Development and Validation of Instrument for Assessing Researcher's Participation in e-Collaboration

Jamilah Mahmood(✉), Halina Mohamed Dahlan, Ab Razak Che Hussin, and Muhammad Aliif Ahmad

Faculty of Computing, Universiti Teknologi Malaysia UTM, 81310 Skudai, Johor, Malaysia
mahmoodjamilah@gmail.com, abrazakutm@gmail.com, maliif.ahmad@gmail.com, halina@utm.my

Abstract. The advancement of recent technology for conducting research helped researcher in many ways such as collaborate in real time, sharing knowledge, accessing unlimited resources of information and produce better research outcomes. However, the advantage of this technology can only be achieved if the researcher participates in e-collaboration. This paper discusses the instrument to examine researcher's participation in e-collaboration. The framework for collaborative technologies was used to develop the instrument. This study was conducted by using a questionnaire survey method. The instrument then tested by using sample of 50 researchers from five research universities in Malaysia, which are UTM, UKM, UM, USM and UPM. The respondents who took part in the survey were lecturer, postgraduate student, research assistant and research fellow who had experience in using e-collaboration tool in conducting their research activities. Smart PLS software was used to evaluate the instrument validity and reliability, and the report shows that all instrument used are acceptable. The final instrument contains of 34 items measurement scales.

Keywords: e-Collaboration · e-Research · Research collaboration
Education technology · Instrument validation

1 Introduction

E-collaboration allows team members to interact virtually to work in the research projects. E-collaboration tools advantages help researchers in many ways such as increase communication, expand the size of the group and provide a new improved methods of communication for team member to easily share and access shared information [1]. Beside that, by using e-collaboration, researchers can also produce better research outcomes and increase the productivity of their research. However, based on Mendeley analysis report, the pattern of the users group shows that not all researchers participate in e-collaboration [2, 3]. Many of researchers prefer to work independently in their research group without involving others. Some of the researchers also face problems in dealing with team members who did not commit themselves to complete the team task because of their priority on their own task. This situation will cause

F. Saeed et al. (Eds.): IRICT 2018, AISC 843, pp. 1066–1076, 2019.
https://doi.org/10.1007/978-3-319-99007-1_99

problems if team members have a different goal and opinion in completing their research project. Researchers can only derive scientific advantage from their participation in e-collaboration only if they work together with team members in achieving their common goal or shared task. Therefore, to further understand the real researcher's participation problem in e-collaboration, this paper will investigate the answer to the following questions:

1. How to develop an instrument that suitable to understand the participation of academic researchers in e-collaboration?
2. How to validate the instrument?

2 Literature Review

Influence factors of online participation in e-collaboration can give impact in providing better learning outcomes. The examples of online participation are seconds spent viewing content pages and number of written posts. Collaboration is most successful in an online environment when the user feels that they have participated effectively in the system or tool. In e-collaboration, the sense of "joint enterprise" is very important and should be fostered within team members. However, many of the researchers using e-collaboration prefer to work individually in their task without sharing much information about their work progress to others. Less interaction happens between team members because they think that they can work on their part without any help from other team member [4]. They may engage in some collaborative processes but they work individually for most of the time. The process of achieving goal is not fully shared by all team members. The participation of researchers in e-collaboration will differ depending on the degree to which team members share their goals, processes and outcome [5].

Collaboration is characterized by sharing in all of the dimensions involved; people share the processes, as well as the goals and outcomes of their work [5]. A conceptual framework for examining collaborative work with groupware technologies consist of four input factors, process variables, and outcome variables [6]. Input factors consists of individual and group characteristic, task characteristic, situational characteristic and technology characteristic [6]. While the process variable is a set of indices that reflects the patterns of activity that occur during collaborative work such as shared knowledge and amount of participation [6]. This study identifies the participation factors based on the reviewed theories and model of e-collaboration. The factors were identified using collaboration technologies input factors. The identified factors were superior influence, peer support, moral trust, self-motivation, collaboration technology experience, task interdependence, awareness, cooperation and social presence.

3 Methodology

In this study, initial instrument was tested by using data from 50 respondents, which are researchers from five research universities. Five research universities selected are UTM, UKM, UM, USM and UPM. Survey was distributed to the researchers that have prior experience in using e-collaboration tools that include lecturer, research fellow, research assistant, PhD student and master student. Smart PLS software was used to validate the instrument.

