User-centered Information System Design: Determinants and Process

A Study of The Structural and Functional Redesign of The NDMC Portal

By

Yi Zhang

Submitted to the Faculty of Extension

University of Alberta

In partial fulfillment of the requirements for the degree of

Master of Arts in Communications and Technology

April 1, 2009

Running Head: USER-CENTERED PORTAL DESIGN

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Abstract

A corporate portal contributes to organizational productivity and effectiveness by providing a single point access to corporate applications, documents, collaboration and community services. Many corporate portals suffer from usability problems such as irrelevant or inaccurate information, poor navigation and limited functionality. This research concentrates on building a user-based portal design process. By examining the results of a quality survey and analyzing user interviews, this paper assesses the usability and information quality of a portal provided by the National Deployment and Management Center (NDMC) of a national telecommunications company. The study suggests six determinants of a successful portal design: identifying stakeholders, users' participation, priority ranking, reducing negative attitude, knowing the potential of new technologies and monitoring changes. A new user-centered portal design process is proposed for future improvement.

Contents List

Introduction

The intranet has a great influence on organizational productivity and effectiveness, significantly changing the way organizations create, share, retrieve and disseminate information (Passmore, 1996). Using the same technologies as internet, an intranet is "a private knowledge network that provides secure collective access to integrated information, services, business applications, and communications", defined by Robert Marcus and Beverley Watters (2002). It is not designed for public access, and it is usually hidden behind multiple firewalls to protect sensitive data being exposed.

A corporate portal is a kind of web site that provides a single point access to corporate applications, documents, collaboration and community services (Marcus & Watters, 2002). Marcus and Beverley described a portal as an extension of intranet, "the gateway to a world of knowledge" (2002). If the corporate intranet is a treasury of information and applications, then the portal is the treasure map to show the locations of each treasure room and instant access to the objectives. Therefore, to design and maintain an efficient and up-to-date portal is extremely important to intranet success. However, sometimes portal design ignores the needs and practices of users. Pfeffer and Sutton pointed out that one of the reasons that knowledge management efforts were failed is that the people who design the systems "have limited, often inaccurate, views of how people actually use knowledge in their jobs" (1999, p.90). As a result, corporate portals can suffer from usability problems such as irrelevant or inaccurate information, poor navigation and limited functionality.

A well designed portal is helping users to complete their work successfully and efficiently, and to feel competent and satisfied. Many effective user interfaces are designed based on principles of human interface design. In the book "Designing the User Interface: Strategies for Effective Human-Computer Interaction" by Ben Shneiderman and Catherine Plaisant (2009, p12), the authors wrote:

> Successful designers go beyond vague notions of "user friendliness," doing more than simply making checklists of subjective guidelines. They have a thorough understanding of the diverse community of users and the tasks that must be accomplished. They study evidence-based guidelines and pursue the research literature when necessary. Great designers are deeply committed to serving the users, which strengthens their resolve when they face difficult choices, time pressures, and tight budgets.

Previous studies suggested some principles and guidelines for improving the usability of the user interface design including the design should be internally and externally consistent, the information and functions should be relevant to users' tasks, the interface should provide timely feedback to users, and so on (Constantine & Lockwood, 1999; Nielsen, 1994; Schneiderman, 1998).

However, little empirical research focuses on the user-based portal design process, yet little guidance on detail steps the designers should take to meet user expectation. And some questions don't have clear answers, for example what the criteria are to implement user-based design, or

what impacts of social influences have on the portal design process. This research concentrates on building a user-based portal design process in order to improve the usability and user satisfaction.

First, literature about the relationship between organization design and information system, benefits and impacts of information system on organization, and framework of user-based information system design were reviewed. Next, we evaluated the quality and usability of current NDMC portal by analyzing the survey and interview results. The analysis of survey results presented an overall understanding of current user satisfaction in each aspect of portal design. Then, qualitative data collected through open-ended questions and interviews enabled the researcher to explore the underlying reasons of users' preferences in portal design. Six determinants were discussed for future improvement and a user-centered portal design process was proposed at the end of the paper.

Problem statement

About the Organization

As one of the biggest telecommunication companies in Canada, STECO provides a full range of communication products and superior services for business and residential customers. STECO is a pseudonym for the company. Respondents' identities have been disguised to protect the individuals and the company because the information discussed in this paper might be commercially sensitive. The National Deployment Management Centre (NDMC) plays a critical role in the process of delivering a positive service experience and exceeding customer expectations. NDMC manages and balances the service demand and usable manpower based on the skill set, availability and geographic location of field technicians. Dispatching the right person to the right place in the right time is a constant goal of NDMC.

Generally speaking, NDMC links field technicians, knowing as CSD (Customer Service Delivery), with other front-line teams like sales and CSR (Customer Service Representative), etc. Although field technicians, sales and CSRs are all customer-facing roles, they delight customers in different ways. Sales and CSRs negotiate with and make oral commitments to customers based on the availability of the services. On the other hand, field technicians are people who implement the commitments by installing new services or fix existing troubles. NDMC's responsibility is to ensure that every commitment is heard by field technicians and completed on time. A work flow shows the interactions between NDMC and its internal partners as below (FIG 1):

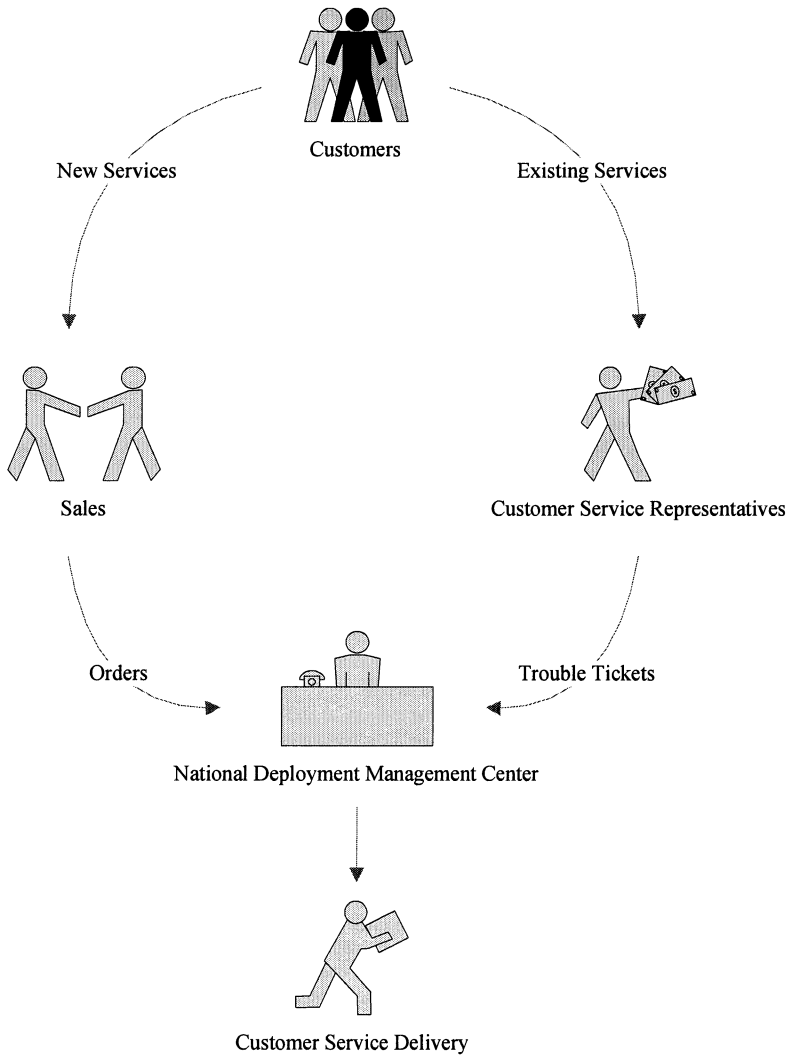


FIG. 1 NDMC and Internal Partners

There are several roles in NDMC: business analyst, resource planner, service order clerk, deployment clerk and deployment support clerk. Each role takes different responsibilities to keep the business running smoothly and successfully.

