Cognitive Interview for Knowledge Creation in IT Projects to Accelerate Digital Innovation

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Abstract. The Knowledge Creation in Information Technology Projects to Accelerate Digital Innovation Questionnaire (KCITDIQ) is a questionnaire created to investigate the degree of influence and clarify the link between the factors associated with knowledge creation in information technology project. This paper discussed how cognitive interviews with IT project managers were used to improve item quality of the KCITDIQ. Three sessions of cognitive interviews via online video conferencing were conducted with ten IT project managers from Malaysia's Klang Valley. Project managers having more than five years of IT project management experience were recruited from the Malaysia Chapter of the Project Management Institute. To uncover difficulties of answering KCITDIQ during the cognitive interviews, both thinking-aloud and probing strategies were employed. This consisted of two steps: the first step was participants to think aloud and voice their views while reading the questions. In second stage, the interviewer utilised follow-up questions to get further information regarding the questionnaire's comprehension and interpretation. The pattern of difficulties was used to determine whether the items and scales were functioning properly and to enhance the surveys. Participants offered a total of hundreds of eleven feedbacks over the three sessions of cognitive interview. Twenty-two feedbacks reported items were poorly comprehended, which may need improve the statement or using more generic terminology. The other eighty-eight feedbacks, on the other hand, do not represent a serious challenge to the questions comprehension. The cognitive interviews were a significant contribution to the improvement of KCITDIQ. It was discovered via this exercise that the questionnaire was well comprehended by IT project managers and their understanding could be improved from the interviews. Cognitive interviews broaden practitioners' perspectives and assist to develop their personal knowledge by exchanging practical information and experiences in small group interview sessions and this may help to enhance their competence, which benefits the IT industry and digital innovation.

Keywords: knowledge creation, digital innovation, information technology, cognitive interview.

1. Introduction

However, the traditional manufacturing sector is at danger of obsolescence. As a consequence, the Malaysian government launched the Industry4WRD programme in 2018, with the goal of transforming the manufacturing sector and accelerating the transition to Industry 4.0. (I4.0) (MIDA, 2021).

I4.0 or known as "smart factory" refers to a new industrial age to achieve greater industrial performance by integrating cutting-edge developments in the digitalization and automation of manufacturing processes (Dalenogare et al., 2018), which include the adoption of advance technologies such as 3D printing, machine learning, cloud computing, Big Data to reduce production costs and increase productivity. For instance, smart factory implement automation in manufacturing processes with artificial intelligence (AI) technology can minimize equipment downtime, improve decision making, lower production costs and increase efficiency. When it comes to I4.0, widespread of advance technology adoption is expected to accelerate the development of new knowledge within the workforce as well as stimulate digital innovation (DI) (Ehrehail et al., 2018). DI is refers to the use of digital technology in a wide range of creative endeavors (Nambisan et al., 2017).

The adoption of advance technology results in the creation of a large number of new information technology (IT) projects. In a nutshell, IT projects become more complex every day. According to Forbes, current IT project managers must deal with challenges including the inability to recognize team members' competence and knowledge and mutual trust (Brownlee, 2021). With technology advancing at such a quick pace, IT project managers require to create new knowledge to overcome the challenges. Research studies in the past shown that Transactive Memory System (TMS) (Barnier et al., 2018) and trust (Nonaka & Takeuchi, 1995) helped individual to geneate new knowledge in team. However, the research of TMS and trust on KC was still scant.

This paper describes the KCITDIQ development process for enhancing item quality using cognitive interviews. Cognitive interviews are an approach to obtain thorough understanding of the respondents when they answer the questionnaire. During the course of responding each survey question, respondents are asked to "think aloud," which might entail paraphrasing, offering retrospective thinking, or making judgments on their level of confidence in the meaning of the subject at hand.

Prior to the interviews, draft version of the KCITDIQ was created with the review from the methodology and subject matter experts from universities, each questions was tested for content validity against the constructs in the study. The findings of the research have major ramifications for organizations when it comes to the understanding of project managers on dealing with IT projects challenges.

