

# **Relieving the Overloaded Help Desk: A Knowledge Management Approach**

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## **ABSTRACT**

*The establishment of an organizational help desk (HD) is to provide technical support to users when they encounter technical problems related to hardware, software and network connections. Due to the lack of resources, users often have to wait for a considerably long time before their enquiries and problems are answered and solved. This paper discusses the background of HD and its existing challenges. The application of Knowledge Management (KM) techniques and Knowledge Management System (KMS) enables HD to manage its knowledge effectively. In addition, the combination is capable of relieving the overloaded HD by shifting some of the troubleshooting responsibilities to users.*

## **INTRODUCTION**

Over the past two decades, the widespread application of Information Technology (IT) has resulted in majority of organizational activities to be automated and computerized. In order to solve business problems, gain competitive advantage and sustain organizational improvement, organizations have been investing heavily in IT and business information system development. Consequently, the complexity of the business systems has created infinite number of technical and functional problems. This complexity also means that users are not able to work at optimal productivity when they encounter technical problems related to the system. Organizations may face potential loss in income, whether direct or indirect, immediate or in the future. The establishment of a help desk (HD) is to provide technical support to users when they encounter technical problems related to hardware, software, application programs and network connections.

HD also known as computer call centers, contact centers, assist centers, or support centers, and provide an access point for IT-related advice, information and troubleshooting problems for users. It also acts as a facilitator to collect and analyse data that can transform itself to a more proactive role (Marcella & Middleton, 1996). The Central Computer and Telecommunications Agency (1989) stresses that the responsibilities of HD include first line incident support in case of IT failure, day-to-day communication between IT department and user, business systems support and service quality report generating. Workman and Bommer (2004) cite the importance of HD as to provide technical assistance to users in case of computer-related hardware or software failure. In short, it is a first contact place for users to relate to all IT support issues. Generally, IT related support issues include:

1. Software / application / hardware / data communication device/ telecommunication device usage enquiry
2. software / hardware / data communication device / telecommunication device installation
3. repair, troubleshoot and configuration
4. user account setup
5. security issue
6. Internet / email support
7. service / product purchasing
8. inventory management
9. training

In most cases, HD is divided into front line (first level), second and third levels support (Czegel, 1999). Enquiries come into the front line (first level) from various sources. At this level, the first level operator will attempt to provide answers to simple questions. Users can choose to access HD through various channels which include telephone, web forms, email, fax or walk in. If first level operator cannot resolve the problem, it will be escalated to the second or third level. Second level analyst, who possesses more in-depth IT knowledge, will conduct a series of

research and testing to solve the problem. If it involves on-site support such as hardware installation, second level engineer usually takes over the job. If second level analyst still cannot handle the problem, then the case will be passed to the third level specialist such as database administrator, website developer or vendor to solve the problem. The emphasis and popularity of business information systems in organizations have increased the complexity of the IT infrastructure as well as the coverage of HD on software, hardware, network and other IT related areas. It is not unusual for a single HD to cover hundreds of thousands of IT related products. On the other hand, downsizing and business process reengineering has led to the shrinkage of the size of HD because its overall budget has been reduced. This not only reduced a significant number of experienced HD staff, it has also led to the loss of priceless knowledge which is considered crucial for daily operation within the HD boundary. According to a recent research conducted by the Help Desk Institute (Broome & Streitwieser, 2002), most respondents in the HD industry have reported their call volume has been increasing every year for the past ten years. Another research conducted by Leung (2006) points out that a majority of HDs have low ratios of "HD staff to the number of users". In the research, one of the survey respondents indicated that the HD has hired only 17 staff (5 full-time and 12 part-time) but it has a huge user base of 42000 individuals. This means that a single staff member has to service 2471 users in this particular HD. One can easily imagine the predicament of this HD if there is a sudden outage on one of the essential systems: more than 40,000 users may call at the same time but only a few are available to answer the calls. The result also demonstrates an example of unrealistic demands on HD's workload in which HD with a handful of staff has to deal with a large number of users while the staff members are simultaneously expected to handle high level support issues, to participate in proactive support activities and to attend regular training. When HD is expected to provide more service with less staff, the outcome is quite obvious: the user often has to wait comparatively longer before the first level operator is available to pick up the call. Heckman and Guskey (1998) confirm that "help unavailable when needed" is one of the major reasons for service delivery failure in the HD, which in turn leads to user dissatisfaction. To relieve HD from heavy workload, it is required to develop a mechanism that can control the overwhelming enquires from users. This paper discusses the background of help desk and its existing challenges. This paper also includes the discussion of applying Knowledge Management (KM) techniques and Knowledge Management System (KMS) to manage HD knowledge and overcome HD challenges.

The rest of paper is organized as follows. Section 2 discusses the development of knowledge managing techniques in HD. The proposed re-distributed KM framework is outlined in Section 3. This includes the discussion of the proposed web-based user self-help KMS. Finally, conclusion is given in Section 4.