- **Business Analysts** analyze the performance of projects or teams in a certain period to identify business problems and propose solutions to help managerial decision-making.

- **Resource Planners** manage the "time bucket". Time Bucket is a term to descript how many hours are allowed to be booked for different types of trouble tickets or service orders within 24 hours. For example, a time bucket starts with 75 hours for in-service troubles and 75 hours for out-of-service troubles. If today's bucket is full, in other words, all 150 hours are used up, then appointments start to use the hours in tomorrow's bucket which means the customer will get an appointment for tomorrow. According to how many technicians are available in the field, they adjust the bucket to allow less or more appointments to be booked every day.
- **Service Order Clerks** monitor and manage new service orders booked by sales to make sure that all the orders sent to the field are doable (which means that the order has correct customer information and technical information).
- **Deployment Clerks** deploy technicians according to the workload in each area and technicians' skill sets (Some technicians can do ADSL installation while others can do pay phone jobs or key telephone systems).
- **Learning specialists** are responsible for developing and implementing trainings to facilitate projects for new and existing NDMC employees.

Every day trouble tickets and service orders created by CSRs and sales are gathered at NDMC waiting for dispatch. Over 200 employees work in NDMC across Canada. They collect, analyze, prioritize and monitor workloads, plan and deploy appropriate workforce to the field to

maximize customer expectations as well as to meet CRTC (Canadian Radio-television and Telecommunications Commission) Metrics.

Statement of the Problem and Research Purposes

Nowadays, web-based technologies have been widely adopted by business to enhance internal and external communications, support the gathering, sharing, and distributing of knowledge. STECO grants each department the ability to design and utilize web-based technologies based on their needs. Besides other individual-based technologies such as Microsoft Communicator and E-mail System, NDMC has an intranet portal which is defined as a formal communication platform, and a single point of access for NDMC related knowledge. However, the features and functions of NDMC portal have not been developed completely. Most communication and knowledge dissemination process happen informally which always cause uncertainties and confusion as people might get different versions of the information from different resources.

Insufficient communication not only affects the over-all effectiveness and efficiency, it also has negative influence on customers. For example, a CSR made a repair appointment for a customer in rural areas. However, the repair schedule in some rural areas did not follow the regular routine which meant that technicians could be there once a month or until the number of trouble tickets over a certain amount. If a CSR didn't remember these rules, he/she might make an invalid appointment for the customer. Finally, when NDMC informed the customer that the appointment had to be put off by several days or weeks because of the misunderstanding of the CSR,

obviously customer won't happy with what had happened. The unhappy experience might have a bad influence on the customer for future business opportunities.

Through the above example, an existing communication gap was demonstrated between NDMC and partner departments. Making common knowledge available to all stakeholders is a critical requirement for effective operation of an organization (Hine & Goul, 1998, pp.120). If the CSR could check schedules on the NDMC portal before booking appointment for the customer, he might save one more customer from other competitors. In order to effectively utilize the portal to support the operation of NDMC, managers decided to redesign the structure and functions of the portal. The new designed portal, as a part of organizational knowledge management plan, will become a multifunctional platform to support internal and external communication, education and training, knowledge storage and diffusion, and feedback collection. One challenge managers facing is how to combine organizational strategies with operational needs to enhance the usability of the new designed portal.

Usability is formally defined in ISO 9241-11 as:" the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (Jacko, Harris, Stephanidis, 2003, p45). To improve the quality of the portal doesn't mean to increase the investment or hire more web designers. Dr Edwards Deming pointed out that "quality is achieved by improvement of the process" (1981, p12). According to Dr Deming, improvement of the process led to lower costs and reduction of waste, so that

productivity is increased. This research aimed for a better design process to improve the usability of the portal. The research focused on two purposes:

1. To investigate determinants of a successful portal design;
2. To propose a new user-centered portal design process.

Literature review

Having summarized the communication challenges that faced by the organization in the previous section, we will review some literature regarding theoretical bases and practical strategies of user-centered portal design in this part.

Organization Design and Information System

An organization's goals and direction determines the way how the organization is designed and managed, which includes choices about organization structure, information system, selection of technology and so on (Daft, 2004). The classical perspective viewed an organization as a hierarchical system which worked well in a stable environment (Daft, 1998). Over the past two decades, emergence of the Internet and other advanced information technologies made the organization much harder to always keep in a winning position because of the unpredictable market and uncertainties of environment (Daft, 2004). In response to rapid changes, "many organization are shifting to flexible, decentralized structures that emphasize horizontal collaboration and widespread information sharing" said Dr Daft (2004, p28). The new pattern of organization is known as learning organization.

According to Peter Senge (1990, p.3) learning organizations are:

> ...organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together.

The basic rationale for learning organizations is to create organizational learning capability to gain competitive advantage. "The more learning capability is increased, the more adaptable and successful the organization" (Daft, 1998, p.347). In order to support organizational learning, organizations need to 'discover how to tap people's commitment and capacity to learn at all levels' (Senge, 1990, p.4).

When an organization changes towards learning organization, the components of the organization are intended to change as well. Information system's ability to reconfigure makes it easy to follow the direction of organizational management without destroying the organization (Castells, 2000). Web-based Technology such as Intranet has been adopted widely in maintaining and building networks and knowledge sharing. And a corporate Intranet portal provides immediate access to enterprise information, applications and knowledge base to each internal and external user (Kendler, 2000). It is generally agreed that Information Technology contributes to information processing by enabling new ways of knowledge acquiring and sharing, increasing the concentration and diffusion of knowledge, improving knowledge interpretation (Carneiro, 2005).

Benefits of IT Investment

Benefits that modern organizations can obtain from Information Technology include innovation, organizational learning abilities, increased intellectual asset and improved operational efficiency (Metaxiotis, Ergazakis & Psarras, 2005). Other benefits of an intranet support system reported by Pedley (1999) were:

- Allow different platforms to be linked by a common interface;
- Make a profound impact upon internal communication and organizational cultures;
- Cost saving and reduced access time.

A study about intranet benefits (Ward, 2002) showed that qualitative returns of Return On Investment (ROI) is more important than quantitative returns to users. According to Marcus & Watters (2002), quantitative returns refer to any cost saving benefits which can be measured such as cost saving in printing or distributing documents, travel expenses for employees in a global organization, reduced decision-making time, etc. And qualitative returns, on the other hand, are very subjectivity and intangible benefits which are related to feelings, capabilities and satisfactions (Marcus & Watters, 2002). A survey conducted by Prescient Digital Media partnered with the Katz School of Business at the University of Pittsburgh in 2002 had some interesting findings (Ward, 2002). Two-hundred and seventy-five (275) people participated in the survey to rank in order of importance almost 70 different intranet investment benefits. And the researchers surprisingly found that "softer, harder to measure benefits such as competitiveness, communications and content management (the big 'C's') were rated the most important. Traditional areas of focus for ROI benefits, including procurement, sales and time to market were rated among the lowest benefit categories" (Ward, 2002). The top 5 most important ROI benefits are:

Most important ROI benefits

1. Improved information sharing 97%

2. Enhanced communications and information sharing	95%
3. Increased consistency of info	94%
4. Increased accuracy of info	93%
5. Reduced or eliminated processing	93%

While managers and executives are waiting to see cost savings and market share increasing, end-users are more care about soft benefits (or qualitative ROI) which might generate even bigger unexpected profits for the organization according to survey results (Ward, 2002). This study shows the big differences of expectation between management and end-users. It also reminds designers how important it is to consult with users in order to meet their expectations.

