A Framework for Web Content Management System Operations and Maintenance

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***ABSTRACT**: Organizations increasingly utilize Web Content Management Systems (WCMS) to improve development speed, online flexibility and cost effectiveness for web applications. However, organizations lack the organizational processes and structure to effectively maintain WCMS. We propose a WCMS Process Framework for the operation and maintenance phase of Web Engineering. In this paper we elaborate on the construction of the framework. It encompasses the description of a generic IT Management framework and the inclusion of Web Content Management processes into a strategic, tactical, and operational level. The framework is validated through an expert validation consisting of three industry experts and a case study at a large Dutch telecommunications services provider. The case study substantiates our vision that the WCMS Process Framework contains a set of process descriptions that effectively supports the operations and maintenance of web applications.*

Categories and Subject Descriptors
H.3.5 [**Online Information Services**]:Web-based services: **H [Information Systems];** Modles and principles

General Terms
Web engineering, Information systems management

Keywords: Content management, Web content management system, Web application, Information systems maintenance

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1. Introduction

Since the end of the nineties several web modeling methods have been developed, varying from E-R based to UML based, from conceptual to architecture design and from web to hypermedia application orientation. However, these methods focus on the design and creation of web applications from scratch rather than building web applications based on a platform with a focus on managing the information – or content - of the web application. These web applications are known as *Web Content Management Systems* (WCMS) and are specifically designed to anticipate on the ever changing demand of Internet visitors [27]. A WCMS can be defined as a group of business rules and editorial processes applied to content by people and organizations to align efforts of online publication with the business goals [6]. With experiences of more than five hundred industrial implementations of WCMS software, we found that although WCMS help organizations from a technological point of view, a lot of organizations are struggling with the business processes surrounding the WCMS.

The research area we are addressing in this paper is Web Engineering which is defined as "the application of systematic and quantifiable approaches (concepts, methods, techniques, tools) to cost-effective requirements analyses, design, implementation, testing, operation, and maintenance of high quality Web applications" [16], p.3. The existing research provides useful insight into Web Engineering in general but the operations and maintenance of Web applications are underexposed. We present a WCMS Process Framework for organizing web content management which can be used in conjunction with existing frameworks such as ITIL, ASL and BiSL ([1], [19], [21], [24], and [25]).

The WCMS Process Framework which we presented in [35] detailed the processes of the operations and maintenance phase of web applications. In this paper we will re-address the foundation of this framework in more detail. We will provide more insight into the integration of our framework with the complementary frameworks as well as another case description. Furthermore, we added an expert validation based on three industry experts and compare our research to related research.

The paper is structured as follows. The next section discusses current issues in operation and maintenance within the field of Web applications. We then give an overview of a generic IT Management model which is the foundation of our WCMS Process Framework and describe how our WMCS Process Frameworks is integrated in the generic model. In section 3 we describe the validation of the framework through an expert validation and new case study. Section 4 elaborates on related work. We end this paper with some conclusions and point out future research.

2. A framework for Web Engineering operation and maintenance

Our WCMS Process Framework is based on the assumption that web engineering is different than traditional IS development. The authors in [17] and [15] critically examined

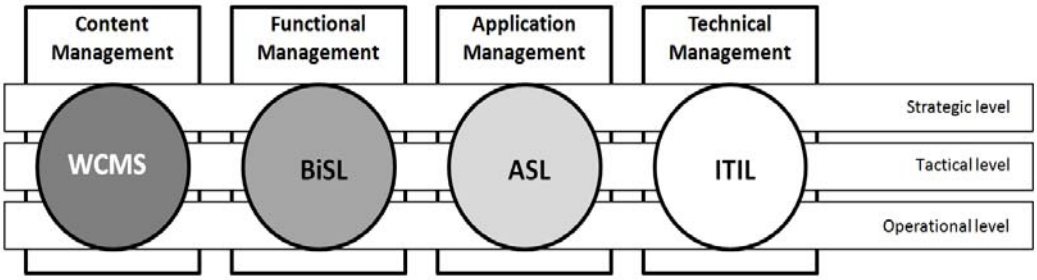

Figure 1. Overview of Frameworks

these differences and concluded that web development methods are not radically new but merely extensions or variations of fundamental dynamics which have characterized information systems since the inception of the discipline. There may not be one single characteristic which is unique to web development; the collection of characteristics definitely is [2]. Methods proven for traditional information systems should however not be disregarded. Our WCMS Process Framework therefore uses existing models when possible and only differentiates where specific web related issues arise. In [35] we detailed these web specific issues: 1) identifying the user groups and the fit with their needs and requirements; 2) definition and implementation of a content maintenance strategy; 3) keeping the content valid, accurate, current and complete; 4) coordination of operational content management activities; and 5) management of external content providers.

