AUTOMATION OF LIBERAL PROFESSIONS BY APPLYING THE DYNAMIC MANAGEMENT OF DISTRIBUTED CASES CONCEPTS

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This paper is intended to define a new concept, the Dynamic Management of Distributed Cases – DMDC, and to describe it in the context of its implementation in the automation of processes put in execution by liberal professions. It also makes an inventory of existing systems' shortcomings and identifies the minimal set of standards for process formalization and data exchange as well as re-usable components for a DMDC-type solution.

Keywords: Dynamic Management of Distributed Cases, Case Management, BPMN, CMMN, ebMS3 AS4

1. Introduction

The authors' experience in the field of case management systems is of almost 20 years, during which a series of case management systems were implemented in various domains, healthcare being the field of application for the most ones. Considering all specifics of business areas, of different technologies used within projects, of various categories of users and notational languages used for business processes' modelling, we managed to identify a common set of requirements for these systems and as we gained more experience, we also identified a common set of shortcomings. In time, existing systems' shortcomings as well as approach errors that we encountered within different projects, led us towards building a sufficiently solid motivational package, which sits at the base of this paper. Following, we'll show an inventory of existing systems' shortcomings as well as approach deficiencies that we encountered within various projects, in order of their importance, according to our views:

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- In most cases, solving cases is not achieved in isolation. Even though notational languages used in modelling cases, like BPMN [1], CMMN [2], and others, offer formalization possibilities to external information exchanges, case management solutions and/or process servers are not tackling the matter of integration “by design”, thus needing significant integration efforts.
- There are generic messaging standards based on the "smart endpoints and dumb pipes” [3] principle, but there's no standard technical formalization mode for messages exchanged between case management solutions, which could insure syntactic and semantic inter-operability.
- There is no functional standard dedicated to generic case management solutions and no standard applications programming interface (API) either.
- Most solutions are specific to the business domain and are not generic, which makes difficult to apply them in new domains.
- Graphic interfaces are outside of the users' cultural context and case visualization, especially in distributed environments, becomes a major barrier in implementing this kind of solutions [4].

The main objective of this study is to define the Dynamic Management of Distributed Cases – DMDC [5], with the goal of standardizing the implementation of this type of systems. This step has higher amplitude, is outside the scope of this paper and somehow similar to IHE [6] Technical Frameworks (for instance, Laboratory Technical Framework). It targets identifying all standards embedded in DMDC-type solutions and proving their functionality by means of a reference implementation. The secondary, derived objectives are shown below:

- Exemplifying the concept in context of its implementation in liberal professions' specific projects' automation.
- Identifying and selecting a set of standards useful to the DMDC-type solution.
- Identifying the components that may be re-used by a DMDC-type solution.

2. The business use case to automate

Organizations of all size and kind from many domains of activity use un-specialized instruments and informatic systems in order to handle cases in basic business process management. Usually, we see documents associated to specific cases, revised by authorized persons in order to solve it. Some organizations formalize business processes and ways to solve cases in documents assimilated to their corporate culture and known as best practices. The use case shown below is part of a project of industrial research and development of an innovative software service shared by a cloud-type infrastructure, CaseBond [7]. The final result of this project consists in two software applications together with processes specific to the kind of implemented cases: an application dedicated to automate the

interaction with the common citizen, available by a web interface and a mobile smartphone application, and back office-type application for liberal professions.
This business use case is located in the notary public of the common law domain and describes a simplified process of interaction between the citizen and the Notary public in order for the applicant to obtain power of attorney documents necessary for movable goods sales. Here's the list of entities implied in the two applications:

- **Applicant citizen** – is the person who applies for legal documents' authentication, taking of affidavits and statutory declarations, witnessing deeds and signatures, etc.
- **Applicant Organization** – is the legal entity who applies for legal documents' authentication, taking of affidavits and statutory declarations, witnessing deeds and signatures, etc.
- **Notary public -** is a public officer constituted by law to serve the public in non-contentious matters usually concerned with estates, deeds, powers-of-attorney, etc.
- **Assistant notary public –** is the person mandated by the Notary public to assist within the boundaries of the law, in the office.
- **BackOffice System** – is the Daemon-type element which executes automated activities for a Notary public office.
- **Front Office System** – is the Daemon-type element which executes automated activities for an organization offering DMDC services for liberal professions.