2. Literature Review

2.1. Knowledge creation

KC is a continuous process which one acquires new context, perspective and knowledge to exceed the limitations of the old self to become new self (Nonaka & Takeuchi, 1995). Many research considered KC as a sub-process of Knowledge Management (KM) (Alavi & Leidner, 1999, Liebowitz, 2005). In order to distinguish KC from KM research, KM research focuses on the socio-technological approach. On the contrary, KC research is looking at the socio-cognitive perspective of KM (Antonacopoulou & Chiva, 2007). Organisational behaviour (Kao & Wu, 2016) and organisational learning (Brown & Duguid, 1991) are examples of the common themes investigated under KC from the past research, which might include other subjects from a variety of different disciplines of study.

This paper adopted Theory of Organizational Knowledge Creation (TOKC) developed by Ikujiro Nonaka and Hirotaka Takeuchi (Nonaka & Takeuchi, 1995) as the basis for this research. From the epistemology dimension, TOKC explained KC is a social interaction that specifies the conversion of tacit knowledge, a type of knowledge which is individual occurs under unique circumstances that entails a significant cognitive component of the human mind into explicit knowledge which is organised, formalised, and methodical or vice versa through four processes including Socialization, Externalization, Combination and Internalization (Nonaka & Takeuchi, 1995). From the ontological perspective, TOKC explained the shift of knowledge from the individual to the group, and subsequently to the organisation.

2.2. Knowledge creation in IT projects (KC-IT)

IT projects has transformed dramatically in the recent years. In past studies, researchers were debated on how to approach KC from a contemporary, systematic, and multidisciplinary perspective in IT projects. According to the findings from the literature study, the research on KC in IT projects may evolve in a variety of ways since new technical concepts are created at various times (Bartolacci et al., 2016). For instance, IT projects have transitioned from information processing to develop knowledge-based systems (Chin et al., 2020).

With the current advancement in virtual organisations and digital economies, KC in IT projects are more readily shift personnel, resources, and expertise across geographical boundaries. New sorts of knowledge were developed in the IT projects by relying on human experience and software simulation findings. For example, grey knowledge which is a synthesised type of half-explicit and half-tacit knowledge was created to solve technical challenges arising from complicated product systems (Li et al., 2018). When individuals obtained specialised knowledge via KC in IT Projects, they can recombine the new knowledge to develop DI.

2.3. Knowledge creation in IT for digital innovation (KC-IT-DI)

DI occurs at numerous phases of an IT projects including design, implementation, operation and maintenance (Markus & Nan, 2020). Recent studies show that DI contains sociotechnical characteristics that linked to the concept creation about how users interpret and use certain features in the digital technology (Markus & Rowe, 2018). For example, user interface designers collaborate through remixing platform, a web-based online platform, DI happens in remixing platform whereby users create new knowledge and obtain feedbacks from co-workers, new knowledge lead to develop new form of artworks (Nickerson, 2020). Furthermore, remixing platform allows users to share digital representations and the metadata about the artefacts simultaneously.

DI is not only tied to visible IT functions but also consider what an application allows users to perform. Another example of KC in IT projects that results in DI throughout the implementation, operation, and maintenance of an IT project is the use of a source code management platform (Nickerson, 2020). A collection of features that were generated individually are efficiently brought together and deposited into source code management platform using branching and merging code operations. It is likely that new coding knowledge may result in improved features that will improve the performance of IT applications.

2.4. Transactive memory system (TMS) and trust influence KC

TMS and trust have been shown to influence KC in previous literatures [Seng et al., 2021, Nonaka & Nishihara, 2018, Berraies et al., 2014]. TMS is a cognitive system which individually unique information is encoded, stored and retrieved via the use of a shared cognitive framework that is centered on mutual understanding of each other's specialised knowledge areas (Wegner, 1987). The underlying principle of TMS was derived from Transactive Memory, a theory that explains mutual understanding among members of the team about who knows what (Wegner, 1987). Trust is defined as the conviction in the ability of two people to maintain confidence in one another (Kreitner, 1992). A number of studies have shown that trust facilitates the transfer of information and it is important in the generation of new knowledge (Berraies et al., 2014, Pham & Le, 2018).

