Enterprise Content Management: An Integrated Perspective on Information Management

Tero Päivärinta
Agder University College
Department of Information Systems
Tero.Paivarinta@hia.no

Bjørn Erik Munkvold
Agder University College
Department of Information Systems
Bjorn.E.Munkvold@hia.no

Abstract

Enterprise Content Management (ECM) is an emerging concept involving numerous software vendors, consultants, and information management practitioners around increasing market potential. However, there exist yet few academic reports on ECM from the viewpoint of organizational system implementations. This article analyses 58, mainly practitioner-oriented, case narratives of ECM projects and implementations to identify a framework of major issues that require managerial attention in organizations. The main areas covered by the framework are: objectives/impacts sought with ECM, enterprise model to be supported by ECM, content model, technological infrastructure, administrative resources and practices, and change management issues. The issues identified in this framework serve information management practitioners to facilitate ECM development from the viewpoint of the enterprise. Comparing the concept of ECM with related research on information resource management, electronic document management, and knowledge management, we argue that ECM represents a modern, integrated perspective on information management.

1. Introduction

Enterprise content management (ECM) integrates the management of structured, semi-structured, and unstructured information, software code embedded in content presentations, and metadata together in solutions for content production, storage, publication, and utilization in organizations. The concept originates in pioneering efforts of the mid-1990s to manage corporate web content with in-house systems [5]. Nowadays, the idea and solutions reach beyond plain "web content management" to manage the convergence of all "front-end" applications and devices with "back-end" document/file management systems and databases. The diffusion of content structuring and interchange standards, particularly those based on eXtended Markup Language (XML), and emerging technologies for integrating Web pages and multiple access devices with organizational databases and applications [11], facilitate this enterprise-wide convergence. Further, the ECM concept goes beyond technological solutions, also including "the strategies, tools, processes and skills an organization needs to manage its information assets over their lifecycle" [15].

ECM is an emerging topic. Hundreds of software vendors exist on the immature market with varying product philosophies, architectures, functionalities, and price tags, together with a plethora of consultancies. A number of books represent recent hands-on consulting knowledge [e.g., 4, 5]. Professional forums such as AIIM International, "the ECM association", attract participants.

Beyond the current hype, few sources have reported research on actual ECM practices in organizations [12]. Another pertinent issue is whether ECM actually represents anything new compared to the established constructs of information management, such as information resource management (IRM), electronic document management (EDM), and knowledge management (KM). In light of these traditional areas, what has ECM to offer to justify its current standing as a "new field" of its own?

This article discusses ECM-related practice in organizations today to identify the distinguishing issues. The discussion is based on reported experiences from ECM implementations in industry, together with an on-going case study of a major ECM initiative in an oil company. Comparing the issues highlighted in these cases with the areas of IRM, EDM, and KM, ECM can be regarded as a modern perspective on information management that integrates the major issues covered in these areas, while also going beyond their individual and collective scopes. The resulting framework of the ECM issues may serve as a handle for information management practitioners struggling with getting a grip on the concept from the viewpoint of the enterprise.

2. Contemporary issues of ECM

We analyzed 56 publicly available case narratives of ECM projects shared by the AIIM organization [1], a major professional forum of the ECM area. Although

mainly representing vendor or consultant perspectives on practical content management initiatives, with a few page summaries each, these cases provide an overview of foci and scopes, and the key issues involved in ECM. In addition, we draw upon data from two more in-depth case studies: our study of an ongoing enterprise-wide ECM-program in Statoil [12], a Norwegian-based oil company, including eight in-depth interviews, discussions with the ECM developers, and project documentation; and a case study report from J.D. Edwards, a global software and service provider in the field of enterprise systems [14]. In analyzing these 58 cases, we identified the objective and scope of each ECM project, as well as the issues reported to be of key importance related to managing the ECM implementations. These issues were then grouped into a set of categories, to be presented below.

Reflecting the current lack of a unified perspective on ECM, the AIIM narratives varied greatly in focus and scope, from automation of specific business or information processing tasks (logistics processes, distributed scanning, document conversion, forms processing) to extensive programs involving holistic streamlining of corporate and inter-organizational content management. Accordingly, the reported financial investments varied from $10000 to millions of dollars per project or development program.

