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Key Success Factors of Knowledge Sharing Behavior among Software Developers in Indonesia

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Abstract

Knowledge sharing is a crucial element for enhancing efficiency in the software development process. However, it proves to be a challenging and complicated task in practice, particularly due to the insufficient knowledge and experience of software developers. The aim of this research is to pinpoint key success factors in knowledge sharing behavior among software developers. Based on Social Cognitive Theory (SCT), the research divides components into three categories: behavioral, environmental, and personal. For a more complete picture, an additional organizational aspect is included. The partial least squares structural equation model was utilized to analyze the data collected from 198 software developers in Indonesia. The findings reveal that motivation, trust, social interaction, organizational culture, reward, and management support positively influence knowledge sharing behavior, while geographical distance has a negative impact. This research contributes by filling a gap in previous research that utilized SCT, broadening the model to identify determinant factors explaining knowledge sharing behavior within an organizational context.

A. Introduction

Software development, by its nature, is a complex activity that involves various technical knowledge [1]. Additionally, it requires effective collaboration and communication among individuals involved in the process [2]. As the time passes, various innovations emerge in the software development process. Currently, the software development industry employs various methodologies in its practices, with Agile being one of the most well-known and well-used in industry. The Agile method involves rapid development with continuous improvement and feedback. However, this fast-paced nature often leads to a lack of technical documentation and the potential loss of knowledge when a team members leave [3]. Therefore, the exchange of knowledge or knowledge sharing between teams in Agile method and software development in general, is something that is important to be done.

A recent survey [4] directed at software developers indicates that one of the significant challenges affecting their productivity is the lack of necessary knowledge or technical skills within the development team. Similarly, another survey [5] reports that inadequate technical knowledge or experience is a prevalent issue and poses challenges for software developers. Therefore, overcoming these challenges can enhance the performance and productivity of software developers.

Knowledge sharing has proven to significantly impact the software development process. It has the potential to enhance the performance of global-scale organizations, as well as small and medium-sized businesses (SMEs) [6], [7] and even global-scale organizations [8]. Knowledge sharing also enables Global Software Development (GSD). By leveraging the talents of employees from around the world, a feat achievable only when employees actively share their knowledge [8], [9]. Knowledge sharing procedures have a great deal of potential to foster creativity and teamwork in the software development industry.

Based on the issues mentioned before, this research addresses the following research questions. First, what are the variables that influence software engineers' knowledge sharing behavior (KSB). Second, what suggestions are there to enhance the behavior of information sharing itself? In order to do this, an online survey was conducted as part of our research to determine the key success factors affecting the behavior of knowledge sharing among Indonesian software developers. Using a model based on social cognitive theory and a partial least square structural equation modeling (PLS-SEM) technique, we were able to determine the critical success factors for knowledge sharing. Furthermore, we identify the most often used methods of knowledge sharing and formulate suggestions grounded in previous research to tackle the second research question.

This study is divided into eight segments. The literature review is presented in Segment 2. Segment 3 presents the conceptual model and the formulation of the hypothesis. In Segment 4, the research methods used in this study are explained. Segment 5 displays the analysis's results. Segment 6 discusses the findings. Segment 7 presents the study's implications. The conclusions are finally given in Segment 8.

B. Literature Review

a) Knowledge Sharing

Knowledge sharing constitutes an integral component of the knowledge management process, involving the communication of tacit or explicit knowledge to fellow individuals [10]. In an organization context, knowledge sharing refers to employees or teams within an organization that exchange and discussing knowledge within and or across the organization [7]. The knowledge sharing process can be facilitated through various channels such as discussions, conferences, and knowledge bases [10].

Effective knowledge sharing can offer significant benefits to the organizations that implement it. Knowledge sharing facilitates the accessibility of strategic knowledge across all levels within the company [11]. This process has the potential to enhance the quality of innovations generated by individuals, teams, and the entire organization [12]. On the other hand, to ensure effective knowledge sharing it requires organizations with adequate internal capabilities [13]. Therefore, knowledge sharing also presents challenges that organizations need to address.

