Use of Integrated ECM/BPM Platforms
in Financial, Quality, and HR Processes –
Case Study of Large Organization from Medical Industry

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Abstract. This paper discusses the integration of two independently evolving fields in management and information technology: business process management (BPM), and enterprise content management (ECM). The paper's objective is to highlight the advantages of integrating these fields – particularly from practical and technological perspectives. The analysis of the integration benefits is based on a case study of a project that was focused on digitizing financial, quality, and HR processes within a nationwide network of diagnostic laboratories. In this project, an integrated open-source ECM/BPM platform that combined the Camunda BPM and Alfresco ECM environments was used as the primary technological component. The analysis of the implemented processes showed that most of them were classified as content-/ document-centric, thus necessitating the use of the standard content processing services that were embedded within the ECM systems during their execution. Furthermore, the content that was generated and shared within these processes was stored more efficiently and securely in the ECM repository. The final aspect that is discussed was the potential for creating a centralized content processing model across the organization by using the integrated ECM/BPM platform as the central component.

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1. INTRODUCTION

In recent years, the theoretical and practical relationships between two management methods have been examined: business process management (BPM), and enterprise content management (ECM). Both methods have evolved theoretically and practically since the early 21ˢᵗ century and are now supported by highly advanced dedicated IT systems; namely, business process management systems (BPMS), and enterprise content management systems (ECMS). These methods are continually advancing, yet they remain independent. Mendes and Bax (2018, p. 96) emphasized that, when "supported by IT platforms, ECM and BPM have evolved as autonomous fields of knowledge." When analyzing the basic concepts of this relationship (namely, the processes and content), it is worth noting that content is a critical resource that is processed within these workflows. The content encompasses unstructured collections of data, information, and explicit knowledge that is contained on electronic media (such as documents, emails, social media messages, and audio/video recordings) (Trąbka, 2020, p. 112). Formally, the term "content" is broader and also includes structured and semi-structured data (Päivärinta & Munkvold, 2005). In the Polish literature, the original term "content" is sometimes translated as "information resources" (Klimek, 2011). To emphasize the growing importance of unstructured data, it is worth quoting research findings: "According to Gartner, unstructured data constitutes about 80 to 90 percent of all new data processed in enterprises. Moreover, its volume is growing three-times faster than structured data" (Heeg, 2023). Content-/document-centric processes are among the three main types of processes that are supported by BPMS systems (Mendes & Bax, 2018). Larrivee (2016, p. 8) aptly underscored the mutual relationship and the necessity of integrated process and content management, stating, "a process without content serves no purpose, and content without a process goes nowhere".

From the technological and market perspectives, there is also a clear division of the tools into two distinct classes: BPMS, and ECMS. One can reference reports from the research and analytics agency Gartner (mentioned previously). Gartner issues annual reviews of various IT system markets under the title *Magic Quadrant*. The *Magic Quadrant for Intelligent Business Process Management Suites* (Gartner, 2019a) discusses the market for systems that support process management and automation. Separately, Gartner analyzes content management systems and publishes the *Magic Quadrant for Content Services Platforms* (Gartner, 2019b). The observed lack of ECM and BPM integration in enterprise operations may lead to various risks. Mendes and Bax (2018) argued that the lack of integration between these disciplines significantly reduced the potential benefits of the change management programs within an organization. This situation arises when separate BPM and ECM teams work independently on solutions to improve organizational processes; the consequences of this include duplicated goals, resources, and competencies, the creation of partial dispersed solutions, and user dissatisfaction from having to use multiple tools at a single workstation. From an enterprise-IT-architecture perspective, the fact that an organization maintains different systems for automating processes that nearly always create or use documents and other types of content while simultaneously maintaining separate ECM-class repositories for storing content from other sources is extremely costly. This also leads to resource and data redundancy and, most importantly,

to the loss of a unified and reliable source of information for the entire organization. The proposed solution to these risks is the use of integrated ECM/BPM platforms. These platforms combine the main components of BPMS systems (namely, process modelers, process engines, and process repositories) with ECMS components – particularly, content repositories and various library and indexing services.

