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Towards a Process Model for Digital Content Analysis – The Case of Hilti

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Abstract
Enterprise Content Management (ECM) is an emerging concept in Information Systems (IS) research providing the means for an efficient administration of digital content. However, there are lots of obstacles which may face enterprises when adopting ECM. In particular the diligent analysis of an organisation's individual content situation often turns out to be a major success factor. However, adequate guidelines for performing content analyses can hardly be found in ECM literature. In this paper, we propose a process model for analysing content and present the first results that have been gained during its application within the Hilti Corporation.

Keywords: Content, Content Analysis, Enterprise Content Management (ECM), Process Model

1 Introduction

Organisations create vast volumes of digital content. According to the IDC GROUP, 161 billion gigabytes of digital information was captured in the year 2006 – and this number will increase more than six fold by 2010 (Gantz et al. 2007, p. 1). Nowadays, particularly large-scale enterprises are becoming more and more aware of this information overload and are confronted with the challenge of efficiently handling it. Enterprise Content Management (ECM) is a newly emerging field in Information Systems (IS) research dealing with strategies, processes, skills, and technologies providing the means for an efficient management of digital content (Munkvold et al. 2006, p. 70; Smith and McKeen 2003, p. 647). However, according to the blog of the ECM ASSOCIATION, organisations are confronted with various challenges when adopting ECM (www.aiim.org). In particular, the diligent analysis of an organisation's individual content situation represents a major success factor for ECM systems (ECMS) implementations (cf. O'Callaghan and Smits 2005, p. 1271). The reasoning for this perception can be illustrated as follows.

The analysis of content exceeds the sole identification of content captured within an organisation. In fact, it is about analysing content concerning its specific managerial requirements. For instance, documents created by several authors are usually changed at a high frequency rate. Thus, they particularly require ECMS functionalities supporting the process of collaboration (e. g., by versioning). In contrast, invoices (created more or less automatically) are infrequently edited and may have to be archived in the long run due to legal restrictions. In addition, an ECMS often has to ensure that such content is not edited during that time (e. g., by access protection). As a result, diligently analysing content is of great importance for identifying and applying the most suitable ECMS functionalities. However, adequate guidelines for analysing content can rarely be found within the field of ECM research. Thus, in this paper, we propose a process model for digital content analysis.

According to a design science approach (Hevner et al. 2004; Simon 1996), the remainder of this article is structured as follows: We first analyse previous work in the field of ECM in order to

derive specific requirements for content analysis (section 2) and present a framework for ECM research serving as a theoretical foundation for our approach (section 3). We then introduce our process model for content analysis on that basis (section 4) and subsequently present the first results of its application within the Hilti Corporation (section 5). Experiences that have been gained during the application and fields of success and failure are then presented as lessons learned (section 6). We finally conclude with a short summary and give an outlook on fields of further research (section 7).

2 Content and Content Analysis

Though ECM is a key concept for issues of compliance, governance, and business process efficiency (cf. Vom Brocke et al. 2008), it has, up to now, mainly gained the attention of practitioners (cf. Browning and Lowndes 2001). The scientific interest in ECM is in contrast still remarkably low (Tyrväinen et al. 2006, p. 627). Certainly, there are lots of scientific contributions referring to ECM-related disciplines, such as Web Content Management (WCM) (e. g., McKeever 2003; Proctor et al. 2003; Dewan et al. 2003), Document Management (DM) (e. g., Dourish and Edwards 2000; Yiu et al. 2006), Digital Rights Management (DRM) (e. g., Hollaar et al. 2005; Cohen 2003), or Records Management (RM) (e. g., Bridges 2007; Wei et al. 2006). However, there is a significant need for specific ECM research – as ECM is a specific concept as well (cf. Tyrväinen et al. 2006). In the following, we intend to document this perception by analysing previous work in IS research explicitly focussing on ECM. Furthermore, the literature review serves two other purposes: Firstly, the review shows the necessity of content analyses and documents that there is a lack of adequate guidelines. Secondly, a brief introduction into the term "content" is given. The clarification of the content term serves as a basis for introducing our process model for content analysis. Contributions being considered within the literature review are displayed in the following Figure 1 (on the basis of their perspective on ECM).

