Building Taxonomies Using Organizational Resources: A Case of Business Consulting Environment

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ABSTRACT: Taxonomies are becoming an increasingly important tool for companies to effectively manage information, particularly in the business consulting environment, where information is considered a main asset and a key product. This paper describes a case study of developing a taxonomy system for a regional business consulting company. The taxonomy, consisting of 12 main categories and approximately 500 terms, was built based on the existing knowledge structure and information needs of consultants in a selected company. This prototype can be conveniently utilised and adapted by other companies in their efforts to develop their own taxonomy system.

1. Introduction

Companies that depend largely on information for the success of their business have to make extra efforts to ensure that their information resources are properly organized. It is particularly important for business consulting companies, since "knowledge and analysis is what [they] sell to clients" (Silverman 2002). A significant proportion of work in such companies involves capturing information on real-time news, best practices, industry analyses, etc. and making it accessible to their researchers and consultants. According to the Delphi Group's research (2002), the "lack of organisation of information is in fact the number one problem in the opinion of business professionals." One of the most common problems faced is that information databases often become information dumps as a result of badly classi-

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fied information. The traditional taxonomy, typically used to organize information, has been found to be an effective solution to this problem.

Taxonomy is a term borrowed from biology and has been defined differently by scholars in different fields. Some defined it as categorization based on certain criteria (Hakeem & Shah 2004, Adams 2002) while others defined it as a structure that provides a way of classifying things such as living organisms, products and books, into a series of hierarchical groups to make them easier to identify, study or locate (Graef 2001, VanDercar 2002). The Delphi Group (2004) highlighted the importance of taxonomies as a hierarchical listing of topics or subjects or categories, while Warner (2004) defines taxonomy from a broader perspective considering it a system of labels that form a hierarchical navigation scheme and highlights its emphasis on building intuitive structures and using familiar terminology (labels) from the users' perspective to facilitate resource discovery.

While there are slight variations in the definitions of taxonomy, there seems to be a consensus about the key features: it is essentially a structure, made up of categories and the relationships that connect them, which enables users to classify things into a hierarchy. Several papers have used taxonomy interchangeably with other knowledge organization tools like controlled vocabularies (e.g., thesauri of indexing terms), classification schemes, and ontology. While these knowledge organization tools have some similarities, there are slight differences, particularly in their application. For example, controlled vocabularies focus more on terminology and are used to facilitate searching, and the emphasis in classification schemes is on structuring knowledge resources. Gorshal (2004) highlights the differences in metadata, thesauri, and taxonomy as knowledge support systems. Ontology is an explicit and structured concept that specifies the set of characteristics of resources and their relationships that are deemed relevant to a particular community of users or a specific domain of interest (Uschold 1998, Soegel 1999, and Jacob 2003). Recently there has been emphasis on dynamic taxonomies that are considered more suitable to handle digital knowledge resources that tend to change quickly. These are considered particularly helpful in enterprise applications. They combine the strengths of different knowledge organization tools and can be used to present the same knowledge resources to represent multiple views and paths for diverse users allowing assignment of more than one category and updating tagging as information changes.

In order to benefit from their knowledge pool, it is critical for companies to develop an effective taxonomy that can be integrated into the information database. The taxonomy will provide "a centralised, integrated search-and-browse experience" and deliver "an intuitive browse interface" for their users (Potter 2001). A taxonomy that is well-constructed and properly implemented can help to increase productivity by reducing the amount of time needed to locate the right piece of information at the right time. The taxonomy will provide the framework necessary for efficient categorisation of information, help facilitate the navigation of and access to the information content, as well as aid in the search process of relevant and timely information.

The working environment within the business consulting industry is highly dependent upon and influenced by changes in the information environment. It is an industry often challenged by the insurgence and overload of information. While many other industries encounter similar information management issues, the key difference for business consulting (being very much an information-related activity) is that these changes are experienced more markedly and at a much faster pace. Business consulting companies utilise and process a very large amount of information that covers a wide range of topics. Different business consulting companies typically have varying foci. Some tend to specialise in a single industry while others choose to have broader industry coverage. Given this observation, it would not be feasible to develop a taxonomy that could comprehensively cover the information needs of every company within the business consulting environment. Such a taxonomy would end up either being too general (lack of depth) for companies that are more specialised in their approach, or too specific (lack of breadth) for companies that choose to cover many industries. In order to develop a taxonomy that can be used as a template for business consulting companies in general, the taxonomy would include the major industries covered by most of these companies. It would also have sufficient depth so that information can be managed efficiently.

For the purposes of this study, MR Business Consulting (MRBC) was chosen as the locus for a case study in the development of business taxonomy. (Note: Due to the nature of competitiveness within the business consulting industry, the name of the company used in this study has been changed.) MRBC was selected because it is a 'generalist' organization – its business covers most of the major

industries. For the 'specialist' consultancies, the select industries could be further developed from the appropriate ones in the base template.

MRBC is a business consulting company that provides market research, analysis and consulting services to companies in various industries such as food and beverage, media, retail, electronics and healthcare, to name a few. The geographical focus of this company's activities and research is the Asia-Pacific countries, including Singapore, Thailand, Vietnam, China, India and Australia. The projects and research work carried out by the researchers and consultants at MRBC include competitive intelligence, assessment of market sizes and structures, analysis of distribution channels, partner evaluation, and identification of market opportunities for entry and penetration, and business development consulting.

MR Business Consulting was selected for various key reasons:

– It is an established business consulting company that is representative of its environment in terms of the services it provides and its relevance to the fast-changing business consulting landscape;
– Its business interests include a wide range of industries, which covers most of the key industries within the business consulting environment;
– The coverage of the industries is not excessively in-depth as in single-industry companies (which would make the taxonomy too detailed to be relevant as a prototype);
– It already developed an in-house taxonomy which has a hierarchy of shared document folders for storing relevant files; the structure, usage and benefits of the in-house system provide a good basis for developing a prototypical taxonomy; and,
– The authors' access to MRBC's business environment, systems, information as well as its personnel.

2. Taxonomy Building Principles and Practices

Gilchrist and Kibby (2000) and Graef (2001) provide useful guidelines for capabilities required for business taxonomies. They emphasised that in the business context, it is necessary to have a business-recognised driver for undertaking the development of taxonomy. They also highlight that no matter how small the required effort to create the taxonomy, it would nonetheless take up time and resources of a number of people. They argued that taxonomy can-

not be simply "a good idea," [and that] it must be money making, service delivering or stakeholder-value creating. By tying the taxonomy to business benefit, it enables the taxonomical choices to become interesting to the leaders of the business. This point is vital to the successful creation and implementation of the taxonomy system, as companies that do not have the backing and support of their top management will often find it an uphill task to change the working ways of the managers and their staff, and to convince them to embrace the new system of information management.

Sykes (2001) observed that while some companies already have "sophisticated information and knowledge management systems [and] are creating or updating internal proprietary taxonomies for labelling documents and reports in their electronic information repositories, others are [still] investigating the economics of creating an indexing structure/taxonomy or investing in automated tools for this purpose.

Gilchrist and Kibby (2000) found that the majority of the companies in the survey were looking for greater business effectiveness as a result of access to the right information or else for efficiencies in information retrieval which free time for better use. Companies were looking to the structuring of information as a means to aid their staff in the identification of information that may be critical to their competitive position. However, they also discovered that while the companies were tackling the problems through the use of business taxonomies, they were constructing their own business taxonomies *de novo* and that the working knowledge and theoretical basis underlying classification practice and the development of thesauri was not being fully utilised.

The taxonomy building process for business taxonomies differs from traditional process because of the different information needs of users in the fast-changing business landscape. Different methods have been adopted by various organisations in the development of business taxonomies. These methods can be adapted, in part or whole, to the taxonomy building process, depending on the appropriateness of the methods with respect to the type of business and the information needs of the users. We therefore reviewed guidelines developed and steps recommended by different individuals, organizations, and groups for developing organizational and domain taxonomies and adopted these to develop a step-by-step process for our study. The following papers were particularly helpful in this process:

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– Chaudhry and Saeed (2000) highlighted the importance of using organizational resources to build effective taxonomies. They (Saeed and Chaudhry 2002) also recommended to leverage on classification schemes and controlled vocabularies for building domain specific taxonomies.