Frameworks of User-based IT System Design

Having reviewed the relationships between Intranet portal, organization design, and benefits of building an Intranet system, now we will review some previous studies of frameworks for IT system design.

Some of the studies of information system design emphasize on technology. Kakabadse, Kakabadse & Kouzmin (2003, p.87) stated that the designers of Knowledge Management (KM) System have to understand both "the drive of KM and technology opportunities in order to create a strategic technology plan". From an innovation perspective, Cohen and Levinthal (1990) suggested that the success of most management innovation processes depends on a deep understanding of technological advances and an analysis of benefits. Managers should pay

attention to "the purpose to build a KM system and which technology should be integrated to generate high knowledge levels" (Carneiro, 2005, pp.257).

Meanwhile, other researchers focus on end-users. The importance of user-centered design strategies has been recognized by many researchers and information professionals (Abels et al., 1997; Detlor, 2000, Essex et al., 1998). Hine and Goul's Organizational Learning Support System (OLSS) (1998) emphasized that interpretations of users' underlying opinions are vitally important to the success of the system design. They illustrated a way of information technology helping to present the conflicts to the organizational members in order to achieve the consensus and facilitate positive communication. According to the interpretive organizational learning perspective, IT system design should involve the development of effective interpretation system to reduce conflicting understandings. The OLSS emphasizes the communication of organizational members' underlying opinions, assumptions and interpretations of the environment. It is valuable to managers and web designers to carefully interpret end-users' expectations.

Another user-based study is the 4I's framework (FIG 2) of organizational learning, introduced by Crossan, Lane and White (1999). It consists of "four related (sub) processes—intuiting, interpreting, integrating, and institutionalizing (4I) — that occur over three levels: individual, group, and organization" (1999, p.524). One contribution of the framework is that it uncovers that organizational learning happens at all three levels: individual, group, and organization. At individual level, knowledge is generated from past experiences and stimulated by new ideas.

Through communicating with other group members, individual knowledge is shared within the group. At group level, individual knowledge is tested, adjusted and developed according to other group members' interpretation and feedback. Beyond this point, it becomes group knowledge which is accepted and applied by each group member. Organization level is where individual and group knowledge is recognized by people who are not only from inside the group, but also outside the group. And positive impacts of the knowledge are testified in a much wider range. At organization level, individual and group knowledge become deposited as part of organizational intellectual property. Even though knowledge workers might leave the organization, shared knowledge has been "embedded in systems, structures, strategy, routines, prescribed practices of the organization" (Crossan, Lane and White, 1999, p.529).

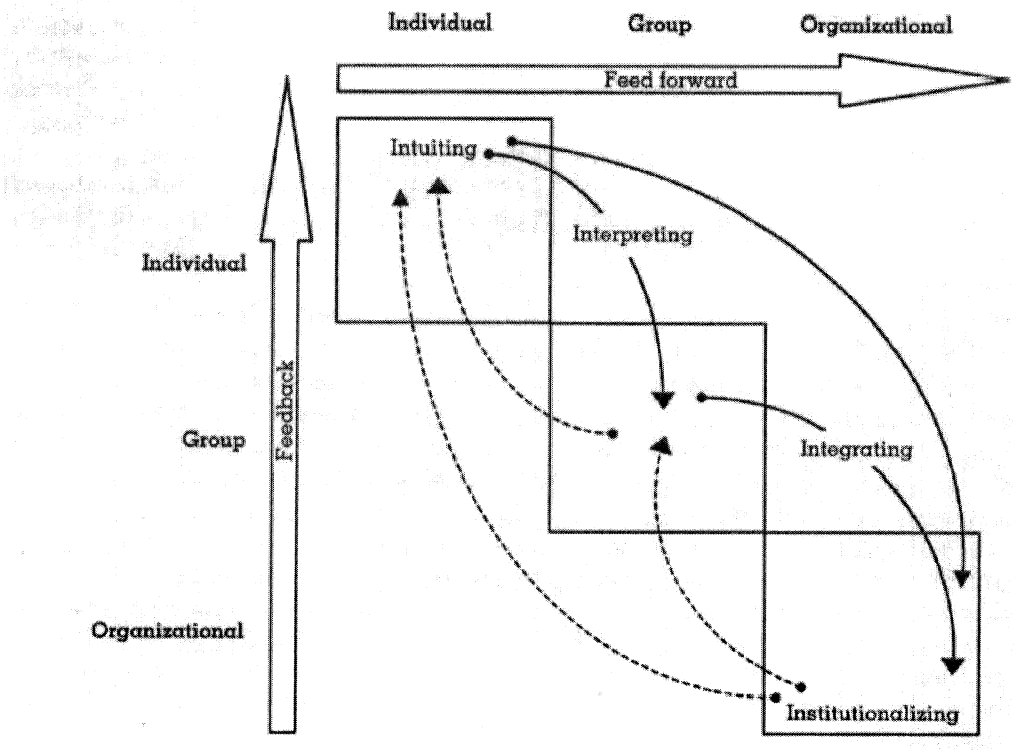


FIG. 2 Framework of Organizational learning (Crossan, Lane and White, 1999)

The second contribution of the framework is that it defines organizational learning as a dynamic process which integrated exploring new learning and exploiting existing knowledge, knowing as feed forward and feedback. From the interpretive perspective, it is "a process of surfacing, sharing, and understanding various interpretations" (Hine and Goul, 1998). It illustrated the processes of how knowledge circulating and developing within an organization (Crossan, Lane and White, 1999). At individual level, intuiting is the reflection of past experiences and the beginning of new learning. Interpreting is the process that people build cognitive map to guide their actions. Interpreting also happens at group level when individual try to explain an idea to others through words or actions. At group level, common understanding and shared knowledge are developed through the process of integrating. The last process is institutionalizing which separates organizational learning from individual or group learning. Through institutionalizing, individual and group knowledge is summarized, documented, distributed and applied as organizational knowledge. The feedback coming down from organization or group helps to generate new ideas and insights.

Next we are going to see how 4I process related to user information behaviours, including their information needs, seeking preferences, and the criteria users applied in determining the usefulness of a portal (Detlor, 2000; Abels et al., 1998).

First of all, we will start with the process of intuiting. From the learning perspective, sufficient, accurate and timely information is necessary for users to make sense of the environment. The information supporting individual intuiting process comes from group knowledge and

organizational knowledge. Therefore, providing the information users need is the key in the process of intuiting.

Next, it is the process of interpreting which consists of two elements: the ways of obtaining information and criteria for judging the usefulness of the information. Recognizing users' information seeking preferences can help designer make decisions towards technologies selections and functional design. For example, a search engine will be appreciated by employees who like to find the answers themselves, and a well-organized forum will be welcomed by people oriented users. To understand the criteria users applied for judging the usefulness of the information is another important component of interpreting process. However, designers must realize that the criteria changes when the user's position is changed.

Thirdly, the integrating process is the process where shared knowledge and common understanding are developed. Sharing knowledge and developing common understanding not only encourage collaborations and reduce conflicts, but also help to stimulate new ideas and better performance.

Last but not least, institutionalizing is the process to transform individual and group knowledge into organization knowledge and embed such knowledge in structures, systems, strategies and routines of the organization. (Crossan, Lane and White, 1999) The benefits of making organization knowledge available online include reducing costs for printing and distributing documents, updating the information easily, providing the most accurate information.

In short, the intuiting process focuses on the information content, the interpreting process focuses on information seeking, the integrating process focuses on information sharing and the institutionalizing process focuses on information summarizing and distributing. Meanwhile, designers must remember that organization learning is a dynamic process. Knowledge circulation happens anytime during each process. Thus, keeping an open and expedite communication with users is suggested to allow constant improvement.

