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THE EFFECT OF KNOWLEDGE WORK PRODUCTIVITY FACTORS ON SOFTWARE DEVELOPMENT

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Abstract

The small and medium-sized enterprise (SME) constitutes a major part of the economy and it has been relatively unsuccessful in developing KWP. In addition a few of SME companies have a little understanding of what the necessary knowledge work (KW) is, and influence the quality of knowledge work or knowledge work productivity (KWP) in software development process. It cannot be denied that knowledge and skill constitutes part of the ability of knowledge workers. This paper seeks to examine thoroughly the influencing factors of the KWP and which primarily significant for the quality enhancement in SME. This study was conducted based on the analysis of the existing literatures, the key characteristics of KW and its productivity are defined. The conceptual model was proposed, which explored the factors of the KWP. This study analyses data collected from 150 respondents, which involved in SME in Malaysia and validates the models by using structural equation modelling (SEM). The results provide an analysis of the effect of factors on the quality of KW and business success, and have a significant relevance for both research and practice in the SME companies.

Keywords: Knowledge work, Knowledge work productivity and SME.

1. Introduction

Nowadays, business has been driven by technology and knowledge. Human continuously accumulate knowledge work (KW) has replaced the manual work to become the most important mode of production. KW is defined as any activities that require specialized knowledge or skill or create new knowledge [1]. In contrast to physical work KW focuses primarily on mental work activities (creating or applying information) to create value [1, 2]. Nevertheless, KWP is a widely concept focusing more on the quality of knowledge work [3]. Therefore, KW is viewed as important not only for understanding the implications of business, but also for developing the capabilities needed to perform well [4].

However, scholars [5, 6] have indicated that Small Medium Enterprise (SME) is neglecting the issues of KW and the quality of knowledge work (KWP). In fact, this study found no published work on a conceptual model that identifies critical factors to improve knowledge work productivity (KWP) used in business in the SME. It has been assumed that the achievement of business in the SME segment will increase a country's competitive advantage, and improved productivity. In regards to that, a number of researchers have emphasized the role of knowledge workers and competitive advantage [7]. Hence, understanding and leveraging knowledge worker competencies in the organization are essential for developing nations [8] and become the key to national prosperity.

Generally, SME companies have less financial and human resources than large enterprises [5]. As an example, they have limitations in labour cost, innovation initiative, access to funding, and working capital [6]. Besides, their limitations in resource, lack of strategic planning in information systems (IS) [9] and limited expertise in IT create great risks. Many projects have failed, because they apply wrong specifications in system requirement. It has been repeated many times in various projects. This indicates that SME companies cannot properly manage the design and development process. On top of requiring knowledge intensive while designing and developing software, the productivity also mainly concerns on quality [10]. Consequently, quality improvement in KW is necessary and important in ensuring the quality of the designing and development process Therefore, a study on the productivity of the factors of the KWP and their effects on the design and development quality is important. It could be the theoretical basis for SMEs in their software development to ensure their potential business values.

2. Theoretical Foundation of the Study

KWP is considered as an integral part of the quality management process to achieve continuous improvement and performance excellence [10]. It means that improvement in KW is necessary and important in order to improve the quality of the process. In determining the factors of KWP that affect quality, this study adapts the KWP model by [11] as a foundation to conceptualize the research model. According to this model, two strategies have been proposed to improve productivity, namely effectiveness and efficiency strategies. In contrast, this model does not focus on the individual and team performance (such as programmer performance, collaboration and innovation) [12,8] in order to improve quality of KW. Thus, this study believes that the expansion of KWP model is an appropriate model to examine the way to an improved quality of KW in organizations.

2.1. Effectiveness and efficiency

Particularly, effectiveness is an important characteristic for knowledge workers to expand KW competently and could easily deal with task complexity [11]. The strategies for effectiveness can be attained by improving on scope, depth and completeness and introducing a novel technology [11]. It focuses on the results of the process and the quality of those results [13]. On the other hand, efficiency is related how well an organization managing approach, timeliness and resources [15]. Efficiency may be achieved by strategizing an improvement plan in the process, procedure or by more productively using information technology [3]. When effectiveness and efficiency strategies have been implemented, SME companies could be more competent. It is very important, because the increased competition could lead SME companies to focus on the collaboration among the knowledge workers to improve the quality of KW, in which the trend could be seen in multinational companies since the past a few decades. Thus, this study hypothesized:

