

## Reuse of knowledge assets from repositories : a mixed methods study

Boh, Wai Fong

2008

Boh, W. F. (2008). Reuse of knowledge assets from repositories: A mixed methods study. *Information & Management*, 45(6), 365-375.

<https://hdl.handle.net/10356/100023>

<https://doi.org/10.1016/j.im.2008.06.001>

---

© 2008 Elsevier. This is the author created version of a work that has been peer reviewed and accepted for publication by *Information & Management*, Elsevier. It incorporates referee's comments but changes resulting from the publishing process, such as copyediting, structural formatting, may not be reflected in this document. The published version is available at: [<http://dx.doi.org/10.1016/j.im.2008.06.001>].

*Downloaded on 15 May 2021 22:05:14 SGT*

# **Reuse of Knowledge Assets from Repositories: A Mixed Methods Study<sup>1</sup>**

Wai Fong Boh<sup>2</sup>  
Nanyang Business School  
Nanyang Technological University

## **Abstract**

Reuse of information retrieved from an electronic knowledge repository and how this complements person-to-person interaction are poorly understood. I developed a research model that examined factors influencing how individuals benefit from reuse of knowledge assets. Using a mixed method approach, two empirical studies were conducted to test the model. The results showed that two key factors helped users to overcome difficulties in reusing knowledge assets: seeking assistance from and sharing a common perspective with the author of the asset. The study explains when and how individuals receive benefits from knowledge reuse. When individuals reuse complex knowledge assets in domains with which they are unfamiliar, they apparently gain more benefit by contacting the author; sharing a common perspective with the author also facilitates asset reuse. Thus both electronic repositories and person-to-person interaction mechanisms complement one another in facilitating knowledge sharing.

**Keywords:**                    **Knowledge Management System; Knowledge Sharing; Project-Based Organizations**

---

<sup>1</sup> An earlier version of this paper was presented at the Academy of Management Meeting in Honolulu in August 2005; it was nominated for the 2005 William H. Newman Award for Best Paper based on a Dissertation

<sup>2</sup> Contact details of the author:  
Wai Fong Boh  
Nanyang Business School  
Nanyang Technological University  
S3-B2A-14, Nanyang Avenue  
Singapore 639798  
(65) 6790 6196 (voice)  
(412) 6792 2313 (fax)  
[awfboh@ntu.edu.sg](mailto:awfboh@ntu.edu.sg)

# **Reuse of Knowledge Assets from Repositories: A Mixed Methods Study**

## **1. Introduction**

Organizations are increasingly using electronic repositories to retain and disseminate their knowledge, but repositories “often fall short of this goal” [14]. The factors affecting knowledge repository usage are not well understood. Recent work has placed significant emphasis on contributions to knowledge repositories [e.g., 15], system characteristics [e.g., 16], and conceptual principles [e.g., 1] of knowledge management systems (KMS). The implicit assumption is that technology with desirable characteristics will lead to effective use of the KMS, and thus many studies have focused on supplying the right information to employees who need it [26]. However, little is known about how they reuse the information. While knowledge creation and storage play an important role in building organizational memory, the process of knowledge retrieval, transfer, and application result in enhanced organizational performance. My study therefore examined the problem of knowledge reuse from repositories.

In particular, it seemed important to examine the problem of reusing knowledge that has not been structured to facilitate it [19]. The requirement to structure knowledge for reuse can be an extreme burden on the knowledge contributor and the time and energy involved makes it difficult to motivate contributions to the repository. Users, however, face more difficulties in reusing such knowledge assets, as they may not provide information on aspects of the knowledge to be transferred. Therefore, I investigated how knowledge workers reused knowledge assets not specifically created for reuse.

Knowledge reuse takes on a particularly significant role in service firms, such as consulting and software engineering, who develop their knowledge and capabilities through the execution of projects. Despite the lack of repetition across projects, common problems may be encountered. Effective sharing of knowledge can thus reduce duplication of effort in re-inventing solutions. The challenge is in matching problems encountered in a new project with solutions created previously. In the process of completing projects, individuals and groups produce deliverables and artifacts. These become knowledge assets of the organization, embodying the experience and learning of the organization.

To reuse knowledge assets from prior projects, individuals must search for a relevant set of assets, then conduct in-depth analyses to determine how the ideas can be adapted to meet the problem at hand [17]. The factors influencing the search process are distinct from those for evaluating and reusing the knowledge asset. Prior research has examined various design attributes of KMS [e.g., 20], but there has been little examination of the reuse of knowledge after it has been retrieved from the repository. Therefore, my study did not focus on the search but examined how individuals evaluated, understood, and applied the knowledge assets to improve their latest project.

The reuse of codified knowledge may not always result in performance improvements. Hence, I generated a model that identified factors influencing a successful reuse, resulting in perceived benefits. Theoretically, the study drew on Argote [2] and Szulanski's [25] framework, which suggested that four sets of factors were likely to ease knowledge transfer. A mixed methods research design consisting of two field studies was used to understand electronic knowledge repository usage in an IT consulting firm and then to test the model.

## **2. Theory and Hypotheses**

Prior research suggested that four sets of factors were likely to affect the ease with which knowledge was shared or transferred:

- (1) Its characteristics;
- (2) characteristics of the person seeking it,
- (3) characteristics of the person providing it, and
- (4) characteristics of the relationship between the knowledge provider and seeker.

This framework has been used to study knowledge transfer between organizational units. I use this framework to guide my study. The dependent variable of concern was the extent to which perceived benefits are obtained by reusing the knowledge asset.

## **2.1 Characteristics of the Knowledge Asset**

Knowledge that evokes more causal uncertainties and requires multiple attributes to describe is more complex and difficult to reuse [9]. Complexity can play a significant deterrent role; people need to understand it before they can reuse knowledge. The more a knowledge asset draws on ideas and information in different domain areas, the more difficult it is to reuse. People need to understand how the different areas relate when information crosses domain boundaries. It is also more difficult to create a complex document so that all the information is complete and understandable [24]. Gaps between information needed and available thus tend to appear.