Interestingly, Statoil and J.D. Edwards focused on ECM under two different "umbrella" terms, whereas both cases still highlighted content management as the core of the reported development programs. In Statoil, ECM was framed as the core of the company's holistic *eCollaboration Strategy* [12], covering the management of all forms of internal and external information throughout the entire content life cycle. For our research purpose, data from this ongoing ECM-program extends the viewpoint of the vendor-oriented case narratives from AIIM. The J.D. Edwards case [14], in turn, has been reported under the title of *knowledge management*, whereas the case report actually discusses lessons learned from implementing three areas of ECM in the corporation: intranet document publishing, content management solution for publishing multi-language manuals on-line, and a web content management solution for the corporate web sites [14].

Figure 1 depicts the major issues of ECM based on our analysis of the cases. The issue categories have been formed based on the question: which issues need explicit *management* in an enterprise to enable ECM?

ECM should support organizational *objectives* and the desired *enterprise model*. Actions based on the objectives result in more or less anticipated and desired *impacts*, interplaying with the future objectives. ECM is realized through design and implementation of the *content model*, including all information content relevant from the viewpoint of the enterprise model. The implementation of ECM is supported by the technological *infrastructure* and *administrative resources and practices* in place. *Change management* is needed to cultivate an optimized fit between the enterprise and its content model, infrastructure, and administration over time. Next, each of these issues is discussed in more detail, based on the findings from the case analysis.

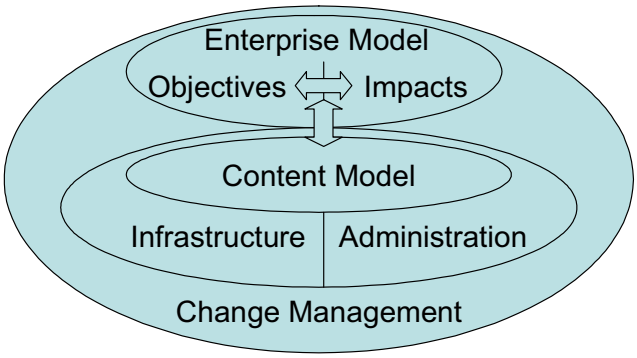

Figure 1. Major ECM Issues

2.1. Objectives and impacts of ECM

Varying types of organizational objectives for ECM and resulting impacts were identified in the case studies:

- *improved internal and external collaboration*, involving knowledge creation and sharing through digital content in and among enterprises with commonly enacted practices;
- *value-added or new customer services and products* involving digital content;
- *reliability and quality* of information content *resulting in less errors in products and services;*
- modern and professional *image* of the enterprise in the eyes of its stakeholders;
- *efficiency, effectiveness,* and *flexibility of knowledge work and business processes*, including *reuse* of previously created content, metadata, templates, and navigation aids;
- *meaningful knowledge work,* involving *easier and less tedious human routines* for content management;
- *organizational memory* recording the practice, history, and transactions of the enterprise;
- *direct cost savings* in information processing operations and facilities;
- *satisfying external regulations and standards*, directly or indirectly governing the enterprise's information management;

- *platforms and capabilities to develop and maintain targeted content management applications quickly* for emerging purposes.

No single type of objective or impact was identified universally as the 'most important'. Moreover, several objectives and impacts could be intertwined in a single development initiative of a particular case.

Direct cost savings in technical information processing operations and facilities were seldom stated as the main rationale for *ex ante* justification of ECM initiatives. Yet, in cases where evaluation was reported, the financial benefits had been measured to the greatest extent. For example, J.D. Edwards reports rather intriguing numbers: 1811% return-of-investment (ROI), especially due to time savings in information searches and reduced printing costs, and 270% ROI already after the first year of using a content manager system to publish multi-lingual manuals. In comparison, the intranet development was justified on more qualitative statements of content quality accountability, lack of metadata standards, and political conflicts of publishing policies due to a lack of common vision for web content [14].

