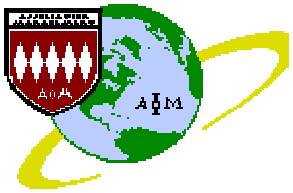

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NETWORK ENABLED META-SEARCH TOOL (NEST): AN ANSWER TO HARMONIZING KNOWLEDGE SOURCING IN A COMPANY?

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ABSTRACT

Knowledge management in organizations is typically found at three levels, the individual level, group level, and the organizational level. Information technology enables the collection of data in knowledge repositories at each organizational level providing a structure of a knowledge sourcing system (KSS). A dilemma occurs when the various repositories are underutilized due to the inability to perform a thorough and encompassing search incorporating all of the available data. We present a framework to help define the data contained within KSSs at each level and how that data is created from knowledge acquired at each level of the enterprise. We also position a potential technological solution, a Network Enabled meta-Search Tool (NEST), which enables organizations to tap into disparate KSSs across their network(s) and utilize their collective knowledge. Lastly, we present illustrations of organizations who have implemented NEST technology and the associated issues surrounding its implementation to provide some initial lessons concerning effective deployment of this emerging technology.[1]

Keywords: Knowledge Sourcing Systems, Network Enabled meta-Search Tool (NEST)

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INTRODUCTION

Knowledge sourcing systems (KSS) are structured, connected collections of "knowledge, information, and unrefined data" (Grover and Davenport [4] , pp. 9). Knowledge repositories within enterprise knowledge sourcing systems (KSS) are critical for Information Technology (IT) enabled organizational learning (Kane and Alavi [6]). Varieties of IT are used by companies to provide support for organizational knowledge sourcing activities. As such, companies have often allowed individuals to create their own personal knowledge sourcing systems, build centralized organizational repositories, and more recently have allowed wikis to grow in the hopes that they will capture and consolidate group knowledge. While these three approaches can offer selective benefits such as the interconnection of users, ease of updating content, and highly relevant information, they often fail to provide a comprehensive knowledge management solution. Finding the right mix has proven difficult, especially given the plethora of technical solutions available.

Current knowledge repositories within knowledge sourcing solutions (KSS) answer some of the problems of maintaining updated content and flexibility of access, but create other problems for their users, creators, and the organization as a whole. First, centralized organizational repositories are viewed as being rigid with little incentive for contribution. These centralized corporate knowledge repositories can lack easy customizability and the information contained within them may be viewed as general or outdated. Second, personal knowledge repositories are by nature localized and thus sharing is an issue. Thirdly, organically built wikis, while addressing some of the concerns waged at the parochialism of personal solutions, still lack exposure and breadth expected for a comprehensive solution (Wagner and Majchrzak [13]). Wikis can suffer from fragmentation of content, duplication, and lack of accessibility. Similar to personal knowledge repositories, wikis can contain non-vetted and hard-to-verify information that is usually customized to the particular context that prompted the creation of the wiki.

Until recently there have been few proposed solutions aimed at using all three knowledge sourcing approaches in a company by minimizing each approach's weakness while leveraging its strengths. However, with the increased popularity and success of Web 2.0 tools, and in particular search engines such as Google, some advocates suggest a new integrating solution that proposes to tie together the enterprise's diverse knowledge sources based on meta-search. In this context, meta-search is the use of a search tool, or search engine, which searches across multiple knowledge repositories in an organization through a single entry search query initiated by a user.

Emerging web search technologies have the potential to seamlessly integrate the disparate knowledge sourcing systems. Network Enabled meta-Search Tools (NESTs) from leading software vendors promise ready-made solutions for use in the enterprise (Conry-Muray [2] Martin [12]). These new technologies take advantage of a fusion between search technologies and the knowledge sharing environment in which the NESTs inhabit by searching the knowledge placed by organizations and their users into knowledge repositories. This article explores the strengths, weaknesses and promise of "Network Enabled meta-Search Tools".

This paper is organized as follows: First we categorize the available sourcing solutions based on salient characteristics derived from literature review. We present the main drawbacks and benefits of each type of sourcing solution. Examples are provided of NEST implementations in several companies. We conclude that a NEST solution can potentially enable a firm to integrate its existing knowledge sourcing systems in a more seamless and transparent way demonstrating that an attentive approach is required in the implementation process if the benefits from a NEST are to be realized. Finally, a practical set of guidelines are provided for organizations considering the implementation of NEST technology within their business strategy.

