016). Additionally, as far as the accuracy of the work increases, the performance of the pharmacy also increases and vice versa. Similarly, positive nexus has been observed by past studies between the accuracy of the work and the performance of the pharmacy (Murakami et al., 2016). Likewise, the accuracy of the work is one of the vital factors that enhance the performance of the pharmacy. In addition, the accuracy of the work is necessary for the improvement in the performance of the pharmacy business (Oldland, Golightly, May, Barber, & Stolpman, 2015). Moreover, work accuracy is the primary element that improves the performance of the business especially pharmacy business around the globe Thus, based on all past literature who found positive nexus among the accuracy of work and performance of pharmacy, this study also formed the following hypothesis:

H1: There is positive nexus among the accuracy of the work and performance of pharmacy in Thailand.

Saving of Human Capital and Performance of Pharmacy

Saving of human capital is necessary for the improvement in the performance of the pharmacy business because it replaces the man to work into machine work that enhances accuracy and performance. In addition, the performance of the firm depends upon the accuracy of the replacement of the man's work into machine work (Ranghchian, Sehat, Akhgari, & Mehralian, 2018). Furthermore, the performance of the pharmacy can be increased by replacing the man to work into machine work. Moreover, the replacement of man work into machine work is the foremost element that enhances the performance of the business specially pharmacy business around the globe. Similarly, positive nexus has been observed by past studies between the saving of human capital and the performance of pharmacy (Wahga, Blundel, & Schaefer, 2018). Additionally, as far as the machine work increases the performance of the pharmacy also increases and vice versa. In addition, there is positive nexus among the saving of human capital and the performance of the pharmacy (Hermawan, 2015). Likewise, the saving of human capital is one of the vital factors that enhance the performance of the pharmacy. Thus, based on all past literature who found positive nexus among the saving of human capital and performance of pharmacy, this study also formed the following hypothesis:

H2: There is positive nexus among the saving of human capital and the performance of pharmacy in Thailand.

Time Efficiency and Performance of Pharmacy

The time efficiency of the organization is the foremost element that enhances the performance of the business specially pharmacy business around the globe (Ourth et al., 2019). Moreover, the performance of the firm depends upon the time efficiency of the organization. In addition, there is positive nexus among the time efficiency and performance of the pharmacy. Likewise, the accuracy of the work is one of the vital factors that enhance the performance of the pharmacy. In addition, time efficiency is necessary for the improvement in the performance of the pharmacy business. Furthermore, the performance of the pharmacy can be increased through the time efficiency of the institution (Lo et al., 2016). Additionally, as far as the time efficiency of the firm increases the performance of the pharmacy also increases, and vice versa. Similarly, positive nexus has been observed by the past studies between the time efficiency and performance of pharmacy. Moreover, time efficiency attracts the client in the fast-moving world that also increases the loyalty of the client that ultimately increases the performance of the pharmacy (Bastian, Kang, Griffin, & Fulton, 2016). Thus, based on all past literature who found positive nexus among the time efficiency and performance of pharmacy, this study also formed the following hypothesis:

H3: There is positive nexus among the time efficiency and performance of pharmacy in Thailand.

Work Quality and Performance of Pharmacy

The performance of the pharmacy can be increase through the quality of work done by the institution. In addition, there is positive nexus among the quality of the work done and the performance of the pharmacy. Additionally, as far as the quality of the work increases the performance of the pharmacy also increases and vice versa (Zhijie, Cai, Ying, Zhou, & Zhao, 2016). Moreover, the quality of the work done is the foremost element that enhances the performance of the business specially pharmacy business around the globe. Likewise, the quality of the work is one of the vital factors that enhance the performance of the pharmacy (Shiyanbola, Mott, & Croes, 2016). In addition, the accuracy of the work is necessary for the improvement in the performance of the pharmacy business. Furthermore, the performance of the firm depends upon the quality of the work done by the organization. Similarly, positive nexus has been observed by past studies between the quality of work and performance of the pharmacy (Teichert et al., 2016). Thus, based on all past literature who found positive nexus among the quality of work and performance of pharmacy, this study also formed the following hypothesis:

H1: There is positive nexus among the quality of work and performance of pharmacy in Thailand.