– Conway & Silgar (2002) stressed that the starting point in building a taxonomy is to look for existing taxonomies, since re-using them will save the developers many man-hours which would otherwise be spent building it from scratch. Besides internal sources, they also suggest looking at external sources for ideas about how to build the taxonomy.

– Ramos, L. & Rasmus, D. W. (2003) summarized best practices in taxonomy development and management based on their consulting experience. Chaudhry and Tan (2005) suggest a 10-step process for developing taxonomies for organizing resources in the domain of cultural heritage. They emphasized on the need for content analysis and survey of users for determining appropriate objectives for taxonomy building exercise. Pahleviand Kitagawa (2005) highlighted the importance of conveying taxonomy context for topic-focused web search. McGregor, B. (2005) described a process of constructing a concise medical taxonomy. Gilchrist (2000 2002, and 2004) has highlighted various principles of developing taxonomies in different writing and emphasised that taxonomy is a mechanism rather than a tool. He also stressed the need for a strategy for development and application of taxonomies.

We realized that although business needs and applications will largely influence the structuring of the taxonomy, the process of building the hierarchical structure would also require a core set of standards or rules that can act as a guideline. While these rules will differ depending on the type of businesses and user needs, it should cover the various basic decisions that have to be made during the structuring process, such as the display of the terms, the levels or depth of the structure etc. The guidelines reviewed in the section were helpful to us in deciding the steps needed for building prototype taxonomy in our environment. The steps are summarized in the next section.

2.1. Taxonomy Building Process

The first step to the building of business taxonomy is actually the recognition of the need for it. In the case of MRBC, it was the realisation of the urgent need to refine/build business taxonomy in order to help users with their information search and retrieval process. The need for a revamped taxonomy for the company's information storage was discovered during informal discussions with the users, when it was realised that they were not paying attention to the system (the categories and structure) implemented in the server. Instead of utilising the system, users were constantly approaching the information team for information, which was retrievable through a search of the server's information database. The reason given for approaching the team for the information was because they were not able to locate it quickly if they were to do it themselves. This was an indication that the current taxonomy implemented was not user-friendly or comprehensive enough for the users. It also highlighted to the information team the need for a modification of the current taxonomy (for example, addition of more relevant categories), to explore more options in order to create a more comprehensive taxonomy to meet the users' needs.

2.2. Information Needs of Users in MRBC

Finding the right information at the right time can often be a difficult task to achieve. Locating that same piece of information again can also be an equally difficult task, if it is not properly stored. In fact, many of the researchers and consultants in MRBC often find themselves in a situation where they urgently require access to a particular piece of information, which they vaguely remember having come across before, but cannot recall where it was found or stored. For the users at MRBC, the most logical way for them to locate previously stored information is to remember which project the information was obtained for and to search for it from that point. Unfortunately, trying to recall the specific project can be difficult as well, either because they are handling too many projects at one time, or the project was carried out a long time back. Some users try to locate information by attempting to recall the title of the file or document, and subsequently to search for it either by browsing through the taxonomy or by using the limited search function offered by the Windows Explorer program (which does not allow for free-text search).

Informal discussions with the users have revealed that:

– they would like to be able to have both options of browsing the business taxonomy as well as to search the information within the server;
– the majority of them do not browse through the current taxonomy because they find it confusing and not user-friendly; and,
– most of them do not utilise the in-house information stored within the internal server as it is not searchable; they would rather spend some time re-doing their search again using external sources, even though they are aware that it is an inefficient way of information search.

As a result of the poorly constructed taxonomy structure, users would rather not attempt to search for the information that is technically available and retrievable within the corporate collection. They would rather start searching for the information they need from scratch, even though it would typically be time-consuming and often tedious In effect, the existing taxonomy was becoming almost obsolete, with little or no knowledge-sharing amongst the users.

Similar to other business consulting companies, the taxonomy used in MRBC focused on three key areas: company information, country information and industry information. To create taxonomy for all three areas would be beyond the scope of this project as it would be too large-scale and extensive. In order to bring a focus to the project, the taxonomy building will concentrate on the industry information, which is most representative of the company's activities and is also the most comprehensive in terms of the amount of information stored.

2.3. Existing Knowledge Structure in the Company

After identifying the need for a properly developed taxonomy structure, the next step undertaken was to review the existing taxonomy system. As with most other business consulting companies, MRBC has developed an in-house version for internal use by staff, which comprises mainly of researchers and consultants. It has attempted to solve the problems of content management (or rather the lack of) by "setting up systems of folders and subfolders" (Hummingbird 2000). The existing taxonomy was manually created by a top management staff of the company. Its development was not systematically carried out and there was no adherence to any particular guideline or methodology. The development of its hierar-

chical structure and the labels and terms used were solely based on his (the developer's) perspective of the business consulting environment in the context of the company's goals and directions. While this method had its advantages (namely, it is a representation of the user's information needs), it was also, from an information management's point of view, clearly an inadequate and unprofessional way of developing a taxonomy.

The business taxonomy is maintained and updated by Library and Information Services. All files and documents created and used by the staff of MRBC are stored within the shared internal server of the company, commonly known as the J drive. The purpose of the J drive is to enforce the storage and sharing of all files and documents so that all information is made readily available to all staff. Although the company has developed a taxonomy system for classifying information, there is much room for improvement in terms of developing a proper and consistent taxonomy, as well as standardising the terminology used.

The taxonomy was implemented using Microsoft's Windows Explorer software to represent the hierarchies and categories as well as to store the actual electronic file. Windows Explorer was used because it was freely available and was able to represent the taxonomy, albeit in a very simple and 'primitive' format. The company chose not to utilise any of the specialised software available in the market because of budget constraints. However, at the time of this study, the company is considering a few enterprise portal solutions such as Microsoft's Sharepoint, for future management of the ever-increasing volume of in-house information.

While reviewing the taxonomy and its content, it was discovered that information was not always placed in the correct category, implying a lack of consistency with the way files and documents have been indexed and categorised. To make matters more confusing, it was discovered that a few of the users had the tendency to create their own new folders whenever they were not able to find the appropriate folders to store a particular document or file. Reasons given for this were either because they did not have the time to look for the correct folder, or more frequently, that the system was not sufficiently well-developed to support the company's information resources. These feedback and user activities were not unreasonable; in fact, they highlight a serious underlying truth about the existing taxonomy – it was poorly developed and urgently needed overhauling

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before the situation got out of ontrol and the categorisation system collapsed from mismanagement of folders.

2.4. Steps Taken for the Development of the Prototype Taxonomy

2.4.1. Development of the List of Terms

Before starting on the construction of the taxonomy and its hierarchy of categories, a list of standard terms (otherwise known as the thesaurus or vocabulary) has to be compiled. This list of terms should define and recapitulate the content of the collection. Currently, there are no published taxonomies or thesauri that are available for public use as templates or guidelines to develop customised taxonomies specifically for the business consulting environment. In order to compile a list of terms that will comprehensively represent the business consulting environment of MRBC, several sets of terms were obtained from various sources in order to populate the taxonomy with relevant, appropriate or frequently used terminology.

For the selection of the appropriate lists of terms, certain criteria have to be set so that the lists would be able to provide a comprehensive perspective of the business environment of the company. A good source for the lists would be the actual tools used by the business consultants during their information search. These commonly used tools generally fall into one of the following three types, namely the company's internal information database, an online database or a portal. From these, three criteria are set for the shortlist: the lists have to be taxonomies, indexes or thesauri of one of the following:

1. a company in the business consulting environment;
2. a business-oriented or business-focused online database, or
3. a business-related portal.

In addition, it is important to ensure that the lists selected are easily accessible.