The framework provides the theoretical support to the research by clarifying the relationship of individual, group and organization in the process. At the same time, it discovers that information technology facilitates organizational learning via establishing multilevel communication channels between individual, group and organization which enable knowledge to circulate within the organization.

Another study emphasizes the influences from environment and users' behaviours. Detlor (2000, p.95) suggested in his discussion of corporation portal design that designers need to understand that "people more often use a portal not to find a specific answer, but rather to help them make sense of their environment, learn new ideas, or resolve their problems". According to Deltor's *Behavioral-Ecological framework* for the design and evaluation of corporate portal, there are three nested layers: the information ecology of the organization, the information behaviors of users, and the value-added processes within a portal (2000). FIG. 3 illustrates how behavioral-Ecological approach works in portal design process.

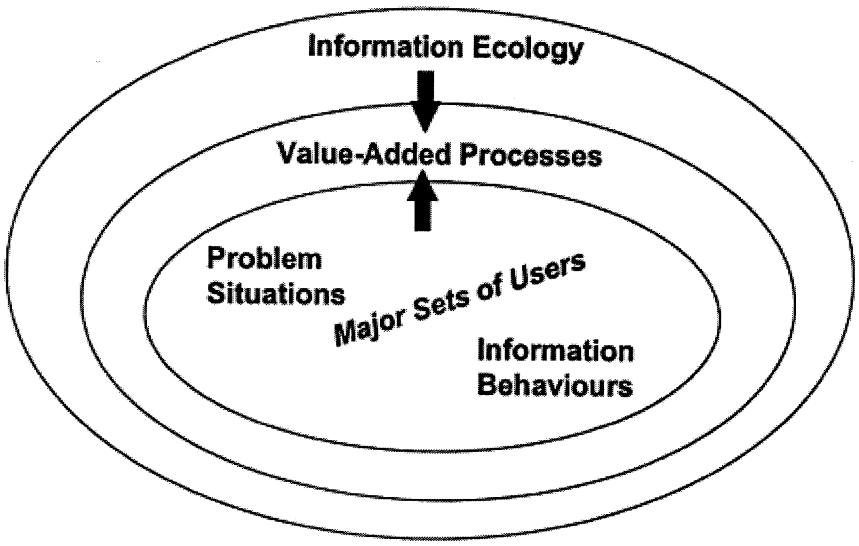


FIG. 3 Behavioural-Ecological framework (Deltor, 2000)

The information behaviours of users locate in the core layer of the framework which emphasizes on how individual and group users behave to interpreter their environments and ways to use information in order to resolve problems (Deltor, 2000). Research by Goul, Shane, and Tonge revealed that "individuals with access to the genetic strategy knowledge interpreted their environment better than did individuals without access to the knowledge-based system" (Hine and Goul, 1998, p.123). One benefit of understanding the information behaviours of users is to detect overlapping and conflicts in individual interpretations of the environments. Conflicts must be addressed in order to reduce equivocal descriptions and consolidate different interpretations into an organizational interpretation. (Hine and Goul, 1998) Deltor (2000) proposed three steps to understand user information behaviours. First of all, it is to identify the major users and understand their information needs and preferences. Secondly, designers need to have a deep understanding of what are problem situations that the users face. The last step is to understand

the way users prefer to use to locate information and in what format the information should be presented.

The middle layer is the value-added processes which implement via a corporation portal's functions and features (Deltor, 2000). The key of the value-added processes is to understand that the design and operation of the corporation portal must base on both the analysis of information use environment and information behaviours of users. The information ecology refers to the elements in the organization that have influences on the information flow. It consists of eight elements: "organizational mission; corporate portal goals; information management plans; information culture; information politics; physical setting; information staff; and information handling" (Deltor, 2000, p.97).

The ideas behind both 4I's framework for organizational learning and Behavioral-Ecological framework for portal design emphasize the awareness of a new trend of portal design which focuses on the interactions between users and organizational environments. Information technology is the tool to build multilevel communication channels to share individual and group interpretations of organization environment and promote knowledge circulation between individual, group and organization.

Social Influence on Portal Design

Based on Kelman's study of social influence and Davis' Technology Acceptance Model (1989), Malhotra and Galleta (1999) approved that three social influence processes: compliance,

identification, and internalization have different effects on individual behaviour, so that affect users' attitude toward the use of the new information system. Kelman's definitions about compliance, identification and internalization are presented as below (1958):

- Compliance: when an individual adopts the induced behaviour not because she believes in its content but with the expectation of gaining rewards or avoiding punishments.
- Identification: when an individual accepts influence because she wants to establish or maintain a satisfying self-defining relationship to another person or group.
- Internalization: when an individual accepts influence because it is congruent with her value system.

Malhotra and Galleta's study (1999) indicated that compliance has a negative influence on users' attitude toward the use of the new system, while as identification and internalization have positive influences on users' attitude. Therefore, Malhotra and Galleta (1999) suggested involving users in the process of information system design and educating users about the benefits of applying information technologies in term of improving individual and organization performance. Understanding the interaction between social influence and users' attitude toward the acceptance and use of information system helps portal designers increase the awareness of monitoring conflicts between organization and individual value system during the portal design process.

Besides organization value system, Deltor (2000) suggested the following elements need to be

considered during the process of portal design because they might influence the portal design: organizational mission; corporate portal goals; information management plans; information culture; information politics; physical setting; information staff; and information handling. To some extent, the functions and features of portal design are determined and limited by organization environment.

Methodology

Method

According to the research purposes and available resources, an approach combining both quantitative and qualitative methods was used to conduct the research. The quantitative data was collected through a web-based survey, while as the qualitative data was gathered through field interviews. The compound approach allowed us to more accurately address the situations.

- Potential Participants: All employees in the National Deployment and Management Centre.
- Data collection involves two steps:

1) A web-based survey (Appendix 1) was used to collect users' opinion. A survey was particularly effective at gathering data and gets an over-all understanding about users' preferences. Furthermore, a web-based survey could be completed anytime which increases the flexibility and convenience to respondents. A link of the web-based survey was distributed through STECO internal email system to all NDMC employees. Respondents were given four weeks to complete the survey. Totally 200 surveys were sent out to all NDMC employees in the period of April to May 2008, and resulted in 66 questionnaire responses. The survey included 18 questions and took approximately 20 minutes to complete. At the end of the survey, participants were asked if they were willing to respond to a one hour interview. Those respondents who showed interests in interviews were asked to provide their name and contact information in order to contact potential interviewees.

2) Survey research also had some significant weaknesses. For example, it cannot reveal the reasons for paticipants' interests or issues that exceed the researcher's knowledge. In some cases, interviews offered cues that were not verbalized (McQuarrie, 1996, pp.132). In this study, an interview (Appendix 2) was used to address the weaknesses of surveys and to support the interpretation of the survey data. The interview was also helpful to discover the relationships among managers, web designers and employees and how their opinion influences the design process. Those employees who showed willingness to participate the interview in the survey were considered as potential interviewees. Totally six employees were chosen for the interviews. Two of them were managers and four employees were from different positions. They were selected for two reasons. First of all, interviewees were all from different team whose managers have different work styles. We wanted to discover if managers' work styles had impacts on the portal design process. Secondly, we selected participants from different levels and positions in order to capture voices from all levels and aspects in NDMC.