The main scenario of the business use case consists of the following stages:

1. Identifying the Notary public office
2. Initiation of the case
3. Selecting the service and sending an application to the Notary public
4. Processing the application
5. Sending feedback to the applicant
6. Scheduling an appointment for verification and signing of the documents
7. Notifying the applicant about appointment scheduling
8. Verification and signing of the documents
9. Closing the case

Details about the business use case, containing all steps every stage involves are shown in APPENDIX 1 – Main scenario.

3. The concept of Dynamic Management of Distributed Cases

In order to correctly define this concept, we must at first define what means “a case”.

Defining the case:

The case is the procedure which, reflected in a sequence of activities, will lead to solving a problem brought by an applicant or a subject. It is also a unitary image

that aggregates all data, files, activities and history involving all case-specific investigations, requests of service and related processes.

Some important items which can be aggregated into a case are enumerated below, as extracted from the CMMN 1.1 [2] standard:

- **Subject** – the person, organization, group, that benefits of the case result. In the case shown above, the applicant citizen is the subject of the case.
- **Participants to the case** – persons or groups that lead to the solving of the case. The Case Manager is the one who can assign other participants to the case to executing a certain activity. In the case shown above the Notary public is the Case Manager and other participants (of the activity executing type) are the Assistant notary, the Notary and the applicant citizen.
- **Case definition**– the model of the case implemented by the business analyst who guides the participants to the case in executing it. In the case shown above, the case model is the type of power of attorney documents solicited by the applicant (movable goods sales). The case type-specific sequence of activities and the time interval for its execution are part of the case definition.
- **Action** – operation that exists in the case definition and is to be executed by the participants. In the case shown above, wording a draft power of attorney is an action existing in the case definition. Actions can be specific to the case in execution or to a structured or un-structured document, part of a case in execution.
- **Decisions** – these can show up in a case definition but will be verified during execution by the participants. The decision in the above shown example is made based on the applicant's feedback (step 16 APPENDIX 1).
- **Milestones** – a case definition may contain milestones which will give an overall picture in a case execution.
- **Case documents** – all structured or un-structured documents registering events in a case evolution, from its opening until it's solved.
- **Case execution** – is an instance of the case type, in which actions can be executed by participants. In an information system these actions will be reflected in adding structured or un-structured document on which actions can be executed to the case instance.

The above shown items are part of a case and implementation of this case in an information system is called a Case Management System.

DMDC concept definition:

Distributed cases management systems are those systems capable of guiding participants to a case in their actions, to the goal of solving the applicant's case based on the case definition that models the good practices of the domain. At the same time, these systems are capable to communicate with similar ones, based on a data exchange protocol which is a part of the case definition.

The DMDC concept knew several implementation steps during its evolution process:

- **2009-2011 EUGEN** [24] - The project was financed through Eurostars mechanisms and the domains in its view are Clinical Pathways and BPM Development. The project's objective was to offer support and create the necessary instruments for adopting proof-based medicine and best healthcare standards.
- **2011-2013 Visual-D** [25] - The project was financed through Eurostars mechanisms and the domain in its view was Visualization of medical data. The project's objective is to implement a user interface for clinical applications, able to offer an overall image of a patient's health status by combining text with advanced graphics.
- **2013-2016 EESSI** [26] - The project was financed by the European Commission and is focused on the electronic information exchange between Social Security organizations in EU countries.

4. Relevant research

BPM [19] helps organizations to improve their productivity by integrating people, resources, information, and by removing all the barriers in order to achieve strategic goals. It is clear that, in the context of the new mobility and connectivity paradigm, removing barriers will extend to countries, organizations and individuals by providing and consuming electronic services in a standardized and interoperable way, in a market where administrative and cultural issues become insignificant.

