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Knowledge Management in Information Technology Help Desk: Past, Present and Future

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Abstract: Information technology has changed the way organizations function. This resulted in the reliance of help desks to deal with information technology related areas such as hardware, software, and telecommunication. Besides, the adoption of business process reengineering and downsizing have led to the shrinkage of the size of help desk. The shorter information technology product life cycle has worsened the situation by increasing the already sizeable help desk's user base. Consequently, the help desk has to cover more information technology products and resolute more technical enquiries with less staff. Thus, the outcome is clear that users have to wait comparably longer before help desk staff is available to offer assistance. This paper describes the contribution of knowledge management in retaining knowledge and solving "knowledge leaking" problem. The research presents the development of user self-help knowledge management system to re-distribute incoming enquiries so that simple and routine technical enquiries can be resolved without help desk intervention.

Keywords: Knowledge Management, Help Desk.

I. Introduction

Help Desk (HD), also named as computer call centre, contact centre, Information Technology (IT) assist centre or support centre, is an access point to provide IT-related advice, information or troubleshooting action to user. Its responsibilities include first line incident support, day to day communication between IT department and user, business system support and service quality report generating [3, 17]. The widespread application of information technology has resulted in majority of organizational activities to be automated and electronic-based. This trend has led to increase coverage of HD's roles and responsibilities in the organizations. The organizations rely on HD to provide technical assistance on all aspects of information technology related areas such as hardware, software, applications and telecommunication.

The complexity of the business systems has created

infinite number of technical and functional problems. This complexity also means that the users are not able to work at optimal productivity when they are faced with technical problem related to the system. In other words, organization may face potential loss in income, whether direct or indirect, immediate or future. The above situations have resulted in shift of HD's role from a traditional non-profit-making function to an important management asset that plays a vital role to ensure organization-wide Information System (IS) is working accurately and smoothly.

One of the existing challenges for HD is how to manage knowledge in an effective manner. The widely exploitation of IT has significantly increased HD's coverage on software, hardware, network connections and other IT related areas. It is not unusual for a single HD to cover hundreds of thousands of software, hardware, application programs and network connections. Sometimes it is difficult even to memorize all the names of the applications and systems used in the organization. What exacerbate the situation is the adoption of management methodology such as Business Process Reengineering (BPR) and downsizing. This leads to the shrinkage of the sizes of help desks because the overall budget has been reduced. This not only reduced a significant number of experienced HD staff, but also led to the loss of priceless knowledge which is considered to be crucial for the daily operation within the HD boundary. On the other hand, the shorter product life cycle in IT industry makes the predicament even worse. The IT product life cycle accelerates at an unbelievable rate that even a brand new product can be obsolete as soon as it hits the market. As a result, the already sizeable user base covered by the HD and the number of incoming enquiries are increased speedily in direct proportion to the shorter product life cycle. According to a research conducted by the Help Desk Institute, most respondents in the HD industry have said their call volume has been increasing every year in the past ten years [2].

When the HD is expected to cover more IT products and resolute more technical enquiries with less staff. The outcome is clear, the user has to wait comparably longer before the HD staff is available to pick up the call. Heckman and Guskey [12] report that "help unavailable when needed" is the major reason for service delivery failure in HD which in turn leads to user dissatisfaction. Thus, HD is desperate for a method that can deal with the above problems. This

paper discusses the role of Knowledge Management (KM) in HD to overcome the above challenges. This paper also includes the discussion of how generic KM process can be customized within the HD environment by developing a user self-help Knowledge Management System (KMS) as an online self-help tool to improve the support process in the HD.

The rest of paper is organized as follows. Section 2 provides background of KM. Section 3 discusses the evolution of KM in HD. The proposed future of KM within the HD industry is outlined in Section 4. Finally, conclusion is given in Section 5.

II.   Background of Knowledge Management

HD experts use both tacit and explicit knowledge to solve user's problem. Tacit knowledge refers to skills, perceptions, assumptions and experiences that reside in the staff's brain whereas explicit knowledge refers to written document, such as technical manual and guide book. KM, a methodology to manipulate tacit and explicit knowledge, has the capability to address "knowledge leaking" problem caused by BPR and downsizing [6, 21, 24]. To examine whether this contribution of KM can be extended to HD, it is critical to review the background of KM.

