Data Centric BPM and the Emerging Case Management Standard: A Short Survey

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Abstract. Case Management, with its emphasis on the case folder as the anchor for managing business processes, is emerging as a way to provide rich flexibility for knowledge workers while retaining key advantages of BPM systems. This has introduced new challenges in connection with modeling case processes. This short survey traces the history of key modeling ideas and constructs that are being incorporated into the emerging "Case Management Model and Notation (CMMN)" response to the Object Management Group (OMG) request for proposals for a Case Management Process Modeling standard.

Keywords: Case handling systems; Case Management; Case Folder; Business Artifact; Guard-Stage-Milestone; CMMN; Modeling notation.

1 Introduction

Case Management (e.g., [1]) is emerging as a way to support knowledge workers in applications that require a level of flexibility beyond the process flows of classical Business Process Management (BPM). Case Management provides this flexibility through the use of a case folder, which holds a collection of business documents and other information, as the primary building block for managing business processes. In 2010 the Object Management Group (OMG) published a request for proposals [2] for a Case Management Process Model standard, and a response entitled "Case Management Model and Notation (CMMN)" [3] is now under development by a consortium of 10 companies. Although CMMN is still a work in progress, agreement has been reached on the core model and notation. This short survey traces the history of key modeling constructs and ideas that have helped to form the model of CMMN.

Case management (see Sect. 2) is fundamentally data-centric, and draws from a stream of research on data-centric approaches to BPM. One of the most important influences on CMMN is the notion of *business artifacts* (also known as "business entities with lifecycles"), introduced in 2003 [4,5] (Sect. 3). A business artifact pro-

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vides a tight marriage of data and process, incorporating both an *information model* and a *lifecycle model*. Early work on business artifacts, and also some work on business objects (e.g., [6,7]), focused on procedural lifecycle models (Sect. 4). Declarative approaches to data-centric BPM (Sect. 5) have roots in the Event-Condition-Action (ECA) rules paradigm, and began with Vortex [8] and the Case Handling system of [9]. The declarative Guard-Stage-Milestone (GSM) model for business artifacts [10,11,12] draws from that work. Commercial Case Management systems (Sect. 6) are adopting declarative approaches. GSM provides the basis for one of the systems [13], and also provides the foundation for the CMMN core model (Sect. 7).

2 Case Management

Case management or case handling was originally developed to help manage social work and related application areas. It was introduced in the BPM literature by van der Aalst and Weske in 2005 [9] who describe it as "a new paradigm for supporting flexible and knowledge intensive business processes. It is strongly based on data as the typical product of these processes." Market analysts at Forrester define case management as "a highly structured, but also collaborative, dynamic, and information-intensive process that is driven by outside events and requires incremental and progressive responses from the business domain handling the case. Examples of case folders include a patient record, a lawsuit, an insurance claim, or a contract, and the case folder would include all the documents, data, collaboration artifacts, policies, rules, analytics, and other information needed to process and manage the case." [14].

The definitions concur that case management is strongly based on data [9] and is information & knowledge intensive [14]. Although business artifacts were originally developed for traditional BPM domains, they have emerged as a good fit for case management. That premise was analyzed by de Man [15] in 2009, where he found that procedurally-based business artifacts provided useful aspects applicable to case management, but not enough to cover all uses. The introduction of Guard-Stage-Milestone [10] in 2010 enhanced business artifacts to the point that the group of companies working on CMMN [3] has found it a good foundation.

3 Introduction of Business Artifacts

Business artifacts were first introduced in the literature by Nigam and Caswell [4]. In the same year Kumaran et. al. [5] introduced the closely related "Adaptive Documents (ADocs)" model. Both models look at process from the perspective of the information represented in the business artifact (or ADoc) as it evolves over time. Both distinguish business artifacts from business objects; historically the latter are based on a more abstract object-oriented concept that does not explicitly model the lifecycle aspect.

