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Sim Lau
University of Wollongong

Nelson Leung
University of Wollongong

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Nelson K. Y. Leung
Dr. Sim Kim Lau
University of Wollongong

School of Economics and Information Systems
University of Wollongong
Wollongong, NSW, 2522, Australia
Email: knl164@uow.edu.au
simlau@uow.edu.au

Abstract

Most help desks have admitted their call volume has increased in the past decade while "help unavailable when needed" is the major reason for service delivery failure and user dissatisfaction. The habit of calling help desk for simple problems has prompted the investigation of transferring part of first-level troubleshooting duty from help desk to user. This research proposes the development of user self-help knowledge management system that allows user to solve simple and routine technical enquiries. The proposed approach incorporates software agent to allow autonomous handling of enquiries so that the most appropriate solution and user communication can be facilitated.

Keywords

Help Desk, Knowledge Management, Software Agent

1 INTRODUCTION

Help Desk (HD) or Information Technology (IT) help desk, a familiar nexus to preserve IT, is expected to provide effective and efficient service for all IT related enquiries and problems. However, the rapid changes in organizational hierarchy as well as other aspects of technology development and globalization keep pushing HD to evolute. Not until the perfect world is emerged or the faultless system is built, HD still has to participate in this game of "hide and seek". This paper discusses the role of IT in supporting HD and to identify HD's challenge. We investigate the application of Knowledge Management (KM) techniques and software agent technology to develop a user self-help Knowledge Management System (KMS) to improve the current support process.

The rest of paper is organized as follows. Section 2 describes the background of HD. Section 3 discusses the current challenges in HD. A proposed self-help KMS development approach is outlined in Section 4. Finally, conclusion is given in Section 5.

2 BACKGROUND OF HELP DESK

Organizations have been investing heavily in IT and Information Systems (IS) development to solve business problems, to gain competitive advantage and to sustain organizational improvement. Consequently, the variety and complexity of software, hardware and network technology have greatly increased. This leads to the establishment of HD to provide technical support to users. HD, also known as computer call centre, contact centre, 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 in case of IT failure, day-to-day communication between IT department and user, business system support and service quality report generating (Central Computer and Telecommunications Agency 1989). In short, it is a first contact place for user relating all IT support issues and one of the HD support specialists will attempt to provide a solution. The HD also acts as a facilitator to collect and analyse its data to help itself in a more proactive role (Marcella et al. 1996).

Before HD emerged, users either called whoever they knew, or so-called "computer expert", in IT department when they required technical support (Smith 1996). However, this ad-hoc support framework has some shortcomings. Firstly, the IT staff might not be available for immediate assistance because they were usually

occupied by other crucial projects. Secondly, excess amount of support duty would lead to high level of frustration within the IT department because they were not able to spend time on their tasks or projects. Thirdly, user usually called the wrong person, workgroup or even department for support. This often led to frustration and users were often required to make another call or be transferred to the person who was responsible for solving the problem (Middleton 1999 and Smith 1996). This not only delayed the support process but also interrupted the development and deployment of new services and systems in the IT department. Thus the idea of HD emerges with the purpose to minimize the above problems and to meet user's expectation.

2.1 Evolution of Help Desk

Decentralized HD model was very popular in 1980s. In this model, organisation often contained more than one HD where various HDs were established by departments, branches and IT work groups. For example, there were nine different HDs in Western Kentucky University, user had to determine which HDs to call, depending on what the problem was, where the problem was and when the problem occurred (Kirchmeyer 2002). The decentralised model shared the belief that diverse support issues could be referred to related HDs easily so that timely response could be acquired. This concept worked well in the very beginning because computer system was simple and straight forward. As IT infrastructure became more complicated, organization-wide systems with more interconnected hardware and software, classification of problem domains became less distinct. In such situations, users became more confused with multiple HDs and they were often "bounced" from one HD to another before obtaining a correct solution.