To cope with the described issues, we developed our WCMS Process Framework, based on Looijen's existing model for organizational IT Management [21]. In Looijen's threefold model of management, control and maintenance of Information Systems, three management units are distinguished: Functional Management, Application Management and Technical Management. Each managerial unit is composed of three managerial levels; strategic management, tactical management and operational management levels.

Although the Functional, Application and Technical management of WCMS software can be covered by Looijen's IT Management Model the management of the content of the website itself is different. This is acknowledged by the authors in [17] where they argue that managing Web Information Systems (WIS) is not comparable to managing non WIS. There seems to be a gap in the existing model. To bridge the gap we add a Content Management Unit focusing specific on the content of the web application. Consequently with the addition of the content management unit, we should be able to give consideration to the overall management of WCMS applications.

2.1 Integration WCMS in the IT Management Model

Over the last 20 years, process frameworks based on best practices have been developed, each addressing a specific part of Looijen's IT management model. The most comprehensive structured approach available is probably the Information Technology Infrastructure Library (ITIL) [1]. Based on ITIL, more specific descendants like ASL (Application Service Library) and BiSL (the Business Information Services Library) evolved, covering the Application Management and Functional Management respectively as described by the authors in [24] and [25]. However, no framework addressing Content Management processes exists. We therefore created our own WCMS Process Framework.

Figure 1 provides an integrated overview of the complete IT Management Model with ITIL, ASL and BiSL covering the technical, application and functional management respectively. Each of these models explicitly addresses the strategic, tactical and operational level. Our WCMS Process Framework should therefore cover the specific content management related issues and should encompass strategic, tactical and operational level. With a certain framework, we create an extended IT Management model for Web Engineering.

Basically the three IT management domains can be viewed upon as respectively the demand and supply side of IT within the business. Viewing the three managerial units in perspective, functional management manages the demands of the user organization. Application and Technical management are the service providers: they deliver the services (application-based and technology/hardware-based respectively) as issued by the functional management unit. With the added Content Management there is a new chain of demand and supplies. In the new situation the end user (or website visitor) creates the demand which should be supplied by the content management unit. The content management unit utilizes the WCMS as an information system to support the process of managing content and is

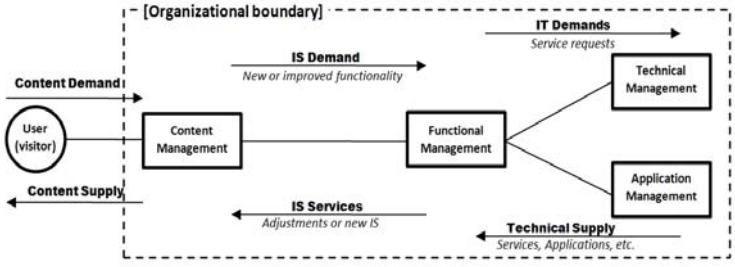

Figure 2. Integrating Content, Functional, Application and Technical Management

now serviced by the functional management unit whenever improved functionality is needed. Functional management translates their requirements into demands. An example of a functional requirement is that the website should at least be able to cope with 5 million pageviews a day. That would be translated into demands to application management (e.g. customizations, CMS-architecture and database-clustering), and technical management (i.e. infrastructure, nr of servers, failover servers, cpu power, RAM). The system architect translates the requirements into application management and technical management demands.

2.2 The WCMS Process Framework

With the differences and specific nature of WCMS we developed the WCMS Process Framework. An overview of the WCMS Process Framework is visualized in Figure 3. We elaborated on each of the processes in [35] and a full description is publicly available at [32]. The framework copes with the earlier raised issues and can be used next to the ITIL, ASL and BiSL models. The WCMS Process Framework conformed to the subdivision of three managerial levels; the strategic, tactical and operational level. This also complies with the five identified issues mentioned earlier where strategy and policy issues indicate a strategic management level, coordination issues point to a tactical management level and the production and maintenance of content designate an operational level. The WCMS Process Framework is developed, based on existing web and content related literature and the results of a web management study. Additional content management specific processes were designed for issues not covered by ASL and BiSL to complement the WCMS Process Framework, using other references [13], [11], [20], [25], and [28].