## **DEVELOPMENT OF KNOWLEDGE MANAGING TECHNIQUES IN HELP DESK**

HD is composed of HD support staff and technical equipment but the actual axis of the overall support process is knowledge. When a user requires technical support, s/he usually lacks sufficient IT related knowledge to carry on her/his duty. The HD staff is responsible to help solve the problem by using knowledge that resides in some sort of repository, such the human brain, database, or a technical manual. Since the amount of knowledge required is enormous, it is essential to develop and standardize a formal process to manage technical knowledge within the HD environment. To do so, we must have a thorough understanding on how knowledge is managed along with the evolution of HD. Thus, a brief overview on the development of knowledge managing techniques in the HD is given in the following section.

### *Evolution of Knowledge Managing Techniques*

At the early stage, a decentralized HD model was popular. Organizations often have more than one HD in 1980s. Various HDs were established by departments, branches and IT work groups. For example, there were nine different HDs in Western Kentucky University in which user had to determine which HD to call, depending on where the problem was, what the problem was and when the problem occurred (Kirchmeyer, 2002). The decentralized HD model shares the belief that diverse support issues could be referred to related HDs easily so that timely response could be acquired. At that time, each HD has its own collection of training manuals, guidebooks, technical manuals and other paper-based documentation in which computer knowledge is stored and organized. Decentralized HD worked well together with this primeval knowledge managing technique in the very beginning because the computer system was simple and straight forward. So it was quite easy for the HD staff to locate the right piece of knowledge from the low-quantity paper-based manuals. On the other hand, the effort required to update the paper-based documentation was light because computer life cycle was relatively longer.

As IT infrastructure grow more complicated and organization-wide information systems continue to become interconnected with a large number of hardware and software, the classification of problem domains often are not so distinct. Users can become confused with multiple HDs and they are often directed from one HD to another before obtaining a correct solution. Then, organizations started to adopt a more centralized HD model (Marcella & Middleton, 1996). The idea is to merge various HDs into one so that a user only needs to memorize a single telephone number for all IT related enquiries. This makes HD the first and single point of contact. Nevertheless, the adoption of HD consolidation also challenges the traditional way to manage IT knowledge. Rather than to allow IT knowledge to be scattered in multiple collections of paper-based documentation, centralized HD require the merger of all of them into one. Obviously, the conventional paper-based manipulation method could not afford the sudden burst of knowledge from various HDs. One can easily imagine the clumsiness of the combined paper-based documents. Moreover, IT knowledge, resided in the combined paper-based version, would be extremely hard to search and update. As long as HD staff realized that electronic repository could provide assistance, they started migrating IT knowledge into computer file system that has the capability to accommodate huge amount of IT expertise. However it has its disadvantage in which there is a lack of flexibility in managing knowledge. Very often a programmer is required to implement complicated programs even in the simplest knowledge retrieval and storing tasks. Then the emergence of database technology overcomes the shortcomings in the file system. Database technology not only provides a more structured way to manage knowledge, but the simplicity and easy-to-learn ability of Structure Query Language (SQL) also allow the HD staff to create, store, retrieve, use and review knowledge effectively and efficiently. Because of the about advantages, database technology has assisted the development and standardization of information and knowledge in HD industry.

Expert systems are another useful tool to manage IT knowledge, especially as to how knowledge is “made available” (Turban & Aronson, 2001). Expert systems are considered an appropriate tool in the HD industry due to the characteristics of scarceness, diverseness and expensiveness of expertise (Goker, Roth-Berghofer, Bergmann, Pantleon, Traphoner, Wess & Wilke, 1998). The expansion of IT makes the HD staff not able to fully understand and handle the enterprise-wide systems. As a result, it is impossible for the HD staff to offer immediate assistant if one of the experts with a particular knowledge is unavailable. Conversely, the HD staff is able to provide recommendations and solutions for routine or even complex problems simply by entering a description and symptoms to the expert system. Then the embedded inference engine will try to find the best diagnostic method from the knowledge base where IT expertise or knowledge is resided. The application of expert system ensures not only the availability of expertise but also minimizes the duration and cost of solving the problem. However, Middleton (1999) argues that expert systems and other artificial intelligence related systems are not as popular as predicted. Though expert systems offer an intelligent method to retrieve knowledge, Czege (1999) points out some shortcomings for HD expert systems. These include high cost and time consuming in knowledge acquisition as well as knowledge base maintenance, high complexity of problem domains, not user friendly and difficulties in system development.

Today, some global corporations implement another model called the distributed or virtual HD model. This model promotes HDs of multiple physical locations. Users can still keep in touch by using one contact number through modern call routing technology (Tischler & Trachtenberg, 1998). In this way, a HD is able to operate twenty-four hours a day, seven days a week regardless of the location. For example, Morgan Stanley, one of the largest investment banks in the world, consists of four HDs in different sites (USA, England, Japan and Hong Kong) which enable them to provide enterprise-wide twenty-four hours HD service. Though distributed HD may only have one electronic knowledge repository located in one particular office, innovative data communication technology allows the HD staff to store, retrieve and update knowledge regardless of geographical and time limitations.