One of the significant challenges in implementing knowledge sharing is encouraging people to actively participate [10]. For example, people may feel reluctant to contribute their knowledge to a repository. Therefore, organizations must guarantee the efficient functioning of the knowledge sharing process within their structure to elevate performance and foster innovation results [6].

b) Social Cognitive Theory

Social Cognitive Theory (SCT) represents a concept introduced by Albert Bandura to explain an individual's behavior and the influencing factors [14]. In SCT, "personal factors", "environmental factors", and "behavior" are three elements that mutually affect each other in shaping human behavior [14], [15]. Initially developed for the field of psychology, the SCT concept has found practical applications in various domains, including but not limited to education, health, and technology [9], [16].

c) Previous *Studies*

Several previous studies have employed the SCT concept to understand the knowledge sharing behavior of programmers [9], [16]. This study will adopt a similar approach, utilizing the SCT framework to investigate the knowledge sharing behavior of a software developer. In a previous study [9], observations were made using personal and environmental factors to understand knowledge sharing behavior, but there is no exploration of external factors from outside of an individual itself. A separate investigation conducted by [6] and [21] delved into factors within individual, organizational, and technological contexts. Nevertheless, this study ignored an examination of the environment based on SCT, and the research participants did not encompass software developers. This research will expand observations from an organizational perspective [18]–[21]. Organization is an important factor when discussing knowledge sharing within a company. Therefore, this study will also incorporate observational factors based on organizational aspects.

C. Development of Conceptual Model and Hypothesis

This study utilized the groundwork established by [9], [22] to construct the primary research model. The formulation of the model and the selection of variables were tailored to align with the study's background, problem statement, and objectives. Three SCT-based components are included in the model creation process: personal, environmental, and behavioral. Given the background of earlier research on knowledge sharing, organizational factors [18]–[21] and technology [6], [7], [23], [24] are factors that can influence knowledge-sharing practices. However, the technological factors found were not diverse. The factors found only specifically related to technological capabilities [6],

[7], [23], [24] and infrastructure [23]. Further literature study is needed regarding technological factors to incorporate them into the model. Thus, this study will incorporate organizational factors as an additional perspective into the SCT model.

Drawing from previous research, a total of 9 latent variables were adopted, encompassing motivation, trust, social interaction, organizational culture, reward, management support, time zone difference, geographical distance, and linguistic distance. Furthermore, knowledge sharing behavior was introduced as the sole independent variable to complement the model in comprehensively representing knowledge sharing behavior among software developers. Figure 1 depicts the proposed research model.

Motivation involves steering behavior towards goals, assisting individuals in achieving objectives [22]. Numerous researchers have explored its significance in fostering knowledge exchange within organizations [9], [25], [26]. Nevertheless, the willingness of software developers to share and merge their knowledge remains a major hurdle [25], where motivation emerges as a crucial factor in encouraging such behavior, given that motivating factors differ from person to person [9]. The absence of both intrinsic and extrinsic motivation poses the risk of knowledge hoarding, ultimately impacting organizational performance. Notably, the lack of motivation within software development teams serves as a barrier to effective knowledge sharing [22]. Individual motivation stands out as the pivotal factor influencing knowledge sharing behavior, particularly among software developers [9]. Consequently, the following hypothesis is proposed:

H1. Motivation positively influences KSB among software developers.

Trust is a condition essential for establishing and sustaining relationships among individuals, thereby fostering the sharing of knowledge [27]. It holds various dimensions, impacting how willing organizational members are to share knowledge as trustworthy sources and recipients [25]. The presence of mutual trust enhances the likelihood of knowledge exchange among software developers, highlighting the pivotal role trust plays in facilitating both tacit and explicit knowledge sharing in this specific professional domain [9]. Therefore, the proposed hypothesis is:

H2. Trust positively influences KSB among software developers.

Social interaction refers to the connections between two or more individuals, characterized by the strength of these connections, the time spent together, and how frequently they communicate [9], [20]. It serves as a way for the exchange of information and resources, fostering an environment conducive to combining and sharing information and knowledge [20], [28]. Various forms of social interaction, such as face-to-face conversations, verbal exchanges, discussions, and dialogues, are recognized as fundamental elements especially for sharing tacit knowledge among software developers [29]. Some research indicates that social interaction positively encourages knowledge sharing behavior [9], [30]. As a result, the following hypothesis is put forth:

H3. Social interaction positively influences KSB among software developers.