## **2.2 Characteristics of the Knowledge Seeker**

Prior studies have suggested that the knowledge seeker's absorptive capacity affects his or her ability to recognize the importance and value of new knowledge, to assimilate the knowledge, and to apply it to the problem at hand. Absorptive capacity is a function of the knowledge seeker's preexisting knowledge [6]. Psychological studies have found that accumulated knowledge increases both the acquisition of new knowledge, and the ability to recall and use it. The process of associative learning establishes linkages between new ideas and pre-existing concepts, allowing individuals to acquire and understand it more effectively. As a result, learning is generally more difficult in novel domains and most effective when the object relates to what is already known. Thus familiarity of the user with the knowledge domain should play a key role in knowledge reuse. When users are not able to obtain all relevant aspects of the knowledge, those more familiar with the domain can better handle any missing information by using prior experience in different contexts to interpret the knowledge and thus making appropriate assumptions to assimilate and apply the knowledge. However, users with low domain familiarity have greater difficulty in reusing knowledge assets, due to a lack of prior knowledge that allows effective assimilation of the knowledge asset.

## **2.3 Moderating Role of Person-to-Person Interactions**

When the knowledge asset is complex or users are unfamiliar with the domain, there are significant challenges in reusing the asset. To overcome the difficulties, users can contact authors of the knowledge

assets directly for clarification and discussion. Effective sharing of knowledge in organizations is difficult, and trying to divorce the knowledge from the person possessing it makes this it even more difficult. Hence, it is important to complement the use of knowledge repositories with person-to-person interaction.

Knowledge seekers who capitalize on this opportunity to create a direct linkage with the knowledge providers will benefit more in using the asset. Prior research has noted that dyadic interactions are superior to using published sources in enhancing knowledge adaptation [11]. Knowledge seekers who seek assistance from the authors obtain in-depth information and explanations about the asset, enabling them to better appreciate complex knowledge and adapt it to their problem. Hence:

H1a: The greater the complexity of the knowledge asset downloaded from a knowledge repository, the more likely users will obtain greater perceived benefits from reusing the asset if they seek assistance from the author(s) of the asset.

Individuals who do not have significant knowledge about a domain also benefit significantly from interaction with authors; users can seek clarifications and advice about how the knowledge can be tailored to their specific situation, enabling better appreciation and utilization of the knowledge. Hence:

H1b: Users who are less familiar with the task domain described in the knowledge asset downloaded from a knowledge repository are more likely to obtain greater perceived benefits from reusing the asset if they seek assistance from the author(s) of the asset.

## **2.4 Characteristics of the Knowledge Provider: Source Credibility**

Source credibility refers to the extent to which a knowledge provider has the relevant expertise and whether she or he is in a position to provide knowledge in the domain. This has a significant influence on the opinions and behavior of users and has been found to increase user acceptance of recommendations from expert systems and improve knowledge transfer [18]. When source credibility is high, knowledge recipients are likely to be more open and receptive to information from the knowledge provider; ideas in the asset are perceived to be worthy of consideration. The knowledge conveyed is thus more likely to be seen as useful, and to influence the behavior of the recipient. On the other hand, when source credibility is

low, the advice or knowledge is more likely to be challenged and resisted and therefore recipients are likely to discount it [8]. Therefore,

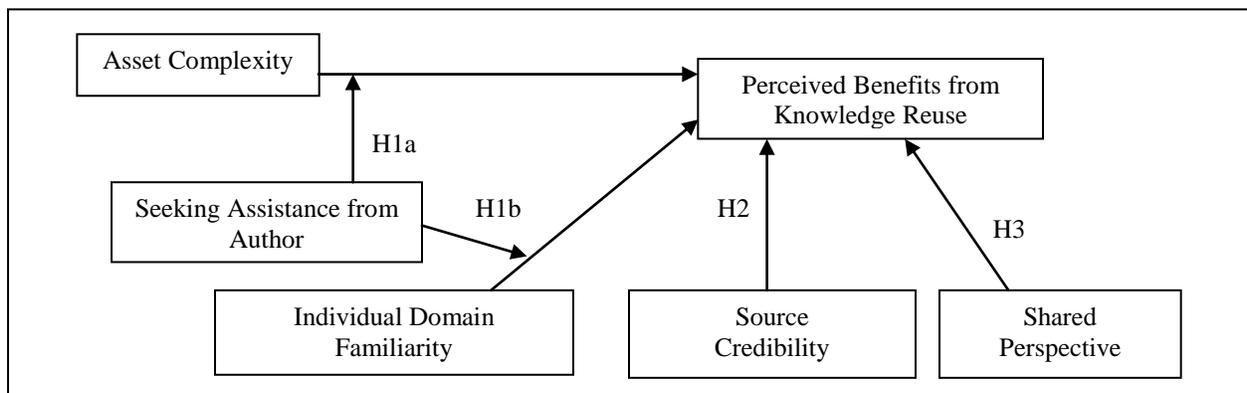
H2: Individuals are likely to obtain greater perceived benefits from reusing knowledge assets authored by a credible knowledge source.

### 2.5 Characteristics of the Source-Recipient Relationship: Sharing a Common Perspective

Prior research suggested that knowledge sharing between people with only limited common knowledge is difficult, whether automated or face-to-face; indeed the IT systems provide a less “rich” medium of communication due to the loss of social cues. Exchange between individuals is enhanced by shared terminology, concepts, and frames of reference. Having a common language – codes, symbols, anecdotes, and rules – helps individuals develop shared meanings to facilitate effective communication [21]. Sharing enough background knowledge also renders messages more meaningful and less channel richness is required. Thus:

H3: Individuals who have a higher level of shared perspective with the author of the downloaded knowledge asset are likely to perceive more benefits from reusing the asset.

Figure 1. Overall Research Model



### 3. Methodology

A mixed methods research design was used to test the hypotheses; it consisted of two field studies examining the use of electronic knowledge repositories in an IT consulting firm. First, an in-depth analysis of interviews with 25 consultants was conducted to test the plausibility of the arguments and to

provide an understanding of how employees reused knowledge from prior projects stored in electronic repositories. The second study involved a more formal test of the hypotheses using data collected through an event-driven survey.

The organization, CI (a pseudonym), does management and technical consulting work. It has more than 50,000 employees in several countries and in different locations within the U.S. Like other professional service and technical organizations, consulting firms regard knowledge as an essential resource. It is important for them to share and utilize their knowledge resources. The temporary and customized nature of projects in consulting firms makes it challenging to ensure knowledge sharing across time and projects. Employees tend to be geographically distributed because the consultants need to work closely with clients. Hence, CI has invested in a centralized repository, where individuals deposit the knowledge artifacts created while completing engagements. In addition, many business units or communities of practice have localized repository to facilitate sharing of knowledge assets more specific to the local practice or its country. The first study examined how individuals reused knowledge assets in the centralized repository. The second focuses on the use of a localized repository to test whether the preliminary results from the centralized repository were applicable in the localized repository.

