D9.5: Conceptual, Technical and Business Pilots

WP 9 – Industrial Project 3: eHealth Business Process Preservation

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List of Acronyms

ADE	Adverse Drug Event
BP	Base Practice
CMMI	Capability Maturity Model Integration
DP	Digital preservation
GP	Generic Practice
GR	Generic Resource
GWP	Generic Work Product
ISO	International Standardization Organisation
IT	Information Technology
PA	Process Attribute
PAM	Process Assessment Model
PRM	Process Reference Model
SPICE	Software Process Improvement and Capability Determination
WP	Work Package

1 Executive Summary

The 3rd Use Case “Industrial Project 3: eHealth Business Process” was not directly assessable due to different non-disclosure agreements. Because of that the TIMBUS processes and tools had been adopted in a simulation of the real use case. The use case represents a rather complex scenario, containing three companies exchanging data describing drug side effects. This includes the drug information itself as well as personal data of patients. The methods and tools were adapted to the derived use case to prove if TIMBUS is adoptable to the scenario described. In the last project year, the goal was to assess if the methods, procedures and tools developed during the projects runtime are adequate to fulfil the needs of the industries and to identify potential gaps which impede the use of digital preservation in this strategic business. The purpose of TIMBUS, was prove concepts in the approach to digital preservation of business processes; this deliverable considers those research outputs with the objective of augmenting them with an objective assessment of their maturity and an identification of future work in order to maximise the impact and usefulness of the approach to industry and SME’s.

Initially a method was identified for developing a method, to assess the eHealth use case, which was defined in D9.3 [2]. The method is based on the international standard ISO 15504 („Information technology -- Process assessment" [3]). This standard describes a general approach on how to define assessment models and procedures for measuring the maturity level of organisations. A good example for illustrating the approach is ISO15504-5, which defines an example for assessing the maturity level of software development processes (SPICE). The assessment was altered to match the different focus of the planned result. Instead of assessing how well the use case followed the defined TIMBUS process, the assessment as documented in this deliverable is focused on figuring out whether the TIMBUS process as defined in D4.6 and the tools developed to support the process are suitable for the intended cause.

The assessment showed that the application of the TIMBUS methods is potentially suitable to conduct digital preservation of business processes in the described use case. But the assessment results also indicated that there is some room for improvement and enhancement in the process itself as well as in the tools developed to support the process. This is at least partially reasoned by the simulation character of the assessed environment. Due to the need to anonymise large aspects of this use case, the application of the TIMBUS process ran into some challenges causing some parts of the TIMBUS process not being executed optimally. Another reason for the experienced challenges is the prototypical state of the tools.

In order to make use of the potential for improvement in the tools, they should be enhanced to further automate parts of the process, as well as regarding better interoperability and linking as the current tools leave some gaps that had to be filled by manual intervention. Regarding the process itself the assessment showed some room for enhancement regarding flexibility of the process in adopting to different preservation approaches by the introduction of tailoring possibilities. Furthermore the assessment indicated that product lifecycle management might serve as an alternative driver for digital preservation. Further research towards this is recommended.

In summary, the results indicate great potential as well as the necessity of further research to bring digital preservation into business environments.

2 Introduction

2.1.1 Objective

The purpose of this deliverable is to document all information related to an assessment performed on the eHealth preservation case. It describes the Assessment Model (the assessment approach) in Chapter 3. In Chapter 4 it describes the assessment context. This contains an overview of the organisations involved in the use case and the business processes which was preserved. The results of the assessment are documented in Chapter 5. The defined goal of the assessment was to evaluate the suitability of the TIMBUS process and supporting tools for the digital preservation of the eHealth use case. Conclusions and recommendations derived from the assessment are documented in Chapters 6 and 7.

2.1.2 Scope

In order to evaluate the digital preservation process defined in the course of the TIMBUS project, the process was applied to several use cases and the application was assessed afterwards. As mentioned above, the main goal of the assessment was to assess the suitability of the TIMBUS process and supporting tools for the intended purpose. This use case faces the special situation of not being performed in the original organisations for secrecy reasons. Therefore it was necessary to anonymise information and reproduce some of the systems of the original use case.

2.1.3 Context

This deliverable is part of the TIMBUS research project, which focuses on the development of a process and supporting tools for digital preservation. As part of this work, several use cases were defined. The process for digital preservation developed by the TIMBUS project was applied to those use cases in order to test the suitability of the process and of the tools developed to support its execution.

This deliverable documents an assessment on the eHealth use case. It includes the assessment model and the results of the actual assessment.

The underlying eHealth use case involved all the TIMBUS partners. Its purpose was to apply the TIMBUS process to the use case as described in [2] (cf. chapter 4 for an overview over the use case). In this context it was also planned to try out, evolve and optimise the tools and processes developed by the TIMBUS project.

As a last step, this assessment was conducted to evaluate how the TIMBUS process served its intended purpose when applied to the use case, and where it can be optimised.

3 Assessment Model

This section describes the model that was used to conduct the assessment of the use case. This assessment established to what extent the use case has adopted the TIMBUS approach towards digital preservation of business processes and their underlying IT support systems.

In order to facilitate capturing these aspects, the assessment needed to consider the application of the TIMBUS digital preservation processes. The assessment therefore audited the adoption of the TIMBUS processes in order to preserve the use case's business processes, i.e., the TIMBUS processes form the process reference model (PRM) against which the implemented preservation processes are assessed.

3.1 Applicable Standards

Today there exists a wide range of standardised methodologies to assess the implementation of processes in an organisation. Of this wide range, a majority of standards uses a two-pronged approach: They define both a set of reference processes that are required to be implemented, as well as a maturity measures to rate the degree of implementation. This degree of implementation is rated against predefined steps or levels, usually ranging from a very immature implementation to a highly mature implementation.

The following table illustrates a number of standards which cover this approach of process assessments:

Table 1 Process assessment standards

	Provides		
Standard	**Reference Process**	**Reference Model**	**Maturity/Capability Model**
Capability Maturity Model Integration (CMMI) [Industry standard, related to ISO/IEC 20000]	X	X [1]	X
Information technology — Process Assessment [ISO/IEC 15504]	(X) [2]	X	X [3]
Software Lifecycle Processes [ISO/IEC 12207]	X		
Information Technology Infrastructure Library (ITIL) [Industry standard, related to ISO/IEC 20000]	X	(X)[4]	

Table 1 clearly illustrates the breadth of the available process quality assessment standards, but at the same time shows that for the purpose of the assessment of TIMBUS use cases, an assessment approach based on ISO/IEC 15504 is the most suitable. Not only does ISO/IEC 15504 not require a predefined reference process, which makes it more flexible and easily adoptable to the assessment of the TIMBUS process than CMMI. It is also an international standard that is widely applied across the industry and it provides a

[1] CMMI compliance is established to the maturity model by way of appraisal. Alternatively the organization can also be appraised against a separate capability model.
[2] ISO 15504 used to contain a process reference model of its own but this has been removed from the standard in 2004.
[3] ISO 15504 does not provide a maturity model but provides a capability dimension as part of its reference model.
[4] No certification for ITIL compliance exists, but compliance to ISO 20000 can be assessed and certified.

capability model sufficient for the purposes of the use case assessment as well as a description on how to run an assessment. That way, ISO/IES 15504 can be adapted to assess against a range of reference processes and is not limited to development-centric processes. While CMMI is geared towards assessing the maturity of a whole organization with all its business processes ISO/IES 15504 is focused on assessing the capability in implementing specific processes. Therefore, ISO/IES 15504 is more easily adapted to the needs of assessing the adoption of the TIMBUS process in the industrial use cases.