The conclusions above regarding the risks that are associated with the lack of ECM and BPM integration have strategic, managerial, and technical significance; however, a practical and operational perspective also merits analysis. This paper poses two research questions:

1) What role does content processing play in the specific financial, quality, or HR processes within an organization?;
2) What should the model be for content and process management across the organization's entire infrastructure?

The aim of this paper is to highlight the benefits of content-centric process management through integrated ECM/BPM platforms. An additional aim is to outline the role that ECM/BPM platforms can play in fully integrating content and processes. To answer these questions, a case study of an ECM/BPM platform implementation in a large medical enterprise will be conducted. The implementation covered dozens of processes in the financial, quality, and HR areas. Selected processes and their system support will be discussed, with an emphasis on any content processing requirements at various stages of their execution. Furthermore, any observed risks that result from isolated (non-centralized) content management will be presented based on the conclusions from the case study. In this regard, a centralized model is proposed, with the ECM/BPM platform as the central component.

2. METHODOLOGY

In order to answer the research questions that have been posed in this work, the authors used a qualitative research approach; mainly, the case study methodology (which provides tools for studying complex phenomena in their real and full environmental context). In this work, the subject of the case study will be a large medical organization that wanted to improve its efficiency through the digitalization and automation of its processes (Yin, 2003). According to the nomenclature of the author who was quoted earlier, the unit of analysis was a project to implement an IT system in a large and complex organization. The case study was explanatory in nature, because the posed research questions were to show what role content processing processes play and what the integrated, technological, and organizational model of the content processing of the entire organization should be. An explanatory case study was used to study complex processes or cause-and-effect relationships in order to understand the mechanisms that led to a specific result. A characteristic feature of case study research is the use of multiple data sources – a strategy that also increases the credibility of data and results (Patton, 1990). In this case study, the authors made extensive use of participant observation, because both took part in the described project; one as an analyst on the side of the ordering company, and the other – a developer on the side of the system provider.

In addition to observation, implementation documentation, and patterns of actually processed documents, process models and IT infrastructure diagrams were also used. The results of the work should serve the company's implementing process and content management systems as a pattern of a general-organizational model of the content processing infrastructure as well as methods for its complete construction.

3.   DESCRIBING CASE

The enterprise that was analyzed in this case study was a network of diagnostic laboratories that were operating throughout Poland; it was comprised of more than 150 laboratories and over 1000 collection points, and it employed more than 5000 people. The organization had several certified quality management systems: the Quality Management System PN-EN ISO 9001:2015 (Polski Komitet Normalizacyjny, 2016), the Medical Quality and Competency System for Laboratory Activities PN-EN ISO 15189:2013 (Polski Komitet Normalizacyjny, 2013), and PN-EN ISO/IEC 17025:2018 (Polski Komitet Normalizacyjny, 2018). These management systems were crucial for defining the requirements for the electronic document circulation system, as the collection of quality documents for all of the standards that were mentioned above was comprised of more 150,000 documents. The company had a highly complex organizational structure, with more than 1500 units across the country. In the financial-administrative area (specifically incoming correspondence), these units processed tens of thousands of documents monthly. Digitizing the document circulation processes became a primary requirement for the implementation that is discussed in this study. The final area that was included in the implementation was the company's HR processes, where the volume of the processes was directly related to the number of employees (along with the added challenge of the physical dispersion of employees and organizational units). Given the organization's scale and process complexity, management determined the need to initiate a project for an "electronic document- and case-circulation system" to digitize and automate the processes in the aforementioned areas. After nearly a year-long search and selection process for a suitable platform and provider, the Alfresco ECM system (alfresco.com), which was integrated with Activiti (activiti.org) and Camunda (camunda.com) BPM engines, was chosen.