KNOWLEDGE SOURCING SYSTEMS (KSS)

Knowledge sourcing systems (KSS) are structured, connected collections of "knowledge, information and unrefined data" (Grover and Davenport [4] , pp. 9). KSSs attempt to capture and communicate expertise and insight on a subject and are geared towards problem solving and task completion. Information in KSSs is often organized into separate containers by functional area, project, or other topics, and is indexed for easy access and browsing.

As a basis for our discussion, we devise a framework with three types of knowledge sourcing systems: 1. *organizational knowledge sourcing systems*, 2. *group knowledge sourcing systems*, and 3. *individual knowledge sourcing systems*.

Organizational Knowledge Sourcing Systems ordinarily have multiple users and contributors. Access to this kind of knowledge repository is open to authorized members of the organization and may also be open to outside partners. The knowledge in the organizational KSS,

which generally covers a wider range of topics and varies in terms of generality and detail, aims at providing predictable results and easily replicable processes, as well as a measure of control over inputs and outcomes. This is learning that typically has been refined through multiple iterations and has passed a rigorous gate keeping process. The content of the organizational KSS is often highly structured and follows strict organizationally accepted formats. An example of this would be an enterprise Microsoft SharePoint knowledge base.

Group Knowledge Sourcing Systems have multiple contributors and users. Access to this kind of group knowledge repositories may be restricted based on affiliation to a group or a department, but it may also be open to all members of the organization or even outside partners. The content of a group KSS is usually solution focused and can be designed to foster discussions and the free flow of ideas and information. The knowledge is structured around a problem or topic, but does not necessarily follow a standard, organizational sanctioned format. New and old ideas are debated and their respective merits and possible improvements are discussed. Knowledge contained in a group KSS is usually more heterogeneous and covers a broader spectrum of topics at various levels of detail than content within personal repositories. The content available is typically moderately structured and formalized, but also allows a moderate amount of customizability. An example of this type of repositories can be wikis.

Individual Knowledge Sourcing Systems commonly are created for an individual personal use and is not typically shared. Access to individual knowledge repositories is usually limited to one person, contains knowledge and information that the creator has used in the past, and may form personal best practices and knowledge. This is the individual's own expertise, in both tacit and explicit formats. Knowledge in individual knowledge repositories tends to be homogenous and focused. The content available is typically customized to the user's need and does not follow organizational standards or formats. An example would be any networked personal space used by an individual to store task and job related information.

Figure 1 illustrates an example of the relational structure of data contained within knowledge sourcing systems relative to the type of KSS. Each type of knowledge sourcing system has its associated benefits as well as potential drawback. A summary of the benefits and drawbacks are listed below in Table 1.