Perspective	Source
Technology	Reimer (2002)
Strategy	Smith and McKeen (2003)
	Rockley et al. (2003)
	O'Callaghan and Smits (2005)
Implementation	Nordheim and Päivärinta (2004)
	Päivärinta and Munkvold (2005)
	Nordheim and Päivärinta (2006)

Figure 1: Selected ECM literature

Technology: A systematisation of the structure and functions of ECMS is given by REIMER (2002). The term "content" is hardly explained and only implicitly described when explaining common ECMS functionalities. From REIMER'S point of view, information becomes content when captured (p. 18). As a result, content can only exist digitized (p. 17). Furthermore, REIMER solely differentiates content on the basis of its format. This – quite limited – perception is emphasised by stating that content is often shared as attachments in e-mails (p. 18). However – and as pointed out in the following – an e-mail itself can be seen as a batch of different content assets (e. g., text, signature, date, address, attachments). In conclusion, REIMER'S approach falls well short of the content term. Furthermore, he does not refer to content analysis at all.

Strategy: SMITH/MCKEEN (2003), O'CALLAGHAN/SMITS (2005), and ROCKLEY ET AL. (2003) primarily discuss common issues of ECM strategy development. Picking up on the obscurity of the meaning of ECM, SMITH/MCKEEN define ECM as "the strategies, tools, processes, and skills an organisation needs to manage all its information assets (…) over their lifecycle" (p. 648). They emphasise that ECM first of all has to consider what content has to be included (p. 648) and further state that there are different "types" (p. 649) and "forms" (p. 651) of content. However, they do not sufficiently explain the differences between a "content type" and a "content form." They

implicitly define content analysis as an assessment of available content assets and the forms in which they reside (p. 651). In addition, they identify a need for defining metadata to search for content (pp. 652f.) and differ between external and internal content (p. 649f.). O'CALLAGHAN/SMITS explicitly point out that ECM involves analysing content needs and deciding what content has to be managed and how it will be managed (p. 1271). However, they do not provide guidelines for implementing a content analysis. As well as ROCKLEY ET AL. they do not consider content assets as complete documents. In fact, they emphasise that ECM is not about managing entire documents, but re-using content to be assembled in multiple documents for different users (e. g., the same content asset may be used in a brochure and a press release at the same time) (Rockley et al. 2003, p. 23ff.). Thereby, ECM finally intends to ensure that the content is up-to-date and of a high quality – and this is a reason why ECM exceeds the abovementioned single approaches as DM or WCM, for example. Furthermore, they state that content is characterised by a certain structure (O'Callaghan and Smits 2005, p. 1273).

Implementation: Both reports from NORDHEIM/PÄIVÄRINTA (2004/2006) deal with case studies in the field of ECM in order to derive key issues and challenges for general implementation. Referring to the results presented above, they do not provide many further issues on content or content analysis, but however emphasise that the management of content has to regard content lifecycles as well. A content lifecycle is composed of content producing, capturing, versioning, distributing, publishing, retrieving, and archiving (Nordheim and Päivärinta 2006, p. 649). Finally, PÄIVÄRINTA/MUNKVOLD (2005) present a content model for ECM that consists of (1) structure, view and layout, (2) lifecycles, (3) metadata, and (4) corporate taxonomy (p. 3ff.). In spite of the aspects that have already been explained, the corporate taxonomy refers to the logical and conceptual structure of content providing the basis for searching for it (e. g., by automatically defining metadata). The layout finally refers to the presentation of content.

In conclusion, an adequate content analysis is of great importance for ECMS adoptions. If accurately accomplished, it reduces implementation costs and improves business process efficiency (cf. Reimer 2002, p. 17). Though most authors point out the necessity for analysing content, there is a significant lack of adequate methodical guidelines. Furthermore, a common understanding of the term "content" has not evolved, yet. However, particularly the work from PÄIVÄRINTA/MUNKVOLD (2005) points out common content properties like structure, layout, metadata, and taxonomies. These issues may serve as an initial basis for developing a process model for content analysis. In the next section, a theoretical foundation for our approach is given to further elaborate these findings.

