CASE MANAGEMENT MODEL AND NOTATION - A SHOWCASE

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Abstract

In this paper, differences and similarities of the Business Process Model and Notation (BPMN) and CMMN are revealed. After introducing the visual CMMN elements, ad-hoc and event sub-processes are then introduced as flexible approaches in BPMN. Although many CMMN elements can be substituted by BPMN constructs, the notations pursue different approaches to modeling processes.

The findings of the literature review resulted in a model for distinguishing BPMN and CMMN, considering participation of knowledge workers as well as the predictability of the process. While CMMN covers the section of less predictable processes with the active involvement of knowledge workers making decisions and planning during run-time, BPMN is best used for highly predictable work where knowledge workers mainly execute tasks.

The results are verified by a case study. The naturalization process of the Swiss canton of Schwyz is translated from BPMN to CMMN to highlight advantages and disadvantages of the new notation. On the basis of the case study, we propose to introduce a visual representation for roles in CMMN as well as to support a case-task element in BPMN to support interaction between the two standards.

Keywords: CMMN, BPMN

Introduction:

In recent decades, there has been a focus on modeling and automating well-structured and routine processes. For these pre-defined processes, the Object Management Group (OMG)'s Business Process Model and Notation (BPMN) has become a commonly accepted standard (OMG, 2011). However, the amount of work done by knowledge workers was 25 - 40% in 2005 (BPTrends, 2009) and is likely to have increased since then. The tasks which knowledge workers such as doctors, judges, executives, or private

bankers execute are difficult to describe owing to the complexity of the work and the high degree of collaboration, which are two main factors defining knowledge work (Davenport, 2005).

Case management (CM) was introduced as a tool for knowledge workers by van der Aalst in 2005 (Van Der Aalst, Weske, & Grünbauer, 2005). Its focus is on supporting unpredictable, knowledge-intensive and weakly-structured processes. In contrast to classic processes, a certain goal and providing possibilities to choose from is more important than the way to achieve the goal itself. Swenson mentions two distinct approaches to case management called Adaptive Case Management (ACM) and Production Case Management (PCM) respectively. With ACM, knowledge workers are allowed to manipulate the case for planning as well as at run-time without constraints. PCM, however, distinguishes between design-time, when the possible elements are developed, and run-time, when the case worker selects tasks and the case evolves (Swenson, 2012).

In May 2014, the OMG, the same organization responsible for BPMN, published a standard for case management called Case Management Model and Notation (CMMN) (OMG, 2014). With BPMN 2.0, elements, for example “ad-hoc sub-process” and “event sub-process”, supporting unstructured work were introduced (OMG, 2011). There has also been discussion about whether a separate standard for case management such as CMMN and extension of the established BPMN standard with elements for case management would be the best solution.

This paper focusses on the differences and similarities between CMMN and BPMN. After an explanation of the methodology in Section 2, a brief introduction of the elements included in CMMN is provided in Section 3 together with flexible BPMN elements. In addition, a comparison of CMMN elements with corresponding elements from BPMN is provided. A literature review will show similarities and differences between BPMN and CMMN. In the case study in Section 5, the results of the literature review are examined and this is followed by a conclusion on whether the existence of CMMN is justified.

I.

2. Methodology

Since CMMN is a relatively new standard, a brief introduction is provided here to aid comprehension. However, apart from ad-hoc and event sub-processes, an explanation of BPMN is not included because it has been well documented elsewhere and the first version was published back in 2004. The literature review forms the foundation of the study and by means of argumentative and deductive reasoning, the differences and similarities between BPMN and CMMN are determined. The standard CMMN contains

fewer elements and is also less complex[109] than BPMN (Marin, Lotriet, & Van Der Poll, 2014), which is the reason why the elements of CMMN are addressed first. Later, an attempt is made to match counterparts from BPMN in order to identify the elements which can be modeled with BPMN as well.

Having identified the similarities and differences between CMMN and BPMN, the results are verified and critically challenged within the framework of a case study. This approach is referenced in literature by prototyping (Wilde & Hess, 2007). The naturalization process model of the Swiss canton of Schwyz is translated from BPMN to CMMN.

3. BPMN Compared With CMMN

3. 1 What is CMMN?

CMMN is a standard for case management published by the OMG. Since CMMN is a relatively new standard and is still beginning to be widely known, a short introduction of the key elements and relationships between these elements is provided below.