RESEARCH METHODS

The study aims to investigate the impact of outcomes of artificial intelligence such as saving of human capital, the accuracy of work, time efficiency and work quality on the performance of the pharmacy business in Thailand. The primary data was collected from the managers of pharmacy who deals with machine intelligence in the institutions. Around 500 questionnaires were distributed to the managers and after one month, 345 valid responses were collected and used for analysis that was approximately 69 percent response rate. Five-point licker scale questionnaire was used in which the dependent variable (performance of pharmacy) has ten items. In addition, independent variables such as saving of human capital, the accuracy of work, time efficiency and work quality have twelve, six, eight and eight items respectively. PLS-SEM was used to analyze the data that are gathered from the respondent.

RESULTS

The findings include validity such as convergent and discriminant and also include the regression analysis. Table 1, given below, show the convergent validity that means items are correlated and results exposed that convergent validity is proved because loadings are greater than 0.50. In addition, the values of Alpha and composite reliability (CR) are higher than 0.70 and AVE is higher than 0.50. Table 1 and Figure 2 are presented below regarding convergent validity.

Table 1: *Convergent Validity*

Constructs	Items	Loadings	Alpha	CR	AVE
Accuracy of Work	AW1	0.892	0.806	0.859	0.553
	AW2	0.812			
	AW3	0.677			
	AW4	0.648			
	AW6	0.657			
Performance of Pharmacy	PP1	0.705	0.849	0.884	0.523
	PP10	0.782			
	PP3	0.821			
	PP4	0.631			
	PP6	0.626			
	PP7	0.680			
	PP8	0.790			
Saving of Human Capital	SHC1	0.805	0.928	0.939	0.585

	SHC10	0.780			
	SHC11	0.761			
	SHC12	0.786			
	SHC2	0.858			
	SHC3	0.547			
	SHC4	0.777			
	SHC5	0.686			
	SHC6	0.719			
	SHC7	0.836			
	SHC8	0.809			
Time Efficiency	TE1	0.884	0.917	0.933	0.637
	TE2	0.864			
	TE3	0.729			
	TE4	0.647			
	TE5	0.811			
	TE6	0.778			
	TE7	0.911			

Table 1 Continue

Constructs	**Items**	**Loadings**	**Alpha**	**CR**	**AVE**
	TE8	0.722			
Work Quality	WQ1	0.748	0.857	0.893	0.582
	WQ2	0.742			
	WQ3	0.781			
	WQ4	0.804			
	WQ6	0.743			
	WQ8	0.758			

The second validity related to the constructs that mean constructs are not highly correlated and the findings indicated that variables are not highly correlated and discriminant validity is valid because the first value of the construct is higher than the rest of the values. In addition, values of cross-loadings are not higher than 0.90. Table 2 and Table 3 are presented below regarding the Fornell Larcker criteria and cross-loadings about the discriminant validity.

Table 2: *Fornell Larcker*

	AW	**PP**	**SHC**	**TE**	**WQ**
AW	0.744				
PP	0.686	0.723			
SHC	0.511	0.531	0.765		
TE	0.463	0.570	0.393	0.798	
WQ	0.384	0.723	0.491	0.667	0.763

Table 3: *Cross Loadings*

	AW	**PP**	**SHC**	**TE**	**WQ**
AW1	**0.892**	0.695	0.493	0.435	0.732
AW2	**0.812**	0.639	0.533	0.361	0.589
AW3	**0.677**	0.398	0.244	0.310	0.649
AW4	**0.648**	0.289	0.197	0.246	0.408
AW6	**0.657**	0.335	0.269	0.338	0.486
PP1	0.372	**0.705**	0.290	0.453	0.392

PP10	0.462	**0.782**	0.356	0.423	0.559
PP3	0.430	**0.821**	0.384	0.326	0.485
PP4	0.314	**0.631**	0.292	0.367	0.341
PP6	0.323	**0.626**	0.402	0.366	0.429
PP7	0.639	**0.680**	0.436	0.466	0.613
PP8	0.730	**0.790**	0.465	0.452	0.686
SHC1	0.298	0.351	**0.805**	0.191	0.240
SHC10	0.272	0.302	**0.780**	0.180	0.239