3 A Framework for ECM Research

According to the results of our literature review, TYRVÄINEN ET AL. (2006) state that ECM received far too little attention in IS research. Hence, they present a general framework for ECM research that we considered within our process model for content analysis. Within their framework, TYRVÄINEN ET AL. distinguish between four relevant research perspectives: Enterprise, processes, content, and technology (cf. Tyrväinen et al. 2006 and Figure 2 in the following).

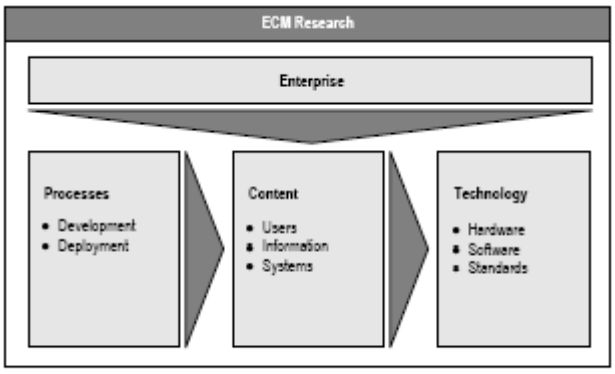

Figure 2: A framework for ECM research

Research questions on the enterprise level refer to institutional, especially social and legal aspects (e. g., compliance, archiving times). The process view refers to both, process development and deployment. We hold that an analysis of an organisation's individual content situation has to take both perspectives into account: In terms of collaboration, for example, an adequate ECM implementation has to consider whether content can be assessed by multiple organisations, by means of a so called "Cross-ECM" (enterprise view), or by multiple users within the same organisation (process view). Therefore, the content perspective comprises general information about content (e. g., format, metadata, and taxonomies), users (and their views on certain content objects) and (the often various) systems in which content objects reside. Hence, being relevant for the two other perspectives, we arranged the content view as the centre of Figure 2. Finally, the technology perspective comprises ECM hardware, software, and standards that are applied for managing the content. As the general purpose of content analyses is identifying and applying the most suitable ECMS at last, we arranged the technology layer as "outcome" on the right side of the figure.

Recapitulatory, our approach is inspired by the idea of analysing content concerning its organisational context (enterprise and process view) in order to identify those ECMS (technology view) that fit the organisational requirements best. In the following section, a process model for implementing content analyses is proposed on the basis of these findings.

4 A Process Model for Digital Content Analysis

Our process model for content analysis is comprised of five application phases, namely: the definition of an application area (I), the identification of content assets (II), the definition of content attributes (III) and attribute values (IV), and the classification of content types (V). Furthermore, the model provides methodical support for each of the phases (cf. Figure 3).