The Knowledge Creation in IT Projects to Accelerate Digital Innovation Questionnaire (KCITDIQ) was developed in response to call for research issued by Seng and colleagues (2021) to examine the theoretical model of knowledge creation in IT projects for digital innovation. Figure 1 shown the theoretical model proposed by Seng and colleagues.
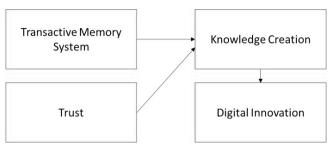
Fig. 1: Theoretical framework proposed by Seng et al. (2021)

TMS and trust influence KC will lead to accelerate DI to create better product and services (Seng et al., 2021).

3. Method

Ten IT project managers have been recruited from the Malaysian chapter of the Project Management Institute (PMI) to conduct the interviews. PMI Malaysia chapter is an association of project managers with more than 1,500 members in Malaysia. Respondents were contacted via the PMI Malaysia chapter's IT WhatsApp group chat. The research used purposive sampling whereby interviewees must fulfil the criteria such as IT project managers under the age of 60 years old, who have obtained project management professional certification or equivalent, with more than 5 years of IT project management experience in the IT industry.

A cognitive interview is essential for identifying questionnaire flaws that may have gone unnoticed prior to the pilot test. The understanding of survey items that have not been intellectually tested will be called out during the cognitive interview via think aloud session. Cognitive interviews are able to reveal further item difficulties such as misinterpretations through probing session. The cognitive interview procedure was adopted from Buers and colleagues (2014) and the procedure was outlined in Figure 2.
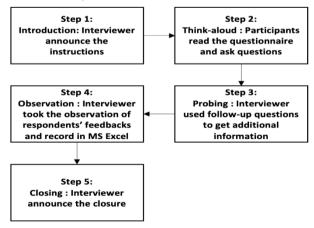

Fig. 2: Procedure of cognitive interview.

Cognitive interviews began with a brief introduction and participants verbally consented to the recording of the session before the interview start. Step two required participants to think aloud and voice their responses while reading the questions. In step three, the interviewer utilized follow-up questions to get further information regarding the questionnaire's comprehension and interpretation. If participants were unsure or hesitant, or if they need clarification or ask the interviewer for assistance, probing was utilized. Furthermore, throughout the interview, the interviewer employed both pre-scripted and spontaneous queries to follow up with participants' question. Step four, the interviewer to take notes on the respondents' feedbacks including their behavior, such as muttering, sighing, and experiencing issues with the questionnaire routing. At the end of the interview, the interviewer announces the conclusion and thanks the participants with a modest gift.

For the interviewer selection, first researcher (Tung) was selected to conduct the interviews, which had undergone training in qualitative research and cognitive interviews from the university. The outcomes of qualitative research are inevitably impacted by the researcher's social and cultural perspective. The first researcher was a male Asian project manager from Malaysia with a university education and an IT background.

To add rigour to the analytic process, the first researcher made thorough notes on categorising the data, which were reviewed with the co-researchers at the conclusion of each interviews. Each interview session consists of two to four participants. Each participant was interviewed in a group about one and a half hours via online conference meetings. Third, same set of KCITDIQ was utilised to ensure that all topics presented during interviews were equitably addressed.

The example items in KCITDIQ were shown in Fig. 3. During the interview, interviewer read the questions one by one, participants were asked with expressing their thoughts. The interviewer used follow-up questions to acquire more information about how respondents understood and interpreted the questionnaire. Lastly, a number of queries were clearly defined and documented utilizing Microsoft Excel Spreadsheet. Fig. 4 showed the list of follow-up questions.

