

## **SUPPORTING KNOWLEDGE WORKERS: CASE MANAGEMENT MODEL AND NOTATION (CMMN)**

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Since the intensive computer automation of operational and administrative processes there has been increase in demand for knowledge intensive work. Knowledge workers have significant impact on companies they work in but the processes they use in their work are not well supported by technology. Case management with its data centric and artefact based approach to business process management is emerging as a way to provide knowledge workers with flexibility they need in planning and executing their tasks. In January 2013 Object Management Group released specification of Case Management Model and Notation (CMMN). Aim of this paper is to present CMMN basic concepts and provide some insights in ways how CMMN can be used to support knowledge workers and their effectiveness and efficiency.

Keywords: knowledge workers, case management, model, notation

### **1. Introduction**

Growing importance of knowledge workers as the valuable organizational asset has its origins in economic and organizational trends of 20<sup>th</sup> and the beginning of 21st Century. As production technologies developed they generated more information flows and needed more communication to manage organizational processes. As a result the demand for informational labour that is capable of handling, synthesizing and creating knowledge has grown while the demand for traditional manual work that can be easily replaced by automation and mechanization has reduced. Increase in industry productivity made room for new workplace in services re-

quired to meet the needs of modern, post-industrial society where economic success increasingly depends on ability to wisely use knowledge.

Workers who engage knowledge-intensive tasks in their daily work are referred to as knowledge workers. Their primary job is to create, distribute and apply knowledge. Knowledge workers differ from other workers in their autonomy motivation and attitudes [7]. Almost all types of job entail some mental effort but what differentiate knowledge work from other conventional work is processing of non-routine problems that require non-linear and creative thinking. In solving problems knowledge workers organize information artefacts, consider and transform them. They are guided by plans which are continuously adapted in reaction to changes of working environment. In modern organizations there are many people who do both knowledge and manual work. Drucker calls them “technologists”. Knowledge in technologist work is relatively subordinate but always necessary [5].

Over last decades it has been reported a growth not only in number of knowledge workers but also in their importance to organizational success. In 2007 McKinsey expected that by 2015 knowledge workers would have accounted for about 44 per cent of total US workforce.

Knowledge workers have significant impact on companies they work in but the processes they use in their work are not well supported by technology. In appraising performance of knowledge worker quality is the first criterion. It means that knowledge worker must or, at least, should concentrate on his or her tasks and eliminate everything else. Case management with its data centric and artefact based approach to business process management is emerging as a way to provide knowledge workers with flexibility they need in planning and executing their tasks.

In January 2013 Object Management Group (OMG) released specification of Case Management Model and Notation (CMMN). Aim of this paper is to present CMMN basic concepts and provide some insights in ways how CMMN can be used to support knowledge workers in improving their performance.

## **2. Case management**

Case management as a practice was developed to help organizations such as government agencies, banks, big legal firms and insurance providers handle complex customer and service interactions. Set of activities, interactions with customer and other parties that are necessary to deal with customer request is known as a “case”. All information concerning the case is gathered in the case folder during the processing to record and to evaluate case progress. The staff working on the case can decide how some parts of the case should be handled relying on his or her judgement and discretion. Although cases follow some general patterns, each particular case can take its own path depending on circumstances and whose case is being processed.

In the business process management literature term “case handling” was introduced by van der Aalst and Weske in 2005 [8] who described it as “a new paradigm for supporting flexible and knowledge intensive business processes”. Building on deficiencies of traditional workflow systems they proposed case handling meta model which position case as a central concept - a “product” with structure and state. Proposed model assumed data and process integration because the state of case (i.e., which activities were enabled) was determined by the presence of data objects. Case workers (actors) could play multiple roles with different rights in model what guaranteed them some degree of freedom.

Forrester analysts 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” [5]. Whereas BPTrends in one of white papers characterizes case management as “long-lived collaborative processes that coordinate knowledge, content, correspondence and resources to progress a case to achieve a particular goal; where the path of execution cannot be predetermined in advance of execution; where human judgment is required to determine how the end goal can be achieved; and where the state of a case can be altered by external out-of-band events” [7].

Both definitions highlight role of knowledge and information in case processing, unpredictable nature of cases, their dynamics, multiplicity of participants and roles, importance of collaboration and coordination. These characteristics indicate not only reasons why case management is so poorly supported but also challenges of its automation.

Staff acquire their knowledge through their experience working on similar cases and through collaboration, becoming thoroughly familiar with the tacit and explicit rules governing how cases should be managed. Obtained knowledge should be quickly applied to process definitions to improve them according to the assumption that solving new problems can be based on solution of similar past problems.

