Libraries as knowledge management centers

Kevin R. Parker
Department of Computer Information Systems, Idaho State University, Pocatello, Idaho, USA
Philip S. Nitse
Department of Marketing, Idaho State University, Pocatello, Idaho, USA, and
Kay A. Flowers
Eli M. Oboler Library, Idaho State University, Pocatello, Idaho, USA

Abstract

Purpose – This paper proposes enhancing libraries to act as knowledge management centers for small businesses, providing both knowledge management (KM) and competitive intelligence (CI) services.

Design/methodology/approach – The requirements for a Library Knowledge Management Center (LKMC) are presented and briefly examined. KM, CI, ontologies, and the Semantic Web are all considered, and the steps needed to realize a LKMC are presented.

Findings – An approach to developing a LKMC is provided, as is a rationale for the proposal. Future research issues for realization of this proposal are addressed.

Research limitations/implications – This paper presents a conceptual overview of a project that is still in its early stages, and as such its practicality is difficult to evaluate.

Practical implications – This proposal, if followed up with future research, will prove beneficial to both small business and to libraries. Small businesses are not always able to gather sufficient internal and external knowledge to assist in strategic planning and positioning, and thus are unable to compete with larger rivals whose resources allow them to develop sophisticated KM and CI systems. LKMCs hold promise to level the playing field. Libraries benefit because this reaffirms their relevance in a digital age in which so much information is freely available to patrons.

Originality/value – This paper proposes a new service for libraries, one that will assist small businesses in competing more effectively with larger competitors.

Keywords Knowledge management, Digital libraries, Internet, Small enterprises

Paper type Conceptual paper

Introduction

As libraries struggle with the fallout of the digital age, they must find a creative way to remain relevant to the twenty first century user who has the ability and means of finding vast amounts of information without setting foot in a brick and mortar library. The internet and the proliferation of personal computers, both at home and at work, has lessened the need to visit the local library to look up information that had once been available only there. The freely accessible information on the web, in conjunction with the escalating costs of library materials, threatens the traditional mission of libraries to create and sustain large, self-sufficient collections for their patrons (Troll, 2002). In a seemingly unrelated arena, large companies are developing and implementing sophisticated knowledge management (KM) systems to capture, store and disseminate much- needed information gathered from their internal and external

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environment. This information is used not only to streamline a company's processes and improve their services, but it also provides intelligence about their operating environment and competitors so that the company can gain or maintain a competitive advantage. Smaller companies often lack the personnel, financial, and technical resources required to implement such a system, and as such are unable to compete at the same level as larger competitors. While all businesses require information to guide their strategic decision making, not all businesses can afford it. Therefore, an opportunity exists for local public and university libraries to provide a service to fill the gap that is developing as a result of the digital age and the need of small businesses for more information and intelligence.

This paper proposes repositioning or enhancing libraries to act as KM centers for small businesses, providing both KM and competitive intelligence (CI) services. In this context, the Semantic Web offers a solution that addresses several of the problems faced by libraries in proactively cataloging and delivering information and intelligence to individuals and businesses. Today's web lacks the capability of automatically linking documents on the basis of semantic similarities. Such linking requires human intervention to ascertain the semantic context and recognize similarities between documents. The Semantic Web is an extension to the current web designed to automatically link documents that are semantically similar (Bonner, 2002). The Semantic Web might also prove useful in connecting library functions to external systems. Using RDF and Semantic Web-based query languages, the semantics or vocabularies of various research communities may be combined to support seamless information retrieval from a single source. The Semantic Web holds promise as a tool for providing services for the growing stream of diverse web-based content available to today's libraries (Rhyno, 2002).

Libraries in the digital age

In the last few years, public libraries have faced challenges from two sides. First, the expansion of the internet has created the perception that libraries are(longer needed since much content previously found only in libraries is now available on the internet. Digital resources enable users to search independently of libraries. Today's users rely on a combination of enhanced resources, user-friendly interfaces, and improving search tools (University Library Services, 2000). This may lead to a decrease in the number of patrons who visit the library or to a decline in circulation statistics – two key measures that libraries traditionally use to demonstrate their success (Bertrot *et al.*, 2004). In a recent survey 29 percent of respondents indicated that they perceive their usage of local libraries has decreased, with 26 percent of those respondents citing internet usage at home or work as the leading cause. However, there are some major limitations to information obtained via the internet. The most significant drawback is that it is often limited to recent information only. While the internet is good source for information from the last eight to ten years, resources prior to 1994 are most likely still in paper form. While many reference books and abstracts have made the jump to the internet and are fully available, they charge a significant fee for access, a fee usually paid by the library so that they can offer their patrons access to these resources. "Libraries of all sizes and types are embracing digital collections, although most libraries will continue to offer both print and digital collections for many years to come" (Tenopir, 2003).