Back to mid 1980s, tools and techniques such as Total Quality Management (TQM), downsizing and BPR were developed by western companies to aid in re-gaining market share occupied by the Japanese Company. However, both input and improvement are short-termed because these solution approaches are generic and easily available to all rival companies. Once an approach is proven successful, the rival company duplicates and adopts the same practice [23]. The practice of downsizing, BPR and outsourcing, which aims for process optimization as well as cost and time saving, have resulted in loss of many experienced employees along with their capability and knowledge which in turn has "drained" away organization's inspiration and creativity [6]. Thus, organizations have to re-pay high, severe and long-term price in return for transient benefit. The worst is after several years of downsizing and BPR, companies in western world are now competing with each other on equal cost, quality and delivery performance levels. This means that the company has difficulties in differentiating with other challengers. What intensify the already fierce battlefield is the availability of cheap labour in Asian and other developing countries. Thus, the concept of KM is emerged to sustain long term competitive advantage by preserving organizational knowledge [26]. Knowledge is now recognized as one of the most important management assets because knowledge enables organizations to utilize and develop resources, enhance their fundamental competitive ability and develop sustainable competitive advantage [23]. In other words, knowledge allows an organization to do better than rivals.

KM is designed to manage and capitalise on knowledge that accumulates in the workplace [18]. This is achieved by organizing formal and direct process to create, store and retain knowledge for the benefit of the organization [10, 24]. The entire process of KM (as illustrated in Figure 1) is divided into five stages: create, store, make available, use and evaluate knowledge [4, 27]. There are four methods to create organizational knowledge by means of the interaction between explicit and tacit knowledge [21]. The first method is socialization. It is the process of developing tacit knowledge from tacit knowledge embedded in human or organization through experience sharing, observation and traditional apprenticeship. The second method is called externalization. This is the process of turning tacit knowledge into new explicit knowledge simply by transforming tacit knowledge in the form of document such as manual and report. The third method is combination. This is the process of merging and editing "explicit knowledge from multiple sources" into a new set of more comprehensive and systematic explicit knowledge. The last method is internalization. This is the process of embodying explicit knowledge as tacit knowledge by learning, absorbing and integrating explicit knowledge into individual's tacit knowledge base.

The second and third stages of KM, store and make available, are often linked with technologies. Explicit knowledge created is collected and stored in some form of database or knowledge base in which the users have the right to access by using "search and retrieve" tools, intranets, web access and applications, groupware and so on [1, 22, 24]. Whether knowledge can create value or not, it is directly connected to the fourth stage of KM because knowledge has little value without use [10]. Though the application of knowledge is varied in accordance with business nature, the focus is still on how to make use of knowledge to improve the current value chains. The fifth stage of KM is knowledge evaluation. This phrase eliminates incorrect or outdated knowledge [1]. In other words, organization must keep creating new knowledge and to replace any knowledge that has become invalid [10].
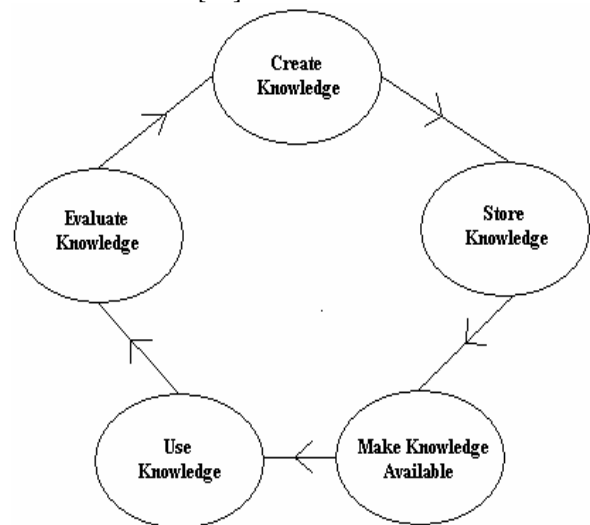

FIGURE 1: The Five Stages of Knowledge Management [4, 27]