Organizational culture represents characterized as a collection of beliefs, values, and shared assumptions guiding the behavior of individuals within an organization [22]. A collaborative and transparent organizational culture stands out as the foremost factor positively impacting knowledge sharing behaviors [18], particularly crucial for software developers engaged in collaborative knowledge-intensive tasks. Within an environment fostering a culture of knowledge sharing, individuals naturally exchange ideas and insights rather than feeling compelled to do so [31]. Multiple sources of literature highlight the correlation between organizational culture and knowledge sharing behavior [18], [19]. Hence, the following hypothesis is proposed:

H4. Organization culture positively influences KSB among software developers.

Apart from the organizational culture, reward systems that offer incentives to guide behavior or enhance learning performance are crucial [20]. These systems encompass motivating employees across various organizational levels to reach organizational objectives [22]. Rewards may include monetary elements like salary increments or bonuses, as well as non-monetary aspects such as promotions [20]. Implementing suitable reward systems that harmonize with the integration and spread of knowledge within organizations can further encourage software developers to share their knowledge [17]. Given that a significant portion of their time is dedicated to product development, the presence of reward systems becomes essential as it provides an incentive for them to engage in activities beyond their primary responsibilities. Several studies have demonstrated the positive effect of reward systems on knowledge sharing behavior [19], [20]. Hence, the following hypothesis is suggested:

H5. Reward positively influences KSB among software developers.

To improve knowledge sharing practices and procedures throughout the company, management support entails the backing of upper and middle management, who motivate employees to spearhead initiatives that foster knowledge sharing [19]. Effective knowledge sharing is facilitated by managers through the creation of an organizational culture that supports it, the use of incentives, and alignment with a vision that uplifts staff members. These actions ultimately result in a sustained competitive advantage through increased motivation [17], [22]. The following hypothesis was developed as a result of many research findings that show managerial support is a critical component influencing knowledge sharing behavior [19], [21].

H6. Management support positively influences KSB among software developers.

In the context of knowledge sharing among software developers, time zone difference refers to the temporal distinction between the locations where these developers are situated. Software development often involves collaboration among teams distributed across different regions or even countries which causes time zone differences. The time zone difference becomes a significant barrier in facilitating communication [32], [33] between team members who may be working in different time zones, especially when coordinating tasks and scheduling meetings which are essential for knowledge sharing. The difference in time zones has been observed to have an negative effect on the sharing of knowledge [9]. Therefore, the following hypothesis is proposed:

H7. Time zone difference negatively influences KSB among software developers.

Geographical distance in this study represents the physical gap among software development teams situated in various geographic areas, posing a hurdle to communication and knowledge sharing among developers. Informal interactions tend to facilitate the sharing process when distance is not an issue [9]. However, as software development companies expand, knowledge sharing is hampered by the growing distance between team members in far-off places [9]. Research indicates a negative impact of geographical distance on knowledge sharing [34]. As a result, the following hypothesis is suggested:

H8. Geographical distance negatively influences KSB among software developers.

Linguistic distance encompasses variations in language, communication styles, and linguistic conventions among developers, particularly in diverse linguistic backgrounds or multilingual teams. This diversity creates a communication gap among team members [32]. Problems and misunderstandings arise when there is no common native language or a lack of shared native languages [9]. This linguistic diversity poses significant challenges for globally distributed team members in terms of sharing and assimilating knowledge [35]. Thus, the following hypothesis is proposed:

H9. Linguistic distance negatively influences KSB among software developers.