Case management entails collection of diverse data including documents, records, e-mails etc. They can be in different formats, structured and unstructured, can come from different resources. There is a need to effectively store, maintain and retrieve case information. Case data should be always provided in the context of current state of the case. Moreover it should be presented to all users in appropriate way and time so they do not become overwhelmed by its volume.

A case can change in unpredictable, dynamic and ad hoc ways as it is progressed through an organization. Although overall pattern of typical case is known, each stage can result in range of outcomes which determine next stage or stages. Traditional process automation assumes that a sequence or pattern can be defined a priori during analysis or design phase. Any routing that is not specified at design

time will not be supported by the system at run-time. However, as far as case automation is concerned, there is no predetermined sequence, and new tasks and processes can be added at any point during the life cycle of the case as the need for them arises. It does not mean that case management cannot be supported by IT or even automated. Any job represents a certain point of a spectrum running from “well defined procedure” to loosely defined “discretionary practice” [7].

Cases can evolve based on users’ decisions and experience. In the beginning of formalization case management practice users have to learn how to specify applicability rules for case activities. Over time they might find out some recurring patterns in case processing.

Presented characteristics of case management cannot be expressed in Business Process Model and Notation (BPMN) which is de facto modelling standard of control flow based processes adopted by most state-of-art business process management systems (BPMS). Dealing with unique, unpredictable cases requires different analysis techniques, different notation and new tools that will implement them. The tools should allow knowledge workers to be involved in designing of processes they participate in. Knowledge workers should be able to define the processes, make changes to them by themselves as a part of their process work. For these reasons OMG and several BPMS vendors have shown an interest in standardization of case management modelling.

### **3. Case management model and notation (CMMN)**

#### **3.1. Background**

In January 2013 OMG released beta version of CMMN specification which is currently in finalization phase [5]. It has been developed to complement BPMN in modelling and managing processes that depend on circumstances and ad-hoc decisions of knowledge workers. CMMN draws on variety of concepts. Many of them can be traced back to the literature and commercial products.

Business artefact is one of the most important notions that laid foundation for CMMN. According to Bhattacharya et al, a business artefact is defined as a business entity used to store information pertinent to a given business context and meaningful to the business user. It has a lifecycle from creation to completion and unique identifier that allows identification of an artefact across the enterprise. Business artefacts allow for measuring whether or not business goals are going to be achieved. [5]. To represent artefact lifecycle, finite state machines were widely used (e.g. by Kumaran et al in ADocs ) [5]. The states are thought of as milestones, i.e., business-relevant operational objectives that an artefact may meet (c.f. Business Entity Lifecycle Analytics method). Declarative lifecycle models were adopted for process management flexibility. The Guard-Stage-Milestone (GSM) ap-

proach was introduced by Hull et al for specifying business entity lifecycles [8]. It enhanced business artefacts to the point that OMG has found GSM to provide basis for CMMN core model.

At least three commercial products have been influential in CMMN development: FLOWer by Pallas Athena (meta-model presented by van der Aalst and Weske was formalization of FLOWer assumptions), IBM Case Manager (developed on GSM ideas, deploys case folder hierarchy and document classes) and Cordys Case Management (uses concept of case file as an information model and activity cluster as building block of behavioural model, offers ability for users to alter run-time plan).

### 3.2. Model

A case is a central notion of CMMN meta-model. OMG defines case “as a proceeding that involves actions taken regarding a subject in a particular situation to achieve a desired outcome” [1, p.15].

Case is top level concept that combines all elements that constitute case model: case file, case plan and case roles. Figure 1 presents relations between case and its plan model.