E-support is another innovative support model that may lead to a new revolution in the HD industry in the near future; it can be achieved due to its ability to provide better, faster and cheaper service. Broome and Streittwieser (2002) specify that all support actions that use the Internet or web as the primary communication channel should be included as e-support. One of the key stimuli in promoting e-support is the emergence of web-based tools. Users can use email or web forms to contact the HD outside normal service hours or users can access online resources, such as knowledge bases and FAQs to look for information useful to resolving their existing difficulties. Furthermore, the HD staff is capable of conducting web training or using remote control technology to help user to resolve their problems.

### *Conceptual Knowledge Management Framework*

KM attempts to manage and capitalize on knowledge that accumulates in the workplace (Martensson, 2000). This is achieved by organizing formal and direct process to create, store, retain, evaluate, enhance and increase knowledge for the future benefit of the organization (Dawson, 2000; Smith, 2001). There are slight variations among researchers in describing the process of KM. For example, Wiig (1997) divides the process into knowledge building, transforming, organizing, deploying and using, whereas Chait (1999) depicts that the KM process is based on capturing, evaluating, cleansing, storing, providing and using of knowledge. In this paper, we divide the KM process into five stages: create, store, make available, use and evaluate knowledge. When the five stages of KM together with IT are applied to manage technical knowledge in the HD, the combination approach proposed by Nonaka, Toyama and Konno (2001) works perfectly well in preserving HD’s knowledge. This paper proposes a conceptual KM framework to create, store, make available, use and evaluate HD knowledge (illustrated in Figure 1).

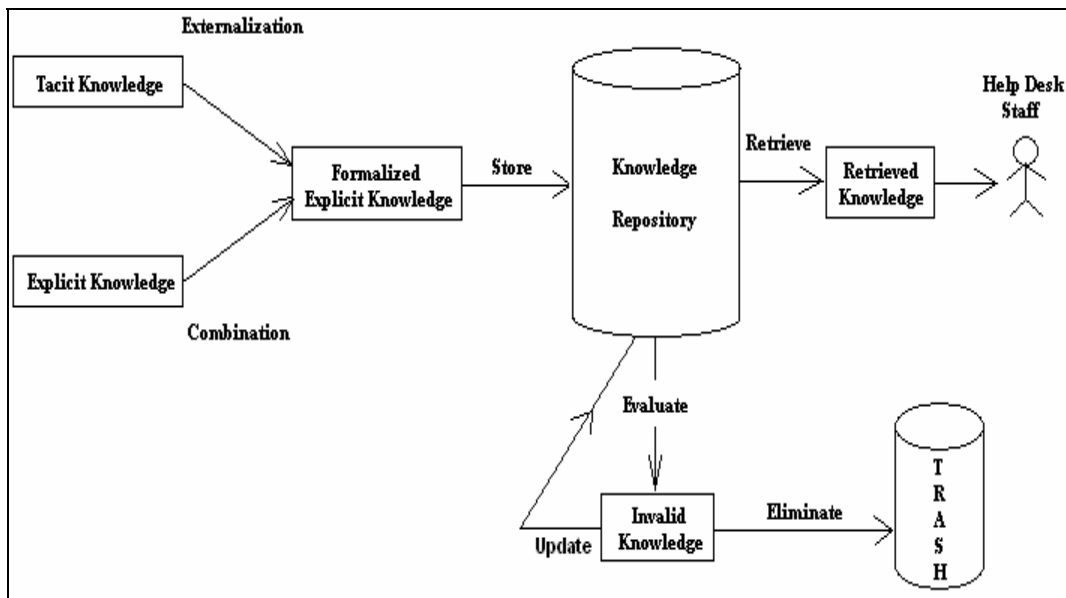


Figure 1: Conceptual knowledge management framework

Technical knowledge required to solve a user’s technical issues usually exists either in the form of explicit or tacit knowledge. Tacit knowledge is personal, complex, hard to communicate and formalize because it is gained through individual insights overtime and is resided in human, mind and body (Martensson, 2000; Nonaka et al., 2001). In contrast, explicit knowledge is structured, relatively simple and can be captured, recorded, documented, codified and shared using formal and systematic language (Goh, 2002; Nonaka & Takeuchi, 1995).