The *case* is a top-level concept which combines all the elements that constitute a case model. It consists of the name of the case in question, lists all possible case roles, and references the *CaseFileModel* as well as the C*asePlanModel*. Roles are used to allow different groups of people to interact with the case in different ways. For example, a manager can plan items at run-time whereas regular workers can only execute these planned elements.

All the information and data used in the case is centrally stored in the *CaseFile* and it includes the context for raising events and evaluating expressions. It also functions as a container for data accessible from other systems. The *CaseFile* consists of *CaseFileItems* which can be any type of information source ranging from a simple XML to a complete folder hierarchy.

There are many different plan items which can be used for modeling the case. Some of them are similar to elements of BPMN, one of them being the *EventListener*. *EventListeners* which can be triggered after a certain amount of time has elapsed (*TimerEventListener*) or manually by a user (*UserEventListener*). *Milestones* are achievable targets which enable evaluation of case progress. No work is directly associated with a milestone but completion of a set of tasks or the availability of key deliverables typically lead to reaching a milestone. A *task* represents an atomic unit of work and there are three types of task. Firstly, the *ProcessTask* invokes a defined process and passes parameters to this process. Secondly, the *CaseTask* invokes a new case that has its own context and also passes

[109] Complexity does refer to the standard and not to the content of the models.

parameters to this newly activated case. Thirdly, for work being performed by case workers, a *HumanTask* can be used. While the system is awaiting the completion of the task, it is called a *Blocking HumanTask*. When the case continues directly after invoking the HumanTask, it is called a *Non-Blocking HumanTask* and can be viewed as if it were a manual task because its status is not tracked by the system.

Dependencies are modeled using *sentries*. A sentry "watches out" for events to occur (the *onPart* of the sentry) and/or a condition to be true (the *ifPart* of the sentry). It is placed on other elements such as stages, tasks, or milestones and is deemed to be satisfied when the onPart occurs and all ifParts are true. When an entry criterion is satisfied, the corresponding task or stage is enabled or a milestone is achieved. An exit criterion terminates a task or stage once completed.

Stages are used to group *PlanItems* and *sentries* in order to arrange them clearly. The outermost stage is called the *casePlanModel* and contains all other elements used in the case.

In contrast to BPMN, there is a clear distinction between design-time, where the whole case is modeled before knowledge workers actually execute the case, and run-time planning. With run-time, case workers can plan elements which are called *discretionaryItems* and are depicted with a dotted line as a border. When a stage consists of (or a HumanTask is associated with) discretionary items, they are decorated with a *PlanningTable*. If the planning table shows a plus sign, the *discretionaryItems* are hidden. If the planning table shows a minus sign, the *discretionaryItems* are shown.

Aspects of control are modeled with *PlanItemControl* elements. There are three different rules which can be applied to stages, tasks, and in some cases to milestones. Firstly, there is the *ManualActivationRule* according to which a task or stage starts automatically or manually. Secondly, the *RequiredRule* defines when an element must be complete before its containing stage can be completed. Thirdly, the *RepetitionRule* defines if and when an item has repetitions (OMG, 2014).