Organizations then started to adopt centralized HD model. The idea is to merge various HDs into one and user only needs to memorise a single contact number for all IT related enquiries which make HD the first and single point of contact. This model not only consolidates the point of contact, it also helps to consolidate and standardize diverse support policies and procedures, service level agreements as well as HD support tools (Middleton 1999 and Kirchmeyer 2002). Other incentives for this model include better resource allocation, improve resolution rate and inter-division communication (Scullen 2001). Nowadays, some global corporations with offices all over the world implement another concept called distributed or virtual HD model. Though this model promotes HD of multiple physical locations, user can still keep in touch with them by using one contact number through the modern call routing technology (Tischler et al. 1998). 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) that enable them to provide enterprise-wide twenty-four hours HD service. Currently, HD is further categorised as internal or external. The former only supports organization-wide users whereas the latter supports external customers and is usually established by software and hardware vendor or internet service provider (Heckman et al. 1998).

Apart from different support models mentioned above, it is also important to discuss the current trend on outsourcing of HD. Dash (2000) reports that the worldwide outsourcing market in HD and technical support would exceed three and a half billon in 2002. Senior IT managers are likely to outsource functions that are immaterial to core business such as HD. The reasons commonly cited for this decision include: 1) in-house IT expert should focus on long term strategic infrastructure planning instead of being burnt out by routine troubleshooting duty, 2) outsourcers can do a better job than in-house HD because they are equipped with latest skill and technology, 3) it can increase HD productivity, efficiency and effectiveness which will lead to cost reduction, and 4) IT manager can be freed up from human resource issues such as difficulty in recruiting experienced HD staff, the need to maintain sufficient staff in peak hour and so on (Ketler et al. 1999). Senior management no longer debates whether to outsource HD. Its main concern is the degree of outsourcing - should it be full or partial, permanent or temporary, onshore or offshore, single or multiple vendors. Other considerations in outsourcing include data security, loss of control, loss of expertise and loss of flexibility. It is important to note that not every outsource project returns in triumph. To eliminate risk and increase transparency, organisation must build on strong alliance with outsource service provider.

E-support is another innovative support model in the HD industry. This model is gaining widespread use due to its ability to provide better, faster and cheaper service. Broome and Streittwieser (2002) describe all support actions that use internet or web as the primary communication channel to be included in e-support. One of the key stimuli in promoting e-support is the emergence of web-based tools. Users now can make use of email or web form to contact HD ignoring its actual service hours. In addition, 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, HD analyst is capable of conducting web training or even using remote control technology to ease user's struggle. However, for HDs that attempt to implement e-support model, they must examine carefully if the current culture, resources and technology within the organisations are ready for such a deployment.

2.2 Support Structure in Help Desk

Although each HD is unique according to the organization's strategic investments, support doctrine, business it supports and customer expectations, generally HD can be divided into front line (first level), second- and third-level support as illustrated in figure 1 (Czegel 1999). Basically, enquiries come into the front line (first level) support from various sources. At this level, the first level operator will attempt to provide answers for 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 support. Second level analyst, who possesses in-dept 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 the second level support staff 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 resolve the problem. Kajko-Mattsson (2003) reports that three levels concept currently dominates a large segment in HD support structures but some organisations choose to simplify it into two levels or even one level support as illustrated in figure 2 and 3 respectively.