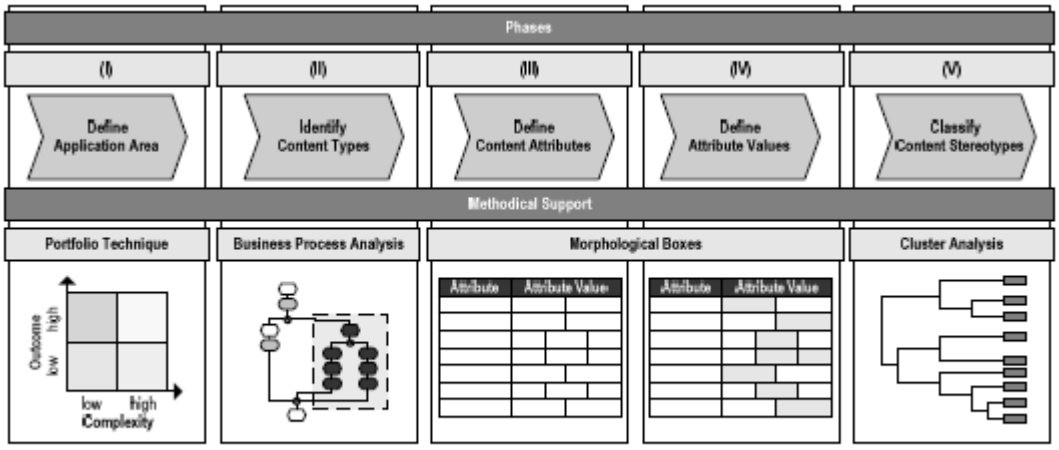

Figure 3: A process model for content analysis

DIERIG, the Change Alliance Director of the Hummingbird Corporation, a large-scale ECM vendor (www.hummingbird.com), holds that the well known adage "think big, start small" is of special importance when implementing ECM (www.documanager.de). The YANKEE GROUP agrees with him and emphasises that an ECM implementation should start with a departmental or line-of-business deployment, before moving ahead with an enterprise-scale adoption (Perry and Lancaster 2002, p. 17). Hence, the definition of the application area (phase I) serves the purpose of selecting those business areas to be considered within the content analysis. Therewith, it mainly refers to the enterprise view of the introduced ECM research framework. We hold that this part of the ECM planning process should primarily focus on the strategic relevance (by means of high ECM outcomes) and feasibility (cf. Nordheim and Päivärinta 2004, p. 3): As symbolised within our process model, an arrangement of an organisation's application areas can be conducted on the basis of the portfolio technique (cf. Dubinsky and Ingram 1984). Application areas offering low implementation effort and high outcomes at the same time are positioned in the portfolio's upper-

left corner (as symbolised by the dark-shaded field). An ECM implementation – and therewith an analysis of content – should ideally first focus on this field of the portfolio.

The second phase of our framework refers to the identification of content types captured within the application area. Therewith, it generally corresponds to the content perspective of the ECM research framework. Suitable methods for identifying the content types are interviews and document analyses, for example. Interviews can be conducted, as employees are usually aware of the content assets they create, access, or edit. In contrast to the traditional understanding of document analyses (cf. Schurmann et al. 1992), documents themselves already represent certain content assets. Hence, we hold that the identification of content types should not be a highly challenging task, but may however turn out to be quite time-consuming. Within this context, this step may be accelerated by analysing business processes. Conceptual specifications of business processes usually contain information objects as model elements (e. g., the EPC; cf. Scheer and Schneider 2006). As these information objects represent certain content types, we hold that in particular process models provide an efficient means to assess an organisational content situation.

The phases III and IV serve the purpose of analysing the content types identified within phase II concerning their specific properties. According to the framework for ECM research, there are a multitude of factors (e. g., taxonomies, metadata, user views, or systems) that have to be considered on both, the enterprise and the process level. An analysis of the content properties is further complicated as those staff members who know about certain content characteristics (i. e., content creators, editors, or reviewers) are usually not aware of available and required ECMS functionalities. As they can hardly differ between content characteristics that are relevant or irrelevant for ECM, they need to be provided with accurate guidelines. Concluding, this step of the framework may turn out to be a highly challenging and complex task. However, the literature review pointed out that there are some content characteristics generally relevant for content analyses (e. g., structure or format). Accordingly, we hold that the identification of specific content properties may be realised on the basis of first applying these general attributes (phase III) and then assigning specific attribute values to them (phase IV). This proceeding can be illustrated as follows.

There are lots of possible attributes and attribute values that can be used for analysing content. One important attribute is a content asset's confidentiality, for example. Whereas an employee record may be highly confidential, a marketing brochure can usually be accessed publicly, e. g., by web access. Within this context, possible attribute values can be of a low, an average, and a high degree of confidentiality. An exemplary assignment of selected attributes and attribute values for these two content assets is displayed in the following Figure 4 on the basis of morphological boxes (cf. Knackstedt and Klose 2005).

Employee Record			
Attribute	**Attribute Value**		
Structure	Unstructured	Semi-Structured	Structured
Format:	Text	Graphics	
Confidentiality	Low	Average	**High**
Change Frequency	Low	Average	High
...	...		

Marketing Brochure			
Attribute	**Attribute Value**		
Structure	Unstructured	Semi-Structured	Structured
Format:	Text	Graphics	
Confidentiality	**Low**	Average	High
Change Frequency	Low	Average	High
...	...		

