Distributed Case Management in the Public Health Area

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Abstract – **The free movement and mobility of citizens is a fundamental principle of European Union (EU). Currently, the data exchanges between social security institutions, including healthcare institutions are mostly paper-based. As a consequence, the process is time consuming, open to error and lengthen the resolution time for the citizens. Efficient and effective administrative cooperation between the institutions is, as a consequence, critical. Therefore, EU regulations triggered the European Exchange of Social Security Information (EESSI) project for the European Commission (EC) to provide the common secure framework that will facilitate electronic exchanges between relevant institutions. The previous attempts of implementing a similar system failed mostly because the clerks are accustomed to work with paper documents and the complex paperless solutions were perceived by the non-technical end-users as a major chance. The clerks need a system able to handle a partial snapshot of the European case, developed around their current social, communication and professional context, able to manage operational processes and, at the same time, to provide an efficient decision support. The present article describes the EESSI response to the main technical challenges encountered: the decomposition of business processes in order to provide a distributed case management solution, composition of business processes in order to provide standard functions across all case types, formalization of EESSI Business Messaging Protocol (BMP) in order to provide semantic and syntactic interoperability and case management visualization.**

Keywords-Public health data visualization; guidelines; timeline; case management; Business Process Modelling Notation (BPMN).

I. INTRODUCTION

Organisations have always been using the case paradigm to review and resolve various workflows like investigations, service requests and more. Typically, there are documents and artefacts associated with a case that are reviewed by authorised people in order to reach a resolution and close the case.

The case management model can be applied to diverse processes across a wide spectrum of industries and government agencies. The normative practice that leads to resolving and closing the case used to be encapsulated in process and procedure handbooks, as well as "stored" in the clerks' community experience and best practice knowledge wealth.

The next wave of case management, after the paper-based one and often in parallel with it, was workflows that sprang from last-generation software.

In many industries, and most particularly in the healthcare one, many organisations still find themselves mired in IT systems that support only limited, if any, coordination across programs. Dating back to the 1980s, organisations were tethered to a legacy of large, disconnected transfer systems that took years to build, were outdated at implementation, and could not interoperate with one another. In the past, categorical funding requirements effectively dictated separate infrastructures.

New coordinated models ask healthcare organisations to work together and help connect people to services more efficiently. In the past several years, as technology has rapidly evolved, policymakers have begun to endorse the operating models that support a vision of distributed dynamic case management. These architectural guidelines recognize the value of a service-oriented approach to IT, in which technology components can be reused across organisations and programs that have similar business processes. By using dynamic case management applications, agencies can reduce the cost and complexity of both acquiring and supporting business applications.

Across the health care industry, information systems have much to offer in managing costs and in improving the quality of care. In addition to the embedded role of information technology in clinical and diagnostics equipment, the systems are uniquely positioned to capture, store, process, and communicate timely information to decision makers for better coordination of healthcare at both the individual and population levels.

At the most general level, a striking feature of the healthcare industry is the level of diversity that characterizes patients (e.g., physical traits and medical history), professional disciplines (e.g., doctors, nurses, administrators, and insurers), treatment options, healthcare delivery processes, and interests of various stakeholder groups (patients, providers, payers and regulators).

The healthcare delivery setting is characterized by a tension between the need for orderly routines and the need for sensitivity to variation in local conditions. As such, the current market offering in healthcare in its diverse organizational and regulatory settings covers several orientations, among which:

- ***Clinical Information Systems*** (CISs), which convert the medical data in relevant information about the patient's health status. The current CISs' market covers most of the healthcare provider operational needs in regard to clinical services with some degree of support for point of care clinical decisions. The Graphical User Interface for documenting clinical cases is centred usually on

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patient and patient banner in order to help the medical personnel to easily identify the current patient clinical context. This ensures a comprehensive standard-based approach in regards to CISs functionalities, which is regulated by the world's leading medical informatics organizations: HL7 EHRS [1], CCHIT [2], Eurorec [3], etc. In this context, in order to analyse the current state of the art, we need to structure the existing knowledge in three domains: clinical pathway visualization, relevant medical data visualization (medical and administrative) and the combination of these two - medical data in clinical context.

Clinical pathway visualization should be considered from two points of view: from the point of view of clinical pathway encoder or designer, and from the point of view of the one who is executing the patient current clinical pathway requested actions. Projects/solutions like Protégé [4], Tallis Toolset [5], GUIDE [6], GLARE [7], VisiGuide [8], AsbruView [9], etc., are suitable for encoding and/or execution of a clinical pathway, but with limited adoption by the healthcare providers.

Not necessary in relation with the clinical context, projects like Graphical Summary of Patient Status [10], Time Lines and LifeLines [11], PatternFinder [12], KNAVE and KNAVE-II [13], VISITORS [14], VIE-VISU [15], Interactive Parallel Bar Charts (IPBC) [16], Gravi++ [17], and others moved in the direction of *visualizing the medical relevant data*.

There are also very few combined approaches of medical data in clinical context: Guideline Overview Tool (GOT) [18], Midgaard [19], CareVis [20], NHS Common User Interface [21], Visual-D [22], but most of them failed to be widely adopted.