#### **4. Qualitative Study**

##### **4.1 Description of the Centralized Repository**

The centralized database was started about 6–7 years before my study. As of 2004, the centralized repository had about 50,000 knowledge asset contributions. To make a submission, consultants had to fill in a form providing a brief description or abstract of the asset. The documents or artifacts were then submitted as attachments with minimal amendment except for removal of client-sensitive information. The repository served consultants who helped customers to implement IT systems and manage IT resources. The repository provided examples of customer projects, and stored prior proposals and work products (e.g., project deliverables) for consultant reuse.

The centralized repository was subdivided into 70 smaller *knowledge networks*, with each focusing on a different topic area. The assets in each was managed and reviewed by a core team of 15 to

120 consultants. Each submission was reviewed by a core team to determine whether it should be accepted. The core teams also maintained and kept the knowledge assets up-to-date by encouraging the submissions of new material. Some knowledge networks were funded by management, others were developed voluntarily. Funded knowledge networks were maintained by a couple of staff members who managed the technical and infrastructural aspects of the network, produced newsletters, and organized conference calls and presentations. The content management responsibilities were retained by the core team members, who contributed to the activities in their free time. Core team members were motivated to contribute their time and energy as it provided recognition of their expertise. As part of the reward system to encourage contributions to the repository, the performance review of consultants included *soft aspects* (i.e., good-to-have aspects of performance) such as whether individuals gave back to the profession. The submission of knowledge assets was recognized as one way to contribute to the profession.

#### **4.2 Methodology for the Qualitative Study**

While based in one of the offices of CI for two months, I collected data using semi-structured telephone interviews with employees in different cities in the US. Five knowledge management staff supporting the centralized repository were first interviewed; they provided an overview of the context and use of the electronic repository. Based on their recommendations, thirty-four consultants were contacted and invited to participate in phone interviews. 25 responded; 20 were consultants or project managers, two were IT architects, and three were IT specialists. Their average company tenure was almost 12 years. There were no significant differences in job types and organizational units between respondents and non-respondents.

The consultants were interviewed about their experience in reusing knowledge assets, focusing on one recent incident. Interviewing respondents about a reuse incident allowed me to probe the circumstances surrounding it in depth [4]. Each interviewee was asked to explain the background and context of the project, what types of knowledge assets they reused, how they used it, and how the reuse helped or affected their work. Each interview lasted for about 45 to 60 minutes. Copious notes were taken during the interviews and transcribed within a day.

### 4.3 Analysis of Qualitative Data

The interview data was coded using the five factors identified in the research model.

**Complexity of Knowledge Asset.** Table 1 lists the eight types of knowledge assets that interviewees reported reusing. Different types of assets differ in their level of complexity and ease of reuse. Two company experts providing internal knowledge management support (who were not interviewees) rated the complexity or difficulty of reusing the different types of assets by indicating, per Gosain [10], for each type of knowledge asset, the extent to which they agreed that a new practitioner, without external help:

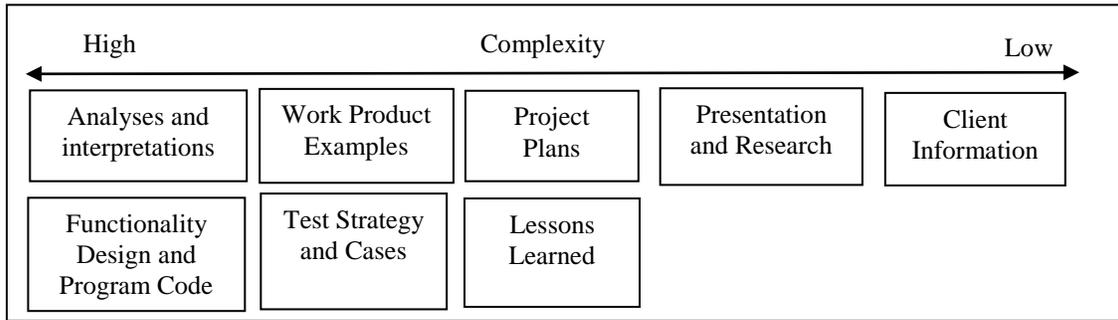
- Would need to spend a time in understanding and reusing each type of knowledge asset;
- Would need to understand many different areas to be effective in reusing each type of asset,
- Could easily understand and reuse each type of asset.

**Table 1. Description of Knowledge Assets Identified in Qualitative Study**

<b>Knowledge Asset</b>	<b>Description</b>
1. Functionality design and program code	Architectural designs of systems and software code
2. Analyses and interpretations	Project reports providing analyses, interpretations and recommendations about the strategies and plans of an organization.
3. Work product examples	Deliverables to the clients – such as project reports, frameworks, roadmaps, etc.
4. Test strategy and cases	Cases for and approaches to systems testing
5. Project plans	Documents describing the project plans – including processes, milestones, budgets, etc.
6. Lessons learned	Documents noting lessons learned from a particular project
7. Presentation and research	Client presentations and research about trends in a particular industry
8. Client information	Information about clients and competitors

Figure 2 shows the relative complexity of the assets, based on the average responses of the two experts. Knowledge assets rated above three were classified as having high complexity in Tables 2 and 3..

**Figure 2. Types of Asset and Their Complexity Ratings**



Factual information or that about customers was least complex and easiest to reuse. On the other hand, analyses and reports not created for reuse were more complex and difficult to reuse. CI reused a significant number of project documents and assets, such as project proposals, plans, client presentations, client reports, software code, system architectures, system test cases, etc. The more complex assets required multiple attributes to describe them and had more causal uncertainties between the multiple attributes so that more information was required to understand the assets. For example, the blueprint specifying the design of a major IT system was highly complex. To comprehend its design, consultants and developers had to understand the system requirements and how they translated into the different components and modules of the system.

**Domain Familiarity of the Knowledge Seeker.** The extent to which interviewees were familiar with the domain they were reusing was coded to allow examination of any differences in the complexity of the assets reused by interviewees with different levels of familiarity. Table 2 shows the initial coding results; the number in each quadrant represents the number of incidents in which individuals with high or low familiarity in the task domain reused the knowledge assets.

**Table 2. Knowledge Complexity and Individual Familiarity of Reuse Incidents**

	Complexity Low	Complexity High	Total
<b>Familiarity Low</b>	1	6	7
<b>Familiarity High</b>	13	5	18
<b>Total</b>	14	11	25

The results suggested that most users had high familiarity with the domain of the assets being reused but there were a significant number of incidents in which users were not familiar with the domain.

