

Tacit Knowledge Mapping for Business Intelligence Analysis

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Abstract

The tacit knowledge in a higher institution, especially in university libraries, contains a series of intuition and inspiration that a librarian arises in exploring solutions to the various problems. Thus, limited sources of knowledge or information is a critical factor in the failure to provide accurate information. The main problem of the BI system is to capture tacit knowledge and use tacit knowledge as one of the data sources for data analysis to enhance the analytic results. The unstructured data can define as tacit knowledge in the form of data and information presented in the Knowledge Management System (KMS), and the cognitive business use both structured and unstructured data with highly sophisticated analytical techniques to identify, evaluate, and recommend a business plan of actions. The idea of being able to capture knowledge from different sources can be very beneficial to the BI system. This paper explored the solution to extracting tacit knowledge from librarians in order to enhance the data sources to be used in the BI by exploring the library's academic services, which use much tacit knowledge for answering questions with the requirement of data analysis as online or offline queries.

Keywords: Tacit Knowledge, Business Intelligence, Knowledge Management System, BI System

1 Introduction

The academic library has consumers who are not as heterogeneous as the public library, namely students and lecturers. This study limits the context by taking academic libraries as research contexts. Context control also simplifies the problem so that it leaves aspects of the complexity of tacit knowledge in the library [1]. The simple stages of capturing tacit knowledge can be illustrated in Figure 1 below. After a theoretical review, the data collection scheme consists of three stages, namely interviews to find out the context for tacit knowledge, that is none other than the problems faced by librarians; the survey stage that detects librarians who have the tacit knowledge needed to solve the problem; and the second interview stage, which revealed tacit knowledge [2].

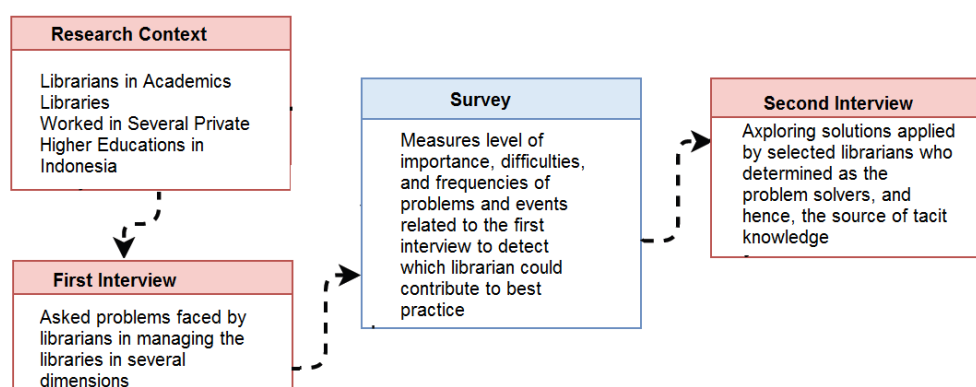


Figure 1 Research Data Collection Scheme

2 Linguistic Source of Tacit

2.1 Design for Capturing Tacit Knowledge

The effort to capture knowledge is made through a social process where the transfer of knowledge takes place from an expert to an interviewer [3]. For this reason, the interview process needs to be based on the Systemic Functional Linguistics (SFL) theory [3, 4]. According to SFL theory, only a fraction of “can-do” turned into “can mean” and only a fraction of “can mean” turned into “can say” [3, 4, 5]. This is what is meant by Polanyi when he said, “we know more than we can tell” [6]. Hence, only a portion of tacit knowledge can be captured by linguistic means.

