Web Content Management

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Abstract

Most organizations have implemented a Web site. Many are now experiencing problems associated with maintaining the content of their Web site. The Web manager often becomes a bottleneck for new content, old content fails to be removed, and new content can be published without approval. Although Web content management (WCM) methods and technologies are emerging, the market is crowded with suppliers and there is confusion concerning what WCM is, where it came from, and what facilities and services it should incorporate. We describe the antecedents of WCM (document management, customer relationship management, software configuration management) and develop a WCM framework. The WCM framework is applied to a case study of an intranet implementation in order to test the framework and to highlight WCM problems in the case study.

Keywords: web content management, XML, RDF, document management, configuration management

1. Introduction

The Internet has proven to be an easy and efficient way of delivering a wide variety of services to millions of users; as of July 2000, the estimated number of Internet users stood at 216 million [21]. Not only do the services themselves attract people, but also the convenient way of accessing them via an Internet browser; under most circumstances the same services can be used all over the world - as long as one has access to an appropriately configured personal computer and the Internet. On the supplier side, benefits also accrue; the services are created and stored on a server, and can often be quickly and conveniently changed with off-the-shelf authoring tools, providing an extremely short time-to-market with reduced service development time [1]. However, as the volumes of information provided by
organisations on the Web increase, so do the problems of managing that information. Moreover, such issues are not only prevalent in the business-to-consumer e-commerce sector, but also increasingly between organisations (e.g. via extranets) and within them (e.g. via intranets).

As with many new IT trends, Web content management (WCM) is in part a practical response to a pressing business problem – how to organize and manage large-scale Web sites – and in part a technology push on the part of software suppliers. Ovum (www.ovum.com) predicts that the market for content management tools will grow from the 1999 level of $475 million to $5.3 billion by 2004. We define web content management as an organizational process, aided by software tools, for the management of content on the Web, encompassing a life cycle that runs from creation to destruction. Early to market software suppliers, such as Interwoven (www.interwoven.com) and Vignette (www.vignette.com), are finding many software suppliers jumping on the WCM bandwagon. There is a plethora of companies providing Web content management software and the feeling of industry analysts in January 2001 is that the WCM market is overcrowded and due for a shakeout as the industry leaders emerge over the next 12 to 18 months. Some of these offerings are extant software products that are being re-positioned (or possibly just re-branded) in the WCM domain. Some of the ‘new’ WCM products are rooted in document management, while others have developed from customer relationship management, e-commerce, and software configuration management. In the crowded WCM marketplace there is some confusion about what constitutes WCM. The aim of this paper is to explore the antecedents of WCM and to develop a framework that allows us to talk more coherently about WCM services.

In the next section of this paper we explore the drivers and motivations for WCM. In the third section we look at the disciplines and software application areas that comprise WCM. In the fourth section we propose a framework for WCM, drawing from history and current developments in WCM. In the fifth section we report on an intranet case study of WCM. This examines what can go wrong when WCM is not handled well and uses the WCM framework to diagnose the problems. Finally, the paper concludes with a summary of the key issues discussed in the paper.

2. Issues in Web Content Management

Many organizations have created a Web site and most have established some infrastructural support for their Web site, such as a Web manager or a Web services department. There has been an explosion of content on Web sites as the potential of the Web for internal and external communication is recognized. For a Web site to “live and breathe” it must be fed with new content and out of date content must be removed. Organizations therefore need to encourage the activities of content providers. However, increased activity in content generation has raised a number of issues:

- **Bottlenecks.** The Web management function can become a bottleneck for content revision. Content arrives in different forms and has to be edited -
usually manually - into a form suitable for publishing on the web. Funneling content through a Web manager resource can lead to delays in publishing on the web.

- **Consistency.** Where Web editing is devolved to departments there can be inconsistencies in the look and feel of the site and variable quality of layout and content. Stroud [24] refers to the problem as the “anarchic approach”. At a very basic level it can result in a company losing the coherence of the style and design of the presence it projects. At a higher level of abstraction, there is an effect on the exploitation of a site’s strategic value.

- **Navigation.** Where structure and content are not closely controlled, there is a danger that navigation and search capabilities will suffer, making it hard for content users to find information easily.

- **Data duplication.** The content on the Web is often a copy of data held in a departmental or institutional system; changes to one system are manually replicated in the other systems. Ideally, data will not be stored redundantly in the organization. There will be one source accessed by all business applications, whether internal or external. Where data needs to be copied then replication should be automated and controlled.