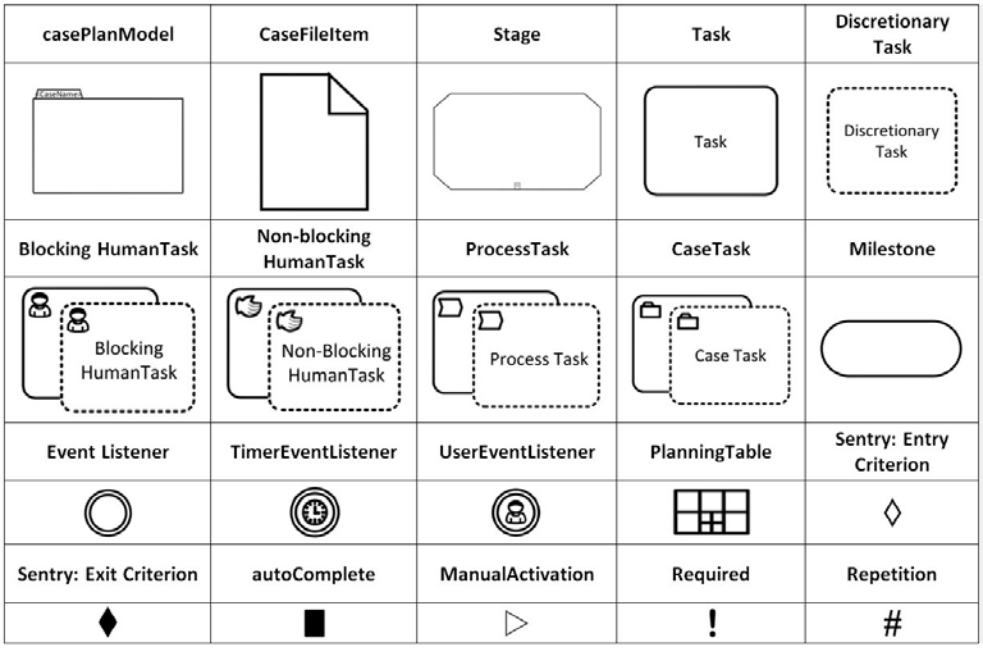

Fig. 1. Visual CMMN elements

3.2 BPMN - Attempts Towards Greater Flexibility

There have been attempts to support flexibility within BPMN processes with ad-hoc and event sub-processes. Since the first version of BPMN, ad-hoc sub-processes have been supported. However, in BPMN 2.0, the behavior of ad-hoc sub-processes is described in more detail than in the previous versions and event sub-processes are included in the standard for the first time in Version 2.0.

3.2.1 Ad-hoc sub-process

Ad-hoc sub-processes are marked with the tilde symbol (~) and contain internal tasks and sub-processes. The elements located in the ad-hoc sub-process can be executed in any order, multiple times, or even omitted altogether. The person operating the process is responsible for this decision since there are no rules attached to the elements in the ad-hoc sub-process. Data objects, sequence flows, associations, groups, message flows, gateways, and intermediate events may (and activities must) occur within an ad-hoc sub-process. BPMN 2.0 specifies that start and end events, symbols for conversations, and choreographies are not to be used within an ad-hoc sub-process.

3.2.2 Event sub-process

An event sub-process is placed into another sub-process and it becomes active as soon as the corresponding start event is triggered. The

surrounding sub-process is either interrupted or executed in parallel depending on the start event. Designing models with event sub-processes assists understanding and it is considered best practice to wrap parts of processes that are repeated, executed multiple times in parallel, or cancelled, in event sub-processes (OMG, 2011).

3.3 Comparison of Elements

In *Table 1*, the visual elements of CMMN are listed. For each element, we found either a direct matching element (green section), an indirect way to model the same behavior (yellow section), or no possibility of expressing a CMMN element in BPMN (red section).

Table 1. Comparison of CMMN objects with BPMN objects

CMMN Object	BPMN Object
CaseFile	Data Store
CaseFileItem	Data Object
EventListener	Start Event
TimerEventListener	Timer Start Event
Task	Abstract Task
HumanTask	User Task / Manual Task
RepetitionRule	Loop Characteristics / Gateways
Sentry	(Conditional) Sequence Flow
Stage	(Ad-Hoc) Sub-Process / Group
Milestone	Event
DiscretionaryItem	Ad-hoc sub-process
ProcessTask	Message Events / Send and Receive Task / Signal Events
RequiredRule	Default
PlanningTable	Tilde symbol of ad-hoc sub-process
Sentry (ifPart)	Event
Case	-
CaseTask	-
UserEventListener	-
ApplicabilityRule	-
ManualActivationRule	-

The elements in the green section correspond completely with elements from BPMN. Therefore, no further explanation is needed, except in the case of the *RepetitionRule*, which can be represented directly with the loop characteristics - or loops can be modeled with gateways and flow elements.

Additional comment is needed for the elements in the yellow section, which cannot be represented with equivalent BPMN items.