4 Instrument Development

The model in Fig. 1 describes the relationships between variables and the constructs to be measured. This model consists of 12 constructs that need to be measured. This study use multi-item scale to easure the concept of each constructs. Figure 1 depicts the illustration of the relationship of each construct along with their items. All constructs have reflective measurement model as indicated by the arrows. The indicators used to measure the constructs are listed in the Table 2.

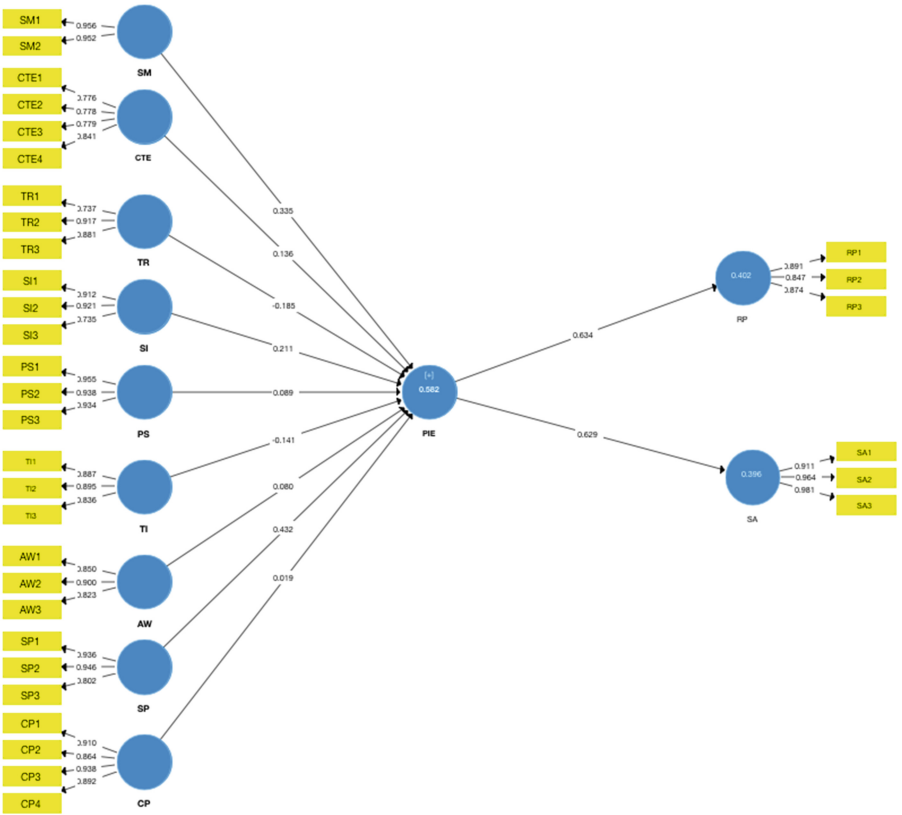

Fig. 1. Participation model for e–collaboration.

This study adapted and modified some indicators from previous studies to measure the constructs from the models. The indicators are identified based on the definition of the constructs (refer Table 1).

Table 1. Constructs definition

Constructs	Definition	Ref.
Self Motivation (SM)	Team member's ability to share or obtained knowledge based on their interest without involving pressure from others	[7, 8]
Reliance (RE)	Team member's feeling towards their responsibility that they can rely on others	[9]
Collaboration Technology Experience (CTE)	Team member's ability in using specific type of technology	[10]
Trust (TR)	Team member's action and commitments toward other and the actions in favor of a desired research outcomes	[11, 12]
Peer Support (PS)	Team member's help and support to others to share their experience and knowledge	[13, 14]
Superior Influence (SI)	Team member's belief on importance of their superior opinion that they should use e-collaboration tools	[15]
Task Interdependence (TI)	Research group needs towards support and information from others to complete their research work	[16]
Social Presence (SP)	Technology's ability to transfer non-verbal signals (e.g., gestures and facial expression) and non-word signals (e.g., voice inflection)	[17]
Awareness (AW)	Team member's awareness about what information is being shared among them and also what others can see about their behavior	[18]
Cooperation (CP)	It is the joint operation of members of the group within shared workspace for completing tasks including building, refining, manipulating shared objects. For examples to decide team member's role, sharing resources and planning activities	[19]
Participation in e-Collaboration (PIE)	A process that helps team members interacts, share knowledge and working together to achieve a common goal	[20, 21]
Research Performance (RP)	Team member's performance, which includes expressions of creativity, originality, and facts discovery	[22]
Satisfaction With Research Output (SA)	Team member's desire and expectation from the research output	[22]