Technical knowledge is created by both the approaches of externalization and combinations. Consider the following scenario that describes the techniques of externalization and combination. Externalization is used to convert skills, techniques, experiences and perception from experts into explicit knowledge. Consider conducting a training session on Oracle database tools usage by the HD. Throughout the training session, the HD staff must encourage users to raise questions so that the HD staff can recognize the users’ common difficulties and mistakes when using the software. In addition to answering the users’ questions, the HD staff must also note the users’ questions and answers. The recorded questions and answers are a form of explicit knowledge elicited from the skills, techniques and experiences of the HD staff using the technique of externalization. On the other hand, combination is used to combine and revise explicit knowledge from manual, guidebook and training documentation into a more systematic and organized knowledge. For example, the HD has organized ten training sessions on the usage of Oracle database. The ten different sets of questions and answers can be merged and edited to become a more comprehensive and systematic set of explicit knowledge using the approach of combination. In this way, both types of knowledge are converted to a form that can be stored in an electronic repository and Structure Query Language (SQL) can be applied to allow the HD staff to retrieve the required knowledge from the repository. More advanced techniques such as search engine, agent technology and artificial intelligence can also be applied to retrieve this knowledge. The retrieved knowledge can be used to resolve a particular user’s problem.

The shorter product life cycle in IT also means the knowledge that resides in the repository must be evaluated regularly in order to maintain its validity. Any invalid knowledge is either renewed and stored into the repository or

removed permanently from the knowledge repository. This conceptual KM framework has provided a way to manage knowledge in the HD. Undoubtedly, in order to maximize its effect, a certain degree of customization may be required depending on the organizations.

### **PROPOSED RE-DISTRIBUTED KNOWLEDGE MANAGEMENT FRAMEWORK**

The conceptual KM framework enables a HD to organize and manage an enormous amount of knowledge in a structured and standard way, but the framework is not capable of relieving the HD from overwhelming enquiries. To ease the overloaded HD, one approach may lie in the composition of the incoming enquiries. Knapp and Woch (2002) indicate that 80% of calls made require no specialized knowledge. Dawson and Lewis (2001) point out that close to 50% of calls to the HD at Deakin University are related to login name and password. Both research studies indicate that a majority of technical enquiries and difficulties can be classified as simple and routine. Rather than calling the HD, users would be capable of solving simple and routine technical problems themselves if sufficient knowledge and guideline are provided. Academic researchers and HD practitioners have invested substantial resources in developing new HD models, support structures and technologies to ease the overloaded HD, however the results have not been encouraging. Most studies have focused on design issues that can provide users with a more convenient way to contact the HD. In fact, it actually encourages more users to contact the HD. For example, e-support and virtual HD model allows a user to contact HD twenty-four hours a day, seven days a week. In another instance, an automatic call distribution system - one of the most significant HD tool - is designed to handle a large number of calls simultaneously using a single phone number. To effectively relieve the overloaded HD, the solution should be focused on call flow re-distribution. Here, we propose a re-distributed KM framework to identify and re-distribute simple and routine enquiries.

Let us first define the phrase “simple and routine technical enquiries.” Simple and routine technical enquiries in this paper refer to technical problems that can be solved by the user if adequate relevant information is provided without direct or indirect intervention from the HD staff. Based on the HD support areas defined by Sundrud (2002), these enquiries can be categorized into four types: IT administrative enquiries, hardware enquiries, software enquiries and miscellaneous enquiries. The IT administrative enquiries include account setup, account termination, account maintenance, account login, account suspension, password retrieval, password reset, password syntax information, password invalid, software installation and purchasing, hardware installation and purchasing as well as service purchasing. The hardware and software enquiries include performance and functional concerns in relation to various types of hardware and software. The miscellaneous enquiries include queries on missing and corrupted files, unreachable website and server plus their performances. Such categorization not only provides a structured way to further identify and elaborate simple and routine enquiries, it also helps to associate and retrieve solutions for the related enquiries. For example, a software functional enquiry can be further categorized into functional enquiries of Microsoft products, Adobe products, Oracle products and so on. Thus, solutions for functional enquiries of Adobe PDF reader and Photoshop can be grouped under Adobe products category. When the user has a functional enquiry on Adobe products, the associated solutions of PDF Reader and Photoshop can be retrieved. Besides, the above categories may vary due to the different types of software and hardware, users, users’ skill sets and business processes.

One way to identify routine and simple enquiries is to use the reports generated by the HD management system and the automatic call distribution system. These reports provide data and information by problem type, resolution method, call duration (time required to solve the problem) and so on. By inspecting the reports in a regular manner, the HD manager can determine which enquiries are routine and simple. The proposed mechanism of identifying simple and routine enquiries is illustrated in Figure 2.

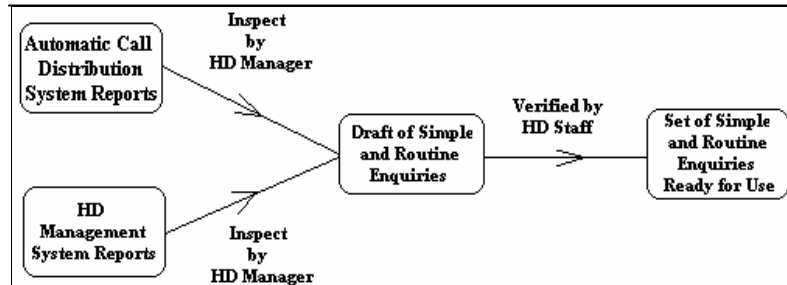


Figure 2: Proposed mechanism to identify simple and routine technical enquiries

For example, the HD management report may have indicated that there were many enquiries about “email login failure” in which most of them were related to “password invalid” and the required resolution method was merely to “reset password”. Thus by matching the above information with call duration in the automatic call distribution system report, the HD manager could confirm the enquiries as simple and routine because the duration for each call was short. The classifications of the enquiries that have been deduced by the HD manager should be verified by the HD staff to ensure accuracy. Hence, the advice from the first level support operator is extremely important because they are in the front line answering users’ enquiries daily. Therefore, they have the ability to identify simple and routine enquiries that are not found in the HD management and automatic call distribution system reports.