Nigam and Caswell [4] were concerned with "a notation and a methodology useful for business process design at the business operational level". Their operational specification (OpS) tries to achieve a balance between being understandable by business users, and a formal characterization useful for verification. An OpS model specifies the information models and lifecycle models for a family of related business artifact types, and there is no distinction between control flow and data flow.

Document engineering [16] is also related to business artifacts. For example, the document-driven workflows of Wang and Kumar [17] model the process as a flow with *business documents* and *activities* connected by and-forks, or-forks and joins. Each activity produces a distinct document; this contrasts with business artifacts, for which multiple activities may interact with documents over a long period of time.

4 Finite-state machine based lifecycles

In the second half of the decade 2000-2010 the business artifact community and groups extending business objects gravitated towards the use of finite state machines to represent the lifecycles. The notion of associating a state machine with an artifact lifecycle appears in the original ADocs [5]. Kumaran et. al. [18] proposes this association much more explicitly and in particular incorporates activities directly into the state machine, as annotations on the transitions between states. In contrast with OpS, in [18] the interaction between artifacts is limited to activities of one artifact being able to send a message to a different artifact. CMMN also makes this assumption.

In the Business Entity Lifecycle Analytics (BELA) method [19] the states are thought of as *milestones*, i.e., business-relevant operational objectives that an artifact may achieve. Over time the notion of milestone has matured in BELA, and now includes specification of *achieving conditions*, based on which attributes have been assigned values. A related, less formal notion of *milestones with deadlines* is discussed in [20].

Similar to business artifacts, PHILharmonicFlows [7], enable a strong integration of process and data, supporting business objects with finite-state machine based lifecycles. Another finite-state machine based approach for business objects is FlexConnect [6]. In contrast with the artifact approach and with [7], states in FlexConnect represent activities, and the transition between states corresponds implicitly to achievement of a business goal.

5 Declarative Lifecycles

A key ingredient in enabling rich flexibility in data-centric workflow and BPM systems is the shift from procedural to declarative lifecycle models. The prominent work in this area has been rule-based (rather than using, e.g., Linear Temporal Logic).

Perhaps the first publication describing a declarative, data-centric process framework is on Vortex [8], introduced in 1999. Vortex supports highly flexible workflows, especially automated ones for personalization applications in call routing and web store fronts. In Vortex, condition-based *guards* control if/when modules are launched, providing more flexibility than typical flow-based approaches. However, the core Vortex constructs have limitations that prevent their use for general-purpose BPM.

The first publication describing a declarative case management model is [9]. The Case Handling model there is quite rich. The model provides for a collection of *data object definitions* (essentially a case folder) and a collection of *activity definitions*. Each activity has a finite-state machine based lifecycle, and activities are arranged into a directed acyclic graph. The control of activities is formally specified by Event-Condition-Action (ECA) rules derived from the concept of activity pre-conditions.

The GSM approach for specifying declarative artifact lifecycles was introduced in [10] and further refined in [11,12]. GSM can be viewed as a substantial generalization of Vortex that permits multiple artifact types and removes many of the restrictions required in Vortex. Figure 1 shows a sketch of the Requisition Order artifact from a "Make to Order" application [11]. In the figure, rounded rectangles represent *stages*, which model clusters of work performed for the artifact. Stages are hierarchical and may run in parallel. The circles represent *milestones*, corresponding to business-relevant operational objectives that an artifact may achieve. Diamonds correspond to *guards*, which control stage opening. If a stage is open and one of its milestones becomes true, the stage closes (intuitively, because the purpose of a stage is to achieve one of its milestones).