III. Evolution of Knowledge Management in Help Desk

Basically, HD composed of HD support staff and technical equipment. Nevertheless, the actual axis of the overall support process in HD is knowledge. When user requires technical support, this means s/he lacks sufficient IT related knowledge to carry on her/his duty. The HD staff is responsible to help to solve the problem by using knowledge resides in some sort of repository, such as human's brain, database or technical manual. One can easily imagine the predicament if HD only contains staff and equipments. When the five stages of KM together with IT are applied to preserve technical knowledge in HD, the combination works perfectly well in preserving HD's knowledge (see in figure 2). The technical knowledge is converted by both externalization and combination. Externalization is used to convert skill, technique, experience and perception from experts into explicit knowledge and combination is used to combine and revise explicit knowledge from manual, guidebook and training documentation into a more systematic and organized knowledge. In this way, both types of knowledge are converted to a form that can be stored in the electronic repository. Structure Query Language (SQL) can be applied to allow the HD staff to retrieve the required knowledge from the repository. More advance techniques such as search engine, agent technology and artificial intelligence can also be applied to retrieve this knowledge. The retrieved knowledge is used to resolve user's problem. The shorter product life cycle in IT also means the knowledge resides in the repository is required to be evaluated regularly in order to maintain its validity. The outdated knowledge is either renewed and stored into the repository or removed permanently from the repository.
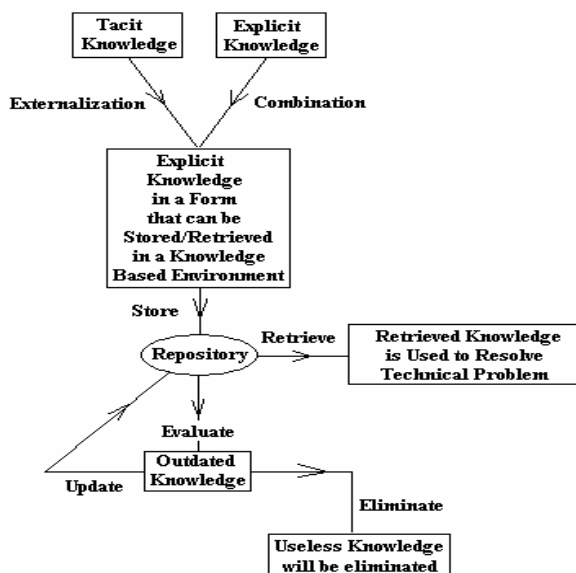

FIGURE 2: The Generic Process of Knowledge Management in Help Desk Environment

These five stages have provided a framework to preserve knowledge in the HD. Undoubtedly, in order to maximize its effect, a certain degree of customization may be required depending on the organizations. Although literature has shown that research has been conducted on the application of KM in HD, most of them are focused on technical aspect of how to store and retrieve knowledge and only a handful covers the entire KM process in HD [5, 7, 8]. To effectively customize the five stages of KM, it is essential to have a thorough understanding on how knowledge is managed along with the evolution of HD. Thus, a brief overview on the development of knowledge handling techniques in the HD is given in the following section.

III. 1   Past and Present

At the early stage, decentralized HD model was very 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 HDs to call, depending on where the problem was, what the problem was and when the problem occurred [14]. 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 had its own collection of training manual, guidebook, technical manual and other paper-based documentations in which computer knowledge was stored and organized. Decentralized HD worked well together with this primeval knowledge handling technique in the very beginning because 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 grew more complicated and organization-wide information systems were interconnected with a large number of hardware and software, the classification of problem domains became not so distinct. Users became confused with multiple HDs and they were often being directed from one HD to another before obtaining a correct solution. Then, organizations started to adopt centralized HD model [17]. The idea is to merge various HDs into one and 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 challenged the traditional way to manage IT knowledge. Rather than to allow IT knowledge to be scattered in multiple collections of paper-based documentations, centralized HD was required to merge 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 handling knowledge. Very often a programmer is required to implement complicated programs even in 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 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 system is another useful tool to manage IT knowledge, especially on how knowledge is "made available" [26]. Expert system is considered as an appropriate tool in the HD industry due to the characteristics of scarceness, diverseness and expensiveness of expertise [11]. The ever 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 assistance if one of the experts with a particular knowledge is unavailable. Conversely, HD staff is able to provide recommendation and solution for a routine or even complex problem simply by entering its 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 problem solving duration and cost. However, Middleton [19] argues that expert system and other artificial intelligence related system are not as popular as predicted. Though expert system offers an intelligent method to retrieve knowledge, Czegel [7] points out some shortcomings in the HD expert system. 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

Nowadays, some global corporations with offices all over the world implement another model called distributed or virtual HD model. This model promotes HDs of multiple physical locations. Users can still keep in touch with them by using one contact number through the modern call routing technology [25]. In this way, 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 that located in one particular office, the innovative data communication technology allows the HD staff to store, retrieve and update knowledge regardless of geographical and time limitation.