- **Content audit and control.** Unauthorized content may appear on the Web site. Material published on the Web should be subject to a review and authorization process - is the material acceptable from a marketing viewpoint? A legal viewpoint? Procedures and controls need to be defined to manage the Web publishing process.

- **Tracking.** To use content effectively it is necessary to know things about the content, such as who created it, when was it created, and when was it last updated. The ability to track and reconstruct the changes that have occurred to content is an important part of content management.

- **Business processes.** Content is often tied tightly to business processes. For example, the production of a market intelligence report is a complex business process, involving data collection, data analysis, and the generation of commentaries and forecasts. Not only is the ‘final’ report published on the web in some cases, but also updates and revisions are likely to be needed on a regular basis. The business process and Web content management need to be integrated, allowing content to be published internally for inspection and review and only released once it has been approved. Furthermore, the process itself may need to be redesigned to take account of differences between paper and Web publishing.

Although many WCM packages are aimed at large organizations with tens or hundreds of thousands of pages, smaller organizations are also running into the problems caused by a lack of control over the content management process.
3. The Genesis of Web Content Management

WCM solutions must be capable of dealing with data with different degrees of structuredness. Some content will have a high degree of structure, such as employee records, and be amenable to being broken down into tables and stored in a traditional relational database system. Other content will be low in structure, such as a video clip of an Internet consultant talking about security issues. In between will be range of content, such as a health and safety manual or an in-house magazine, which will display more or less degrees of structure. A WCM must be capable of managing content in different media and with different degrees of structure, which suggests a combination of traditional data management and document (hypermedia) management technologies. Many e-commerce products have specialized WCM facilities to address the maintenance of product and customer data. From a process perspective, there is a lot to learn from software configuration management, which is concerned with aspects of change such as versioning and audit trails. From an enabling perspective, technologies that support semantic interoperability, such as XML (eXtensible Markup Language) provide a basis for sharing and the automated interchange of content between partners, i.e., humans are not the only users of Web sites. We now consider these antecedents and enablers of WCM in more detail.

Document Management and Work Flow Integration

Rein et al. [23] report on early experience of document management using the Web at Xerox. In constructing web-based repositories of documents they identified the need to incorporate versioning, locks, viewing times, security, and self-administration (e.g., users register themselves). Rein et al. noted that the less successful Web applications at Xerox were the ones that contained complex data and supported work processes that were not well understood by system designers. Rein et al. identified three roles that a WCM must support: the writer, reader, and collection manager. The collection manager is responsible for the organization of documents, including versioning and link management. Rein et al. concluded by arguing for the need to define standards for Web objects and collections of documents, an area that has seen considerable activity with XML.

In a case study of the Merrill Lynch Trusted Global Advisor (TGA) initiative, Balasubramanian and Bashian [2] defined the requirements of the TGA document management system (Table 1), which were similar to those defined by [17]. The traditional, Web manager-centric, model of authoring and management would not work for a site with more than 10,000 documents, particularly given the goal of developing a low-maintenance system where responsibility for content is delegated to the various stakeholders. At the time the TGA project started, 1996, document management and the Web were not integrated and it was a considerable struggle for the project team to create a web-enabled document management system with Documentum (www.documentum.com). In 2001, no organization should be
considering carrying out an integration exercise themselves, since any serious
document management system should be web-enabled by the software supplier.
Both [23] and [2] underline the importance of workflow integration and the need to
understand the work processes of Web enabled applications.

<table>
<thead>
<tr>
<th>Np.</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>1</td>
<td>Manage and deliver large amounts of unstructured material in multiple media</td>
</tr>
<tr>
<td>2</td>
<td>Provide a consistent and predictable information structure, user interface, and navigational mechanism</td>
</tr>
<tr>
<td>3</td>
<td>Enable linking of related materials</td>
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<tr>
<td>4</td>
<td>Ensure information is up-to-date</td>
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<tr>
<td>5</td>
<td>Support well-defined roles, responsibilities, and access control for various stakeholders in various departments</td>
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<tr>
<td>6</td>
<td>Enable workflow between authors, product managers, content administrators, editors, attorneys, and system administrators</td>
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<tr>
<td>7</td>
<td>Enable the composing and publishing of different views of marketing information for different audiences: financial consultants, clients, the public</td>
</tr>
<tr>
<td>8</td>
<td>Provide version control to support regulatory requirements</td>
</tr>
<tr>
<td>9</td>
<td>Provide a locking or concurrency control mechanism to prevent two people from simultaneously updating the same content</td>
</tr>
<tr>
<td>10</td>
<td>Enable searching and retrieval of content using the predefined business characteristics of products and services</td>
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Table 1: Document management requirements [2]

