FUTURE TRENDS OF CONTENT MANAGEMENT SYSTEMS (CMS) for e-Learning: A Tool Based Database Oriented Approach

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Abstract

Ever since the inception of IT, Content Management Systems (CMS) came into existence in different forms such as system utilities, software tools, subset of authorizing systems etc. However, during the past ten years the web has brought about some radical changes in terms of content creation and maintenance for documents and other data. Further, web based directory search mechanism and business intelligence tools have evolved during this period to facilitate more efficient access and search mechanisms. The large volume of content to be handed in the present-day context necessitates the visualization and conceptualization of new trends for immediate future development and deployment of Content Management Systems, especially for e-Learning environments.

Keywords: e-Learning, CMS, Software Tools, Utilities, Database, HTML, XML, DAP, LDAP, GUI, Text, Graphics, Multimedia.

1. Introduction

The deployment of IT since the birth of 1st generation (Electronic) Computer Systems has implied the handling of ever increasing volumes of digital content. Over the past 3 decades, the exponential reduction in the cost of IT hardware – particularly CPU and memory has facilitated the creation of very large databases and documentation systems. This necessitated the deployment of appropriate Content Management Systems (CMS). The birth of Internet and a broad spectrum of web based applications have added a new dimension to the technologies and techniques employed for enhancing the features and performance of the CMS. The handling of e-Learning systems in conjunction with other prominent web applications and the seamless integration of content creation, search/access, updating etc., in terms of the different web / networking / middleware / database technologies is still inconclusive and remains as an open ended issue. This paper provides overview of the trends for the evolution of such a unified Content Management System.

2. What is CMS?

Content Management Systems (CMS) is a system facilitating the creation, retrieval and editing of information/knowledge in digital fashion including raw, semi processed or fully processed content handling text, images/graphics/animation, audio/video etc., in real time or otherwise as needed.

In the e-Learning context, the requirements typically are the following –

Education

- Courseware Creation, retrieval, updating
- Handling research/patent related information
- Interactive retrieval, real-time content exchange, multimedia provisioning etc.
- Extensive search mechanism for document handling
- Transform the content for presentation over different devices including hand-held and other portable/mobile communication devices.
- On-line publishing etc.

Corporate Level

- Same as above for training
- o Corporate Data including financial, production and administration related matters, annual reports etc.
- Raw/processed data for MIS/EIS/DSS purposes
- Technology & Marketing related information for closed user groups / public access

3. Why is CMS important ?

The need for establishment of a properly designed and implemented CMS is because

- There is an exponential and astronomical growth of raw data that is required to be accessed quickly in present day scenario for a well-organized and controlled access.
- Considerable chunk of the same data being available over the web from millions of servers with several hundreds of thousands / millions of terabytes of data in public domain, needs better management.

The typical strategic foundation for e-Learning, as depicted at fig.1 indicates the activities such as evolution of a learning architecture in terms of change management and re-inventing the conventional training organization apart from other issues. As per the new framework for learning, it can be noted that the transition from old to new framework of learning has to be considered as indicated at Table 1.

These considerations result in a workflow integrated and automated environment that necessitates the establishment of different levels of knowledge management as shown at fig.2.

Further, a brief look at the economics arising out of the deployment of e-Learning environment as against conventional classroom approach and a via., media technical cum classroom approach show significant improvement in the time spent. For a hypothetical five day course of learning, the student days are compressed from five through four to under three days as at fig.3, whereas the product delivery cycle time reduces from a typical eight months through seven months to real time for e-learning as at fig. 4.

The typical costing in the US environment indicates a saving of 4.3 M USD over three years for training 1000 candidates as per the key facts and assumptions detailed at Table 2.

The order of savings expected out of e-Learning methodology apart from other factors of real time, anytime – anywhere kind of concepts are sufficient motivating factors for paying serious attention for a better CMS in the near future.

