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Study on the Influencing Factors of Stakeholders Knowledge Sharing Behavior in Aircraft Product Development

WANG Juan-ru, LUO Ling

School of Management, Northwestern Polytechnical University, Xi´an 710072, P. R. China

Abstract: Based on the individual level, influencing factors of stakeholders knowledge sharing behavior in aircraft product development are discussed, which are participant degree, sharing intention, and sharing capability. And the relationship of these factors between explicit knowledge sharing behavior and tacit knowledge sharing behavior are analyzed theoretically, some assumptions are put forward, and a theorittcal study model is established. Then, using a structural equation model, the assumptions are validated through principal component analysis and model fitting for 215 sample data. Lastly, the conclusion is gained that participant degree, sharing intention, and sharing capability all have a significant positive effect on the explicit knowledge sharing behavior and tacit knowledge sharing behavior in aircraft product development.

Key words: aircraft product development; principal component analysis; knowledge sharing behavior

1 Introduction

Aircraft product development is complex and implies many uncertainties, which results in the interdependence between the key stakeholders. Stakeholders can complete a common goal to achieve the success of the development of an aircraft products system through effective interaction, communication and cooperation. The individual factors of key stakeholders play a vital role in knowledge sharing and creation. Bock & Kim[1], Kuo[2] point out that individual attitudes towards knowledge sharing significantly influence individual participation in knowledge sharing activities. Guthrie[3], Stovel[4] conclude that an individual makes major contribution to the organization´s utilities, and that the demand of individuals involvement in the organization activity of knowledge innovation becomes increasingly important. However, the status of knowledge sharing is often unsatisfactory, since individuals don´t want to provide personal knowledge to the organization knowledge management system initiatively. Such as, Almashari et al[5]. show that 78% of individuals are unwilling to come up with personal knowledge for sharing; Bartol & Srivastava[6] believe that knowledge sharing is a voluntary behavior that the individual in the organization diffuses relevant information to others and is the most important activity of knowledge management; its ultimate objective is integration of the organization´ assets and resources. At the same time, O´Dell & Grayson[7] find that some

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individuals do not realize the importance of knowledge sharing and transfer, other individuals are reluctant to share knowledge due to their worries, such as the fear of the loss of their own advantages and intellectual property after sharing knowledge. Van den Hooff et al[8]. indicated that the individual learning ability has a positive impact on knowledge sharing. Based on the above analysis, this research argues that the stakeholders´ participant degree, sharing intention and sharing capability affect knowledge sharing behavior, which is divided into explicit and tacit knowledge sharing behavior according to Polanyi[9] classification of knowledge, and then we test and verify the proposed assumptions and analyze these effects quantitatively by empirical research.

2 Theory and hypothesis

2.1 Participant degree

The participation degree of stakeholders in the aircraft product development will affect the knowledge sharing and the result of the development. First, the intense participation of stakeholders from different organization and cultural backgrounds is a must for aircraft product development due to its features like long periodicity, high cost, great design complexity and involving a variety of knowledge and skills. Secondly, the early involvement of stakeholders is also a must for the requirements of the aircraft product system due to many components or subsystems of aircraft products are not produced by system integrators manufacturers themselves. Bonaccorsi[10] suggest that participant degree means the extent of partners´ systematical integration into the design, production and business process, partners´ direct involvement in the initial stages of the design and communication, and partners´ participation in decision-making and goal-setting. Walker[11] find that participation contributes to knowledge sharing and the production of innovation behavior. Henderson[12] thinks that active participation of key stakeholders can help to maintain the relationship and promote knowledge sharing. Squire et al[13] research that cooperation has positive impact on knowledge sharing and transfer, since cooperation can reduce cognitive gaps and contribute to the socialization process between stakeholders. In addition, Lundkvist[14] propose by the case study that the need information resides with the customer, and the solution information lies with the manufacturer in the product development process, so a customer´s active participation helps to reduce uncertainty; in the meanwhile, as the customer´s main contribution is tacit knowledge, a customers´ active participation is beneficial to the knowledge sharing and uncertainty reduction of the R&D. Miguel[15] show that partners´ involvement in the operation, production and design process will be very helpful to knowledge sharing behavior. According to the above analysis, the deeper stakeholders´ participation is, the more understanding of the development process will be. Creative running-in and interaction, especially the face-to-face communication, can effectively facilitate explicit knowledge sharing in the development process. At the same time, deep-seated involvement also makes implicit knowledge sharing possible. In summary, taking an interaction mode of involvement in the aircraft product development process helps to promote explicit and tacit knowledge sharing and learning between stakeholders. The higher the degree of participation of the stakeholder, the more favorable the effective knowledge sharing will be. As such, this research suggests the following hypotheses:

H_{1a}: Stakeholders´ participant degree has a positive effect on the explicit knowledge sharing behavior in aircraft product development.