Consultants were tasked to work on a new domain for various reasons, such as work with repeat customers, or product changes requiring the team to learn a new domain area in order to continue to service the client. As highlighted by one interviewee:

*“I think you need a certain amount of knowledge in an area before you can intelligently and efficiently make use of a document in the knowledge database... From the [database], you will never be able to get anything that is plug and play. You will always need to customize it and that is why we are recruited to add value to the work.”* [Consultant A]

Cases were then reviewed in detail to examine how individuals reused complex knowledge assets when they had little familiarity with the domain area.

**The Moderating Role of Person-to-Person Interactions.** Individuals who had low familiarity with the domain of the knowledge assets faced significant challenges in reusing them, especially if they were complex. In such cases, they often contacted the authors of the asset. Electronic documents and assets did not only convey content information and knowledge that applied to the users’ work, they also contained information about who produced the asset. Individuals could thus obtain help and assistance in using and understanding the assets, and they could make use of both knowledge repositories and person-to-person interactions in a complementary manner when trying to understand and apply knowledge to their problem. Interviewees explained why they followed up with authors of knowledge assets:

*“I like to call them up to get a greater understanding of the context surrounding the work they submitted to the database. Moreover, ... people won’t take the time to make the work products more generic and reusable. So I would typically need to call the person to get a greater understanding of what’s going on.”* [Consultant B]

Some interviewees said that it was individuals with low familiarity in a domain area that needed most help:

*“It depends on the people – their seniority and experience. If people are in organization design for several years, and they are already familiar with the theory and structure of engagements in this area, they would need very little help, and can probably understand the knowledge assets pretty well. Others*

*who have less intuition about why things are the way they are would need more advice and training... An experienced practitioner will look at an asset and probably think this is similar to what I am already doing. A junior person, on the other hand, will be treating this asset more like a recipe book. They have no perspective and experience to draw on to distill the principles behind the asset."*

[Consultant C]

The interview data were coded for the number of incidents in which users approached the authors for help in reusing the assets. Table 3 shows the results of these analyses.

	Complexity Low		Complexity High		Total
	Assistance Sought	No Assistance Sought	Assistance Sought	No Assistance Sought	
Familiarity Low	0	1	6	0	<b>7</b>
Familiarity High	0	13	1	4	<b>18</b>
<b>Total</b>	<b>0</b>	<b>14</b>	<b>7</b>	<b>4</b>	<b>25</b>

The number in each quadrant represents the number of incidents in which users with high or low familiarity reused knowledge assets of high or low complexity and the number of incidents in which users approached the authors of the assets. They sought assistance in all six incidents in which the assets were highly complex assets and in a domain with which they were unfamiliar--thus complementing the use of knowledge repositories with person-to-person interaction. The assistance ranged from a simple clarification email to more interactive phone conversations, holding face-to-face meetings, and workshops, or even moving the author into the project team. In five of the six cases, individuals reported benefits from knowledge reuse; in the sixth, the asset was so complex that even approaching the authors for help did not make it easier to reuse the information: the interviewee felt that the cost savings in reusing the asset were *"mostly eaten up by the learning curve [her] team went through to get up to speed."* These results provide preliminary support for hypotheses H1a and H1b that approaching the authors to complement the use of knowledge assets increased the perceived benefits from knowledge reuse when the knowledge asset was complex and also when the users were not familiar with the domain.

User's prior social interaction with the author of the asset was also examined to determine its effect on the user's propensity to seek further assistance and clarification. Of all cases where users followed up with authors, three previously knew the authors. For the 18 cases in which users did not seek assistance, four knew the authors. Interviewees, however, pointed out that they would readily approach authors for assistance even if they did not know them, because it was rare for users to know the authors:

*“There are more than 5,000 project managers in this organization. Being project managers, it is rare that we will work together on the same projects. So we have few chances to get to know each other well.”* [Project Manager D]

### **Relationship between Knowledge Source and User – Sharing a Common Perspective.**

Having a shared schema or common perspective aids users in understanding the knowledge embedded in the asset. CI trained all its consultants in a common methodology for project management and their set of proprietary methodology or tools and frameworks. Consulting firms normally have their own set of proprietary methods and tools. CI's methodology set is an encapsulation of many best practices that the firm had found to be effective, based on thousands of engagements. This set of methodologies serve as a common language and approach to thinking about problems and helps in sharing knowledge and experience across projects.

Internalization of the methodologies help consultants find and use prior work products; for example, a complex engagement that follows a particular methodology is more easily understood by peers who know the methodology and how different components of the model relate to one another. The standardized methodology thus helps consultants understand available knowledge assets. The interviewees, for example, highlighted the use of shared schemas and experience, providing some preliminary support for H2:

*“Since we have been trained the same way, everyone was speaking the same language instantly. This is extremely helpful for reusing documents that are based on the same process frameworks.”* [Project Manager E]

*“It generally takes time for people to be trained in the methodologies. I think it is key for competing in a globalized environment. We work in an environment that is in constant change. We need to have experience reports from others, otherwise it can introduce risk for the things that you do not project, and these methodologies help provide a common framework for us to share these experience reports.”* [Project Manager F]

**Credibility of Knowledge Provider.** To examine the influence of source credibility, interviewees were asked how they would assess it. Responses were mixed. Some said that there was no way they could adequately establish credibility of the source, due to the size of the community and lack of knowledge of the author:

*“Basically, I would need to review the documents. There is no way to establish credibility by looking at who the author is, because there are thousands of consultants in Consulting Inc. Especially since we are distributed all over the world, it is really impossible to know consultants beyond those whom you regularly work with.”* [Project Manager G]

*“It is difficult to establish the credibility of the author, since we do not know them. Reusing knowledge assets from repositories is not like reusing assets from your departments, where you know who the authors are and where their expertise lies. Although we do have an expertise directory, the information there is provided voluntarily and unverified”* [Consultant D]

Others noted that they tried to assess the credibility of an author, when possible, by calling him or her to evaluate the source level of expertise:

*“I look at the author. Sometimes, if the author is someone who has frequently contributed to the repository, or I have read his work before, I would be more comfortable with reusing his work in this case. Sometimes, I would just call up the author of the document. You will be able to get a sense of whether this person knows what he is writing about by talking to him.”* [Consultant E]

Thus there was little support for H3, as it appeared that source credibility was too hard to assess and may not play a salient role in influencing effective reuse of knowledge assets in large communities.

## **5. The Quantitative Survey**

To formally test the hypotheses and research model, an event-driven survey was conducted, examining a different community in CI. The survey was sent to each participant every time she or he downloaded a knowledge asset from the repository. The survey items are shown in Appendix A.