Based on the SFL theory, tacit knowledge consists of three levels [3, 4, 5, 6]. The first level is the most basic level where a person can only do but cannot interpret it, let alone say it. It can only be collected through observation. In this study, it is assumed that the person is a peer. Researchers collected data on tacit knowledge from peers through cognitive interviews. The second level is the level where experts can do and can interpret the action but cannot say it. This can be revealed through phonological cues and nonverbal cues. Data collection is done through grammar-targeted interviews. The third level is the level of professional knowledge that experts can say in clear language. Language consists of two forms, namely the lexicogrammar shape and the semantic form. This form of lexicogrammar was also captured through grammar-targeted interviews. The semantic aspect, which is the most direct and clear aspect, can be captured by a questionnaire or content-targeted interview. The questionnaire method can only be used if the desired knowledge is problem-solving [3, 7].

Data from the questionnaire is numerical and analyzed quantitatively. Meanwhile, data from interviews, both content-targeted, grammar-targeted, and cognitive, were analyzed qualitatively. Figure 2 shows the design used to capture the comprehensive knowledge of experts.

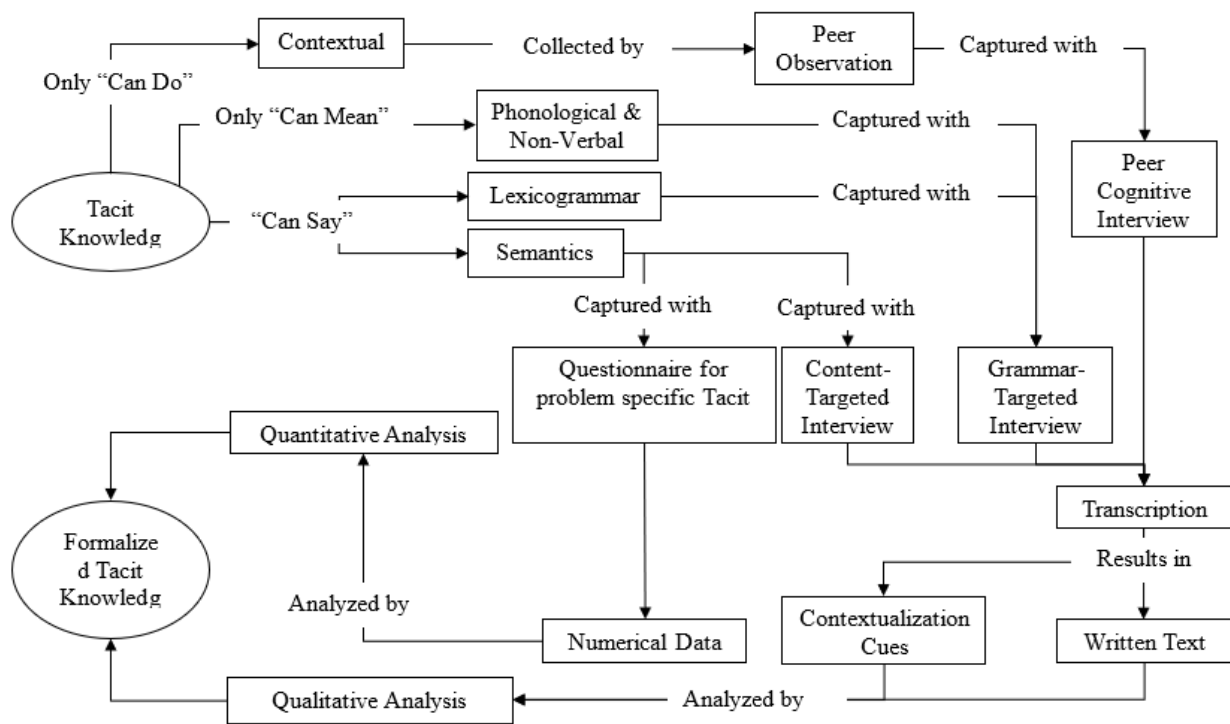


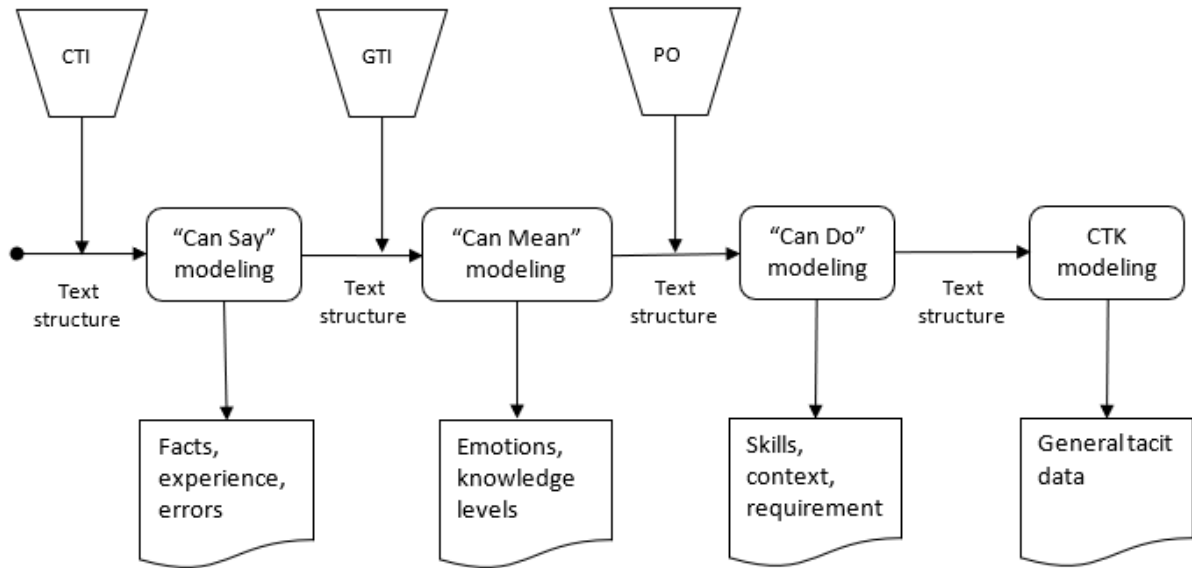
Fig 2 Design for Capturing Tacit Knowledge

2.2 Comprehensive Tacit Data Collection

The technique above only collects “can say” dimension of tacit knowledge. Furthermore, the “can say” in this sense only focused on the problem stated, not all the tacit knowledge possessed by the participant, at least for the problem field [4, 6, 7]. The solution is to collect tacit knowledge data more comprehensively by three means:

1. Using content targeted interview (CTI) and grammar targeted interview (GTI) to collect “can say” dimension of tacit knowledge, not bounded by a problem.
2. Using grammar targeted interviews to collect “only can mean” dimension of tacit knowledge.
3. Using peer cognitive interviews (PCI) to collect “only can do” dimension of tacit knowledge.

The data collection and analysis process is illustrate in Figure 3.



Note: CTI = Content-targeted interview, GTI = Grammar-targeted interview, PO = Participant observation, CTK = Comprehensive tacit knowledge

Figure 3 Comprehensive tacit data collection

2.3 Data Acquisition

The questionnaire was designed based on the first round of interviews. Half the questions are questions about the frequency of events while the other six are about the degree of importance or ability to deal with problems/events. Common questions are made so that basically, there are six groups of questions.

The data table present in this paper is about the problems faced by the librarian. Moreover, the actual research was done by analyzed more than problems that faced by librarians such as inter-librarian relationships, librarian and patron relationship, emergency events, external relationships, and library services, all by the interview and questionnaire findings.

2.4 Problem Faced by Librarians

Table 1 Problems frequency that faced by librarians

Q1	Items	Number of Answers					MFA
		1	2	3	4	5	
PF1	Inputting Books' data	1	-	3	4	6	5
PF2	Agreement issues with third parties	-	2	8	2	2	3
PF3	Outdated information system	-	1	1	1	11	5
PF4	Collection's data in physical does not match with the data in the computer system	1	-	1	4	8	5
PF5	Incorrect position of books placement	-	2	3	1	8	5
PF6	Visitors do not know what they are searching for	-	2	3	1	8	5
PF7	Time consuming in serving one customer	-	3	9	2	-	3
PF8	Fuss among visitors that not relevant with the library	-	1	1	4	8	5
PF9	Less budget	-	1	1	7	5	4
PF10	Limited collection for new books	4	-	-	3	7	5