- ***Patient Case Management Software***, such as FAM Care Human Service [23] by Global Vision Technologies, ClientTrack [24] by ClientTrack, Ahshay [25] by DataCare (the latter focusing on compensation industry better management of medical treatment and billing), Allscripts Care Management [26] by Allscripts, Penelope [27] by Athena Software, PracticePal [28] by PracticePal, etc. Such software are customised for the healthcare industry and cover all or a specific mix of features like: Activity Tracking, Assessment Notes, Billing & Invoicing, Calendar Management, Candidate Identification, Case List Management, Medical History Records, Patient Records, Referral Management, Treatment Planning, etc.
- ***Dynamic Case Management generic applications***, which need customisation to match healthcare industry specific requirements and context. Some of the most significant software providers are: Pegasystems with Pega Dynamic Case Management [29], Be Informed with Be Informed Business Process Platform [30], Kana Software with Kana Enterprise [31], IBM with IBM Case Manager [32], Isis Papyrus with Papyrus Platform [33] (including Framework Solution for ACM), Appian with Appian BPM Suite [34], OpenText with OpenText Cordys [35], OpenText BPM Everywhere [36], OpenText Process Intelligence [37], OpenText Cordys and Process Component Library [38], EMC with EMC Documentum xCP [39], Kofax with Kofax TotalAgility [40], Whitestein Technologies with Living Systems Process Suite [41], DST Systems with AWD10 [42], Oracle with Oracle BPM Suite 12c [43], and Hyland Software with OnBase [44].

  The applications listed are characterised by various degrees of strong design time case management combined with strong runtime case management support use cases. There are two variations of Dynamic Case Management generic applications, variations described below.

  Strong design time case management – capability that assumes that 90% or more of what the user will do is developed, tested, and deployed prior to user getting started. Case workers have less flexibility, e.g., adding new tasks or involving other users, and the overall process flow is well defined and more repeatable. These use cases tend to be more production oriented; for example, managing exceptions for financial transactions.

  Strong runtime case management support – use cases where work is highly variable. The way in which the case unfolds over time is far less predictable. The case view is altered by user actions and system events, with users who are able to add tasks, processes and participants on the fly at the point of need.

The requirements that we had to meet for the EESSI project were focused on cross-European Member State cooperation between social security institutions through an electronic platform capable of supporting the current and future ability of all social security institutions to connect and fulfil their legal obligations of social security coordination through electronic exchange. Subsequent to market offer analysis, it was determined that the optimal approach was for the solution to be designed and developed in-house. The challenges and the way responses were elaborated to meet them are described in the next sections.

The paper structure, section by section, is presented below: Section II describes the business area that we are focusing on, public health and social security data exchange, Section III describes the system principles and high level architecture, Section IV describes the main challenges in the project implementation, Section V presents the response to the previously described challenges, Section VI refer to the project adoption, Section VII brings up the conclusions and future work and Appendix 1 depicts the system main features.

II. PUBLIC HEALTH DATA EXCHANGE IN THE CONTEXT OF EESSI

Better cooperation between social security institutions is a necessity in an increasingly mobile society in order for EU citizens to exercise their right to free movement and secure their social security rights.

The EU provides common rules to protect social security rights of citizens when moving within Europe. The European rules of coordination make sure that social security

institutions of the EU plus Iceland, Norway, Liechtenstein and Switzerland, all communicate with each other to ensure social security rights are addressed correctly.

Currently, these data exchanges between the social security institutions are mostly paper-based and as a consequence are time consuming, open to error and lengthen the resolution time for the citizens, partly due to the method of exchange.

Efficient and effective administrative cooperation between the institutions is therefore critical and as a consequence the revisions of the European rules of coordination that came into force on May 1st, 2010 stated that "*The transmission of data between the institutions or the liaison bodies shall be carried out by electronic means either directly or indirectly through the access points under a common secure framework that can guarantee the confidentiality and protection of exchanges of data*."[45].

Therefore, the aforementioned requirement of the EU regulations triggered the EESSI project for the EC to provide the common secure framework that will facilitate electronic exchanges between relevant institutions.

The overall vision for the EESSI project is to deliver an electronic platform that will support the current and future ability of all social security institutions to connect and fulfil their legal obligations of social security coordination through electronic exchange.

The EESSI platform has to enable secure exchanges for all relevant business messages that guarantee confidentiality, integrity and availability, and to have a sufficient level of validation. It should ensure wherever possible the right message is sent to the correct recipient on the first occasion at a time that is suitable to all institutions and contributes to the optimization of social security coordination.

EESSI is a cross-sectorial platform with competences in the area of public health. The main EESSI use cases in the area of public health are the following:

- Entitlement for short or long term healthcare related benefits;
- Validation of the person's right to healthcare related benefits during his/hers temporary stays in another Member State;
- Establishing the reimbursement rates for healthcare services;
- Cost reimbursement based and fixed amounts reimbursement or healthcare services;
- Certificate the incapacity of work and cost reimbursement for incapacity of work;
- Request for medical examinations or administrative checks, etc.

III. PRINCIPLES AND HIGH LEVEL ARCHITECTURE

Figure 1 below, provides a high level view of the conceptual architecture. This section will provide an explanation of the application domains in the conceptual architecture.