### **5.1 Description of Local Repository**

The knowledge repository used in the event-driven study was local and not linked to the central repository used in the qualitative study. This local repository focused on issues surrounding the development and implementation of a product (System X) of CI. Developers and consultants who were involved in developing System X or helping clients implement it formed a community of practice sharing information about its administration, design, architecture, etc. The community was sponsored by the management executives of a CI business unit. The community had two full-time staff members to provide internal support for various community activities (e.g., supporting its infrastructure, moderating forums, publishing newsletters, organizing conference calls, etc.). The electronic repository was used to promote reuse among its members. Membership in the community had steadily increased since it was established two years prior to the beginning of this study; at the time of this study it had 5,610 members, 58% of whom were from in the U.S. and about half were active users

The local repository stored two types of material: lessons learned (documents describing experiences and solutions to non-trivial issues) and reusable assets (e.g., components, utility classes, object models, architectures, and designs). At the time of the study, the community had about 220 reusable assets and 310 lessons learned in its repository.

**Local vs. Centralized Repositories.** Local repositories collect information about a particular topic (e.g., practitioners developing, implementing, and maintaining specific systems). Their assets are rarely applicable to users who do not practice in the topic area. Contributions to them are seldom reviewed; hence the process of submission is much faster than the typical two-week time required before storing contributions in the central repository. Focusing on one domain area makes it less cumbersome for practitioners to search and locate articles in local repositories. The downside of local repositories,

however, is that they are hidden, as they are relatively invisible to irregular users who must search through many databases to find possible assets.

Examining the two repositories in different studies allowed me to determine whether the proposed model was applicable to repositories with different characteristics.

## **5.2 Response Rates and Sample Characteristics**

During this four-week research period, 651 people downloaded assets from the repository. The number did not include individuals who visited the repository but did not download knowledge assets. A little under half (295) of these were sent invitations to participate (they had agreed to being contacted by community leaders when they joined). No significant differences were found in the job types, number of downloads, and characteristics of the assets downloaded for people invited or not invited to participate. No unusual events occurred during this four-week period. Within two weeks after they downloaded an asset, potential respondents were sent a web-based survey that asked them about the asset they downloaded and how they made use of it. Three experts providing knowledge management support to the community had reviewed this survey instrument before it was distributed. Minor changes in wording, based on their suggestions, were incorporated into the final version of the questionnaire.

The web survey sent to each of the 295 participants listed the assets that they had downloaded: of the 121 responses (a 41% rate), 90 downloaded only one knowledge asset during the period and 31 downloaded more than one, in which case, they were asked to identify one asset and respond to the survey based on it. There were no significant differences between the characteristics of respondents and non-respondents and there was no significant difference in the usefulness ratings by individuals who made one download than those who made more than one ( $t = 0.137$ ,  $p = 0.891$ ). Since my study examined how individuals reused assets from prior projects in solving problems for their current project, only 103 of the responses were valid and included in the analyses.

## **5.3 Independent and Dependent Variables**

**Perceived Benefits from Asset Reuse.** To determine whether practitioners obtained benefits from reusing the knowledge asset, they were asked to indicate if the downloaded asset provided the

following benefits: (1) reusable intellectual capital (e.g., code, patterns, or architecture), (2) prevented the respondent from making mistakes that others had made, (3) saved time, and (4) increased customer satisfaction. In addition, drawing upon Constant, et al. [7], they were also asked to rate the usefulness of the asset in helping them solve their problem.

**Knowledge Asset Complexity.** The complexity of the asset was measured with Gosain's complexity measure. Of the 38 knowledge assets downloaded, 18 were rated by more than one respondent. To examine if there was a significant difference in using an asset-level *versus* individual-level rating of complexity, the complexity ratings of all respondents for each asset were averaged to obtain an asset-level measure of complexity. This correlated highly ( $r = 0.92$ ,  $p < .001$ ) with the complexity measure calculated from the ratings for each respondent.

**Individual Domain Familiarity.** Respondents' familiarity with the task domain was measured by asking respondents to rate their knowledge of with the domain area of the downloaded asset. Respondents were also asked how many years they had worked in the area. Both were use in measuring individual domain familiarity.

**Assistance Sought from the Author.** Respondents were asked to indicate how many hours, if any, they spent following up with the author of the asset. Respondents were also asked to indicate if the asset helped them to identify a critical expert who could provide advice and explanations and if it helped them to enhance their professional network.

**Similarity of Job Type.** The qualitative study described how standardized methodologies helped create a shared perspective in a domain area. For the quantitative study, the extent to which the respondent has a shared perspective with the author was measured by using a proxy that indicated whether respondent and author had a similar job type. While this was not a direct measure, it was a reasonable proxy, because the two were more likely to have undergone the same type of training and have a common language with similar experiences if they had the same job type. Bechky [3] stated that occupational communities tended to specialize in a specific set of tasks, and that these resulted in the

formation of a set of perspectives that could be specific to an occupation. Sharing knowledge across occupational community can thus be a problem, due to diverse experiences and training.

To determine the similarity in jobs of the knowledge source and recipient, they were classified into seven types: consultant, developer, IT architect, IT specialist, project manager, sales personnel, and support staff. Two independent raters categorized the job type of each survey respondent and each asset author, based on the job titles and descriptions obtained from CI's online organizational database. Inter-rater reliability was high ( $\alpha=0.91$ ). For each respondent, his/her job type was compared to the job type of the author of the asset downloaded and thus coded whether or not their job types were similar.

**Source credibility.** As the community is large and geographically dispersed, individuals seldom know one another personally. To determine a way to operationalize source credibility [22], two users of System X were asked how they would assess the credibility of asset authors. Interviewees replied that they would determine whether the author had previously made contributions to the repository and the quality of the prior contributions. In addition, System X had a discussion forum used by community members to pose questions on issues they were facing and to obtain advice and solutions. Thus another way would be to find whether the member has actively participated in the forum and provided useful advice to others. Based on such inputs, source credibility was thus measured as construct of three variables (1) the number of prior contributions made by the author; (2) the average number of downloads per asset for the other contributions made by the author; and (3) the number of solutions suggested by the author in the community forum over the past year. To test the validity of this measure, a listing of 10 contributors, ranked according to the measure for source credibility (selected to ensure sufficient range), was given to one of the knowledge management experts who knew the contributors. He was asked whether the ranking conformed to his perceptions, and he agreed with it.