3.2 Assessment Methodology

This section delineates the assessment methodology, i.e., which reference processes of the use case were assessed against and which approaches were used to evaluate and rate the result of this assessment.

The assessment makes use of a process quality auditing methodology, as defined in ISO 15504. This entails that the assessment of the use case is conducted based on the application of the TIMBUS process in the context of this use case.

In order to perform this assessment, the use case processes were evaluated against a given Process Reference Model (PRM). This evaluation identified areas of compliance and compliance gaps with regard to the use case process landscape, which – in turn – were used to determine a capability level for the use case with regard to its application of TIMBUS processes.

In particular, process evaluation methodology and capability levels for this assessment are based on the respective parts of the methodology and capability levels defined in ISO 15504.

3.2.1 Process Reference Model

For the purpose of this assessment the TIMBUS process model as defined in "D4.6: Use Case Specific DP & Holistic Escrow" [1] shall serve as the PRM. It clearly defines the involved processes of digital preservation (DP).

For each of these DP processes, the PRM provides the following components:

- Process Name;
- Process Purpose;
- Process Outcomes.

All processes defined in the PRM were in scope for this assessment.

3.2.2 Considered Capability Levels

For the assessment of TIMBUS process application in the use cases, not all six capability levels (cf. Table 2) defined for ISO 15504 [3] are deemed applicable. Only levels 0-2 are considered, due to the following rationale:

- The digital preservation process is a newly developed process
- This assessment assesses its first time execution
- Main goal is to determine whether or not the desired outcome could be achieved using the newly developed digital preservation process

Table 2 ISO/IEC 15504 capability levels

Level	Description
5	Optimizing process
4	Predictable process
3	Established process
2	Managed process
1	Performed process
0	Incomplete process

Considering these constraints, it is deemed impossible for this use case to reach a level higher than "Managed Process", whilst reaching even this level is highly unlikely, as it would require not only successfully implementing all sub processes but also to establish a process management capability for these sub processes in parallel.

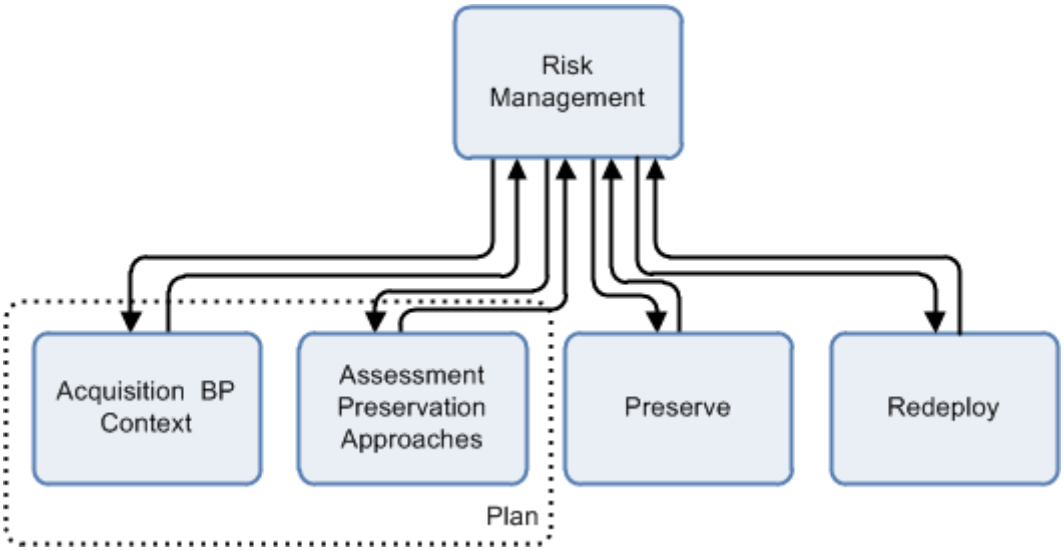

Figure 1 TIMBUS DP High-level Process Overview

3.3 Model Overview

This section defines and discusses the Process Assessment Model (PAM) for the TIMBUS process framework for digital preservation developed by the EU founded TIMBUS Project.

The purpose of PAM is to enable an assessment that determines whether the TIMBUS Process for Digital Preservation as defined in the PRM (see section 3.2.1) is suitable to achieve its goal to capture the context of a business process, digitally preserve it in full and redeploy it to a new environment later on. The PAM is intended to be used to assess three example implementations of the TIMBUS.

3.3.1 Processes

In order to ease the handling of the various (sub-) processes, inputs, outputs and relationships in the digital preservation process developed by TIMBUS we break down the whole process as follows for the purpose of this assessment:

The main processes (as shown in Figure 1) will be represented as accordingly named Process Groups containing their processes as defined in the PRM.

Individual process steps (and/or sub processes) will be represented as Base Practices. In ISO/IEC 15504 a base practice is defined as "an activity that, when consistently performed, contributes to achieving a specific process purpose" [3].

The concluding structure is laid out in the following paragraphs.

3.3.1.1 Process Group Risk Management

Process Identification	Process Name	Source
RISK.1	Risk Management	[1] 3.4.2.1

3.3.1.2 Process Group Planning

Process Identification	Process Name	Source
PLAN.1	Acquisition of business process context	[1]3.4.2.2
PLAN.2	Assessment of Preservation Approaches	[1]3.4.2.3

3.3.1.3 Process Group Preserve

Process Identification	Process Name	Source
PRES.1	Preserve	[1]3.4.3

3.3.1.4 Process Group Redeploy

Process Identification	Process Name	Source
DEPL.1	Redeployment	[1]3.4.4

3.3.1.5 Process Monitoring

Process Identification	Process Name	Source
MON.1	Monitoring of business process context in source environment	[1]3.4.5.1
MON.2	Monitoring of preserved business process	[1]3.4.5.2

3.3.2 Process Dimension

The Process Dimension of this PAM is defined in clause 3.4 (Process Performance Indicators).

3.3.3 Capability Dimension

As stated in section 3.3 this assessment considers only the capability level zero to two. The meaning of these levels is described by the ISO 15504 as follows:

- **Level 0: Incomplete process**
  The process is not implemented, or fails to achieve its process purpose. At this level, there is little or no evidence of any systematic achievement of the process purpose.
- **Level 1: Performed process**
  The implemented process achieves its process purpose.
- **Level 2: Managed process**
  The previously described Performed process is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.

3.3.3.1 Capability Measurement

Within the PAM, the measure of capability is based upon three of the nine process attributes defined in ISO/IEC 15504-2, since only three attributes are applicable to capability levels 0-2. Process attributes are used to determine whether a process has reached a given capability. Each attribute measures a particular aspect of the process capability.

The list of process attributes is shown in the following Table 3.

Table 3 Mapping of Process Attributes to Capability Levels

Process Attribute ID	Capability Levels and Process Attributes
	Level 0: Incomplete process
	Level 1: Performed process
PA 1.1	Process performance
	Level 2: Managed process
PA 2.1	Performance management
PA 2.2	Work product management

The process attributes are evaluated on a four point ordinal scale of achievement (cf. 5.3), as defined in ISO/IEC 15504-2. They provide insight into the specific aspects of process capability required to support process improvement and capability determination.