Table 3 Continue

	AW	PP	SHC	TE	WQ
SHC11	0.347	0.351	**0.761**	0.251	0.300
SHC12	0.465	0.408	**0.786**	0.355	0.383
SHC2	0.480	0.504	**0.858**	0.429	0.484
SHC3	0.262	0.246	**0.547**	0.244	0.274
SHC4	0.460	0.478	**0.777**	0.365	0.478
SHC5	0.396	0.437	**0.686**	0.389	0.466
SHC6	0.384	0.438	**0.719**	0.298	0.464
SHC7	0.429	0.424	**0.836**	0.264	0.362
SHC8	0.390	0.410	**0.809**	0.234	0.306
TE1	0.326	0.439	0.280	**0.884**	0.506
TE2	0.336	0.392	0.278	**0.864**	0.496
TE3	0.444	0.511	0.283	**0.729**	0.604
TE4	0.418	0.430	0.311	**0.647**	0.512
TE5	0.252	0.336	0.220	**0.811**	0.401
TE6	0.431	0.559	0.376	**0.778**	0.664
TE7	0.366	0.471	0.332	**0.911**	0.534
TE8	0.297	0.395	0.376	**0.722**	0.419
WQ1	0.441	0.497	0.347	0.647	**0.748**
WQ2	0.656	0.634	0.434	0.416	**0.742**
WQ3	0.413	0.508	0.384	0.622	**0.781**
WQ4	0.489	0.532	0.350	0.649	**0.804**
WQ6	0.738	0.518	0.347	0.342	**0.743**
WQ8	0.800	0.590	0.371	0.414	**0.758**

The second criterion regarding the discriminant validity is HTMT ratio. The findings indicated that variables are not highly correlated and discriminant validity is valid because the values are less than 0.90. Table 4 is presented below regarding the HTMT ratio about the discriminant validity.