#### **5.4 Control Variables**

**Task Routineness.** Prior research has found that organizations whose work and products are standardized tend to benefit more from knowledge-sharing strategies that focus on knowledge codification [12]. On the other hand, organizations whose work is non-routine tend to benefit from using

person-to-person knowledge-sharing strategies. Similarly, individuals whose work is routine may benefit more from knowledge reuse than those who encounter a wide variety of problems in non-routine work. Hence, the task variability of individuals making downloads should be controlled in the analysis.

One major difference in the work of the respondents was whether they were sales personnel, helping customers design or implement System X (consultants, IT specialists, IT architects, etc.), or developer or support staff. The work for practitioners in sales, design, and implementation tended to be less routine, as their work was more unstructured and included interactions with customers. Development and support tasks were more routine in nature; they generally involved more structured programming and debugging tasks. Hence, to control for task variability, an item indicating whether the respondent was a developer or a support staff or involved in the sales or implementation of System X was added.

**Prior Relationship with Author.** To control for prior relationship with the author, respondents were asked how well they knew the author. The scale for this question included the answer to one of the following: (1) know him/her well, (2) have communicated with him/her before, (3) previously heard his/her name, or (4) do not know him/her.

**Number of Downloads.** Information on the number of times each asset was downloaded was used to determine the popularity of the asset that the respondents rated.

**Type of Download.** The two types of assets stored were “reusable assets” and “lessons learned.” A variable was added to show which type was downloaded .

**Experience with Using the Repository.** To control for respondent experience in reusing knowledge from the repository, respondents were asked how often they made use of the two types of assets. This controlled for the possibility that individuals familiar with the database were more skilled in reusing knowledge from the repository.

## 5.5 Test of Factors

**Formative vs. Reflective Indicators.** When items used to measure a construct do not necessarily covary, they are *formative* indicators. In contrast, *reflective* indicators tap into the same underlying factor and tend to covary with one another. The individual domain familiarity and source credibility constructs

were formative measures, as different items measuring them could not be expected to covary. The other constructs tap into the same underlying factor and thus can be considered reflective.

**Content Validity.** Content validity was qualitatively assessed by reviews of experts. Three users from Community X were asked to participate in a conceptual validation exercise, based on procedures of Moore and Benbasat [23]. Each user was given the fifteen survey items in randomized order. They were asked to sort the questions by grouping those corresponding to a construct together in a set and then to give a label to each set. The labels given by the five users corresponded closely with the actual constructs. Only one item (Assistance02 – measuring assistance sought from an author) was not consistently placed in its construct. Hence, it was dropped from the analysis.

**Convergent and Discriminant Validity.** Principle components analysis was conducted for the four multi-item reflective constructs. The results are shown in Table 4. All items loaded highly on their factors (loading > 0.5). Reliability of the survey instrument’s items was also quantitatively validated by calculating Cronbach alphas for each construct. The standardized alphas, shown in Table 5, ranged from 0.74 to 0.94, and are greater than Nunnally’s threshold. Convergent validity was demonstrated: the correlations of all items measuring the same construct were significantly different from zero at the 0.001 level of significance. Discriminant validity was demonstrated because an item correlated more highly with items intended to measure the same factor than with others. The analysis showed this.

**Table 4. Results of Principle Components Analysis**

	<b>Perceived benefits from asset reuse</b>	<b>Asset complexity</b>	<b>Assistance sought from author</b>	<b>Experience with using repository</b>
<b>Benefits01</b>	<b>0.85</b>	0.14	0.05	0.03
<b>Benefits02</b>	<b>0.81</b>	0.04	0.03	0.02
<b>Benefits03</b>	<b>0.87</b>	-0.05	0.13	-0.01
<b>Benefits04</b>	<b>0.84</b>	0.09	0.21	0.10
<b>Benefits05</b>	<b>0.83</b>	-0.19	0.29	0.04
<b>Complexity01</b>	-0.01	<b>0.96</b>	0.15	-0.03
<b>Complexity02</b>	-0.006	<b>0.92</b>	0.20	0.06
<b>Complexity03</b>	0.07	<b>0.91</b>	0.21	-0.08
<b>Assistance01</b>	0.33	0.37	<b>0.81</b>	-0.13
<b>Assistance03</b>	0.28	0.49	<b>0.77</b>	-0.00
<b>ReUseExp01</b>	0.02	0.03	0.06	<b>0.90</b>
<b>ReUseExp02</b>	0.09	-0.07	-0.14	<b>0.87</b>

**Table 5. Reliability of Factors**

Construct	Number of Items	Cronbach Alpha	Standardized Alpha
Perceived Benefits from Asset Reuse	5	0.86	0.91
Asset Complexity	3	0.94	0.94
Assistance sought from author	2	0.89	0.90
Experience with reusing assets from repository	2	0.74	0.74

**Common method bias.** To address possible common method bias effects, Harman's single-factor test was performed [13]. Unrotated factor analysis using the eigenvalue-greater-than-one criterion revealed seven factors, and the first explained only 24.1 percent of the variance in the data.

## 5.6 Analysis and Results

The research model and hypotheses were tested using PLS-based SEM. The measurement model of PLS showed that the loadings of individual items loaded highly (>0.70) in their respective constructs. Table 6 displays the descriptive statistics and correlation analysis of the constructs used to test the hypotheses. The diagonal cells are the square root of Average Variance Extracted (AVE) and the off-diagonal cells are the correlations between constructs. Table 6 shows that the values in the diagonal cells are higher than all the others in the same row, indicating high discriminant validity for the constructs.

**Table 6. Correlations of Factors**

	1	2	3	4	5	6	7	8	9	10
1. Perceived benefits from asset reuse	0.85									
2. Assistance sought from author	0.45	0.95								
3. Individual domain familiarity	0.12	-0.15	0.82							
4. Asset complexity	0.11	0.57	-0.05	0.86						
5. Similarity in job type	0.20	0.06	-0.06	-0.01	N.A.					
6. Source credibility	0.22	-0.07	-0.05	-0.33	-0.01	0.59				
7. Experience with using repository	0.10	-0.11	-0.04	-0.12	-0.07	0.06	0.89			
8. Task routineness - Developer	0.08	-0.01	-0.08	-0.12	-0.02	0.19	-0.01	N.A.		
9. Prior relationship with author	0.11	0.24	-0.22	0.12	0.13	0.19	-0.16	0.04	N.A.	
10. Number of downloads <sup>3</sup>	0.14	-0.06	0.00	-0.18	0.19	0.62	-0.02	0.04	0.18	N.A.
11. Type of download - Reusable asset	-0.14	0.06	-0.08	0.12	0.13	-0.28	-0.08	-0.17	-0.09	0.05

The results of the PLS analyses are given in Table 7. The indicators of each interaction variable were obtained by multiplying all indicators of the two interacting factors [5]. This shows that Model 1

<sup>3</sup> Number of downloads are in hundreds.

explained 38.9% of the variance in the dependent variable. Adding the interaction effects explained an additional 2.6%.