Table 2. Indicator for each construct

Factor	Item	Indicator (revised item)	Ref.
Self Motivation	SM1	I like to help my research team	[21]
	SM2	I know that other members in the research team will help me so it's fair to help them	[21]
Reliance	RE1	I feel comfortable counting on research team to do their part	[9]
	RE2	I was not bothered by the need to rely on research team	[9]
	RE3	I feel comfortable trusting research team to handle their tasks	[9]
Collaboration Technology Experience	CTE1	I have a good experience in using messaging tools	[17]
	CTE2	I have a good experience in using audio conferencing	[17]
	CTE3	I have a good experience in using video conferencing	[17]
	CTE4	I have a good experience in using technologies similar to collaboration tools	[17]
Trust	TR1	Trusting my research team helps me to make a mutual understanding in order to achieve the goal of research	[22]
	TR2	I believe my research team is willing to share research information with each other	[22]
	TR3	I believe that resources and data shared by our research team are accurate	[22]
Peer Support	PS1	My research team support creative and higher order of thinking for the progress of the research	[22]
	PS2	My research team helps each other to refine research questions and research design in order to improve the quality of the research	[22]
	PS3	My research team encourages each other to share solutions to work related problems	[23]
Superior Influence	SP1	I believe that top management would like me to use e-collaboration tools to conduct research with my research team	[17]
	SP2	My supervisor suggests that I use e-collaboration tools to conduct research with my research team	[17]
	SP3	There is pressure from the organization to use e-collaboration tools to conduct research with my research team	[17]
Task Interdependencies	TI1	The results of my research work are dependent on the efforts of people from my research team	[24, 25]
	TI2	My research work often involves using knowledge or information from my research team	[24, 25]

(*continued*)

Table 2. (*continued*)

Factor	Item	Indicator (revised item)	Ref.
	TI3	My research work requires frequent coordination with my research team	[25]
Social Presence	SP1	Using e-collaboration tools to interact with research team creates a warm environment for communication	[17]
	SP2	Using e-collaboration tools to interact with research team creates a sociable environment for communication	[17]
	SP3	Using e-collaboration tools to interact with research team creates a personal environment for communication	[17]
Awareness	AW1	I feel that I control the availability and work progress information I am broadcasting to others	[18]
	AW2	I provide rich enough information for my research team to understand my availability and work progress status well	[18]
	AW3	I feel that people are well informed about my availability and work progress status	[18]
Cooperation	CP1	I could easily create the shared document	[26]
	CP2	I could easily refine the shared document	[26]
	CP3	I could easily manipulate the shared document	[26]
	CP4	I had access to the information needed to operate together	[26]
Participation in e-collaboration	PIE1	I am participating in e-collaboration to contribute to pool of information	[21]
	PIE2	I am participating in e-collaboration to contribute my knowledge	[21]
	PIE3	I am participating in e-collaboration to contribute my idea	[21]
Research Performance	RP1	I achieve good research results with the efforts of our research team	[22]
	RP2	I critically analyze my assigned task and perform accordingly in order to achieve good research findings	[22]
	RP3	I achieve good publication through our research results	[22]
Satisfaction with research output	SA1	I am satisfied with the research results achieved by our research team	[22]
	SA2	I am satisfied with the publication derived from our research results	[22]
	SA3	I am satisfied with the empirical data derived from our research results	[22]

5 Instrument Validation

This section consists of discussion of the instrument validation. The evaluations for the measurement model are as follows:

i. Internal consistency

Cronbach's Alpha value shows the reliability based on the inter correlations of the indicator variables. Values of 0.60 to 0.70 are acceptable [27].

ii. Convergent validity

It is the extent to which a measure correlates positively with alternative measures of the same constructs. The value of outer loading should be 0.708 or higher while outer loadings with value 0.40 and 0.70 should be considered for removal if deleting the indicator changes composite reliability value (or AVE) to increase. Indicators with value below 0.40 should be eliminated from the model [27] (Table 3).