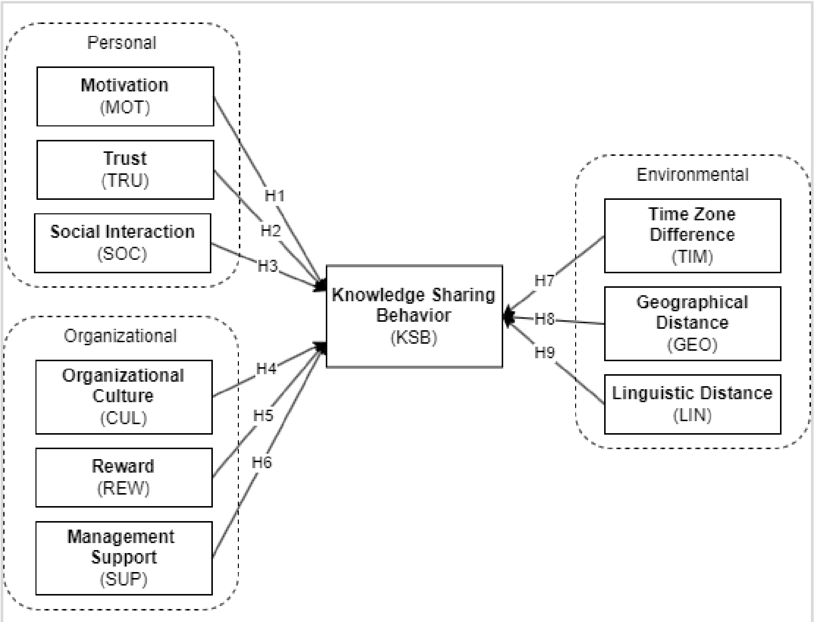

Figure 1. Proposed Research Model

D. METHODOLOGY

a) Research Methods

Online questionnaires are used in this study to collect quantitative data from respondents who are especially software developers in Indonesia. Eight steps make up the research: formulation of the problem, review of the literature, model design, creation of the questionnaire, test of questionnaire readability, data collecting, analysis of the data, and conclusion drawing. Before being shared on social media, the questionnaire was put through a readability test to make sure it was legitimate and reliable. SmartPLS 3, which was selected for its appropriateness in examining intricate cause-effect-relationship models with an emphasis on prediction and a comparatively small sample size, as is the case in this study, was utilized to process the obtained data along with PLS-SEM technique.

b) Research Instruments

survey was divided into three sections: a section for validation, questions about demographics, and questions about. The validation phase sought to match participants with the study's subject requirements. Questions concerning respondents' backgrounds were directed toward their demographics. Based on their experiences with knowledge sharing within their firms, respondents assessed the research-related questions in Table 1. An assessment was conducted using a 5-point Likert scale, where 1 denoted strongly disagree, 2 disagree, 3 neutral, 4 agree, and 5 strongly agree.

Table 1. Research Instruments

Code	Statement	Ref
MOT1	It brings me joy to share knowledge to my coworkers	[9]
MOT2	Sharing knowledge with coworkers brings me satisfaction	
MOT3	It gives me great pleasure to share knowledge to my coworkers to help them with work-related problems	
MOT4	My coworkers value me when I share my knowledge to the others	
TRU1	I think I can completely rely on my coworkers to share expertise with me	[9]
TRU2	I trust that the knowledge possessed by my colleagues is reliable	
TRU3	I am certain that my coworkers will responsibly use the knowledge that we have shared	
TRU4	I believe that the knowledge held by my colleagues is valuable	
SOC1	I still have close social relationships with a few of my coworkers	[9]
SOC2	I frequently exchange knowledge with some of my colleagues	
SOC3	I like to share my knowledge to a few coworkers that I know personally	
SOC4	I often exchange ideas with some of my colleagues	
CUL1	I think that if the business encourages a learning culture, knowledge sharing events will happen more regularly	[17], [19]
CUL2	I think that if the company lets its employees use their creativity, knowledge sharing activities will become more common	
CUL3	If a company prioritizes a collaborative and team-oriented culture, I think there will be more knowledge sharing activities	
CUL4	My team/department values employees who bring forth new ideas and knowledge	
REW1	If employees receive bonuses or incentives for participating in knowledge sharing events, I think these activities will happen more frequently	[17], [19]
REW2	I believe knowledge-sharing activities will be more common if promotions are granted to employees who participate in them	
REW3	My team/department evaluates and acknowledges knowledge-sharing efforts among colleagues	
REW4	Knowledge sharing is one of the aspects evaluated for promotions in my workplace	
SUP1	My supervisor/manager leads by example when it comes to sharing knowledge to others	[17], [21]
SUP2	My supervisor/manager encourages me to share knowledge to team members in different departments	
SUP3	My supervisor/manager provides guidance to me and colleagues on how to share knowledge with coworkers	
SUP4	My supervisor/manager consistently strives to cultivate a knowledge sharing culture (e.g., providing incentives, etc.)	
TIM1	Time zone differences affect productivity in sharing knowledge with my colleagues	[9]
TIM2	I find it challenging to communicate with my coworkers because of time zone variations.	
TIM3	It is difficult for me to plan time for knowledge sharing with my coworkers due to time zone differences	
TIM4	Time zone differences impact the quality of knowledge sharing with my colleagues	
GEO1	Location differences sometimes accidentally make me feel excluded or isolated from information shared by my colleagues	[9]
GEO2	Location differences with colleagues make it challenging for me to find the right people to share knowledge	
GEO3	Location differences with colleagues result in the loss of knowledge due to ineffective knowledge sharing	