Questions	Scale
Scale Description: 1= Strongly Disagree; 2= Disagree; 3= Somewhat Disagree; 4= Neutral; 5= Somewhat Agree; 6= Agree; 7= Strongly Agree	
Transactive Memory System | Source: Lewis [26]	
1. Our team members have specialized knowledge of some aspects of our task.	1 2 3 4 5 6 7
2. Our team members are comfortable accepting procedural suggestions from other team members.	1 2 3 4 5 6 7
3. Our team members are confident of relying on the information that other members bring to the discussion.	1 2 3 4 5 6 7
Trust | Source: Lee & Choi [27]	
1. Our team are generally trustworthy.	1 2 3 4 5 6 7
2. Our team have faith in other members' intentions and behaviours.	1 2 3 4 5 6 7
3. Our team have faith in others' decision toward organizational interests than individual interests.	1 2 3 4 5 6 7
Knowledge Creation | Source: Lee & Choi [27]	
1. Our team share experience with suppliers and customers.	1 2 3 4 5 6 7
2. Our team engage in dialogue with competitors.	1 2 3 4 5 6 7
3. Our team use deductive and inductive thinking.	1 2 3 4 5 6 7
Digital Innovation | Source: Del Giudice et al. [28]	
1. Our team use new technology such as big data, smart sensors etc to generate innovation.	1 2 3 4 5 6 7
2. Our team are stimulated to employed new technology to come up with new ideas.	1 2 3 4 5 6 7

Fig. 3: Example items from KCITDIQ

A. Understanding on the questions

1. Is the item wording, terminology, and structure clear and easy to understand?

B. Retrieval from the questions

1. Has the respondent ever formed an attitude about the topic?
2. Does the respondent have the necessary knowledge to answer the question?
3. Are the mental calculations or long-term memory retrieval requirements too great?

C. Judgement on the questions

1. Is the question too sensitive to yield an honest response?
2. Is the question relevant to the respondent?
3. Is the answer likely to be a constant?

D. Response on the questions

1. Is the desired response available and/or accurately reflected in the response options?
2. Are the response options clear?

Fig. 4: Cognitive interview questions adopted from Buers et al. (2014)

4. Result

4.1. Demographic profile

Table 1 shows the demographic profile of the participants.

Table 1: Demographic profile of the participants.

Participant	Interview Session	Job Title	Gender	Year of experience in IT Project Management
1	Session 1	Project Manager	Male	7 years
2		Project Manager	Male	9 years
3		Senior Project Manager	Male	11 years
4		Project Manager	Female	6 years
5	Session 2	Project Manager	Female	9 years
6		Project Manager	Female	15 years
7		Project Manager	Female	16 years
8		Project Manager	Male	5 years
9	Session 3	Project Manager	Male	6 years
10		Project Manager	Female	9 years

A total of ten participants, both five male and five female were interviewed for this study. The participants had an average of nine years of experience in IT project management. All of the participants are employed at IT business organizations based in Malaysia's Klang Valley. One participant held the role of senior manager, while the other participants worked as project managers in their organisation.

4.2. Comprehension

Table 2 summarizes the difficulties noted by participants in each round of interviews in terms of comprehension. Four participants said that they had trouble comprehending questions 1 and 2 in the item on Transactive Memory System. For trust and digital innovation items, two participants suggested that the sentences should be structured with simple language that is comprehensible to everybody. Four participants said that they were unable to comprehend question 3 of the knowledge creation.

Table 2: Interview response about question comprehension.

A. Understanding on the questions

1. Is the item wording, terminology, and structure clear and easy to understand?
Transactive Memory System
Participant 5, 6, 7 & 8: "Question 1 is difficult to understand."
Participant 5, 6, 9 & 10: "What does procedural suggestions mean in Question 2?"
Trust and Digital Innovation
Participant 1: "Please provide definition in lay-man terms and examples."
Participant 6: "Try to elaborate the statement in lay-man fashion to support better understanding."
Participant 7 & 8: "Overall questions are understandable."
Knowledge Creation
Participant 3: "I don't understand Question 3, what is deductive and inductive thinking?"
Participant 5, 9 & 10: "I need example for deductive and inductive thinking."