4.   UNDERTAKEN ACTIONS

The implementation was conducted in an incremental cycle with distinct phases – each encompassing the processes to be implemented sequentially. At the highest level, each phase covered an entire process area, with progression to the next phase being dependent on the successful completion of the previous one. The organization's management prioritized its financial and administrative-office processes in the first phase, followed by quality processes in the second phase and HR processes in the final phase. Each area's implementation began with a pre-implementation analysis and solution design phase – both carried out by a joint team of employees from both the

client and the system provider. The implementations of the individual processes were conducted iteratively, with functionality prototypes delivered, tested, and evaluated in weekly intervals. Each phase (consisting of analysis, implementation, and deployment) took approximately 18 months to complete. It is important to emphasize the complexity of implementing systems within enterprises of such an extensive organizational and geographical structure and workforce scale. During the deployment, methods such as cascading training sessions and gradual regional-system rollouts were employed.

4.1. Content-/document-centric processes

The first process that was implemented in the financial area was the submissions and settlements of business trips. This was a straightforward process that made it easy for users to adopt while also being high-volume; once digitized, this provided significant cost and time savings. At this stage, the primary mechanisms for managing users, roles, and the organizational and geographical structures were established. A business-trip document is a structured data set that may include additional settlement documents (invoices, tickets, etc.), which are treated as attachments. On the implemented ECM/BPM platform, attachments are stored directly in the content repository (as separate documents that are linked by the appropriate relationships). This enables direct searchability (including full-text searches) through the OCR technology.

In the administrative processes, a process entry can be virtually any form of content (emails, electronic documents, document images, or EDI documents). Below, the most high-volume administrative process – invoice handling – is presented (Fig. 1). Due to its complexity, the diagram shows only the initial part of the model. It is described using business process model and notation (BPMN) and created with the Camunda Modeler tool. The diagram is executable BPMN, meaning that the model will be sent directly to the process engine – the Camunda BPM Core Engine – where, along with forms and services, it will handle real process instances. Automated activities (marke with a two-gear symbol in the upper-left corners) and actions such as content loading (from various sources), text recognition, and classification (highlighted in blue by the authors) are typical ECM system services. In this case, these are provided by Alfresco ECM services. Later in the described process, additional content-handling services were used, while the original forms of the documents and process attributes were retained in the ECM content repository.
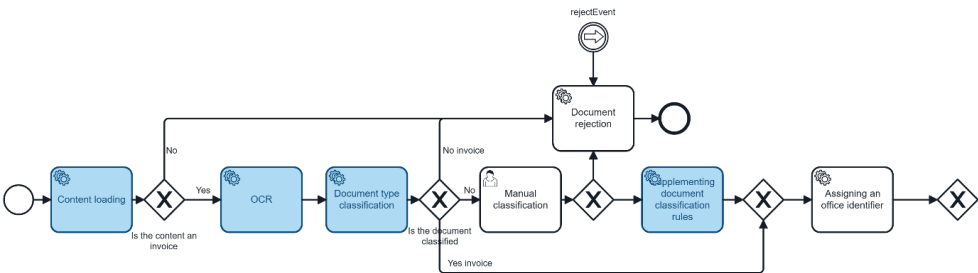

Fig. 1. *Invoice handling process – BPMN diagram*

As with the business-trip process, an essential requirement is the ability to search for a document by its content (regardless of the status of the process that handles it). For financial (business) documents, the key steps include description, approval, and accounting. These processes are executed by a process engine, which uses complex decision tables to automatically designate specific employees to be responsible for each step. It is worth noting that the system manages all types of expenses that are incurred by different organizational units, resulting in decision tables with hundreds of entries. The most demanding processes in terms of content handling were those in the quality area. Managing the quality document repository and the processes of creating, updating, and distributing these documents required functionalities that were typical of ECM systems. The required functions for the quality processes included versioning, check-in/check-out, collaborative document work, audit trails, indexing, cataloging, tagging, full-text search, and record management. An example of a quality process that required complex content processing was the creation and distribution of a quality document. This process was comprised three sub-processes:

1) initiation and preparation of quality document;
2) substantive and system approval;
3) distribution to employees.