To effectively re-distribute simple and routine technical enquiries, the proposed mechanism will be added to the proposed conceptual KM framework in Figure 1 and the resulting re-distributed KM model is shown in Figure 3. Here, rather than storing explicit knowledge into repository straight away, the proposed mechanism will be applied after externalization and combination, with the aim to distinguish the knowledge and into two categories: 1) simple and routine, and 2) complex. While simple and routine knowledge is stored in a proposed web-based user self-help KMS, the complex knowledge is resided in the general knowledge repository. Consequently, users can first access the proposed web-based user self-help KMS and look for the most appropriate solution to solve their problems. Only if the solution is not available in the system, then the user can contact the HD for assistance. The repository where complex IT knowledge is resided will be used by the HD staff to answer complicated technical enquiries. Furthermore, knowledge evaluation will be conducted regularly to remove invalid knowledge from the web-based user self-help KMS and the complex knowledge repository to ensure valid knowledge is stored and updated.

The proposed re-distributed KM framework not only retains the characteristic of the proposed conceptual KM framework to create, store, make available, use and evaluate knowledge, but it also helps to minimize a large amount of incoming enquiries for the HD. In other words, users may be able to resolve simple and routine enquiries by retrieving the most suitable solution from the proposed web-based user self-help KMS instead of using HD. To demonstrate the difference between the two frameworks, let us take a look at the following examples.

On one Monday morning, John is very frustrated because he cannot login to his email account with his usual password. He decides to call the HD right away. Monday morning is considered to be peak hours for the HD because quite a number of users have changed their email passwords the previous Friday and most users cannot remember the new passwords when they return to work on Monday. He waits on the phone queue for about fifteen minutes until Mary, who works as the first level operator in HD, is finally available to pick up his call. Mary carefully listens to John’s problem and asks him to make sure the “Num Lock” on the keyboard is on. She also reminds him to disable the “Caps Lock” on the keyboard since email passwords are case sensitive. Then Mary asks John to try the password again. John still cannot get into his email account and receives the same error message “password invalid” as before. Suddenly, John remembers that he had changed his email password last Friday before he finished his work, but he is unable to remember that password now. Not wasting any time, Mary quickly walks John through the steps to access the password reset webpage where he can reset his password to the default. Subsequently, John is able to successfully login to his email account using the default password. Before hanging up the phone, Mary reminds John to change the default password for security reasons. Afterwards, Mary takes another five minutes to open a ticket, fill in the troubleshooting details, and finally close the ticket in the HD management system. Under the conceptual KM framework, John takes approximate twenty-five minutes to solve this extremely simple enquiry while Mary requires fifteen minutes to complete the whole support process.