H_{1b}: Stakeholders´ participant degree has a positive effect on the tacit knowledge sharing behavior in aircraft product development.

2.2 Sharing intention

Stakeholders´ knowledge sharing behavior is directly determined by knowledge sharing intention in the aircraft product development process. Knowledge sharing intention is the subjective tendency intensity that stakeholders intend to share knowledge. There is a significant relationship between the willingness that the individual perform a behavior and the behavior´s occurring. An individual will first decide whether he has the willingness before taking an action. In other words, the individual has the actual behavior occurred after the willingness of the behavior. Ye et al [16]. argue that there is a strong direct relationship between the behavior intention and actual behavior. Thus, knowledge sharing behavior is more frequent when individuals have a higher willingness of knowledge sharing. As Vallerand [17] suggests, individuals will focus on knowledge sharing behavior itself when they have high willingness, which will result in more knowledge sharing behavior. Hendriks [18] finds that the aims of knowledge holders to share knowledge is to get self-serving benefits. Therefore, the higher the desired benefit, the better the shared effectiveness will be. It is further demonstrated by Bartol [6], who propose that the success of knowledge sharing lies with a good incentive mechanism. The mechanism can make knowledge sharers owning an expected income, ultimately promoting knowledge sharing in the organization. Herzberg [19] puts forward the two-factor theory suggesting that the stronger the knowledge sharing intention, the better its effect will be. Stott [20] argue that knowledge that workers´ willingness to share knowledge is not to earn money or to improve the relationship between colleagues, but to fulfill three high level of demand, that are self-sense of belonging, self-esteem and self-realization. Davenport [21] suggest that the reason why employees choose to share knowledge is that they can obtain three types of reward, that is altruism, mutual benefit and reputation in the knowledge sharing process. Altruism is that some people who are born a great guy would share knowledge with others for only thanks. Mutual benefit refers to the knowledge provider´s expectation for getting the recipient´s return when necessary in the future. Reputation is that knowledge owners hope to shape a lofty image. Though reputation is invisible, it can produce tangible benefits, such as job security, promotion and status. All these types of reward determine the individual knowledge sharing intention. According to Davenport [21], Govindarajan [22], Bock [1], sharing intention has a positive effect on knowledge sharing. Osterlohh [23] argue that sharing intention can promote tacit knowledge sharing. Cummings [24] indicate that the intention of knowledge providers and absorber are both key factors that make knowledge sharing success. Gibbert [25] suggest that knowledge sharing depends on the intention that the individual share their creative and acquired knowledge with others. Hsu et al [26] investigate the influencing factors of knowledge sharing in the virtual community, and argue that community members´ knowledge sharing intention will affect actual knowledge sharing behavior. As for the aircraft product development, the strong sharing intention is advantageous to the explicit knowledge sharing, for example, work reports, operating manuals and so on. In addition, the strong sharing intention contributes to the tacit knowledge sharing, such as work experience and skills, through conference and face-to-face communication. Therefore, the stakeholders' sharing intention can promote explicit and tacit knowledge sharing in the aircraft product development process. As such, this research proposes there hypotheses.

H_{2a}: Stakeholders' sharing intention has a positive effect on the explicit knowledge sharing behavior in aircraft product development.

H_{2b}: Stakeholders' sharing intention has a positive effect on the tacit knowledge sharing behavior in aircraft product development.