GEO4	Location differences impact the quality of knowledge sharing with my colleagues	
LIN1	Language differences make it challenging for me to share knowledge with my colleagues	[9]
LIN2	Language diversity with my colleagues can complicate communication and collaboration across countries	
LIN3	Language differences make it take longer for me/my colleagues to understand the intended meaning of shared knowledge	
LIN4	Language differences impact the quality of knowledge sharing with my colleagues	
KSB1	My coworkers and I frequently share knowledge	[9], [21]
KSB2	I usually take some time to talk with my coworkers about complicated matters	
KSB3	I share knowledge related to work experience with my colleagues	
KSB4	When I acquire new job-related knowledge, I share it with my colleagues	

E. Results and Analysis

a) Demographics of Respondents

Between December 8, 2023, and December 18, 2023, the questionnaire was distributed, and 198 valid questionnaires were collected consequently. Typically, a practical minimum sample size is 100, and a recommended one for research employing SEM is 150 [36]. Therefore, the number of respondents gathered for this study is considered appropriate. For a comprehensive overview of respondent demographics, refer to Table 2.

Table 2. Demographics Of Respondents

Question	Answer Options	Percentage	Frequency
Gender	Male	85.35%	169
	Female	14.65%	29
Age	17 – 25 years old	61.11%	121
	26 – 35 years old	38.38%	76
	36 – 45 years old	0.51%	1
Domicile	Jabodetabek	69.19%	137
	Outside Jabodetabek (Inside Java)	28.28%	56
	Outside Java	2.53%	5
Education Level	High School	1.01%	2
	Diploma	2.53%	5
	Bachelor's	83.84%	166
	Master's	12.63%	25
Working Experience	< 5 years	58.08%	117
	5-10 years	35.86%	71
	> 10 years	5.05%	10
Company Size	< 51 employees	21.72%	43
	51-200 employees	23.23%	46
	201-500 employees	28.28%	56
	> 500 employees	26.77%	53
Working Location	Remote (WFH)	41.92%	83
	On-site (WFO)	31.31%	62
	Hybrid (WFH + WFO)	26.77%	53

b) Outer Model

The initial step in model estimating to determine the link between constructs was the measurement or outer model. The measurement model in this study was validated through the use of convergent validity, along with the reliability tests. Convergent validity was assessed using factor loadings and average variance extracted (AVE), with a loading threshold of 0.7 [36], while indicators with factor loadings below 0.7 could be removed and an AVE requirement of over 0.5 for each latent variable [36]. Based on the threshold, one indicator was removed from organizational culture (CUL4), geographical distance (GEO2), and knowledge sharing behavior (KSB2); two indicators were removed from motivation (MOT3 and MOT4), social interaction (SOC1 and SOC3), and reward (REW1 and REW2); three indicators were removed from trust (TRU1, TRU2, and TRU4) and management support (SUP1, SUP3, and SUP4); and zero deletion for time zone difference and linguistic distance. The remaining indicators and their outer loading values were presented in Table 3.

Table 3. Outer Loadings Test Results

Indicator	Outer Loadings
CUL1	0.769
CUL2	0.753
CUL3	0.892
GEO1	0.759
GEO3	0.853
GEO4	0.929
KSB1	0.788
KSB2	0.760
KSB3	0.796
LIN1	0.919
LIN2	0.848
LIN3	0.926
LIN4	0.900
MOT1	0.826
MOT2	0.940
REW3	0.939
REW4	0.885
SOC2	0.884
SOC4	0.905
SUP2	1.000
TIM1	0.769
TIM2	0.775
TIM3	0.769
TIM4	0.925
TRU3	1.000

Composite reliability (CR) was used to measure reliability, with values above 0.7 being the goal [36]. Both assessments passed. The AVE and CR values for every latent variable are shown in Table 4.

Table 4. CR and AVE Test Results

Variable	CR	AVE
MOT	0.878	0.783
TRU	1.000	1.000
SOC	0.889	0.800
CUL	0.848	0.652
REW	0.889	0.833
SUP	1.000	1.000
TIM	0.885	0.660
GEO	0.886	0.722

LIN	0.944	0.808
KSB	0.825	0.611

Conducting discriminant validity testing is the next step after passing the convergent validity testing. Through correlation values between variables, discriminant validity measures how well a latent variable exclusively reflects itself and how much it genuinely varies from other latent variables [36], [37]. It was required to determine whether a latent variable's square root of its AVE exceeded its correlation with other latent variables in order to perform this test [38]. The findings of the discriminant validity tests show that the square root of the AVE values for each variable is greater than the correlation value of that variable with other latent variables. Therefore, it can be concluded that the measurement model has passed the discriminant validity test based on the data displayed in Table 5.