So as libraries have experienced stagnation in traditional services, they have, in many cases, increased network services and resources (Bertrot *et al.*, 2004). Purchases of journals, magazines, and abstracting and indexing services are heavily weighted toward digital (Tenopir, 2003). Many libraries have increased their expenditures for information technology, telecommunications, and related services and resources. Network-based services and resources offered by libraries today, including digital references, digital collections, online databases, e-journals, and e-books, enable libraries to operate in an anytime/anywhere mode, allowing patrons with internet access to access content, services, and resources 365 days a year, 24 hours a day (Bertrot *et al.*, 2004).

Yet another challenge facing public libraries is the erosion of the sense of libraries as a public good. This erosion is particularly evident as libraries become candidates for major cuts or even closure as cities and towns experience flat sales tax revenue and rising costs in other areas. School, public and academic libraries in more than 40 states have absorbed more than $50 million in funding cuts in 2004, according to a national study by the American Library Association (American Library Association, 2004). Some libraries have already had choose between requesting special tax ballots or closure (Reuters, 2004). Buffalo, New York, scheduled closure of all 52 of its libraries in January 2005 (Libraries Online, 2004). Public libraries in 41 states report funding cuts of as much as 50 percent and are reducing staffs, cutting their operating hours and closing branches (American Library Association, 2004).

Libraries must determine how best to react to these challenges. They must not only continue to complement their traditional role with digital collections and services, but they must also embrace opportunities to expand the services that they offer. Rigorous planning is critical to staying competitive in any information intensive and highly dynamic market. The evolution of information technology continues to redefine patterns of library usage and continues to impact users' expectations of libraries (University Library Services, 2000). Libraries must consider their entire marketing mix for what they offer in the marketplace. They must examine their entire range of services, where they will compete, the services with which they will compete, how to best deliver their services, and who provides their competition (University Library Services, 2000).

In this era of change there are opportunities for libraries to take a role in economic development to help secure their place in the community. Public libraries have a long tradition of serving businesses in their communities. Many libraries also include business collections and government documents, and some offer copy services to their patrons. The 1998 Public Library Association document, *Planning for Results: A Public Library Transformation Process*, lists several "components" for business and career services including assistance with job placement, resume preparation, a web site, and career guidance. As noted by the author:

> For the most part, these are services for the individual. They do not emphasize services of likely interest to established businesses, to community agencies involved with economic development, or to corporations (Lynch, 1998).

This demonstrates an unfilled niche that libraries can satisfy – providing services to established businesses.

Many large corporations and businesses have developed their own in-house libraries that are both digital and paper-based. As information began to "explode" in the 1950s and 1960s, these units were used to track specific information and to provide reference for researchers and others who did not have time to do the work themselves. In the late 1960s, selective dissemination of information was improved through the use of the first online database services. Searches could be entered once and saved, and then rerun against the database as information was added. These in-house libraries are highly specialized to specific industries and are forming the basis for companies to develop KM systems to capture, store and disseminate much needed intelligence for companies to gain or retain a competitive advantage in their industries. Companies are spending vast amounts of money and personnel resources on these libraries to keep abreast of the daily happenings in their very dynamic business environments. Smaller companies cannot afford the investment required to maintain an in-house library, nor do they have the personnel or resources to develop one. However, to compete with larger, more sophisticated companies in their individual industries smaller companies still need access to highly specialized KM systems. Therefore, an opportunity exists for local public and university libraries to provide a service to fill the gap that has developed as a result of the digital age and the need for more information and intelligence.

Technology and the small business

Although there has been a great deal of research on the impact of technology on large companies, relatively little has focused on very small firms. It is important to acknowledge the fact that 90 percent of firms in the USA are classified as small businesses with fewer than 500 employees, and most of them have fewer than twenty employees (Zimmerer and Scarborough, 2002). This means that there is a large market for libraries to target.