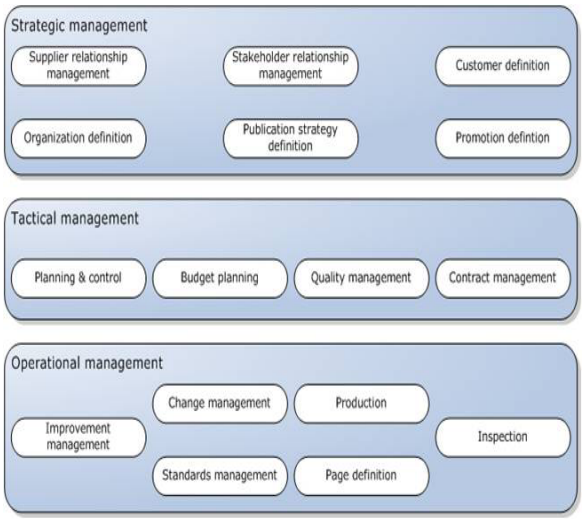

Figure 3. Framework Overview

Within each level, processes are designed consisting of relevant activities. In order to reveal the relations between activities (the process) and artefacts (the data produced in the process) meta process delivery diagrams (PDD) are used. The PDD technique is based on a UML activity diagram, reflecting the activity side, and a UML class diagram which reflects the deliverables side. The UML semantics are strictly applied, however, some primitives have been added in order to deal with composition issues. For detailed information about the technique, we refer to as proposed in [30]. We detail one process to illustrate how a rationale of a process is built up and how a process is presented and explained: the 'Content Inspection' process, which is part of the operational processes.2.3 Detailing the Content Inspection Process

While the structure and presentation of a Web application are subject to change request, they are generally kept stable over a lengthy period of time [11]. For the content itself, the opposite is true. Content of most web applications are subject to permanent changes which impacts the content's volume, currency, consistency and reliability [14]. According to Ebner et al. [11], this means that various update cycles have to be considered, depending on the Web application type. By nature, update cycles of news oriented Web applications are short. These update cycles are executed as soon as information changes or hourly. However, a Web application concerning a company presentation will have longer update cycles. In order to ensure the content remains up-to-date it should not only be reviewed before publication but should be reviewed regularly [13]. A process monitoring the content currency throughout the Web application and deciding when and what content should be updated could ensure the currency of the available content of the Web application. According to Schwickert [28] the initial review should be done by a hierarchically super ordinate instance. For the periodic review, Fuller more concretely mentions a supervisor, an executive, a Web council or a Public Affairs officer as examples [13]. Fuller further notes that 'retired' content should be retained in an archive for reference purposes, or as Schwickert notes, to serve as a source for content re-use. Also with legislation concerning archiving, it is a necessity to keep track of the content. However, in his content lifecycle model, Schwickert also added a Destroy process to dispose of content [28]. The next illustration provides an overview of the activities and the deliverables of the content inspection process. The three main activities are Content Inspection, Request Update and Completion. As can be seen, two activities contain multiple sub-activities. The deliverables "content" and "archive guidelines" provide the necessary input for the activities. One possible outcome is the "request for operations" deliverable. With this schema, we can model and communicate the activities and deliverables.

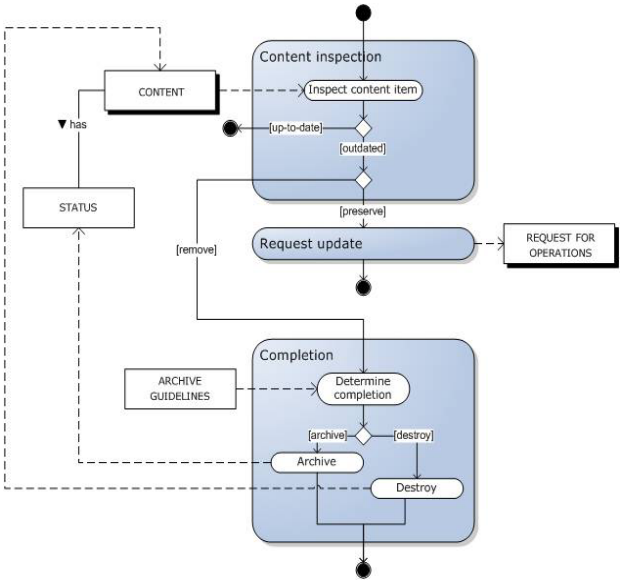

Figure 4. Content Inspection Process Description

Each activity and sub-activity is then detailed in a table, providing a textual description per sub-activity. A breakdown of the activities and sub activities of the Content Inspection Process is provided below.