The received mismatch that we observed between many of the initial objectives and the issues actually measured by *ex post* evaluations (where any such evaluation was conducted at all) throughout the cases signals shortcomings in actual evaluation practices and methods. Instead of evaluating ECM implementations against a variety of original objectives, it seems to be more intriguing to present figures of cost savings to evaluate ECM *ex post*. However, e.g. in Statoil, the cost savings were not regarded as the main reason to initiate the ECM program, and even some scepticism against plain financial justifications was expressed:

"Our decision-makers simply don't believe in the overwhelming ROI calculations." (Corporate ECM counsellor, Statoil)

In a few cases, the need for complying with external regulations and standards alone served to justify ECM. Several enterprises simply must fulfil externally set records management and safety regulations with robust content management in such domains as the pharmaceutical industry, airline-based logistics, or the military.

The objective that could probably be most challenging to justify with traditional ROI measures, perhaps alongside the image-building of the organization, is the development of future capabilities with ECM. That is, ECM development as such builds competence and technological platforms in the enterprise, on which it becomes quicker to develop and maintain targeted content management applications for emerging purposes. For example, Winterthur-Europe Insurance reported that their XML-based content management architecture was targeted "*…to build applications… that can adapt automatically when an insurance product is modified in the central database*." [1].

All in all, the emergence of particular objectives varied greatly among the cases depending on the business area or domain in which the enterprise was operating. Hence, the justification and evaluation arguments for ECM need to be rather contextually defined and prioritized. The cases revealed few or no undesired impacts from ECM implementations. Unless we would assume that ECM brings up only positive consequences, there remains thus a challenge to complement the success stories with in-depth studies on all possible impacts, including negative ones.

2.2. Content model

The core of any ECM solution resides in understanding of the content itself and its role in the organizational context. In this paper, we refer to this understanding, to the extent it appears as explicit in the organization, with the overall term of the *content model*. While this concept sometimes is used only to refer to the content types, objects, content and characteristics as such [8], we here extend the concept of content model to include the following four broad and challenging subareas: 1) *content structure, view, and presentation models*, 2) *content life-cycles*, 3) *metadata,* and 4) *corporate taxonomy*.

Content structure, view, and presentation models [8] describe the structural elements by which content is produced, technically organized in content repositories, and presented in publications or views, and the relationships between these elements. Traditional document management systems dealt largely with plain file repositories, and file-based production and publication of documents [16]. Relational databases indexed the files and metadata. However, modern structured document systems and web content management applications – increasingly integrated with the "back-end" transaction processing databases [11] – involve varying structures and relationships in and between the content elements of varying granularity, and content production forms and publication templates.

We found no mentions of explicit, let alone unified, content modelling approaches utilized in the cases. Hence, the 'modelling' of content structures, views, presentations, and their relationships emerges largely as implicit practice among ECM developers, observable mainly in the actual system implementations afterwards, instead of explicit, let alone methodical, pre-modelled content designs for organizational implementations. Taken that the underlying models for content vary greatly among the contemporary content management packages [8], this situation becomes more understandable – as organizational ECM system implementations utilized purchased software packages almost without exception in the examined cases. However, the issue of whether

existing *de facto* content structures of an enterprise would be transportable to a particular model embedded in the selected software package might require more explicit scrutiny in organizations than currently observable from the cases.

Content life cycle management will build on the understanding of existing content types and structures, and combining that with knowledge of how particular content should be managed throughout its existence. In ECM, the challenges reach beyond the traditional document management issue of managing life-cycles and versioning of files, also including:

- effective content creation and capture from heterogeneous external and internal sources (integrated production environments, scanning and imaging, conversion of file formats, forms-based data capture)
- controlled editing, review, approval, and (multi-channel) informing, distribution, publication and update of content – with appropriate workflows for technical content production, processing, and publication tasks (including policies for all levels of "publishing": in groups or teams, within organization, for external partners or targeted customers, or for the public in general)
- controlled storage with selected file/data formats, including version control and revision history management on various levels of content configurations, and management of relationships between pieces of content in certain complex system implementations
- retention, preservation and format transformation for long-term archival, and necessary deletion.