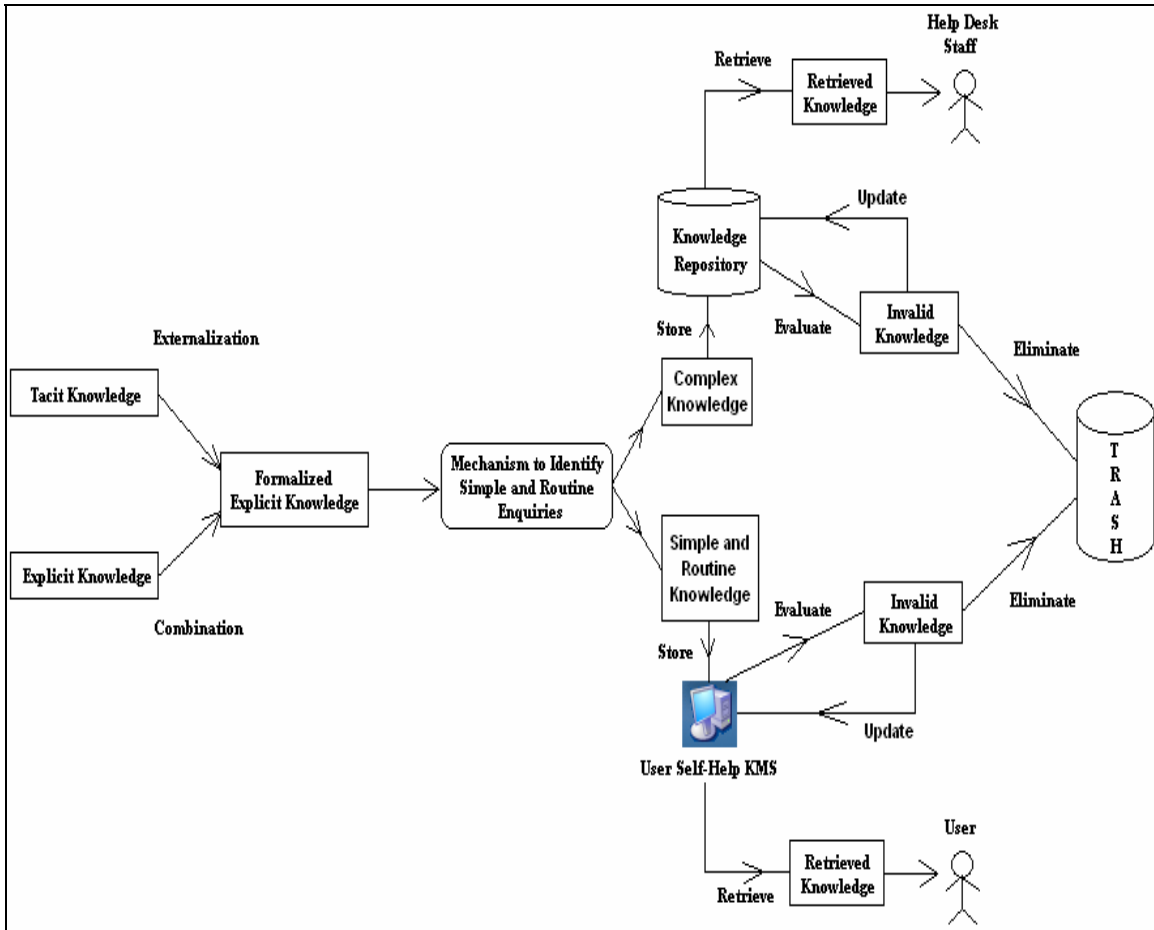


Figure 3: Proposed re-distributed knowledge management framework

Under the proposed re-distributed KM framework, John can access the proposed web-based user self-help KMS soon after encountering the email login problem. By selecting a few keywords that best describe the problem, the resolution will be delivered and displayed on the user interface of the proposed user self-help KMS within a second. Based on the resolution guidelines, John is able to log into his email account with the default password. Within the proposed re-distributed KM framework, John only requires ten minutes or less to solve the same problem. On the HD side, Mary is available to perform high level and proactive support activities when John conducts his own troubleshooting task. This scenario demonstrates that the proposed re-distributed KM framework allows the HD to better utilize its resources and manpower.

In another situation, if John wants to purchase a dial-up Internet service so that he can access the Internet when he is away from the office. The first thing he can do is contact the HD for this service. In most of the cases, the HD requires written approval from the department manager for purchasing of the dial-up service. Therefore, if the purchasing guideline is provided, John will not contact the HD until he gets the written approval from the department manager. It is not expected that users will have the ability and knowledge to fix an unworkable monitor, but if there is a monitor troubleshooting guideline available, users can first follow the guideline to make sure the power point is switch on or the power cable and the monitor cable are connected properly. Thus, this troubleshooting guideline can save a significant amount of HD resources.

*Proposed Web-based User Self-help Knowledge Management System*

The re-distributed KM framework allows the proposed web-based self-help KMS to be tailor-made in accordance with user's skill sets. For instance, if the target group of users only possesses low to medium IT skills, the KMS should avoid adopting "keyword search" as the front end user interface because the target users may find it hard to describe the problems using their own words. As IT knowledge often contains a lot of technical terms and jargons, the HD staff can rephrase and simplify the resolutions stored in the proposed system to ensure users understand the resolution methods. Figure 4 illustrates the basic architecture of the proposed user self-help KMS. There are five basic components within the architecture: user's browser, interface agent, search agent, resolution knowledge base which stores solutions for simple and routine technical enquiries and the ontology which stores information required to facilitate user communication. Modern web technology is used as a means to deliver the system through the Internet and can appear on the browser to facilitate the interaction with the user and deliver user request for resolution. On the other hand, software agent is a computer program that behaves like human and is capable of autonomous actions in pursuit of specific goal (Liu, Zeng & Lin, 1999; Nienaber & Cloete, 2003). In this system, software agent technology is used to free user from onerous search duty by dedicating itself to look for the most suitable solution in the extensive database based on user's requirement. Moreover, it is also used to facilitate user communication.