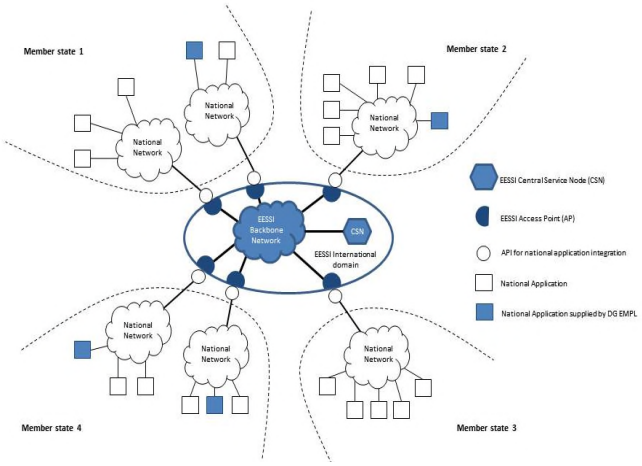

Figure 1. Conceptual architecture diagram

The diagram depicts the conceptual principles on how the inter-connection is achieved:

- A data exchange network interconnecting national administrations;
- National institutions are linked via national networks to the EESSI Access Points;
  -AP establishes the border between the national and international domains of EESSI end-to-end network. The APs are the gateways that enforce the stateless messaging protocol; they check that the structure and the semantic of the EESSI business messages are correct. A stateless protocol is a communications protocol that treats each request as an independent transaction that is unrelated to any previous request so that the communication consists of independent pairs of request and response. A stateless protocol does not require the server to retain session information or status about each communications partner for the duration of multiple requests. In contrast, a protocol, which requires keeping of the internal state on the server is known as a stateful protocol.

The main principle in building the EESSI platform is *"smart endpoints and dumb pipes"* [46] [59], which means that in most of the cases, when a National Application receives a request, it will apply the logic as appropriate and will produce a response and the AP will perform a minimal stateless validation. The diagram depicts the two fundamental domains of the EESSI network:

- The International Domain that hosts components, which are common to all participant countries. It is itself divided in two sub-domains: the Central Service Node (CSN) – designating the components that will be hosted centrally (e.g., hosted by EC) and the AP – a domain that holds components common to all countries, developed centrally and assumed to be hosted within each participant country. The components under the CSN and the APs, connected electronically as one system environment, constitute the EESSI Platform, a secure, reliable, pan-European data exchange platform;

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- The National Domain that hosts national specific elements of the network can also be divided in two sub-domains: the National Application (NA) and National Gateways (NG).
  The NG are the National components that specifically integrate NA with the international domain and the Institutions' Domain – where the NA of the social security institutions resides.
  The NAs are the actual "client"; being themselves direct instruments of the "end-users", the clerks.

For a faster adoption of the EESSI platform and in order to help the Member States (MS) to provide better services for the citizens, the EC decided to provide an open source Distributed Case Management Solution called Reference Implementation for National Application (RINA). RINA consists in a collection of infrastructure and communication services, foundation, repository and publishing services, business, integration and user interface services, which will provide for clerks and their organizations, the tools to implement the EESSI data exchange protocol based on Structured Electronic Documents (SED).

IV. CHALLENGES

The main challenges are generated by the fact that EESSI is a peer-to-peer network where the International Domain of the platform, especially the Apps, are just the enablers of the communication between NAs, completely transparent from the business perspective.

Formalization of EESSI vision started about 10 years ago, and part of the project challenges at that time are still present in the nowadays industry:

- *Formalization of EESSI Business Messaging Protocol* in order to provide semantic and syntactic interoperability.
  One of the main outcomes of EESSI is the interoperability standard. The magnitude of the project is emphasized by the following facts: multi-sectorial data-exchange, around 110 businesses use cases (BUC) with at least two application roles involved, and around 320 business documents/SEDs.
- *Decomposition of business processes* in order to provide a distributed case management solution and composition of business processes in order to provide standard functions across all case types.
  All the EESSI business processes/case types are foreseen to be distributed and they involve from the applicative software perspective multiple application roles (e.g., case owner, counterparty, liaison body, etc.). Being a distributed system, the decoupling of the application roles in EESSI needs to be aligned to the EC guidelines in terms of messaging, more precisely, web services and ebMS3 [47] - AS4 profile [48]. Most of the Business Process Management Systems [49] (BPMS) are able to decompose the processes but they are not natively able to decouple the application roles through web services. The composition of business processes in order to provide standard functions across all case types is available in the BPMS tools build on top of Business Process Modelling Notation (BPMN) [50] [2] but the complexity and the multitude of the administrative processes in EESSI makes BPMN as it is difficult to use.
- *Case visualization* and case visualization in distributed environment.
  It is obvious that the level of adoption of case management solutions in the institutions participating in EESSI is quite limited and the main barrier in adopting it comes from the fact that implementation does not take into account the end user practices and their context.
  The clerks are accustomed to work with paper documents and previous attempts to create a distributed paperless solution have failed due to the magnitude of change perceived by the often non-technical end-users mainly because of Graphic User Interface (GUI) complexity.
  Therefore, the clerks need a Distributed Case Management System able to handle a partial snapshot of the international case, developed around their current social, communication and professional context, able to manage operational processes and, at the same time, to provide an efficient decision support.

V. EESSI RESPONSE TO DISTRIBUTED CASE MANAGEMENT CHALLENGES

This section presents the EESSI response to the previously mentioned challenges.

A. Formalising the EESSI Business Messaging Protocol

The data exchange protocol of EESSI consists in a collection of separate specifications that can be grouped in the areas of technical messaging and business messaging.