For example, BOC Gases [1] describe their challenges related to managing life-cycles of heterogeneous content, combined with a complex model for content structure, views, and presentations, as follows: "…[T]*he collection of content needed to design and build a portion of a plant can include hundreds of pieces of content in a variety of formats, including engineering drawings, 3-D CAD files, Bill of Materials (BOM) information, photographs, standard operating procedures, budget documents, or sales presentations. Typically, there are four or five such packages per plant, plus smaller contractor-specific construction packages. The content within these packages exists in numerous locations across the global enterprise, and on numerous hardware and software platforms… To further complicate matters, content in fabrication packages could be involved in the creation of multiple plants, which creates a much more complex lifecycle… The content in these fabrication packages isn't just used for engineering and construction; it is used for maintenance, operations, and sales… BOC wanted to repurpose content in multiple places but also maintain relationships between documents such that a revision to a drawing, for instance, would automatically ripple through all the fabrication packages associated with it."* [1].

In several cases, the content creation/capture or the retention parts of the life-cycle were regarded as great challenges of their own. For example, international logistic firms such as FedEx and DHL report their benefits from investments in distributed document scanning technologies [1]. As well, after content is stored in the system, it often needs to be maintained for a long time as a record – including such exemplary areas as life insurance companies (e.g. Souther Farm Bureau Life), public authorities (e.g. land records in Library of Virginia or human records in University of Cincinnati), or courts (King County) [1].

Metadata should provide information about a content element or configuration and its production, ownership, and intended utilization context to facilitate its retrieval or re-use for organizational purposes. Major challenges are standardization of corporate metadata models, easy and maximally automated and dynamic production of metadata, and awareness among content producers and owners of the importance of metadata for the anticipated contexts of retrieval and reuse. As reported related to the J.D. Edwards case [14]: *"When metadata is created and managed enterprise-wide, it describes published information and improves ease of browsing and retrieval. But metadata design is difficult because the design objectives for information retrieval are rarely made clear enough to those implementing the systems."* [p. 44].

Corporate taxonomy represents the logical and conceptual structuring of the whole content resource. It should provide the basis for users to access and navigate through logically integrated content collections (implemented, e.g., as shared repository hierarchies or visualized semantic nets to access content in enterprise portals), and to conduct effective searches based on a taxonomy functioning within the search engine. For example, Statoil declares that corporate taxonomy represents a fundamental part of their ECM efforts, and the related software should support the maximally automated definition and cultivation of it [12]. Parts of the taxonomy can serve as a basis for automatic creation of metadata on content elements. A major challenge remains in the taxonomical integration (in addition to the technical integration) of numerous and heterogeneous content databases under practical taxonomies for organizational purposes, especially if those databases have been cumulated *ad hoc* over years e.g. in distributed enterprises or inherited through takeovers or mergers.

2.3. Enterprise model

The content model intersects with detailed *enterprise model*s and specifications in the organizational

implementation of ECM systems. The concept of enterprise model refers here to the issue that any organization should have, to some extent, a shared idea about what needs to be done in the enterprise (including the idea of the business, required support operations, and reaching out from within the enterprise itself to the selected partner and customer networks), who does what, and who is in charge of what, before it can build meaningful information systems to support the operations. Contemporary objectives for ECM may influence needs to change the enterprise model itself, and vice versa.

Different organizations may have different ideas about the central concepts needed for their enterprise models. For example, several organizations consider themselves as process-based [7], and it will be natural to build ECM systems to support workflows for identified business processes. Business process improvement and workflow modelling from the business viewpoint also require logical understanding and modelling of content structures, content life cycles, and the user roles connected to the process-level information processing rules, so that business processes could be supported and streamlined by ECM systems. Good examples from the "process-based approach to ECM" are the content management challenges related to shipment data and billing documents in the very core of the operations of global logistics companies, e.g. FedEx and DHL [1], or the automation of the invoice processing in ABB:

"The project aim was to: ...install central and automatic processing for invoices. It was important to ensure that the various locations and companies were incorporated in the invoice management process by workflow or Lotus Notes, and it was also important to ensure that they are able to intervene in the auditing process…" [1].