Data Analysis

At least three techniques were adopted in data analysis: establishing priorities, creating indexes and elaborating relationships. (Israel, 1992) Establishing priorities was useful for summarizing and ranking key determinants of the success of NDMC's websites. Creating indexes helped to make rough comparisons among research items which had dissimilar response categories. Finally, elaborating relationships was used to clarify the relationship

between research items which helped us to understand the interplay of key determinants. Data were analyzed through the following stages:

1. Coding and grouping: Both quantitative and qualitative data were read and coded very carefully, and they were grouped according to different interest catalogues. The affinity diagram was used to group related user input; and the tree diagram was used to expand core ideas that emerge from the affinity diagram.
2. Comparing and eliminating: in this stage, data collected from users and analysis results of organization environment were compared to identify the differences between end-user needs and business preferences. The comparisons enabled us to summary the range of possible improvement and eliminate improvements that cannot be supported.
3. Drawing conclusions: suggestions were made according to the ranking of key determinants. We selected improvements that yield the greatest visible results to users and the organization.

Validity and Reliability

Some of the survey questions were derived from past research, and some were designed for the unique purposes of this research. Then the preliminary questionnaire was pre-test by a small group of users including web designers and some end-users. The feedback was used to revise the content and design of the questionnaire. The revised survey questions were then reviewed by communication manager for approval before the survey was opened to public. This process provides support for content validity of the research. In Appendix 1, we see 18 questions,

including open-ended text questions, multiple choice questions and interval scale questions. Questions 3 to 14 were selected from WebQual instrument originally developed at University of Bath (Barnes & Vidgen, 2003). Barnes & Vidgen (2003) pointed out that WebQual is different from evaluation instruments because it is able to use quantitative techniques to analyze data collected from subjective questions. Respondents were asked to rate the qualities of a website using a seven-point scale. WebQual has been identified as an effective tool to capture the voice of customers by many researchers (Barnes & Vidgen, 2001a, b) We eliminated unrelated questions and selected 12 out of total 23 questions from the standard WebQual instrument. Question 15 to 17 were designed to give users opportunities to talk about features that didn't cover in WebQual questions. Question 15 was asking users to rank the importance of each quality including coverage of information coverage of information, design and appearance, functionaries, ease of navigation, and availability of search engine. Question 16 and 17 were open-ended questions to encourage further discussion about users' needs. Data collected from interval scale questions was analyzed by using SPSS 13.0 for Windows software.

Reliability is a fundamental concept of test construction. The most common measure of reliability, Cronbach's Alpha, is frequently used by researchers to determine how consistently individuals respond to the items with a scale. According to Guiford (1965), Cronbach's Alpha of 0.70 or higher is considered high reliability and Cronbach's Alpha of 0.35 or lower is considered low reliability. The Cronbach's Alpha reliabilities for overall items and each category range from .895 to .971, with the majority in the high .90 range. The strong Alpha reliabilities show

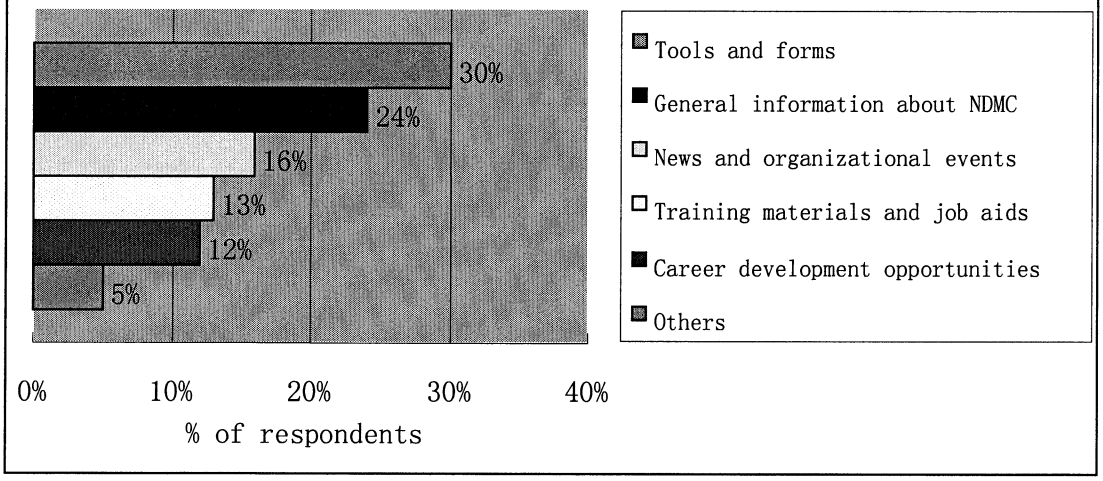
that the users are responding consistently to the survey items. The reliability test helps to avoid the situation that users may be inconsistent in how they respond to the survey questions, for example, users might randomly mark their answers without understanding the questions.

Findings

Users' Satisfaction with NDMC Portal

The main purpose of the survey was to evaluate users' satisfaction with the existing portal. The survey results show that 36% of respondents visit the portal everyday and 45% of respondents visit the portal at least once a week. Thus, visiting the portal has become a part of the job routine for most employees in NDMC. The purposes of visiting the portal are various. The top 5 information people looking for on the portal are: tools and forms, general information about NDMC, organizational news and events, training materials and job aids, career development opportunities (see FIG. 4). Other reasons people visiting the portal include getting access to partner team sites, checking reports, guidelines and processes within the department, accessing systems and applications on the intranet, etc.

FIG 4: Purposes of Visiting the Portal



Questions 3 to 14 are interval scale questions. Users were asked to rate the portal for each quality using a scale ranging from one (strongly disagree) to seven (strongly agree). The results revealed

high user satisfaction with the portal's quality (See Table 1, M ranged from 5.09 to 5.66, SD ranged from 1.250 to 1.517). Top three items with the highest scores are:

- The site has an attractive appearance. 5.66
- The site provides easy to understand information. 5.54
- The response time of the site is acceptable. 5.52

And the bottom three factors that users are not satisfied with are:

- The site makes it easy to communicate with organization. 5.09
- I can find relevant information on the web portal. 5.14
- The site provides a broad range of information. 5.21

Table 1. Interval Scale Questions

	Mean	Std. Deviation	Std. Error Mean
3. I find the site easy to use.	5.41	1.385	.185
4. I find the site easy to navigate.	5.29	1.410	.190
5. I can find relevant information on the web portal.	5.14	1.507	.201
6. My interaction with the site is clear and understandable.	5.33	1.318	.179
7. The response time of the site is acceptable.	5.52	1.265	.169
8. The site has an attractive appearance.	5.66	1.283	.171
9. The site makes it easy to communicate with	5.09	1.517	.203

organization.			
10. The site provides a broad range of information.	5.21	1.498	.206
11. The site provides accurate information.	5.29	1.498	.200
12. The site provides timely information.	5.36	1.445	.195
13. The site provides easy to understand information.	5.54	1.250	.167
14. The site presents the information in an appropriate format.	5.46	1.307	.175

Priority of Portal Qualities

In question 15, users were asked to rate the importance of each quality of the NDMC portal using a scale ranging from one (less important) to seven (most important). The five major qualities are examined:

- Coverage of information
- Design and appearance
- Functionality
- Easy of Navigation
- Availability of search engine

The score in each area reflects the level of users' expectation as showing in FIG 5. Most scores are above 5, and the only score below 5 is Design and appearance which got 4.97. The result presented a specific priority in the qualities determined by the portal users. Users had high expectations for the portal's navigatability and information coverage while as design and

appearance appears less important to users. After all, the original motivation of building a corporate portal was to enhance access to business information for better performance. The portal should be able to help users easily find information and perform their jobs. Gerry McGovern, a well-known content-management expert and author of the books, "Content Critical" and "The Web Content Style Guide" said in an interview that "more and more web teams are realizing that infrastructure and architecture gets you on the pitch, but it is content that will win you the game" (Perfetti, 2006). Our finding provides further support to Gerry's point that content is one of the most critical elements of a web site.