While Model 1 showed that those users who sought assistance from asset authors perceived more benefits from reuse (Model 1, path coefficient = 0.57,  $p < 0.01$ ), Model 2 showed that users who were seeking to reuse complex assets obtained the most benefits from reuse by seeking assistance from authors (Model 2, path coefficient = 0.41,  $p < 0.05$ ). This supports H1a. Model 2 showed that users who were less familiar with the task domain obtained more benefits from reuse by seeking assistance from authors, but this effect was not statistically significant (Model 2, path coefficient = -0.12,  $p > 0.10$ ). Hence, H1b was not supported. In addition, the results showed that individuals who had the same job type as the author were likely to perceive more benefits from asset reuse (Model 2, standardized score = 0.20,  $p < 0.05$ ), providing support for H2. Source credibility, on the other hand, had a positive but insignificant effect on the perceived benefits from asset reuse (Model 2, standardized score = 0.19,  $p > 0.10$ ). Hence, H3 was not supported.

**Table 7. Results of PLS Analysis**

	<b>Model 1</b>	<b>Model 2</b>
	<b>With only Main Effects</b>	<b>With Interaction Effects</b>
Experience with using repository	0.15 (0.09)	0.13 (0.09)
Task routineness - Developer	0.05 (0.08)	-0.01 (0.09)
Prior relationship with author	-0.01 (0.10)	-0.03 (0.10)
Number of downloads	0.00 (0.11)	-0.04 (0.11)
Type of download - Reusable Asset	-0.09 (0.08)	-0.11 (0.08)
Asset complexity	-0.10 (0.15)	-0.05 (0.15)
Individual domain familiarity	0.23 <sup>+</sup> (0.12)	0.14 (0.11)
Assistance sought from author	0.57** (0.12)	0.07 (0.27)
Similarity in job type	0.20* (0.10)	0.20* (0.08)
Source credibility	0.20 (0.14)	0.19 (0.13)
Asset complexity * Assistance sought		0.41* (0.20)
Familiarity * Assistance sought		-0.12 (0.14)
R-square	38.93	41.57

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

Since respondents who downloaded the same knowledge asset were rating the usefulness of the same asset, the responses may not be independent. To test whether the non-independence of responses would affect the results, a sensitivity test using SAS Proc Mixed (equivalent to using Hierarchical Linear Modeling) was conducted, estimating random effects for each asset with the factor scores for multi-item constructs. There were no significant differences in the results of the Proc Mixed and the PLS analyses.

## **6. Discussion**

My study highlighted the need to recognize that social processes can complement the use of knowledge sharing mechanisms. The repository serves as a referral system for individuals to identify others they can approach for help and advice. When individuals seek assistance from authors, they can gain more benefits from reusing the knowledge asset, especially when the asset is complex. In the survey, respondents were asked to indicate all reasons for contacting the authors. Almost all sought assistance indicated that they wanted to understand the knowledge assets; about 72% also approached the author to find out if similar types of assets also existed. In addition, a common perspective between the knowledge source and recipient help users assimilate and apply the knowledge from the asset, thus generating more perceived benefits from reusing it. The qualitative study showed that training consultants in proprietary frameworks helped them create common interpretative schemas and thus interpret the knowledge. It also showed that when users and authors had the same job type, they tended to have a common perspective, which enabled users to reuse the knowledge in the asset more effectively. Source credibility was not found to influence the perceived benefits of using the knowledge assets.

### **6.1 Limitations**

My research was subject to several important limitations. First, the data collected is cross-sectional in nature. Hence, while the existence of a statistical relationship among the variables can be tested, conclusions about the direction of causality cannot be drawn. Second, as the data was gathered from a single organization, the findings may thus may not be generalizable. To mitigate both limitations, a multi-method approach was adopted and two different communities making use of two different repositories were examined. Hence, this paper examined whether the results were applicable in two

different contexts, though both within the same firm. Third, the effect of the characteristics of the repository was not investigated because each study examined how individuals used a single repository. Because the nature of the repository was controlled for across all cases within each study, there was no variation in its characteristics. Finally, my research focused only on short-term benefits of approaching authors of assets for help. There may be a value in follow-ups leading to long-term benefits.

## **6.2 Contributions and Implications**

*Implications for Research.* Factors influencing the usage of electronic repositories are not well understood. The assumption has been that having technologies with desirable characteristics and ample contributions will result in effective knowledge reuse. How users value the information they locate in an knowledge repository, however, has received little attention. I examined reuse incidents, focusing on the process of evaluating and applying the knowledge retrieved to solve problems in real projects. This paper thus takes a first incremental step to building theory on knowledge reuse. It also provides some insights into complementing the use of knowledge repositories with person-to-person social interactions.

*Implications for Practice.* Organizations need to recognize that sharing knowledge based on direct interactions between two individuals offers many advantages over trying to share knowledge by codifying it and divorcing it from any individual. Thus, instead of trying to share knowledge using only the codified knowledge found in repositories, organizations can try to facilitate personal contact between users and authors when the need arises; for example, users would probably not have obtained as much benefits in 22% of the cases in the survey if they had not contacted the authors of the asset. Creating a common perspective between the knowledge provider and knowledge seeker is also important in knowledge reuse. This has implications for determining the scope of the potential user community for a repository. While it may be attractive to extend the usage of a system to a large community of people from different backgrounds and occupations, it may be difficult for them to use the same repository.

## **7. Conclusion**

I examined how knowledge workers could obtain benefits from the reuse of knowledge assets generated from prior projects. I empirically investigated how employees of the consulting firm reused

knowledge in their ongoing work. A research model stipulating when and how individuals obtained the most benefits was developed, and the two field studies were conducted to test it. Asset complexity and individual familiarity with the domain were found to play an important role in affecting the ease with which individuals could reuse knowledge assets. In addition, there were two key factors that helped users overcome difficulties associated with reusing complex assets in domains with which they were unfamiliar: seeking assistance from the author and sharing a common perspective. In addition, a shared perspective between the author and user enhanced users' perceived benefits from reusing the knowledge.