Customer Relationship Management and E-Commerce

A defining aspect of e-commerce is the ability to treat each and every customer as an individual, to personalize a Web site offering based on customer preferences and their previous history of interactions. The customer relationship management (CRM) process consists of selection, acquisition, retention, and extension. CRM software packages allow organizations to manage the CRM process, to build profiles of their customers, and to personalize Web content for individual customers. The personalization of Web content to individual users has been identified as a requirement of document management systems (Table 1) and forms a central and defining characteristic of CRM products. Examples of WCM products that have roots in CRM and e-commerce are ATG (www.atg.com) and BroadVision (www.broadvision.com).

CRM is grounded in marketing, albeit a post-Internet reading of the ‘4Ps’ (product, price, place, promotion). Mass access to consumers has given rise to mass customization and customer relationships as a central concern [26]. Case [7] identifies the terms one-to-one marketing and permission marketing and Peppers et al. [22] argue that for CRM to work the front office and back office must be integrated. The SAS Institute similarly argue that the operational aspects of CRM
must cater for the integration of customer-facing business processes, including front office, customer touch point sales, marketing and customer service via multiple and interconnected delivery channels. Thus, as with document management, CRM underlines the importance of workflow integration and content customisation for WCM.

**Software Configuration Management**

The aim of software configuration management (SCM) is to manage change in the software development process [4]. The types of object that need to be managed include specifications, code, test plans, enhancements, and fixes [5]. Software support for change control and change management has allowed paper to be largely eradicated form the SCM process and for much of the SCM process to be automated. Software has fine grain, is inherently complex, volatile, and has “subtle and complex relationships that must be understood and recorded prior to making any change to it” ([5, p.105]. This suggests that many of the techniques developed in SCM will be valuable for WCM, particularly where there are complex and interlocking documents with different granularities of document component.

SCM products allow one to find out who made what change when, undo any change made, and to reconstruct past versions. With larger projects, communication and control are significant factors and therefore SCM products, such as Continuus (www.continuus.com) and Merant (www.merant.com) have a strong workflow perspective (in this case the software development process), providing support for cooperative work and shared workspaces [11].

There has been considerable work in the SCM community in developing meta models of component-based repositories, although problems of layering the complex requirements of SCM onto relational databases has proved difficult, while Object-Oriented databases offer powerful opportunities for component-based systems. However, the complexity of modeling SCM is such that robust and scalable repository designs are still proving difficult to achieve.

The advent of a new type of software artifact – the Web page – has presented SCM with a further challenge. Compared to source code, the number of pages is 100 times larger than the number of code files, the time between changes is 10 times shorter, and the number of contributors is 100 times greater [11]. Unsurprisingly, SCM products are evolving into WCM products, driven by the need to manage Web objects in the software process and the market opportunities of applying SCM techniques to WCM.

**Data Management**

Data management techniques differ from document management, SCM, and CRM in that they are an enabling technology and meta-discipline for WCM. Most Web pages today are constructed using HTML (Hypertext Markup Language). HTML is concerned primarily with the presentation of data and not with what that data
means, XML, the eXtensible Markup Language, provides the capability to separate out the structure of Web content from the way in which it is presented to a user client [28]. Consider a Web site that sells personal computers. There is a sale on one of the laptop computers. With HTML it is easy to emphasize this product line, possibly by putting the price in a bold font, <b>£999</b>. There is no meaning associated with the price of £999; it is just text that is formatted for presentation in a browser. A search engine is going to struggle to find all the laptop computers on special offer on the web. It will be even harder to find a model with a given specification, e.g., a 500 MHz chip and 128 MB of RAM. With XML the laptop can be coded with user-defined, tags such as <price>£999</price> and <ram>128 MB</ram>. This separation is a fundamental requirement for Web content management [28]. Firstly, it allows content to be shared with business partners and others (subject to an XML data definition, or schema, being agreed). Secondly, the separation of content from presentation means that content can be formatted for delivery to multiple platforms (e.g., Web browsers, mobile telephones, and palmtops) through the use of stylesheets. Thirdly, Web content can be searched intelligently, since content is inscribed with data definitions allowing Web data to be exploited (e.g., to support knowledge management on an intranet).