PF11	Less visitors	-	3	-	-	11	5
PF12	New collections are borrowed by one person for long period	1	-	-	7	6	4
PF13	Workload is too large	5	2	2	3	2	1
PF14	Visitors asked for help that is not relevant to the function of the library	3	1	-	1	9	5
PF15	Translating hard knowledge into knowledge that can be understood by visitors	-	-	-	3	11	5
PF16	Interruptions at work	1	3	-	-	10	5
PF17	Deprofessionalization (librarian profession harassment)	-	-	-	5	9	5
PF18	New technology understanding	-	-	2	2	10	5
PF19	Low salary	2	4	6	1	1	3
PF20	Social relations between staff are not good	-	1	2	5	6	5
PF21	Visitors fluctuation	5	1	2	1	5	
PF22	Staff also teaches	2	1	2	-	9	5
PF23	Gender relations, for example dating, flirt with each other	-	1	-	2	11	5
PF24	Lazy staffs	-	-	-	2	12	5
PF25	Vandalism	5	-	1	5	3	
PF26	Backpain	6	1	5	2	-	1
PF27	Poor coordination with other institutions	3	7	3	1	-	2
PF28	There are visitors who are alone and do nothing	6	4	2	1	1	1
PF29	Political issues	3	1	6	4	-	3

Annotation: MFA = most frequent answer. Answer choices 1 = almost never, 2 = rarely, 3 = sometimes, 4 = usually, 5 = very often or almost always. N = 14 respondents

Table 2 Difficulty level problems faced by librarians

Q1	Items	Number of Answers					MFA
		1	2	3	4	5	
PD1	Inputting Books' data	7	1	3	1	2	1
PD2	Agreement issues with third parties	5	4	3	-	2	1
PD3	Outdated information system	12	1	-	1	-	1
PD4	Collection's data in physical doesn't match with the data in computer system	2	11	1	-	-	2
PD5	Incorrect position of books placement	6	2	-	3	3	1
PD6	Visitors do not know what they are searching for	-	-	2	3	9	5
PD7	Time consuming in serving one customer	1	-	3	4	6	5
PD8	Fuss among visitors that not relevant with the library	-	-	2	5	7	5
PD9	Less budget	-	-	1	6	7	5

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PD10	Limited collection for new books	-	-	3	3	8	5
PD11	Less visitors	-	-	5	2	7	5
PD12	New collections are borrowed by one person for long period	8	4	2	-	-	1
PD13	Workload is too large	-	-	2	3	9	5
PD14	Visitors asked for help that is not relevant to the function of the library	8	2	4	-	-	1
PD15	Translating hard knowledge into knowledge that can be understood by visitors	-	1	7	2	4	3
PD16	Interruptions at work	-	1	4	1	8	5
PD17	Deprofessionalization (librarian profession harassment)	-	6	6	1	1	-
PD18	New technology understanding	1	1	5	2	5	-
PD19	Low salary	-	2	4	1	7	5
PD20	Social relations between staff are not good	-	1	3	1	9	5
PD21	Visitors fluctuation	-	3	1	5	5	-
PD22	Staff also teaches	-	1	2	6	5	4
PD23	Gender relations, for example, dating, flirt with each other	-	2	5	2	5	-
PD24	Lazy staffs	-	1	5	1	7	5
PD25	Vandalism	5	-	2	5	2	-
PD26	Backpain	1	1	7	-	5	3
PD27	Poor coordination with other institutions	-	-	5	3	6	5
PD28	There are visitors who are alone and do nothing	-	-	3	5	6	5
PD29	Political issues	2	2	3	2	5	5