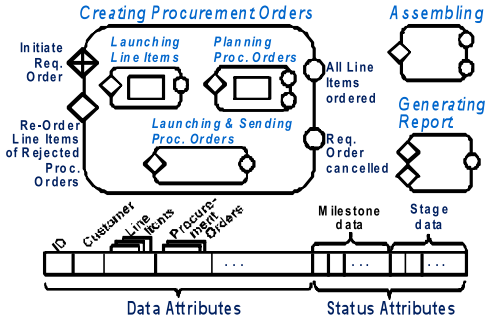

Fig. 1. Requisition Order artifact of "Make to Order" application (adapted from [11])

Guards and milestones are controlled by *sentries*, i.e. expressions of the form **on** <event> **if** <condition> (the **on** or **if** part might be empty). Events may come from the external environment, or be internal, corresponding to a change in stage or milestone status. Sentries are mapped to ECA-like rules, similar to [9]. The operational semantics is based on the notion of *Business Step* (*B-step*), which corresponds intuitively to having the system respond to a single incoming event, including the firing of all applicable ECA rules until stability is achieved.

6 Commercial Products

There are at least three products that have been influential on CMMN development.

FLOWer*:* The Case Handling model described in [9] is a formalization of the model used by the commercial system FLOWer, offered by the company Pallas Athena. As mentioned in Section 5, the Case Handling model assumes that the case processing activities will be executed based on a pre-designed acyclic graph. Activities might be omitted because of pre-designed rules or by case worker choice.

IBM Case Manager: This product [13] was developed based on the GSM ideas. It uses a content management repository for the information model, which consist of a case folder hierarchy and document classes. Placing, removing, or modifying documents in those directories trigger events; these and other kinds of events can be used in guard conditions to launch stages as in GSM.

Cordys Case Management: This product [21] is event driven, and uses the concept of case file with properties for the informational model. The basic building block of the behavioral model is *activity cluster*, which may hold tasks and/or other activity clusters. At the outermost level activity clusters are organized into a state machine. *Dynamic planning* allows users to do instance level planning and adding new tasks.

7 OMG Case Management Process Modeling

The emerging Case Management Model and Notation (CMMN) combines a variety of capabilities, many of which can be traced back to the literature and products described in preceding sections. As with any case-based approach, there is a clear separation in CMMN between the case folder (information model) and the case behavioral model (lifecycle). Since IBM and Cordys are active participants of the team developing CMMN, their products [13,21] have had an influence on the proposal.

The core behavioral model of CMMN comes from GSM. In particular, the behavioral model is composed of tasks, hierarchical stages, milestones and events. These are essentially the same constructs as in GSM, generalized to support finite-state machine based lifecycles (cf. [9]). The GSM operational semantics is generalized for the CMMN model. In GSM milestones are tightly linked to stages, whereas in CMMN the milestones may stand separately from stages (although they can occur nested inside stages).

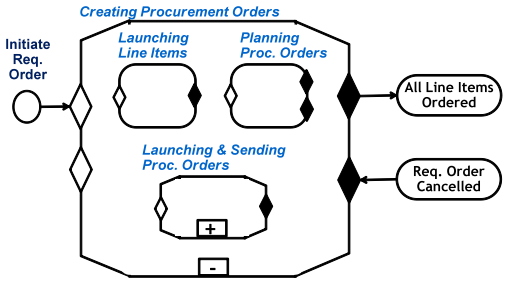

Fig. 2. One stage of Requisition Order of Figure 1, modeled using CMMN notation

An important influence of the Cordys model [21] on CMMN is the ability for case workers to alter the runtime plan. This feature is not present in any of the published business artifact models.

Although the current version of the CMMN proposal [3] does not include examples or a definitive indication on how the notation should be used, we have attempted to model the behavioral aspect of one stage of the "Make to Order" application from Figure 1 in the CMMN notation, shown in Figure 2. (Key – task: rounded rectangle; stage: cut-corner rectangle; milestone: elongated circle; event (listener): circle; guard: white diamond; terminating criteria: black diamond. Arrows are used as a shorthand indicating a triggering relationship.)

8 Conclusions

This survey has traced the history of key concepts that contribute into the draft Case Management Model and Notation (CMMN) standards proposal, with an emphasis on the core modeling constructs. CMMN is just the first step in the establishment of a Case Management standard; we can anticipate refinements and extensions as the community starts to use CMMN in practical settings.

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