4. Methodology

The general requirements of CMS and the functionality expected includes the formulation of the following –

- Scope of system (e.g. metadata recording, process management, online publishing, integration with other systems)
- Data structure (including the ability to record your required metadata, to hold links to digital assets and to hold text which can be edited and published)
- Templates (including design, layout and accessibility for different types of page; also your ability to update templates)
- Security and access (including access rights for different types of user, e.g. retrieval only, editors, publishers, web manager, administrator etc.)
- Workflow management and process control
- Ability to integrate database information - either for publishing on-the-fly or in batches
- Ability to generate navigation and links between pages automatically and consistently
- Ability to interoperate with existing systems and to comply with prevalent data standards
- Ability to run on existing technical infrastructure
- Ability of database to search across metadata and narrative text content
- Ability to manage metadata across the database, e.g. update or assign values globally or across a selection
- Ability to archive data, and to output reports in digital and printed form

In addition, the future-proofing of CMS is another importing consideration to ensure that the content management system will not be obsolete in three or five years time, and that content will be secure & accessible in perpetuity. There are a number of issues which necessary to be considered including the following:

- Will it deal with existing standards for data - and do the suppliers take a pro-active approach to keeping their products up-to-date?
- Does the system use a standard, open operating environment and hardware?
- Is the system able to import and export data in formats understood by other systems?
- Does it allow data to be archived in standard formats using secure, stable storage media?
- Is the database extensible - for example, can new fields be added if you decide to extend the range of metadata you record?
- Are the specialist skills necessary to maintain the application and the underlying

technology, both readily available and affordable?
- Is the system in widespread use in similar projects?
- Does the underlying technology fit with your organization's IT strategy?
- Maintenance Strategy?

5. Techniques & Technology

Until early 90s, the implementation of CMS was carried out in a non-unified manner, excepting for a few document management systems during 80s. The CMS was primarily handled through a range of tools and utilities as following –

- OS Tools
  - Text editors
  - Cross reference generators
- Utilities
  - Cross reference generators
  - Image editors
  - Source Code & Version Control Systems
- Database Tools
  - Querying & Search Facilities
  - Schema & Record Creation, Edit facilities
  - Reporting Systems
- AI Tools
  - Knowledge implementation Systems
  - Knowledge Retrieval Systems

However, the more recent CMS implementations are based to a large extent on -

- GUI based presentation
- HTML Content for web hosting (e.g.: Style sheets, backend database driven content management
- Java based content creation for web hosting (along with database driven content management, client/server side validations, middleware deployment etc.)
- More recently XML standard documentation for business as well as education purposes
- Data retrieval & presentation, particularly for corporate level using meta-data concepts extensively in terms of Business Intelligence Tools (BI) & Workflow automation based approaches (e.g.: Business Objects, Cognos etc. – BI; ARS remedy, Object Store etc. – Workflow tools)
- X.500 based DAP (Directory Access Protocol) based net distributed databases / information access
- More recently LDAP 2(Light weight Directory Access Protocol & later versions)

Still, the degree of seamless operation for an integrated CMS to be used in conjunction with other web/net based applications needs improved facilities & performance.

6. The Future

Many common technology related issues exist for handling the conventional

- Very large distributed database environment
- Knowledge management / BI / Workflow needs
- EIS/MIS/DSS/Expert System requirements
- ASP/Web Applications

vis-à-vis

- e-Learning Systems

All of them need

- Advanced Database Architecture on typically object oriented preferably unconventional, similar to the erstwhile C database of C-DAC for language processing or that of CEDAR/Buffalo for US Mail Delivery Automation
- Extensive Deployment of Web enabled Directory Architecture (e.g. LDAP enhanced versions)
- Basic content as per XML / eb XML Conceptualization
- Security & Access with high degree of Control
- Overlay of Meta-database creation similar to the existing BI tools. (e.g. Cognos, but better functionality & maintainability)
- Better & more efficient search/querying/reporting facilities on the databases (e.g. SQL*Plus is only text based querying environment and more execution overhead as the same is processed through D2K). Tools such as TOAD which are GUI based, QSL*Plus which are GUI based & directly interacting at database level are needed for search & retrieval/reporting).
- New generation of Content Conversion tools such as HTML to WML conversion (parser based will full graphics transformation capabilities) for mobile deployment
- New generation of faster Internet access over wireless such as iDEN (64KBPS), 3G Cellular

(144KBPS upwards), HDR-CDMA (2.4MBPS / 7.2MBPS) etc., with comprehensive range of WAP applications, enhanced WAP browsers etc.