Defining the concept of DMDC is a natural continuation of the established case management concept in the context of adopting inter-organizational processes. Inter-organizational processes have captured the attention of the scientific community and today there is a large number of scientific publications dealing with this topic. This is the reason why we will review two recent, significant, papers from the area of inter-organizational processes. The main challenges of inter-organizational business processes are identified and presented in the paper *"Challenges and opportunities in collaborative business process management: Overview of recent advances and introduction to the special issue"* [32]. These identified challenges are: the definition of business services that organizations can provide and consume, technical implementation of a collaborative business process, maximizing the autonomy of organizations during the execution of inter-organizational processes, formalizing the business partnership, change management impact, security and monitoring inter-organizational processes. The challenges are grouped into four categories: modeling, monitoring, security and change management, and the authors are highlighting the technologies that can contribute to addressing identified

challenges. Among the most important technologies mentioned by the authors, we would like to mention: WS-BPEL [33], WS-CDL [34], WS-Coodination [35], WS-AtomicTransaction [36] and WS-BusinessActivity [37].

Another interesting paper addressing one of the challenges mentioned in the previously presented research, belongs to a team of Romanian researchers from the Academy of Economic Studies Bucharest: *"Inter-organizational Performance and Business Process Management in Collaborative Networks"* [38]. The paper deals in particular with the challenges in monitoring the inter-organizational processes and the authors identify the main features of the collaborative processes. The main identified characteristics of inter-organizational processes are: independence of the participating entities, terms of collaboration and governance among stakeholders, several workflow engines, secure communication, several decision-makers and collaborative activities. The approach proposed in this paper is to combine BPM [19] with Service Oriented Architecture. The paper identifies several success factors of inter-organizational processes: knowledge creation, information exchange, capitalization of information, innovation, trust, quality of communication, interoperability, scalability and transparency. The authors create a mathematical model of inter-organizational process monitoring, a model that depends on establishing specific weights associated with success factors.

5. Standards for DMDC solutions

In identifying the standards for DMDC-type solutions we started from the concept definition, more precisely from case modelling and the need of exchanging data with business partners. Following, we'll review the most important standards, developed by various organizations and relevant to DMDC-type solutions.

- **ebXML** [8] - obviously the DMDC domain implies electronic interaction between organizations or between people and organizations with specific interests by means of an electronic data exchange, hence each organization or individual can advertise services to others and have a managed dialogue within an interest area. The ebXML regulates these aspects and aims to become a substitute to the EDI [9] (Electronic Data Interchange) standards. The ebXML (Electronic Business Extensible Markup Language) is a suite of standards regulating the electronic business processes between partners. Developing of ebXML standards was initiated in 1999 in a co-operation between UN / CEFACT [10] and OASIS [11].
- **BPMN 2.0**[1] - is a standard which was developed by the Object Management Group–OMG [12] and regulates formalization of business processes. Its main objective is to offer a notation which should be easy to understand by all

business users, but also by technical users in charge with implementing processes into applications. This way, BPMN wishes to represent a standardized bridge between the business process design and its implementation in real life.

- **CMMN 1.1**[2] - This specification wishes to become a common meta-model for defining and graphic displaying a case, as well as a format for various Case Management software platforms data interchange. It identifies common elements used by case management systems, considering the newest contributions to this domain.
- **DMN1.1**[13] - Its main purpose is to offer a common notation which would be easy to understand by all business users, beginning with analysts, who are creating the initial decision requirements and afterwards, the detailed decision models, ending with technical people who develop decision automation into processes and the decision managing and monitoring industries. DMN creates a standardized bridge over the gap between defining a business decision and implementing it. DMN notation is designed to be used in conjunction with BPMN and CMMN
- **ebMS3 AS4**[14] - According to messaging specifications of ebMS3[15], the ebMS3 AS4 sub-standard focuses on the following targets: re-using existing standards where possible, ease of implementation, applies to organizations of any size, support for a wide variety of communication protocols: HTTP, SMTP, FTP, and others, unaware of transported data formats: XML, EDI, binary, trustworthiness, receipt on delivery and high security level.