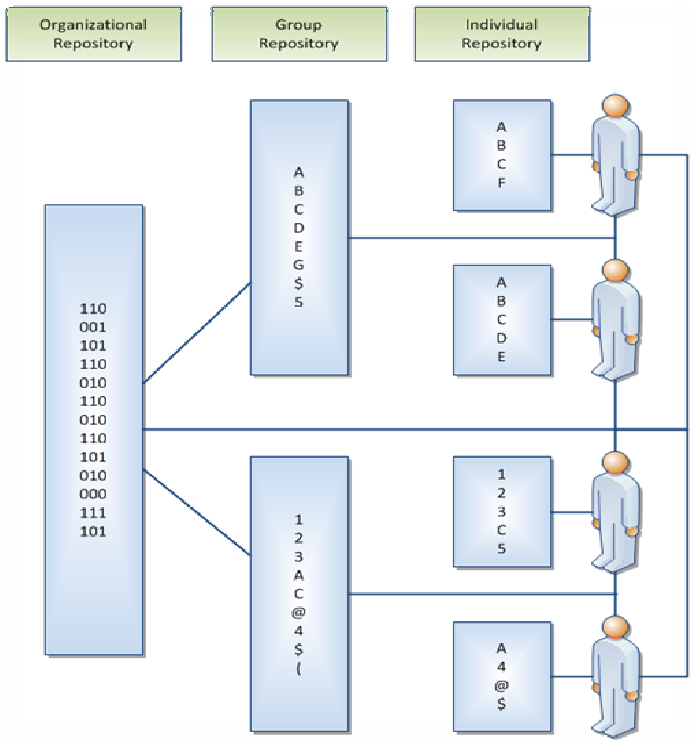

Figure 1: Relational data structure contained in KSSs

Table 1: Benefits and Drawbacks of KSSs

Type of Knowledge Sourcing Systems	Benefits	Drawbacks
Organizational Knowledge Sourcing Systems	– Many, interconnected users – Open access (depending on rights) – Organizational control over content – Broad coverage of topics and content – Usually highly structured content – Usually highly vetted and reliable content – Usually has dedicated personnel to create and manage content	– Can be hard to updated quickly – Does not easily support individual customization (format, content schema) – May not contain all relevant content (tacit vs. explicit) – May not cover all required topics – Can be outdated/no-longer-relevant – Content can be at a higher level and may require adaptation to the local context – Not all users can create content – Can use complicated and hard to understand index and searching schemes – High initial costs of setup
Group Knowledge Sourcing Systems	– Many users, but can be divided based on affiliation – Flexible access can be restricted or opened based on affiliation – Focused content can be adapted to a local context – Highly relevant content to the context of its creators – Flexible content presentation and indexing schema – Easy to update depending on flexible access rights – Transparent content and schema creation processes within affiliation – Relatively low initial costs of setup	– Some of the content in the group KSS can be non-vetted/untried – Some constraints regarding individual customization of content still exist – It is usually focused on one or a few areas of interest to its creators – May not be accessible from outside of initial affiliation – Relies on a group of individuals being willing to create and maintain content – Often is project relevant, but no longer updated once group project is over – Usually relies on "build it and they will come" philosophy – Other groups may not be aware of the content because of different affiliations
Individual Knowledge Sourcing Systems	– High individual content and schema customization – Highly relevant content to the individual and individual task – Intuitive content and search schema for the individual creator – Very low initial setup costs – Very good at capturing tacit knowledge of the individual creator	– Contains knowledge that has not been vetted outside of the individual creator – Usually very hard to share/access outside of individual creator – Usually not the most "best practice" or "up to date" content – Very limited coverage of topics and subjects – Can be lost if individual quits the organization or group

Typically, in larger companies, knowledge is stored in three main types of repositories; *organizational knowledge sourcing systems*, *group knowledge sourcing systems*, and *individual knowledge sourcing systems*. Organizational knowledge sourcing systems (Kane and Alavi [6] , Grove and Davenport [4] , Abecker et al. [1]) are the most comprehensive information storage sources available to the organization. Most of these organizational KSSs employ a standardized schema for storing and representing knowledge, and provides limited flexibility for individuals in changing this schema. Group repositories, an example of group KSSs, (Wagner and Majchrzak [13]), consolidate the knowledge of topic/task oriented groups and provides greater access to its members. Relative to individual KSSs, group KSSs employ a more standardized schema of representation and more accessibility to data storage. The knowledge contained in group KSSs is more comprehensive than in individual KSSs, but are still only a subset of the overall organizational knowledge. Its development tends to be organic and based around expediency and representation focused around group tasks or interests. Finally, the individual KSS is the basic storage location for information and knowledge related to the tasks an individual has to perform as part of his or her job. In this type of KSS, knowledge is arranged in the individual's own representation and storage schema based on their own personal information usage and retrieval schemes and capabilities.

Six Characteristics

To provide greater depth and to further differentiate the three types of knowledge sourcing systems we propose six key characteristics that help identify strengths and weaknesses of each KSS type. These characteristics describing knowledge sourcing systems were identified by a literature review noted in each description.

The first two characteristics are related to technical aspects that describe knowledge sourcing systems are *organizational widespread accessibility* and *personal changeability*

Organizational widespread accessibility is the capability of any individual within the organization to access the information s/he needs from the sourcing network (Hansen [5] , Lazer and Friedman [9]). On the continuum of accessibility, individual repositories are hardest to access for someone who is not their creator, whereas organizational repositories are relatively easier to access throughout the organization.

Personal changeability describes how easy or convenient it is for a user to employ his/her own personalized standards for formatting, filing and presentation of the knowledge in the repository as well as how easy it is for a user to add, modify and remove information from the repository (Goodwin [3]). For example the choice of formatting style in individual repositories is entirely under the individual's control, since the repository is created and maintained by one individual.

In addition to the technical characteristics of KSS we further identify characteristics that describe the *knowledge contained* in the repositories

Organizational knowledge comprehensiveness describes the extent to which the knowledge contained in the sourcing system covers the solution space for the constellation of organizational problems. What this means is that certain knowledge sourcing systems provide broad knowledge that covers a great breadth of topics. For example, personal files provide low coverage since they cover only a limited set of issues which an individual deals with in his or her work.

Organizational knowledge standardization is the level of formality and validation or approval that a piece of knowledge found in the sourcing network has to go through to be accepted as part of the repository. Usually, before a piece of knowledge is introduced in a corporate organizational-wide repository, it has to go through a rigorous vetting process. On the other hand, individual repositories are usually vetted by a party of one – their creator.