Figure 2 shows a part of the sub-process: the initiation and preparation of the quality document. This process was initiated by the quality management system document repository (QMSDR) administrator. The entire QMSDR is stored within the ECM system. Documents are created based on predefined templates, and each document can be prepared simultaneously by multiple authors. During the content preparation process, typical ECM system functions are used (represented in the diagram by activities with blue backgrounds): check-in, check-out, versioning, creating attachments, etc. In this case, these functions are provided by Alfresco ECM services.
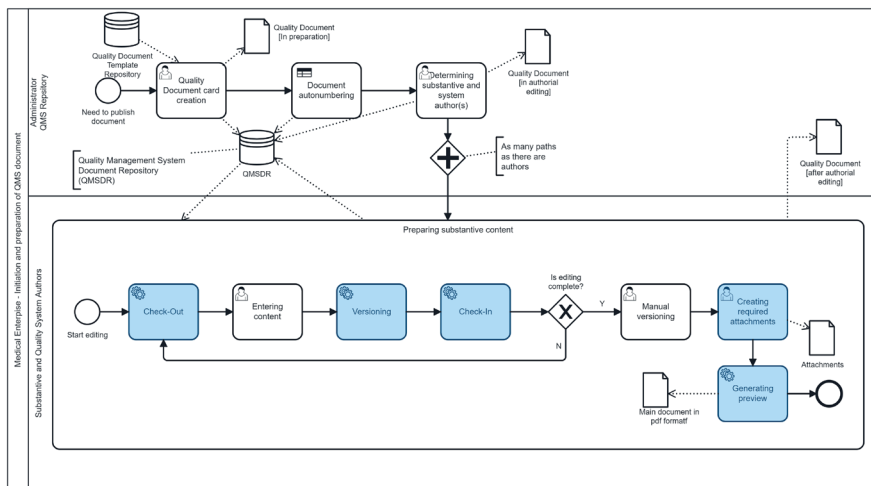

Fig. 2. *Initiation and preparation of quality management system document process – BPMN diagram*

Task management in processes is, obviously, handled by process engines, with the process history being stored in the process repository. However, these two core BPMS components do not meet the requirements for the content that is processed within these workflows (which is a primary reason for using integrated ECM/BPM solutions). In the quality area, additional processes for non-conformance management, corrective actions, and complaint-handling are also implemented. HR processes are also content-centric. In these processes, various types of employee documents are generated, acquired, and processed. A requirement emerges here for signing documents with either qualified or standard electronic signatures. This area also requires handling confidential documents that are in compliance with GDPR regulations.

The HR area was the final planned phase of the implementation. Specifically, the secure storage and sharing of contracts in this area became the foundation for planning the next phase: a central contract repository. This contract repository must be equipped with processes for document preparation, approval, and distribution. According to the authors, this area is particularly well-suited to be efficiently handled by integrated ECM/BPM platforms.

4.2. ECM/BPM infrastructure design

When implementing the processes in an integrated ECM/BPM environment, a key question often arises regarding the project's scope across an entire organization. It is clear that BPMS systems cannot replace other systems in an organization or handle all of its processes. In this case, other systems support the core laboratory processes (laboratory information management system – LIMS), resource-related processes (enterprise resource planning – ERP), and customer and sales processes (customer relationship management – CRM). These systems are also classified as process-aware information systems (PAISs) and are indispensable and irreplaceable in their specific areas. BPMS systems can only supplement these with their own processes or act as integrators in highly complex end-to-end processes. The situation differs when it comes to processing locations – especially for storing and sharing content. Practically every major system within an enterprise infrastructure (see Fig. 3) stores content for the processes that it supports. This raises a question: how can a user who primarily works in one system locate specific content that resides in other organizational systems? First, they need to know which system created or stored the content; unfortunately, the same content (or parts of it) may sometimes exist in multiple systems simultaneously. Second, the user must access the identified system and obtain the appropriate permission level. This procedure is time-consuming, costly, and insecure. If one were to provide access to content in other systems from the system that the user operates in at the technological level, interfaces would need to be created among these systems. Looking at an entire organization and its requirements, however, this would necessitate the creation of a network of interfaces among the individual systems (in an "all-to-all" model). This network is illustrated in Figure 3. From a technological perspective, creating such a network of connections would be highly time-consuming; what is more,