Figure 4: Exemplary definition of attributes and attribute values

According to the findings provided by the framework for ECM research, attributes represent both, the enterprise level (e. g., confidentiality) and the process level (e. g., change frequency). Furthermore, the attribute values imply a deviant treatment of the content types and consequently different requirements on the technological level. For example, the high degree of confidentiality of the employee record may require the implementation of access rights. In contrast, the high change frequency of the marketing brochure points out the necessity of versioning this content asset more accurately.

Particularly in large-scale organisations there are lots of different content types. Hence, the assignment of ECMS functionalities to all of them may turn out to be a very time-consuming task. However, we hold that content types possessing the same attribute values may require an equivalent management. Therefore, within phase V, suitable content types are combined to so called "content

stereotypes" that are supported by the same set of ECMS functionalities. In case there are content types that only differ with regard to a few attribute values, it has to be decided whether they obtain the same ECM support or not. Within this context, a company should be aware of the fact that some attribute values possess a very high strategic relevance, particularly due to legal restrictions (e. g., archiving times, protection of modification). As symbolised in the process model, an adequate means for identifying such content stereotypes is the cluster analysis (cf. Kaufman and Rousseeuw 1990).

5 The Case of the Hilti Corporation

The Hilti Corporation provides manufactures and services for the construction and building industry. Hilti comprises close to 20.000 employees in over 120 countries creating nearly 20.000 new documents a day. Currently, Hilti is implementing ECM processes worldwide in order to realise an efficient management of this huge amount of information. In the following, we present exemplary results that have been gained from a content analysis at the Hilti Corporation. Please note that the results have been slightly simplified for the sake of a preferably clear presentation and due to the confidentiality of the Hilti content.

According to our process model, first of all, a company's business sub areas have to be analysed concerning the potential ECM outcomes and feasibility of implementation. As proposed in the previous section, we arranged possible application areas for the Hilti Corporation (divided by benefits and complexity) on the basis of the portfolio technique (cf. Figure 5 for an extract).

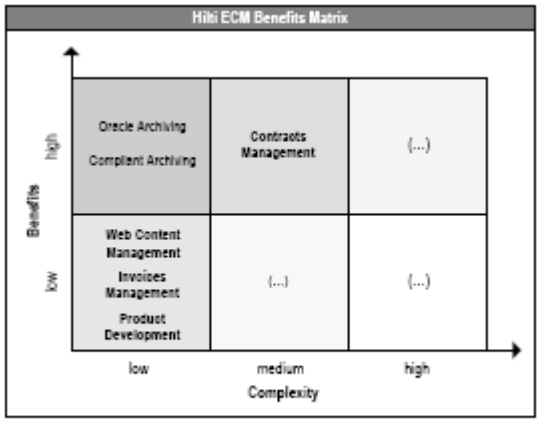

Figure 5: ECM benefits matrix of the Hilti Corporation

According to this classification, Hilti should start the ECM adoption in those business areas exhibiting high ECM benefits and low implementation complexity at the same time (e. g., Oracle Archiving). However, our project work is not only limited to these areas. In fact, we extended the content analysis to all the fields being displayed in Figure 5. In the following, we present exemplary results particularly according to the highlightedareas:

- *Contracts Management:* Currently, there are 300.000 digital contracts that have to be managed within the Hilti Corporation. This number increases by 1.000 – every day. Hilti estimates this rate of growth is to even increase in the next years. The management of digital contracts specifically requires the support of workflows, e. g., by automatically reminding employees to renew contracts.
- *Invoices Management:* During the last four years, the Hilti Corporation created about 50.000.000 invoices in SAP. Hence, within the context of the ECM implementation, the challenge is particularly to efficiently archive this vast quantity of data and to further fulfil legal restrictions.
- *Product Development:* There are a multitude of different content types created or edited within product development processes, e. g., office documents or CAD drawings (Computer Aided Design). In the following, we exclusively refer to technical

documentations. The management of these content types particularly requires the support of collaboration and – due to the confidentiality of product specifications – a secure storage.

- *Web Content Management:* Hilti provides online content for customers and employees in over 120 countries. As web content is published in more than 40 different languages, the special challenge is to ensure the content's up-to-dateness and to avoid redundancies.