Alongside the process-based enterprise models, e.g. certain team-based or project-based organizations may prefer different kinds of logical understanding about the enterprise, which furthermore could influence the different parts of the content model and ECM implementations. Moreover, in the engineering enterprises, the product (or product model) forms another conceptual basis as such to organize content. Furthermore, user rights and access control management often require role-based modelling of organizational units, groups, and content users, together with external partners and customers, relating the modelled organizational and user roles to particular content collections and structures.

The advertising company Saatchi & Saatchi, for example, uses ECM technology to facilitate creative idea generation and teamwork: "*Doing that collaboratively and world-wide was a big issue; we have a creatively oriented team that needs to communicate ideas clearly and efficiently. We were looking for a package that managed all types of media, especially video; offered security; was integrated; was Web-based; and didn't take up too much time in terms of maintenance*." [1].

In Johns Hopkins University Hospital, imaging and workflow technologies share patient data with a world-wide network of doctors so that a patient can get a second opinion diagnosis from a Johns Hopkins physician. Here, effective and efficient knowledge creation within an expert team of selected physicians is thus combined with well-defined workflow designs in the ECM system:

"*The Global Access system greatly enhances the patient referral services through efficient modification of the old business process. By automatically monitoring and managing the referral, the system proactively tracks specific response times and automatically acts when thresholds are exceeded… Both physician and customer satisfaction are increased through easier access to medical records and faster turnaround of patient referrals."* [1].

As an example of project-based organizing that actually involves an inter-organizational network of organizations, BOC Gases utilize an advanced ECM solution, integrated with an ERP package, to manage their inter-organizational projects to build plants. Such projects can involve tens of subcontractors, and the challenges to manage the related content require in-depth understanding of the project organization, standards for collaborative processes, the product, user roles and rights, and the content as such:

"In addition to linking content to various plants and parts within plants, the system links the content directly to BOC's ERP system which manages the Bill of Materials for the plant. The Bill of Materials is the complete list of the hundred of components required to build the plant… With the system, BOC can issue a purchase order with embedded links to drawings and other related documents in the repository, to allow a contractor to click on the link and instantly access the necessary documents..." [1].

The issue of content ownership relates closely to the general-level understanding of who should be in charge of what in the enterprise – causing direct implications for the ECM system implementation. For example, J.D. Edwards built a new editorial organization to ensure the content ownership and cultivation for their publications about different areas of technological expertise [14]. In Statoil, instead of building new editorial organizations, the existing idea of process ownership was expected to apply rather straightforwardly to content ownership.

Personalization and user profiling, applied for tailoring ECM to the individual user's perspective, will also require role-based and individual models of content utilization preferences among the enterprise's stakeholders. However, these content management techniques were not so visible in the reported implementations. For example, Statoil defined the capability to implement a "*[c]ommon role model to be used for security and access control, workflow and*

personalization" as one of the main areas required from the future content management tool [17].

To build such multi-faceted understanding about the enterprise as described above, i.e. the enterprise model, and to relate it to the content model to implement an ECM system surely emerges as a non-trivial challenge. Again, little guidance on how to do this in practice, taken the varying possibilities to organize the enterprise, exists.

2.4. Infrastructure

The information technology infrastructure of the enterprise involves a number of challenges in wide-scale ECM initiatives:

- *Integration of standardized applications and tools throughout the content life cycle* (integrating production/capture, storage, processing workflow, publication, and long-term archival of heterogeneous content). This also includes the challenge to identify and manage business-critical content from personal e-mail boxes to ECM solutions, and integration of content management software with other enterprise-wide applications e.g. to enable cross-application workflows. The cases reported integration needed against ERP, GIS, product data management, CAD systems, search tools capable of indexing across multiple database solutions, user management tools, etc.
- *Developing user-friendly, intuitive, and integrated user interfaces to content management*, seamlessly integrated with "front-end" content production and browsing solutions. For example, the J.D. Edwards case reported about the importance of logically integrating intranet and internet resources from the viewpoint of the users [14].
- *Updates in software, hardware and operating system infrastructure* were reported throughout the cases. Software updates in ECM were required as the user and content volumes were increasing over time beyond the capacity of previously successful applications, e.g. in J.D. Edwards [14]. Content capture devices, networks, and storage devices in high-volume content environments required continuous monitoring in terms of their capacity to respond to the increased volumes of content production, usage, and storage. The infrastructure also needs to be flexible and scalable in relation to future updates of hardware and software.
- *Technology updates for utilizing 'application-independent' content formats such as XML,* reducing dependence on vendor-specific content formats or structures, streamlining the updates of application infrastructure, and enabling the smooth sharing of content between organizations. For example, The King County case [1] highlighted the possibilities of the "Legal XML" standard to share electronic court records among appropriate governmental organizations, taking this into account in their application development for records management.
- *Information security issues,* e.g. integrating technologies for public key identification, electronic signatures, digital rights management, content encryption, and secure data networks with content management solutions. This related to a range of cases from the public sector, health, and military, to businesses requiring confidentiality or other kind of protection of content (e.g., considering intellectual rights).