Annotation: MFA = most frequent answer. Answer choices 1 = very easy, 2 = easy, 3 = fair, 4 = hard, 5 = very hard.
N = 14 respondents

Table 3 Matrix Combination of Frequency and Difficulty of Problems

		Q2				
		Very easy (1)	Easy (2)	Fair (3)	Hard (4)	Very hard (5)
Q1	Very Rare (1)	1	2	3	4	5
	Rarely (2)	2	4	6	8	10
	Sometimes (3)	3	6	9	12	15
	Usually (4)	4	8	12	16	20
	Very often or almost always (5)	5	10	15	20	25

Table 4 Urgency Value of each problem

Items	Q1	MFA	Q2	MFA	Urgency
Inputting Books' data	PF1	5	PD1	1	5
Agreement issues with third parties	PF2	3	PD2	1	3
Outdated information system	PF3	5	PD3	1	5
Collection's data in physical does not match with the data in the computer system	PF4	5	PD4	2	10
Incorrect position of books placement	PF5	5	PD5	1	5
Visitors do not know what they are searching for	PF6	5	PD6	5	25
Time-consuming in serving one customer	PF7	3	PD7	5	15
Fuss among visitors that not relevant to the library	PF8	5	PD8	5	25
Less budget	PF9	4	PD9	5	20
Limited collection for new books	PF10	5	PD10	5	25
Fewer visitors	PF11	5	PD11	5	25
One person borrows new collections for an extended period	PF12	4	PD12	1	4
The workload is too large	PF13	1	PD13	5	5
Visitors asked for help that is not relevant to the function of the library	PF14	5	PD14	1	5
Translating hard knowledge into knowledge that can be understood by visitors	PF15	5	PD15	3	15
Interruptions at work	PF16	5	PD16	5	25
Deprofessionalization (librarian profession harassment)	PF17	5	PD17		-
New technology understanding	PF18	5	PD18		-
Low salary	PF19	3	PD19	5	15
Social relations between staff are not good	PF20	5	PD20	5	25
Visitors fluctuation	PF21		PD21		-
Staff also teaches	PF22	5	PD22	4	20
Gender relations, for example, dating, flirt with each other	PF23	5	PD23		-
Lazy staffs	PF24	5	PD24	5	25
Vandalism	PF25		PD25		-
Backpain	PF26	1	PD26	3	3
Poor coordination with other institutions	PF27	2	PD27	5	10
Some visitors are alone and do nothing	PF28	1	PD28	5	5
Political issues	PF29	3	PD29	5	15

Table 5 Detailed Respondents' Answers for Every Urgent Problem

No	PD6	PD8	PD9	PD10	PD11	PD16	PD20	PD22	PD24
Urgency	25	25	20	25	25	25	25	20	25
Respondent 1	4	4	4	4	3	3	5	5	3
Respondent 2	5	4	4	3	5	5	3	3	3
Respondent 3	3	3	5	5	3	5	5	5	5
Respondent 4	5	5	5	5	5	5	5	4	5
Respondent 5	5	5	5	5	5	5	5	4	5
Respondent 6	5	5	5	5	5	5	5	4	5
Respondent 7	5	5	5	5	5	5	5	4	5
Respondent 8	4	5	4	4	3	3	3	4	4
Respondent 9	5	5	5	5	3	3	3	3	3
Respondent 10	5	4	3	5	5	5	5	5	3
Respondent 11	5	5	5	3	5	5	5	5	5
Respondent 12	4	4	4	4	4	2	2	2	2
Respondent 13	3	3	4	3	4	3	5	5	5
Respondent 14	5	4	4	5	3	4	4	4	3
Min Answer	3	3	3	3	3	2	2	2	2
Number of min answer	2	2	1	3	5	1	1	1	1
Who?	R3, R13	R3, R13	R9	R2, R11, R13	R1, R3, R8, R9, R14	R12	R12	R12	R12

Table 5 shows the nine urgent problems and each respondent's answer to the level of difficulty of the problem. The PD6 problem is a problem with a high level of difficulty because the most significant proportion of answers is 5 (very difficult). However, it can be seen that there is a value of 3 (moderate) in the distribution of the 14 respondents' answers. Two respondents answered value 3 in PD6, namely respondent 3 (R3) and respondent 13 (R13). This means that R3 and R13 have a solution to this problem because of the many respondents, they are the ones who find this problem easy. Therefore, it was concluded that R3 and R13 would be targeted for the second round of interviews with questions about solutions to PD6 problems. With the same logic, we can identify who and what questions will be given to them in the second interview by looking at Table 5.