Table 4: *HTMT Ratio*

	AW	PP	SHC	TE	WQ
AW					
PP	0.713				
SHC	0.522	0.569			
TE	0.512	0.623	0.408		
WQ	0.706	0.803	0.532	0.742	

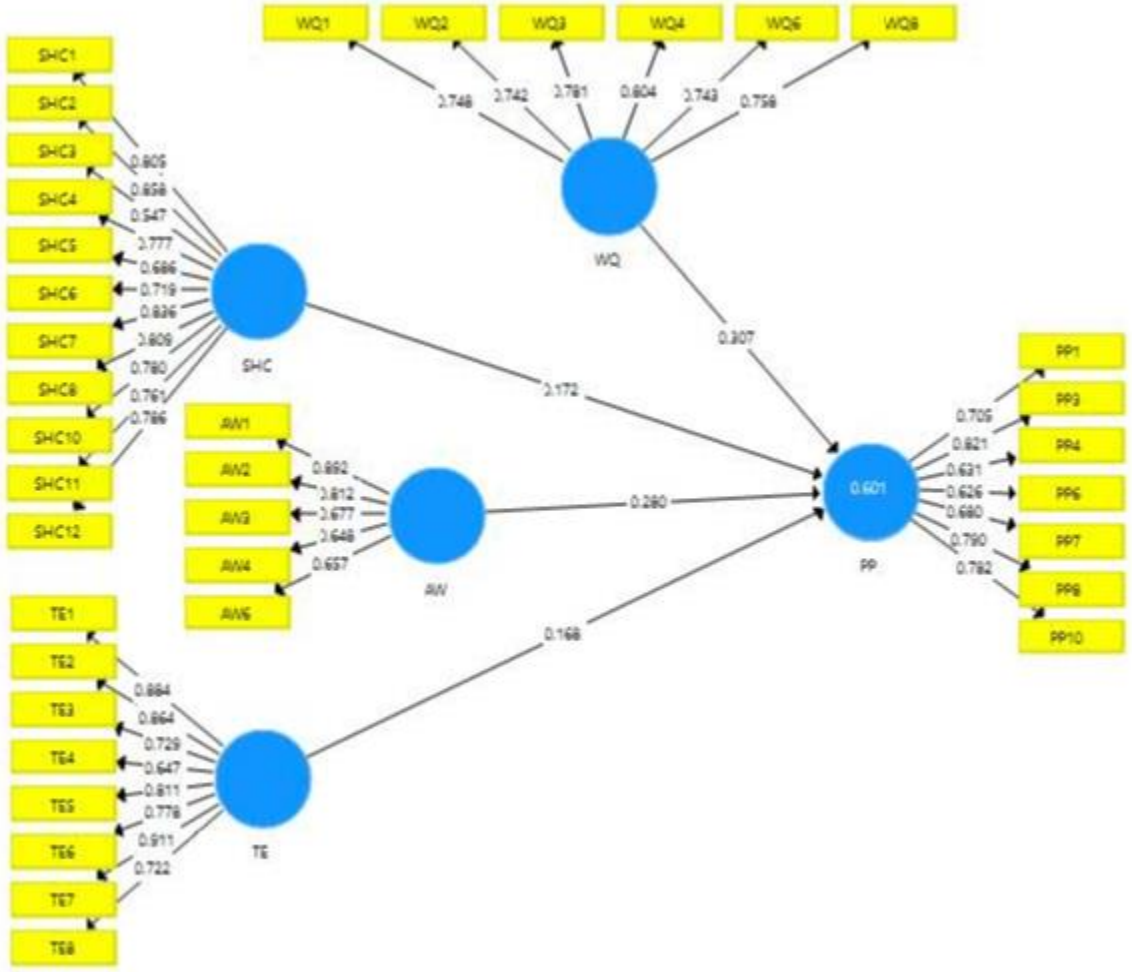

Figure 2: *Measurement Assessment Model*

The regression analysis is used to test the hypothesis of the study. The findings indicated that positive nexus between the saving of human capital, the accuracy of work, time efficiency, work quality and performance of pharmacy because positive sign exists with beta values, "t" statistics are higher than 1.64 and "p" values are lower than 0.05. In addition, there is one unit increase in accuracy of work; the performance of pharmacy will increase by 0.280 units and vice versa and also supported H1. Moreover, there is one unit increase in saving of human capital; the performance of pharmacy will increase by 0.172 units and vice versa and also supported H2. Furthermore, there is one unit increase in time efficiency, the performance of pharmacy will increase by 0.168 units and vice versa and also supported H3. Finally, there is one unit increase in work quality; the performance of pharmacy will increase by 0.307 units and vice versa and also supported H4. Table 5 and Figure 3 are presented below regarding the path analysis of the study.

Table 5: *Path Analysis*

	Beta	**S.D.**	**t-values**	**p-values**	**L.L.**	**U.L.**
AW -> PP	0.280	0.065	4.283	0.000	0.179	0.389
SHC -> PP	0.172	0.051	3.400	0.000	0.084	0.251
TE -> PP	0.168	0.056	2.997	0.001	0.091	0.273
WQ -> PP	0.307	0.089	3.468	0.000	0.154	0.442