H1 KWP is positively influenced by effectiveness strategies

H2 KWP is positively influenced by efficiency strategies

2.2. Collaboration

Organizations have traditionally adopted quality management and performance improvement in their team work [14]. Practically, teamwork is the foundation that brings together the knowledge, experience, and skills of various members in the team to contribute to the development of a new product more effectively than individual team members performing their narrow tasks in support of product development. This is because collaboration requires effective team works, and trust and respect among the team members are very prominent in the team collaboration. Hence, all team members must communicate voluntarily and are ready to accept any different views from others. In a dynamic business environment, KW teams have become more and more popular in high-tech organizations. For SME companies to be productive and able to produce quality products. Thus, this study hypothesized:

H3 KWP is positively influenced by collaboration

2.3. Programmer Performance

Programmer performance is one of the important in software development where [15] has proposed KWP should not depend merely heavily on the input and output measurement only, but consider also specific parameters that affect programmers' performance (such as programmer or system analyst) in software company. Among the proposed parameters include quantity and quality of day-to-day work, quality of interaction with different stakeholders, the innovation behaviour with respect to business and professional innovations [16], compliance with professional and organizational standards, and skill development in experts. With that, SME companies will be able to innovate creations. Thus, this study hypothesized:

H4 KWP is positively influenced by programmer performance

2.4. Innovation Strategies

Conceptually, innovation refers to the creation of better products or more efficient processes, services, technology or idea accepted by the market, government, and society. It also reflects the creative and novel fashion on a process that regards to the improvement in effectiveness and efficiency or marketability. Additionally, the crucial of innovation in order to improve KWP [17]. Thus, this study hypothesized:

H5 KWP is positively influenced by innovation strategies.

An organization have been concerned on quality management and performance improvement tools as a result of their need to innovate and improve the effectiveness, quality, productivity, and performance of the various elements of the organization, such as employees, organizational structure, management, and technology [2]. Accordingly, most companies have been struggling to improve their quality and increase productivity and performance. This study attempted to validate the KWP factors and its contribution to organizational performance and quality of KW, attributed to the way for a convincing argument to make the case for the relationship between the two paradigms of knowledge work and definitely improve productivity. Moreover, understanding the relationship among the factors in KWP will provide a venue to argue for the utility of their programs from a quality perspective. In the context of SME the literatures also show that few works have been published on the possible relationship between the factors of the KWP and their effect of the KWP.

3. Design Conceptual Model and Hypothesis

In order to explore the effect of KWP factors on the quality of KW a conceptual model, five factors of KWP are proposed (based on the literature review), which can be seen in Fig. 1. On the KWP layer, five characteristics are considered; effectiveness strategies, efficiency strategies, collaboration, programmer performance, and innovation strategies. Accordingly, the following five hypotheses which based on the conceptual model as depicted in Fig. 1 are formed to understand the correlation between KW domain and its productivity.

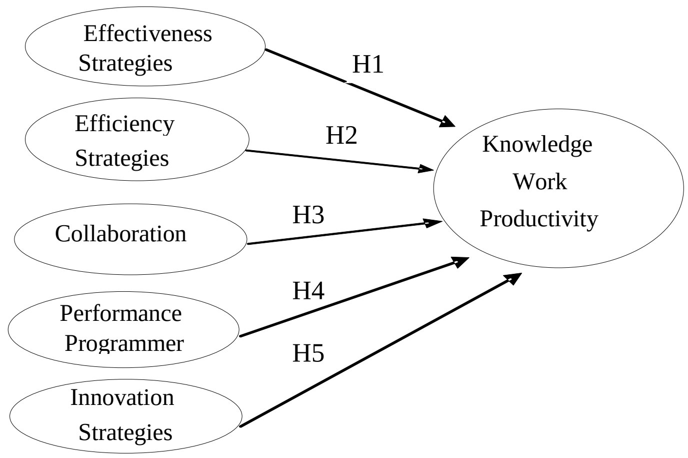

Fig. 1. Conceptual model of knowledge work productivity.