	Sub-activity	Description
Content Inspection	Inspect content item	Inspect the published CONTENT ITEM(s). By CONTENT ITEM is meant the page, article or other content (banners etc.) placed on the website.
Request Update	*Outdated branch*	Determine whether the CONTENT is outdated or up-to-date. When the CONTENT or parts of the content are outdated the next branch is triggered.
	Preserve branch	Determine whether to preserve or remove the outdated CONTENT. When the content is outdated but should be preserved an update is necessary. This results in a REQUESTFOR UPDATE. A practical implementation of this activity could be to depict the content item and to attach comments in order for the assigned or responsible author/editor to know what the purpose of updating this CONTENT ITEM is.
Completion	Determine completion	When content which is outdated and is not desired to be preserved, a decision needs to be made about the way it is completed. In general two options are available; either retaining the content in an archive or destroying it by removing the actual content. Guidelines for determining the completion are recorded in the ARCHIVE GUIDELINES.
	Completion branch	*Here the actual choice is made whether to archive or destroy a certain CONTENT ITEM.*
	Archive	Here the activities necessary to archive the CONTENT ITEM are located. Within a CMS-based Web application most of this process is done automatically. However, the STATUS of the CONTENT ITEM has to be set to an archive status in order to trigger this automatic process. Archiving in a CMS-based Web application is mostly done by versioning.
	Destroy	Another activity which can be triggered by the completion branch is the destroy activity. Here the activities necessary to perform a physical removal of the CONTENT ITEM are located. The actual destruction of removal itself is done automatically by the CMS-based Web application.

Table 1. Activities and sub activities of Content Inspection Process

The content inspection is usually done by a (chief) editor supported by the WCMS: the system notifies the editor when a page needs to be checked. The inspection itself - judging the actual content - is a manual process. Completion is again supported by the WCMS: with the archiving or delete option within the WCMS, the chief editor or his delegate can remove the content from the website.

3. Empirical Validation

Following [26] we carried out an expert validation and a case study in order to determine the usefulness and correctness of the WCMS Process Framework.

3.1 Expert Validation

Within the expert review a number of experts of GX, a medium-sized WCMS vendor, were selected to study and review the WCMS Process Framework. GX implements web-applications based on its WCMS GX WebManager as described in [3]. As the framework consists of strategic, tactical and operational process levels three experts were selected based on their knowledge on managing web content and their experience with WCM on these particular levels. The resulting selection consisted of a senior consultant, a project manager and an online marketer (strategic, tactical and operational level respectively). To evaluate the validity of the WCMS Process Framework, test-criteria were defined using the validation methodology presented by Beecham, Hall, Britton, Cottee and Rainer in [34]. Resulting test-criteria are *scope*, *comprehension*, *ease of use* and *tailorability*. Validating against these criteria also addresses our research question, in which we indicated to search for an effective approach for organizing WCM: we define effectiveness as dependent on the four test-criteria. A questionnaire was designed to measure these criteria. The experts were provided with a full explanation of the WCMS Process Framework and its processes and activities separately. After this explanation individual interview sessions were scheduled. Similar to the method of Beecham et al. [34] we provided a 5-point scale for the possible answers on the statements and questions (ranging from strongly disagree to strongly agree). Additionally, we requested the respondents to comment critically where possible. The results of the expert validation are grouped according to each test criteria and discussed briefly.

*Scope.*The respondents agreed that the framework could be used as an initial guideline for WCM in organizations (2 agreed and 1 strongly agreed). One respondent remarked that the process description included in the framework "incorporates quite a level of detail compared to what I've read on this subject so far". The respondents also agreed that the level of detail within the processes should be sufficient to guide users/practitioners of the model to recognize these processes in practice (1 agreed and 2 strongly agreed). Concerning the completeness of the framework they all agreed that the WCMS Process Framework should cover all relevant processes.

Subsequently the respondents were asked to select the key processes of WCM. Unanimously they identified the content production process as the key process of WCM. Other key processes mentioned were the publication strategy definition and the customer definition process. For the scope of the model we can conclude that the WCMS Process Framework can offer a solution for the WCM issues. Users or practitioners of this framework however should be aware that the applicability of each process should be assessed and evaluated for each organization.