maintaining and securing it over the long term would be practically impossible. This decentralized content-storage model is referred to as a "content silo" (analogous to the commonly known concept of "information silos").
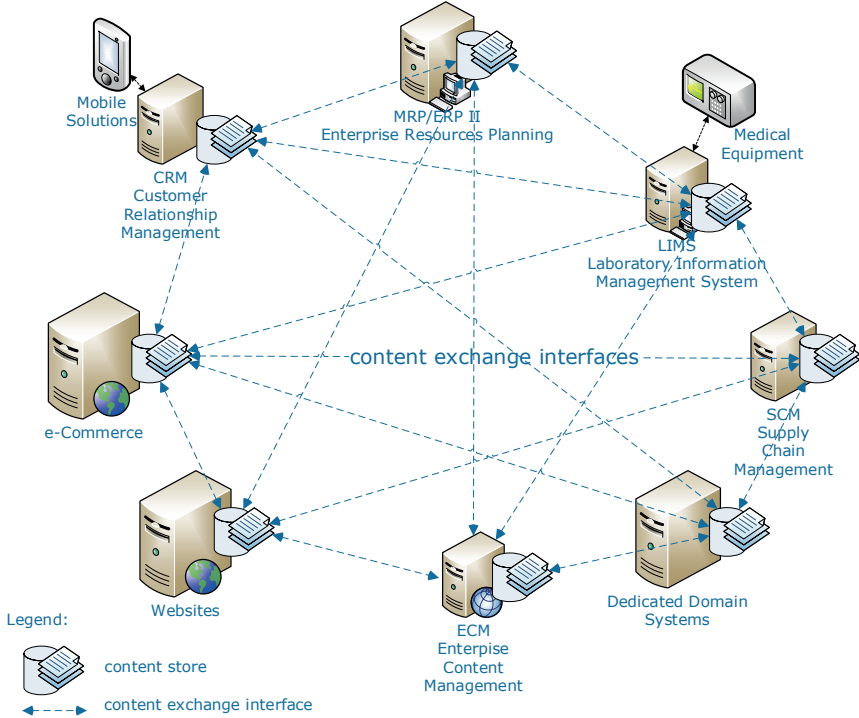

Fig. 3. *Content silos – non-centralized model of content processing*

A centralized model could solve the issue of content silos. This model assumes that every system within an organization's infrastructure stores content (including unstructured documents, document images, multimedia files, etc.) in a single location – the ECM repository. A centralized model of this is illustrated in Figure 4. The ECM repository provides built-in functions for efficient and secure content storage and sharing. Most repositories of this type (including Alfresco ECM) offer open communication interfaces across the multiple technologies that are available. By creating bidirectional interfaces, each system in the organization would use the ECM repository for storing or retrieving any content, thus eliminating the need for multiple interfaces between each system (see Fig. 3). The centralized model enforces a unified security policy for access to specific types of content across various user groups. An additional significant benefit is the ability to establish a company-wide retention and archiving policy for content. The proposed model lays the foundation for creating a central content repository for the organization – a requirement that is now very common among organizations (even though the authors' experiences indicate that few effective solutions of this type currently exist).

Fig. 4. *Centralized model of content processing*

4.3. Process orchestration

With content being integrated and accessible for processes via API, it is now possible to automate the entire process end-to-end. BPM components can play a key role in overseeing the processes for adding and retrieving content from the ECM repository. These components can also manage the orchestration in end-to-end processes that involve other systems within an organization. Additionally, other systems can (and should) utilize the built-in content management services within their own processes, thus avoiding the need to create redundant functions across multiple systems (see Fig. 5).