2.5 Cognitive-map Analysis

The extracted tacit knowledge then mapped using Banxia Decision Explorer tool [8, 9]. In this paper, we present four mappings, which are Fuss among visitors that are not relevant to the library, Lazy Staff, Visitors do not know what they are searching for, and providing the information needed by visitors. Furthermore, we analyze the probabilities of predictions for problem-solving in the Business Intelligence tool, Microsoft Power BI [10]. The mapping process can be seen in Figures.

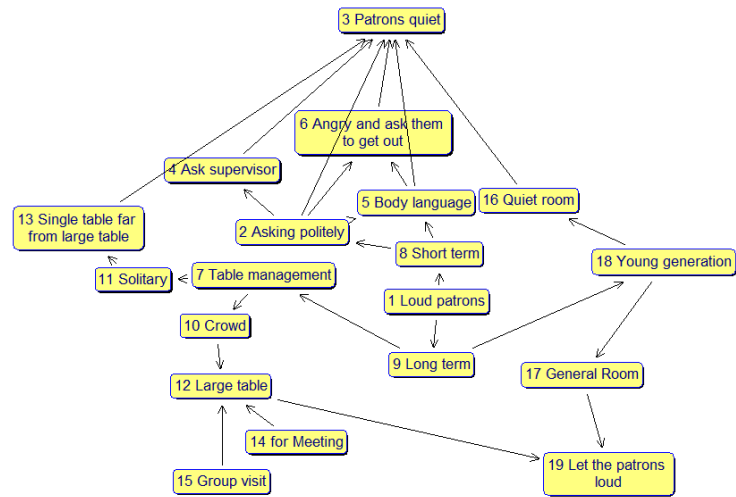


Figure 4 Fuss among visitors

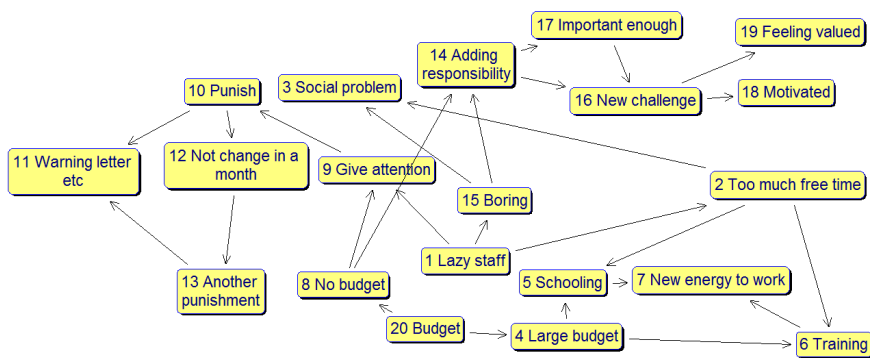


Figure 5 lazy staffs

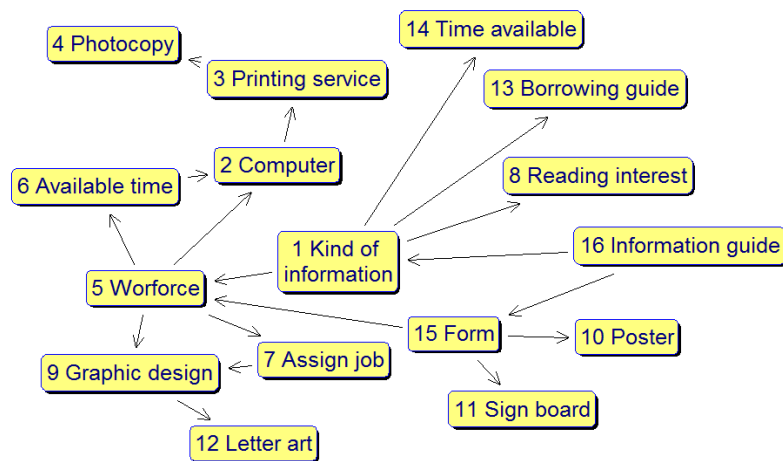


Figure 6 Providing information needed by visitors

2.6 Predictive Analysis using Business Intelligence Tool

In this paper, predictive analysis is performed on all the critical elements identified in the cognitive map based on problem difficulty (PD), such as social Fuss among visitors that are not relevant with the library, Lazy Staff, Visitors do not know what they are searching for, and Providing information needed by visitors.