Comprehension. On the comprehension the framework the respondents were all positive (all ranging from 'agree' to 'strongly agree'). They indicated that each process was easy to understand (1 agreed and 2 strongly agreed), clearly defined (all noted 'agree'), clearly presented (all noted 'agree') and the division between strategic, tactical and operational processes was found easy to understand (all noted 'agree'). According to one respondent the differentiation between strategic, tactical and operational processes are logical but he mentioned that this would depend on the size of an organization. For example, in smaller organizations these processes are executed by just a couple of people which therefore make it difficult to clearly distinguish between

		XYZ - Board of directors	XYZ - Employee council	XYZ Corporate Communications	XYZ - Product managers	Manager XYZ.com	Manager Marketing	Formula manager	Marketing manager consumer/business	Traffic manager	Manager operations
Organization definition	*Define organization*	RA	C			S					
	Manage organization	RA	C			S					
	Evaluate organization	RA	C			S					
Publication strategy definition	*Corporate strategy alignment*			S		A		R	C		
	Formulate publication guidelines						A	R	C		
Promotion definition	*Define promotion strategy*				S			A	I	R	

Table 2. Sample of the Strategic Processes Validation

strategic, tactical and operational levels.

Ease of use. The framework provided enough information to make it easy to interpret it (2 agreed and 1 strongly agreed). However, one respondent mentioned that some previous theoretical knowledge or experience in practice is needed to be able to use all processes. According to this respondent "the explanations are clear but will raise some questions at less knowledgeable readers when they try to create a direct link with the processes described". As another respondent mentioned more examples would benefit each process.

Tailorability. The respondents were asked whether the processes and their activities are general and most likely to apply to most companies. On the applicability of the processes two respondents agreed and one respondent strongly agreed. One respondent noted that "only in large organizations people work according to procedures which are defined top-down. To adapt these procedures in the WCMS Process Framework, even the smallest change could be very hard". Another respondent stated: "the approach might be to overwhelming for smaller organizations". As mentioned the framework can be applied to most organizations. Smaller organizations could also benefit from the framework but should evaluate each process on its usefulness and applicability just like the BiSL and ASL frameworks are used [25]. Implementing a process framework for WCM could require organizational changes.

3.2 Case Study

Yin [31] describes four validity types that should be taken into account when establishing case studies: 1) construct validity; 2) internal validity; 3) external validity; and 4) reliability. With regard to the construct validity we interviewed two respondents and introduced the WCMS Process Framework beforehand to avoid discrepancies. The addressed the internal validity by explaining the 'how' and 'why' of each process and its activities. Further, explanation-building occurs for each statement through a thorough clarification. We externally validated the WCMS Process Framework by means of an expert validation [7]. Future case studies will provide us with more insight into the framework's external validity. The reliability is provided through the case study with the use of the RASCI method to assess each process and its main activities as defined in the Control Objects for Information & related Technology (COBIT) [9]. The RASCI method identifies the roles and responsibilities in an organization by identifying who is (R)esponsible, (A)ccountable, (S)upportive, (C)onsulted and (I)nformed. Since the COBIT framework can be regarded as an auditing instrument, we adopted this method in order to identify the roles and responsibilities used in practice for each of the processes and sub processes of the WCMS Process Framework. In [35] we described a case study of a Dutch inter-municipal cooperative union in which municipalities of a city region cooperate in order to promote common interests. We performed a second case study at a large Dutch telecommunications services provider. For their business customers they provide services ranging from voice, Internet and data services to full-managed outsourced IT solutions in The Netherlands, Germany, and Belgium. The organization serves 2.2 million Internet Customers in the Netherlands. Their WCMS was initially designed to provide self-service functionality to their customers via the Web (cost reduction). Currently sales incentives are the main reason for having a web presence and their WCMS is an important distribution channel. The case validation included a business consultant of the web department. Presented below are the validation results of the case validation at the organization.

It became clear that all strategic, tactical and operational processes were present at the organization. A sample of the RASCI table is printed in table 2. The observation of the data reveals that strategic WCM activities are somewhat scattered throughout the organization. For instance the Organization definition process, the board of directors is both responsible and accountable and the employees' council is consulted. This indicates that WCM activities are interwoven into the corporate structure. On the tactical level the Manager operations is responsible for the 'Budget planning', the marketing manager is accountable. This indicates that budgeting for WCM activities is a marketing expense due to the main sales incentives of the WCMS. For the management of suppliers the organization has appointed a supply chain manager. This role executes the tasks of the contract management process. This role was also supportive in the strategic process of Supplier relationship management. On the operational level, the following observations were made: for producing content and creating pages, two different roles