- *Milestone*: In CMMN, milestones are used to indicate progress. In a process, the evolution of the process can be shown by triggering events.
- *DiscretionaryItem*: Discretionary items are plannable objects during run-time. In BPMN, there is no such thing as planning during the execution of the process. Nevertheless, tasks in an ad-hoc sub-process can be selected if required.
- *ProcessTask*: A process task activates a BPMN process outside the context of the case. Even if there is no task element in BPMN which calls another process, this behavior can be designed with send and receive tasks or signal events.
- *RequiredRule*: Elements are required to be executed by default in BPMN. Nevertheless, this optional rule is not available in ad-hoc sub-processes. The knowledge worker has to decide autonomously whether the task should be performed.
- *PlanningTable*: Given that discretionary items correspond to elements in an ad-hoc sub-process, the tilde symbol of the ad-hoc sub-process indicates plannable objects such as a planning table in CMMN.
- *Sentry (ifPart)*: Sentries placed on the border of an item without a connection to another element are used to apply rules. Tasks or stages become active or plannable under certain conditions. This can be modeled in BPMN with events. Nevertheless, the model becomes confusing when multiple events are placed on numerous items.

Furthermore, CMMN includes elements with no equivalent in BPMN and no work-around. The elements *Case* and *CaseTask* belong in this category. BPMN does not yet support case management and in particular CMMN. It would make sense to include these items in the future if CMMN were to become an accepted standard for case management. *UserEventListeners* are triggered by a user but this manual activation of an element is not possible in BPMN. As planning is only partially supported by BPMN (ad-hoc sub-processes), the *ApplicabilityRule* is not really supported either. Items in ad-hoc sub-processes are automatically applicable to the knowledge worker. The last element not included in BPMN is the *ManualActivationRule*. This specifies under what conditions tasks and stages begin automatically or must be started manually. In processes, all tasks and sub-processes start automatically by default.

4. Literature Review

The following sections focus on different topics related to BPMN and CMMN.

4.1 Complexity

In Marin et al., the complexity of CMMN is examined, this being the initial criterion for comparing the standard with other process-modeling notations, including BPMN. It was found that CMMN is less complex than BPMN, suggesting that CMMN is easier to learn and more user-friendly. This result also indicates that if one of the notations were expanded to include the other, BPMN would be extended using CMMN and not vice versa (Marin et al., 2014).

4.2 Spectrum of Work

Work can be classified from routine, prescribed work to unpredictable knowledge work. On the left-hand side of Figure 2, automatable work which can be modeled before run-time is defined. Those people carry out the work but are not responsible for the evolution of the process. On the right-hand side of the spectrum, there is the unpredictable, non-routine work. Case workers not only execute the tasks available but also plan and decide which tasks should be performed. Whereas BPMN can be placed between fully automated processes and flexible processes, CMMN covers the section on the right-hand side (Motahari-Nezhad & Swenson, 2013).

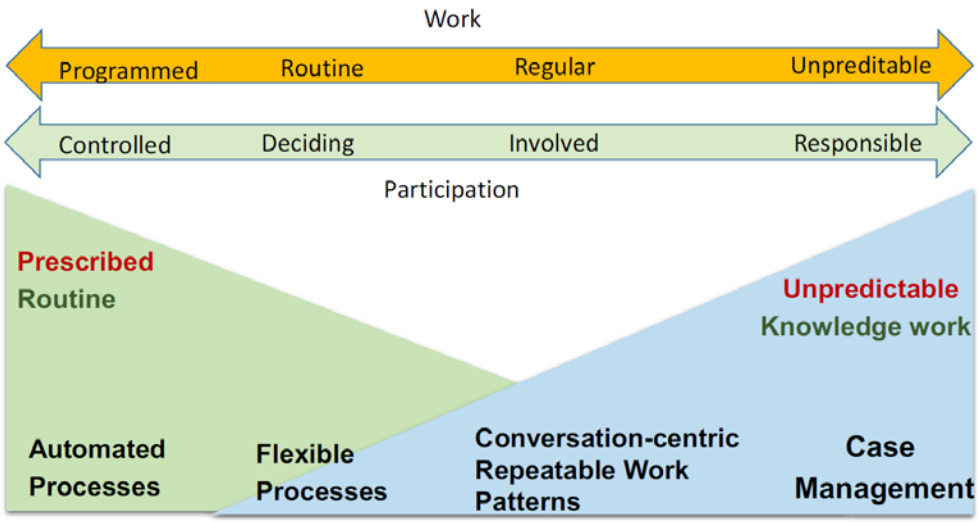

Fig. 2. Classification of work and participation

4.3 Scenarios for Process Automation

Two factors, namely how structured a process is and which actors interact with each other, can be used to compare different process tools. A process might be highly structured, weakly structured, ad-hoc structured, or unstructured. The process model is available before the run-time and the