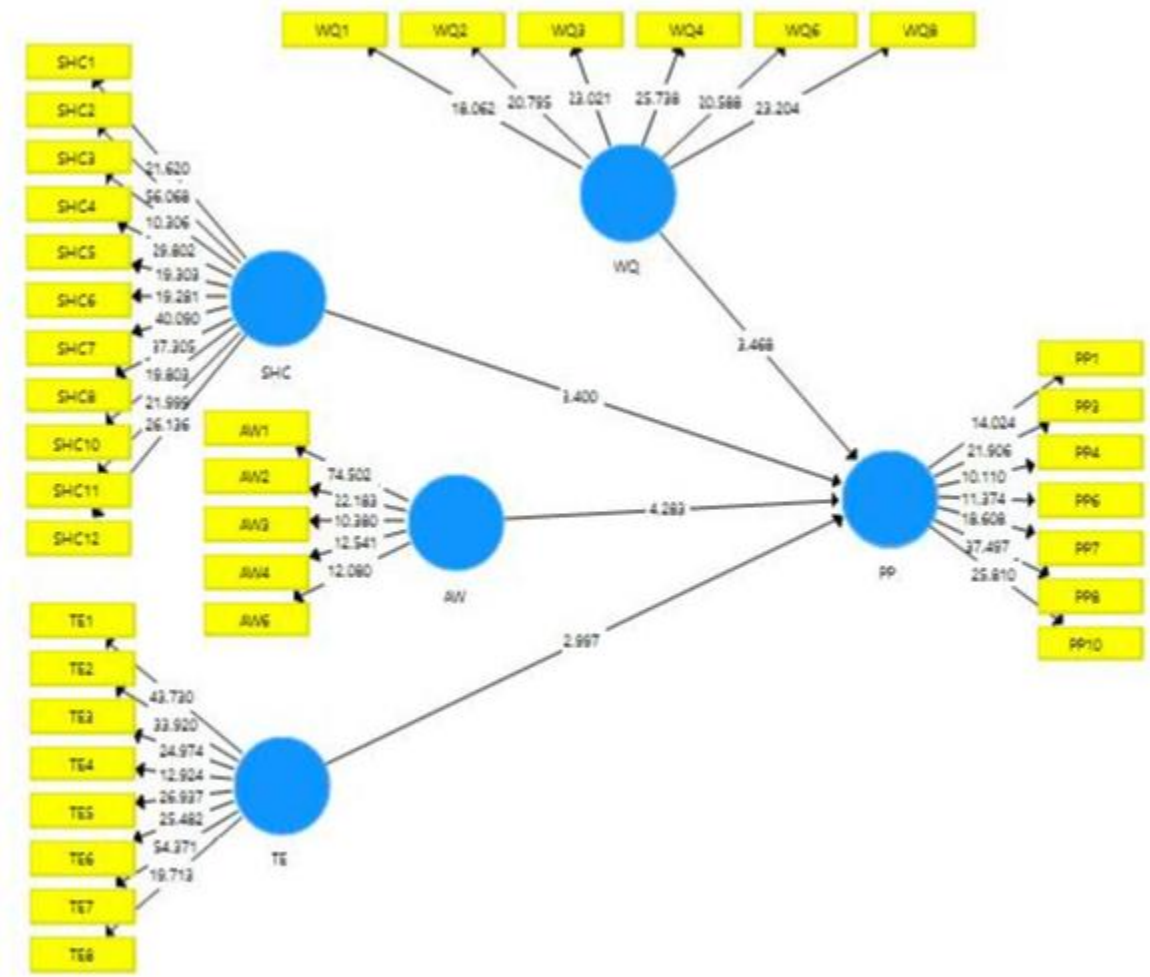

Figure 3: *Structural Assessment Model*

DISCUSSIONS AND CONCLUSION

The finding elaborated that if the accuracy of work done by the pharmacy in Thailand increases, the performance of the pharmacy also increases because the accuracy comes through artificial intelligence that improves accuracy which is the essential element of high performance. In addition, outcomes of the paper also exposed that less human capital increases the machine work that is also the output of artificial intelligence that enhances the effectiveness which is the essential element of high performance. Moreover, the results are indicated that time efficiency also comes from machine work that is the output of artificial intelligence that enhances the effectiveness of time which is the essential element of high performance. Furthermore, the quality of the work also the essential element of high performance of the pharmacy and machine work increase the quality of the work that enhances the performance of pharmacy in Thailand. The outcomes of this paper are matched with past paper Wall et al. (2015) and Micallef et al. (2017) who also found positive nexus among the outcomes of artificial intelligence and the performance of the firm.

Finally, the current study concluded that all the outcomes of artificial intelligence, such as saving of human capital, the accuracy of work, time efficiency, and work quality enhance the performance of the pharmacy in Thailand. All the outcomes regarding artificial intelligence have the ability to get the client's attention and loyalty moreover also have the ability to enhance the quality and efficiency of business processes that are necessary for high performance of the business. Thus, this study also suggested to the regulators that they develop and implement the policies that enhance the quality of the outcomes of artificial intelligence which improved the performance of the pharmacy business.

The current paper also has a few limitations that are the directions for prospective scholars. The present study takes only four outcomes of artificial intelligence to predict the firm performance and ignored the other factors that may include future studies in their examination. In addition, this study investigates only the pharmacy business and ignored other business and prospective scholars may add other businesses in their analysis. Finally, this study only on Thailand and ignored the different countries and further literature may include other countries and must focus on cross country analysis.

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