Table 3. Construct reliability and validity

	Cronbach's Alpha	Composite reliability	Average Variance Extracted (AVE)
AW	0.821	0.893	0.736
CP	0.925	0.945	0.812
CTE	0.812	0.872	0.630
PIE	0.875	0.923	0.801
PS	0.937	0.960	0.888
RP	0.845	0.904	0.758
SA	0.948	0.967	0.907
SI	0.821	0.894	0.740
SM	0.901	0.953	0.910
SP	0.880	0.925	0.804
TI	0.852	0.906	0.762
TR	0.801	0.885	0.721

The next measure of convergent validity is AVE, and the value should be 0.50 or above. While, AVE with value 0.50 and below shows that more inaccuracy in the items [27]. According to the results for the outer loadings in Table 4, all items have loadings more that 0.70, which are all items are acceptable. For this measurement model, the AVE values are above 0.50, thus show that all constructs are valid.

Table 4. Indicators outer loading.

Items	Outer loading	Items	Outer loading
AW1	0.850	SA1	0.911
AW2	0.900	SA2	0.964
AW3	0.823	SA3	0.981
CP1	0.910	SI1	0.912
CP2	0.864	SI2	0.921
CP3	0.938	SI3	0.735
CP4	0.892	SM1	0.956
CTE1	0.776	SM2	0.952
CTE2	0.778	SP1	0.936
CTE3	0.779	SP2	0.946
CTE4	0.841	SP3	0.802
PIE1	0.925	TI1	0.887
PIE2	0.901	TI2	0.895
PIE3	0.858	TI3	0.836
PS1	0.955	TR1	0.737
PS2	0.938	TR2	0.917
PS3	0.934	TR3	0.881
RP1	0.891		
RP2	0.847		
RP3	0.874		

iii. Discriminant validity

This evaluation is to validate that the constructs are distinctive and not redundant. Cross loading and Fornell-Larcker's criterion are the measures used for discriminant validity. Table 5 illustrates the result for cross loadings. The indicator's outer loading must be higher than its loading on other constructs [27].

While in Fornell-Larcker's criterion, the square root of AVE is compared with the latent variable correlations. The value should be higher than any other constructs. In Table 6 shows that each value is higher than any other constructs. Therefore, the instrument is valid.

Table 5. Cross loadings.