4. Method

Data have been collected from knowledge workers with over 1 year work experience. Altogether, 200 questionnaires have been sent out through email, 150 collected and valid for further analysis. In this research, all items were anchored 7 point interval scale ranging from “strongly disagree” (1) to “strongly agree (7). The content validity of the research instrument established, by consulting group of experts in the field of information system. Based on their comment, modification was made and no item was dropped. The pilot study was conducted to determine the reliability of instruments. This was actually done by using actual data collection procedures which involved 30 software developers as respondent (programmer and system analyst) for this study in SME company. Furthermore, 100 SME software company was selected as population for this study, which located in Peninsular Malaysia. Apart from these 70 companies was selected randomly as sample size for the purpose of this study. The measurement and structural model were analysed using SmartPLS 3 because the ability to predict theoretical model. The analysis indicates that the research instrument demonstrated satisfactory reliability (Cronbach Alpha equal to 0.98) and validity. In addition, composite reliability (CR) is used to measure data's reliability (internal consistency). Convergent validity assessment is used to measure data's validity.

4.1. Data analysis measurement model

Reliability test CR values (detailed in the Appendix A) show a desirable reliability, which is greater than 0.7 (between a range of between 0 and 1, in which higher value represents better internal consistency) for 68 items asked. Besides that, validity test is another important criterion for data analysis. Two criteria for convergent validity test have been underlined by [19] : a) all indicators must be significant (at least at 0.05 values) and their loading should exceed 0.7 or 0.6 and b) the Average Variance Extracted (AVE) for each construct exceeds the variance due to measurement error for that construct (AVE should exceed 0.5). Having analyzed the gathered data, this study obtained results as exhibited in Table 1 (Appendix A). Meanwhile, discriminant validity can be assessed by [19] as exhibited in Table 3 (in the Appendix). The square root of AVE value must be greater than the value of the variance shared between the construct and other constructs [19]. For this study, based on the result, it is seen that the square root of AVE values is greater than the value of the square. This indicates adequate discriminant validity. On top of that, all indicators loading are greater than 0.6 on their respective constructs and significant at $p < 0.005$. Meanwhile, the AVE value for each construct is greater than 0.50. Hence, both criteria for validity are satisfied. According to [20] the common method bias is problematic if a single latent factor would account for the majority of the explained variance. The correlation matrix exhibited in Table 4 (Appendix A) shows that the value is less than 0.9, indicating that the common method bias is not a serious threat in the study [20].

4.2. Structural model

However, efficiency strategies (β= -0.063, p> 0.05), is not significant in relation with KW. Hence, the four hypotheses (H1, H3, H4 and H5) received statistical support and H2 did not receive enough statistical support.

Fig. 2 and Table 2 (Appendix B) show the results of the structural model. The model explains a significant amount of variance in the dependent variable (KWP) (R^2= 0.695). The results indicate that KWP is strongly influenced by collaboration (β = -0.280, p > 0.05) followed by innovation strategies (β= 0.254, p> 0.05), programmer performance (β= 0.244, p< 0.05), and effectiveness strategies (β= 0.213, p < 0.05) by using two-tailed test (T test > 1.96).

5. Results and Discussion

Based on the gathered data, the results of analysis prove that the KWP is influenced by effectiveness strategies, efficiency strategies, programmer performance, collaboration, and innovation strategies as illustrated in Figure 2. This is line with the previous findings by [13]. In such context, effectiveness refers to the degree to which objectives are achieved and the extent to which targeted problems are solved. It concerns on the right thing and is determined without reference to costs, but it has to be strategized, developed to enhance the KWP. It has a significant relation to KWP and has the strongest total effect or positive effect on the KWP. Programmer performance also has a significant relation with and positive effects on the KWP. It means the accomplishment of a given task measured against the present known standards of accuracy, completeness, cost, and speed. Meanwhile, efficiency is found as not significantly influencing and has negative effects on the KWP. One possible explanation for the non-significant influence of efficiency is because most of SME companies do not concern on such strategy. They are emphasizing on the individual's roles as software developers. Finally the KWP model should include KWP factors that influence KWP or quality of KW are effectiveness strategies, collaboration, programmer performance and innovation strategies.

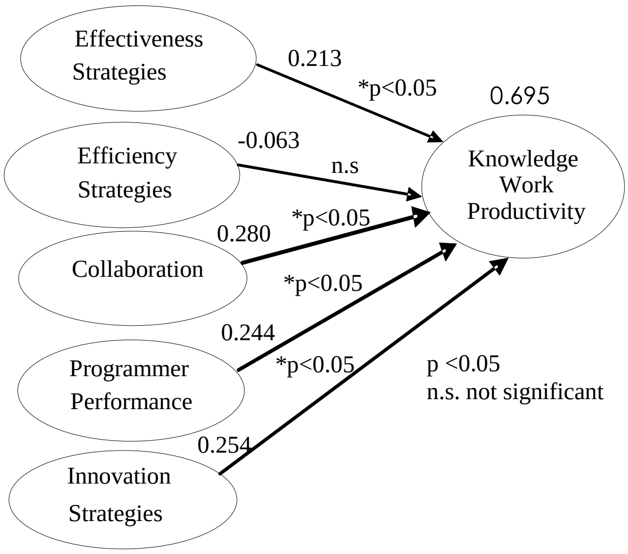

Fig.2. Result from structural model of knowledge work productivity.