Technically, the standard selection for a DMDC-type solution was based on four criteria: the modeling language capabilities, inter-operability and integration/execution/monitoring support, ease of use and notoriety. **The selected standard was BPMN 2.0, the most widely adopted and supported by many modeling open-source platforms and process servers.**

The CMMN has a high growing potential, being the only case management domain specialized standard. But, because it is very recent, there aren't many implementations; the only CMMN 1.1 and DMN 1.1 based tested solution is Camunda [16].

Messaging standard selection was performed based on the European Commission recommendations and the number of existing implementations: Domibus [17] (offered as an open-source by the European Commission), EESSI AS4.NET, Flame, Holodeck [21], IBM, Laurentius, Mendelson, RSSBus, ADES, iFenix, Integration Cloud, a.s.o.

6. Reusable components for DMDC solutions

In the process of DMDC-type solutions re-usable components' identification, we started from the two fields of interest in re-usage: modeling and data exchange with business partners. In the following, we review the most important components that may be re-used:

- **Activiti** [18] - Is published by Alfresco, the creator of ECM, and aims to become a pragmatic alternative to jBPM. Wishing it to be a self-standing component, Alfresco promotes the solution as an open-source and puts it up to become a reference for all open-source BPM solutions. Activiti has already an excellent spreading dynamic due to its sponsor's popularity.
- **Bonita** [19] - This instrument was initially developed by Bull in early 2000's, then taken over by BonitaSoft (2009) and promoted as an open-source product. Bonita offers an extremely easy-to-use graphic business process modeler which makes direct implementation of simple processes a matter of minutes. Forms are automatically generated or may be configured beforehand. Access to cases is simple, thanks to an intuitive interface, looking very much like an e-mail client. But Bonita's real power consists in its connectors' system, available in a default form and easy to develop.
- **jBPM** [20] - It is developed by the Community with support from JBoss. As an open-source reference for the BPM domain, many software companies lately integrated jBPM into their solutions. Presently the product lacks a good dynamic within the community. However, its most recent version is promising, and the product remains a solid BPM technical building block and a key to many projects in open-source circles. jBPM is an excellent BPM engine, strong as well as easy to use for users-developers. When re-used as as a software component, it's easy to configure and has a comprehensive API.
- **Holodeck B2B** [21] - A Message Service Handler (MSH) type solution, Holodeck B2B is an open-source implementation of the ebMS3 AS4 [14] profile. Among its characteristics we can mention: multi-platform, Linux, Windows and MacOS tested, XML-based configuration, API and file-based integration, both ebMS patterns, One Way / Push and One Way / Pull [21], bi-directional, p-Mode configurable messaging, Multi-hop messaging, AS4 compression, AS4 Signals for reception and errors, multiple transmitters and receivers, Pull-type pattern configuration, a.s.o.
- **Domibus** [17] or Domain Interoperability Bus is an MSH-type solution in compliance with e-SENS [23] ebMS3 AS4 [14], implemented by the European Commision. It is a reference implementation, used to test other e-Sense technical specifications' implements.

Technically, in evaluation for re-usability of these components, 4 criteria were considered as relevant for a DMDC-type solution:

- **Modeling** – the graphic interface, the presence and quality of a process modeling instrument, the translation of the visual model into an executable process;
- **Integration** – Support for multiple integration technologies, standard connector system developing mechanism, event-driven processes and the ability to integrate events into processes, API to access internal functions, ability to manage user's positions and permissions through an internal function or an integration capability, internal process archive or ability to integrate an external one, capability to differentiate processes by versioning, use of BPMN 2.0 and of import / export function;
- **Execution** – Support for implementation of usage cases in a DMDC-type system (start, end, message receiving, message sending, human activity, system activity, sub-processes, a.s.o.), management console allowing process monitoring (process definition, process instancing, workflow variables, data, a.s.o.), logging function (especially for exceptions), process event monitoring;
- **General** – The general ease-of-use of the instrument, its architecture, especially modelling components' separation, execution and management, size of the developing community, solution provider's capabilities, documentation quality, ease of installation on various servers and application platforms, instrument efficiency, localization.

The only instrument which was capable to wholly implement the pilot business case was Bonita. The product seems to be mature, having the largest developing budget and widely used, the only open-source product mentioned by Gartner and Forester Research.