2.4.2. Terms for the Main Categories

Based on the criteria above, seven lists were chosen to provide the terms for compiling a set of main categories which would form the first level hierarchy of the taxonomy. The lists are: MRBC's current in-house business taxonomy; four leading online databases/information providers, namely Profound (by Dialog), Factiva (by Dow Jones and Reuters), LexisNexis and OneSource; and two business portals, CorporateInformation and Hoovers. The main categories from each of these seven lists were tabulated within an Excel spreadsheet. Different terms used to represent a particular category (or industry) were grouped together.

Although the seven lists provided a wide range of industry categories, there were many category-overlaps among the lists. It was decided that this research would concentrate on the main categories of industries which MRBC's business clients come from. Although the in-house taxonomy of MRBC would give a good indication of these industries, the existing taxonomy was not completely relevant. This is because it was not updated regularly, and there was a possibility of redundant or outdated industries. As such, an informal survey was carried out with individual users within the company to find out which categories should be included in the taxonomy. The survey was carried out through one-to-one discussions about the various categories and their relevance to the existing consulting work of the company. Categories of industries that are not within the scope of MRBC's current work were removed from the spreadsheet. As differing terms were used by the various lists to represent the same industry, comparisons are then made across each of the remaining categories to determine the most suitable term to be used. Many factors are taken into account during this process. These include:

1. the frequency in which a particular term was used by the different lists
2. the industry terms used by MRBC, and,
3. the opinions of respective industry experts, obtained through informal interviews.

2.4.3. Terms for the Subcategories

From the seven lists, four were further selected for the compilation of a database that would represent the entire business consulting environment of MRBC. The four lists were MRBC's in-house taxonomy and three of the online databases, namely Factiva, Profound and LexisNexis. MRBC's taxonomy was selected, as its terms would best represent the company's information needs and environment. Factiva, Profound and LexisNexis were chosen because they were leading online database providers for

many business entities. As such, each of their taxonomies would provide good business coverage. OneSource was not used as their list of terms was not readily available for review. The other two lists, CorporateInformation and Hoovers, were not chosen as their taxonomies were more focused on representing different types of company information.

The four selected lists were individually reviewed and the appropriate industry-related terms were extracted from each. Approximately 3,000 terms were compiled from the four lists and entered into an Excel spreadsheet. This compiled list of terms would form the base for establishment and development of the prototype taxonomy. Each of these terms were tagged with the name of the list from which it was extracted, as well as the level of hierarchy or the categorisation it was placed in the original lists. This tagging is necessary so that each term can be traced to its original source, if necessary. The tagging would also give an indication of the importance or hierarchical level of each of the terms in relation to other terms. For example, a term used at the first or second level of the hierarchy would be deemed more significant for use in taxonomy building, as opposed to a term appearing in lower levels of the hierarchy. Lower level terms typically have a narrower scope and may not be useful in taxonomies that are more general in nature. Higher level terms are more frequently applied as most consist of at least 2-3 levels. However, there are exceptions to this rule, depending on the context in which the terms are used and the industry in question.

2.5. Review and Selection of Appropriate Terms

Having compiled these terms, the next step was to cull the terms into a manageable and workable size. In her checklist for the design of the tree structure for Illinois State Library's thesaurus, Schriar (2000) indicated that the size of the thesaurus should be not more than 700-1,000 terms. Although the figure would differ depending on the type of taxonomy and the breadth and depth of the taxonomy, this would nonetheless act as a useful guideline.

The list of terms in the Excel spreadsheet were first sorted by alphabetical order to aid in the identification and consolidation of all duplicate terms. Terms that appeared more than once were first tagged to indicate the frequency of appearance, which would in turn suggest the suitability of the term for use in the taxonomy. For example, during the selection of appropriate terms for the taxonomy

at a later stage, more emphasis will be placed on terms that appeared in more than one list by virtue of its more frequent utilisation by other taxonomies or indexes. Any duplicate term was then removed from the list.

After the list has been culled of any duplication of terms, the next step was to remove the terms that were irrelevant to MRBC's scope of work. The scope of industries covered by the three online databases is much broader than that of MRBC's. These databases cater to the needs of a wider spectrum of industries in the business environment. In order to bring more focus into the taxonomy and to make it relevant to the users, industries that are beyond the scope of the company's work were removed from the list.

2.6. Development of the Hierarchical Structure

Having compiled a list of terms that are representative of MRBC's working environment, the next step was to develop the hierarchical structure of the taxonomy. This involved combing the finalised list of terms and individually tagging each term with a relevant industry category (taken from the list of categories compiled as described in the earlier section). In determining the category for each term, some level of general knowledge and common sense was applied. However, a good understanding of each category (based on my past project experiences) is also essential in order to make a calculated decision. Another useful guideline which was applied during this process was to refer to the original category which the term was linked to in its original database. Once each term was appropriately tagged, they were sorted out and separated according to their respective categories so that the hierarchical structure can be developed on a category-by-category basis.

In order to determine the hierarchical position of each of the terms within its respective categories, a few guidelines were followed:

– The original taxonomy developed by the company was a very useful guideline to the way the researchers' minds perceived the way information should be organised within each category.
– The more times a particular term appeared in the initial list of collated terms (as indicated by the tags), the more important is the term for the category.
– Relevant websites relating to each category were studied where available. For example, Business. com's web site (www. business. com) was a useful

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website/portal that categorises the information on various industries very clearly and concisely. Other similar useful web sites provided guidelines on the terms and their hierarchical positions for each category.

– Additionally, both 'common sense' as well as a 'business consulting mindset' application of the meaning of the terms should be applied when deciding on the appropriate layer into which each term should be placed.

Following these guidelines, the list of terms was organised into a set of categories which was then arranged in a hierarchy. This forms the first draft of the taxonomy for MRBC.

2.7. Modification and Refinement of Business Taxonomy

Although the draft taxonomy was formed from sources that were credible and representative of the current business consulting environment, the selection of terms and the development of its hierarchical structure were carried out based on a single person's perception of the same environment. While some guidelines were followed, bias and error are inevitable. In order to circumvent this problem, the draft prototype taxonomy was presented to six industry experts for their review. These industry experts were either consultants from MRBC or other persons experienced in a specific industry. These experts have extensive experience in their respective field so as to know the domain and at the same time sufficient work experience in the company to keep in view the context while suggesting a particular term or label or assisting in determining the hierarchical level. This provided a good combination for assuring the literary as well user warrant in the proposed taxonomy.

The review was carried out on an informal basis, using face-to-face meetings, email communications, and/or telephone interviews. While no questionnaire or interview schedules or forms were given them to fill (as there was a bit of hesitance on the part of the experts to provide input using such formal means). The researcher used worksheets to fill for the purpose of consistency and proper documentation. The opinions of the experts were sought on the validity of the terms selected as well as their respective hierarchical levels within the taxonomy structure. Efforts were taken to ensure that the context of the study and the taxonomy were explained clearly to the experts. The experts were presented with the relevant sections of the taxonomy, and discussions were carried out based on their comments and queries about the taxonomy. The draft taxonomy was then revised accordingly, and the final prototype taxonomy was presented to the industry experts for a final review.

3. Prototype Taxonomy

The main outcome of this study is prototype taxonomy. Implications in different taxonomy building steps and lessons learned during the process are discussed in the next section. The entire taxonomy is made up of approximately 500 terms; different categories having different number of terms or subcategories attached to them, depending on the industry in question and its degree of importance to MRBC's business development. A sample from the prototype is given in the appendix.

3.1. Consideration in Developing the Prototype

3.1.1. Terms and Hierarchies

During the process of compiling the list of terms for the taxonomy, various sources were used. The terms from each source were combined and built into a pool of terms (amounting to over 3000 terms). The process involved culling irrelevant terms and reconciling terms that were similar in meaning. This was a difficult task to accomplish as each of the sources selected had different formats with regards to the terms that were used.