process adheres to this strictly during execution for highly structured processes. For weakly structured processes, a model exists before execution but allows for a certain amount of flexibility during run-time. Ad-hoc processes are characterized by a raw process model at design-time but are executed infrequently or once only. Unstructured processes can be modeled only vaguely or not at all before run-time. Interactions can happen between people and/or applications. Three possibilities, P2P (People to People), A2A (Application to Application), and P2A (People to Application) can occur. BPMN covers the area of highly structured processes where people interact either with other people or with applications. Case management and therefore CMMN also covers the areas P2P and P2A, but for weakly structured processes. However, an overlapping of modern BPM systems and case management can be observed, illustrating that parts of processes can be modeled by either notation (Tony et al., 2013).

4.4 Comparing BPM and Case Management

In Auer, Hinterholzer, Kubovy, and Küng, BPMN and CMMN are compared with a focus on how suitable the notations are for supporting knowledge work. Four aspects are covered in the study: Complexity of work, level of interdependency, flexibility, and knowledge work. Complexity of work includes predictability, which is high for BPM and low for case management, as well as routine. BPMN covers routine work whereas CMMN favors knowledge-intensive, non-routine work. The second aspect is the level of interdependency: BPMN and CMMN can handle both individual performers and collaborative groups. In contrast to BPM, however, case management allows run-time changes. Whereas BPMN is activity-centric and data updates can only occur within tasks, CMMN is driven by data and the user. Data can be updated as long as the case is active. The two parameters ‘activation’ and ‘data updates’ are combined under ‘flexibility’. The fourth and last aspect is knowledge work. In traditional processes, knowledge is used to design the process. During run-time, the role of the user is limited to executing the process. In case management, knowledge is required while designing as well as executing the case. Furthermore, the knowledge worker executes and plans throughout the run-time phase. (Auer, Hinterholzer, Kubovy, & Küng, 2014).

4.5 Seven Domains of Predictability

Another comparison of the different technologies is made by Swenson. In Figure 3, the technologies are classified by their predictability and how many times a process is carried out. In addition, the type of data and how structured it is, is assigned to the technologies. On one side of the spectrum, for highly predictable and repeatable processes, there is

application development. Databases and structured data are used with application development. On the other side of the spectrum, there are unique and highly variable processes with completely unstructured data. Case management lies between these two extremes. As stated in the introduction to this paper, Swenson mentions two distinct approaches to case management which are called Adaptive Case Management (ACM) and Production Case Management (PCM) (Swenson, 2012). Since CMMN does not introduce (but nor does it explicitly forbid) creating new elements during run-time, we may assume that CMMN is a standard for production case management rather than for adaptive case management. PCM is a flexible approach yet with a predefined set of possible actions to choose from and it is designed for high volume situations. However, the author explicitly chooses not to rank BPM in this model (Swenson, 2013).

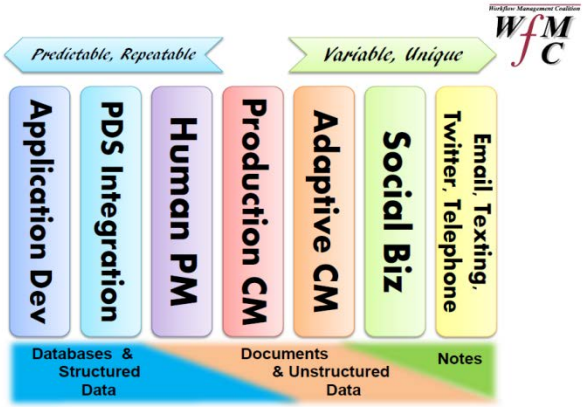

Fig. 3. Comparison of different technologies

4.6 Conclusion of the Literature Review

Both BPMN and CMMN are used to describe repeatable processes. The development of models for unique processes is not feasible since the benefits do not justify the costs involved. Furthermore, the notations apply to systems where people interact either with other people or applications. BPMN and CMMN handle individual performers in addition to collaborative groups.

BPMN, however, is used for predictable and well-structured processes with a little complex work and therefore minimal participation by knowledge workers. This is in direct contrast to the characterization of CMMN, which is designed for unpredictable and flexible processes. Data is central and tasks have to be executed and can be planned by knowledge workers.