The technical messaging is aligned with EC messaging guidelines and consists in the ebMS3.0/AS4 EESSI profile and is physically implemented through XML Schema Definitions [51] (XSDs) and additional EESSI specific technical messaging validation rules.

The business messaging consists of three separate specifications:

- SEDs - physically implemented in around 320 XSDs,
- Standard Business Document Header [52] (SBDH) - specified through EESSI SBDH Implementation Guide and physically implemented through an EESSI constrained SBDH XSDs,
- The BUCs, which consist in around 110 descriptive documents including BPMN representation of the BUCs.

It is important to understand that the SED and SBDH schemas validate many of the business conformance requirements of EESSI, but are too general to enforce the data exchange in the context of Business Use Cases (BUC) [53]. This introduces genuine interoperability risks into the business domain. To address this, EESSI created a business messaging standard known as the EESSI BMP.

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The EESSI BMP is the minimum standard by which all NA must adhere to produce business messages that can be accepted as fully validated transactions within the EESSI domain.

The EESSI BMP is a specification able to define constraints for business and data validation, the common denominators of EESSI through the integration of the key aspects of BUCs, SBDH and SED physical models.

The chosen approach for implementing the BMP is made through XSD constraints. XML technology is already an inherent part of the EESSI domain and continuing its use for the BMP does not introduce unnecessary additional technologies.

In EESSI, this technology is used by two application domains with two different scopes:

- The National Applications, the messages' authoring systems, by directly using the constrained XSD schemas of each defined transaction for producing valid messages and
- AP, the common denominator of EESSI, by validating any received message against a single constrained XSD schema for each transaction.

The following elements of the SBDH along with the SED itself will be constrained though the BMP: BUC type, BUC version, participant role (the role of the sender and receiver participants), number of participants (unilateral vs multilateral case types), case action, SED type, SED XSD version, SED version (if multiple SED versions are allowed) and attachments allowance (if the attachments are permitted for the transaction).

The BMP is a transaction oriented specification that defines specific authoring rules for a specific SED transaction, for a specific participant role, in the context of a specific BUC.

Each identified transaction will constrain the SBDH and SED schemas through a single XSD schema definition that will import and redefine the aforementioned schemas.

Business messages that validate against this constrained version of the transaction are, by definition, also valid SED instances and valid SBDH and therefore, a fully validated transaction within the EESSI domain.

In Figure 2, a BPMN collaboration diagram, illustrates how the transactions are identified, for a specific participant role, in the context of a BUC.

Within the EESSI domain there are four main business level exchange patterns that can occur between the participant roles. These are:

- A Case Owner sends a SED to a Counterparty;
- A Counterparty sends a SED to the Case Owner;
- A Counterparty sends a SED to another Counterparty
- A Case Owner forwards a SED to a Case Owner.

The BMP ensures these patterns are enforced within the context of BUCs though constraining the Sender and Receiver Roles in line with the BUC specifications.

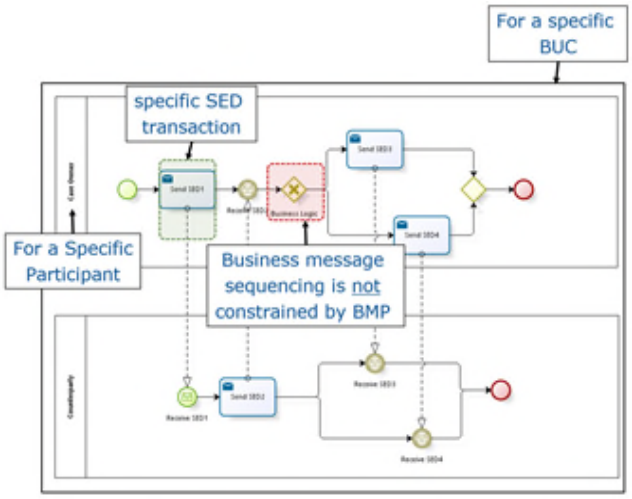

Figure 2. **BPMN** collaboration diagram

The syntax that is issued to uniquely identify each transaction with in the EESSI domain is the following: [BUC Short Name]-[BUC Version]-[Sender Role]-[Receiver Role]-[Case Action]-[SED Type] (e.g., S_BUC_19-1.0-CaseOwner-Counterparty-Start-S080.xsd).

For exemplification of the concept, a Public Heath case type will be briefly introduced. The illustrative example consists in a Healthcare Services Reimbursement Based on Actual Cost (S_BUC_19). The sequence diagram in Figure 3 bellow illustrates the interactions between the Case Owner and the corresponding Counterparty.

This case deals with the business transactions of a reimbursement based on actual costs whereby the Member State of Residence or Stay claims the reimbursement to the Competent Member State on behalf a Creditor Institution.

This case is used where the Institution in the Member State of Residence or Stay provides benefits when the treatment was necessary due to an accident at work or an occupational disease.

The Creditor Institution's Liaison Body (Case Owner) acting on behalf of a Creditor Institution (Claimant) or for itself sends a Reimbursement Claim for Benefits in Kind to the corresponding Debtor Institution's Liaison Body (Counterparty).

The Debtor Institution's Liaison Body (Counterparty) accepts, disputes or rejects the claim and notices it to the Creditor Institution's Liaison Body (Case Owner).