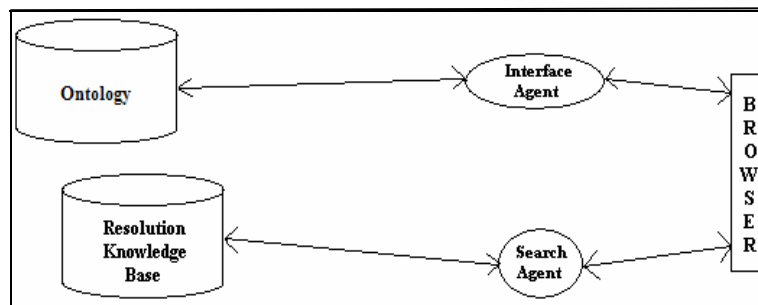


Figure 4: Basic architecture of the proposed web-based user self-help knowledge management system

Though traditional programming approach is able to develop a similar system, using software agent approach to develop the proposed user self-help KMS tends to: 1) be more natural in depicting and modeling the complexity reality, 2) reduce problems associated with coupling of components, and 3) reduce difficulties associated with managing relationship between software components (Jennings, 2001). The unique characteristics in software agent technology also enable the HD to customize its own user self-help KMS based on this architecture. In accordance with its own support requirements in the HD, the system can be modified by: 1) adding extra software agent, 2) removing software agent, 3) inserting additional attributes into software agent, and 4) removing existing attributes from software agent. For example, if it is decided that additional feature to allow the user to conduct an online consultation with the HD staff when users cannot find any suitable solution, then the system can add an additional communication agent that is capable of facilitating online consultation. This type of customization is straightforward and does not require major changes to the system.

The following steps describe how the proposed web-based user self-help KMS will be deployed.

- To activate the proposed web-based user self-help KMS, the user simply clicks on the target URL. Subsequently, the interface agent that possesses communication capability will deliver a dynamic user interface to the browser, based on the information stored in the ontology. The dynamic and interactive communication capabilities of the interface agent help users to identify and present their problems. First, the interface agent asks the user to select an enquiry type on the user interface. Based on the input, the interface agent will generate the next category of possible problem scenarios. This type of interaction will continue until the agent has gathered sufficient information to process the query. A simple implementation of dynamic user interface is shown in figure 5.

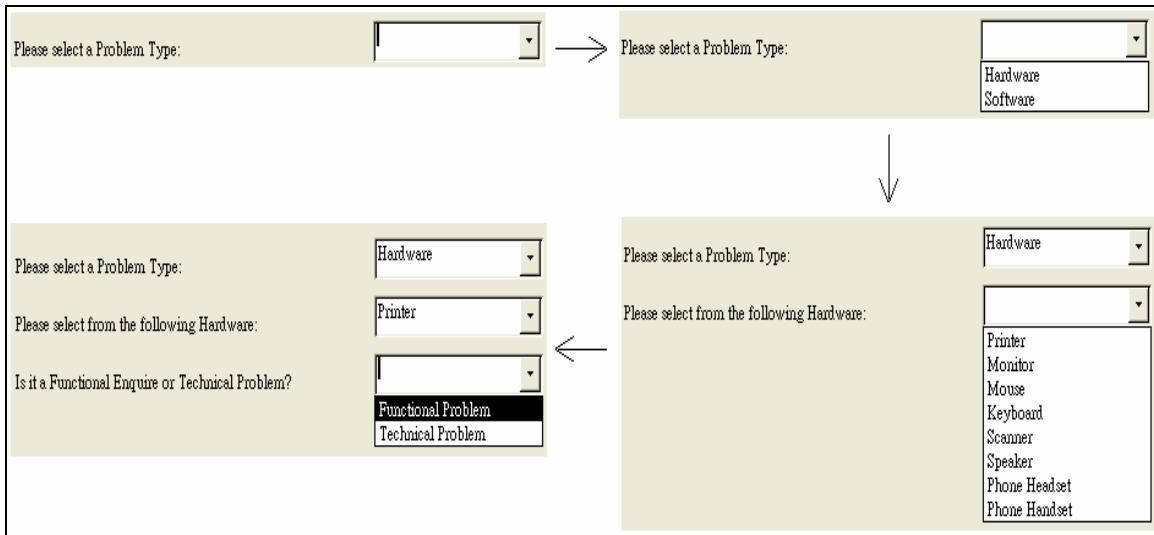


Figure 5: Simple implementation of dynamic user interface

- When the problem is described through the deployment of the interface agent, the search agent will be deployed to search for possible solutions. The search agent possesses “the ability to act with autonomy” and becomes responsible for this task. Here, “the ability to act with autonomy” refers to the capability of an agent to perform its task without direct control from the user or with only minimum supervision and direction. To achieve the preset goal of finding the most appropriate resolution, the search agent will be deployed as soon as the agent is able to “sense” that sufficient information has been gathered. The search agent will then examine the contents in the resolution knowledge base, make its own decision to select a solution according to user’s problem description and finally return the solution to the user.