Table 1

Evaluation results

Criteria	Activiti [18]	Bonita [19]	jBPM [20]
Modeling	30	50	30
Integration	70	89	75
Execution	30	45	25
General	60	85	60

Its first version was launched in 2001. Since then it was downloaded more than 2.5 million times worldwide. It's used by organizations of all sizes for projects ranging from the simplest to the most complex. BonitaSoft started providing commercial services in June 2009 and presently has over 700 clients in over 60 countries. The only tested MSH-type solutions were Domibus si Holodeck. The major downfall of Domibus is related to its database, Oracle being the only recommended one. Performance tests made in configurations other than the recommended one were unsatisfactory. Because of these limitations, the chosen solution was Holodeck B2B.

7. Applying the DMDC concept for the automation of liberal professions

The DMDC concept is in the process of implementation in the liberal profession area as a service. More precisely, the applicant citizens through the mobile or web application (FrontOffice System) will identify the service provider of a specific domain (e.g. notary), on the basis of proximity of the citizen, or based on the service provider rating, then the specific service will be selected, and the distributed case will be created. The BPMN case definition will be configurable through Bonita BPM [19], one of the reusable components described in the previous chapter. The citizen will prepare the service submission based on the guidance provided by the FrontOffice System and Bonita BPM [19] and will send its application for processing to the Service Provider. The message exchange between the citizen environment and the service providers will be coordinated by the selected Message Service Handler, Holodeck B2B. The service provider will be able to register itself in the CaseBond FrontOffice [7] System and its BackOffice application will either be deployed on premise or in cloud. The CaseBond [7] service deployment is depicted by Fig. 1.

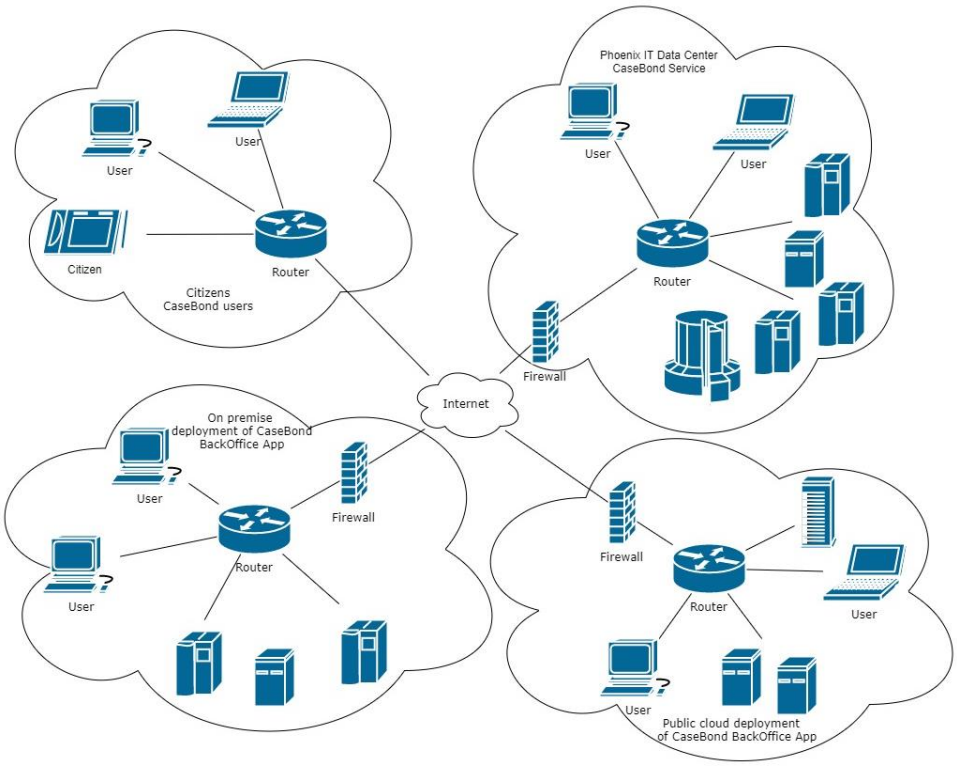

Fig. 1. CaseBond service deployment

The CaseBond platform is in developement process for next coming year as a multitenant/cloud solution and the underlying development technologies are: Ionic 2 Framework [27], Angular 4 [28], Spring Boot 2[29], Bonita BPM 7 [7], ElasticSearch 5.5 [30] and Logstash 5 [31].