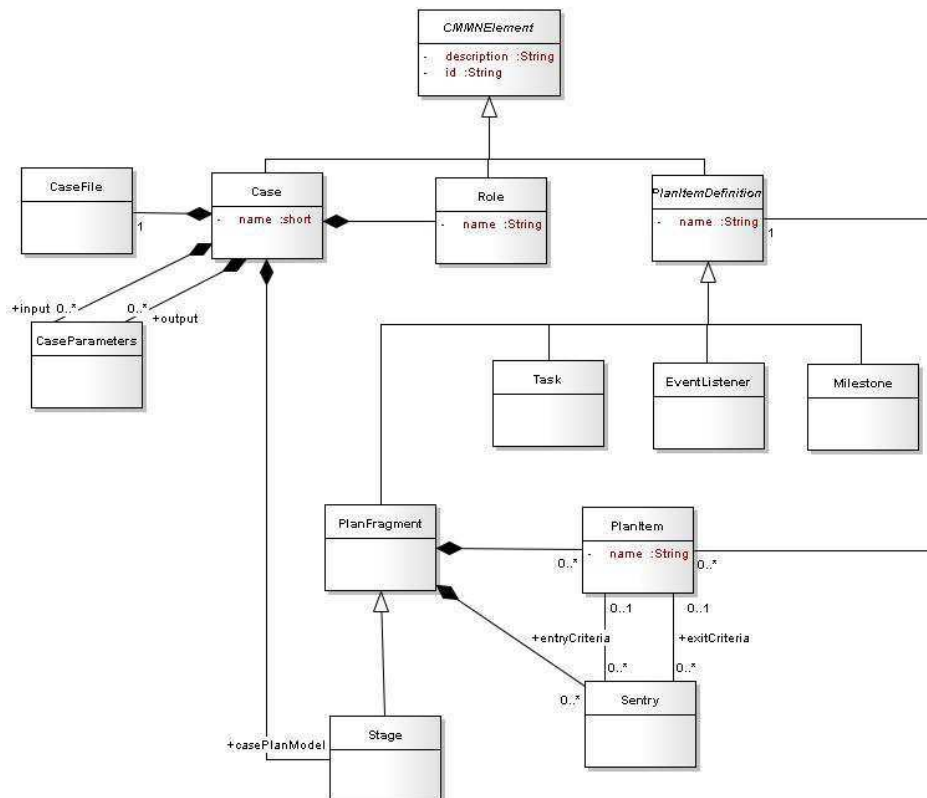
A case is different from a process which is predefined, fully specified and repeatable. Process model specified at the design time serves as its plan for execution. Process planning is equivalent to process modelling. Fundamental characteristic of case management is planning at run-time. During the design-time phase, business analysts define tasks that are always part of pre-defined segments in the case model, and “discretionary” tasks that are available to the case worker, to be applied in addition, to his/her discretion. In the run-time phase, case workers not only execute the plan, particularly by performing tasks but they can add discretionary tasks to the plan of the case instance as well. This run-time planning is based on information that has become available to the case.

Documents and other unstructured or structured data about a case are captured and referenced in the case file for decision-making by case workers. Case file is logical information model. Information in the case file serves as context for raising events and evaluating expressions as well as reference point for case parameters, such as inputs and outputs of tasks. Case file also serves as a container for data that is accessible (through case parameters) to other systems and people outside the case.

Plan model contains all elements that represent initial plan of the case and all elements that support the further evolution of the plan through run-time planning by knowledge workers. Plan consists of tasks, event listeners and milestones organized by stages, meant to handle the case.

Task is an atomic unit of work. It can denote human task or serve to invoke processes or other cases. Event listener is used to capture time and user events.

Milestone is a plan element, which represents an achievable target, defined to enable evaluation of progress of the case. Stage can contain any element required to construct and further evolve case plans. It is a recursive concept - stages can be nested within other stages. The “most outer” stage is associated to the case as its plan. Stage has its run-time representation, thus its progress and completion can be tracked based on its lifecycle.



**Figure 1.** Case model as UML class diagram  
Source: Own elaboration based on [5]

Sentry is a criterion to enable or terminate a task or stage or to achieve a milestone. It is defined as combination of zero or more events and zero or one condition. A sentry, as criterion, is satisfied when the event(s) has (have) occurred, and the condition has evaluated to “true”. Sentries express dependencies between plan items. If sentry is satisfied, plan item is enabled (entered) or terminated (exited). For example: completion of one task satisfies the sentry that enables the start of the other.