From a technical perspective, the ECM/BPM platform that is created for an organization includes the most popular open-source tools, thus enabling solutions for various business needs:

– **Alfresco ECM Document Repository:** This component provides document management, high performance for large volumes, auditability, and data-model flexibility.
– **Camunda BPM Process Engine:** This component offers a work management environment and service orchestration according to BPMN 2.0 standard. It also provides full monitoring and exception handling – supporting even the most complex processes.
– **Camunda DMN Rule Engine (Decision Model and Notation):** This component helps centralize knowledge by separating applications from dynamic logic, thus supporting declarative programming in order to create comprehensible business rules.
– **Document Transformation Tools:** A service that was designed for long-term operations on large document sets.
– **Search and Reporting Tools:** These tools support the constructions of complex registers that encompass data from documents and processes as well as a full-text document search with result rankings.
– **Authorization and Permission Management Tools:** Each platform element utilizes a unified user and group database for managing access and permissions.
– **Form and User Interface Builders:** The use of Alfresco application development framework (ADF) components for form and interface creation allows all elements to be implemented using low-code technology – even as standalone applications.

Each of these elements is crucial and has a significant impact on the platform's efficiency. An additional benefit of this platform design is the absence of licensing restrictions (open-source) and its ease of integration.
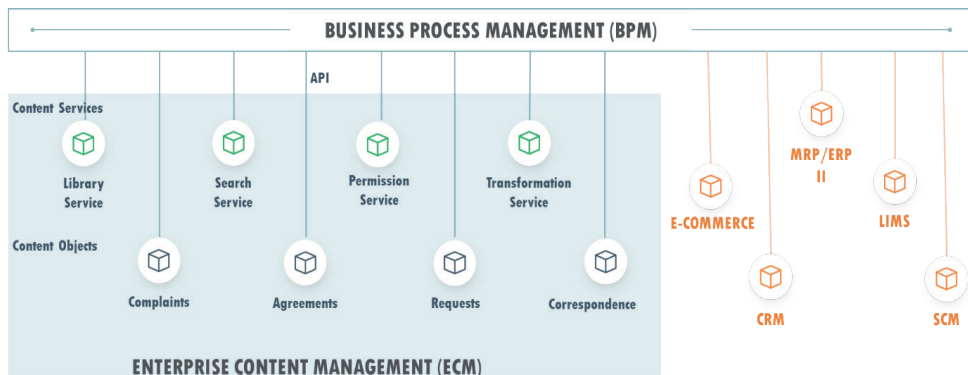

Fig. 5. *Model of process orchestration*

5. RESULTS AND SUMMARY

The case study of the ECM/BPM platform implementation demonstrated that, within an organization's financial, quality, and HR areas, there are processes that require functionalities that are specifically designed to handle unstructured content. Such functionalities are not included in standard BPMS; this underscores the need for integrated platforms that combine process handling with the unstructured content that these processes create or utilize – ECM/BPM platforms. Another observation is the issue of content silos, where content is stored and shared in a non-centralized manner across various organizational systems. To address this, a centralized model was proposed, with an integrated ECM/BPM platform as its main component. This implementation led to the digitization and automation of dozens of processes across various areas of the organization's operations. In some processes (e.g., quality processes), all of the employees are required to participate, resulting in over 5000 active users on the platform. Quality management documents are distributed to each employee exclusively in an electronic form. The ECM/BPM platform repository already holds more than 1.5 million documents from incoming correspondence alone. Each year, the platform handles more than 100,000 invoices and other cost-related documents, which are ultimately posted automatically in the ERP system. The greatest benefit to the organization (as was emphasized by management and employees) is that the implementation of the electronic document and case management system enabled the organization to continue uninterrupted operations during the pandemic. Handling such a volume of processes and documents in a traditional paper-based form would have been extremely challenging – especially when the staff could only work from home.

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