In order to overcome these difficulties, it was important to first identify and develop a concept and understanding of what is needed, and then develop guidelines as to which terms to cull or reconcile. It was also necessary to apply personal professional insight, as well as the opinions of subject experts, before eventually deciding what to include and what to remove from the compiled list of terms, as well as how the terms should be arranged in a hierarchical order. There are no hard and fast rules to follow as this is a subjective process, often depending on the individual experiences and perceptions of the people involved in the development of the taxonomy. It is highly possible that two experts within the same industry will each come up with a taxonomy that is different from the other. The differences arise from how the individual perceives the industry, which in turn is dependent on their respective circumstances and experiences. There is no right or wrong answer as there
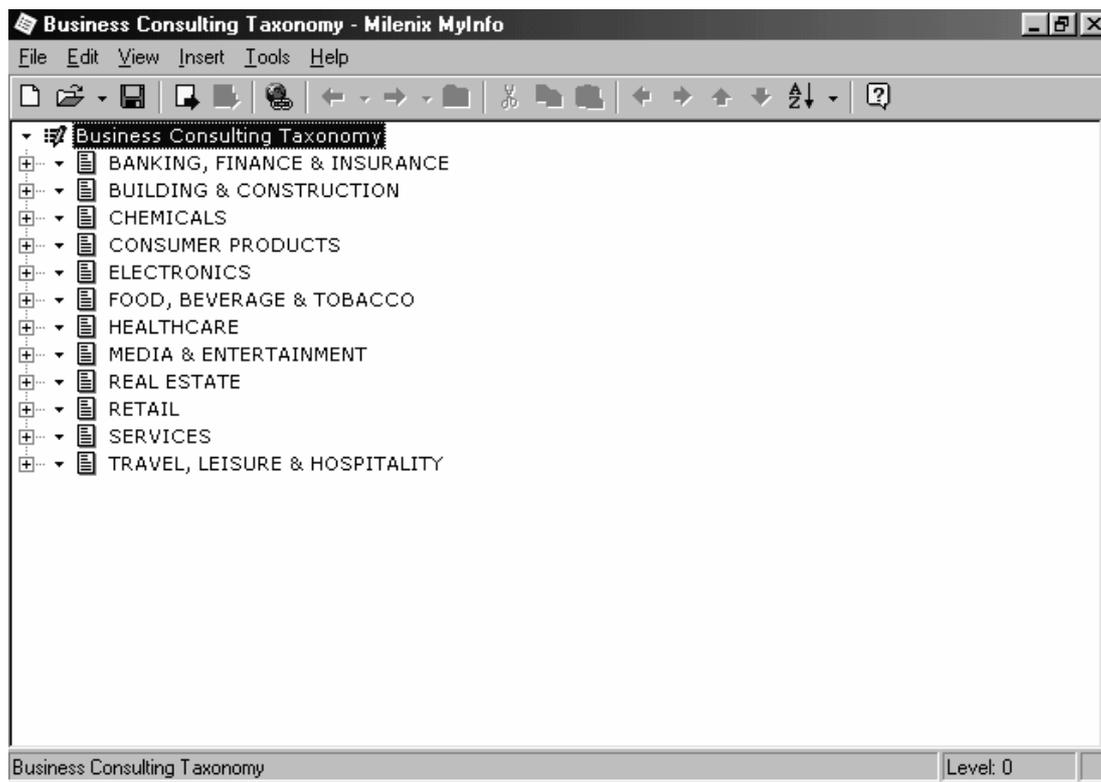
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Figure 1. Main Categories

is no perfect taxonomy. It is therefore important to bear in mind that it would be impossible to come up with a taxonomy that will meet every single user's needs. What is important is to know how best to utilise the resources available and to develop a taxonomy that would capture the essence of the environment it is meant to represent. It is therefore vital that the people in the team have a good understanding of the specific work environment of the company; that the knowledge of subject experts are tapped upon for a deeper and broader insight of the industries; and last but not least, that the opinions and needs of users are incorporated into the process.

3.1.2. *Differences between the Original and the Prototype Taxonomy Structure*

In order to present the taxonomy as a hierarchical structure, with the options to expand and collapse the tree structure, it is created as a .kbf file using the *MyInfo* software (a free version of the software is available at http://www.milenix.com/download.php). Prototype taxonomy is given at the end of the paper. Main categories and different levels of taxonomy are shown in Figures 1-6.

The original taxonomy developed for MRBC consists of 15 main categories which represent the core industries of MRBC's past business consulting work. The prototype taxonomy is made up of 12 main categories, which are the key industries that MRBC is currently involved in. Figure 1 shows the use of 12 main categories representing main industries as the first level of hierarchy. These broad themes were devised to provide unifying points for diverse resources rather than division by resource type.

A quick comparison between the newly developed taxonomy and the original version would reveal that, while most of the industries remain intact, a few have been added or removed, reflecting the changes in the focus of the consulting world from MRBC's perspective. Some main categories have been added as MRBC expands its business to flourishing industries, while others have been removed because the company no longer sees the industry as an area of focus for growth (either due to the economic conditions or the inability to compete with other competitors in that specific industry).

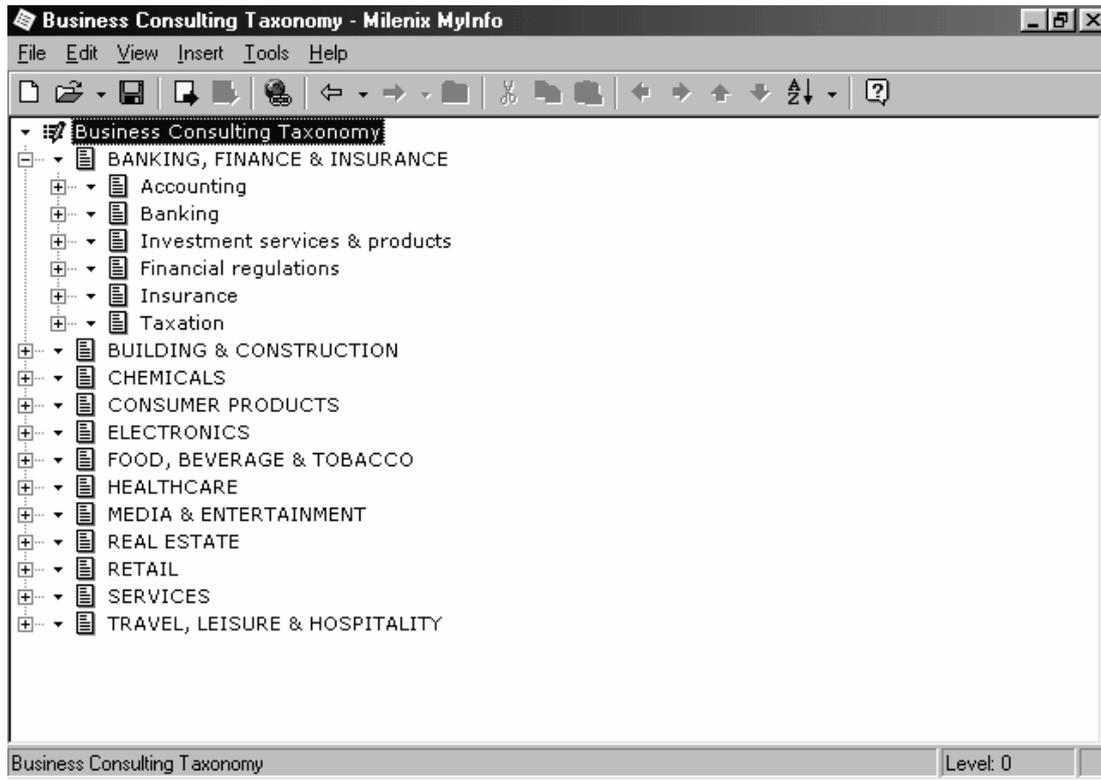Figure 2 and 3 show the second level subcategories of the Banking, Finance & Insurance industry and Chemicals.