Several studies have shown that the size of the firm is related to adoption rates of technology (Auger and Gallaugher, 1997; Haynes *et al.* 1998; Department of Trade and Industry, 2000; Riquelme, 2002). The research is mixed on whether large or small firms benefit the most from technology adoption. Information technology has been recognized as an important strategic advantage to achieve a competitive advantage (Davies and Garcia-Sierra, 1999; Soliman and Janz, 2004). However, small firms often have negligible purchasing power, limited access to information, limited experience in using technology, and a lack of a long-range point of view (Davies and Garcia-Sierra, 1999; Thong, 1999; Burpitt and Rondinelli, 2000).

Knowledge management

KM is the explicit and systematic management of vital knowledge (Skyrme, 1997), and includes capturing, organizing and disseminating that knowledge within an organization (Rubenfeld, 2001). KM allows organizations to generate value from their intellectual and knowledge-based assets (Santosus and Surmacz, 2001), and makes it possible to get the right information into the hands of the appropriate people at the time they need it to make decisions (Petrash, 1996).

Importance of KM

KM has several benefits and is a useful resource for any organization. KM "caters to the critical issues of organizational adaptation, survival and competence in face of increasingly discontinuous environmental change" (Malhotra, 1998). The importance of KM is corroborated by various research studies. A survey by PricewaterhouseCoopers International found that 95 percent of the CEO's who participated saw KM as an essential ingredient for the success of their company (Suresh, 2001).

Several sources (Choo, 2004; OSD Comptroller iCenter, 2002; Library Co-Op, 2004) attribute a variety of benefits to a well-planned KM effort, including the following:

- KM encourages the free flow of ideas, which fosters insight and innovation and creates new value through new products or services.
- KM improves customer service and efficiency by streamlining response time.
- KM enhances employee retention rates by recognizing the value of employees' knowledge and rewarding them for it.
- KM streamlines operations and reduces costs by eliminating redundant or unnecessary processes and promoting reuse.
- KM facilitates better, more informed decisions by reducing uncertainty.
- KM contributes to the intellectual capital of an organization.
- KM boosts revenues and enhances the current value of existing products by getting products and services to market faster.
- KM leads to greater productivity by increasing speed of response.

Resources required by KM

Although KM is a useful resource, it can be prohibitively expensive for a smaller company. Qualified and dedicated personnel are required for a successful KM effort, as is supporting technology. The overall capital outlay may be beyond the means of a smaller organization.

One of the resources required for a successful KM effort is personnel. KM is about what employees know, and how what they know can support business and organizational objectives. It is not a technology-driven concept, but rather it draws on human competency, intuition, ideas, and motivations (OSD Comptroller iCenter, 2002). KM requires not only knowledgeable employees, but also specialized knowledge workers. A KM worker requires varying depths of knowledge in particular areas (Skyrme, 1998):

- *Technical skills* – information (resources) management, information technology skills.
- *Business knowledge* – industry, markets, customers, competitors, and general business context.
- *Interpersonal skills* – networking, listening, interpreting, challenging, teamwork, communications.
- *Management skills* – motivating, coaching, facilitating, influencing.
- *Company/organization knowledge* – Knowledge of procedures and culture.

- *Personal characteristics* – integrity, confidence, openness, trust, supportive, honesty, willingness to learn.

The financial component is also critical for the success of a KM effort. The expenditures for a serious KM effort can be quite significant. It has been estimated that the major consulting firms may spend as much as 6-12 percent of revenues on knowledge sharing programs (Gartner Group, May 28, 1998). A 2001 survey conducted by supportindustry.com and STI Knowledge reveals that 31 of 49 companies (63 percent) reporting a KM initiative spent between $100,000 and $249,000; 16 percent (eight of 49) spent $250,000 to 499,999; three of 49 spent between $500,000 and $749,999; one of 49 spent between $750,000 and $999,999; four of 49 spent between $1,000,000 and $1,999,999; and 2 of 49 spent between $2,000,000 and $4,999,999 (CRMindustry.com, 2001). None of these amounts is negligible.