1. *Fuss among visitors that are not relevant to the library*: Figure 7 below shows that when hard increases, that is, the difficulty in solving fuzz among visitors, then fuzz among visitors will also increase exponentially and vice versa. Therefore, solving this problem should be a priority.



Figure 7 Prediction for Fuss among Visitors that are not relevant to the library

2. *Lazy Staff*: This is another problem difficulty item. Figure 8 below shows that lazy staff is a problem that occurs very often. It also shows that 60% of library staff in the study area are lazy. The graph also displays a rapid increase in this phenomenon if the issue is not resolved quickly.

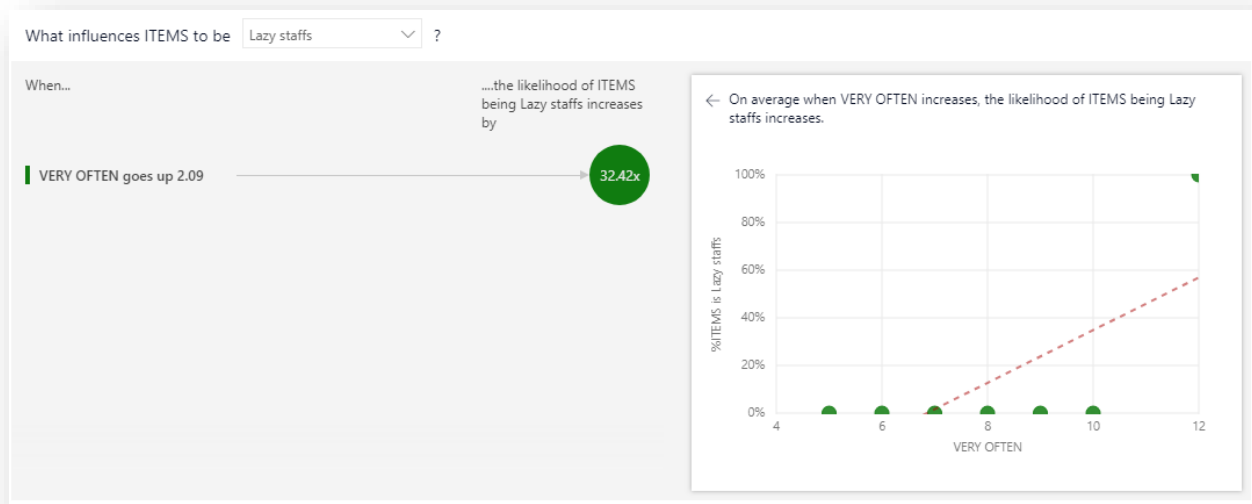


Figure 8 Lazy Staff

3. *Visitors do not know what they are searching for*: Figure 9 below shows that the more difficult it is to locate books or services in the library, the more the patrons/visitors do not know what they are searching for. The more this increases, the less likely it is that they will keep visiting the library. The graph already shows that,

on average, patrons that visit libraries within the story area find it hard to locate what they are looking for or do not what they are looking for.