The literature review results in the following model for comparing CMMN and BPMN (see Fig. 4). Participation of knowledge workers and the predictability of the process seem to be the two most critical factors.

- Participation: Knowledge workers contribute to a process in different ways. Either they only carry out the tasks given, decide on, and actively influence the evolution of the process, *or* they actually plan tasks during run-time.
- Predictability: This includes the predictability of the process before it is executed.

As stated above, CMMN covers the section of processes with low predictability with the active involvement of knowledge workers making decisions and planning during run-time. BPMN is best used for highly predictable work where knowledge workers mainly execute tasks. However, there is an area of overlap where both notations may be used.

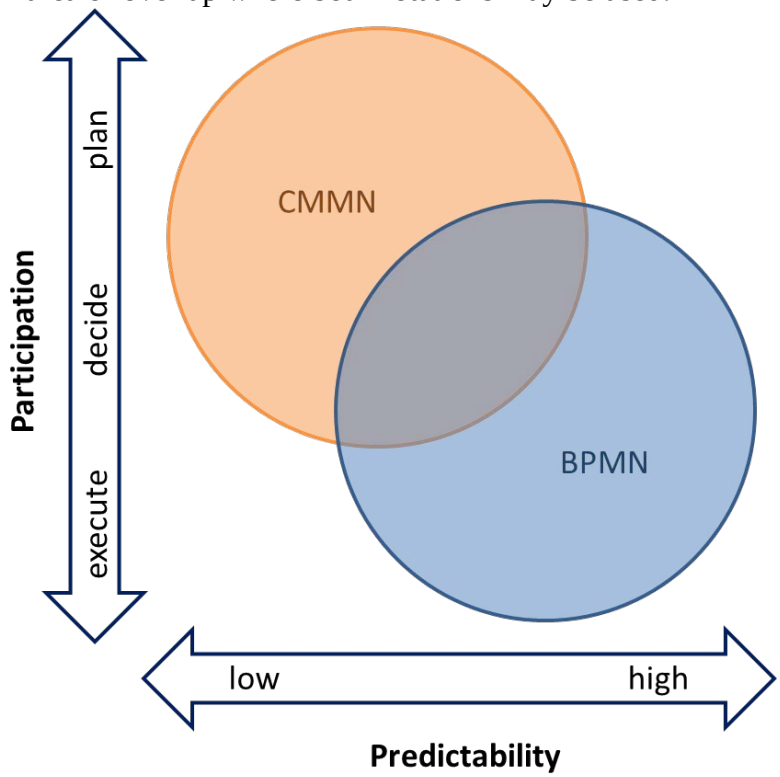

Fig. 4 Areas covered by CMMN and BPMN

5. Case Study

The aim of the case study is to verify whether the outcome of the literature review can be validated. Here the naturalization process used by the Swiss Canton of Schwyz modeled in BPMN is translated to CMMN. Since public administration processes are often document-driven and collaborative, the work is considered knowledge work and therefore CMMN is suitable for modeling such a process. Using the two dimensions 'participation' and 'predictability' from the previous sections, the

naturalization process can be classified as moderately predictable and moderately participative. Hence, it is in the overlapping region shown in Figure 4.

Initially, we tried to translate the BPMN process to CMMN with respect to the semantic. The connections with a sentry were used as sequence flows but the model lacked flexibility for the knowledge worker. In order to provide greater flexibility for the case workers, we redesigned the model by taking the paradigms of case management into account, having discovered this during the literature review and leading ultimately to the model in Section 4.6. The participation and responsibility of the knowledge workers increased and expanded from primarily one of execution to include decision-making and planning during run-time.

5.1 BPMN Process

There are two main protagonists involved in the naturalization process: One of them is the applicant and the other is the local government of Schwyz on whom we will focus in this study. In addition to this, the Cantonal Police Department has a minor role. The communication flow between the different parties is illustrated in Figure 5 to assist understanding of the whole process.

The process for the local government starts with informing the applicant about the procedure and handing out the application forms. On receipt of the relevant documents from the applicant, an initial invoice is sent to the applicant and the documents are checked for completeness and formal correctness. If necessary, the documents are returned for correction or additional information. As soon as all the documents are to hand and the fee has been paid, the documentation is checked and a character reference is requested from the police. If, after review, there are insufficient grounds to grant the application, the applicant is informed and the process is terminated. If the review is successful, the next step is to publish details in the official gazette. For a period of 20 days, citizens may lodge objections to the application with the local government, and these are added to the record. After the 20-day period is over, a second invoice is sent to the applicant and once paid, a date for the naturalization interview is set. The applicant has the opportunity to write a statement and if he or she chooses to do so, the statement is added to the record. On the basis of the documentation provided, the final decision is made. If the decision is negative, the candidate is informed and the process terminated.