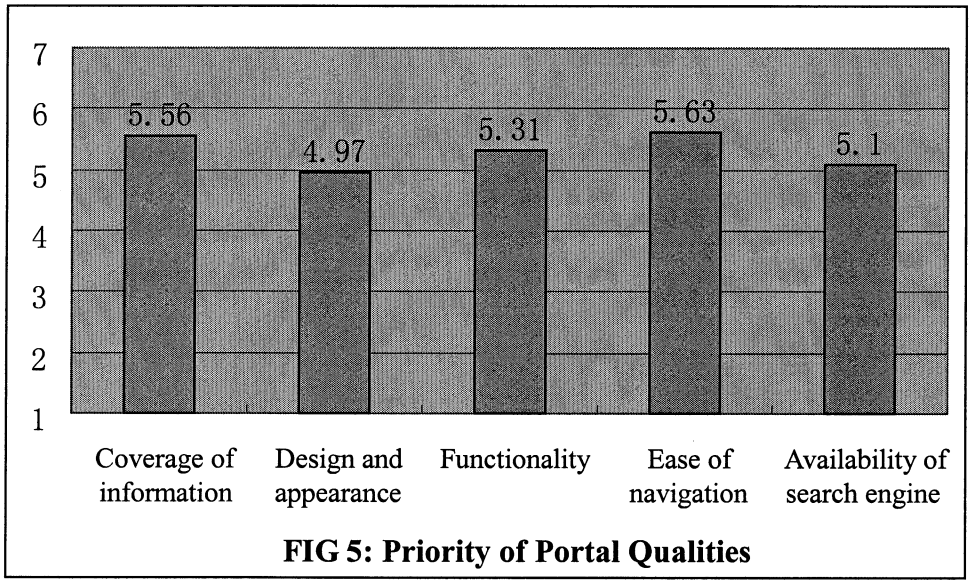


FIG 5: Priority of Portal Qualities

Results of Qualitative Data

Through analyzing the results of open-ended questions and interviews, we are able to confirm findings from quantitative analysis, understand users' reasons for rating the portal as they did and explore the underlying expectations of portal users. The analysis of the transcripts uncovered the following problems with current NDMC portal.

1) Search engine

Because the organization keeps producing huge amounts of information, it is far beyond the personal ability to process. The search engine was designed to increases people's ability to manage and control information. In open-ended questions, users identified improving search capabilities as the top task on designers' "To-Do" list. Almost all interviewees mentioned that the capabilities of current search engine should be improved in order to increase the usability of the portal. Users complained that 90% of the search results returned by the search engine were not related to the topics that users were searching for. Interviewee described their experience with the search engine as below:

> Like new employees, everybody starts internet and knows how to use google. They probably are expecting our search engine to be like google search engine, but it is not. Our search engine searches for stuff from sales, you get crazy stuffs usually don't have to be involved... If I'm typing in what does this term mean, it never ever brings up the prefect information what I'm looking for. I have to go and track down myself.

> It's almost impossible to find anything through a search, due to the awkward and illogical way information is collected and displayed.

Another problem with the search engine is efficiency. Users expected to just search NDMC relevant information. However, current search engine would search the entire company's intranet and returned lots of unrelated information. Users suggested an option that let users

select the searching range (within NDMC or the entire company) would be nice to have. And it would significantly improve the searching efficiency by reducing respond time and increase information accuracy.

To address the issue, designers need to first evaluate the performance of current search engine. Lancaster and Fayen (1973) recommended 6 criteria for measuring the performance of information retrieval systems.

a) Coverage (proportion of literature on a topic)

b) Recall (retrieve relevant items)

c) Precision (hold back non-relevant Items)

d) Response time (from request to results)

e) User effort (expended to achieve a satisfactory response)

f) Form of output(presentation of the search results)

Even though the criteria have more than two decades old, but they are still capable for assessing today's search engines. Essentially, the Intranet is a huge information retrieval system with multimedia structure and distributed architecture. Through the evaluation process, designers are able to determine what the root causes of inefficient search system were, and whether it was a technical problem or information sources problem and how to improve it.

2) Navigability

In our study, the overall feedback on navigability is positive. Information and applications were grouped in a reasonable manner and easy to access. A consistent pattern of side menu in all

pages (main page and subpages) enabled users to easily switch to a different category without going back to the main page. However, users expected more consideration of first time users or new employees who had less experience about the operation and terms used in NDMC. Users' comments were:

> That's one big thing that if you don't have experience and you don't know what's going on, you pretty much will lost here and you search around, finding all sorts of information but nothing actually you are looking for.

> The thing that I think that need to be improved is the way that people find information on the site. It is definitely hard if you don't know what you are doing. It is definitely a little bit overwhelming when you are new employee.

Zazelenchuk and Boling (2003) suggested that easy access to clear instructions and help information contributes to users' satisfaction with a web-based portal. Appropriate instructions and help feature might be usually ignored by experienced users, but they are necessary for new users to overcome frustrations and fears caused by adopting new technology or changing to a new working environment.

3) Content

Survey results indicated that users had difficulties to find relevant information. Data collected from interviews confirmed this finding. There are several reasons caused difficulties to locate relevant information: one, the information was left out by designers; two, the information was

out-of-date; three, the information wasn't presented in a proper format. Users mentioned most was to keep information updated. Keeping information updated is a difficult issue to web administrators because they are not the provider of the information. It requires continuing cooperation with content providers. For example, if a business analyst changed a working process, it was his/her responsibility to inform the web administrators about the change, so they could replace the document posted on the portal. One interviewee suggested designing a section in which users can submit recommendations of what information the portal should contain, or assigning one person in each team to monitor and communicate changes to web administrators so that the portal always has accurate and timely information.

The dead link was another big issue bothering users. Those dead links should be removed from the portal. Users kept checking on items which are saying "coming soon" to find out if there is any useful information. Some items had said "coming soon" for over six months and hadn't updated yet. Users felt disappointed at the quality of the portal and gradually lost interests in visiting the portal. Moreover, from cost saving perspective, if everyone in NDMC takes 5 minutes a day to click on those dead links, it will be totally 1000 minutes, almost 17 hours per day (considering 200 people in NDMC). If we calculate a NDMC employee's wage as $16 per hour, then it will cost the company $99,280 ($16*17*365) per year.

4) Design and appearance

40% of respondents are strongly agree that the site has an attractive appearance, a few respondents thought that the information on the portal is not very well organized, the looking is

cluttered and the color of the news titles are a bit dark compared to what's on the company portal. Some frequently accessed information should be made available on the first page, such as training materials. Currently training materials are placed under Resources – Learning academy catalog. It is hard to be found for people who have very little experience with the portal. Same as other frequently accessed applications like team STECO directory, e.time and e.pay should have quick links on the first page of the portal. Some interviewees felt that unattractive graphics, over-large graphics and dark graphics are considered annoying. At the same time, a few small graphics enhance consistency of appearance between pages and provide navigational support.

The quality of design and appearance can be improved by regularly monitor and analysis the web usage log. A web usage log is a document created by the web server to record all the activities happened on a certain web site. Through usage log analysis, the web administrator is able to understand each user's preferences and identify the most popular information on the web site, so that appropriate adjustments can be made to improve the accessibility of those information and applications. Users' opinions can also be gathered through other means, such as observation at work, questionnaires or interviews. This is a constant process since users' preferences might be changed according to dynamic business requirements.

5) Functionality

Most respondents are satisfied with the functions that the portal provides currently, such as events calendar to show big events which are going to happen in NDMC, career opportunities

within NDMC, and helpful links to partner sites, etc. However, additional functions will make it a better portal. Users suggested:

a) Using a variety of colours to denote difference between learning events from social events from holidays etc;

b) Links to references and tools should be opened in a separate window (instead of interrupting the system that users are working with);

c) A program or a toolbar which we could drag and drop shortcuts, web links onto (a customized section where the user can set up their own settings);

d) A FAQ (Frequently Asked Questions) section;

e) A chat forum for users to ask questions, whoever knows the answer is able to provide the answer online, so that facilitates knowledge sharing within NDMC;

f) Combine the information on the portal and STECO Knowledge Base (STECO wikipedia);

g) Building a section for each team in NDMC which provides general information about the team like staff information and support areas. It is helpful to create a sense of belonging to the team members and also improve the communication between teams.