Another essential KM component is technology. KM tools range from standard, off-the-shelf packages to sophisticated collaboration tools designed specifically to support community building. Generally, tools fall into one or more of the following categories: knowledge repositories, expertise access tools, discussion technologies, knowledge representation, expert systems, e-learning applications, synchronous interaction tools, and data warehouse and data mining tools (Zhang, 2004; Library Co-Op, 2004).

Other KM products include (Murray, 1996; Nantel, 2003):

- Business intelligence (BI).
- Collaboration.
- Content/document management.
- Data integration.
- Portal.
- Search/retrieval.
- Decision support systems.
- Database technologies.
- Help-desk technology.
- Brainstorming applications.
- Web mapping tools.

A successful KM effort can be a drain on a company's resources. Although there are several benefits, the resources required go beyond the personnel, economic, and technical capabilities of many smaller organizations.

Competitive intelligence

Organizations use the CI process to gather information, to add value to it through analysis, and to report the findings to managers to solve a wide variety of problems or satisfy requests for information. CI projects range from competitive information about competitors or customers to information on mergers and acquisitions or recruiting. The types of information needed to answer these requests may include financial information, demographics, biographies, economic indicators, news articles, and customer and competitor information. Some types of information are easily gathered,

while others require greater amounts of time and money to obtain. Once the information is secured, it must be analyzed and proper reports must be generated and disseminated to the appropriate individuals within the organization.

Breeding (2000) identified several problems that users of CI have with the information that they receive from the CI process. These problems include shallowness, credibility, timeliness, focus, providers, quantity, and information sharing. The source of these problems can often be traced back to the way in which the CI process is carried out. If CI providers are consulted late in the decision-making process, shallow and poorly focused information is often the result. If sufficient time is not taken for analysis then the reports are often information-based rather than intelligence-based. In addition, the sheer quantity of information contained within the reports often overwhelms the reader. Lack of lead-time also limits the sources that can be accessed, thus calling into question the credibility of the sources of information. However, if decision-makers wait for better intelligence and analysis, it may come too late to be useful in the decision-making process. Other problems include lack of clear objectives, numerous users, massive quantities of information available, organizational barriers, lack of feedback and low budgets. Each of these problems can degrade the quality of intelligence that CI professionals can provide to users.

Still, CI is important for even small organizations. Any organization that fails to monitor its environment to determine the conditions under which it must operate courts disaster (Mitroff, 1985). Identification of key economic, social, and technological issues that affect the organization, its life cycle stages, and their relevance to each other helps managers allocate attention and resources to them (McCann and Gomez-Mejia, 1992). CI is a fundamental, early step in the chain of perceptions and actions that permit an organization to adapt to its environment (Hambrick, 1981).

The Semantic Web

Before exploring the role of the Semantic Web in a Library Knowledge Management Center (LKMC), the Semantic Web itself must be understood. Today's web pages are designed for human use, and human interpretation is required to understand the content. Because content is not machine-interpretable, any type of automation is difficult (Lassila, 2002). The Semantic Web augments today's web to eliminate the need for human reasoning in determining the meaning of web-based data. The Semantic Web is based on the concept that documents can be annotated in such a way that their semantic content will be optimally accessible and comprehensible to automated software agents and other computerized tools that function without human guidance (Bonner, 2002). Thus, the Semantic Web might have a more significant impact in integrating resources that are not in a traditional catalog system than in changing bibliographic databases. For example, some scientific datasets do not have access points that convert well to bibliographic descriptions, but convey a multitude of critical concepts for the researchers that use the datasets (Rhyno, 2002).

Realization of the Semantic Web relies primarily on five core technologies: XML, URIs, RDF, ontologies and intelligent agents. The extensible markup language (XML) and its accompanying technologies are the fundamental facilitator of the Semantic Web (Berners-Lee *et al.*, 2001). XML provides for language customization through the definition of new tags to describe the data elements used in an XML document – hence the term "extensible." Unlike HTML, which controls how data are displayed on the

web, XML is intended to facilitate the sharing of structured text and information across the internet. The data display remains the job of HTML. In short, XML and HTML perform complementary, rather than overlapping, functions. XML supplements presentation markup with markup that provides a context for understanding the meaning of the data, for example, <author>Gordon Davis</author>. The advantage of XML is that software programs can read the specialized tags and perform operations such as extracting bibliographic information (Adams, 2002).