2.3 Sharing capability

There are plenty of interpersonal communication and interactive programs in the aircraft product development process. During this process, the stakeholders, who lack the capability relevant to the knowledge sharing, even with strong knowledge sharing intention, will definitely affect the progress of the knowledge sharing and transfer. Consequently, stakeholders' ability to learn from others or to obtain the required knowledge is also a key factor contributing to the knowledge sharing. Van den Hooff et al [8]. propose that individual capability has a positive impact on knowledge sharing. Baldwin [27] find that individual ability is an important factor to influence knowledge sharing and transfer. The knowledge sharing capability is beneficial to the behavior. The stakeholders can improve knowledge sharing capability through knowledge searching, communication and absorption. As Goh [28] argues, it is very important for members to have the capability of quick and effective knowledge transfer. Knowledge, which is stored in the database or individual, but not shared and circulated, cannot be used for member's learning activities in the organization. The limitation of individuals' inherent information or capability imperfection leads to the obstacle of knowledge sharing. This situation brings more difficulties to the knowledge receivers. The difficulties are as follows: the knowledge receivers must have the ability to search the source of required knowledge, and then they have to communicate and share it with the knowledge provider, so that they must have sufficient absorption capability to transfer the knowledge to themselvies. Therefore, Goh believes that knowledge sharing capability is constituted of searching capability, communication capability and absorption capability. Based on the above discussion, there are three points for knowledge sharing during aircraft product development. The first point is that stakeholders with knowledge searching capability need to understand the position of the knowledge in the organization. Generally, the knowledge is stored in the knowledge base, where stakeholders can use relevant knowledge. The second point is when they find the demanded knowledge. The stakeholders need to communicate and express themselves correctly to avoid misunderstandings in the process of knowledge sharing. If they have a better communication skill in knowledge sharing activities, less gaps and mistakes will happen. The third point is after acquiring knowledge, the stakeholders must have sufficient absorption capacity. Otherwise, even if knowledge providers are willing to share knowledge with others, knowledge recipients cannot internalize it into their own and use it. That is to say, knowledge sharing defeats its own purpose. Therefore, the stronger the knowledge sharing capability, the stakeholders will be more willing to share explicit and tacit knowledge. As such, we propose the hypotheses:

H_{3a}: Stakeholders´ sharing capability has a positive effect on the explicit knowledge sharing behavior in aircraft product development.

H_{3b}: Stakeholders´ sharing capability has a positive effect on the tacit knowledge sharing behavior in aircraft product development.

Based on the above hypotheses, the proposed research model is shown in Figure 1.

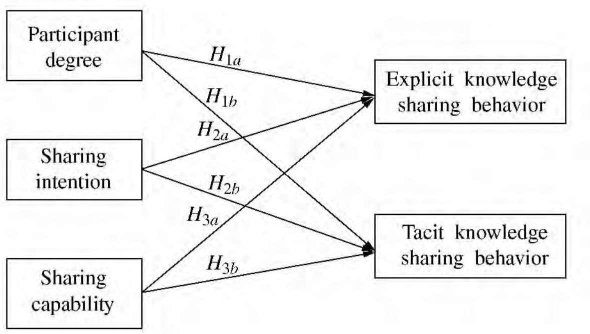

Figure 1 The research model

3 Research methodology

3.1 Research sample

This study adopted a questionnaire survey to obtain data. The collected samples come from stakeholders engaged in the aircraft product system development in Shanxi, Beijing, Shanghai, Jiangxi, Sichuan, and Liaoning. The formal questionnaires were issued and collected from May to August 2011. Three methods for collecting data are used, which are questionnaires sending directly to the stakeholders, questionnaires sending by E-mail, and questionnaires sending by mailing, a total of 310 questionnaires were distributed, 235 questionnaires were collected, and 215 questionnaires were validated. The effective response rate of the questionnaire was 69.35%, satisfying the specific data processing requirements.

3.2 Variable definition and measurement

In order to ensure the reliability and validity of the research tool, measure items were adapted from the existing scale in the literature at home and abroad whenever possible. Some modifications and adjustments were made according to the purpose of the survey, the respondents and the pre-trial feedback, and then the formal questionnaire was formatted.

We reference Dwyer [29], Miguel [15] and other people´s point of view to develop the scales of participant degree, which is measured by three items: I am often involved in formulation of objectives about project development; I will adopt other stakeholders´ views when I make decisions; I am actively involved in the decision making. We learn from the questionnaire of Ajzen [30] and Bock [1] to develop the scales of the sharing intention. The sharing intention is measured by three items: I look forward to the feedback of each other after I share my own knowledge with others; I can get better image and reputation through the knowledge sharing; I am enthusiastic and willing to share knowledge due to I view helping others as a starting point. We reference the scales of Hansen [31] and Goh [28] to design the scales of sharing capability. Four items are designed, which are, I have a strong knowledge searching capability, I have a good communication skill in knowledge sharing process, I have a strong absorptive capacity in the process of knowledge sharing. We reference the scales of Lee [32] and Bock [1] to design the scales of explicit knowledge sharing behavior. Four questions are included: I often share my work report and office files with other stakeholders; I often share my operation manual, methods and models with other stakeholders; I often record all I know and provide it to other stakeholders for reference; I am willing to answer the questions of other stakeholders. Tacit knowledge sharing behavior is developed based on the scales of Bock [1] and Lin [33], which are, I often share my experience and skills with other stakeholders; I am willing to help other stakeholders to seek learning opportunities; when discussing the work, I often do my best to provide my views; I am very happy to do demonstrations for other stakeholders to deal with what is difficult to explain in the work.