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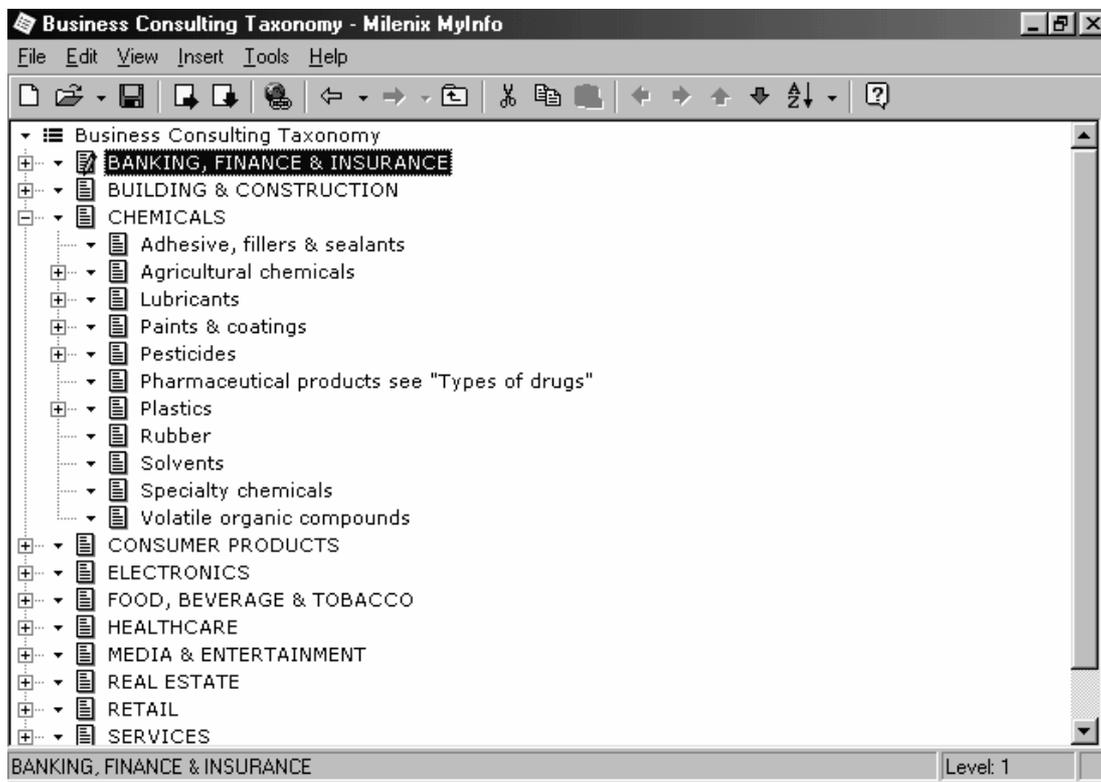*Figure 2. Level 2 Subcategories for Banking, Finance & Insurance*
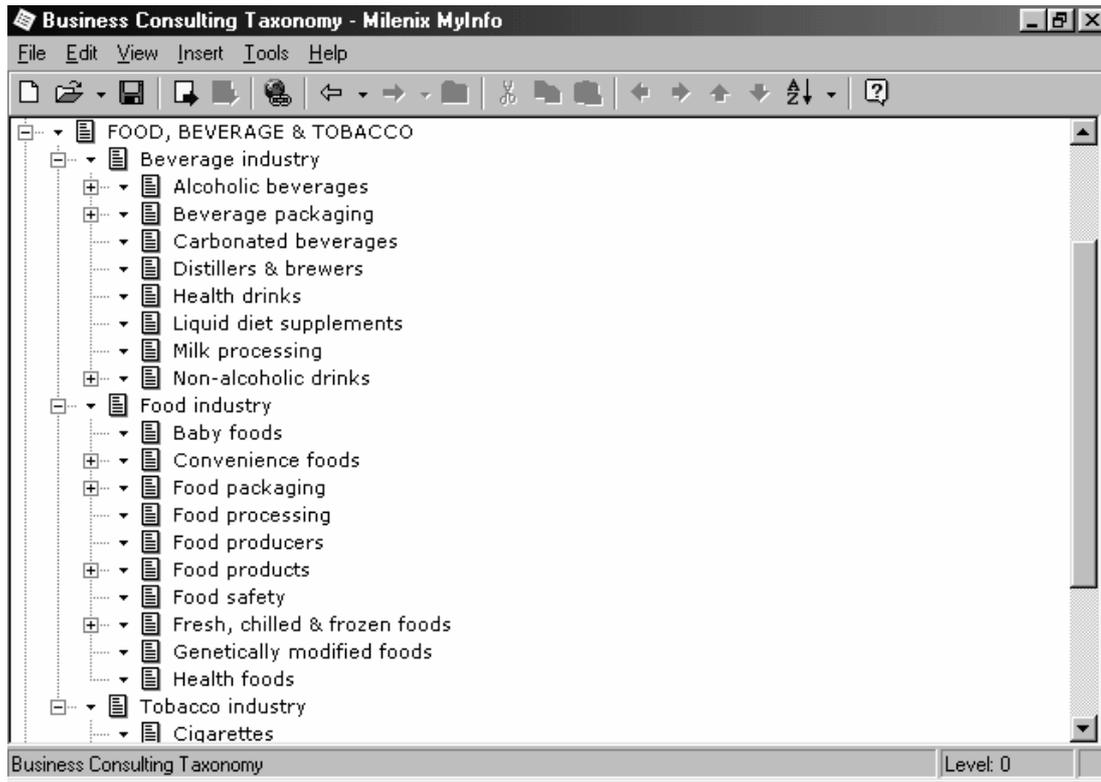

Figure 3. Level 2 Subcategories for Chemicals

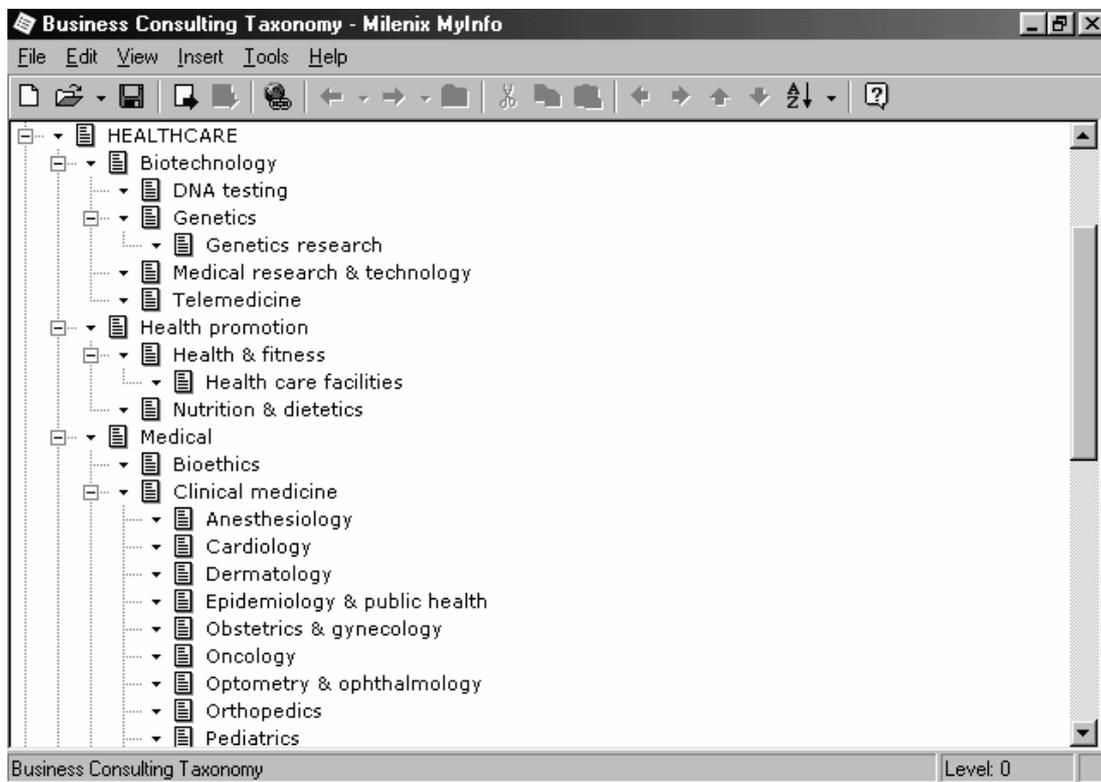*Figure 4. Level 3 Categories for Food and Beverages*

Figure 5. Level 4 Subcategories for Healthcare

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Most of the main categories in the original taxonomy had only two to three levels in terms of depth. Some of them did not even have any subcategories created. This lack of depth resulted in too many documents being placed in a single subfolder. This slows down the search process for users as they have to scroll down a long list of documents that have not been categorised into more specific folders. In order to classify the documents into more specific subcategories, the prototype taxonomy was created with more levels in depth. However, based on some user feedback and other studies on the number of levels optimal for browsing, the number of levels was limited to five. This was to ensure that the taxonomy can be used in an efficient manner, as too many levels in depth would make it difficult for users to browse through quickly, because they would have to drill down many levels of the taxonomy before arriving at the information needed.