In order to achieve Capability Level 1, the TIMBUS process needs to be implemented at least largely or fully. A partial or no implementation of the TIMBUS process would lead to achieving only Capability Level 0. The level of achievement for the overall process is determined by calculating the average achievement scores of all its sub processes.

3.3.4 Assessment Indicators

With regard to the meaning and usage of assessment indicators this process assessment model is directly based upon the explanations in ISO 15504[3]. For this reason the following sections are giving only a short

overview regarding the respective topics. For a more detailed explanation of the concepts described here please confer ISO 15504 [3].

The PAM is based on the idea to break down the whole process into capability indicators. These indicators should be defined in a manner not only enabling to decide whether or not a process fulfilled its purpose, but also to which extent and quality. They can therefore help to derive constructive conclusions on how to improve the process and its implementation.

There are two types of assessment indicators: process capability indicators and process performance indicators.

While the process performance indicators deal with the basic execution of the process and therefore address mainly whether and to which extent it was performed successfully, the process capability indicators address the maturity of the process implementation.

The process capability indicators are:

- Generic Practice (GP);
- Generic Resource (GR);
- Generic Work Product (GWP).

Process capability indicators are taken into account for capability level 2 and higher.

The process performance indicators are:

- Base Practice (BP);
- Work Product (WP).

Process performance indicators are used to decide whether a process reaches at least capability level 1.

"The process performance and process capability indicators defined in the Process Assessment Model represent types of objective evidence that might be found in an instantiation of a process and therefore could be used to judge achievement of capability." [3]

3.4 Process Performance Indicators

This clause defines the processes and the process performance indicators, also known as the process dimension, of the Process Assessment Model. The processes in the process dimension can be directly mapped to the processes defined in the PRM.

The processes are classified (for the purpose of this PAM) into Process Categories and Process Groups which are listed in section 3.3.1.

The individual processes are described in terms of Process Name, Process Purpose, and Process Outcomes.

In addition, the process dimension of the PAM provides information about the Base Practices, including a definition of tasks and activities needed to accomplish the processes purpose. Each Base Practice is explicitly associated to a process outcome.

Where applicable, sub processes are described in an equal manner and marked as sub process.

The Work Products table describes work products flowing into and out of Base Practices as part of process execution. This table lists work products flowing into a Base Practice in the "Inputs" column and lists work products flowing out of Outcomes in the "Outputs" column. Impacted Base Practices and Outcomes are listed for each work product. Descriptions of the Work Products are provided in Annex A.1.

NB: Any given work product may serve as the input to multiple Base Practices and may be the output of several Process Outcomes. In order not to unnecessarily increase the size and the complexity of the Work Products table, in these cases, work products are listed only once as input or output and all impacted Base Practices or Process Outcomes are listed in one line. If a WP is modified by a Base Practice (e.g., enhanced by additional information) it is placed in a single line as input and output.

3.4.1 Process Group Risk Management

3.4.1.1 RISK.1 Risk Management

Process ID	RISK.1
Process Name	Risk Management
Process Purpose	The purpose of the Risk Management process is to identify, analyse, evaluate and treat the risks associated with a business process, which can lead to a decision to use digital preservation as a mitigation action. This process also decides on which preservation strategy shall be executed.
Process Outcomes	O.1 Context Model of the business process is established O.2 Risks for the business process are identified O.3 Risks for the business process are analysed regarding likelihood and impact O.4 Mitigation strategies are evaluated O.5 Risks are treated according to chosen mitigation strategy
Base Practices	BP.1 Establish Context [O.1] BP.2 Identify Risks [O.2] BP.3 Analyse Risk [O.3] BP.4 Evaluate Risk [O.4] BP.5 Treat Risk [O.5]

Work Products	
Inputs	**Outputs**
WP.05 Business Process Specification [BP.1]	
WP.06 Source Environment [BP.1]	
	WP.02 Context model instance (CMI) [O.1]
WP.02 Context model instance (CMI) [BP.2]	
	WP.33 List of identified risks [O.2]
WP.33 List of identified risks [BP.3]	
	WP.34 Report about likelihood and impact of identified risks [O.3]
WP.34 Report about likelihood and impact of identified risks [BP.4]	
	WP.01 Risk Assessment Report [O.4]
	WP.03 Process Preservation Plan (PPP) [O.4]

WP.03 Process Preservation Plan (PPP) [BP.5]	
	WP.18 Preserved business process [O.5]

3.4.2 Process Group Planning

3.4.2.1 PLAN.1 Acquisition of business process context

Process ID	PLAN.1
Process Name	Acquisition of business process context
Process Purpose	The purpose of the Acquisition of business process context process is to establish an initial Process Context Model that enables the Risk Management to develop digital preservation approaches if necessary.
Process Outcomes	O.1 Decision if business process is well specified and sufficient documented O.2 Specification of business process, sufficient for preservation purposes O.3 Requirements of the stakeholders (concern) are known O.4 Domain specific information of the context is gathered O.5 Context model instance (CMI) is developed O.6 CMI with views is developed
Base Practices	BP.1 Check whether business process is sufficiently specified [O.1] BP.2 Refine business process specification [O.2] BP.3 Identify Stakeholders [O.3] BP.4 Acquisition of domain specific context [O.4] BP.5 Context Model & Dependencies Modelling [O.5] BP.6 Create Views [O.6]

Work Products	
Inputs	**Outputs**
WP.05 Business Process Specification [BP.1, BP.2, BP.3, BP.4]	WP.05 Business Process Specification [O.1, O.2]
WP.06 Source Environment [BP.2, BP.4]	
	WP.07 Requirements of the stakeholders (concern) [O.3]
	WP.08 Domain specific information of the context [O.4]
WP.09 Domain specific models [BP.5]	
	WP.02 Context model instance (CMI) [O.5]
WP.02 Context model instance (CMI) [BP.6]	WP.10 CMI with views [O.6]

3.4.2.2 PLAN.2 Assessment of Preservation Approaches

Process ID	PLAN.2
Process Name	Assessment of Preservation Approaches
Process Purpose	The purpose of the Assessment of Preservation Approaches process is to specify requirements for the preservation process followed by identification and evaluation of preservation approaches in order to choose the one best fitting the requirements. As a last step a preservation Action Plan is built, based on the chosen approach.
Process Outcomes	O.1 Context model instance (CMI) is refined and extended to re-

	flect the needs of this process O.2 Preservation requirements are identified and documented O.3 Process context is abstracted where applicable O.4 Possible preservation approaches are identified, evaluated and documented in preservation plans O.5 Process Preservation Action Plans (PPP) are built and delivered to risk management as decision paper.
Base Practices	BP.1 Acquisition business process context for Digital Preservation (sub process) [O.1] BP.2 Document preservation requirements [O.2] BP.3 Abstraction of process context (sub process) [O.3] BP.4 Develop Preservation Plan (sub process) [O.4] BP.5 Build Preservation Action Plan [O.5]