Personalized knowledge schema/filter is the degree of personalization and customizability that an individual has in representing, classifying, and interpreting the knowledge available. Individual repositories are the most flexible in applying and changing the interpretative schema used by their creator. Organizational repositories, on the other hand, are less likely to allow individual flexibility in the types of schema or filter that individual's use for representing knowledge.

Finally, the *personal motivation to update the knowledge* is another important characteristic to investigate about knowledge sourcing systems (Wasko and Faraj [14] , Kankanhalli et al. [7]). This characteristic refers to the individual's motivation to keep the knowledge in a repository up to date. Since individual repositories are created with a specific purpose in mind by one individual, they are more likely to be kept up to date by that individual. Organizations have to rely on specific organizational incentives to motivate individuals to update the knowledge in organizational repositories.

Understanding the individual characteristics of knowledge sourcing systems is important because it allows managers to better understand how their existing knowledge sourcing systems function dependent upon the specific environment of their organization. It is also im-

portant to understand how a Network Enabled meta-Search Tool (NEST) can mitigate the drawbacks of the different types of knowledge sourcing systems by supplementing the limitations of knowledge sourcing systems regarding some of their characteristics.

Using these six characteristics of knowledge sourcing systems as an overarching framework, we conducted an in-depth case study to explore the deficiencies of a knowledge sourcing system and how it may be improved by deploying a NEST.

A TECHNOLOGY TO BRIDGE THEM ALL

A NEST is a meta-indexing content search system that integrates the majority of information created and used by an organization by parsing a defined network space and providing ranked and customized query results that evolve and improve over time by analyzing historical and social patterns of use of the tool. NESTs can be employed to discover and disseminate dormant or infrequently used information (Kim et al. [8]) throughout the organization. They provide a meta-view, or an all-encompassing view, of all data sources by parsing all KSSs available on a network and by indexing and ranking the knowledge contained within them (Markus and Tanis [11]). NESTs regularly employ different indexing schemes, search algorithms, search interfaces, and presentation format of search results. NEST tools are customarily associated with a set of hardware and software requirements as well as the types of content sources that they can search. A variety of such NESTs are available from a number of vendors (for a comprehensive list of vendors please visit www.searchtools.com/tools/tools.html).

A NEST has the potential to improve organizational accessibility, knowledge comprehensiveness and standardization while ensuring personal changeability of the various knowledge sourcing systems adopted by the organization. First, the NEST has the potential to improve the *accessibility* of the various knowledge sourcing systems being used by the organization. It provides information about the "existence, whereabouts and relevance of substantive knowledge" (Hansen [5]) available in the organization's memory (documents, file servers, content management systems, etc.) by providing democratic access to information sources approved by the NEST administrator. As depicted in Figure 2, it increases the *breadth* of the knowledge that individuals in the organization can access by integrating the knowledge from organizational knowledge sourcing systems, group knowledge sourcing systems, and individual knowledge sourcing systems.

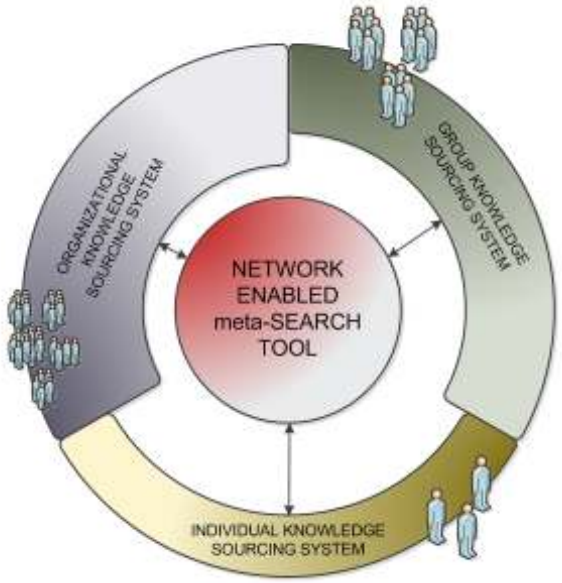

Figure 2: Integrative Nature of NESTS

Secondly, as a result of the improved accessibility of knowledge sourcing systems, the *comprehensiveness* of content in the collection of these systems may also be improved compared with isolated knowledge sourcing systems. Organizational members may search and find new information, or potential solutions, that they were previously unaware of. The visibility to all the organizational knowledge helps people gain a more holistic view of the organization, which can be especially helpful for cross-functional collaborations. They may also appropriate this new knowledge into their own local schema, thus helping in creating new knowledge for the organization.