Table 5. Discriminant Validity Test Results

	GEO	KSB	LIN	SUP	MOT	CUL	REW	SOC	TIM	TRU
GEO	0.850									
KSB	-0.161	0.782								
LIN	0.388	-0.210	0.899							
SUP	-0.052	0.176	0.031	1.000						
MOT	0.023	0.299	-0.045	0.223	0.885					
CUL	-0.016	0.205	-0.031	0.118	0.338	0.807				
REW	0.069	0.314	0.188	0.236	0.026	0.271	0.913			
SOC	0.248	0.348	0.146	0.172	0.256	0.362	0.160	0.894		
TIM	0.429	-0.170	0.503	0.042	-0.002	0.096	0.083	0.046	0.812	
TRU	0.160	0.069	0.280	0.212	0.224	0.204	0.203	0.368	0.209	1.000

c) Inner Model

The first step in estimating the inner or structural model was to evaluate the model's goodness of fit, or the degree to which the projected values of the model align with the observed data. A good fit implies that the model effectively captures the underlying relationships within the data, giving assurance in the accuracy and dependability of further analyses and interpretations. This study demonstrates that all the goodness-of-fit criteria employed, including Chi-Square, SRMR, and NFI, achieved acceptable levels, as detailed in Table 6.

Table 6. Goodness of Fit Test Results

Index	Threshold Value	Result	Remark
Chi-Square	As small as possible	836.437	Acceptable Fit
SRMR	< 0.08	0.072	Acceptable Fit
NFI	> 0.9	0.918	Acceptable Fit

The next action was to calculate the coefficient of determination, which is a measurement of the percentage of variance in a dependent variable that can be accounted for by predictor variables [39]. Greater accuracy in predicting the dependent variable is indicated by a higher correlation square (R^2), which has a range of 0 to 1, as shown by previous research [36], [39]. An R^2 value more than 0.25 denotes a weak effect, greater than 0.5 denotes a moderate effect, and greater than

0.75 denotes a large or strong effect [39]. The findings of the coefficient of determination test are displayed in Table 7.

Table 7. Coefficient of Determination Values

Variable	R^2	Effect Size
KSB	0.433	Weak

Finally, the study examined the direct impact of each latent variable on the dependent variable by testing the proposed hypotheses. Lastly, the study looked at how each latent variable directly affected the dependent variable by testing the suggested hypotheses. The significant value (P) of less than 0.05 would determine the acceptance of a hypothesis in a two-tailed test with a recommended significance threshold of 5% [36]. Consequently, 7 proposed hypotheses were accepted while the other 2 were rejected, as seen in Table 8. Moreover, the final research model along with the path coefficient of each variable was presented in Figure 2.

Table 8. Direct Effect Hypothesis Test Results

Hypothesis	Path Coefficient	P-value	Result
H1: MOT → KSB	0.165	0.013	Accepted
H2: TRU → KSB	0.193	0.008	Accepted
H3: SOC → KSB	0.413	0.000	Accepted
H4: CUL → KSB	0.124	0.021	Accepted
H5: REW → KSB	0.398	0.000	Accepted
H6: SUP → KSB	0.183	0.001	Accepted
H7: TIM → KSB	-0.039	0.591	Rejected
H8: GEO → KSB	-0.159	0.023	Accepted
H9: LIN → KSB	-0.055	0.487	Rejected