Work Products	
Inputs	**Outputs**
WP.01 Risk Assessment Report [BP.1]	
WP.02 Context model instance (CMI) [BP.1, BP.2, BP.3, BP.4]	WP.02 Context model instance (CMI) [O.1, O.3]
WP.06 Source Environment [BP.1]	
	WP.11 Preservation Requirements [O.2]
WP.11 Preservation Requirements [BP.3, BP.4]	
	WP.12 Evaluated preservation plan [O.4]
WP.12 Evaluated preservation plan [BP.5]	
	WP.13 Evaluated Process Preservation Action Plan (PPP) [O.5]

3.4.2.2.1 PLAN.2.1 Acquisition of business process context for digital preservation (sub process)

Process ID	PLAN.2.1
Process Name	Acquisition of business process context for digital preservation
Process Purpose	The purpose of the Acquisition of business process context for digital preservation process is to finalize the Context Model, enabling development of plan and execution of the digital preservation.
Process Outcomes	O.1 Requirements of the stakeholders (concern) are known O.2 Domain specific models of the context are gathered O.3 Context model instance (CMI) is finalized O.4 CMI with views reflecting the needs of the stakeholders is developed
Base Practices	BP.1 Identify Stakeholders [O.1] BP.2 Acquisition context and dependencies BP.3 Context Model & Dependencies Modelling [O.3] BP.4 Create Views [O.4]

Work Products	
Inputs	**Outputs**
WP.02 Context model instance (CMI) [BP.1, BP.2 BP.4] (version from previous process)	WP.02 Context model instance (CMI) [O.3] (updated / finalized version)
WP.06 Source Environment [BP.2]	
	WP.07 Requirements of the stakeholders (concern) [O.1]
	WP.08 Domain specific information of the context [O.2]
	WP.09 Domain specific models [O.2]
WP.08 Domain specific information of the context [BP.3]	
WP.07 Requirements of the stakeholders (concern) [BP.4]	
	WP.10 CMI with views [O.4]

3.4.2.2.2 PLAN.2.2 Abstraction of business process context (sub process)

Process ID	PLAN.2.2
Process Name	Abstraction of business process context
Process Purpose	The purpose of the Abstraction of business process context process is to remove unnecessary implementation details from the CMI while preserving all necessary information for preservation and re-deployment.
Process Outcomes	O.1 Abstraction possibilities are identified O.2 Possible abstractions are implemented O.3 Abstraction implementation is verified O.4 Decision about successful abstraction that fulfils all requirements is made
Base Practices	BP.1 Analyse context model instance [O.1] BP.2 Perform abstraction [O.2] BP.3 Verify abstraction [O.3] BP.4 Decision [O.4]

Work Products	
Inputs	**Outputs**
WP.11 Preservation Requirements [BP.1, BP.3]	
WP.02 Context model instance (CMI) [BP.1, BP.2, BP.3] (For BP.3: both original version and version with abstracted concepts)	WP.02 Context model instance (CMI) (with abstracted concepts) [O.2]
WP.35 Suggestions for Abstractions [BP.2]	
WP.36 Results of verify abstraction [BP.4]	
	WP.35 Suggestions for Abstractions [O.1]
	WP.36 Results of verify abstraction [O.3]
	WP.37 Decision [O.4]

3.4.2.2.3 PLAN.2.3 Develop Preservation Plan (sub process)

Process ID	PLAN.2.3
Process Name	Develop Preservation Plan
Process Purpose	The purpose of the Develop Preservation Plan process is to develop a valid preservation plan
Process Outcomes	O.1 Components for preservation are selected O.2 Preservation approaches are defined, including procedure to acquire data, strategies to maintain significant properties over times etc. O.3 The defined preservation plan is evaluated against the preservation requirements O.4 Results of the evaluation of the different approaches are compared and the collected data from the evaluation step is prepared for decision making O.5 Decision whether Plan is fulfilling preservation requirements or a refinement is needed is made based on the results of O.4
Base Practices	BP.1 Select components [O.1] BP.2 Define Preservation plan [O.2] BP.3 Evaluate plan [O.3] BP.4 Analyse results [O.4] BP.5 Decision: Plan fulfils the requirements ? [O.5]

Work Products	
Inputs	**Outputs**
WP.11 Preservation Requirements [BP.1, BP.2]	
WP.02 Context model instance (CMI) [BP.1, BP.2, BP.3] (from BP.2 on including the changes from O.1)	WP.02 Context model instance (CMI) (with selected components) [O.1]
WP.01 Risk Assessment Report [BP.2]	
WP.38 Preservation Knowledge Base [BP.2]	
WP.03 Process Preservation Plan (PPP) [BP.3]	
WP.06 Source Environment [BP.3]	
WP.39 Results of evaluation of the preservation approaches against the preservation requirements [BP.4]	
WP.12 Evaluated preservation plan [BP.5]	
	WP.03 Process Preservation Plan (PPP) [O.2]
	WP.39 Results of evaluation of the preservation approaches against the preservation requirements [O.3]
	WP.12 Evaluated preservation plan [O.4]
	WP.37 Decision [O.5]

3.4.3 Process Group Preserve

3.4.3.1 PRES.1 Preserve

Process ID	PRES.1
Process Name	Preserve
Process Purpose	The purpose of the Preserve process is to execute the actual preservation of the business process, including operational planning and quality assurance
Process Outcomes	O.1 Preservation is planned from an operational perspective O.2 The data regarding the business process is gathered O.3 The verification data regarding the business process is gathered O.4 Preservation action defined in the Preservation Action Plan (PPP) are performed O.5 Quality Assurance measures are performed on the preserved process O.6 Decision if preservation was successful is made O.7 Preserved Process is stored in archive O.8 Monitoring events for re-evaluation of the preserved business process are defined
Base Practices	BP.1 Operational planning of preservation execution [O.1] BP.2 Acquisition of process data [O.2] BP.3 Acquisition of validation and verification data [O.3] BP.4 Perform preservation action [O.4] BP.5 Perform quality assurance [O.5, O.6] BP.6 Archival storage [O.7] BP.7 Define monitor events [O.8]

Work Products	
Inputs	**Outputs**
WP.13 Evaluated Process Preservation Action Plan (PPP) [BP.1, BP.2, BP.3, BP.4, BP.7]	
WP.14 Selected preservation strategy [BP.1]	
	WP.15 Execution plan for preservation of the business process [O.1]
WP.06 Source Environment [BP.2, BP.3]	
	WP.16 Captured data [O.2]
	WP.17 Validation and Verification data for the preserved business process [O.3]
WP.16 Captured data [BP.4]	
	WP.18 Preserved business process [O.4]
	WP.19 Results of QA [O.5, O.6]
WP.18 Preserved business process [BP.5, BP.6]	
	WP.20 AIP (Archival information packages) [O.7]
WP.02 Context model instance (CMI) [BP.7]	
	WP.21 Monitor Events [O.8]