The data structure retention and resting capabilities of XML with reference to a document structure, apart from other merits make this a defacto web content creation standard. This is proposed to be further enhanced in terms of ebXML to facilitate XML/EDI integration, thereby providing an excellent vehicle for web based content management.

Considering the large number of medium to small sized computer systems forming part of the web, it is observed that LDAP-V3 (with extensions) is one of the best candidates for web oriented directory & search. This architecture in conjunction with advanced BI tools facilitates a seamless integration of heterogeneous databases with querying and reporting capabilities. However, major limitations in respect of BI tools in terms of dynamic update of the cubes, deployed for multi - dimensional analysis & viewing, dynamic enhancement of the schema & meta–database etc., need to be overcome.

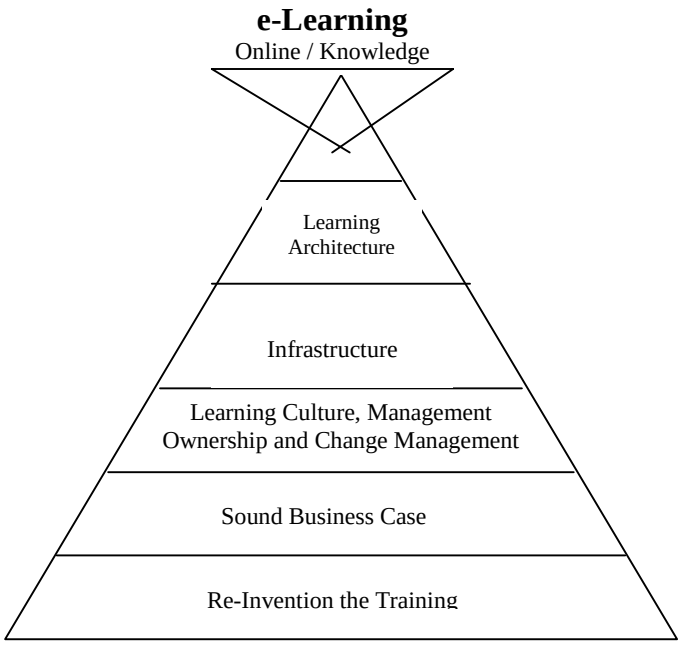
Extensive deployment of on-line multimedia education and interactive learning processes also demand large bandwidth over the net. Improved methodologies in terms of MPEG-7 standard, advanced data compression techniques and learning protocols are essential for the evolution of future generation CMS.

The recent initiative at Quantum Softech Limited, Hyderabad, India (http:// www.qslproducts.com) in terms of tools and products development activity has the following outcome -

- e-Learning package for learning XML – XML based document handling (demo at www.qslproducts.com)
- Vacations & matrimonials portals for a US company – cliks2india.com at Boston with database driven content management, style sheet based screens, Java based server side validations & middleware
- Database driven catalogue management & XML based document management for e-Procurement & e-Auctions (demo at www.qslproducts.com)
- Faster, efficient GUI based database querying & reporting tool “QSL * Plus”
- HTML to WML conversion tool

7. Conclusion

A broad range of existing and disjoint tools, protocols and methodologies need to be integrated with further enhancements to develop an integrated CASE environment for handling future CMS implementation. The need for the development of an integrated software tool suite is obvious.



“Figure 1. A Strategic Foundation for e-Learning”

From	To
▪ ***Learning***	▪ ***Performance***
▪ ***Classroom***	▪ Anytime…Anywhere
▪ ***Telling***	▪ Interactivity
▪ ***Paper***	▪ On-line
▪ ***Cycle Time***	▪ Real Time
▪ ***Physical Facilities***	▪ Network Facilities
▪ ***Individual***	▪ Organization
▪ ***Events***	▪ Systems
▪ ***Training Management***	▪ Knowledge Management
▪ ***Education Results***	▪ Business Results

Table 1. A New Framework for learning"