Some of the suggestions might be easy to implement by the web designer, some might need to involve outside contractors to develop a special program to meet users' requirements, for example, the chat forum and customized tool bar.

6) Support from middle management

It was surprising to find out that middle management had big influence on employees' attitudes towards using the portal. By analysing the transcripts, we found out there were two types of middle managers in NDMC: people-oriented and technology-oriented managers. People-oriented managers believed in face-to-face communication rather than technology-based communication like intranet. When an employee had problems at work, they usually recommended him to seek help from experienced team members. Therefore, employees under people-oriented managers spent less time on the portal. On the other hand, technology-oriented managers tended to help their employees to fully understand and utilize benefits of technology.

So far, no clear conclusions about which type of managers led to better team performance. But we did see negative impacts on employees' attitudes towards using the portal if their manager was people-oriented. Those employees had less interest in exploring new features and functions of the portal. Some users described the portal as NDMC's newspaper, not so much job-related information; or it was faster and easier to just ask people than search information on the portal by themselves. Employees whose manager was technology-oriented had more positive attitudes toward the portal and more positive perceptions of system effectiveness.

This finding provided evidence of the important role of social influences in determining the acceptance and usage behaviour of new information system (Malhotra and Galleta, 1999). Malhotra and Galleta (1999) indicated that external influences such as peer pressures (or influences from managers in our case) might generate a feeling of compliance which would result in ineffective acceptance and negligible performance improvements.

Recommendations for Future Design

Through the analysis of both quantitative and qualitative data, we revealed several problems with current portal design such as insufficient content, navigation and appearance issues, and deficient functionality. Middle managers' attitude toward technology also had a big impact on employees' technology acceptance and usage behaviour. In the following part, we recognized six essential determinants and proposed a user-centered design process to help NDMC designers to reach a successful portal redesign.

Essential Determinants

1) Identifying stakeholders

Harkness (2003) suggested that before we start building intranet, we need to identify the following stakeholders: Management, Content Contributors, Developers, Designers, the Network Administrator, and the end users. It is the same for intranet portal design. Identifying stakeholders will help web designers have a better understanding of the scope of the project, budgets, contents and technical limitation (Harkness, 2003). Management and end users are of more importance than the rest. Management provides budgets for the portal and set up a framework based on company's policies and strategies. On the other hand, end users determine what information the portal should contain. It is necessary for the designers to identify users' needs and respond via adopting appropriate technologies.

2) Users' participation

The root cause of many problems with current NDMC portal design was marginal user

participation. Designers should "start thinking about how they can create a website that can serve their customers better. (This is as true for an intranet as a public website, where the customer is a staff member.)...Customer focus is the beginning, middle and end of a successful web strategy" according to Gerry McGovern (Perfetti, 2006). Other literature suggested that the user-centered design approach requested designers to involve users in all stages of the design process and understand user information behaviours such as their information needs, seeking preferences, and the criteria for usefulness of information (Detlor, 2000; Abels et al., 1998).

To successfully redesign, Shneiderman (1998) suggested that the initial step was to identify the users and the users' tasks. Knowing who is using the site and what they are doing with it help designers to better understand users' requirements. Methods to establish user requirements are interviews, focus groups, questionnaires or observing end users' performance, etc. After a preliminary design, designers need to collect users' feedback to evaluate every aspect of the site such as content, structure, search, appearance, etc (Abels et al., 1998). Even after the implementation phase, "users continually have the ability to suggest new resources, to react to organization or links, or to make comments about the appearance of the Web site" (Abels et al., 1998).

Continual user input is useful in helping to improve accuracy of user requirements, but also avoid wasting time and resources on unused or little-used features (Koyani et al., 2004). Malhotra and Galleta (1999) also suggested involving users in the process of information system

design can increase user acceptance toward the use of new information system. To systematically capture the customer's voice, designers can either set up ongoing systems to collect customers' feedback like online survey and link to suggestion box, or regularly go into the field to confirm customer needs.

3) Priority ranking

Designers should set up priorities and the range of possible improvement, and eliminate improvements that can't be support due to lack of resources, for example, a limited budget or users' computer proficiency. It is impossible to make a system that meets every user's unique requirement. Thus it is important for the designers to set up a clear goal of the portal according to business needs and then rank the priority of user requirements. Designer should focus on improvements related to user performance like content, format, navigation, etc, rather than color and appearance (Koyani et al., 2004).

4) Reducing negative attitude

Designers have to pay attention to the influences of middle manager on employees' attitude toward the use of new information system. We have mentioned that involving users in the design process can improve users' technology acceptance (Malhotra and Galleta, 1999). Designers can try to arrange people-oriented managers or employees from their teams to participate in the design process to fully understand their concerns about new technology. At same time, those users have opportunities to personally invest in use of the new system which will have a positive affect on the attitude toward system use (Malhotra and Galleta, 1999). Training or presentations

about the portal's functions and features will also give users opportunities to experience the benefits brought by new technology.

5) Knowing the potential of new technologies

According to Marcus and Watters (2002), intranet has been developed from a simple publishing tool to a web-based collaborative tool. Users has come to expect more functions on intranet portal as they experienced on other internet sites, such as navigation and search tools, and customized functions. From the results of survey and interviews, we can perceive the changes of users' expectations. Some respondents want a search engine like google, and some want a personalized toolbar, etc. In order to respond to the new expectations and keep improving the usability and users' satisfaction of the portal, designers must combine users' needs with technology advantages. This requests designer to:

1) Interpret the underlying meaning of users' needs.
2) Know the potential of new technologies.

The ability to interpreting the underlying meaning of users' needs enables designers to find common interests between different users in order to fulfill major users' expectations. Knowing the potential of new technologies gives designers the flexibility of deploying alternative technology to implement similar functions. For example, a new information retrieval application might perform the similar functions but less expensive than investing on Google's searching technology. By doing so, designers are able to have a clear view of what users are expecting and which technology should be selected to meet the expectation.

6) Monitoring changes

In the user-centered design process, portal design is "an ongoing, iterative process, responding to changes in the user's information seeking and the availability of additional resources" (Abelse et al., 1998). And it is common for an improvement effort to create additional problems. Therefore, monitoring is critical in this approach. By monitoring changes of user requirements, availability of resources and technology advantages, designers can catch negative factors and take alternative action if necessary.

A User-centered Design Process

Based on Abelse, White and Hahn's work of 4-stage user-based design process (information gathering, development, test and evaluation, and implementation), we complemented with additional findings in this study to propose a new user-centered portal design process.

The process starts with identifying stakeholders that helps to understand who are using the portal, the scope, budget and goals of the portal. User requirement is established through exchanging information with users or analysing user information behaviour. Then designers need to rank priorities and identify possible improvement according to organization's business value, project budget, and other elements of internal and external environments. A preliminary design reflecting users' needs is created to be evaluated by users. If users are satisfied with the preliminary design, designers will start to develop details like content, applications and features, etc. If users are not satisfied with the preliminary design, designers have to refine user requirement according to users' feedback.

After the portal development, at least one section of user testing should be conducted to assess the quality and usability of the portal. Users' feedback will be collected to redefine user requirement and then start over again the whole developing, evaluation process. In the implementation phrase, we suggest to begin with user training and presentations to give users opportunities to get familiar with the system and in-depth understanding of the capabilities of the new system. It is useful to increase the level of users' technology acceptance. Formal launch of the portal is not the end of the project. Designers must keep monitoring changes of user requirement, technology advantages, organization environment, etc. Maintenance and modifications are made on regular bases for further improvement.