Thirdly, The NEST can help with the *standardization of knowledge* by promoting and disseminating the organization approved formats. NESTs provide a higher level of structure and control to the search results, since the presentation format of the content, as well as the content itself, can be controlled according to company guidelines. This characteristic can promote the social evolution and acceptance of these formats due to the built in social algorithms provided by the NEST.

Lastly, in terms of the *personal changeability* of the knowledge sourcing systems, the NEST makes the information in these systems searchable and accessible to authorized individuals, and rarely diminishes the rights of

the individual, the group, or the organization owner. This permits the owner to maintain control over their own knowledge repositories. By keeping *local knowledge* resources local, the NEST can allow individuals and groups to maintain their knowledge schema while allowing access to others within the organization.

Furthermore, NESTs provides a quick and efficient way to parse various knowledge sourcing systems. Efficacy of knowledge search is enabled through a NEST's intelligent weighing and search algorithms that learn from previous searches and dynamically change the order and presentation of search results. Improvements constructed by socially influenced algorithms allow NESTs to better serve a community by integrating social effects. The social effect is the influence of organizational member's past searching behaviors on how the information is represented via the display of search results. These effects are represented as a variable in the ranking algorithms of the search results. These algorithmic changes will shape the information presented and on average improve the accuracy of the search. For example, in some NESTs, people with subject matter expertise are able to recommend a subset of the research results that they consider more accurate and relevant and these recommended results provide a way to share experts' knowledge with the rest of the organization.

In addition, as accurate, usable, and relevant knowledge is socially vetted and acknowledged as valuable to others, owners of that knowledge source tend to receive recognition in their company. With greater visibility of information contained in group and individual knowledge sourcing systems and the social vetting of contained information, the motivation of individuals and groups can increase, driving them to improve the quality of information produced and keep it up to date.

In summary, individuals in the company have the potential efficiently and effortlessly obtain relevant information residing in disparate knowledge sourcing systems. Not only can their productivity improve, but individuals have better control over the search process and gain trust in the quality of information gathered by the NEST. Confident perceptions associated with the NEST are likely to positively influence people's attitude toward information and information use, improving the information culture and mindset in the company.

When applying the framework presented with the six aspects described above, we can start to see differences within each type of KSS. Variations within each characteristic exist dependent upon the level of the KSS described, albeit individual, group, or organizational.

This can be seen first within the *technical aspects* of KSSs, which can be expressed in terms of the exhibited levels of organizational accessibility and personal changeability. The organizational KSS is widely accessible through the organization by all employees. However, because the organizational KSS does not contain the customized data required by employees and does catalog items easily, the organizational KSS may not satisfy the needs of all the employees.

Individual KSSs are on the opposite side of the spectrum from organizational KSSs. An individual KSS allows individuals to customize the data stored, but it does not provide the level of exposure and access to the entire organization that an organizational KSS has.

Group KSSs are somewhere in the middle between organizational and individual KSSs. A group KSS contains data that is somewhat customized to the local needs of its users, but it still maintained a less strict level of standardization. Access to this data has a wider audience than that of any individual KSS used in the organization. These relationships are depicted in Figure 3 below.

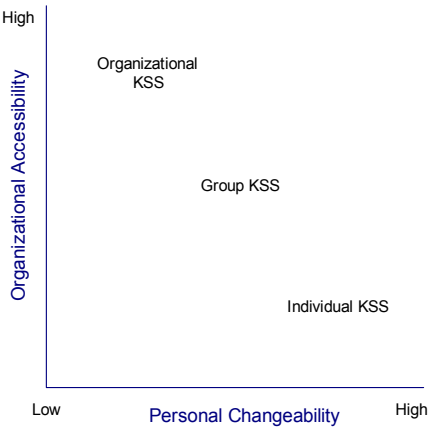

Figure 3: KSSs Accessibility and Changeability

Extending into the *knowledge contained aspects*, other differences can be found to further identify the characteristics of each type of KSS. Individual knowledge sourcing systems, which typically created and maintained by one individual, are customarily related only to the topics that a particular individual is interested in. Because of this, the organizational comprehensiveness of knowledge contained in individual KSSs is typically lower than the knowledge contained in other types of KSS. Subsequently, because knowledge contained in an individual KSS is created for the sole purpose of use by an individual in his or her job, normally there is greater personal motivation

the individual to keep that particular knowledge up to date.

Group KSSs provide their users with a lower level of coverage or comprehensiveness, but they allow users greater latitude in the way the KSS is structured and updated. Since the knowledge within group KSSs is closer and more useful to the people maintaining it, their motivation for updating and refining the knowledge contained in group KSSs is higher than for the knowledge from organizational knowledge sourcing systems.