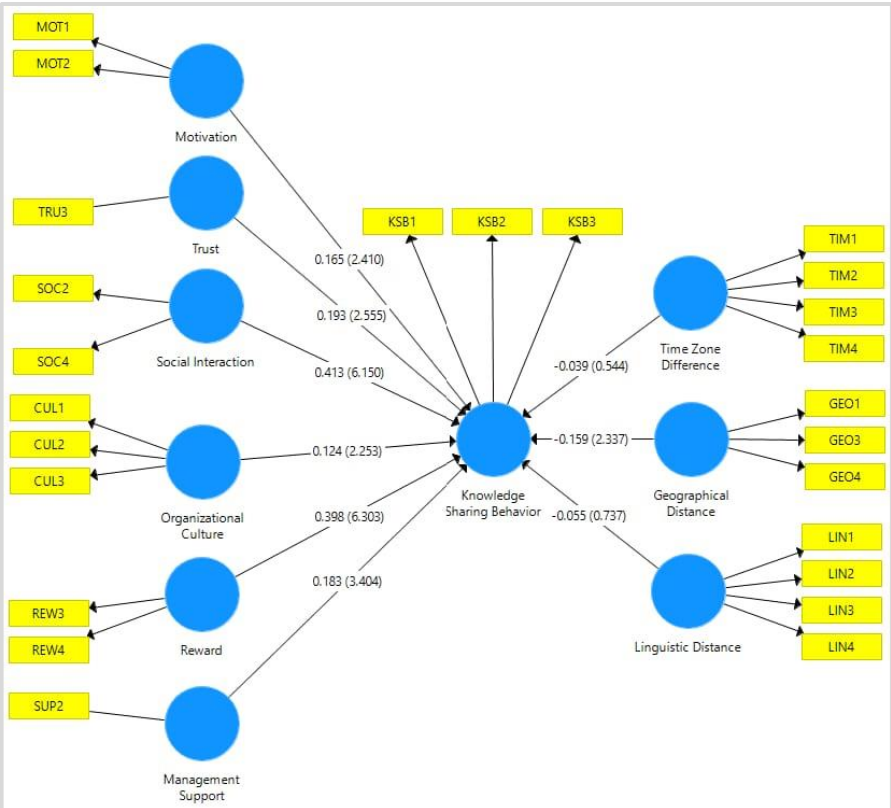

Figure 2. Final Research Model

F. Discussion

In the domain of individual factors, the analysis outcomes reveal that motivation statistically and significantly has a positive effect on knowledge sharing behavior, leading to the acceptance of H1. The most significant indicator for motivation is MOT2. The indicator with the highest outer weight value is the most significant factor. This signifies that greater motivation among software developers enhances the likelihood of knowledge sharing. These findings corroborate the research conducted by [9], [25], [26], underscoring the critical role of motivation in shaping knowledge sharing behavior. According to this study, trust positively influences knowledge sharing behavior as well, which results in the acceptance of H2, with TRU3 being the most important signal. This finding implies that knowledge sharing practices are likely to be encouraged by high levels of trust among software developers, and vice versa. This discovery aligns with previous research by [20] and [38], affirming that trust is a key determinant variable affecting knowledge sharing. Additionally, H3 is acknowledged, indicating that social interaction positively influences knowledge sharing behavior among software developers. The factor that affects social interaction the most is SOC4. This underscores that knowledge sharing tends to occur more frequently when there is increased interaction or communication among developers. This corresponds with the results reported in [9], which asserted that social interaction stands out as the most influential variable in determining knowledge sharing behavior, proven to have the most influence.

In the organizational factors context, culture has a favorable impact on knowledge sharing behavior, resulting in the acceptance of H4. The most significant indicator of culture found is CUL3. The outcome indicates that an organization fostering a culture supportive of knowledge sharing contributes positively to enhancing knowledge sharing practices among developers, as noted in [19]. This finding is consistent with the results reported in [41]. Moreover, it has been established that reward exhibits a correlation with knowledge sharing behavior positively, leading to the acceptance of H5, with the most significant indicator is REW3. In essence, organizations should implement reward systems to motivate software developers to share their valuable knowledge. This corresponds with the conclusions drawn by [18] and [29], asserting that well-structured reward systems, harmonized with the generation and distribution of knowledge within an organization or company, can stimulate employees' willingness to share their knowledge. Additionally, management support is validated to have an effect on knowledge sharing behavior in a positive way, leading to the acceptance of H6. The management support indicator that shows the most significant impact is SUP2. Managers who can inspire and motivate their teams to share valuable or productive knowledge contribute to the establishment of effective knowledge sharing practices. This result aligns with various studies emphasizing the value of management support for the successful implementation of knowledge sharing in organizations, as highlighted in [17], [19], [21].