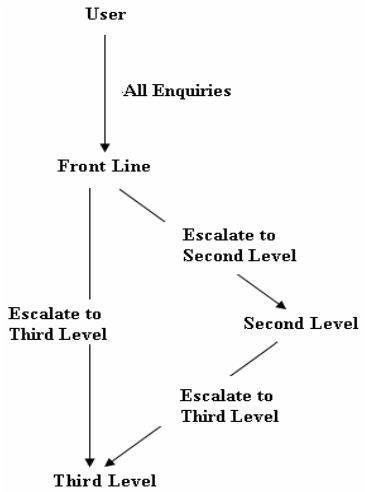

Figure 1: Three levels support structure

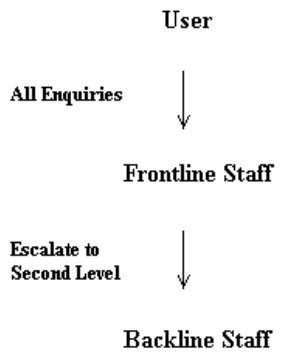

Figure 2: Two levels support structure

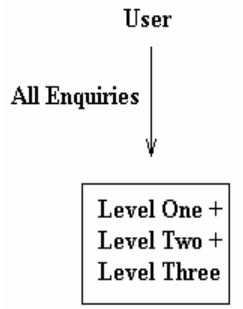

Figure 3: One level support structure

2.3 Technology Issues

To support different users, HD should be equipped with high technology equipments to ensure efficient and effective troubleshooting. Fully loaded HD is never a by-product of sudden universal explosion, rather the transformation takes a long period of time with a lot of resources and efforts. According to Kendall (2002), HD in mid-late 1980s only contained a desk, a phone and a pen. At that time, senior management executives never recognized HD's value. On the other hand, HD is viewed as a non profit-generating function that always showed up as a cost on the ledgers (Czegel 1999). When the organization realizes IT malfunction will hinder individual user or sometimes the whole organization from working at optimal productivity, senior managements start to invest strategically on HD technologies. In addition, modern technology has also accelerated the delivery of HD evolution. High technology tools have been used to support, stimulate and accelerate the consolidation of multiple HDs.

Automatic Call Distribution system (ACD) plays an important role in promoting HD consolidation because it can handle a large number of calls simultaneously on a single phone number. ACD is a system that helps to manage the flow of phone calls, record historical data and generate call statistic report (Underwood et al. 2003). When user calls, the ACD that interconnects a finite number of HD operators will distribute the call to the first available operator. If all the staff are busy, the call will be placed in a queue. Most of the systems will then play a recorded message to inform the user that "all lines are currently busy and the first available HD operator will answer the call as soon as possible". At the same time, the ACD keeps monitoring the queue, sending "the first user in the queue" to the next available operator and makes sure the calls are evenly distributed among the HD operators. An Interactive Voice Response system (IVR) is widely installed as a front end for the ACD. The IVR is an automated answering system that allows user to interface with other technology, such as mainframe, database and fax machine. It also allows the users to get information or to perform a specific function simply by selecting the required options from the menu via the telephone pad (Czegel 1999). Additionally, the ACD that possesses supervisory functions enables HD supervisor to monitor the workload, listen-in to calls, monitor queue

status, re-route calls and re-configure ACD settings to fit different call patterns. Supervisory and management reports that include total incoming, outgoing plus abandoned calls, call answered, average talk time and average hold time can be generated by the ACD (Underwood et al. 2003 and Czegel 1999). These reports allow the HD to continuously enhance its performance by re-arranging manpower, purchasing or developing new technologies or changing ACD configurations. For example, if the statistic shows that there is an enormous number of abandoned calls in the morning, then more staff should be added to the morning shift.

The emerging of HD management system is a major step for HD automation (Middleton 1999). Czegel (1999) depicts four basic functions of HD management systems as call information logging, ticket escalating, ticket storing and reporting. Call logging function enables the HD operator to record user's personal detail, computer setting, and problem description in a ticket storing function or ticket repository. The HD operator always refers to that piece of record as a ticket. As soon as the user calls to request technical support, the HD operator has to open a ticket, fill in the details and then save it in the storing function. If the problem requires further escalation, the operator can forward or assign the ticket to a particular analyst or workgroup by the ticket escalating function. Analyst or workgroup who holds the ticket is responsible for updating all follow-up action, progress and resolution method into the ticket repository. When the problem is resolved, the ticket will be closed. The reporting function allows HD supervisor or manager to generate report with difference parameters, such as high priority ticket, outstanding ticket, problem type and so on (Underwood et al. 2003). Reporting is a very powerful function to manage the daily operation of HD. For example, if there are too many outstanding tickets waiting to be resolved, it may be an indication to hire more staff; if there is a huge amount of tickets related to a software or hardware problem, then it may require a thorough check up on the system concerned.