2.5. Administration of content management

Administration of ECM consists of policies, standards, regulations, routines, and administrative procedures for content management, and the organizational responsibilities and resources assigned for facilitating their enactment.

The stakeholders of ECM need to be *aware* of the existence of relevant administrative guidelines and motivated to follow them in their daily work [12]. A service organization can be necessary for upkeeping ECM and for supporting users. Such service organizations should train and support users, partners, and local ECM advisors – including the establishment of a collaborative network sharing knowledge of ECM throughout the enterprise.

New work roles emerge for administering the content model and implementations, e.g. to upkeep forms and templates, links, user and access rights, personalization techniques, workflow models, metadata specifications, and corporate taxonomy. These roles may gradually take over the responsibilities of current roles of information professionals such as archivists, librarians, database managers, and webmasters. For example, in the J.D. Edwards case, five new organizational roles were explicitly defined in 2003 to govern and facilitate ECM: web council (communicating departmental objectives to enterprise level), channel producers (addressing information needs of particular user audiences), web consultants (educating channel producers on corporate practices and standards, and supporting them), subject matter experts/content owners (submitting content for publishers), and web publishers (editing content for display, and developing on-line forms and web programs as required) [14]. The details of organizing these and other roles will probably vary among organizations.

In addition to the cultivation of the content and enterprise models, the technical administration of ECM systems needs to be organized as well, including the

everyday upkeep of servers, networks, and particular applications (such as corporate-wide user management solutions) that now need to be related to the ECM infrastructure as well. In addition, the administration part needs often to cover juridical issues related to the publication, utilization, and re-use of digital assets, as necessary.

2.6. Change management

Change management issues identified in the cases include:

- *justification of ECM investments* to gain management support and *evaluation* of the results (alike in the field of IT investments in general); especially Statoil addressed a general-level lack of meaningful, practical, and commonly accepted justification and evaluation approaches, and has started internal efforts to build such meaningful measures, alongside the plain financial ones, to evaluate their ECM implementation,
- *maintaining top management support and development resources* throughout large-scale ECM programs,
- *building competence to develop, maintain, and operate ECM systems*, also including legal and contractual issues (e.g. related to collaboration with vendors and consultants); expertise in the constantly evolving ECM technology and markets to acquire commercial software, combined with an understanding of changing organizational needs, typically is a scarce resource,
- *opposition to tool and content standardization and reluctance to adoption of new technology among the users.*

A visible investment in change management in Statoil is the appointment of a separate "change manager" for the ECM program aside the project manager, who coordinates the development effort of the actual ECM application portfolio. Before selecting the portfolio of future ECM technologies, Statoil also used considerable effort and resources on internal competence-building on ECM (including a team dedicated to learn about modern content management technologies, corporate taxonomy tools, and networking with other organizations that had implemented ECM, as well as research institutions) to be able to coordinate the software acquisition process and to act as an informed and reasonably demanding customer.

A corporate survey of existing use of collaboration technologies in Statoil had identified lack of user training as a major cause for frequent underutilization of the technologies among the users [12]. Consequently, the ECM project in this company lists facilitation of corporate services providing training and active user support as a key priority.

In several cases prototyping of the systems together with future users was considered crucial for successful adoption, as ECM technologies involve potential to renew traditional thinking and practices around document management, content publication, and/or web site management. Without look-and-feel prototypes adapted to particular organizational contexts, these opportunities will often not be comprehended, leaving the users unmotivated to change their existing practice.