Another key difference and improvement over the original taxonomy is the number of terms or subcategories allowed for each level. The original taxonomy had as many as 26 subcategories within one level, which made the structure difficult to view when browsing or drilling down the structure. The prototype taxonomy used 10 subcategories for each level, so that the time spent browsing each level can be reduced. Although there was some feedback that the limit should be set at four or five subcategories, this was not applied to the entire taxonomy as it would have affected the representation of certain industries.

Figure 4 and 5 are showing sub-categories in different classes.

Figure 6 shows the depth in hierarchy listing part of the second, third, fourth and fifth levels subcategories of the Consumer Products category.

Other smaller details, neglected during the development of the original taxonomy, were attended to during the development of the prototype taxonomy. These include standardising the form and format of the terms used to represent the various categories and subcategories, such as the use of capitalisations within each term, and sorting of terms within each level in alphabetical order for easy reference.

While the end product of this study is prototype taxonomy for a business consulting environment, the development process helped in understanding of information needs of users, as well as greater exposure to the various tools available in the market that can be used in taxonomy development.
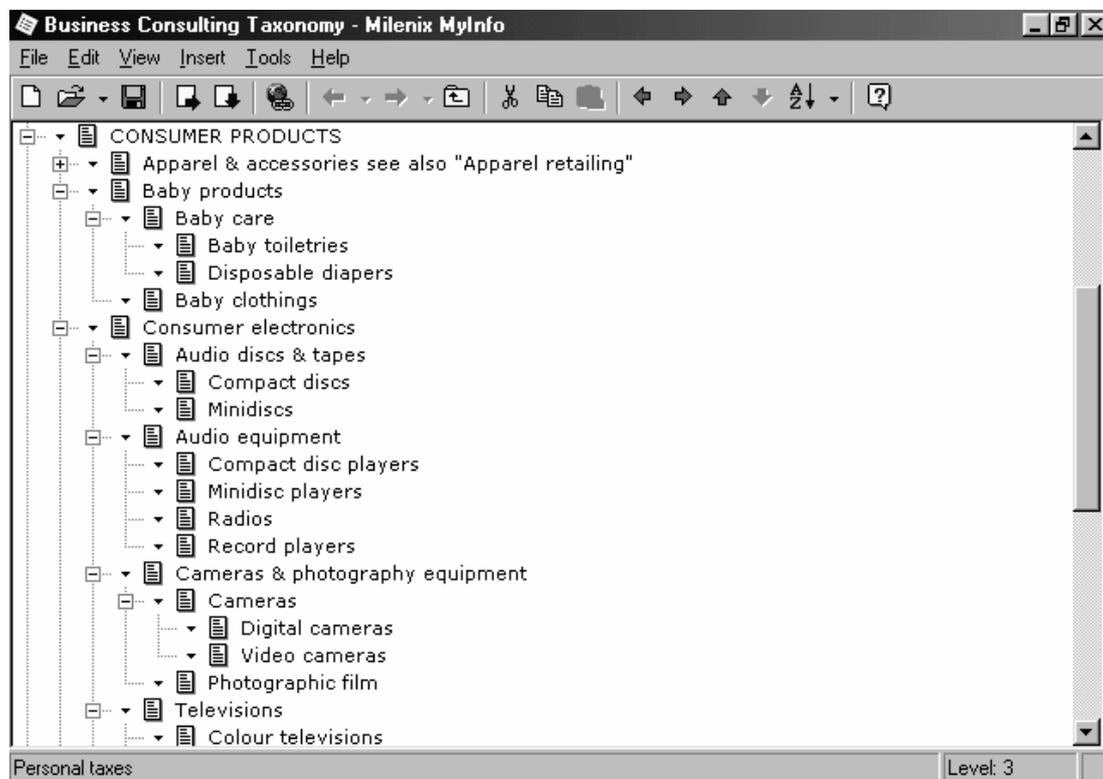

Figure 6. Depth of Hierarchy in Prototype Taxonomy

3.2. Selection of Tools for Taxonomy Development

A search for a standardised, off-the-shelf taxonomy for the business consulting industry did not turn up anything of relevance. Unlike the medical or engineering industries, where taxonomies are widely applied, the business consulting environment appears to be a laggard and lacking in this area. Without a published example to use as a guideline, the next alternative was to find a thesaurus or an index that is tailored towards business consulting terminology. Again, there is a dearth of published lists of this type available for use or download. However, there were a number of published thesauri or indexes of terms that have been developed for the general business environment. While these could be used as a guideline, most were proprietary and not freely available.

Fortunately, a search through these commercial thesauri and indexes came up with a few that could be readily accessed. The first was LexisNexis, which was an exception to the rest, as they chose to make their SmartIndexing Technology Topical Indexing Terms available on their web site. Factiva's Intelligent Indexing (FII) was also accessible for the purpose of this project, as it was made available to its clients, NTU being one of them. Another list that was accessible was Dialog's Newsroom Sourcebook as MRBC was a subscriber of this database.

LexisNexis', Factiva's and Dialog's databases are catered for the business community and their index of terms naturally fit the overall structure of most business consulting companies. However, when it comes down to the specifics, the availability of suitable terms for the taxonomy is very much dependent on the areas or industries in question. As business consulting companies sometimes cover very broad ranging industries, it would therefore be necessary to combine the three databases to ensure the industry coverage is sufficient. In cases where certain industry coverage is found to be lacking, it may also be necessary to make use of other sources to supplement the terms used.

3.3. Lessons Learned during the Development of the Prototype Taxonomy

3.3.1. Managing Users Expectations and Needs

Before embarking on the development of taxonomy for a company, it is vital that the information professional is equipped in managing the expectations of the users. It would be near impossible to develop a taxonomy structure that would please all the users. This is because different users have different needs as well as different perspective of the various industries. Some users may also have political agendas to fulfil in terms of their requirements for the taxonomy. For example, users who are experts in a particular industry may protest when they find out that their particular industry has been represented as being 'smaller' than others in terms of the breadth and depth of their industry in the taxonomy structure. Another area of expectation to be managed is the inevitability of incompleteness within the developed taxonomy. The information professional must bear in mind, and must communicate to the users, that the taxonomy is an expandable and flexible structure, and will be adapted accordingly when new business interests arise for the company. As choice of terms was largely based on the existing information content of the company, the taxonomy could be adapted and new subcategories added when documents pertaining to new topics are added.

3.3.2. Manual versus Automatic Development of the Taxonomy

There were many challenges faced during the taxonomy creation process. One of the first considerations is whether the tasks are to be carried out manually or automatically. Although no formal study has been made on the necessity of manual intervention for taxonomy development (Hagedorn 2001), it is generally recognised and agreed amongst information professionals that manual intervention is necessary, the opinions differ only in where the extent of human involvement should be. In most cases, the extent of manual versus automatic involvement would be determined on a company-by-company basis, depending largely on the type, size and unique characteristics of the company in question. Manual involvement could range from the minimum effort to a full-fledged participation.