According to the second phase of our framework, content types relevant for these application areas have to be identified. As proposed in the previous section, we analysed several Hilti business processes for this purpose. As a result of the business process analysis, an overview of selected content types captured within the Hilti Corporation is provided in Figure 6. The content types highlighted within the figure specifically refer to the four application areas. Within this context, invoices (generated more or less automatically by SAP) are classified as transactional content. In contrast, technical documentations and contracts belong to business content. Depending on whether it is published on the internet (mainly for customers) or on the intranet (for employees), web content may be both, persuasive or business content.

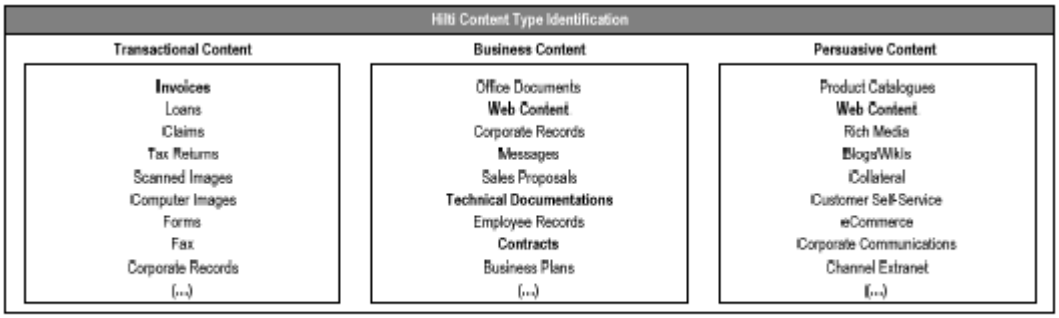

Figure 6: Transactional, business, and persuasive content of the Hilti Corporation

Within the phases III and IV of our framework, these content types are analysed concerning their specific managerial requirements. In order to identify common content attributes and possible attribute values for the four content types, we arranged two three hours workshops with the Hilti Head of Global IT security and Operations Information Technology who is responsible for the global ECM project. Selected attributes and attribute values that were elaborated in the workshops are displayed in the following Figure 7. According to the ECM research framework that has been presented within section 3, we arranged them on the basis of their relevance for the enterprise and the business process view. Furthermore, exemplary requirements on thetechnological level are given.

	Attributes	Attribute Values				ECM Technologies
Enterprise	iConfidentiality	Low	Average	High		Encryption Mechanisms
	Cross Enterprise Access	No		Yes		Portals, VPN
	Availability	Not Relevant	< 1 Hour	< 1 Day	...	Backups
	External Usage	No		Yes		Access Rights
	Archiving Time	Not Relevant	< 1 Year	1–10 Years	...	Records Management
	Language	English	French	Italian	...	Wikis, Work Flow Support
	...	...				...
Business Processes	Change Frequency	Low	Average	High		Versioning
	Multi User Access	No		Yes		Access Protection
	File Size	Not Relevant	≤ 100 KB	≤ 1 MB	...	iCompression, Storage Units
	Frequency of Usage (per day)	< 1	1–5	> 5		Short Term Access
	Archiving Format	Hard Copy	Digital	Not Relevant		Scanning, Printing
	File Format	jpg	pdf	gif	...	Converting, Imaging
	...	...				...

Figure 7: Selected attributes, attribute values, and related ECM technologies

To further derive specific values for the four content types, subsequently, we conducted four one hour interviews with Hilti members working within the affected business areas. Interviewee 1 is responsible for web content management and global internet/intranet. Interviewee 2 is a CAD system specialist responsible for the product data management (technical documentations). Interviewee 3 (professional services, fleet management) was interviewed concerning the contract

properties. Finally, interviewee 4, the Hilti Head of Process Competence Center Management Services, was consulted in order to analyse the invoices.
Instead of presenting all the results that have been gained from the interviews, in the following, we will focus on the lessons learned in order to evaluate the applicability of our approach. However, within Figure 7, we exemplarily highlighted those attribute values relevant for the technical documentations.