	AW	CP	CTE	PIE	PS	RP	SA	SI	SM	SP	TI	TR
AW1	0.850	0.322	0.511	0.478	0.600	0.647	0.546	0.418	0.407	0.702	0.447	0.612
AW2	0.900	0.383	0.652	0.616	0.635	0.611	0.387	0.399	0.530	0.753	0.522	0.763
AW3	0.823	0.465	0.474	0.562	0.672	0.597	0.632	0.548	0.525	0.535	0.577	0.631
CP1	0.444	0.910	0.483	0.326	0.452	0.510	0.381	0.498	0.549	0.257	0.466	0.537
CP2	0.252	0.864	0.342	0.221	0.346	0.328	0.235	0.362	0.411	0.073	0.368	0.328
CP3	0.389	0.938	0.438	0.398	0.416	0.496	0.282	0.472	0.529	0.224	0.566	0.487
CP4	0.502	0.892	0.416	0.415	0.598	0.559	0.488	0.590	0.518	0.249	0.595	0.512
CTE1	0.622	0.379	0.776	0.599	0.585	0.496	0.510	0.411	0.546	0.563	0.422	0.511
CTE2	0.393	0.372	0.778	0.321	0.165	0.201	0.251	0.425	0.221	0.260	0.289	0.195
CTE3	0.398	0.302	0.779	0.399	0.236	0.193	0.217	0.378	0.193	0.397	0.285	0.293
CTE4	0.540	0.436	0.841	0.407	0.450	0.449	0.518	0.433	0.279	0.354	0.299	0.397
PIE1	0.596	0.346	0.577	0.925	0.518	0.597	0.580	0.347	0.515	0.555	0.317	0.516
PIE2	0.490	0.408	0.437	0.901	0.478	0.515	0.539	0.406	0.479	0.464	0.439	0.448
PIE3	0.647	0.310	0.523	0.858	0.420	0.585	0.567	0.379	0.501	0.716	0.317	0.547
PS1	0.729	0.474	0.489	0.526	0.955	0.562	0.522	0.389	0.570	0.526	0.532	0.739
PS2	0.716	0.483	0.513	0.503	0.938	0.547	0.479	0.487	0.542	0.473	0.571	0.650
PS3	0.647	0.510	0.398	0.458	0.934	0.464	0.492	0.435	0.532	0.457	0.557	0.621
RP1	0.693	0.466	0.421	0.676	0.545	0.891	0.545	0.330	0.641	0.670	0.498	0.675
RP2	0.496	0.566	0.365	0.433	0.436	0.847	0.546	0.457	0.557	0.321	0.549	0.486
RP3	0.651	0.405	0.391	0.494	0.457	0.874	0.616	0.382	0.485	0.450	0.575	0.485
SA1	0.598	0.403	0.511	0.555	0.624	0.609	0.911	0.468	0.399	0.402	0.400	0.425
SA2	0.542	0.368	0.432	0.594	0.416	0.618	0.964	0.468	0.391	0.383	0.396	0.313
SA3	0.579	0.372	0.488	0.645	0.482	0.630	0.981	0.462	0.404	0.415	0.352	0.322
SI1	0.523	0.548	0.426	0.391	0.540	0.447	0.564	0.912	0.287	0.161	0.474	0.393
SI2	0.387	0.527	0.574	0.393	0.319	0.382	0.425	0.921	0.246	0.134	0.398	0.271
SI3	0.471	0.309	0.318	0.295	0.326	0.278	0.236	0.735	0.025	0.431	0.499	0.318
SM1	0.583	0.607	0.407	0.546	0.556	0.634	0.439	0.295	0.956	0.420	0.548	0.669
SM2	0.509	0.468	0.414	0.518	0.555	0.611	0.355	0.142	0.952	0.540	0.437	0.740
SP1	0.732	0.184	0.429	0.676	0.495	0.577	0.432	0.200	0.515	0.936	0.335	0.661
SP2	0.746	0.244	0.484	0.628	0.490	0.532	0.442	0.248	0.475	0.946	0.442	0.661
SP3	0.576	0.226	0.562	0.386	0.390	0.439	0.195	0.278	0.321	0.802	0.390	0.512
TI1	0.548	0.518	0.402	0.442	0.594	0.613	0.439	0.388	0.581	0.395	0.887	0.536
TI2	0.450	0.451	0.342	0.243	0.430	0.479	0.287	0.495	0.310	0.307	0.895	0.344
TI3	0.561	0.516	0.348	0.290	0.457	0.465	0.264	0.529	0.376	0.391	0.836	0.469
TR1	0.517	0.601	0.312	0.443	0.648	0.540	0.367	0.249	0.730	0.347	0.444	0.737
TR2	0.761	0.409	0.424	0.538	0.604	0.590	0.328	0.386	0.634	0.668	0.434	0.917
TR3	0.704	0.356	0.464	0.451	0.569	0.513	0.241	0.317	0.518	0.725	0.493	0.881

Table 6. Fornell-Larcker's criterion.

	AW	CP	CTE	PIE	PS	RP	SA	SI	SM	SP	TI	TR
AW	0.858											
CP	0.458	0.901										
CTE	0.641	0.471	0.794									
PIE	0.650	0.395	0.575	0.895								
PS	0.742	0.518	0.498	0.528	0.942							
RP	0.718	0.543	0.454	0.634	0.559	0.871						
SA	0.601	0.399	0.500	0.629	0.528	0.649	0.953					
SI	0.530	0.548	0.519	0.421	0.463	0.435	0.489	0.860				
SM	0.573	0.565	0.430	0.558	0.582	0.653	0.417	0.231	0.954			
SP	0.772	0.238	0.529	0.652	0.516	0.582	0.420	0.259	0.501	0.897		
TI	0.604	0.573	0.425	0.397	0.586	0.613	0.400	0.523	0.518	0.426	0.873	
TR	0.785	0.531	0.473	0.566	0.713	0.647	0.368	0.379	0.738	0.690	0.536	0.849

6 Conclusion

For future study, the instrument developed can be used for survey with larger sample size. Besides, this study was conducted with the samples from five research university in Malaysia. The research can also be extend by using sample from other university in Malaysia which their researchers may have different patterns of participation in using e-collaboration tools compared to the existing sample.

Acknowledgements. This work is supported by the Research Management Centre (RMC) at Universiti Teknologi Malaysia (UTM) under Research University Grant (VOT PY/2016/06537/Q.J130000.2528.15H45), and MyPhD Scholarships (Jamilah Mahmood) from Ministry of Higher Education Malaysia (MOHE).