Thus, using XML to structure Web content allows information to be processed in a way that is not possible with HTML. Data interchanges with partners can be automated and internal data can be structured to support knowledge management [14],[18]. A further W3C standard for semantic interoperability is the resource description framework (RDF). The RDF is a recent standard designed to standardize descriptions of web-based resources [9], [25]. From any given data structure it is possible to devise many valid XML schemas, all of which may perform perfectly well. The RDF works at a higher level of abstraction, closer to a traditional data model such as the entity-relationship model [3] or the object-oriented universal modeling language (UML) model [6]. This means that a domain model (rather than a document structure) could be shared between organizations. With XML, the organizations have to agree on an XML implementation of the domain model before they can interact. This is because XML describes a grammar, the structure of a document, rather than the semantics, or meaning, of a domain. Although ‘schema wars’ continue (XML document type definitions versus XML schemas, XML versus RDF), we argue that a fundamental underpinning of WCM is the notion of the semantic web.

**An Integrated View of WCM**

In Figure 1 we show how the three antecedents of WCM – document management, customer relationship management, and software configuration management – together with enabling technologies in Web semantics can be combined to provide a platform for WCM technologies.
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Figure 1: Antecedents and enablers of Web content management

The antecedents also point to the range of disciplines that are encompassed by WCM. Research areas in hypermedia and document management, software engineering, marketing, and business process design are all relevant, underpinned by data management and Web semantics. This diversity of interest suggests that although the idea of WCM is intuitively simple to grasp, the different emphases and permeable boundaries will make it more difficult to tackle in research and in practice.

4 A Framework for Web Content Management

The integrated view of Web content management developed above provides a basis for developing a framework that brings together a range of content management related issues and requirements (Figure 2).

Content Lifecycle

The core is the content lifecycle and a logically unified repository. The content lifecycle covers creation to destruction of content components. New content will arrive from a number of sources, including electronic documents (e.g., from word-processors, such as MS Word), paper documents, templates (e.g., press releases, new product descriptions), Web design tools (e.g., MS FrontPage, Macromedia Dreamweaver), and direct edit on the Web into the repository. In many cases, the source will require some sort of review. This may be a review in terms of acceptable content, or it may be a review to determine the optimum place for the data within the structure of the system. The original data may require storage prior to publication and this may need to be continued after publication if it is published in a different form. With regard to publication, apart from the obvious requirement of making the content available, this should include:
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- **Authentication** - which is concerned with identifying the user through a mechanism such as a user id and password or biometrics.
- **Personalization** – which relates to the ability to present different users with different views and different data depending on, e.g., preferences, access profiles, role, and previous accesses.
- **Transformation** – which is concerned with constructing (e.g., combining subcomponents into new documents) and transforming content at the time of delivery.

There may be requirements to *archive* the data. This may happen automatically after a given date, or it may be a manual process. The archives may be stored online or offline. Finally, at some stage, there will be a need to *destroy* the content permanently. This may affect either online or archived data. The repository is a collection of data stores that cater for components with more or less structure, including relational and object-oriented databases, document stores, file systems, etc. The WCM must give seamless access to the content components regardless of where and how they are stored.

![Figure 2: A framework for Web content management](image)

**Organizational Integration**

Content is generated by and in support of business processes, which indicates a workflow and application perspective. To take advantage of the Web effectively it is likely that some of the workflows will need to be redesigned, possibly to incorporate computer mediated communication and collaboration [13, 15]. This suggests that content management may go beyond routine automation and require, be constrained by, or initiate organizational change. As with any information technology, the consequences are likely to be unpredictable and are always as much social as they are technical. The WCM core (content lifecycle and content
component repository) must therefore be integrated with business processes and workflows and the existing business information systems that support those processes.

**WCM Process Management**

Management of the WCM process suggests a range of activities that need to be catered for, including data management, metadata management, and site management.

Data management is essential if content is to be exchanged, reused, shared, and searched intelligently. It is a likelihood that Web content will be marked up using XML and presentation will be defined using the style language XSL. To define and manage the XML data structures a modelling notation is required, such as the Universal Modelling Language (UML). If UML class diagrams are used to model the data structures (possibly represented in RDF), then XML documents can be thought of as physical implementations of an underlying and consistent enterprise class diagram. Connallen (www.rosearchitect.com) has made some UML diagrams that map the hierarchical structure of XML documents. These hierarchies need to be shown to be consistent with the class diagram (i.e., the UML schema can be derived by navigating through the class diagram). The combination of UML/RDF/XML is a promising approach to enterprise-wide data management.