By recognizing the differences between the three types of KSSs within the described framework summarized in Table 2, it can help identify the characteristics a knowledge repository will be composed of at each level. Additionally, the disparities presented expose a gap an organization needs to fill in order to take advantage of the knowledge contained within an organization. By bridging this gap and providing access to informational resources, organizations can leverage this knowledge to build its competitive advantage.

Table 2 : Characteristics of the Knowledge in Sourcing Systems

		Organizational Knowledge Sourcing Systems	**Group Knowledge Sourcing Systems**	**Individual Knowledge Sourcing Systems**
Technical Aspects	Organizational Widespread Accessibility	Available and accessible to all members of the organization	Available and accessible to departments or specially assigned groups within organization	Typically available and accessible to only one, or perhaps two individuals
	Personal Changeability	Requires approval for additions, deletions, and updates from a organizational level decision maker	Flexible in approval for additions, deletions, and updates dependent upon group rules and purpose	Requires no approval due to limited audience. Additions, deletions, and updates occur at will of the individual
Knowledge Contained Aspects	Organizational Knowledge Comprehensiveness	Provides information regarding solutions for overall organizational needs (high organizational comprehensiveness)	Provides information regarding solutions related to the group's scope or purpose. It may build upon organizational standards, but can create a separate group level standard of solutions (moderate organizational comprehensiveness)	Little to no organizational information. Mostly related to individual task solutions. (low organizational comprehensiveness)
	Organizational Knowledge Standardization	Language, format, and content are highly standardized and uniform among all components of information. (high organizational standardization)	Language, format, and content are standardized based on the level of need within the group. (moderate organizational standardization)	Little to no standardization and can vary among individuals. Personal preference of language, format, and content are used. (low organizational standardization)
	Personalized Knowledge Schema/Filter	Little influence of individuals in how the information is presented or searched. Typical schemas are based on larger organizational decision makers for larger organizational solutions (low personalized schema)	Some personalization may be present in smaller groups. Larger groups may limit personalization. General rules are applied so information can be understood among group members only. (moderate personalized schema)	Personal influence of schema is at its highest potential. The individual is free to make adjustments based on the needs of his/her individual tasks. (high personalized schema)
	Personal Motivation To Update The Knowledge	Motivation is mostly due to organizational policies, job requirements, or other incentives. May be linked to organizational procedures to maintain a knowledge sourcing system. (low personal motivation)	The synergy and dynamics of the group provide motivation to upkeep group knowledge sourcing systems. Team dynamics to share solutions and complete goals quickly provide a need for knowledge collection. (moderate personal motivation)	Simplification of tasks or job improvement can motivate the individual to maintain a personal solution knowledge source. The level of motivation can vary dependent upon the task and/or the individual themselves. (high personal motivation)

KNOWLEDGE SOURCING SYSTEMS IN PRACTICE

To develop a better understanding of the application of NESTs to integrate the organizational, group, and individual knowledge sourcing systems in organizations, we conducted a comparative analysis of a small set of cases that illustrate some applications of NESTs (Table 3). We focus on the knowledge sourcing challenges faced by each organization and how NESTs helped overcome these challenges. Based on these illustrative samples, we identify some conditions under which NESTs have the potential to make a positive impact.

Table 3: KSS Applications in Organizations

Organization (industry)	Knowledge sourcing systems in use	Challenges	Benefits
Legal Services of Northern California (legal)	- File application server with staff's individual folders at each of the 10 offices - Sharepoint repositories - Google Docs documents - Intranet content including policies, protocols, forms, administrative and case manuals, etc. - Peer-reviewed examples of pleadings, memoranda, and other documents. - Supporting documents for cases and projects	- It is time-consuming to find the right legal advice and documents especially for newer employees in remote offices. - It is difficult for people to find the right legal documents especially sample documents and other important materials - Although legal staff could log into local office servers via VPN to look for files, they rarely did so because going through the VPN was very cumbersome.	- NEST enables users to easily find documents and content in various sources (e.g., Sharepoint repositories, file servers in all offices, and Google Docs documents) across the organization. - NEST provides a single point for accessing shared documents throughout the organization. - Search results can be customized and filtered based on users' needs (e.g., files of a particular file type, or files belonging to specific collections such as pleading examples). - In summary, users can locate organizational content efficiently and effectively.
Wellstar (healthcare)	- Access to the latest medical information is critical to the company's success. Such information includes research, medical, and procedural information from more than 70 clinical sites and 60 unique portals for different departments. - A central content management system contained such information and it could be accessed through an employee-specific portal.	- Employees needed to know in advance which portal to search on. As the amount of information increased, it became increasingly challenging for employees to find the right information. - The company's index servers and isolated searches were ineffective and inefficient to handle the requests from an increasing number of employees and patients. - The company only had limited technical personnel supporting 11000 employees' information search; the web team had only three members.	- Search accuracy improves significantly. - Documents can be located and updated across the Intranet. - Number of users viewing updated compliance documentation increases. Employees are able to find relative information on medical procedures and protocols. - Reduced workload for technical personnel associated with information search in the enterprises.