References

1. Luzón, M.J.: Academic weblogs as tools for e-collaboration among researchers. Encyclopedia of E-collaboration, pp. 1–6 (2008)
2. Mohammadi, E., et al.: Who reads research articles? An altmetrics analysis of Mendeley user categories. J. Assoc. Inf. Sci. Technol. **66**(9), 1832–1846 (2015)
3. MacMillan, D.: Mendeley: teaching scholarly communication and collaboration through social networking. Lib. Manag. **33**(8/9), 561–569 (2012)
4. Mahmood, J., et al.: Researcher's participation in e-collaboration. In: International Conference on Research and Innovation in Information Systems 2017, ICRIIS, pp. 1–5. IEEE (2017)
5. Jeong, H., et al.: Joint interactions in large online knowledge communities: the A3C framework. Int. J. Comput. Support. Collaborat. Learn. **12**(2), 133–151 (2017)
6. Olson, G.M. Olson, J.S.: Research on computer supported cooperative work. Handbook of Human-Computer Interaction 2, 2nd edn., pp. 1433–1456 (1997)
7. Kankanhalli, A., Tan, B.C., Wei, K.-K.: Contributing knowledge to electronic knowledge repositories: an empirical investigation. MIS Q. 113–143 (2005)
8. Wasko, M.M., Faraj, S.: Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. MIS Q. 35–57 (2005)
9. Turel, O., Connelly, C.E.: Team spirit: the influence of psychological collectivism on the usage of e-collaboration tools. Group Decis. Negot. **21**(5), 703–725 (2012)
10. Carlson, J.R., Zmud, R.W.: Channel expansion theory and the experiential nature of media richness perceptions. Acad. Manag. J. **42**(2), 153–170 (1999)
11. Hardwig, J.: Epistemic dependence. J. Philos. **82**(7), 335–349 (1985)
12. Hardwig, J.: The role of trust in knowledge. J. Philos. **88**(12), 693–708 (1991)
13. Bruner, J.: Vygotsky: an historical and conceptual perspective. In: Culture, Communication, and Cognition: Vygotskian Perspectives, pp. 21–34. Cambridge University Press, London (1985)
14. Sykes, T.A., Venkatesh, V, Gosain, S.: Model of acceptance with peer support: a social network perspective to understand employees' system use. MIS Q. 371–393 (2009)
15. Venkatesh, V., et al.: User acceptance of information technology: toward a unified view. MIS Q. 425–478 (2003)
16. Fry, L.W., Slocum, J.W.: Technology, structure, and workgroup effectiveness: a test of a contingency model. Acad. Manag. J. **27**(2), 221–246 (1984)

17. Brown, S.A., Dennis, A.R., Venkatesh, V.: Predicting collaboration technology use: Integrating technology adoption and collaboration research. J. Manag. Inf. Syst. **27**(2), 9–54 (2010)
18. Szostek, A.M., et al.: Understanding the implications of social translucence for systems supporting communication at work. In: Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work (2008)
19. Shah, C.: Collaborative information seeking. J. Assoc. Inf. Sci. Technol. **65**(2), 215–236 (2014)
20. Sobel, J.: Can we trust social capital? J. Econ. Lit. **40**(1), 139–154 (2002)
21. Karna, D., Ko, I.: We-intention: moral trust, and self-motivation on accelerating knowledge sharing in social collaboration. In: 48th Hawaii International Conference on System Sciences (HICSS), pp. 264–273, IEEE (2015)
22. Karna, D., KoIllSang: Collaboration orientation, peer support and the mediating effect of use of e-collaboration on research performance and satisfaction. Asia Pac. J. Inf. Syst. **23**(4), 151–175 (2013)
23. Wang, X., Clay, P.F., Forsgren, N.: Encouraging knowledge contribution in IT support: social context and the differential effects of motivation type. J. Knowl. Manag. **19**(2), 315–333 (2015)
24. Teo, T.S., Men, B.: Knowledge portals in Chinese consulting firms: a task–technology fit perspective. Eur. J. Inf. Syst. **17**(6), 557–574 (2008)
25. Sharma, R., Yetton, P.: The contingent effects of training, technical complexity, and task interdependence on successful information systems implementation. MIS Q. 219–238 (2007)
26. Lee, M.: Usability of collaboration technologies. Doctoral Dissertation, Purdue University (2007)
27. Hair Jr, J.F., et al.: A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications (2016)