E-support is another innovative support model that is believed to lead to a new revolution in the HD industry in the nearest future; it can be achieved due to its ability to provide better, faster and cheaper service. Broome and Streittwieser [2] specify that all support actions that use 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 make use of email or web form to contact the HD ignoring its actual service hours or users can access online resources, such as knowledge base and Frequently Asked Question lists (FAQ), to look for information that is useful to resolve 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. The concept of e-support breaks through the customary KM border by expanding the third and fourth stages of KM (make knowledge available and use knowledge) to the user.

IV. Proposed Future of Knowledge Management in Help Desk

The five stages of KM have standardized the process of organizing knowledge in the HD. What is more, the combination of KM and database technology enables the HD to manipulate enormous amount of knowledge in a structured way. Both tacit and explicit knowledge are converted in a form that can be stored in knowledge base. The knowledge can later be retrieved and used by HD staff and user. No doubt that KM succeeds in dealing with the loss of knowledge caused by BPR as well as downsizing, but is that all the contribution that KM can make to the HD industry? Nonetheless, the potential of KM is far beyond that: effective customization in KM has the capability to aid HD in going through the existing challenges and enables HD to control the ever increasing user base. The best method to stop the expansion of user base is to slow down the IT product life cycle, but this approach is perceptibly out of HD's control. Moreover, slowing down the IT product life cycle may cripple an organization's profit and competitive advantage. The clue to control user base lies in the composition of the incoming enquiries. Knapp and Woch [15] state that 80% of enquiries request no specialized knowledge. Dawson and Lewis [9] point out that close to 50% of calls to ITS help desk at Deakin University are related to login name and password. Both researches indicate that the majority of incoming technical problems and enquiries are classified as simple and routine. Rather than calling HD, users are capable of solving simple and routine technical problems themselves if sufficient knowledge and guideline are provided. The concept of e-support sustains the idea of transferring part of the troubleshooting duty from the HD to users. When the users have problems, they can solve their problems by searching related solution from online knowledge base or FAQ.

However, online user knowledge base normally shares the same design as the one access by the HD staff. If the knowledge base is designed to support "keywords search" in which users have to locate the most appropriate solutions by entering a few keywords that best describe the problems, users often do not know how to use the right jargons to explain the problems. Although they may successfully use their own words to depict the problems, the "keyword search" may return ten or even more solutions which will deepen users' frustration. The complexness of the user interface can drive away novice users or even users classified as medium-skilled. Similarly, FAQ is always overlooked by users because its mechanism lacks the ability to support users in dynamic and flexible manners.

IV. 1   Proposed Re-distributed Knowledge Management Model

To ease the overloaded HD, we propose a new mechanism to re-distribute simple and routine enquiries in the KM process within the HD environment. We propose to develop the user self-help KMS as a replacement to the legacy online knowledge base and FAQ in order to improve the support process in the HD.

Let us define the phrase "simple and routine technical enquiries" first. Simple and routine technical enquiries in this paper are referred to technical problems that can be solved by user if adequate relevant information is provided without direct or indirect intervention from the HD staff. These enquiries can be categorized into four types: account and password enquiries, service guidelines, hardware and software enquiries and miscellaneous enquiries. The account enquiries include account setup, termination, maintenance, login problem and suspension, whereas password inquiries include password retrieval, reset, syntax information and password invalid. On the other hand, service guidelines refer to guidelines on hardware installation, software installation, software purchasing, hardware purchasing and service purchasing. The hardware and software enquiries include performance and functional concerns in relation to the hardware and software. The miscellaneous enquiries include queries on missing and corrupted files, unreachable website and server plus their performances.