4.3. Retrieval

Table 3 summarizes participant responses to an interview on the retrieval process. The retrieval process is used to determine the extent to which certain participants respond to inquiries based on their past rather than present condition. Overall, six participants are able to answer the questions effortlessly in terms of memory retrieval needs. However, four participants said that they continue to have concerns, indicating that they are answering the questions based on their prior experiences.

Table 3: Interview response about retrieval process.

B. Retrieval from the questions

1.   Has the respondent ever formed an attitude about the topic?
Knowledge Creation
(Below topic is related to KC Question 2)
Participant 3: "Question 2, we are not allow to have dialog with competitor and external parties in my organisation."
Respondent 4, 5 & 6: "it is against with our code of conduct in organisation. Hence we can not have dialogue with competitor."
(Below topic is related to KC Question 3)
Participant 1, 2, 3 & 4: "We share feedback to our supplier rather than share our experience."
Participant 2: "We don't share experience with the suppliers, but we give our requirements to them."
Participant 4: "We share product knowledge to our supplier, rather than share our experience."
Participant 9 & 10: "Our project team does not share experience with suppliers, it is more like we tell the suppliers about our requirements and they deliver the products or services to us".
2. Does the respondent have the necessary knowledge to answer the question?
Trust
Participant 5 & 7: "Trust level on the project team are depend on the project phases. Over the time, project involved new comers to join in different phases."
Digital Innovation
Participant 2: "Big Data is not a technology, suggest to change the example of technology".
3. Are the mental calculations or long-term memory retrieval requirements too great?
Participant 1, 2, 3 & 4: "Partially, we still have doubt in our mind."
Participant 5, 6, 7 & 8: "Questions are easy to understand."
Participant 9 & 10: "We have no issue."

Four participants demonstrated strong objection to agree on the question of knowledge creation regarding to engage dialogue with competitors because it violates their professions' and organization's code of conduct. Eight participants express significant opposition to agreeing on the question of knowledge creation about sharing experience with suppliers, stating that this statement is very improbable based on their prior experience. Indeed, it seems as if sharing feedback or product knowledge with suppliers makes more sense for them.

In terms of participant having the essential knowledge to answer the question, two participants shared their thoughts on how the degree of trust in an IT project varies from one phase to another, depending on whether or not a new project team member is brought on board. One participant said that the phrase "Big Data" is not appropriate for usage in the context of digital technology example. This feedback demonstrated the participant had adequate knowledge to answer the questions.

4.4. Judgment

Participants were asked whether they had been truthful in their responses during the judgment process. Table 4 presents the responses to the interview question concerning the judgment process.

Table 4: Interview response about judgement process.

C. Judgement on the questions
1. Is the question too sensitive to yield an honest response?
Participant 1 to 9: "All questions are not sensitive to yield an honest response."
2. Is the question relevant to the respondent?
Participant 7: "The questions are relevant. However, various projects and positions in the project may have a different perspective."
Participant 9: "The questions might not relevant to all IT project managers."
3. Is the answer likely to be a constant?
Participant 1, 4, 5: "Not constant."
Participant 6, 7, 8 & 9: "It's vary and subjective to the project team setup, so you won't get the constant answers."

Nine participants said that all questions are not sensitive in the sense that they would yield to an honest response. Nevertheless, all questions are neutral in the sense that respondents may answer the question based on their honesty without fear of being assessed by others. Regarding the relevance of the questions to the respondent, one participant said the questions are relevant. However, different projects and roles within a project could have develop unique viewpoint. Another participant said, the questions may not be applicable to all IT project managers. Seven participants said that the response would not be constant. According to four participants, the structure of the project team has a significant impact on the judgment.

4.5. Response

Table 5 provides the interview responses about the response process. The option with scale explanation was straightforward to respond to for all ten participants. Two sorts of response process issues were highlighted. First, one participant requests that the "not applicable" option should be included. Second, one participant believed the neutral choice was unhelpful in addressing the issue, thus requesting its removal.

Table 5 Interview response about response process.