In the case of MRBC, manual involvement in the taxonomy development ranks high, largely due to the lack of a taxonomy application or software to utilise and automate some of the processes. As the collection size is currently still manageable, it is feasible to carry out most of the development manually. However, this will probably not be the case should the collection start to expand rapidly.

3.3.3. Identification of Main Categories and Terms

Another key issue faced during the development process was the need to identify the categories and terms in line with the company's current business environment, as well as comprehensively represent the information within the company. The selection of various online databases and business web sites was an attempt to get a broader view of the types of main categories and terms used in the business world to represent the industries. The frequency of usage of a particular term by the sources can also give an indication of its appropriateness as a term for business taxonomy.

It should, however, be noted that while these sources do provide a useful "database" of terms to choose from, it may sometimes be necessary to select a less commonly used term or even to modify the terms available so as to better reflect the specific information needs of the company. This is because each company has its own unique requirements and the application of an information professional's understanding of the company may help contribute to a more accurate and useful taxonomy for the users. Hence, although it is important to include external sources to ensure some form of standardisation and objectivity to the taxonomy, the process of taxonomy development would still require input and opinions from individuals who understand the company's needs.

3.3.4. Development of the Hierarchical Structure

The development of the hierarchical structure is carried out based on two main factors: firstly, the common sense perspective of the various industries, and secondly, the industry experts' view of the respective industries. This process is highly subjective and dependent on the views of a few individuals. It is therefore crucial that industry experts are involved so that the industries are not misrepresented in the taxonomy. It is also important that the users are consulted on the hierarchical structure developed for each of the categories, since they will be the ones who are utilising it.

4. Taxonomy Deployment

The company has agreed in principle to use the prototype taxonomy for categorization of knowledge resources of linking of exiting documents to different categories. It is intended to be implemented within the framework of their recently required enterprise portal software that supports developing knowledge repositories. Among other features, the system also has a sub-system for category management. However, the company is still struggling for developing a mechanism for automatic tagging as no hundred per cent machine solution has yet been found. As an interim measure they have decided to develop classification rules that should assist in tagging and categorization using a manual system as a stop-gap arrangement with an ultimate objective of a system that is assisted by automated tools in facilitating the indexing and categorization work. They have also decided to use Dublin Core as metadata schema as there is a strong feeling that without comprehensive metadata they will not be able to take full advantage of the potential of taxonomy. It is estimated that a reasonable number of knowledge resources will be linked to selected categories. We intend to do a study to assess the effectiveness of taxonomies once a reasonable level of tagging is achieved.

5. Summary And Conclusions

In order to facilitate the discovery of the information resources within the company, it was realised that there is an urgent need for some clear guidelines on the development process of taxonomy building. Using the existing taxonomy and business environment of MRBC as a base, prototype taxonomy was developed for business consulting companies. The prototype taxonomy consists of 12 main categories and approximately 500 terms. The main categories represent 12 business industries, which are the key industries of the company's business consulting work. The taxonomies and indexes used by various online database providers and web sites were used to provide the building blocks for the prototype taxonomy, while informal interviews with industry experts and feedback from users of the company were instrumental in helping to determine the structure of the taxonomy.

We have learned in the process that before embarking on the development of a business consulting taxonomy, it is important that the team involved should make careful plans and decisions about the priorities of the business and the balances between the business goals, the users' needs, the budget available for setting up the system as well as the management's long-term plans for the company. All these would differ from company to company, and

would determine the steps to be taken as well as the final product of the taxonomy.

While it was useful to compile and compare terms used by different sources to represent their information, it is useful to bear in mind that these terms are selected to provide a guideline, rather than a hard-and-fast rule, to the types of terms that would populate the taxonomy structure. This is especially important in the context of developing taxonomy to meet the unique requirements of a specific company.

It is also vital that the information professionals within the company are able to develop a good rapport with their colleagues, because their input is needed to ensure that feedback from the users of the taxonomy themselves is incorporated into the building of the taxonomy. While industry experts have helped to provide a good perspective of the various industries, their interpretation may not be easily understood by the users of the taxonomy. Industry experts are likely to describe the industries to a high degree of depth or detail, which may not be necessary for the purposes of the business consulting environment. It is therefore important that most staff in the company are involved in the development process. Without the cooperation of these users, it would not be possible to fine-tune the taxonomy to ensure that it meets their information needs.

The manual development of the prototype taxonomy was a long and time-consuming process, from the compilation and selection of terms, to the formation of the hierarchical structure. It would be more efficient if the process can be partially automated, if budget permits. Although sophisticated tools were not available for this study, some manual processes were shortened by making use of available software such as Microsoft Excel, which was used to compile and cull out the terms more quickly, and MyInfo, a software that was able to effectively present the taxonomy in its hierarchical structure.

The development of business taxonomy does not end with the formation of the taxonomy structure. The work continues with the constant maintenance of the hierarchy. As the company's goals and directions change with the times, and as the information collection and usage evolve, so must the taxonomy adapt and be modified in order for it to remain relevant and effective. This is a massive task and a taxonomy that relies totally on manual efforts to build and maintain will prove to be impractical. Not only will it be prohibitively costly, but also it will lack the agility to respond quickly to changing content. However, there is also no packaged solution pres-

ently available that can address the problems in its entirety without involving some extent of manual inputs. Companies would still need to customise these packaged solutions to tailor them according to their business needs. Hence, the best approach to developing business taxonomy would integrate both the manual and automated approaches in the right proportions as determined by the business nature and the company's specific information needs. The taxonomy developed for MRBC can be used as prototype taxonomy for other business consulting companies. The guidelines and methods developed during the process can also be similarly applied to modify the prototype taxonomy according to the information needs of each company, bearing in mind that business taxonomies are as unique as the companies they represent.

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Appendix

**PROTOTYPE TAXONOMY FOR THE
BUSINESS CONSULTING ENVIRONMENT**

BANKING, FINANCE & INSURANCE

Accounting
Accounting standards
Audits

Banking
Banking & financial services
Commercial banking
Commercial lending
Interbank lending
Retail banking
Retail mortgages
Small business lending
Consumer banking
Consumer loans & deposits
Credit, debit & stored value cards
Financial planning
Investments
Private & priority banking
Electronic banking
Internet banking
Banking technology
Automated banking
Phone banking
Electronic funds transfer (EFTPOS)
Banks
Central banks
Commercial banks
Investment banks

Investment services & products
Bonds
Commodities
Derivatives
Equities
Initial public offerings
Stock options
Online trading
Real estate investments
Unit trusts

Financial regulations
Banking & financial regulations
Insurance regulations
Securities regulations
Monetary policies
Taxation laws

Insurance
Insurance agencies & brokerages
Insurance products
Automobile insurance
Health insurance *see also* "Healthcare
policies"

Life insurance
Property & casualty insurance
Reinsurance

Taxation
Corporate taxes
Duties & tariffs
Personal taxes

BUILDING & CONSTRUCTION

Architectural services
Design
Extension to existing building
Interior decoration
Interior design
New building design
Design & build

Building renovations
Home improvements
Home remodelling

Construction
Building materials
Insulation products
Masonry products
Metal construction products
Plastic construction products
Building permits
Construction equipment
Construction machinery
Construction tools
Construction spending
Home construction

CHEMICALS

Adhesive, fillers & sealants

Agricultural chemicals
Fertilisers
Herbicides

Lubricants
Industrial lubricants

Paints & coatings
Coatings
Colourants
Dyes & pigments

Pesticides
Insecticides

Pharmaceuticals *see "Types of drugs"*

Plastics
Resins

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Rubber

Solvents

Specialty chemicals

Volatile organic compounds

CONSUMER PRODUCTS

Apparel & accessories *see also "Apparel retailing"*
    Clothing
        Childrenswear
        Menswear
        Sleepwear
        Sportswear
        Underwear
        Womenswear
    Fashion
        Fashion accessories
        Leathergoods
    Footwear

Baby products
    Baby care
        Baby toiletries
        Disposable diapers
    Baby clothings