Uniform Resource Identifiers (URIs) are another foundation of the Semantic Web (Berners-Lee and Miller, 2002). A URI is much like a URL, but it does not have to map to a real web address. Further, a URI can represent concepts ("author"), living entities ("Gordon Davis"), and virtually anything else (Rhyno, 2002). Thus, URIs provide the capability to uniquely identify not only resources, but can also indicate the relationships among resources (Berners-Lee and Miller, 2002).

The Resource Description Framework (RDF) leverages URIs and XML to provide interoperability between Web applications that must exchange machine-understandable information (Brooks, 2002). RDF provides a structure that, in functional terms, expresses the meaning of web documents in a way that specialized software can understand (Adams, 2002). Through RDF, authors can specify the contents of pages and how those pages relate to one another and to other known bodies of data (Bonner, 2002). An RDF description can include various types of metadata such as the authors of the document, the date of its creation, the name of the sponsoring organization, intended audience, subject headings, etc. (Adams, 2002).

The next element required for the realization of the Semantic Web is an ontology that can formally describe the semantics of classes in the many domains of interest and the semantics of properties (or attributes) used in web documents (Sadeh and Walker, 2003). Hendler (2001) defines an ontology as "a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic." Ontologies allow computers to communicate with each other by providing a common set of terms – vocabularies – and rules that govern how those terms work together and what they mean. Ontologies define terms and then lay out the relationships among those terms (Adams, 2002). Web ontologies provide a shared and common understanding of specific domains that can be communicated between different application systems (Singh *et al.*, 2005).

Intelligent software agents are software entities that carry out operations and process information on behalf of a user or another program with some degree of independence or autonomy, directed by some awareness of the user's goals or needs. Agents are used when the software must possess human-like capabilities such as the ability to perceive and assess the environment, proactive behavior in pursuing a goal, ability to learn from their experiences, and social behavior (Ermolayev *et al.*, 2004). In the context of the Semantic Web , intelligent agents typically gather, sort and process information found on the web without human interaction. "The real power of the Semantic Web will be realized when people create many programs that collect Web content from diverse sources, process the information and exchange the results with other programs" (Berners-Lee *et al.*, 2001). Agents should be able to discover content that is appropriate given the customer's preferences and requirements (Kungas and Rao, 2004).

The Semantic Web promises to give well-defined meaning to the web by incorporating into web documents well-defined semantics. Agents should be able to determine the semantic linkages between web resources by following links from web pages to topic-specific ontologies. The meaning of vocabulary terms or XML tags used in a particular web document would be defined by a topic-specific ontology. For example, ontology cross references would make it possible for an agent to understand that "blouse" and "dress shirt" are similar concepts (Adams, 2002). Using a semantically based view of web resources, intelligent agents will be able to automatically discover, interpret, and evaluate web content (Arai *et al.*, 2003).

Components of a library knowledge management center

Several steps must be undertaken for libraries to utilize these technologies in order to expand their services to act as KM centers for small businesses. First, libraries must develop domain ontologies to help categorize resources for specific businesses. A domain ontology provides a specification of a shared conceptualization to be used for formulating knowledge-level theories about a domain (Domingue and Motta, 1999; Guarino, 1997). Specific domains can be identified and a common ontology can be defined to map vocabularies of specified terms with generally accepted definitions (Gruber, 1991). "Ontologies inform the system user of the vocabulary that is available for interacting with the system and about the domain and the meaning that the system ascribes to terms in that vocabulary" (Farquhar *et al.*, 1997). A domain ontology is an explicit formal specification of all the basic concepts (objects, concepts, and relationships) that are assumed to exist in some area of interest. The goal of domain ontologies is to specify the conceptual vocabulary and representational framework for the classes of a domain. Tools like the Ontolingua Server can assist in the construction of ontologies (Farquhar *et al.*, 1997).