Metadata is the information that needs to be stored about a data item for an agent to use it. For example: expiry date, source, revision history, title, keywords, date created, time to archive, version number. The metadata might also define how content can be combined to make new/virtual documents; for example, can this section be combined with that one? In what order? Is there a pre-requisite/co-requisite? “Bursting” documents into subcomponents has great potential for data reuse but is going to be difficult to implement and control. Consequently, any content management system should be expected to have sophisticated metadata capabilities.

Site management is concerned with Web site design and structure. Content must be separate from style and be device-independent. It should be possible to change the look and feel of the site by changing a style sheet. It should be possible to add a new device, such as a personal digital assistant (PDA), without affecting the content structure.

The content lifecycle suggests that there will be a number of roles to be considered: content contributor, content publisher, content consumer, Web designer, Web developer, content manager, design/navigation manager. This list is not necessarily exhaustive and neither does it imply that in all cases, all these roles will require separate individuals. However, the list does indicate the type of roles that will need to be considered in most cases in managing the WCM process.
5 Case Study: Intranet Development and Content Management

We use a short case study to illustrate some of the issues of WCM that arose in the implementation of an intranet. The case study is also used to test the usefulness and relevance of the WCM framework (Figure 2).

The company concerned, “MegaEngineering” (name changed for purpose of anonymity), operates in the manufacturing/engineering sector, trades in many countries, employs many tens of thousands of people, and has a turnover in the region of several billion US dollars. Over the last 8 years it has been involved in a number of takeovers/mergers, with decentralized management and a fragmented culture that means that corporate standards and initiatives can be difficult to establish and implement. MegaEngineering implemented intranet technology relatively early. Although it started in a small way, it had a corporate intranet server running by 1996. This was driven by a pro-active and forward looking corporate IS group, but it suffered from lack of ownership of the data and lack of interest by senior staff. Because the data was frequently outdated, it lacked credibility and hence had low usage. In this case, we focus on the efforts to redevelop the intranet in “EuroEngineering”, a major and autonomous division of MegaEngineering.

Early in 2000, senior executives from the Communications (public relations) and Information Systems groups within the division decided to ‘reinvent’ the intranet and take it forward in a more proactive manner. One of the authors was retained in a consultancy role for this project. At an early stage, a number of points were made to the company staff:

- Ownership of the content was vital;
- Regular and timely updating was vital;
- A consistent ‘look and feel’ was important;
- Without some central management and control, structure and accessibility of data were likely to diminish.

It was also explained that although content management software packages could have a high up-front cost, the long-term labour maintenance costs would be high without them. Investing in one of these packages would also require effort in understanding what content needed to be managed and how. Although the executives accepted all of this, there was never the will or the budget to pursue content management software packages. Earl and Feeny [10] categorize senior management leadership using metaphors. The ‘hypocrite’ espouses the strategic importance of IT but negates it through personal actions. In a different light, we might use the metaphor of ‘waverer’ – reluctantly accepts the strategic importance of IT but is not ready to get involved. Views tended to be short term – “Let’s just get something up and running” was a common comment. However, despite this short term-ism a top-level structure was formulated with the agreement of all of the relevant departmental and business process managers. Furthermore, each of the managers agreed to take responsibility for the content of their areas.
The project started well. A prototype site was built and agreed and templates were provided to allow various groups to contribute content in a consistent fashion. However, despite consultancy advice to the contrary, further progress was poor and can be explained through the following factors. There was little or no investment; executive interest and attention drifted away; there was no project champion; there was little or no central control. These are common issues in IS implementation and are well documented in the IS literature [8] [12] [16] [27]. Some sections of the intranet, typically those with proactive owners or resident “techies” who liked to play with Web pages, expanded dynamically and at the end of 2000 were up-to-date and perceived to be useful. Other sections of the intranet - after 12 months – have no content whatsoever.

In many respects, there is a vicious circle; the intranet is not perceived as useful as there is little useful content, but because it is not perceived as useful, there is little incentive to add more content. Any implementation of an intranet must have a strategy for breaking through this perceptual barrier, using a mixture of incentives, community building, and management diktats as appropriate.