A flowchart of the user-centered design process is showed as below (FIG 6).

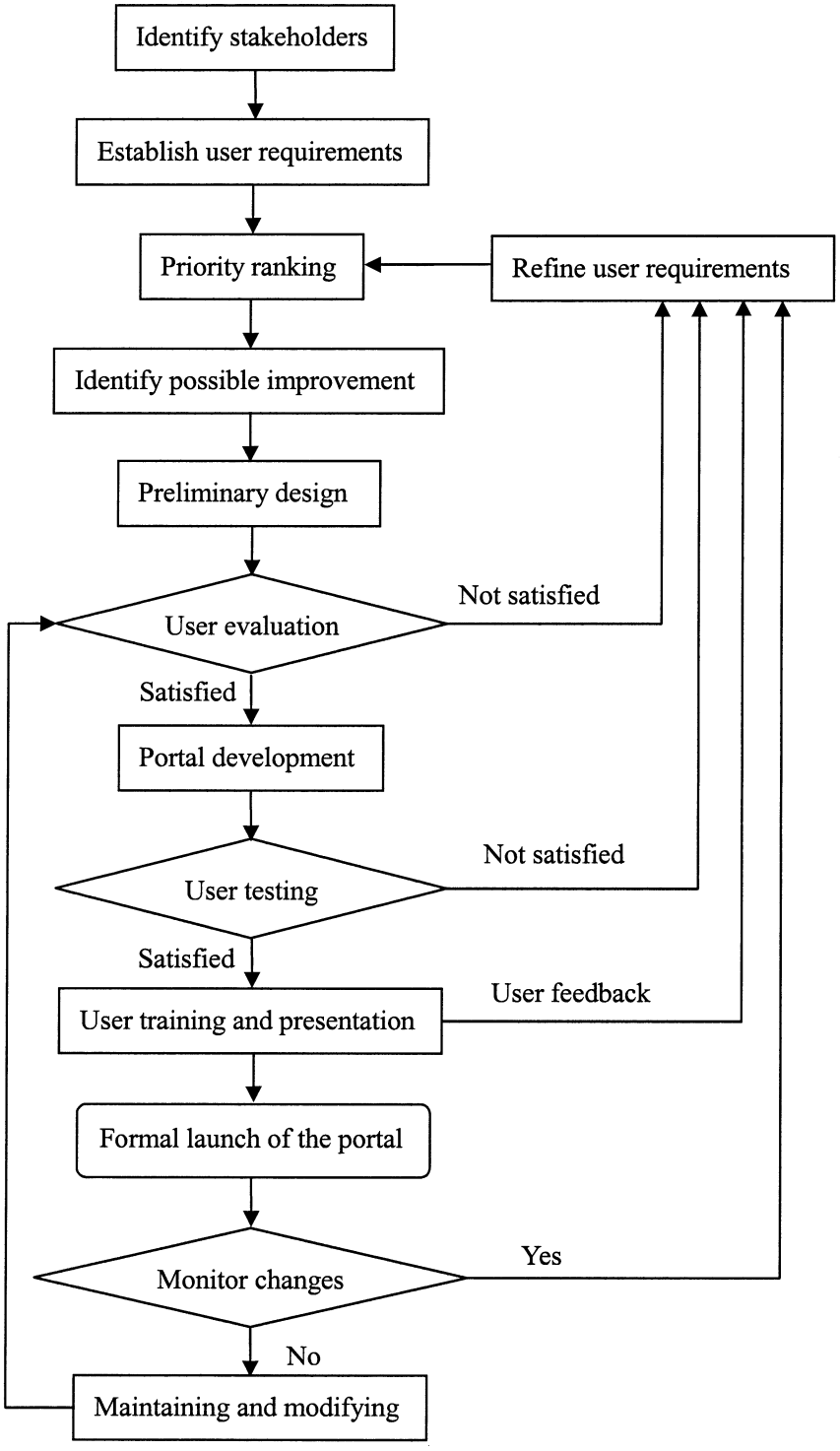


FIG 6. A user-centered portal design process

Discussion/ Conclusion

In this paper, we revealed six determinants of a successful portal design: identifying stakeholders, users' participation, priority ranking, reducing negative attitude, knowing the potential of new technologies and monitoring changes. And we also proposed a new user-centered portal design process for future improvement. However, to redesign a portal is far more complex than we described in this study. Here, we just revealed a tip of the whole ice burger.

There were limitations with the survey and interview method in this study. Firstly, the low respond rate (33%) of the survey reminded us that the survey results only represented a small amount of NDMC employees and it might not reflect majority needs. Although we were trying to interview people from different levels and positions to ensure that a cross-section of people were reached, we were only able to select six participants in this study due to limited time and resources. Others who did not respond to the survey might have various reasons, such as uncomfortable with online survey, lack of interests or having difficulties to understand questions, etc. Furthermore, because it was anonymous survey, we were not able to identify participants' age, gender, position and other personal information. Thus, we could not discover if their responds were influenced by any of those factors. But all six interviewees who volunteer to participate in interviews were male. Bias could be generated because of differences in gender.

There were other limitations with the research method, for example, the chosen example was not randomly selected. Therefore, recommendations in this paper were made specifically based on NDMC environment, might not be transferable to other portals and organizations. And the

effects of proposed new user-centered design process are also waiting to be tested in the real world.

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APPENDIX 1—Survey Questions

1. How often do you visit the portal?
   a) Daily
   b) Weekly
   c) Monthly
   d) Several times a year
2. What's your purpose(s) of visiting our portal? (You can select more than one option.)
   a) For general information about NDMC
   b) For news and organizational events
   c) For personal career development opportunities
   d) For tools and forms
   e) For education programs
   f) For support information
   g) For Leisure
   h) Others (Please specify):

Please evaluate the following statements using a 1 to 7 scale where:

Score Meaning : 1 strongly disagree ; 4 neutral ;7 strongly agree

3. I find the site easy to use
4. I find the site easy to navigate
5. My interaction with the site is clear and understandable
6. The response time of the site is acceptable
7. I can find relevant information through the search engine

8. The site has an attractive appearance
9. The site makes it easy to communicate with organization
10. The site provides a broad range of information
11. The site provides accurate information
12. The site provides timely information
13. The site provides easy to understand information
14. The site presents the information in an appropriate format

15. Please rank how important the quality is to you in this particular context. The importance rank is on a 1 to 7 scale where: Score Meaning : 1 least important ; 7 most important.
    a) Coverage of information
    b) Design and appearance
    c) Functionaries
    d) Easy of navigation
    e) Effectiveness of Search engine
    f) Others (Please specify):
16. Please name three of the most useful parts to you on the current portal?
17. Please list up to three changes you would like to make to the current portal?
18. Are you interested in a one-hour interview to discuss the portal design? (Yes or No)

APPENDIX 2—Interview Questions

1. What are the purposes of your visit?
2. When you need to find and use information, does the portal make it easier?
3. What are the major resources you usually use to obtain information other than the portal (e.g., paper documents, colleagues, Internet)? And why do you choose that resource? Please give examples.
4. What are some reasons you don't use the portal (weakness of the portal)?
5. What work related information or functions do you feel are necessary to be added or highlighted in the portal?
6. How comfortable are you with innovative technologies such as an online forum, wiki, facebook? And how important do you think for the portal to apply innovative technologies such as these?
7. Do you have any additional comments or suggestions related to the design of NDMC portal?

APPENDIX 3—Interview Participants

1. Chris front-line worker
2. Jef front-line worker
3. Martin front-line worker
4. Alex front-line worker
5. Peter manager
6. Fahad manager