3.4.4 Process Group Redeploy

3.4.4.1 DEPL.1 Redeployment

Process ID	DEPL.1
Process Name	Redeployment
Process Purpose	The purpose of the Redeployment process is to deploy an archived business process into a new environment. This includes preparing the target environment as well as verifying the redeployment against the previously collected verification data.
Process Outcomes	O.1 Description of the preserved Process is retrieved from archive O.2 A model of the redeployment environment is developed O.3 Gaps between the needed redeployment environment and the actual are identified O.4 Alternatives to close identified gaps are evaluated O.5 Data associated with the preserved process is extracted from the archive O.6 Preserved Process is deployed into the target environment O.7 Preserved process is re-executed to test the redeployment O.8 Results of the re-execution are verified against verification data stored with the process O.9 Decision to proceed or repeat assessment of re-deployment alternatives is made
Base Practices	BP.1 Retrieve business process from archive [O.1] BP.2 Capture redeployment environment [O.2] BP.3 Gap analysis [O.3] BP.4 Assessment of redeployment alternatives [O.4] BP.5 Retrieve data from archive [O.5] BP.6 Setup environment [O.6] BP.7 Perform re-execution [O.7] BP.8 Verify results [O.8, O.9]

Work Products	
Inputs	**Outputs**
WP.22 Archive[BP.1]	
	WP.23 Business process description [O.1]
WP.24 (empty) Redeployment environment [BP.2]	WP.24 Redeployment environment [O.6] (with preserved process deployed but not executed)
	WP.25 CMI of the redeployment environment [O.2]
WP.23 Business process description [BP.3]	
WP.25 CMI of the redeployment environment [BP.3]	
	WP.26 Gap report [O.3]
WP.26 Gap report [BP.4]	
	WP.27 Redeployment plan [O.4]
WP.27 Redeployment plan [BP.5, BP.6, BP.7]	
	WP.28 Retrieved business process data [O.5]
WP.29 Instantiated environment [BP.7]	
	WP.30 Redeployed business process [O.7]
	WP.31 Monitoring measurements [O.7]
WP.31 Monitoring measurements [BP.8]	
	WP.32 Validation result [O.8, O.9]

3.4.5 Process Group Monitoring

3.4.5.1 MON.1 Monitoring of business process context in source environment

Process ID	MON.1
Process Name	Monitoring of business process context in source environment
Process Purpose	The purpose of the Monitoring of business process context in source environment process is to recognize changes in a preserved process' context.
Process Outcomes	O.1 Business process description is retrieved from archive O.2 Current business process context is gathered O.3 Gaps between archived and current context are identified O.4 Process Assessment of preservation approaches is triggered in case of Gaps
Base Practices	BP.1 Retrieve business process from archive [O.1] BP.2 Acquisition business process context [O.2] BP.3 Gap analysis [O.3, O.4]

Work Products	
Inputs	**Outputs**
WP.22 Archive [BP.1]WP.05	
	WP.23 Business process description [O.1]
WP.06 Source Environment [BP.2]	
	WP.02 Context model instance (CMI) [O.2]
WP.23 Business process description [BP.3]	
WP.02 Context model instance (CMI) [BP.3]	
	WP.26 Gap report [O.3]

3.4.5.2 MON.2 Monitoring of preserved business process

Process ID	MON.2
Process Name	Monitoring of preserved business process
Process Purpose	The purpose of the Monitoring of business process is to actively monitor dependencies and requirements of a preserved process in order to ensure the capability to redeploy it.
Process Outcomes	O.1 Business process description is retrieved from archive O.2 Current redeployment environment is captured O.3 Gaps between archived and current context are identified O.4 Process Assessment of preservation approaches is triggered in case of Gaps O.5 Redeployment is planned O.6 Data associated with the preserved process is extracted from the archive O.7 Preserved Process is deployed into the target environment O.8 Preserved process is re-executed and monitored in test the redeployment O.9 Results of the re-execution are verified against verification data stored with the process O.10 Decision to proceed or repeat assessment of re-deployment alternatives is made
Base Practices	BP.1 Retrieve business process from archive [O.1] BP.2 Capture redeployment environment [O.2] BP.3 Gap analysis [O.3, O.4] BP.4 Plan redeployment [O.5] BP.5 Retrieve required data from archive [O.6] BP.6 Setup test environment [O.7] BP.7 Perform test re-execution [O.8] BP.8 Verify results [O.9, O.10]

Work Products	
Inputs	**Outputs**
WP.22 Archive [BP.1]	
	WP.23 Business process description [O.1]
WP.24 Redeployment environment [BP.2]	
	WP.25 CMI of the redeployment environment [O.2]
WP.23 Business process description [BP.3, BP.6]	
WP.25 CMI of the redeployment environment [BP.3]	
	WP.26 Gap report [O.3, O.4]
WP.26 Gap report [BP.4]	
	WP.27 Redeployment plan [O.5]
WP.27 Redeployment plan [BP.5, BP.6]	
	WP.28 Retrieved business process data [O.6]
WP.28 Retrieved business process data [BP.6]	
	WP.29 Instantiated environment [O.7]
WP.29 Instantiated environment [BP.7]	
	WP.30 Redeployed business process [O.8]
	WP.31 Monitoring measurements [O.8]
WP.31 Monitoring measurements (of original and retrieved business process) [BP.8]	
	WP.32 Validation result [O.9, O.10]

3.5 Process Capability Indicators

This section presents the process capability indicators related to the process attributes (PA) associated with the capability levels 1 and 2. A detailed explanation of the attributes as well as their generic practices, generic resources and generic work products can be found in ISO 15504 [3].

Indicators for Level 0 are not described because Level 0 reflects a non-implemented process or a process which fails to achieve its outcomes and therefore does not include any indicators.

3.5.1 Level 1: Performed process

The following attributes of the process demonstrate achievement of Level 1 as defined in [3]:

- PA 1.1 Process Performance Attribute
  This attribute reflects whether or not the assessed process achieves its defined outcomes.
  - Generic Practices for PA 1.1
    Reflects whether Base Practices were performed as intended and associated Work Products were produced as evidence of the process outcomes.
  - Generic Resources for PA 1.1
    Resources are used to perform the intent of process specific base practices.
  - Generic Work Products for PA 1.1
    Work products exist that provide evidence of the achievement of the process outcomes.

3.5.2 Level 2: Managed process

"The previously described Performed process is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained." [3]

The following attributes of the process demonstrate the achievement of this level:

- PA 2.1 Performance management attribute
  "The performance management attribute is a measure of the extent to which the performance of the process is managed." [3]
  - Generic Practices for PA 2.1
    - GP 2.1.1 Identify the objectives for the performance of the process.
    - GP 2.1.2 Plan and monitor the performance of the process to fulfil the identified objectives.
    - GP 2.1.3 Adjust the performance of the process.
    - GP 2.1.4 Define responsibilities and authorities for performing the process.
    - GP 2.1.5 Identify and make available resources to perform the process according to plan.
    - GP 2.1.6 Manage the interfaces between involved parties.
  - Generic Resources for PA 2.1
    - Human resources with identified objectives, responsibilities and authorities;
    - Facilities and infrastructure resources;
    - Project planning, management and control tools, including time and cost reporting;
  - Generic Work Products for PA 2.1
    - Plan
    - Record
    - Register
    - Report
- PA 2.2 Work product management attribute
  "The work product management attribute is a measure of the extent to which the work products produced by the process are appropriately managed."[3]
  - Generic Practices for PA 2.2
    - GP 2.2.1 Define the requirements for the work products.
    - GP 2.2.2 Define the requirements for documentation and control of the work products.
    - GP 2.2.3 Identify, document and control the work products.
    - GP 2.2.4 Review and adjust work products to meet the defined requirements.
  - Generic Resources for PA 2.2
    - Requirement management method / toolset;
    - Configuration management system;
    - Documentation elaboration and support tool;
    - Document identification and control procedure;
    - Work product review methods and experiences;
    - Review management method / toolset;
    - Intranets, extranets and/or other communication mechanisms;
    - Problem and issue management mechanisms.