3.3 Unbiased test

The variance analysis and T-test were used to compare the three ways of questionnaire (sending directly, sending E-mail and mailing) in order to ensure the representativeness and unbiasedness of the questionnaire. The result indicated no significant differences of the sample data. $P>0.05$ means that the data collection channel has no significant difference on the three-parts of the data. So we can put them together for analysis. Therefore, there is no difference in the answers in this research.

In addition, each questionnaire was filled by one person, which was prone to Common Method Bias. Consequently, it is necessary to use the Harman single factor test, recommended by Podsakoff and Organ, to test Common Method Bias. The test is done as follows: all indicators in the questionnaire should be done with the factor analysis together; the first principal component, gotten by not rotating, reflects the Common Method Bias. If there is no a single factor, or a variable which can explain the majority of the covariance of the independent variable and dependent variable, it means that the Common Method Bias doesn´t exist. In this study, all items of the questionnaires were done with an exploratory factor analysis. The first principal component was gotten without rotating, which accounts for 23.451% of the amount of load. It shows that the value doesn´t account for the majority, so the Common Method Bias is not serious.

3.4 Reliability and validity

SPSS18.0 was used to test the reliability of the questionnaire. This study uses the coefficient of Cronbach´s α to test the questionnaire reliability, and the results are shown in Table 1. From Table 1, the Cronbach´s α of the participant degree, sharing intention, sharing capabilities, explicit knowledge sharing behavior and tacit knowledge sharing behavior are 0.802, 0.750, 0.737, 0.762 and 0.721, respectively. All the coefficients are greater than 0.70 and within an acceptable range, indicating that the questionnaire has a very good reliability.

Table 1 α coefficient, correlation coefficient and AVE value

	a	AVE	PD	SI	SC	EKSB	TKSB
PD	0.802	0.658	(**0.811**)				
SI	0.750	0.606	0.533**	(**0.778**)			
SC	0.737	0.624	0.468**	0.587**	(**0.790**)		
EKSB	0.762	0.653	0.738**	0.843**	0.706**	(**0.808**)	
TKSB	0.721	0.714	0.712**	0.775**	0.763**	0.395**	(**0.845**)

Note: 1) PD-Participant degree; SI-Sharing intention; SC-Sharing capability; EKSB-Explicit knowledge sharing behavior; TKSB-Tacit knowledge sharing behavior.

2) Figures in brackets is the square root of the AVE; ** indicates $P<0.01$.

In terms of validity testing, most of the items of the questionnaire used in this study came from the existing literature, and we pre-tested and corrected the formulation and content of part of the questionnaire by consulting experts before finalizing the questionnaire. Therefore, the questionnaire has a very good content validity. In addition, we also need to analyze the construct validity of the questionnaire. Construct validity is composed of convergent validity and differential validity. In this study, the confirmatory factor analysis was used to test convergent validity and differential validity. Two principles to determine the convergent validity are adopted: the factor loadings coefficients of the observed variables exceed 0.55, i.e., the extracted variance of the observed variables is greater than the measurement error; the constructed average extracted variance (AVE) is greater than 0.5, i.e., the constructs explained variance is greater than 50%. Two methods are applied to test the differential validity: the square root of AVE values of all the factors are greater than the correlation coefficients of the factors; a number of competitive models are built, and the differential validity of the basic model structure can be distinguished through the comparison of the model fitting indices.