The above categories may need to vary depending on the types of software and hardware, users, users' skill sets and business processes. To identify routine and simple enquiries, we propose to use the reports generated by the HD Management System and the Automatic Call Distribution System (ACD). These reports provide data and information on 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 work out which enquiries are routine and simple. 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

ACD report, the HD manager could confirm the enquiries as simple and routine because the duration for each call was short. However, the advice of the HD staff can never be overlooked. Hence the classifications of the enquiries that have been deduced by the HD manager must be verified by the HD staff to ensure the accuracy. The proposed mechanism of identifying simple and routine enquiries is illustrated in figure 3.
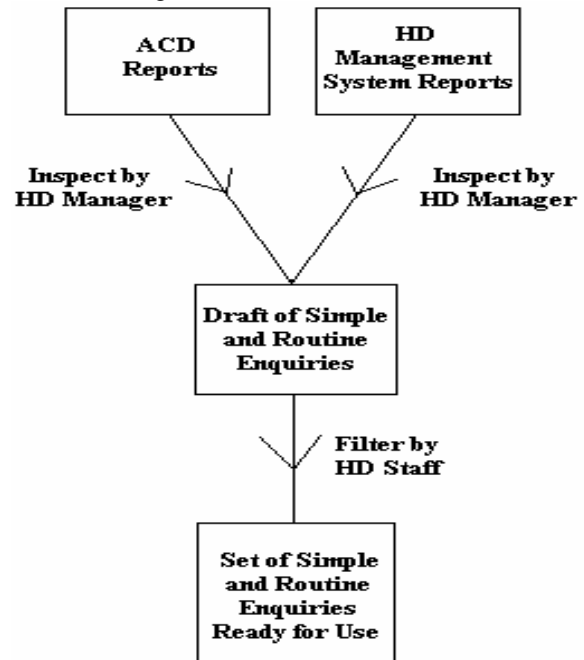

FIGURE 3: Proposed Mechanism to Identify Simple and Routine Technical Enquiries.

To effectively re-distribute simple and routine technical enquiries, the proposed mechanism will be added to the generic KM process and the resulting model is shown in figure 4. Rather than storing explicit knowledge into repository straight a way after externalization and combination, the proposed mechanism will be applied between these two steps, with the aim to distinguish the knowledge into two categories: 1) simple and routine and 2) complex. While simple and routine knowledge is stored in the proposed user self-help KMS, the complex one is resided in the general knowledge repository. Consequently, user can first access the proposed user self-help KMS and look for the most appropriate solution in accordance with the associated IT problems. Only if the solution is not available in the proposed self-help KMS, then the user will 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. This model also allows the proposed system to be tailor-made in accordance with user's skill sets. Because IT knowledge often contains a lot of technical terms and jargons, the HD staff can rephrase and simplify the resolutions that store in the self-help KMS to ensure users can understand the resolution methods.
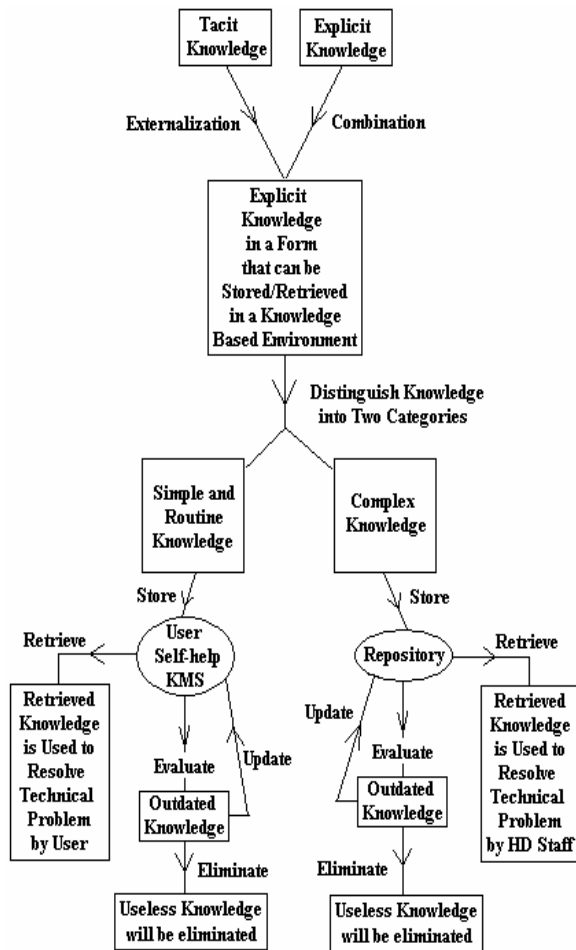
Figure 4: Proposed Re-Distributed Knowledge Management Model in HD

The basic architecture of the proposed user self-help KMS is shown in figure 5. There are five basic components within the architecture: user's browser, two software agents (interface and search agent), resolution knowledge base that stores solutions for simple and routine enquiries and the interface database that stores information required to facilitate user communication. Software agent is a computer program that behaves like human and is capable of autonomous actions in pursuit of specific goal [16, 20]. Software agent technology can be used to free user from onerous search duty by dedicating itself to look for the most suitable solution in the extensive knowledge base based on user's requirement. Moreover, it is also capable of facilitating user communication and description of problems.