HD expert system has been highlighted as a feasible application in the HD industry due to the scarceness, diverseness and expensiveness of expertise (Goker et al. 1998). The ever and fast expansions of IT often result in the HD staff require specific knowledge and expertise to understand and handle enterprise-wide system. Consequently, it makes the HD staff impossible to offer immediate assistance if one of the experts with a particular knowledge is unavailable. Expert system or knowledge-based system is a subset of artificial intelligence which imitates human reasoning process to solve specific problems (Turban et al. 2001 pp.402-413). If an expert system is developed, the first level operator is able to provide recommendation and solution for a routine or even complex problem simply by entering its description plus symptom to the system. Then the embedded inference engine will try to find the best diagnostic method from the knowledge-based system. This way, the second and third level support staff can be freed for more important duty. However, Middleton (1999) argues that expert system and other artificial intelligence related system are not as widely used as expected. Some of the problems in developing HD expert system are high cost and time consuming in knowledge acquisition and knowledge base maintenance, high complexity of problem domains and difficulties in HD expert system development (Czegel 1999).

Remote control software is a HD software that makes use of modern data communication technology to view, access or even take control of computer to carry out troubleshooting over the network (Underwood et al. 2003). There are two types of remote control software: client based and web-based. The difference is that the client based one requires installing a small program called client, whereas web-based simply connects through the internet. Comparing to traditional on-site support method, remote control provides a quicker way for problem solving as long as the target computer has internet access and it also encourages user's involvement in fixing a problem by watching and learning the required process through the technician's demonstration. However, security is always an important issue with remote access. Auspiciously, most of the software can be configured so that the technician must gain permission from the user before viewing and controlling the target computer. Additionally, user can re-take control or even terminate the session at any time. In Griffith University, the HD is able to solve 75% to 85% of problems remotely whereas resolution rate drops to 53% without the aid of remote control software (Scullen 2001).

3 HELP DESK'S CHALLENGE IN THE 21st CENTURY

In the past two decades, the emergence of IT has converted a large part of organizational activities from manual and paper-based to automatic and electronic-based. Such a conversion not only increases the complexity of IT infrastructure, but also increases the HD's coverage on software, hardware, network and other IT related issues. It is quite common for a single HD to cover hundreds of thousands of software, hardware, application programs and network connection, sometimes it is difficult even to memorize all those names. The HD situation has worsened as a result of wide adoption of management methodology such as Business Process Reengineering (BPR) and downsizing. It is almost impossible for the HD to add an extra headcount to ensure that the support is provided to the users. The consequence for more service with less staff is quite obvious: user has to wait comparably longer before first level operator is available. In addition, the HD staff is no longer available for high-level and proactive support activity or training. According to a recent research conducted by the Help Desk

Institute (Broome et al. 2002), most respondents in the HD industry have reported that their call volume has been increasing every year for the past ten years. Heckman and Guskey (1998) confirm that "help unavailable when needed" is the major reason for service delivery failure in the HD which in turn leads to user dissatisfaction. Moreover, the entire support process in between is indirect and slow, along with the opportunity to cause miscommunication and misinterpretation.

HD experts and academic researchers continue to look for ways with the purpose of relieving the above burden and the effort includes development of systems, support structures and models, but the hard work seems in vain. What goes wrong? Human always uses reflective design concept as a method to develop a system, in other words, we tend to solve a problem based on past experience and conscious reflection without local adaptation. For example, the New South Wales (NSW) Government tries to improve access to Sydney Airport, Port Botany and the City for people living in the west and south west of Sydney by building M5 East. But M5 East itself is actually creating congestion problem, more than 100,000 vehicles a day travel on the M5 East. This almost doubles the Roads and Traffic Authority's calculation in its environment impact statement, predicting that 55,000 vehicles would be using the tunnel by 2011 (Smith 2005). This shows that rather than alleviate congestion, M5 East itself encourages more people to drive more often which in turn carries 7.1% passengers away from the East Hill Rail Lines (Smith 2004). Similarly, various support models, structures and technologies are designed to ease high volume of enquiries within the HD environment, however, such actions actually create more troubles in the real world if the problem domain and user's need have not been investigated thoroughly.