- Generic Work Products for PA 2.2
  - Plan
  - Record
  - Register
  - Repository
  - Standard
  - Template
  - Work product

4 Assessment Context

This section will specify the organizational context, in which the assessment will be executed. In Chapter 4.1 the organisation where the assessment will take place is described. A description of the Business Case is written in Chapter 4.2 and the major requirements for the preservation are shown in chapter 4.3.

The Use Case as described in the following sub clauses is a real business use case that was anonymized due to non-disclosure agreements etc. The network of organizations as well as the business processes and services exists as explained but were their names were altered.

For the assessed preservation the original business case was setup in an anonymized manner. The actual preservation was conducted on the anonymized duplicates of the business processes.

4.1 Organisation

The eHealth use case involves three companies directly: DrugFusion, DataMole and SemanTech, and also utilizes services of two external organizations: CMRDP and PhC.

DrugFusion is a German IT company with an extensive customer base of doctors and pharmacists. It has contractual and legal liabilities to provide an online service for subscribed doctors and pharmacists, assisting them with drug prescription decisions. The company has business relationships with CMRDP and PhC.

CMRDP provides commercial online services for receiving up-to-date drug-usage data.

PhC provides additional information for enhancing and validating search results.

DataMole is a Spanish IT company, which provides a service for discovering new Adverse Drug Event (ADE) rules by using a unique discovery engine. These rules contain information about ADEs which a patient is more likely to have, with a predefined set of conditions, in case of prescribing of a particular drugs combination. This company is responsible for maintenance and improvement of the ADE rules discovery algorithm.

SemanTech is a United Kingdom IT company, which provides software and hardware infrastructure for performing fast ADE rules indexing and search. It receives ADE rules from DrugFusion (initially discovered by DataMole), uploads and indexes them in a relational database. The main objective of the ADE rules indexing is to provide the efficient retrieval process, considering a large number of customers coming through the DrugFusion portal.

4.2 Business Case

The general structure of the use case from a business perspective is shown in Figure 2. As the figure shows it consists of a variety of Services that are connected with two processes at DrugFusion: ADE Discovery and ADE Search which are detailed out in Figure 3.

ADE Discovery is initiated by the event of releasing new drug usage data by CMRDP. The ADE Discovery Business Process is constantly monitoring the drugs repository via a web-service provided by CMRDP. When a new portion of drug usage data becomes available DrugFusion initiates pre-processing and rule discovery

steps. The actual rule discovery is performed by the DataMole service. Any newly discovered ADE rules are indexed by the SemanTech service. After indexing is finished the identified rules can be utilized by the ADE Search Business Process.

ADE Search is initiated by the end-user (doctor or pharmacist), by instrumenting the ADE Search Service via a web-client provided by DrugFusion. After initial pre-processing of the search query the actual search is conducted using SemanTechs' ADE Rules Retrieval Service. The results are enhanced and validated via PhCs' ADE Rules Validation Service and formatted by DrugFusion for display in the end-users web-client.