## 8. References

- [1] M. Alavi and D.E. Leidner "Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues," *MIS Quarterly* (25:1), 2001, pp. 107-136.
- [2] L. Argote *Organizational learning: Creating, retaining and transferring knowledge*, Kluwer, Norwell, MA, 1999.
- [3] B.A. Bechky "Sharing meaning across occupational communities: The transformation of understanding on a production floor," *Organization Science* (14:3), 2003, pp. 312-330.
- [4] E. Chell "Critical Incident Technique," In *Qualitative methods and analysis in organizational research : A practical guide*, G. Symon and C. Cassell (Ed.), Sage Publications, Thousand Oaks, CA, 1998,
- [5] W. Chin, B. Marcolin and P. Newsted "A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study," *Information Systems Research* (14:2), 2003, pp. 189-217.
- [6] W.M. Cohen and D.A. Levinthal "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* (35:1), 1990, pp. 128-152.
- [7] D. Constant, L. Sproull and S. Kiesler "The kindness of strangers: On the usefulness of weak ties for technical advice," *Organization Science* (7:2), 1996, pp. 119-135.
- [8] A.H. Eagly, W. Wood and S. Chaiken "Causal inferences about communicators and their effect on opinion change," *Journal of Personality and Social Psychology* (36:4), 1978, pp. 424-435.
- [9] P.S. Goodman and E.D. Darr "Computer-aided systems and communities: Mechanisms for organizational learning in distributed environments," *MIS Quarterly* (22:4), 1998, pp. 417-440.
- [10] S. Gosain "Mobilizing software expertise in personal knowledge exchanges," *Proceedings of the Academy of Management Meeting*, Seattle, WA, 2003.
- [11] P.H. Gray and D.B. Meister "Knowledge sourcing methods," *Information & Management* (43:2), 2006, pp. 142-156.
- [12] M.T. Hansen, N. Nohria and T. Tierney "What's your strategy for managing knowledge?," *Harvard Business Review* (77:3), 1999, pp. 196-206.
- [13] H.H. Harman *Modern factor analysis*, University of Chicago Press, Chicago, IL, 1967.
- [14] P. Hinds and J. Pfeffer "Why organizations don't "know what they know": Cognitive and motivational factors affecting the transfer of expertise," In *Sharing expertise: Beyond knowledge*

*management*, M. Ackerman, V. Pipek and V. Wulf (Ed.), MIT Press, Cambridge, MA, 2003, pp. 1-22.

[15] A. Kankanhalli, B.C.Y. Tan and K.K. Wei "Contributing knowledge to electronic knowledge repositories: An empirical investigation," *MIS Quarterly* (29:1), 2005, pp. 113-143.

[16] M.M. Kwan and P. Balasubramanian "KnowledgeScope: managing knowledge in context," *Decision Support Systems* (35:4), 2003, pp. 467-486.

[17] A. Majchrzak, L.P. Cooper and O.E. Neece "Knowledge reuse for innovation," *Management Science* (50:2), 2004, pp. 174-188.

[18] B. Mak, B.H. Schmitt and K. Lyytinen "User participation in knowledge update of expert systems," *Information & Management* (32:2), 1997, pp. 55-63.

[19] M.L. Markus "Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success," *Journal of Management Information Systems* (18:1), 2001, pp. 57-93.

[20] S. Masterton and S. Watt "Oracles, Bards, and Village Gossips, or Social Roles and Meta Knowledge Management," *Information Systems Frontiers* (2:3), 2000, pp. 299-315.

[21] B.E. Mennecke and J.S. Valacich "Information is what you make of it: The influence of group history and computer support on information sharing, decision quality, and member perceptions," *Journal of Management Information Systems* (15:2), 1998, pp. 173-197.

[22] P. Meyer "Defining and Measuring Credibility of Newspapers: Developing an Index," *Journalism Quarterly* (65:3), 1988, pp. 567-574,588.

[23] G.C. Moore and I. Benbasat "Development of an instrument to measure the perceptions of adopting an information technology innovation," *Information Systems Research* (2:3), 1991, pp. 173-191.

[24] K. Sherif and A. Vinze "Barriers to adoption of software reuse: A qualitative study," *Information & Management* (41:2), 2003, pp. 159-175.

[25] G. Szulanski "Exploring internal stickiness: Impediments to the transfer of best practice within the firm," *Strategic Management Journal* (17:Winter Special Issue), 1996, pp. 27-43.

[26] J.H. Wu and Y.M. Wang "Measuring KMS success: A respecification of the Delone and McLean's model," *Information & Management* (43:6), 2006, pp. 728-739.

## Appendix A. Survey Items

Code	Question
	How did this asset help you in your project? (Please check where applicable)
Benefits01	Provided reusable intellectual capital (e.g. code, patterns, architecture, etc.)
Benefits02	Prevented me from making the same mistakes others made
Benefits03	Saved time on the project
Benefits04	Increased customer satisfaction
Benefits05	Please rate the usefulness of the asset that you downloaded (5-point likert scale)
	In order to make use of the asset, to what extent do you believe that practitioner would (Using a 5-point likert scale)
Complexity01	Need to spend a lot of time to understand this asset
Complexity02	Need to understand many different areas to make use of this asset
Complexity03	Be easily able to make use of this asset
Familiarity01	How familiar are you with the domain area that this asset describes? (5-point likert scale)
Familiarity02	No. of years in the domain area that this asset describes: _____
	How did this asset help you in your project? (Please check where applicable)
Assistance01	Helped me to identify a critical expert who can provide advice and explanations
Assistance02	Increased my professional network
Assistance03	Please indicate how much time you spent in follow-ups with the author of the asset, if any. Select from: <ul style="list-style-type: none"> <li>- None</li> <li>- Less than 1 hour</li> <li>- 1-3 hours</li> <li>- More than 3 hours</li> </ul>
PriorRelation	To what extent do you know the author of this asset? Select from: <ul style="list-style-type: none"> <li>- Know him/her well</li> <li>- Have communicated with him/her before</li> <li>- Heard of his/her name before</li> <li>- Do not know him/her</li> </ul>
ReUseExp01	Please indicate which activities you participate in for the Community, and the extent of participation. Select from: <ul style="list-style-type: none"> <li>- None</li> <li>- Make use of reuse collection about once every 2-3 months</li> <li>- Make use of reuse collection almost every month</li> </ul>
ReUseExp02	Please indicate which activities you participate in for the Community, and the extent of participation. Select from: <ul style="list-style-type: none"> <li>- None</li> <li>- Make use of lessons learned about once every 2-3 months</li> <li>- Make use of lessons learned almost every month</li> </ul>