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 [13]. In practice, systems developer can customize the system based on the actual needs of both users and the organizations

by inserting different attributes into software agents. Examples of agent characteristics include autonomy, reactivity, proactiveness, collaborativeness, mobility, adaptability, personality, temporal continuity, communication ability, flexibility, learning ability and intelligence [13, 16, 20]. The agent approach also minimizes the re-programming effort for system updating and maintenance because adding, converting, removing or replacing an agent is relatively easier than any other existing approach [13]. The unique characteristics in software agent technology enable the HD to customize its own user self-help KMS based on this architecture. This architecture can be modified to suit different HD's criteria: 1) by adding extra software agent, 2) by removing software agent, 3) by inserting additional attributes into software agent and 4) by removing existing attributes from software agent. For example, if it is decided that additional feature in which the user can choose to conduct an online consultation with the HD staff (in case the user cannot find any suitable solution), then the system can add an additional communication agent which possesses the ability to facilitate online consultation. This type of customization is straightforward and does not require major changes to the system.
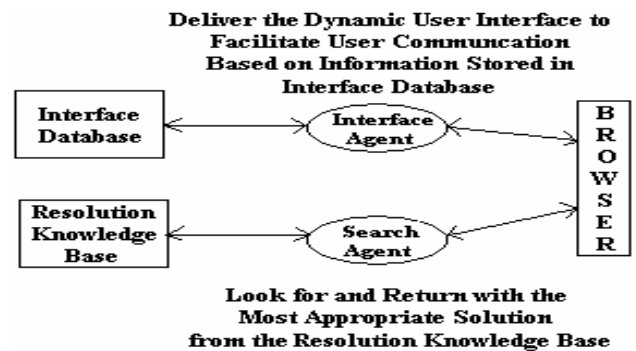

FIGURE 5: Proposed Architecture of User Self-Help KMS

The proposed user self-help KMS also makes use of modern web technology as a mean to deliver the system. The system is delivered by internet and appeared on the browser to facilitate the interaction with user and delivering user request for resolution. The following steps describe how the system will be deployed.

- To activate the system, 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 interface database. The dynamic and interactive communication capabilities of the interface agent provide an "easy to use" user interface in helping user to present and identify the problems. A simple implementation of dynamic user interface is shown in figure 6. Firstly the interface agent interacts with user by asking user to select a problem 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.

- 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 which possesses "the ability to act autonomy" is responsible for this task. Here, "the ability to act 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" sufficient information has been gathered. The search agent will then examine the contents in the knowledge base, make its own decision to select a solution according to user's problem description and return the solution to the user.

FIGURE 6: Simple Implementation of Dynamic User Interface

V.   Conclusions

The generic KM process enables HD to create, store, make available, use and evaluate both tacit and explicit knowledge.

These five stages not only allow HD to manipulate enormous amount of knowledge, they also solve the problem of knowledge loss associated with BPR and downsizing. By adding the proposed simple and routine technical enquiries identifying mechanism and user self-help KMS to the generic KM process, simple and routine technical enquiries are re-distributed in a way that users can look for their own solutions instead of calling HD.   Since a sizeable amount of enquiries are now re-routed to the user self-help KMS, HD staff can 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, user can look for the most appropriate solution simply by using the system 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 are available and fewer users are in the queue. This means the user can now enjoy a better, quicker and more direct service. Economically speaking, the user self-help KMS is an extremely cost-effective support method because the average cost for a web self-help transaction is four hundred times less than a telephone transaction and eighty times less than an email transaction [2]. Finally, the potential to convert the radical habit in user's dependence upon the HD as well as promote self-learning atmosphere cannot be overlooked as an old Chinese proverb says "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime."

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