In this aforementioned exemplification, the Case Owner is the Creditor Institution's Liaison Body of the Member State of Residence or Stay that notifies the claim of a reimbursement payment on the basis of actual costs on behalf of a Creditor Institution and the Counterparty is the Debtor Institution's Liaison Body of the Competent Member State that replies for the claim of a reimbursement payment on the basis of actual cost on behalf of a Debtor Institution.

Figure 3 represents the sequence diagram that illustrates few transactions allowed between two the participant roles, in the context of S_BUC_19:

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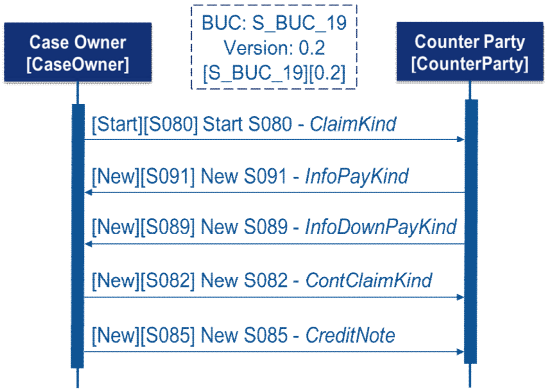

Figure 3. Sequence diagram

B. *EESSI Standard Business Document Header*

The Standard Business Document Header (SBDH) is an UN/CEFACT [54] standard that enables business applications to exchange documents using a consistent interface.

In the EESSI context, the SBDH enables the integration of Access Points with National Applications, with National Gateways or any other business-to-business infrastructure by providing consistent correlation data about a specific business document to be used across the EESSI ecosystem. It also enables any National Application to determine the logical routing and the logical processing of a SED/business document.

The EESSI implementation of SBDH standardizes the data presentation, the data elements within the SBDH that can be easily located and leveraged by multiple applications. The SBDH is created before the transport routing header is applied to the business document and is retained after the transport header is removed. SBDH data can be used also by transport applications like AP to determine the routing header since it does contain the sender, receivers and relevant document metadata. It can also be used by the national applications to determine the appropriate process instance to which the business document needs to be attached.

This EESSI SBDH Implementation Guide clarifies the function, design and implementation considerations of the SBDH in the context of EESSI.

The EESSI SBDH implementation guide deals with the sender and receivers identification together with their role in the case processing (process owner and counterparty), the unique case identifier, the case type, the version of the case definition, the sensitivity flag of the case (medical information case or protected person), the document identification attributes like SED type, schema version, the unique id of the SED, the SED instance version, the creation date, the attached files' metadata and the case action to be performed (start case, new/update document to an existing case, forward SED).

C. *RINA Distributed Case Management Visualization*

RINA is a Distributed Case Management Solution and the purpose of case visualization is to convert the case related data, the SEDs, in relevant information about the case status according to the main goal, which is case resolution. The process of conversion from disparate data into useful information should be analysed at least from three perspectives:

- Communication;
- Graphical user interface;
- Business use case or case type definition.

The SEDs-provided information used by the case management visualization process could be grouped in two categories: the social, demographic and administrative information and case specific information.

The case management view should represent the operational decision support system for the clerk. It is essential to visualize the current case and its corresponding case definition; also, to know what the existing exchanged SEDs are, what the contextual details (like medical history) are, what the social, demographic and administrative details are, etc. The progress observed in the case execution, the definition of the case with specific actions, stages, conditions and so on and nevertheless the best practices of the specific case type, should be accessible.

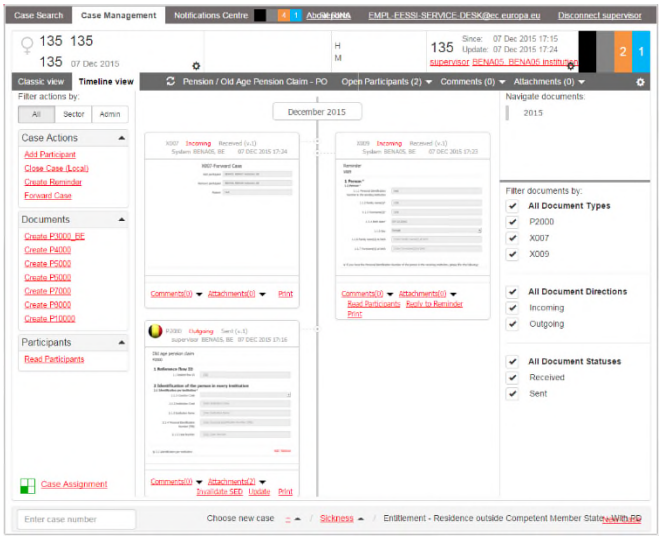

Figure 4. Case management - Timeline view

The primary goal of the Timeline-based visualization [58] into the RINA Case Management System, as illustrated in Figure 4, is to offer a comprehensive picture of the case, both real-time as well as historically, using textual and graphical means, and to sustain, in a task-oriented approach and based on decision support algorithms, the case progress.

Another important characteristic of this approach is the fast development and reusability of administrative SEDs, achieved through an external component, part of a Business Process Management Solution (BPMS) also used to execute the cases that encode and organize the decisions and action tasks for clerks.

A BPM-based case management solution in social security and public health offers the benefits of configurable workflows for both the medical areas as well as the administrative sub-processes.