are distinguished; the content manager and the content specialist. This is a similar hierarchy between an author and an editor. The content manager creates articles (pieces of content) to be used on the different pages. The content specialist creates and maintains the pages, reviews the content produced by the content manager and takes care of the inspection of the content later on. Marketers support the production of content and ultimately the respective product manager (i.e. phone, internet, etc.) is consulted and informed about the results. Standards are developed and tested by respectively the developers and testers. Business consultants however are accountable for these developments. Solution and technical architects are responsible defining, organizing and specifying improvements. The manager of operations is ultimately accountable and informed concerning these improvements. Compared to the case study at the non-profit organization (presented in [35]), this case supports the WCMS Process Framework. Due to the strategic importance of their WCMS, managing web content professionally is also regarded of importance. This could be the reason why the framework was considered complete, as the case study organization did not execute activities that were not part (or could not be recognized) in the framework. However, the remark was made of secondary processes of the overall web management, like transactions and logistics of the products and services offered through the Web, could benefit a future version of the framework. Moreover, the processes Budget planning, Quality management and Improvement management process were not regarded as useful for the non-profit organization but are identified within this second case study. These processes might not be as useful for non-commercial organizations but could be for commercial organizations.

4. Related Work

The WCMS Framework is part of the Web Engineering Method (WEM) [27]. In the field of Web Engineering, there are several research groups working on related work. We briefly elaborate on three relevant research groups ([8], [18] and [23]).

Ceri et al. describe in [8] their Web Modeling Language (WebML), a notation for specifying complex web sites at a conceptual level. The WebML approach consists of seven phases: from requirements specification to maintenance and evolution. They acknowledge the need for maintenance, but do not elaborate on it on a process level. WebML is a model-drives approach where change requests are translated to the data-model or the hypertext model. An overview of the processes from an information management perspective is underexposed.

Koch et al. describe the UML-based Web Engineering (UWE) approach in [18]. UWE is an object-oriented, iterative and incremental approach for the development of web applications. The development process of UWE consists of five phases, including maintenance. The development process of UWE is based on the Unified Process (UP) and tailored towards web application development. The development process of UWE consists of five phases: inception, elaboration, construction, transition and maintenance. Within these phases a variable number of iteration workflows take place: risk management, iteration management, iteration evaluation, requirements capture, analysis and design, implementation, validation, verification and testing. We concluded that UWE is more similar to our framework since it acknowledges the importance of maintenance of Web Applications. It also has certain workflows which correspond with our tactical and operational processes. However, Koch and Kraus neglect the strategic processes and indicate that the main UWE modeling activities are: requirements specification, conceptual, navigation and presentation design. Pastor et al. describe different methods with the Object-Oriented Web-Solutions Modeling approach (OOWS) being the closest one to our method. OOWS provides mechanisms to deal with the development of hypermedia information systems and e-commerce applications in web environments [23]. OOWS strongly focuses on the generation of the required Web Application. OOWS comprises of two main activities: *system specification* and *solution development*. Within the system specification activity the functional requirements are specified by the creation of five models which form the basisfor the second activity, solution development, wherein the actual web application components are generated. Within solution development the transformation from the conceptual schema to a software product is realized. OOWS provide some useful insight into the modeling and development of Web applications however the organizational processes to maintain the generated Web application is not provided.

The main contributions of WEM consist of a set of tools, process descriptions and guidelines to create, organize and maintain content driven Web Applications. The contribution of this research is the WCMS Framework as proposed in this paper about the processes supporting the maintenance of Web Content Management activities.

5. Conclusion and Future Research

In this paper we presented a process framework for Web Content Management Systems. We used fragments from existing models and combined them into our model. The framework consists of a set of guidelines and process descriptions separated over three managerial levels: strategic, tactical and operation. Each process is described by means of Process Delivery Diagrams and descriptive tables. We validated the model through an expert review and a second case study. Based on the two case studies we are even more convinced that the WCMS Process Framework could act as a useful set of guidelines for organizations to organize WCM processes. Some remarks were made however of the absence of secondary processes and three processes in non-profit organizations. We trust that we have made a step forwards in developing a method for the implementation and maintenance of WCM systems. Furthermore, we think that the framework of WCM processes is useful beyond the scope of Web Content Management and could be applicable in other content driven areas (e.g. publishers). We are currently researching the influence of user generated content and community technologies on existing organizational processes, especially the implications on information control and security. We also continue our research to extend WEM with a modeling language to model the processes in the Web Application itself.

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