D. Response on the questions

1. Is the desired response available and/or accurately reflected in the response options?

Participant 1: "I suggest to add 'Not Applicable' option and highlight scale number four is the neutral score."

Participant 10: "I prefers to exclude the neutral score (scale number four)."

2. Are the response options clear?

Participant 1 to 10: "All options are clear."

5. Discussion

KCITDIQ's problems were recorded in Table 6. The summary was created based on the interviewees' responses to questions on comprehension and retrieval. A total of 110 responses were received from the interviews, with 88 responses stating that the items were easy to comprehend. 22 responses said some items caused hesitancy and misunderstanding, which will need to be addressed in the next step prior to the pilot test. The items will be considered a difficult question if participants show hesitate, display confusion or have opinions on the items. Otherwise, the comprehension of the question is regarded as satisfactory.

Table 6: Summary of comprehension and struggle problems in KCITDIQ.

Questions		
Description: C: Comprehension (number of participant understand the question correctly) S: Struggle (number of participant hesitate, express confusion or have different opinion)		
Transactive Memory System	**C**	**S**
Item 1	6	4
Item 2	6	4
Item 3	10	0
Trust		
Item 1	8	2
Item 2	8	2
Item 3	8	2
Knowledge Creation		
Item 1	4	6
Item 2	6	4
Item 3	6	4
Digital Innovation		
Item 1	7	3
Item 2	8	2
Total (C, S)	**88**	**22**

Six participants are satisfied with TMS item one and two. On the contrary, four individuals displayed the struggle sign. TMS item three has been responded satisfactory by all ten participants. With regard to the trust questions, all three items received satisfy response from eight participants. However, two participants made an indication of struggle to understand the items.

KC item one has been understood by four different participants. Six participants wore the struggle indication from their feedbacks. Six participants are satisfied in terms of the comprehension with the KC item number two and three. However, the struggle sign was seen from another four participants. A total of seven participants expressed satisfaction with their comprehension of DI item one. Three participants wore the difficulty indicator that they had received in the interview. A total of eight participants are pleased with the comprehension to the DI questions item two and three. The struggle sign was seen by two different participants.

The research highlights the implication of the cognitive interview in the current study, which may impede the demographic of unreported information such as national, cultural, linguistic and ethical groups, which is important to establishing the success of any interview as reported. Future cognitive interviews are suggested to be performed in a variety of demographic contexts, including varied geographical, national, cultural, linguistic, and ethical groupings, among others.

6. Limitation and Future Recommendation

This research was done in an informal setting with online interviews, which are usually conducted in person face-to-face. Furthermore, the study was conducted with restricted resources and a small sample size in a short period of time. As a consequence of the limited number of participants, the empirical findings cannot be generalised. Future study should focus on including diverse roles of participants in IT projects and developing a more formal and thorough interview approach.

The goal of this study is to conduct cognitive interviews in order to improve item quality of the KCITDIQ. Future study on KC in IT Projects will assist scholars in understanding the relevance of KC in IT Projects. Researchers may acquire a greater understanding of the difficulties plaguing the KC community, such as how to enhance communication, cooperation, and information sharing in IT Projects. Future research will concentrate on extrapolating new aspects to promote KC in IT Projects within the Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) environment by looking at new factors or dimensions connected to KC in IT Projects.

7. Conclusion

Overall, the cognitive interview provides important inputs from participants in order to enhance the item quality of the KCITDIQ. This research adds to the body of knowledge in two folds. To begin, this research emphasise the critical nature of

conducting cognitive interviews in order to improve the items on survey questionnaires. Second, one may simply argue that the more cognitive interviews perform, the more likely to uncover common difficulties that respondents have.

The next step is to revise the questionnaire before conducting the pilot test. Some of the results have broad implications for qualitative questionnaire testing. This study provides useful information to Malaysia's governmental and business sectors. Moving forward, KC will be important in moving the NI4.0 strategy forward. The results are anticipated to pique people's interest in KC research by filling a vacuum in literature and theory via collaboration between government, business, and academia.

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