3. ECM as related to its referential areas

The issues discussed above *altogether* suggest a general-level framework for the ECM concept, as illustrated in Figure 1, highlighting the complexity and holistic nature of the topic. When viewed separately, however, many of these issues can be identified within the established research areas of information resource management (IRM), electronic document management (EDM), and knowledge management (KM). We therefore provide a brief analysis of the ECM concept in light of these referential areas, to see whether/how ECM may be distinguished from these.

IRM and EDM represent the closest "ancestors" of ECM. The most visible difference between the traditional IRM construct [9] and the ECM issues resides in a lack of focus in the IRM tradition on heterogeneous content structures beyond well-formalized databases, content life cycle issues, metadata of heterogeneous content, and corporate taxonomy beyond traditional data dictionaries and structured databases. The scope of ECM might also appear a bit wider from the mainstream of traditional "intra-organizational" IRM, reaching towards collaboration through content management in inter-organizational customer and partner networks, and high-profile web content targeted to large audiences which play an important role in the image-building of the enterprise in general.

The major contribution of the concept of ECM in relation to EDM resides in the fact that the modern, especially Web-based, applications integrate the previously separated issues of structured databases and dynamic application interfaces [11], semi-structured documents, and unstructured file management. This brings in a new level of complexity, beyond the traditional "file-based" connotations of EDM [16], to the management of content structure models and life cycles of content configurations. The advanced personalization techniques and innovative customer services based on ECM represent another modern area not so denoted in the IRM and EDM constructs.

Knowledge management (KM) research identifies three general-level types of organizational KM initiatives: *the coding and sharing of best practices; the creation of corporate knowledge directories;* and *the creation of knowledge networks* [3]. *Knowledge Management Systems (KMS)* are developed to support and enhance the tasks of knowledge generation, codification, and utilization, combining technologies such as intranets, knowledge repositories, and corporate directories [2, 3]. From the viewpoint of KM research, ECM could be phrased as a subarea of KM to manage the directories of "explicit" knowledge [13], i.e., the "repository model" of KM [2]. In addition, the taxonomy and metadata tools of ECM also reach into the area of managing information *about* corporate knowledge resources, often referred to as "corporate yellow pages" and included within the "network model" of KM [2] for facilitating human-to-human communication in knowledge networks. All in all, the field of KM has been mostly related to the resource-based theory and viewpoint of organizations, in which knowledge has been viewed as an asset related to certain organizational units [2].

The concept of ECM somewhat unites the resource-based view with the process-based view [7] of the organization, thus going beyond the typical resource-based focus of KM [2, 3]. Whereas the resource-based view on knowledge management focuses on the capabilities of a particular organizational entity to produce and share new knowledge, the process-based view on organization mainly focuses on the efficiency and effectiveness issues of established operations. ECM can contribute to both perspectives, through focusing on the codified knowledge resource for organizational units to develop their knowledge capabilities, and by providing support for business processes. The Johns Hopkins case referred to in Section 2.3 provides a good example of this. In parallel to the idea of documents as a vital concept for organizational memory [10], the idea of documents as a central concept in the business process viewpoint of the enterprise was present already in the traditional document management systems and their workflow functionality [16]. The process-based content management continues to be a relevant viewpoint, e.g. in the complex content production, editing, and publication processes of modern web content management systems [5].

Beyond the often rather immediate forms of knowledge creation and sharing highlighted in KM research, the concept of ECM also highlights the importance of managing certain content long-term. For instance, in engineering fields involving construction and long-term maintenance of technical products, content describing such constructions must be preserved for active use and managed for tens of years. In health care, the human record life-cycles may exceed one hundred years. The enterprise-wide focus of ECM might also reach beyond the "community of practice" scope [2] of several KM implementations.

Furthermore, the issues of metadata and corporate taxonomy seem to be more denoted in the practitioner literature of ECM than in the academic literature of KM. Hence, although KM represents a wider concept including also the management of tacit knowledge with related organizational arrangements [6], the concept of ECM highlights the special challenges of managing content life cycles long-term, involving sophisticated understanding of content structures, metadata, and corporate taxonomies with the enterprise-wide focus, and promoting both process and resource-based views to information management directed externally to partners and stakeholders as well as internally.