Table 2 The results of the principal component analysis

	PD	SI	SC	EKSB	TKSB
Q_1	**0.715**	0.205	0.154	0.149	0.187
Q_3	**0.688**	0.167	0.118	0.215	0.210
Q_2	**0.792**	0.223	0.190	0.128	0.204
Q_4	0.120	**0.760**	0.156	0.206	0.136
Q_5	0.253	**0.738**	0.285	0.114	0.185
Q_6	0.219	**0.734**	0.313	0.231	0.222
Q_9	0.118	0.272	**0.745**	0.217	0.175
Q_8	0.151	0.245	**0.772**	0.139	0.177
Q_7	0.187	0.139	**0.683**	0.142	0.212
Q_{13}	0.214	0.078	0.155	**0.667**	0.246
Q_{10}	0.223	0.103	0.222	**0.725**	0.132
Q_{12}	0.087	0.182	0.275	**0.718**	0.189
Q_{11}	0.138	0.075	0.115	**0.759**	0.257
Q_{14}	0.293	0.178	0.136	0.097	**0.796**
Q_{15}	0.258	0.143	0.133	0.163	**0.675**
Q_{17}	0.156	0.221	0.163	0.242	**0.693**
Q_{16}	0.194	0.210	0.109	0.115	**0.735**

Table 2 shows the results of principal component analysis. From Table 2, the factor loadings of 17 items involved in the questionnaire correspond to the assumptions, and the factor loadings of the items exceed 0.55 ($P < 0.001$), so it is statistically significant. From Table 1, the AVE values of the five factors are greater than 0.60, indicating the average explained variances of the five latent variables are greater than 60%. Consequently, the questionnaire has a good convergent validity. In addition, Table 1 shows the minimum AVE of the five factors is 0.606, and the minimum square root of AVE of these factors is 0.778, greater than the correlation coefficients of the factors. Therefore, the questionnaire has a good differential validity.

4 Analysis and results

4.1 Model fitting analysis

The overall goodness-of-fit analysis of the model is processed using Amos 17.0, and the analysis is used to test the fitting degree of the overall model and observed data. When the SEM is used to do actual analysis, the common model evaluation index and its standard are as follows: the value of Normed chi-square generally is less than 3; the value of Goodness-of-fit index (GFI), Tacker-lewis index (NNFI), comparative fit index (CFI) and incremental fit index (IFI) is above 0.9, which indicates that the model fits well; Root mean square error of approximation (RMSEA) is less than 0.05, which indicates that the model fits well, and RMSEA between the 0.05 to 0.08 shows that the model fit is acceptable. Based on the above considerations, this study chose χ^2/df, GFI, NNFI, CFI, IFI, and RMSEA to test the fitting degree of the model. The model fitting results show acceptable values of χ^2/df (1.362), GFI (0.963), NNFI (0.946), CFI (0.950), IFI (0.937), and RMSEA (0.039), indicating that the model fits well.

4.2 Path coefficients and hypothesis testing

The model path coefficients and variance explained was calculated using Amos 17.0. The results are shown in Figure 2. The results shows that H_{1a} and H_{1b} are supported, the path coefficients of β are 0.248 and 0.271 ($P < 0.01$), and the participant degree has a positive impact on both explicit and tacit knowledge sharing behavior. As supported, H_{2a} and H_{2b} also got support, the path coefficients β are 0.305 and 0.253 ($P < 0.01$), that is, sharing intention has a positive impact on both explicit and tacit knowledge sharing behavior. Last, H_{3a} and H_{3b} gain support, the path coefficient of β are 0.228 and 0.292 ($P < 0.01$), respectively; thus, sharing capabilities has a positive impact on both explicit and tacit knowledge sharing behavior. In addition, the result demonstrates that the three factors, participant degree, sharing intention, and sharing capability, have a significant impact on explicit and tacit knowledge sharing behavior in aircraft product development, since their explained variance rate to explicit and tacit knowledge sharing behavior is 65.305% and 61.154%, respectively.

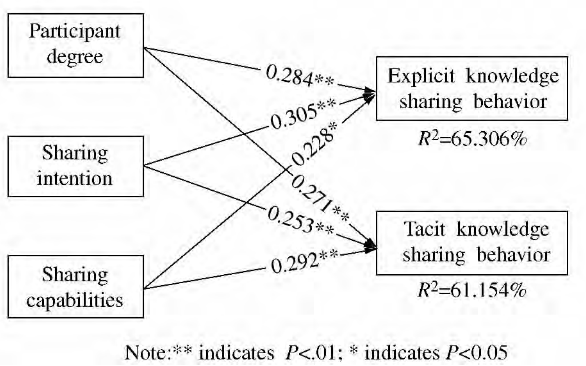

Figure 2 Research model and testing results

5 Conclusions

More recently, some studies empirically discussed the influence factors of knowledge sharing in aircraft product development on various aspects. However, few researche study knowledge sharing from the perspective of the individual. This research divided the individual knowledge sharing behavior into explicit knowledge sharing behavior and tacit knowledge sharing behavior, and analyzed the influence factors of individual knowledge sharing behavior of stakeholders in aircraft product development by way of empirical study. First, the hypotheses were proposed and the structural equation model was established based on the analysis of the relevant literature. Then, a questionnaire was conducted among the key stakeholders of aircraft product development in order to get the required data. Finally, the collected data was processed using SPSS 18. 0 and Amos 17. 0 and the proposed model was verified. The results are discussed in the following section.