Figure 9 Visitors do not know what they are searching for

4. *Providing information needed by visitors:* Figure 10 below shows when hard goes up by 0.74%, then providing the information needed by visitors becomes 8.27 times more difficult. On average as well, when hard decreases down the line, the likelihood of providing the information needed by visitors will automatically increase.

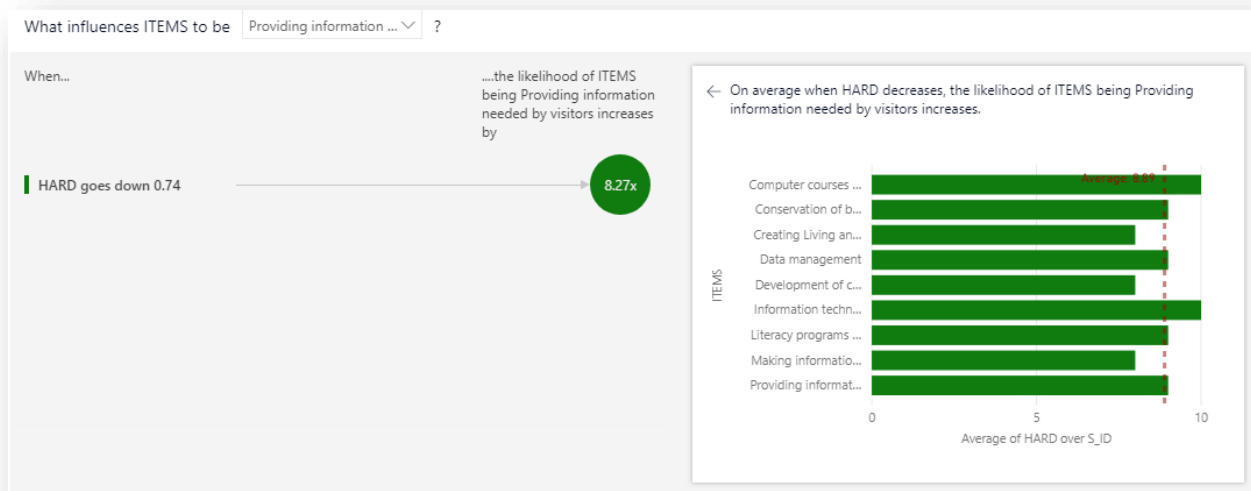


Figure 10 Providing information needed by visitors

3 Conclusion

It is realized that tacit knowledge works by focusing on one particular problem. For instance, when it was only descriptive, the knowledge that arises is very unstructured and contains a lot of noise that does not provide specific information [11]. Moreover, when a problem is more focused, tacit knowledge starts to emerge and can be recognized and structured into cognitive maps. Notably, the problem becomes a kind of anchor that allows tacit knowledge in a person's mind to be structured by that person and ultimately encourages a structured narrative that can be mapped. Moreover, the software that used only records with human agents thinking of causal relationships that can be formed into cognitive maps. Without human agents, existing transcripts are still unable to be processed in a structured way to be used as automatic data collectors for the benefit of business intelligence [12].

The process only requires three stages of data collection, namely interviews for problem exploration, questionnaires to detect informants who have tacit knowledge, and a second interview to explore tacit knowledge. This method is more practical than the Delphi method [13], which is commonly used to collect structured tacit knowledge data. The results of the data analysis show that the nodes in the cognitive map can be linked to certain keywords in the form of conjunctions, which provide clues in which direction the map will develop.

Although there are many conjunctions that are possible in constructing cognitive maps, the reading of these maps can provide a comprehensive picture in a single unit of tacit solutions to existing problems. Existing maps can then be collected in a repository that will be called when a problem arises and requires a tacit solution within a business organization. Therefore, the next research can deal with how this process works and leads to an excellent business intelligence model and validation and evaluation of the models found using prototypes and expert reviews, like our suggestions for further research.

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