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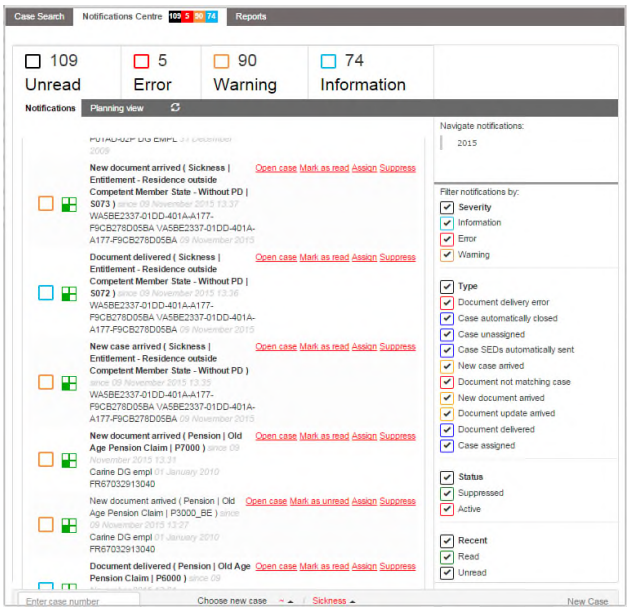

Figure 5. RINA notification module

The RINA notifications, presented in Figure 5, are also part of the process definition by the fact that the process can be started based on a received message from a counterparty institution. Being a Distributed Case Management Solution, RINA notifications are focusing mostly on the collaboration with partner institutions. The application is able to notify the case assigned users when a new case is received, when a SED is received or updated, when a case is closed by the case initiator, but also when a user is assigned to a case by his supervisor or when a case defined alarm is triggered.

RINA overcomes the problem raised from the unavailability of easily interpretable guides within existing applications and takes the recording of clinical information beyond historical and statistical reasons, by being a proactive solution that provides to the clerk strong decisional support. RINA targets directly any clerk or medical personnel involved in public health cases.

The central piece of this approach is the Timeline, representing a historical view of SEDs disposed along a vertical time axis as thumbnails, which offers a clear and actionable insight into the case history, as presented in Figure 5.

As such, one of the main benefits of this approach, when compared with the tried and proven case management interfaces, is represented by the possibility of dynamically loading a large volume of data that is time-sorted, meaning that most recent documents will be shown first, allowing clerks to have a quick overview of the case status. Moreover, the timeline provides a unified browsing experience for a volume of heterogeneous data that was collected at different points in time.

The pervasiveness of computing platforms and their wide-scale adoption has led to the emergence of several new methodologies for user interface design that have been widely embraced by the public.

One of the relatively new means of data presentation is the timeline. In order to provide a gentle learning curve and natural grouping of information, RINA GUI is developed around familiarity gained from social networking services like Facebook and suitability of this approach to the social security and public health domain, and therefore, embraced the established graphical presentation patterns.

While not a new idea with regards to the presentation of public health information, timelines have been embraced with the advent of widely used social networks that popularized them. As such, they can be considered an already mature and well-known means for data presentation, significantly reducing the steepness of the learning curve.

VI. EESSI ADOPTION – CASE STUDY AND EXPERIMENTS

To ensure adoption, a **collaborative** and **incremental** approach has been selected for the design and development of EESSI.

By adopting a project approach based on successive incremental iterations, as well as close collaboration with stakeholders that have well defined roles in all project phases, EESSI ensures that Member States and designated sectorial experts actively contribute to the application design and development.

Healthcare experts and Member States representatives (clerks) have the opportunity to provide input to BUCs through the Business Playground, which is a central web-based platform, to be used as a "playground" by the relevant involved stakeholders in order to fulfil three major objectives:

- To review and confirm how the business use cases are to be implemented in the EESSI system;
- To facilitate the re-validation and prioritisation of the Business Layer (BL) requirements. Using the playground environment Member States representatives are able to review and provide feedback about how the business use case should be implemented. The BL requirements are revalidated and prioritised based on the feedback and requests from the user representatives;
- To provide a platform for execution of the Dry-Run activities based on voluntary involvement of Member States representatives (clerks). The Dry-Run activities are primarily aimed at confirming the business processes with real cases, and the corresponding SEDs that are to be used within the business processes.

The BUCs are validated and agreed on as they will provide the playground business content to be modelled and validated. They are also the main vehicle to be used (together with the data modelling efforts) on agreeing on the approach to tackle the points on which there are different opinions.

Bonita BPM [55] is used to implement, in stages, the various processes that are being used in the BUCs, to validate if there is some scenario/branch that cannot be executed in a workflow engine. During this phase agreement is reached over the level of IT implementation of the case (what is implemented in the workflow engine and what is left for the clerk to execute manually).

The Business Playground appears as an essential element taking into consideration the complexity level implied by

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performing business processes in a distributed environment of 32 countries, 8 social security sectors, with over 10.000 institutions to be connected. Having a Business Playground in place is an appropriate measure to adopt in the context of challenges raised by the integration of national-level applications with the AP.

A strong collaboration between the EC and the Member States as well as significant involvement of the end users in the development of the solution is a key factor in making the development of EESSI a success.

The playground work stream is being delivered in three phases – each phase delivering a number of BUCs (as illustrated in the below diagram) and providing an increasingly functionally rich NA. Additional details are presented in Figure 6.