First, the participant degree of stakeholders has significantly positive effects on both explicit and tacit knowledge sharing in aircraft product development. Aircraft product development is a systematic project, involving the stakeholders from R&D institutions, manufacturing companies, subcontractors, suppliers, end users, government agencies and other departments. The higher the stakeholders´ participant degree, the greater role does the stakeholder play in the R&D process. On the one hand, owing to the stakeholders´ direct participation, the demand information can be defined clearly in preliminary aircraft product development, and all kinds of knowledge, especially tacit knowledge, can be fully shared through a sharing mechanism such as face-to-face communication, which reduces the uncertainty of the R&D; on the other hand, apart from providing explicit and tacit knowledge, the stakeholders´ direct participation can create some new ideas and concepts through exchange and collisions, and also improve the development speed and quality through the sharing of new knowledge. Therefore, managers should establish a perfect incentive mechanism and knowledge exchange mechanism, build a comprehensive knowledge management system, and take various measures to encourage stakeholders to participate actively in the process of aircraft product development to promote all kinds of knowledge to be effectively shared in the R & D process.

Second, the sharing intention of stakeholders has significantly positive effects on both explicit and tacit knowledge sharing in aircraft product development. In the process of aircraft product development, knowledge sharing intention is the willingness of the stakeholders´ sharing, transferring and spreading their own knowledge related to development work and performance to other stakeholders in the development organization through meetings, documents, group discussions or informal communication, chat, and other forms. Consequently, the stronger the sharing intention, the higher the degree of explicit and tacit knowledge sharing among stakeholders will be. As such, in order to facilitate the tacit and explicit knowledge sharing, the manager should organize exchange activities, such as a regular tea party, learning exchange, and celebration, to promote exchanges and contacts between stakeholders, and build a frequent and close informal interactive relationship and trust, so as to enhance the relationship of each other and improve stakeholders´ knowledge sharing intentions. In addition, the manager should establish a comprehensive incentive mechanism to make stakeholders form the common interest in aircraft product development and have the sense of accomplishment, pride, identity and promotion opportunities etc, which can enhance stakeholders' knowledge sharing intentions.

Third, the sharing capability of stakeholders has significantly positive effects on both explicit and tacit knowledge sharing in aircraft product development. Explicit knowledge has the characteristics of standardization and systematization, so it can be communicated and shared easily. On the contrary, tacit knowledge is highly personal knowledge, so it is difficult to share with others. In aircraft product development, if the stakeholders have the knowledge sharing capabilities that can transfer personal knowledge to others appropriately, such as the capability of externalizing personal intuition and inspiration by metaphor, will facilitate the explicit and tacit knowledge sharing. As such, the manager should create a strong incentive mechanism to encourage stakeholders to learn how to share knowledge. In addition, in order to improve the knowledge sharing capabilities of stakeholders, managers can set up educational training relevant to knowledge sharing, to teach stakeholders how to actively search and acquire knowledge, establish the culture and IT systems of knowledge sharing to promote the stakeholders to communicate effectively and absorb and utilize the obtained explicit and tacit knowledge.

There are some limitations in our exploratory empirical research. First, the sample size and the surveyed industry of this study are limited. The future work can be focused on expanding the sample size, broadening the industry background, using a more comprehensive and objective method to collect data, further improving the research method, and studying the differences that the individual factors influence the knowledge sharing behavior in aircraft product development of different industries. Secondly, this study only used cross-sectional data, which can't carry out a long time of longitudinal study. It' s very necessary to adopt the longitudinal data in the future in order to further explore the causal link of all variables, and thus to propose a more scientific and effective strategy for knowledge sharing in aircraft product development.

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Brief Biographies

WANG Juan-ru is now a professor in the School of Management, Northwest Polytechnical University. Her research interests include knowledge management and innovation management. wjuanru@nwpu.edu.cn

LUO Ling is a graduate student in the School of Management, Northwestern Polytechnical University. Her research interests include knowledge management and innovation management. rowling1213@163.com