4. Concluding remarks: ECM as an integrative concept of information management

ECM consists of a wide set of interrelated issues: objectives and impacts, content and enterprise models, infrastructure, administration, and change management. Based on our analysis of the cases, we conclude that the concept of ECM integrates several areas of information management:

- ECM pursues holistic content life-cycle management to integrate solutions for content production, capturing, storage/archiving, versioning, distribution, publishing, retrieval, and retention.
- ECM strives for integrating the content structure models, metadata, and corporate taxonomy to reach production, storage, and retrieval environments involving all formats of (often heterogeneous) content with varying granularity of content elements and configurations; from unstructured via semi-structured to structured information.
- ECM combines the content model with enterprise-wide (and beyond) user and process modelling issues (personalization, user and access rights management, workflow).
- ECM covers the process-based and resource-based organizational viewpoints to information management.
- ECM represents a significant part of enterprise application and infrastructure integration - from heterogeneous content production applications and databases providing "raw data" for content management systems, through controlled workflow applications for content editing and publishing with multi-channel publishing opportunities, to integrated content search and taxonomy tools.

- ECM may amalgamate several contemporary job roles of corporate information professionals (archivists, librarians, database managers, webmasters).

Integrated ECM solutions require a lot of technological and socio-organizational competence and change management in order to correspond to the enterprise's objectives over time. Development of ECM is not a one-time project involving a labelled set of technologies. It is a continuous, even evolutionary [14], process to cultivate and elaborate the enterprise's content resources, infrastructure, and administrative practices under the continuous change of organizations, markets, and technology.

From the framework grounded upon the case study analysis in this paper, we may also derive a coarse 'checklist' for practitioners in charge of coordinating and developing ECM, addressing areas that need to be managed in an ECM program:

- Justify ECM initiatives in relation to the enterprise's objectives. Identify significant types of organizational objectives (section 2.1), prioritize these, and concretize them to context-specific benefit expectations from ECM.
- Evaluate the impacts of ECM investments in relation to the key benefits originally expected.
- Develop and share content and enterprise models among the key stakeholders of ECM development, as the basis for implementing ECM solutions. This includes content structures, views, presentations, life cycles, metadata, corporate taxonomy, and the related role models, user models, and workflow/process models.
- Analyze how new solutions would affect the current understanding of the content requirements and organization.
- Analyze the contemporary constraints and opportunities to reach an integrated ECM environment, and how the information technology infrastructure for ECM should be managed.
- Establish effective and efficient routines and policies for administering ECM operations in practice.
- Assess whether the necessary competence on ECM can be developed and maintained in-house, instead of relying only on vendors and consultants.
- Develop a shared understanding of the change management challenges, and the required resources for meeting these challenges.

Information systems research should explore the field of ECM further from the enterprise viewpoint and provide organizations with more holistic and systematic means to manage the complex ECM solutions. The constructive research elaborating ECM technology as such should be complemented with research reporting experience on previous ECM initiatives in organizations, thus supporting the organizational implementations of the future. Such research might focus on:

- Practical means for evaluating the *main* impacts sought by ECM investments beyond plain cost savings in information processing operations and facilities; including also experiences from unwanted impacts and realized risks of ECM development projects.
- Practical and holistic techniques for modelling and implementing ECM systems to make sense of complex and heterogeneous content structures and their relationships, life cycles of content elements and configurations, metadata and corporate taxonomy, and related enterprise models.
- Technological challenges faced by enterprises pursuing comprehensive ECM programs that may require extensive application integration and customization in their technology infrastructure.
- Administrative and change management challenges of ECM.

ECM pursues integrated solutions to modern challenges in information management. Whereas practitioners are already facing these challenges, researchers still have provided few aids to manage them from the viewpoint of the enterprise. Research on ECM experiences remains scarce as well. However, the constantly changing objectives, structures, and processes of numerous enterprises today, together with the evolution of the technological opportunities and markets, imply that the relevance of this area will not cease in the near future.

5. References

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