To ease the overloaded HD, one way is to develop a trouble-free system, but it is technically impossible up to this moment. Another way is to stop user from calling the HD. Researches conducted by Knapp and Woch (2002) as well as Dawson and Lewis (2001) have provided a clue to resolve HD's challenge: The former indicates that 80% of calls request no specialized knowledge whereas the latter points out that close to 50% of calls to the ITS Help Desk at Deakin University are related to login name and password. Both researches confirm that a majority of incoming enquiries and technical difficulties are simple and routine. If sufficient information and guideline are provided, it is conceivable that users have the capability to resolve simple and routine technical problems themselves, rather than calling the HD to troubleshoot the problem for them. This research proposes to develop the user self-help KMS that is capable of assisting the user to perform his/her own troubleshooting for simple and routine technical enquiries.

4 PROPOSED USER SELF-HELP KMS DEVELOPMENT APPROACH

Modern technology and management technique elicit a great opportunity for the HD to resolve its existing difficulty. This research proposes the user self-help KMS development approach with the intention to provide a foundation of using knowledge management techniques and software agent technology to develop the user self-help KMS to improve the user support process for routine and simple technical enquiries as well as to provide simple technical support within the HD environment. The research proposes to deploy software agent to facilitate the solution path.

Let us define the phrase "simple and routine technical enquiries" first. Simple and routine technical enquiries in this paper refer 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 technical enquiries, we propose to use the reports generated by the HD Management System and the 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. Classification of the enquiries that have been deduced by the HD manager must also be verified by the HD staff to ensure accuracy. The proposed method of identifying simple and routine

technical enquiries is illustrated in figure 4.

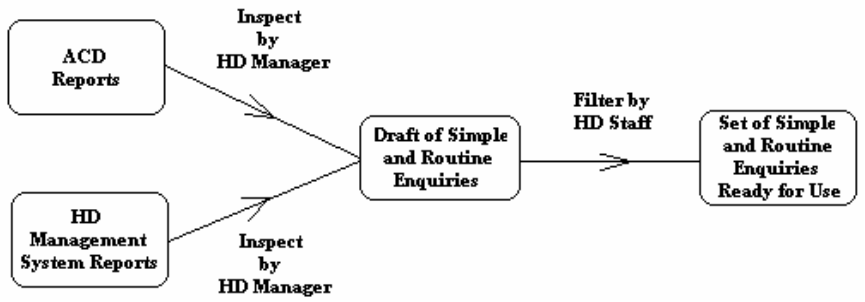

Figure 4: Proposed method to identify simple and routine technical enquiries

The proposed user self-help KMS will be developed based on knowledge management framework. In the mid 1980s, downsizing, outsourcing and BPR which aim for process optimization as well as cost and time saving, have resulted in a significant reduction of a number of experienced employees along with the capability and knowledge reside with the employees. To fill the gap caused by downsizing, outsourcing and BPR, KM has emerged with the aim to retain organization's competitive advantage by creating, storing, "making available", using and evaluation of the already existed but always overlooked organization asset - knowledge. This research proposes to use the approaches of externalization and combination to elicit tacit and explicit knowledge as shown in figure 5. The rationale of the proposed approach is discussed as follows.