6. Conclusion

The main objective of this study is to determine the KWP factors that influence the KWP or quality of KW. Based on the proposed research model, this study has proven that KWP factors have significant influence on KWP in software development process. Collaboration and Innovation strategies have the strongest effect on quality but efficiency strategies has a less effect in software development process for the SME companies. The positive results shows that knowledge workers need to create a new ideas through innovation depending their skill and knowledge and willing to collaborate as a mechanism to attract quality contributions from members. The model shall provide support for management practice and overcome the challenges in organizational in order to enhance the KWP or quality of knowledge work among SME company. Therefore, it is a hope that this model can be implemented in other working environment to identify and overcome human failure in KW aspect among knowledge workers. It's also very important for SME to stay competitive in the business world. A further study of the various quality factors for KWP will be conducted to understand how far the stored knowledge will be useful to the developers and the organization.

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Appendix A

Table A1. Performance of each variable

Latent variables	Item	loading	T Statistic	AVE	CR
KWP	AD	0.758	14.819	0.530	0.90
	AD2	0.786	19.771		
	AD3	0.737	13.857		
	AD4	0.666	6.964		
	AD5	0.796	26.264		
	AD6	0.654	11.326		
	AD7	0.662	9.738		
	AD8	0.751	17.264		
Effectiveness strategies	EFFECT 1	0.710	17.835	0.655	0.919
	EFFECT 2	0.788	19.388		
	EFFECT 3	0.822	25.713		
	EFFECT 4	0.840	34.455		
	EFFECT 5	0.849	30.762		
	EFFECT 6	0.839	22.889		
Efficiency strategies	EFFIC1	0.829	24.315	0.626	0.893
	EFFIC2	0.707	13.035		
	EFFIC3	0.827	23.279		
	EFFIC4	0.806	26.202		
	EFFIC5	0.781	19.540		
Innovation strategies	INNOV1	0.830	31.083	0.668	0.910
	INNOV2	0.862	30.434		
	INNOV3	0.816	15.375		
	INNOV4	0.841	26.799		
	INNOV5	0.813	24.520		
	INNOV6	0.817	26.838		
Programmer performance	PPERF1	0.797	24.495	0.690	0.917
	PPERF2	0.784	21.116		
	PPERF3	0.831	27.402		
	PPERF4	0.877	39.233		
	PPERF5	0.795	15.273		
Collaboration	COLLA1	0.785	18.988	0.689	0.930
	COLLA2	0.848	29.362		
	COLLA3	0.828	23.015		
	COLLA4	0.844	30.784		
	COLLA5	0.845	33.283		

Appendix B

Table B2. Significant relationship of each variable towards KWP.

Latent variables	*t* values	Significant level	p values
Collaboration-> KWP	3.431	**	0.002
Effectiveness Strategies -> KWP	2.376	**	0.048
Efficiency Strategies -> KWP	0.697	NS	0.888
Innovation Strategies -> KWP	2.852	**	0.002
Programmer Performance -> KWP	2.474	**	0.044

Table B3. Discriminant validity.

Construct	Collaboration	Effectiveness strategy	Efficiency strategy	Innovation strategy	Programmer performance
Collaboration	**0.830**				
Effectiveness strategies	0.694	**0.810**			
Efficiency strategies	0.710	0.776	**0.791**		
Innovation strategies	0.763	0.699	0.743	**0.830**	
Programmer performance	0.793	0.757	0.715	0.705	**0.818**

Table 4. Latent variable correlation.

Construct	Collaboration	Effective strategies	Efficiency strategies	Innovation strategies	Programmer performance
Collaboration	1.000				
Effectiveness Strategies	0.694	1.000			
Efficiency Strategies	0.710	0.776	1.000		
Innovation Strategies	0.763	0.699	0.743	1.000	
Programmer Performance	0.793	0.757	0.715	0.705	1.000