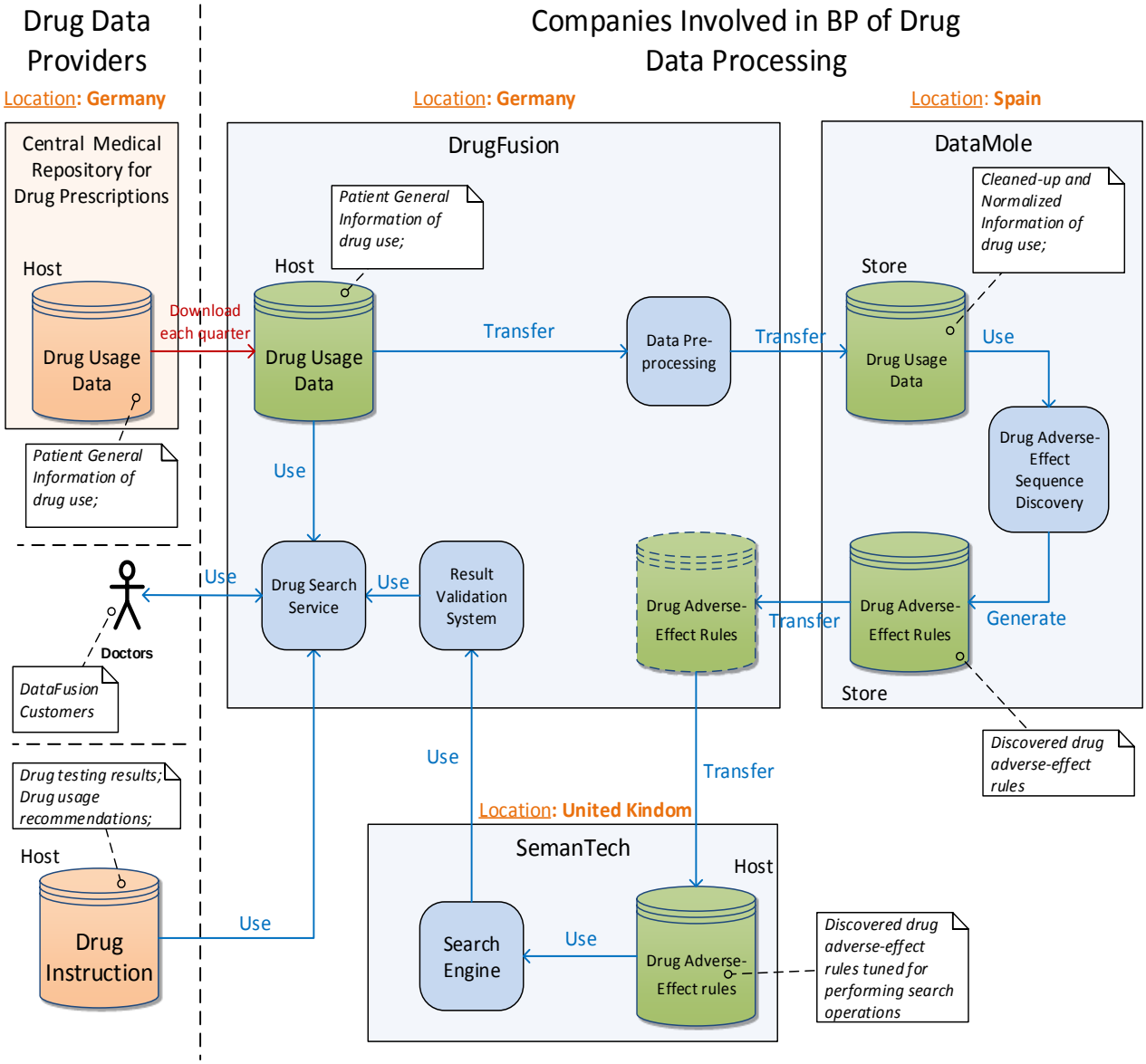

Figure 2 Use Case General Structure

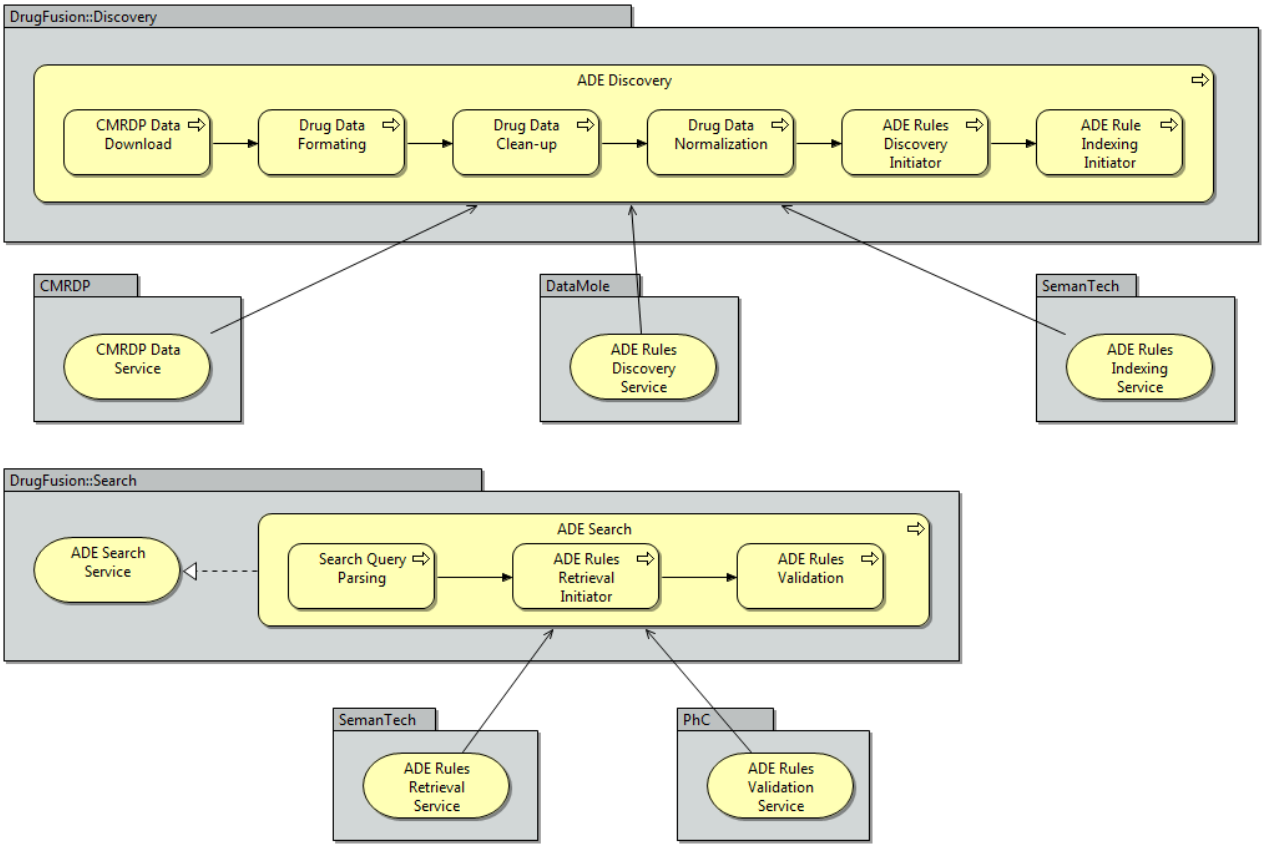

Figure 3 ADE Discovery and ADE Search Process

4.3 Preservation Case

While the Use Case itself consists of several organizations only one organization is directly exposed towards the end user. For this reason the preservation case is defined and handled from DrugFusion‘s perspective.

The need for digitally preserving the business processes, outlined in the two former clauses, arises from two main reasons:

- The Use Case consists of a relatively complex network of independent organizations and services which introduces a high risk of one or more organizations leaving the network and possibly rendering the whole system non-functional.
- Furthermore a faulty or incomplete search-result poses a risk of people getting hurt which leads to liabilities.

In reaction to the first reason it is necessary to ensure the functionality of the system as a whole in case of one or more services becoming unavailable. For the second reason the input data and system state need to be preserved in order to gain the ability to prove that search results given to a specific search term were correct to the best knowledge of the system at the time being.

From these overall goals 14 functional and 7 non-functional requirements to a digital preservation system for this use case were identified. Detailed descriptions of the requirements and the use case itself can be found in TIMBUS Deliverable D9.3.

The functional requirements are:

FR1 The DP system must be able to monitor and capture context, which are used by BPs running on the DataMole site.

FR2 The DP system must be able to capture the source drug usage data and generated ADE rules from the DataMole BP.

FR3 The DP system must be able to monitor the DataMole execution processes and generate the comprehensive log report for BP mining.

FR4 The DP system must be able to discover semantic relationships within information processing on the DataMole site in a format, where all relationships can be maintained over long period of time.

FR5 The DP system must be able to determine from all relationships captured in FR4, what BP is available and identify the relevant IT landscape.

FR6 The DP system must be able to perform preservation of the DataMole BP for the ADE rules discovery with all contexts identified in FR5.

FR7 The DP system must be able to detect gaps between the DataMole preserved environment and the redeployment environment.

FR8 The DP system must allow an expert to select, which components and data belonging to the DataMole ADE rules discovery process need to be redeployed.

FR9 The DP system must perform redeployment of the DataMole the ADE rules discovery BP identified by FR8 with relevant IT resources into the existing IT environment.

FR10 The DP system must be able to export the preserved DataMole ADE rules discovery BP into the different IT infrastructure.

FR11 The DP system must have long term storage facilities to provide constant access to the preserved DataMole BP and relevant data.

FR12 The DP system must inform an expert if formats used by DataMole for storing the source drug data and discovered ADE rules are not suitable for preservation.

FR13 The DP system must perform preservation by using the following delivery methods: automatic or manual.

FR14 The DP system must only allow one entry point for each delivery method.

The non-functional requirements are:

NF1 The DP system must be able to capture the monitoring DataMole BP in a non-intrusive and transparent way.

NF2 The DP system must guarantee the integrity of the preserved DataMole information.

NF3 The DP system must guarantee that preserved DataMole information is never lost.

NF4 The DP system must guarantee the scalability of the storage system.

NF5 The system must guarantee a scalability of the network.

NF6 The DP system must use an adequate representation of the source drug usage data and discovered ADE rules, that an expert can understand and use it properly.

NF7 The DP system must guarantee easy and straight forward interaction process with the DataMole environment.

5 Assessment Results

This section will describe the assessment and its results.

5.1 Scope

This assessment is about assessing the suitability of the TIMBUS process for digital preservation. Rating the work quality of the people involved in the preservation process is not intended by the assessment.

5.2 Execution

The Assessment took place via video conference on 22nd and 23rd of October in 2014. It was conducted as an interview with the people representing the roles of preservation manager and preservation engineer.

5.3 Results overview

This section gives an overview about the high level results of the assessment of the application of the TIMBUS process on the eHealth use case. A tabular overview is shown in Table 4.

The process attribute ratings reflect the extent to which the goals of a process attribute were achieved. The following ratings are being used:

- N/A = Not applicable
    - The rated of a process attribute is not applicable for the assessed use case and therefore remains unrated.
- N = No
    - The goals of the rated of a process attribute were not achieved at all or the process attribute was not executed.
- P = Partially
    - Less than 50% of the goals of a process attribute were achieved.
- L = Largely
    - More than 50% but not all goals of a process attribute were achieved.
- F = Fully
    - All goals of a process attribute were achieved.