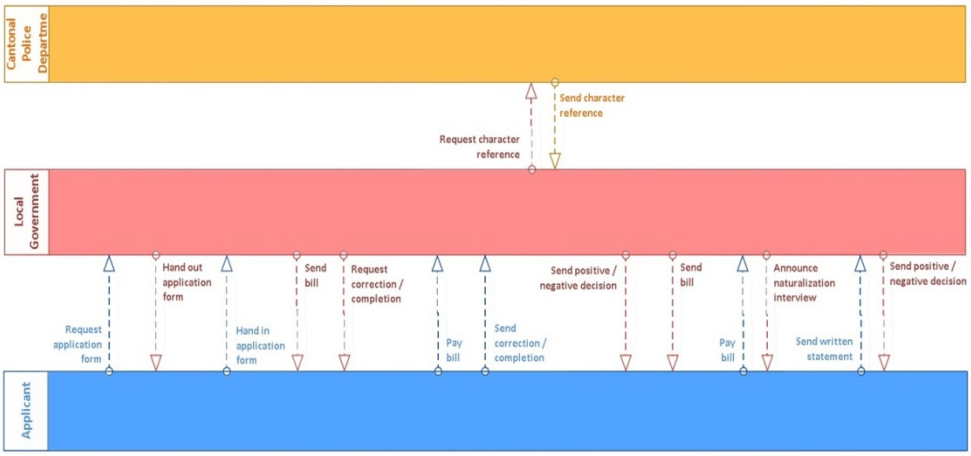

Fig. 5. BPMN model of communication flow

5.2 CMMN Case

The case includes five different stages: *inform applicant, naturalization interview, check documents, publicize candidature,* and the discretionary *billing* stage. Additionally, a case file called *'applicants dossier'* where all documents are stored as well as the option to terminate the case manually are modeled in the case (Fig. 6).

In the *inform applicant* stage, which is the starting point of the case, the knowledge worker has to inform the applicant about the procedure and provide the application form. As soon as these two tasks have been carried out, the stage is automatically completed. The next stage – *check documents* - is available to the knowledge worker after the candidate has been informed (the onPart of the sentry) and the required documents are added to the dossier (the ifPart of the sentry). The *check documents* stage emphasizes the advantages of CMMN compared with BPMN. All documents have to be checked for completeness, formal correctness, and suitability for naturalization. Different knowledge workers can work on different files at different points in time. The character reference has to be requested from the Cantonal Police Department and since this procedure is also a case, it is represented by a *CaseTask*. If any document needs correction, the discretionary item *request correction/completion* can be invoked. There is no visual representation of roles in CMMN so we have used colors to indicate which party is responsible for a certain set of tasks in this example.

The *publicize candidature* stage becomes available when manually terminating the *check documents* stage. After the candidature has been publicized in the local press, objections can be added to the record at any time during the following 20 days. The stage terminates after 20 days indicated by the black sentry on the border of the stage. According to case rules, the discretionary *billing* stage is then available and can be planned by a

case worker. Depending on the payment status, reminders can be sent to the applicant. The milestone *bill paid* indicates when the bill has been paid. The *naturalization interview* stage depends on the completion of previous stages such as *publicize candidature* and the *payment status of bills*. The ifPart of the sentry placed on the stage border takes care of this condition. The *conduct naturalization interview* task follows once the date for the naturalization interview has been set. The applicant has the opportunity to hand in a written statement which will be added to his/her dossier as depicted by the discretionary item.

During the process, several decisions are made by the local government. Consequently, one human task element with a repetition rule is triggered on such occasions. If the decision is negative, the applicant is informed and the process terminated.