In terms of content management, the WCM process is manual, localized, and has little overall control. A common site look and feel and consistent navigation is achieved in part through Web page templates (addressing to some extent item 2 in Table 1), although this still requires content providers to be adept at using a web-authoring tool. Groups that happen to have web-authoring skills do quite well in terms of content, but frequently they rely on a Web enthusiast whose actual duties are often very different. This can lead to a loss of activity in the areas of work that the content provider should be involved in and an under-recording of the time actually spent in generating and maintaining content. Groups without web-authoring skills have to rely on the very small central ‘corporate’ resource which consists of about 0.1 of the time of a relatively junior IS technician with little Web (and less management) expertise. This case underlines the problems of the ‘Web manager bottleneck’ identified above.

A recent development, in the last quarter of 2000, has been the purchase of SiteScape Forums (www.sitescape.com) - a web-based software tool for collaborative working. This software has allowed greatly improved local control of content without the need for any HTML, programming, or web-authoring skills. Usage of the SiteScape software is growing quickly as a result. Although Sitescape does not fully automate content management, it does allow a fine granularity of content access control allowing easy allocation of areas to owners. It has also proved very effective in improving and supporting collaboration within groups and teams, going some way to meeting the workflow integration requirement of WCM. However, problems of senior management commitment continue, with one user commenting “senior management don’t take it seriously so why should we?” The piecemeal approach to content management is also recognized by the users, one of who noted, “It should be all or nothing”. To summarize, the intranet is providing value in localized areas, but has not matured into a corporate resource and first point of call for help and information. To develop the intranet further EuroEngineering will need to pay attention to WCM issues, particularly the
definition of roles, integration with workflow, and a centralized coordinating mechanism.

**The WCM Framework as a Diagnostic Tool**

In our case study, it is clear that there has been little thought about many of the areas of Figure 2 in the development of the EuroEngineering intranet. There have been culture clashes between the decentralized tradition of some departments and the more centralized needs for a corporate intranet structure. Such ideas are not new; for example, Newell et al. [20] describe how the introduction of an intranet in a large international bank reinforced traditional organizational boundaries rather than encouraging information sharing. In a recent paper, Moss Kanter [19] describes one of the ways to fail in moving your company onto the Internet that is equally applicable in this Intranet case:

Under the banner of decentralization and business unit autonomy, reward each unit for its own performance, and offer no extra incentives to cooperate in cyberspace. Keep reminding divisions that they are separate businesses because they are different, and that’s that.

Only in the area of the new collaboration software has there been an alignment between technology, structure and needs.

Once again turning to our case study, we find that there is no concept of data or metadata management. Site management is poor due to lack of skills and experience, while quality management is non-existent. Again, looking back at EuroEngineering’s experiences we see little definition (or even understanding) of WCM roles within the company. There are, by definition, a significant number of real or would-be content contributors as there are content consumers. However the roles of content publisher, Web designer, content manager and design/navigation manager are combined into a very small part of one person’s time who has little understanding of, and who has had no training in, any of them. In terms of the content lifecycle, it is clear that it is neither well understood nor followed in EuroEngineering. Content is created, stored and published but the review process is haphazard at best. Content is never archived and rarely destroyed.

6 Summary

We have argued that Web content management (WCM) is a significant business issue for any organization that maintains a Web site that has a large number of pages or has frequently changing content provided by multiple providers. WCM technologies are emerging with background in document management, customer relationship management, and software configuration management. The WCM market is currently crowded and confused and it is likely that there will be a fall-out of suppliers as the market matures and WCM concepts are clarified. We have presented a framework for WCM in which a number of themes are identified, including content lifecycle management, repository and data/metadata management,
and an awareness of the impacts of organizational change. These ideas are equally relevant whether the consumers of information are customers, business partners or, in the case examined here, employees. One theme that emerges particularly strongly is the need to integrate WCM with business processes and workflows; this theme was picked up in all three WCM antecedents and is reflected in the EuroEngineering case study. The WCM framework developed in the paper was applied to the case study and we believe it to be a useful analytical device for thinking about WCM issues. Further case studies describing how organizations are implementing (or not) Web content management and the problems they face in doing so are needed to identify best practice in this emerging area.

Web Sites Referred to in This Paper

www.atg.com   ATG
www.broadvision.com  BroadVision
www.continuus.com  Continuus
www.documentum.com  Documentum
www.interwovem.com  Interwoven
www.merant.com  Merant
www.ovum.com  Ovum
www.rosearchitect.com  Rose Architect
www.sitescape.com  SiteScape Forums
www.vignette.com  Vignette

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