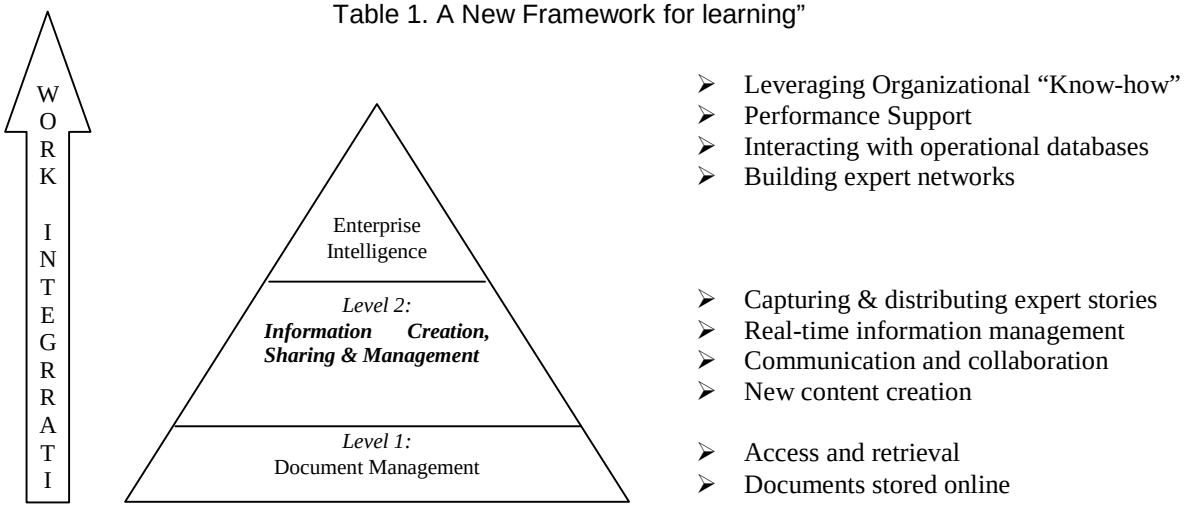


Figure 2. Knowledge Management Levels

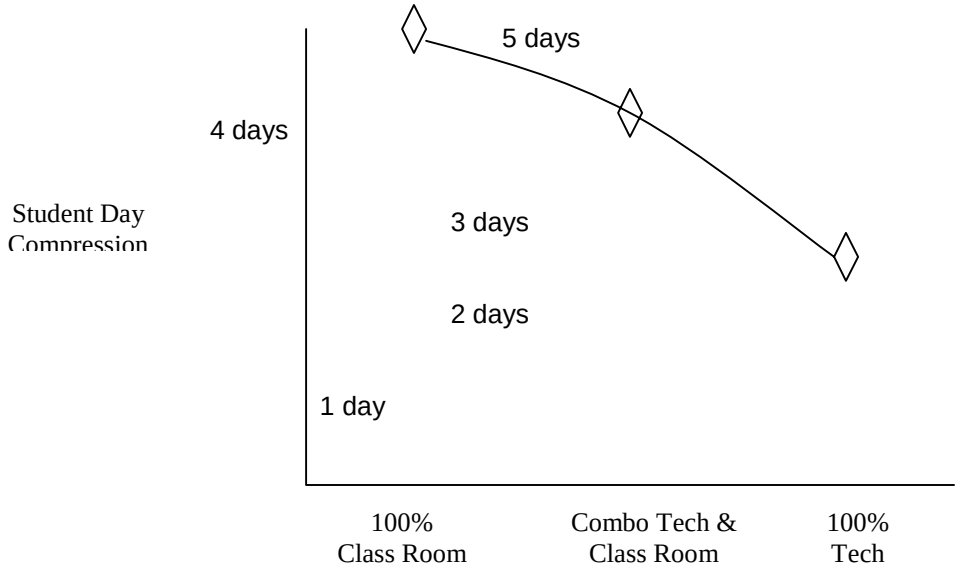
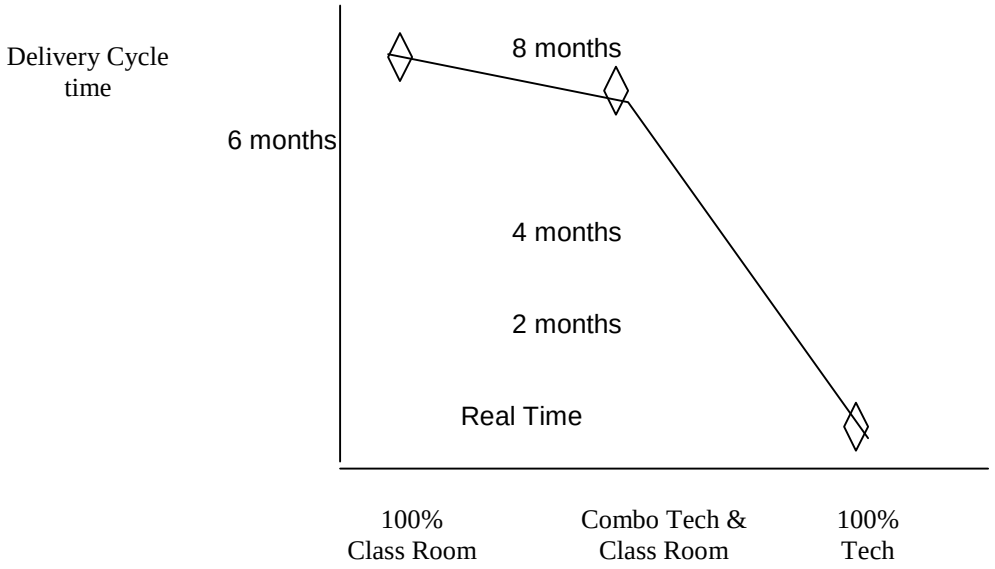