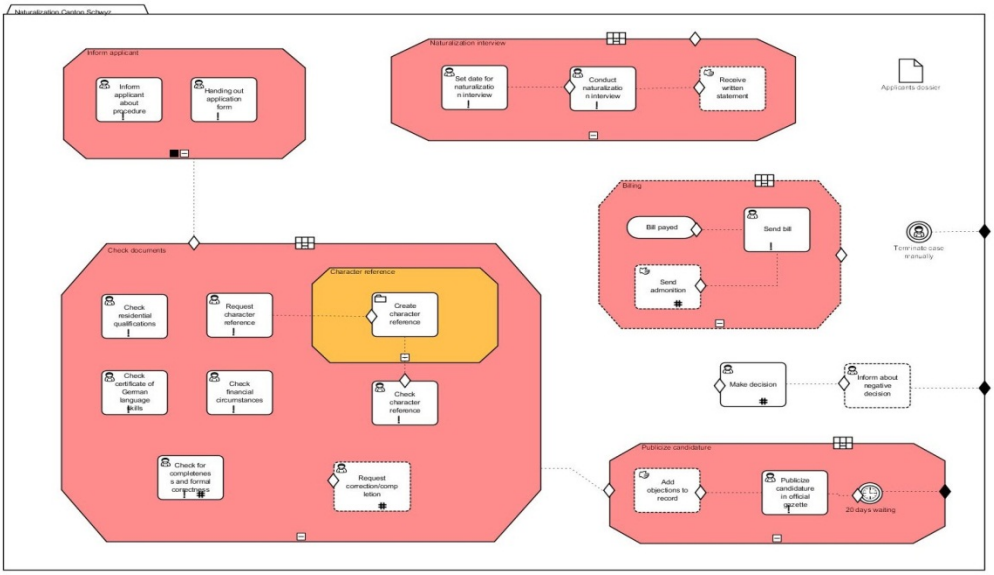

Fig. 6. CMMN naturalization case

5.3 Conclusion of the Case Study

The naturalization process is a good example of a data-driven and highly repeatable process where knowledge workers not only have to execute but also decide on and plan further steps. For this reason, modeling this process as a case using CMMN is feasible. The case study shows that for the tasks concerning documents CMMN has advantages; the *check documents* stage allows for a more flexible execution. In addition, requesting corrections is flexibly plannable and is depicted by a discretionary item. However, this part of the process could have been modeled in BPMN more flexibly with an ad-hoc sub-process as well, but without rules, i.e., the *RequiredRule* or *RepetitionRule*. Another advantage of the case model is the invoicing stage, which becomes plannable under certain conditions and does not have to be

fully modeled every time the applicant is charged. However, in this case, the invoicing stage could have been modeled as an event sub-process invoked every time the invoicing process needed be executed.

One disadvantage is the modeling of roles in CMMN. In comparison to pools and lanes in BPMN, there is no visual representation of roles in CMMN. In this example, we have used colors to indicate which party was responsible for a certain set of tasks. This may be sufficient in this particular case but might present problems if there were more roles and a more complex case. Moreover, parts of the case could have been modeled as a process and would have been easier to understand.

Conclusion:

Although many CMMN elements can be substituted by BPMN constructs, the notations pursue different approaches to modeling processes. Important items, for example rules for tasks (ApplicabilityRule, ManualActivationRule), cannot be modeled with BPMN. Furthermore, there is no equivalent to a CaseTask in BPMN to support CMMN.

The literature review revealed that CMMN is less complex than BPMN. Furthermore, differences and similarities between BPM and case management were studied and the findings were integrated into a new model for comparing CMMN and BPMN. The participation of knowledge workers and the predictability of the process are the key factors in deciding whether to use CMMN or BPMN.

The case study, however, has shown that a process might consist of clearly structured parts as well as flexible parts, which is likely to be true for most knowledge-intensive processes. Consequently, we propose including the CMMN element CaseTask in BPMN. This allows business analysts to model processes with BPMN and to invoke a case in the model where practicable. We also suggest supporting a visual representation for roles in CMMN and propositions for such a role representation could be matter of further studies. Generally speaking, public administrations may benefit from using CMMN in addition to BPMN to model and implement processes. However, the interactions between the two standards as well as the suitability of using two different approaches for one process would have to be studied in detail.

A simple comparison of BPMN and CMMN on a technical level is insufficient for a decision to be taken on which standard to adopt. The approach to modeling differs in core parts as evident when establishing the use case. As the activity-centric approach does not lead to a reasonable model using CMMN, there needs to be a mind switch to data-centric thinking and to tasks working with data. Hence, other skills are needed.

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