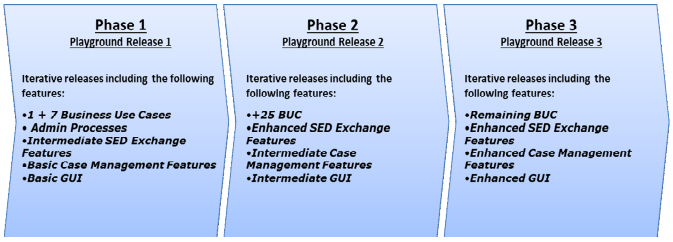

Figure 6. EESSI Playground phases

RINA is in the last year of industrial implementation as a multitenant/cloud solution and the underlying development technologies are: Bonita BPM [55], Elasticsearch [56] and AngularJS [57].

The sizing of Playground and Dry Run iterations is listed below:

Play Ground Environment:

- Number of RINA environments: 6
- Number of users: 103
- Total number of cases performed by participating institutions during the first two Play Ground phases: 2.830.

Dry Run Environment:

- Number of RINA environments: 16 (each RINA institution represents one country)
- Number of users: 240
- Total number of cases performed by participating institutions during the first two Dry Run phases: 13.130

More than 95% of the started cases in the Dry Run environments were successfully closed fully electronically.

The two mentioned environments: playground and dry run, are also involved in collecting feedback on RINA features using the EC change management process.

VII. CONCLUSION AND FUTURE WORK

RINA overcomes the problem raised from the unavailability of easily interpretable guides within existing applications and takes the recording of medical information beyond historical and statistical reasons, by being a proactive solution that is giving a strong decisional support to the clerk. RINA targets directly any clerk or medical personnel involved in public health cases.

The central piece of this approach is the Timeline, representing a historical view of SEDs disposed along a vertical time axis as thumbnails, which offers a clear and actionable insight into the case history.

As such, one of the main benefits of this approach, when compared with the tried and proven case management interfaces, is represented by the possibility of dynamically loading a large volume of data that is time-sorted. Moreover, the timeline provides a unified browsing experience for a volume of heterogeneous data that was collected at different points in time.

In order to provide a gentle learning curve and natural grouping of information, RINA GUI is developed around familiarity gained from social networking services like Facebook and suitability of this approach to the social security and public health domain, and therefore, embraced the established graphical presentation patterns.

The tests conducted so far show a high level of acceptance from users (healthcare domain experts and clerks from a significant number of countries and institutions). Most Member States concerned are currently considering the options available for integration and EC surveys show that a large majority to use RINA, or at least one of its layers.

The next period will be dedicated to supporting the decision making at the Member State and institution level so that integration is planned on the most efficient option for each institution, taking into account on the one hand applicable RINA features and, on the other hand, specific environment characteristics, such as the existence of a centralised e-government infrastructure, the existence of an identity management solution, the technology used for existing national applications, specific national requirements regarding security and usability, specific national requirements for case routing and/or related to the SED content.

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VIII. APPENDIX 1 - RINA MAIN FEATURES

Below, we selected a number of illustrative core features implemented by RINA:

- Search management features
  - Free text search -
    (*free-text search in fuzzy or exact manner on case metadata in order to identify a case or a group of cases*)
  - Structured search
    (RINA allows users to define, modify or delete structured searches using visual search expressions and to persist users searches as pre-defined searches)
  - Applying a predefined search
    (*Users are able to quickly select and apply a predefined search in order to minimize searching effort.)*
  - Refine predefined search results
    (After the system has filtered the cases based on a user's predefined search request, the User can read the list of filtered cases. The User can also use the free text search to further refine the returned results)
  - Configure Search Result
    (Users have the possibility to configure for each case type: the list of columns that will be returned by the search engine, and the order of the columns and of the results.)
- Case management features
  - Create case
    (RINA allows a User to create a case through accessing a hierarchical structure of case types. RINA retains (per session) the last case type instantiated to enable to quickly creation of another case.)
  - Determine Exchange Partners
    (RINA persists the case participant(s) for each case instance RINA allows the User to view the current case participant(s) and any historical changes.)
  - Case available actions
    RINA provides Users with a list of available actions (tasks) related to a specific case instance depending on the state of the case - e.g., forward, create, update - and for any case action executed by a User RINA updates the case state. It also display the available action list upon the change of case state to ensure that Users can only perform actions that are correct based the case state.
  - Execute action
    (A User has the possibility to select one action from the action list presented to him.)
  - Group Case Actions
    (RINA provides logical grouping of case actions at case level or SED level and could provide further logical grouping of case actions as case level. RINA it also offer the possibility to filter case actions by grouping)
  - Case Importance/ Criticality
    (A User is able to specific the level of Importance and Criticality of a case and can change the importance and criticality of a case at time during the case. This can be done for more than one case at a time.)
  - Case Alarm
    (A User is able to set or delete an alarm by which they expect an action to have occurred. The user is notified when an alarm expires)
  - Create SED
    (RINA allows the persistence of documents in multiple draft states)
  - Create Portable Documents

(RINA can create Portable Documents (PD) were the content of the PD can be fully derived from SED content)