Table 3 (cont.)

Northern Trust (financial service)	- 11,000 knowledge workers access information across web servers, email, company contact directory, and a central content management system. Such information is constantly evolving and often contains acronyms and esoteric terms.	- The business processes were supported by a large number of forms that were frequently updated to comply with government regulations. - Employees were uncertain whether they were able to find the correct and latest forms. - Compliance risks escalated when employees created and used their personal information repositories that might not contain the latest versions of forms.	- Employees can easily find the most up-to-date information and forms. - Employees are confident that they are using the right forms and following the right processes. As a result, the company has reduced the risk of non-compliance. - Subject-matter experts can customize the search results by placing recommended links at the top of the results, guiding users directly to the most appropriate page. Consequently, the quality of search results has improved and experts have been able to share their knowledge by recommending keyword matches and promoting pages.
World Bank (specialized agency)	- Its intranet hosts hundreds of independent websites that provide more than 200,000 files on over 400 servers. These websites are maintained by content providers around the world. The contents are often available in a number of languages. - The Bank employees can access an intranet home page that lists the Bank's online resources and consolidates internal and external communications.	- It was difficult and inefficient for Intranet users to access all sites across the network or to obtain useful results. A large portion of these sites was out-dated. - The fact that the volume of information doubled each year increased the cost of overall site maintenance.	- The search engine integrated with the existing intranet allows the users to search the entire intranet. The enterprise search solution is able to handle the increasing number of documents on the intranet. - It was easy to deploy the search solution. And the maintenance cost involved is low.
QAD (high-tech)	- In order to provide support to thousands of global customers in multiple languages, the company needs to provide complex and detailed product information stored in many different repositories (e.g., enterprise content management and collaboration system, knowledgebase, file server, customer service and support system, and a number of web sites) to internal employees such as customer services representatives and external customers.	- Although providing employees and customers with easy access to complex and detailed product information was a competitive necessity, it was challenging to allow employees and customers to efficiently search for relevant information stored in heterogeneous sources. In addition, maintenance of the search tool was time-consuming, inflexible, and costly.	- The NEST connects legacy enterprise systems, enforces security, and provides multiple language support. Global employees and external customers can easily access relevant information about products and services in various repositories across the company. The enterprise search tool has also ensured that authorized users can only access information targeted at them.

We selected five documented Google Appliance case studies as the Google Appliance technology provided the best available documented cases studies of NEST application.[2] Based on these cases, where companies adopted NESTs to overcome the challenges they experienced with their existing knowledge sourcing systems, we identified the following two conditions where the adoption of NESTs may have the potential to make a positive impact on the organization.

First, when there is a higher degree of heterogeneity in terms of information sources and information formats, NEST may bring greater benefits by increasing the accessibility of the diverse information in diverse sourcing systems such as organizational, group, and individual sourcing systems. For example, in the case of Legal Services of Northern California, NEST enables its employees to easily locate and access legal documents in various sources (e.g., Sharepoint repositories, file servers in all offices, and Google Docs documents) across the organization.

Secondly, NEST is more likely to bring greater benefits when the volume of information and the update frequency of information are higher. In the case of World Bank, the volume of information that users need to access doubles every year, making it difficult for them to retrieve relevant information from sites maintained by content providers around the world. In the case of Northern Trust, the information that its employees relies on is constantly evolving. Its business processes are highly dependent on many forms that need to be frequently updated for compliance purposes. Frustrated with the difficulty of finding the right information, the employees used their individual repositories that may or may not contain the correct and latest forms. With the adoption of the NEST, the company was able to direct its employees to the right forms by allowing subject experts to share their knowledge.

However, despite the success of the cases summarized above, we also need to recognize that adopting NESTs is not only a technical implementation process but also an organizational change process that may result in shifts in organizational power and require careful planning.