8. Conclusions

The most important achievements that are addressed in this paper are:

- Defining and exemplifying the concept of distributed cases management in the context of its implementation for automating processes initiated by freelancers.
- Identifying the minimum set of standards and re-usable components for a DMDC-type solution.
- Applying the DMDC concept for the automation of liberal professions

The DMDC concept was demonstrated by a reference implementation which was tested both at the level of European Commission and by a consortium of members countries national agencies. All testing stages proved a high acceptance level from users in various domains. Today, the project is at the beginning of a new implementation stage, in the field of liberal profession specific process automation domain, as a part of the CaseBond [7] research project.

DMDC is a niche domain of the larger DCM – Dynamic Case Management domain. Superimposing the DCM concept over the global trends in connectivity and mobility, we can easily see the fantastic potential of this niche.

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Appendix 1 – Main scenario

Notary public office identification

1. The applicant or his/her designated representative selects the NOTARY PUBLIC OFFICES category from the available categories list within the Front Office System;
2. The Front Office System identifies the GPS location of the applicant;
3. The System sends a list of Notary Public offices to the applicant. The list is arranged based by an automatically system-calculated score;
4. The applicant selects an office and visualizes the main characteristics: name, address, contacting methods, services, prices, terms and conditions a.s.o.

Case initiation

5. Once the office is selected, the applicant may decide to open a case within the selected organization.

Service selection and request sending

6. Once the case has been opened, the applicant can select the desired service from the services list. In this case, a power of attorney document for movable goods sale;
7. After selecting the service, the applicant will be informed about its specific terms and conditions among which the service fee, the appointment no-show fee and the service termination fee are mandatory;
8. If the terms and conditions are accepted, the applicant is informed about the documents that he/she has to electronically submit before the appointment (i.e. applicant's ID, authorized representative ID a.s.o.)
10. The applicant's method of payment (bank card) validity will be verified. If the result is OK, the Front Office System will request the applicant to send the required documents electronically to the Notary public office;
11. If the card is not valid step 10 will be repeated with the option to register new card data;

Request processing

12. The Assistant Notary is notified about the request;
13. The Assistant Notary writes a draft document containing all legally required data – owner of the goods, authorized representative, description of the goods, the way the goods were obtained, the authorities for which the power of attorney is valid, the legal deeds the authorized representative is allowed to perform a.s.o.;
14. The draft, accompanied by the Assistant's comments and the additional required documents list, if any, is sent to the applicant;

Applicant's feedback

15. The applicant is informed that a draft document was received at the Front Office System;
16. The applicant reads the draft and in case he/she considers it doesn't correspond to his/her expectations, the draft is considered unacceptable and a review is requested. Step back to [12.] *[Request processing]*;
17. If additional documents are needed in step [14.], these are scanned and attached to the feedback document. Step back to [12.] *[Request processing]*;
18. If the draft is acceptable, the applicant is marking this aspect in the feedback document.

Appointment schedule for final document proofing and signing

19. The applicant marks the time and date when he/she is available for an appointment according to the Notary public's availability shown in the Office Calendar.

Scheduling notification

20. Both Notary public and applicant are notified one hour ahead about the scheduled appointment.

Proofing and signing the documents

21. The Notary public meets the applicant in the office according to the scheduled appointment;
22. The applicant pays the incumbent fees according to the payment method agreed upon in [10.];
23. Documents are verified and signed, then registered by the Notary in the National Notarial Registers;
24. The Notary marks the closure in the Back-Office System and requests the applicant to send feedback on the service quality.

Service quality score

25. The applicant is notified about final document delivery and is asked to send feedback on the service quality;
26. The applicant marks the score according to his/her perception of the service quality and may send public comments.

Case closure

27. The case is automatically closed once the score is sent/received.