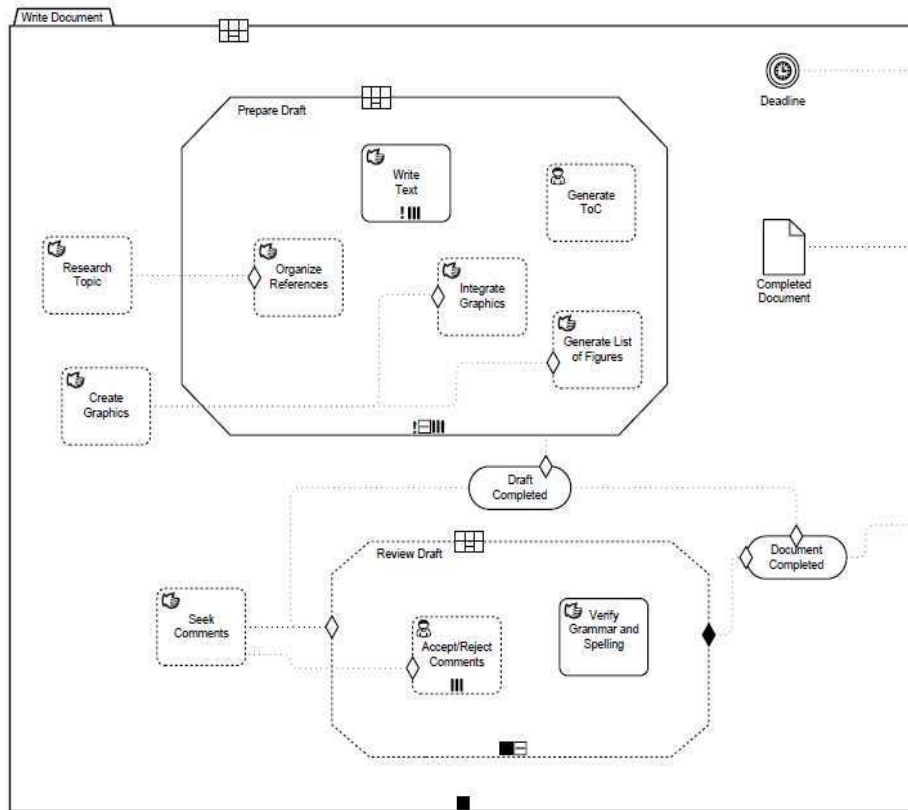
As mentioned above, planning is a run-time effort. It is regulated by planning table that defines scope of planning. Planning table comprises set of elements that can be considered for planning stage or task, rules that regulate their applicability and references to roles that are authorized to use the elements to their “discretion”.

### 3.3. Notation

The CMMN notation provides for the depiction of the behavioural elements of a case (i.e. elements of a plan). Case plan is depicted using a “folder” shape with the name of the case. All elements of case plan model are located within boundaries of case plan shape. Because of declarative nature of CMMN relative positions of shapes have no meaning. Every type of plan item has individual shape assigned to it. A stage is depicted by a rectangle shape with angled corners whereas task is a rectangle with rounded corner. Depending on type and/or parameters, task shape can have some additional symbol placed in upper left corner (e.g. “hand” symbol denotes non-blocking human task). Composite elements (e.g. stages) can take collapsed or expanded form. Discretionary items are outline with dashed lines. Plan items may have associated sentries. Sentry can be used as entry (shallow “diamond” shape) or exit criterion (solid “diamond” shape). When allowed, “diamonds” can be placed as decorator anywhere on the boundary of a plan item shape. Rectangle with half-rounded ends gives a picture to milestone. An event listener is depicted by a double line circle shape with an open centre so that markers can be placed inside to indicate variations of an event listener. Certain dependencies between elements (e.g. when one task depends on completion of other task) can be expressed by connectors. The shape of the connector object is a dotted line.

A stage or a human task can have a planning table. A planning table is symbolized by a “table” shape composed of six cells with the centre bottom cell containing a marker indicating if the discretionary items are visualized or not. The planning table symbol can only be placed as a decorator on the boundary of a stage or a human task.

Figure 2 illustrates process of paper writing modelled with CMMN. Paper writing is undoubtedly intensive knowledge work. It can be handled in different ways. Process has two milestones (draft completed and document completed) that have to be reached. Many tasks (e.g. seek comments) or even stage (i.e. review draft stage) is left to the discretion of the author – case plan and both stages have expanded planning tables. Prepare draft stage with write text task is mandatory. This stage has defined repetition rule what is symbolized by repetition decorator (three bold, black bars). It can be altered by further research or graphic creation. Process will be finished when document is created or the deadline is reached.



**Figure 2.** Paper writing process modelled using CMMN  
Source: [5]

#### 4. Summary and conclusion

Although knowledge work is based on using knowledge, creativity and experience in handling unpredictable and unrepeatable cases, it can be guided and assisted by case management systems. Cases as essential proceedings can be modelled and executed to certain extent. Knowledge workers should be able to define at least “documents” that case is assumed to require or produce, the roles that perform the work and non-exhaustive and maybe only preliminary list of activities that might be relevant in the context of the case. CMMN with its tasks, event listeners, milestones and planning tables offers appropriate tool for this type of modelling. Modelling itself can help knowledge worker to think out his or her tasks to eliminate everything that hampers their performance. Moreover creating the model is first step in implementation of case management system which conducting “rou-



tine” activities allows knowledge workers to concentrate on crucial and creative ones. User is not obliged to predict thoroughly the entire case proceeding, but she or he is rather expected to model some main episodes of the case which provide basis to create and execute case instances. CMMN follows evolutionary paradigm. It assumes that during execution with gaining experience user will be able to reveal and define more plan elements and the rules that regulate their applicability and behaviour, and then to incorporate them iteratively into case model. Building on variety of concepts CMMN represents universal solution that provides interoperability (XML Model for Interchange, XML Schema) and execution semantics.

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