6 Lessons Learned

First of all, the interviewees were asked to assess the general relevance of the issues being addressed by our approach. They all agreed with the fact that an analysis of content plays a fundamental role for choosing the most suitable ECMS. Furthermore, they all stated that the content analysis serves as an important means for applying the right ECMS functionalities ("There are a multitude of functionalities provided by an ECMS. The challenge is selecting and providing those – and only those – functions actually required [to manage a certain content asset]."). Therewith ("and only those"), a special dilemma of ECM implementations is addressed by our framework that was explicitly mentioned by interviewee 2: "On the one hand, it is undisputed that ECMS provide functionalities that may significantly improve the overall business process efficiency [e. g., by reducing searching times]. On the other hand, the usage of the ECMS should be kept as simple as possible in order to avoid that the realisation of these benefits comes along with an implementation overload [in case too many ECMS functionalities need to be performed manually]".
The interviewees assessed all the phases of our framework to be highly important for content analyses. In particular the phases III and IV – the definition of attributes and attribute values – have been evaluated as a suitable means for identifying required ECMS functionalities ("In general, when introducing IS, the special challenge is often to avoid the "nice-to-have" phenomena. If you show people what's possible [i. e., available ECM functionalities], they'll choose nearly everything. Quite often they won't realise that this was not the best idea until it's too late."). Furthermore, interviewee 3 underpinned that such an assignment of attribute values avoids the problem of implementing ECM only on the basis of available ECM systems/functionalities ("We are Hilti. We first define what we need and then select a suitable vendor, not vice versa."). In conclusion, the approach provides a means to first identify the organisational ECM requirements in order to then select a suitable ECMS.
However, the interviews also pointed out that there are some implications of our approach that have to be considered when conducting a content analysis on the basis of our process model:

- There are a multitude of possible attributes that are applicable for content analysis. Furthermore, when the analysis is extended to other application areas, even new attributes may have to be considered. Hence, the challenge is to identify only the most important attributes in order to not unnecessarily increase the complexity of the analysis.
- The exemplary application showed that there are some attributes that are highly important for only a few application areas (e. g., according to content capturing). Applying all the attributes within every application area may turn out to be very time-consuming. Thus, we hold that our approach may be improved, for example by differing between general attributes and application-related specific attributes.
- Our approach does not sufficiently consider different views on content. It turned out that – referring to the same content type – different content users might also need different ECM support. However, we hold that this problem might be solved by not only identifying but also analysing the content types within the phase of business process analysis (as process models usually contain organisational units as model elements, as well). On that basis, content owners and different views on content might be assessed.
- Within our exemplary application, the definition of the attribute values has been conducted on the basis of interviews. Therewith, the results that have been gained so far may be quite subjective. To ensure a more objective analysis, more than one interview partner should ideally be consulted.

- The definition of content stereotypes (phase V) has not been conducted. Due to the multitude of different attributes and attribute values, the analysed content types all turned out to be varied. Therewith, it remains unclear whether it is possible to combine content types to stereotypes in order to reduce the complexity of implementation.

7 Summary and Outlook

With this paper, we proposed a process model for digital content analysis. According to the design science approach, we firstly intended to document the practical relevance of content analyses by means of a literature analysis in the field of Enterprise Content Management (ECM). Thereby we pointed out that adequate guidelines for conducting content analyses can rarely be found within Information Systems (IS) research. A theoretical foundation for our approach was given by presenting a research framework for ECM. Furthermore, we presented the first application results of the process model within the Hilti Corporation. The application showed that our process model may help organisations to assess their individual content situation in order to identify and apply the most suitable ECM systems (ECMS). Finally, we presented fields of success and failure as lessons learned. Within this context, the application particularly pointed out that an analysis of content is a highly complex and challenging task, but nonetheless indispensable for the successful implementation of ECM.

Our findings may provide a basis for future research on the issue of conducting content analyses. In order to further evaluate and elaborate our framework and to provide a deeper insight into its practical applicability, it will be deployed within additional industry projects. For that purpose, we particularly intend to apply ethnography-based research methods (cf. Tan and Hall 2007). Future work will primarily focus on the lessons learned, namely: the integration of user views, a holistic systematisation of content attributes, and the classification of content stereotypes.

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