Figure 3. Economics of Digital Learning



"Figure 4. Economics of Digital Learning"
(Convert a Five-Day Course to Learning Technology and Train 1,000 People a year for Three years)

"Table 2. Economics of Digital Learning"

Classroom Learning Environment:	
Total number to be trained	3,000
Number of years to train	3
Train per year	1,000
Estimated classroom development cost, first year	$ 100,000
Estimated classroom maintenance costs, second & third years	$ 33,000/year
Estimated classroom delivery cost per student day	$ 200 ($ 1,000/course)
Forty percent of the students will travel to training	$ 1,000/trip
Forty percent of the students will travel to training	$ 1.2M
Average student loaded salary	$ 100,000
Total salary investment over three years	$ 5.77M
Total Classroom investment	**$ 9.14M**
e-Learning Environment:	
Digital learning development cost, first year	$ 300,000
Estimated maintenance costs, second and third years	$ 100,000/year
Digital learning delivery cost per student	$ 50
Travel / Living	$ 0
Estimated salary investment for digital learning	$ 3.46M (40% time reduction)
Total digital learning investment	**$ 4.79M**
Savings	**$ 4.3M over three years**

(Convert a Five-Day Course to Learning Technology and Train 1,000 People a year for Three years)

Bio-data:(Dr. JSR Subrahmanyam):

Has done his Bachelor of Engineering (Electronics & Communications) from Andhra University, India, in 1972- First class with Distinction. Ph.D. in Computer Engineering from Indian Institute of Technology, Kharagpur, India in 1986. Has got over 28 years (since Jan 1973) of Industrial/Research/Academic experience with reputed establishments such as BM Birla Science Centre, Birla Institute of Technology, BPL, University of Hyderabad, Nagarjuna University, Bharat Electronic Ltd etc. at India and Intel Corporation, US West, CST Inc. etc. at USA and several other establishments related to the hi-tech areas of Computer/Communications/Electronics Engineering fields. Presently holding the office as Executive Director-Technical at Quantum Softech Limited, a Public Limited Company at Hyderabad, India (Ref. Sites – www.qslproducts.com, www.quantumsoftech.com). He has got several publications on his credit in IEEE International Conference (1984-86) and in IETE journal apart from few other invited papers on various occasions and numerous technical reports. He is a fellow member of IETE (formerly member of IEEE & CSI) and Executive Committee member (elected) of IETE - Hyderabad branch and member of Society for Design and Process Science (SDPS), Texas, USA. He has participated in several national/international conferences related to hi-tech areas of communications and computers. Occupied the positions of chief guest, chairperson, speaker, expert panel member, program rapporter etc., on quite a few occasions. His main areas of interest are Fault diagnosis of computer hardware, Digital design and fault tolerance, computer system / network architecture, software testing, data security, software tools, communication system design and testing and data transmission systems.