*Ontology*

Traditionally, the term “ontology” is defined as the study or the science of being. Gruber and Olsen (1994) first applied ontology to AI as the specifications of common conceptualizations among agents. In other words, an agent is able to understand the semantics of other knowledge since knowledge is represented by the same vocabulary based on common conceptualization. The emergence of semantic webs further magnifies the importance of ontology. Berners-Lee, Hendler and Lassila (2001) recognize that HTML-based web content is solely designed for human to read and therefore computers have no way of understanding and processing the semantics. In the context of the web, ontology provides a shared understanding of a domain that contains a finite list of terms and the relationships (Antoniou & Harmelen, 2004). In this way, ontology enables computer programs and software agents to understand the semantics, thus making it possible for them to process the web content. In the proposed self-help KMS, ontology is designed to represent various types of technical enquiry. The enquiry types are used to support the dynamic interface on which user can choose to describe and identify the problems. Figure 6 illustrates an example of the enquiry types in the ontology. Further expansion for the ontology until there is enough vocabulary to describe the problems.

The popularity of using ontology to manage technical knowledge makes it possible for help desk to reuse other help desks or IT companies’ knowledge in terms of ontology. For example, company A has reached an agreement with Oracle and Norton to allow the help desk of company A to reuse technical support knowledge of Oracle and Norton products. By integrating or merging their ontologies, a software agent from Company A should be able to retrieve technical knowledge from Oracle and Norton. This means that users in Company A can make use of Oracle and Norton’s technical support knowledge to troubleshoot their own problems. The reusability of ontology also allows help desk to save a lot of resources and efforts in creating duplicate sets of knowledge that have already been created in other companies or help desks.

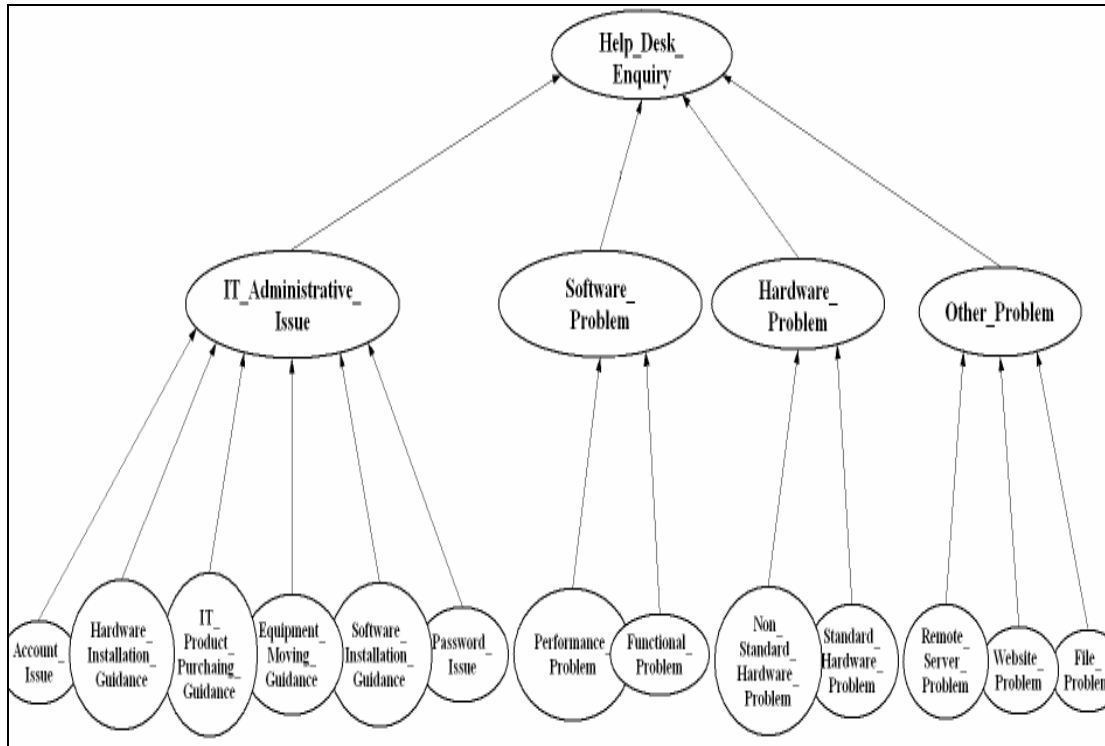


Figure 6: Example of enquiry types in the ontology

**CONCLUSION**

The conceptual KM framework enables HD to create, store, make available, use and evaluate both tacit and explicit knowledge. On the other hand, the proposed re-distributed KM framework developed in this paper has demonstrated that simple and routine enquiries can be re-routed to a web-based user self-help KMS. It allows user to solve their simple and routine problems without contacting the HD. This “self-help” practice provides a way to ease the workload of the HD. This paper has also demonstrated that advances in software agent, ontology and web-based system technologies can be applied.

The applications of the re-distributed KM framework and web-based user self-help KMS allow HD staff to be freed up to handle high level support issues, to participate in proactive support activities and to attend regular trainings. From the user perspective, rather than waiting in a long queue for a simple resolution, a user can look for the most appropriate solution simply by using the KMS regardless of time and geographical restrictions. Alternatively, for those who have complicated enquiries, the waiting and troubleshooting durations will now be shorter because more staff become available and fewer users are in the queue. This means the user can now enjoy a better, quicker and more direct service

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