[2] We do recognize that by only selecting only one vendor's technical instantiation of NEST generalizability is somewhat limited to the Google Appliance context. However we believe that since NEST implementations are administrative innovations including organizational factors beyond purely technical attributes some degree of external validity applies to other implementations of NESTs from other vendors where similar organizational issues are likely to be present. Future research should explore and extend this study's findings using NESTs from other vendors.

NEST PRACTICAL IMPLICATIONS

Several practical implications should be considered in implementing a NEST within an organization.

1. **Garner proper support from stakeholders -** As with any project, proper management support needs to be encouraged for proper acceptance into organizations. Political savvy project leaders understand this principle and manage stakeholder expectations through communication and acceptance. Even though the technology is useful, it does not always sell itself.
2. **Understand the administration of the tool -** A NEST solution can expand deep into the organizational network as specified by its administrator. The need does arise to maintain confidentiality of records and information, such as cases with personnel files. Improper administration of a NEST tool can create a scenario accessing sensitive information and providing public access to it.
3. **Provide users with notice prior to implementation -** Communication is the key when access to information is going to change. People have a tendency to follow routines, even if there is a more efficient manner available for the same task. By providing upfront notice that access to information is going to change, they are more apt to participate with the implementation of the solution or a minimum, ask questions relevant to their job tasks. A feedback loop of this type can improve adoption and meet the implementation goals.
4. **Expect to train users not only through formal sessions, but train them in practice by requesting them to perform tasks related to the tool -** Formal training is easily forgotten if not put into practice. By assisting users in their search for information using a NEST helps to train them while performing their job. If a supervisor has an opportunity, they can request specific use of the tool to solve a certain problem. This emphasizes the use of a NEST and assists with organizational acceptance.
5. **Build upon current standardization practices, don't create new ones -** Although a NEST **is a** valid solution for connection knowledge sourcing systems, it cannot create the system. It

is important that a standard of some type is present to build upon. This has multiple advantages. First it provides a point of reference to observe improvements made to the standardization practices as the system becomes more integrated. Second, without a foundational starting point, a user cannot begin to query information that lacks any sense of uniformity.

NESTs can be implemented with relatively little disruption to the current network, application and knowledge infrastructure within an organization, and have the capability to dynamically crawl, index and tag multiple types and formats of content from many different repositories. However, a successful implementation of a NEST requires planning and support from all of the stakeholders of the project. Hands-on training for the users of the NEST is required for better use of the search tool as well as higher relevance of search results through the better use of key-words and a better understanding of the capabilities and limitations of the NEST. As with any organization and fundamental project management practices, it is important to garner complete support of those whose job functions may be altered and practices require changing.

Caution is provided to state that NESTs are not a replacement for more traditional knowledge management systems such as organizational knowledge sourcing systems, wikis, etc. NESTs enhance these traditional knowledge management systems by providing universal, dynamic, and socially enabled search capabilities. NEST cannot help with poor content. Standards and process have to be in place to make sure that accurate and consistent content is available to the organization. The successful implementation of a NEST requires a thorough understanding of the content that the NEST is going to index.

Lastly, NESTs can quickly make information transparent throughout the enterprise changing political and social relationships. To successfully implement a NEST, it requires an understanding of the environment (technical and social) in which the NEST will operate. That is why careful customization of crawling and access patterns is required to make sure that relevant and useful content is available to the users. At the same time, sensitive content should not be made available to those that should access it. NESTs like any new technology offer solutions as well as challenges that need to be understood before the technology can be fully implemented.

CONCLUSIONS

Organizational knowledge exists at different levels of a business entity, but can be difficult to collect and exploit due to disparities present in their location, structure, and purpose. Data collected at different levels of an organization (individual, group, organizational) can house different types of data created to serve diverse purposes and needs of the knowledge creators. By applying the given framework of Knowledge Sourcing Systems, it is easier to understand where organizational knowledge is created and stored and which information technologies can provide a better structure to the data, albeit a wiki, file server, or an enterprise data warehouse.

Meta search tools or NESTs are presented as a tool which can provide a solution to bridging the gap between each type of KSS. The implementation of a NEST can technology can provide usable search results that can translate into practical information and improving the efficiency of information seekers within an organization. By exploiting the knowledge collected already available in organizational repositories allows a business to build its own unique competitive advantage.

Through understanding of the characteristics of knowledge sources within an organization, key decision makers can be informed as to the best approach to bridge the gap between KSSs. Guidance is provided for practitioners who are considering the implementation of a NEST within their own organization. As with all technology it is difficult to provide a full encompassing view of its potential, but we hope to provide the benefits a NEST can provide as a solution for enterprise level knowledge management.

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