Building a domain ontology requires a thorough understanding of the domain; therefore the process should start with general terms common to all small businesses, and then target specific businesses associated with individual clients, with the purpose of determining common industry terms, organization specific terms, and even project specific terms. Ontology construction can be directed through the use of needs identification tools like key intelligence topics (KITs) or the multi-class interest profile (M-CLIP), generally used in conjunction with CI. Herring (1999) proposes the concept of KITs to help identify intelligence requirements by considering strategic decisions, early-warning topics, and key players. The KITs process can help identify and define critical intelligence needs. The M-CLIP (Parker and Nitse, 2001), provides a strategically aligned framework based on the various types of information needs in order to insure that key items within each domain are accounted for. Thorough needs identification guided by a structured, multi-dimensional framework increases the likelihood of successful ontology development. A complete domain ontology encompasses a wide spectrum of corporate interests, thus providing the means to access a greater percentage of relevant information. A specialist trained in knowledge engineering can greatly assist the specification of key concepts for the domain ontology.

Second, as individual documents are added to the library's collection, natural language processing techniques can assist in determining the contents of each digital document. The library's collection will consist of documents from both internal and

external sources. There are a variety of external sources. These may include items stored at other library locations, or items provided by pay-for-use services such as Dow Jones, Hoover's Company Data Bank, Standards & Poor's, NewsEdge, or free information sources such as SEC's Edgar system, and corporateinformation.com (Breeding, 2000). The library may also subscribe to specialized databases from third-party vendors (Dialog, Lexus/Nexus), press release and newsfeed collections (WavePhore's Newscast Access or NewsEdge's NewsObjects), product literature, competitor Web sites, archived design specifications, company profiles and financial statements, and numerous other sources (Johnson, 1998). Internally generated knowledge refers to that knowledge within the minds of their employees. In order to handle internally generated knowledge the system should provide an interface to allow users to store information that will be sharable with other users of the system.

Next, the library catalog system must be modified to store details about specific topics (concepts) and in what references to find them, because there may be many key topics or concepts in each reference. This is a significant change because libraries will(longer store only catalog details about what is in a particular reference.

Finally, the Semantic Web will be used to semantically link the library's resources, so that semantically related documents can easily be retrieved or delivered. Small businesses will pay a subscriber's fee to use the LKMC, and will also be responsible for working with a knowledge engineer on staff to assist in specifying their information needs. Subscribers will specify multiple search parameters to narrow the search focus and target specific references. Results can be delivered on a push or pull basis to provide ongoing competitive (and other) intelligence.

Alternative approaches

Some libraries currently provide web portals for individuals or communities to access the internet to conduct research on topics of interest to them (Sadeh and Walker, 2003). Although people can do this from a variety of portals such as My Yahoo! or America on Line (AOL), libraries often add access to subscription databases that are too expensive for individuals or the small business owner, especially considering the amount of usage that a typical small business owner requires. The additional expense incurred by the library requires that a small business pay for the service, but the cost of access is spread over a large number of individuals or businesses.

Future research

Future research will address the implementation of each part of the LKMC development plan, and that research will follow a very structured approach, insuring that each individual component can be constructed before integrating the pieces into a complete system. Research areas include the development of a more specific model to guide the implementation of a KM center in the library environment. Some of the components of such a model include domain ontologies, natural language processing, a KM framework suitable for the library environment, and intelligent agents. Since the domain ontologies will be dependent on the subscribers of the system, each library will have to be able to develop ontologies that fit their subscriber base, so an appropriate framework will have to be developed. The same is true of the natural language used to develop key concepts pertinent to the subscriber base. Since a variety of KM frameworks are available, a viable framework will have to be researched, as will the

most appropriate intelligent agents. Additional research will explore the importance of archive theory in the development of LKMCs (Nitse and Parker, 2003).

Conclusion

The LKMC secures the future relevance of libraries by expanding their range of services and by providing a potential source of new funding. Small businesses that cannot afford the major outflow of resources needed to maintain their own in-house KM system will be able to afford the proposed subscription or pay-as-needed service. This should increase library usage by small business and possibly even by individuals, depending on the individual nature of each LKMC. Further, the LKMC should eventually become self-sustaining or even a profit center for the library, thus allowing it to continue operating under the resource-scarce conditions that currently exist.

The use of the Semantic Web in conjunction with a Knowledge Management system that provides Competitive Intelligence, with output directed at small and medium size businesses should provide the direction needed for modern libraries to survive in the digital age. The LKMC expands the services offered by libraries and allows them to provide a vital resource to the business community. Further, it provides a service that enables small businesses to compete on a more even footing with larger rivals. The LKMC serves to insure the continued viability of libraries in this ever-changing environment.

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