Consumer electronics
    Audio discs & tapes
        Compact discs
        Minidiscs
    Audio equipment
        Compact disc players
        Minidisc players
        Radios
        Record players
    Cameras & photography equipment
        Cameras
            Digital cameras
            Video cameras
        Photographic film
    Televisions
        Colour televisions
        Digital televisions
        High-definition televisions
    Video discs & tapes
        Video discs
        Video tapes
    Video equipment
        Tape recorders
        Video recorders

Cosmetics & toiletries
    Cosmetics
    Toiletries
        Body care
        Face care
        Fragrances
        Hair care
        Oral care
        Sanitaryware

Household appliances
    Domestic appliances
        Air conditioners
        Clothes dryers
        Dishwashers
        Microwave ovens
        Refrigerators
        Tools
        Washing machines
        Vacuum cleaners
    Small electrical appliances
        Coffee makers
        Toasters

Home furnishings
    Furniture
        Built in furniture
        Home furniture
        Office furniture
        Unassembled furniture
    Household goods
        Kitchenware
        Tableware
    Lighting products

Paper products
    Disposable paper products

Personal goods
    Jewellery
    Watches and clocks

Pet products
    Pet foods

Toys & games
    Games
    Toys

ELECTRONICS

Electronic components
    Capacitors
    Connectors
    Diodes
    Fuses
    Integrated circuits
    LEDs
    Relays
    Resistors
        Switches
    Transistors

Electronics production
    Board level component manufacturing

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Cable assembly manufacturing
Contract manufacturing
Magnetic products manufacturing
Printed circuit board fabrication

Office automation & supply
    Office equipment
        Facsimiles
        Multifunctional products
        Photocopiers
        Printers
        Typewriters

Optoelectronics
    Amplifiers
    Couplers
    Detectors
    Fibers
    Integrated optical circuits
    Modulators
    Sources
    Switches

Semiconductors
    Non-single-crystal silicon technology
    Single-crystal silicon technology

FOOD, BEVERAGE & TOBACCO

Beverage industry
    Alcoholic beverages
        Beer
        Liquers & aperitifs
        Spirits
        Wines
            Wine production
    Beverage packaging
        Bottled packaging
        Canned packaging
        PET packaging
    Carbonated beverages
    Distillers & brewers
    Health drinks
    Liquid diet supplements
    Milk processing
    Non-alcoholic drinks
        Beverages
            Cocoa beverages
            Coffee
            Hot beverages
            Tea
        Juices
        Milk
        Mineral water

Food industry
    Baby foods
    Convenience foods
        Fast foods
        Pre-packed foods

Take-aways
Food packaging
    Canned foods
    Food labelling
Food processing
Food producers
Food products
    Bakery products
    Breakfast cereals
    Condiments
    Dairy products
    Desserts
    Oils & fats
    Organic foods
    Snacks
    Vegetarian foods
Food safety
Fresh, chilled & frozen foods
    Chilled foods
    Fresh foods
    Frozen foods
Genetically modified foods
Health foods

Tobacco industry
    Cigarettes
    Tobacco

HEALTHCARE

Biotechnology
    DNA testing
    Genetics
        Genetics research
    Medical research & technology
    Telemedicine

Health promotion
    Health & fitness
        Health care facilities
    Nutrition & dietetics

Medical
    Bioethics
    Clinical medicine
        Anesthesiology
        Cardiology
        Dermatology
        Epidemiology & public health
        Obstetrics & gynecology
        Oncology
        Optometry & ophthalmology
        Orthopedics
        Pediatrics
        Surgery & transplantation
    Healthcare policies see also "Health
     insurance"
        Occupational compensation
        Public & health policies
    Healthcare providers

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Health care services
Hospitals & clinics
Managed care organisations
Medical professions
    Nurses & nursing
    Physicians & surgeons
Nursing homes
Medical education
Medical equipment & supplies
Diagnostic products
    Diagnostic imaging
    Immunodiagnostics
Medical devices & equipment
    Cardiovascular
    devices
    Dialysis
    Ophthalmic equip-
    ment
Medical electronics
Medical supplies
    Medical disposables
Medical waste & biohazards
Medical research
Mode of treatment
    Lasers

Pharmaceuticals
    Drug companies
    Direct to consumer drug mar-
    keting
    Drug distribution wholesale
    Drug manufacturers
        Drug labelling
        Pharmaceutical pack-
        aging
    Pharmaceutical associations
    Pharmaceutical product devel-
    opment
        Clinical research
        Clinical trials
    Retail pharmaceuticals
    Drug interactions & side effects
    Pharmaceuticals regulations
    Types of drugs
    Drugs by mode of delivery
        Aerosol drugs
        Oral drugs
        Perental drugs
        Topical drugs
    OTC drugs
        Antiseptics
        Cough & cold reme-
        dies
        Nutritional pharma-
        ceuticals
        Simple analgesics
    Prescription drugs
        Allergy & immunol-
        ogy drugs
        Antiinfectives
        Cardiovascular drugs

        Gastroenterology
        drugs
        Haem-onco drugs
        Nervous system drugs
        Prescription analgesics
        Psychiatric drugs
        Renal drugs
        Respiratory drugs
    Vaccines

Supporting healthcare services
    Alternative medicine
    Chiropractic
    Domiciliary care
    Rehabilitation & occupational therapy

MEDIA & ENTERTAINMENT

Advertising
    Advertising rates
    Broadcast advertising
    Radio advertising
    Television advertising
    Outdoor advertising
    Print advertising

Broadcasting
    Broadcast equipment
    Public broadcasting
    Satellite broadcasting
    Transmissioons
    Television & radio broadcasting
    Cable television
    Radio broadcasting
    Television broadcasting

Film, music & video
    Movie industry
    Film & video production
    Movies
    Theaters
    Music industry
    Audio recordings
    Recorded music
    Recording industry
    Video industry

Intellectual property
    Censorship
    Copyright
    Intellectual assets
    Intellectual property law
    Privacy rights

New media
    New media consultancy
    New media services

Publishing & printing
    Printing

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Publishing
    Book publishing
    Editorials & columns
    Educational publishing
    Electronic publishing
    Magazine publishing
    Newspaper publishing

REAL ESTATE

Auctions

Commercial property
    Commercial property leasing
    Commercial property sales

Industrial property
    Industrial property leasing
    Industrial property sales

Land use & development
    Land use planning
    Land use zoning

Property management
    Commercial property management
    Residential property management

Real estate development

Residential property
    Public housing
    Residential property leasing
    Residential property sales

Retail property
    Retail property leasing
    Retail property sales

Valuations

RETAIL

Apparel retailing *see also"Apparel & accessories"*

Convenience stores

Cosmetics & beauty supply stores

Department stores & shopping malls
    Department stores
    Shopping malls

Drug-based retailing *see "Retail pharmaceuticals"*

Electronics & appliance retailing

Food retailing
    Beer, wine & liquor stores
    Grocery stores
    Health food stores
    Retail bakeries

Housewares & furnishings retailing

Online retailing

Supermarkets & hypermarkets
    Hypermarkets
    Supermarkets

SERVICES

Business services
    Accounting & auditing services
    Consulting services

Design services
    Graphic design services
    Interior design services

Educational services
    Professional continuing education services

Employment services
    Executive-search services

Food services
    Catering services

Information & online services
    Information services
    Online legal research

Legal services

Marketing & advertising services

Personal services
    Child care services
    Cleaning services
        Dry cleaning & laundry services
        Household cleaning services
    Personal communications services

Printing services

TRAVEL, LEISURE & HOSPITALITY

Entertainment & leisure
    Bars & nightclubs
    Casinos & gambling
    Gaming
    Recreational services & attractions

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Amusement parks
Museums & galleries
National parks
Theme parks
Zoos & aquariums
Sports
Golf

Hospitality
Drinking places
Lodgings
Bed & breakfast inns
Hotels & motels
Resorts
Restaurants & food services
Catering services
Fast food restaurants
Restaurants

Travel & tourism
Tourism
Ecotourism
Tourist information offices
Travel
Air fares
Cruises
Package tours
Travel agencies
Vacations