- SED Validation
  (RINA is able to display document validation errors in a clear and logical fashion, allowing the User to navigate directly to the source of the error from the error description.)
- Manage Document Views
  (RINA offers multiple views for Users to view sent and received documents, these can be filtered by: direction, partner, type, status. Users are able to clearly visualise draft documents from sent/received documents and documents that are in different document states. RINA it also offers access to view all document versions)
- Manage document attachments
  (Users are able to manage the attachments through attaching and detaching files. The attachments can be added at case level or at SED level. RINA can restrict the type of attachments allowed and can also restrict the access to attachments of a certain business type where necessary. RINA allows Users the access to read/open attachments directly)
- Print Documents
  (RINA allows a user to choose an action that will render a document as a printable form (PSED))
- Manage comments
  (The User is able to create, read or delete comments (case notes) at document level or case level. RINA persists and display the author and time of each comment and it also ensure that only the author of a comment (or a user with special permissions) can delete a comment)
- Case assignment
  (New Cases (both created locally & received) are automatically assigned to Users using a configurable case assignment rules (via the administration console). A User (with permission) is able to assign a case to users or groups of users that are part of the local organisation and also is able to unassigned/ reassign a case to users or groups of users that are part of the local organisation. A User (without permission) is able to request to a User (with permission) to assign a specific case to them. A User is able to assign/ unassigned/ reassign more than one case at a time. RINA ensures that only assigned users can actively work on/progress a case and is restricting access to certain case types where necessary (e.g., sensitive cases)
- Document Translation
  (A user is able to translate documents content (any free text elements) into any of the EU official languages. Translated document content is not persisted)
- User Settings
  (RINA provides users with possibility to save (persist) user preferences (such as view style, order style etc.))
- Notification management features
  - Generate notifications
    (The notification management requirements cover all aspects of case notification in RINA.)
  - View Notifications
    (*Every time an event condition is fulfilled, RINA notifies the assigned Users of the case. Each notification has associated a type that is either: Error, Alert or Information.)*
  - Notification Actions
    (A User should be able to take logical actions direct from the notification)
  - Filter Notifications
    (RINA offers the possibility to filter notifications based on type and status and to navigate the notifications' timeline.)
  - Notification Summary
    (RINA provides count of notification by types in the notification panel and the case level views. The counts be automatically re-calculated when User take actions on the notifications. A user is also able to receive anytime in every module of the application the delivery of a new notification.)
  - Suppress/Unsuppressed notification
    (The user is able to suppress a notification so that it is not taken into account anymore and also to unsuppressed a previously suppressed notification so that it is taken into account anymore.)
  - Mark notification as read/unread
    (The user can mark a notification as read or unread so that the next time the notifications are displayed the read/unread state is preserved)
- Administration features
  - Administration Console
    (All administrator tasks are provided through a dedicated administrator console)
  - User Management and organization structure
    (An administrator is able to define organization units, together with departments having any level of nesting and also able to define users or to refer them from an external identity management repository. An administrator is also able to configure the default user settings)
  - Authorisation policies
    (For each case type, the administrator is able to configure what users or groups are allowed to create, to execute, to administer or to audit new cases. These are corresponding to the regular user roles: Clerk, Supervisor and Auditor)
  - Audit
    (The administrator is able to configure what events the system needs to audit. The audit is also reflected to all main resources exposed by the functional modules, for all possible operations: create, read, update, delete and execute.)
  - Technical log

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(All the modules of RINA populates a centralised log available for RINA Administrators. The administrator is able to configure the level of logging: trace, debug, info, warn, error and fatal.)

- Notification Management
  (An administrator is able to suspend notification types, and to set notification behaviour (i.e., how a notification is presented to a user))
- RINA updates and versioning of physical artefacts
  (The physical artefacts (forms, case behaviour, vocabularies, etc.) distributed by CSN through AP can be updated by a RINA administrator. These physical models are accompanied with a minimum set of metadata like: version, date of release, name)
- Messaging configuration
  (The messaging configuration is fully available for RINA administrators through the administration console.)
- Counter management
  (The administrator is able to define counters for national case ID. The policies for national case identification can be particular to a department and have a period of availability.)
- Retention policy (case, audit, technical log and notifications)
  (RINA is able to archive the closed cases, audit, technical log and notifications. The retention policy for all of this is configurable)
- Dead letter Queue
  (RINA provides an administrator with access to received documents that it could not logically processed (i.e., unrelated documents, documents with errors) and allows the administrator to return a business exception error automatically for these documents. The sending of business exception error could be a bulk operation)

- General non-functional features
  - User login
    (Any User having the right credentials is able to access RINA. The credentials can be user name and password or smartcards. RINA will logout a user if the application is left idle for a pre-configurable period of time.)
  - Multi-tenancy
    (*One RINA deployment is able to host multiple institutions completely isolated between them and with independent capabilities of administration)*
  - Localization
    (The User can decide any-time what is the language of its user interface. The user interface acts accordingly to this setting by translating all the screens together with the codified fields (vocabularies)).
  - Accessibility
    (RINA is WCAG 2.0 compliant to minimum AA standard.)
  - Browser Compatibility
    (RINA is fully compatible with the following browsers: Chrome (v.40 +), Firefox (v.32+), Internet Explorer (v.11+))
  - Error Handling
    (Application Errors are delivered to users in an unobtrusive manner, while providing sufficient information to understand the problem)
  - Help
    (RINA provides context aware help for users at SED level (Explanatory Notes) and Application level (general usage guidelines))

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