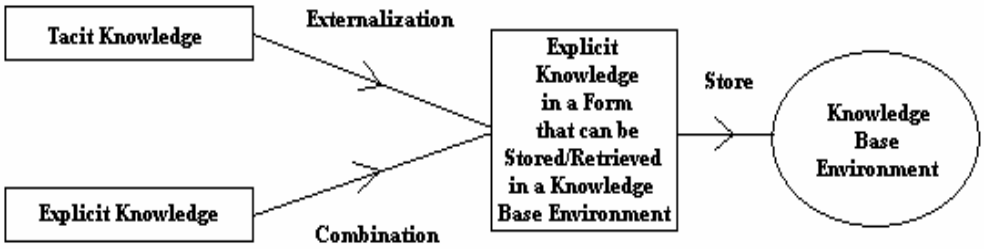

Figure 5: Proposed framework for externalization and combination

The HD experts use both explicit and tacit 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 documented knowledge in written document, such as technical manual and guideline or policy (Nonaka et al. 2001). Nonaka et al. (2001) define externalization as a process of making tacit knowledge into explicit knowledge and combination as a process of merging and editing explicit knowledge from multiple sources into a new set of more complicated and systematic explicit knowledge. HD support deals with technical knowledge that either exists in the form of explicit knowledge or tacit knowledge. To help users to solve routine and simple problem, externalization is used to convert skills, techniques, experiences and perceptions from experts into explicit knowledge, whereas combination is used to combine and revise explicit knowledge from manual, guidelines and training documentation into a more systematical one so that both knowledge are converted in a form that can be stored in and retrieved from the knowledge base within the KMS environment.

Software agent is a computer program that behaves like human and is capable of autonomous actions in pursuit of specific goal (Nienaber et al. 2003 and Liu et al. 1999). 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 database based on user's requirement. Moreover, it is also capable of facilitating user communication. 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 modelling the complexity reality, 2) reduce problems associated with coupling of components, and 3) reduce difficulties associated with managing relationship between software components (Jennings 2001). In practice, systems developer can customize the system based on the actual needs of both users and the organisations 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 (Nienaber et al. 2003, Jennings 2001 and Liu et al. 1999). 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 (Jennings 2001).

Figure 6 outlines 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 that stores

solutions for simple and routine technical enquiries and the interface database that stores information required to facilitate user communication. The unique characteristics in software agent technology 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: 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 capability to facilitate online consultation. This type of customization is straightforward and does not require major changes to the system.

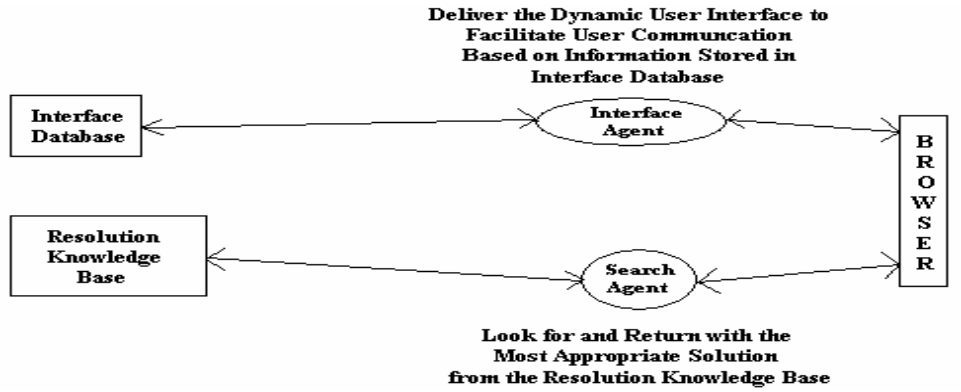

Figure 6: Proposed architecture of user self-help KMS

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 help users to identify and present their problems. A simple implementation of dynamic user interface is shown in figure 7. 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.