In the domain of environmental factors, the analysis reveals that time zone difference does not exert a notable influence on knowledge sharing behavior among software developers in this study, leading to the rejection of H7. This result indicates that the temporal distance between developers is not a significant barrier to impede knowledge sharing. One plausible explanation is that developers are accustomed to this, leveraging the flexibility of their time to perform tasks. Temporal distance may pose a barrier in other contexts, particularly for those not engaged in software development. This finding aligns with the study by [9], asserting that time zone difference does not significantly impact knowledge sharing. However, geographical distance is determined to negatively influence knowledge sharing behavior, resulting in the acceptance of H8. Consequently, knowledge sharing practices among software developers are constrained due to diverse geographical locations, serving as a clear barrier and complicating communication for task coordination and collaboration. This result supports the findings of [9], demonstrating a negative relationship between geographical distance and knowledge sharing among software developers. Finally, in this study, linguistic distance is not proven to significantly affect knowledge sharing behavior, leading to the rejection of H9. This result aligns with the research conducted by [9], which found that linguistic distance had an insignificant effect on knowledge sharing. The rejection may be attributed to the multicultural and ethnic composition of the developers, originating from diverse groups with distinct cultures. This multicultural environment fosters the enhancement of employees' linguistic skills, facilitating improved communication abilities [9].

G. Implications

a) Theoretical Implications

study identifies the underlying variables that affect knowledge sharing among Indonesian software developers. It makes a valuable contribution by addressing a gap in prior research that employed SCT, expanding the model to identify determinant factors explaining knowledge sharing behavior within an organizational context. The findings reveal a positive correlation between personal and organizational factors with knowledge sharing behavior. Notably, geographical distance stands as the sole negative influence from the environmental perspective. The outcomes regarding personal and environmental perspectives under SCT align with the findings of [9], while the organizational aspect mirrors earlier research, as observed in [6], [21]. Moreover, the limited impact observed in the coefficient of determination in this study suggests the presence of numerous additional factors contributing to affect knowledge sharing behavior. One of the potential factors is the technological aspect. One of the potential future discussions is how technological aspects can influence knowledge sharing. Thus, it is recommended for future study to explore more technological aspects to further enhance the model used in this study.

b) Practical Implications

The study's findings might offer the essential perspective to enhance knowledge sharing practices, especially in software development teams and organizations. Developing knowledge sharing strategies based on critical success factors is one action that can be done. Therefore, it is essential to establish a connection between key success factors and practices that are commonly found in the software development environment. According to the findings of the literature review and other studies, it is observed that knowledge repositories [2], [7], [25], meetings [8], [42], [43], and informal conversations [1], [23], [25], [42] are the most commonly found knowledge sharing practices within software development environment.

The study emphasizes how important interpersonal elements like trust and social interaction are for knowledge sharing in software development teams. Management should foster a collaborative atmosphere by facilitating social interaction through routine activities like technology sharing sessions and study groups. Real-time interactions and face-to-face events are vital for building trust and overcoming geographical barriers to knowledge sharing. Additionally, management policies supporting rewards, organizational culture, and knowledge management initiatives can further enhance knowledge sharing. This includes incentivizing knowledge sharing, raising awareness about its importance, and establishing repositories for future projects, thereby cultivating a robust knowledge management culture within the organization.

H. Conclusion

Based on the analysis outcomes, 7 out of the 9 hypotheses in this study were successfully confirmed. Hence, these findings suggest that motivation, trust, social interaction, organizational culture, reward, and management support play positive roles in shaping knowledge sharing behavior among software developers in Indonesia, while geographical distance has a negative impact. On the contrary, time zone difference and linguistic distance exhibit insignificant influence in this study.

This research also contributes by offering insights for companies employing software developers to enhance facilities for effective knowledge sharing. Combining the key success factor of knowledge sharing and knowledge sharing common practices is a good way for software developers and managers to improve knowledge sharing in their respective organization. This can be done by implementing various activities such as sharing sessions, informal study groups, and team building. Creating a company-wide program about good documentation management and reward for doing that also helps to enhance effective knowledge sharing.

Future research could delve into case studies within specific software development companies, potentially yielding more precise analysis results and substantial benefits for the respective companies. In addition, upcoming research endeavors may explore additional factors within the same perspectives or even examine different perspectives that could elucidate knowledge sharing behavior among software developers. There are other potential factors that have not been explored in this study. The given example is technological aspect with the indicator can be how technology can help or even hinder knowledge sharing itself. Another indicator that can be studied is employee technology adoption capability. Technology factor becomes even more relevant when discussing knowledge sharing in the context of software development. Therefore, further study is recommended to consider technology as a factor for exploration.

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