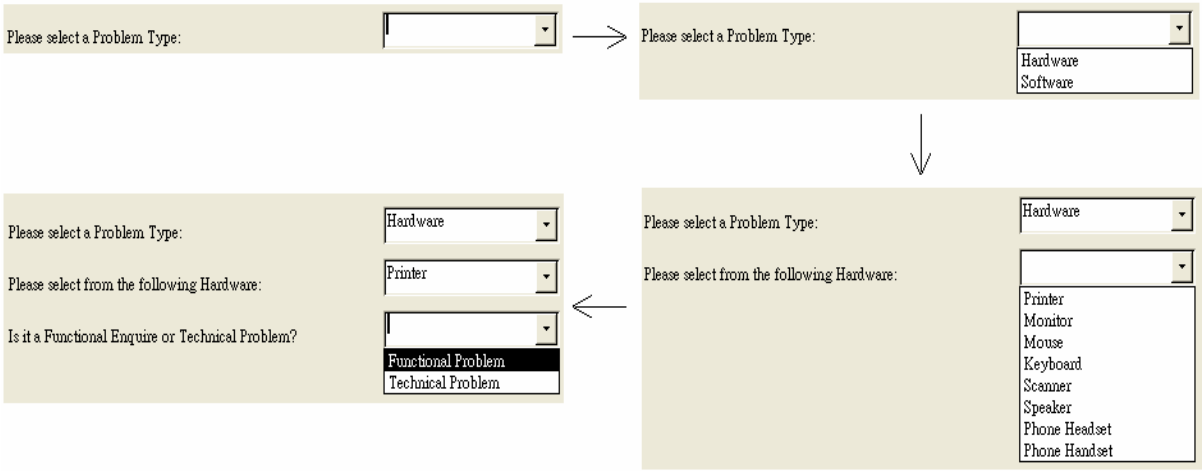

Figure 7: Simple implementation of dynamic user interface

- 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, 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" that 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 finally return the solution to the user.

4.1 Impact of User Self-help KMS

The proposed user self-help KMS is breaking down the traditional boundary of support structure in both the two-levels and three-levels support structure as illustrated in figure 8 and 9. The enquiries will now be re-distributed in a way that simple and routine technical problems will be handled by the user self-help KMS while the others will still be handled by the first level HD operator.

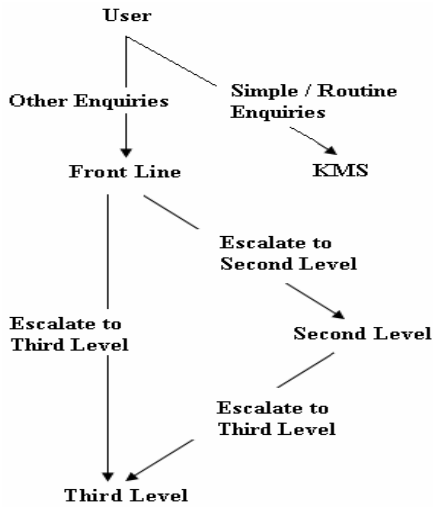

Figure 8: Three levels support structure with user self-help KMS

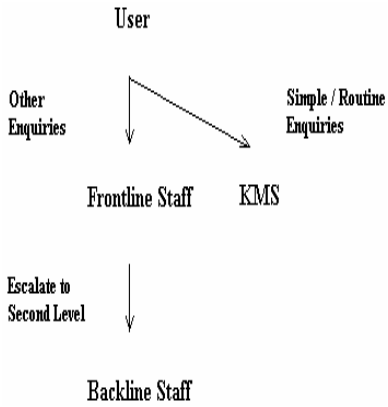

Figure 9: Two levels support structure with user self-help KMS

The proposed support structure allows the HD to better allocate its manpower. Since a sizeable amount of enquiries are now re-allotted to the user self-help KMS, first level support operator 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 (Broome et al. 2002). Furthermore, 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."

5 CONCLUSIONS

HD is essential because it ensures successful operation of the organization-wide IS. It helps to prevent potential income lost, whether it is direct or indirect, immediate or future due to IS/IT failure. However, the ever increasing expansion of IS/IT deployment, the continuous increment in user base as well as the enormous pressure generated by the BPR and downsizing, have forced the HD to run into a dead end to provide more service with less staff. Academic researchers and HD practitioners have invested substantial resources in developing new HD models, support structures and technologies, but the efforts are discouraging because most of them are focused on management aspect only. To effectively enhance the overloaded HD, the solution must base on call flow re-distribution, that is, to find a way to distribute the overwhelming simple and routine technical enquiries. To summarise, the development of the proposed user self-help KMS allows: 1) the HD staff to be freed up from routine and simple technical enquiries, 2) user to enjoy a more effective and efficient support service, 3) HD to provide a low cost support service, 4) user to be self-independent, and 5) to promote self-learning.

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