The above rating scale is based on the four point ordinal scale of achievement, mentioned in section 3.3.3.1 but was extended by the value N/A. This extension turned out to be necessary because during the interview it became apparent, that some parts of the process might not be applicable to the use case.

As the Process Performance Attribute (1.1) clearly shows, none of the process steps achieved its goals in full. Therefore the Performance management attribute (2.1) and the Work product management attribute

(2.2) couldn't be attempted, resulting in an N rating. Since this preservation was intended as a proof of concept that was to be expected.

In an overall view, the TIMBUS process was applied to DrugFusion in an incomplete manner. The overall maturity of process application can therefore be considered to be on level 0.

Table 4 Overview of assessment results for eHealth

		Attribute			
ID	Process Name	1.1	2.1	2.2	Maturity Level
PLAN.1	Acquisition of business process context	L	N	N	1
PLAN.2	Assessment of Preservation Approaches	P	N	N	0
PLAN.2.1	Acquisition of business process context for digital preservation (sub process)	L	N	N	1
PLAN.2.2	Abstraction of business process context (sub process)	P	N	N	0
PLAN.2.3	Develop Preservation Plan (sub process)	N/A	N	N	0
PRES.1	Preserve	L	N	N	1
DEPL.1	Redeployment	P	N	N	0
RISK.1	Risk Management	P	N	N	0
MON.1	Monitoring of business process context in source environment	P	N	N	0
MON.2	Monitoring of preserved business process	N	N	N	0

5.4 Results details

This section will detail the results regarding the process performance attribute as shown in section 5.3 per (Sub-)Process. The Performance management attribute and the Work product management attribute won't be detailed because they couldn't be assessed.

5.4.1 Process Group Risk Management

5.4.1.1 Risk.1 - Risk Management

The purpose of the Risk Management process is to identify, analyse, evaluate and treat the risks associated with a business process, which can lead to a decision to use digital preservation as a mitigation action. As part of this process a decision is being made which preservation strategy to execute.

The aggregate process step performance is rated as "partially".

The results for the related Outcomes and Base Practices are shown in Table 5.

While in a first step the risks relevant for the use case were identified in full, the analysis, evaluation and treatment of risks were only partially rated. That happened mainly because the three latter steps were conducted only for technical risks, while in the identification step a lot of different types of risks (mainly technical and legal) were identified. O.5 was rated as "largely" in difference to the corresponding base practice because most of the risks considered in analysis and evaluation were (planned to be) treated according to the chosen mitigation strategy.

Table 5 Detailed results for Risk.1

	1 Performed	N	P	L	F
1.1	**Process performance attribute**		x		
	Outcomes	N	P	L	F
O.1	Context Model of the business process is established			x	
O.2	Risks for the business process are identified				x
O.3	Risks for the business process are analyzed regarding likelihood and impact		x		
O.4	Mitigation strategies are evaluated		x		
O.5	Risks are treated according to chosen mitigation strategy			x	
	Base Practices				
BP.1	**Establish Context**			x	
BP.2	**Identify Risks**				x
BP.3	**Analyze Risk**		x		
BP.4	**Evaluate Risk**		x		
BP.5	**Treat Risk**		x		

5.4.2 Process Group Planning

5.4.2.1 Plan.1 - Acquisition of business process context

The purpose of the process “Acquisition of business process context” is to establish an initial Process Context Model that enables the Risk Management to develop digital preservation approaches if necessary.

The aggregate process step performance is rated as “largely”.

The results for the related Outcomes and Base Practices are shown in Table 6.

Due to the initial business process specification being deemed suitable for digital preservation the step “BP.2 Refine business process specification” was not conducted and therefor rated “N/A”.

When it comes to identifying the relevant stakeholders only the three companies were taken into account but neither CMRDP nor PhC which leads to a “partially” rating.

For “Acquisition of domain specific context” the extractor tools developed during earlier stages of the TIMBUS project were used. Because some of the tools were still under development many aspects of the context were missing and had to be gathered manually which resulted in a high manual effort to create a still incomplete and troublesome context model instance (CMI) and therefore a rating as “partially”.

As a result from the issues in previous steps modelling the context and creating views required a high level of manual effort as well resulting in a simplified CMI (e.g., no stakeholders modelled) and manually created standard views. The resulting ratings are “partially” for the context modelling and “largely” regarding the views.

Table 6 Detailed results for Plan.1

1	*Performed*	N	P	L	F		
1.1	**Process performance attribute**			x			
	Outcomes	N	P	L	F		NA
O.1	Decision if business process is well specified and sufficient documented				x		
O.2	Specification of business process, sufficient for preservation purposes				x		
O.3	Requirements of the stakeholders (concern) are known		x				
O.4	Domain specific information of the context is gathered		x				
O.5	Context model instance (CMI) is developed		x				
O.6	CMI with views is developed			x			
	Base Practices						
BP.1	**Check whether business process is sufficiently specified**				x		
BP.2	**Refine business process specification**						x
BP.3	**Identify Stakeholders**		x				
BP.4	**Acquisition of domain specific context**		x				
BP.5	**Context Model & Dependencies Modelling**		x				
BP.6	**Create Views**			x			

5.4.2.2 Plan.2 - Assessment of Preservation Approaches

The purpose of the Assessment of Preservation Approaches process is to specify requirements for the preservation process followed by identification and evaluation of preservation approaches in order to choose the one best fitting the requirements. As a last step a preservation Action Plan is built, based on the chosen approach.

The aggregate process step performance is rated as “partially”.

The results for the related Outcomes and Base Practices are shown in Table 7.

As a first step of this process the business process context captured in Plan.1 - Acquisition of business process context was recaptured and refined, using the now available TIMBUS tools for context and dependencies extraction. These resulted in a more complete but still not fully complete CMI. The resulting CMI has a strong focus on technical artefacts and dependencies but lacks information about the data involved in the process which led to a rating “largely” as shown in Table 7. Also a lot of information that has been discovered during a legal assessment was not incorporated to the CMI. The aspects reflected in the CMI however, show that even legal information can be integrated into the context model.

As the requirements for a preservation system, defined in D9.3 (for an overview see chapter 4.3) were used as preservation requirements without further refinement and documentation BP.2 was rated “partially”. O.2 in the contrary was rated “largely” because the requirements are, although supposed to describe a system supporting digital preservation, very use case specific and for that reason reflects many requirements one would impose on the preservation itself.

The sub process "Abstraction of process context" was performed only partially (for details see 5.4.2.2.2) but the process context still was abstracted where applicable. In fact the dependency tree of the context model was shortened to only contain top-level dependencies. Since in this case it was decided to perform the preservation by virtualization of the physical environment, the transitive dependencies are bound to be included and a separate preservation for these artefacts was not necessary.

The two remaining steps of this process were rated as "partially" because they were done with a lot of manual effort with the DPES tool exclusively for the software aspects of the system. A complete preservation plan however, should have considered at least hardware and data as well. The outcomes of those two steps are only achieved partially too. This is mainly because no alternative approaches were evaluated due to the established timeframe of the project.

Table 7 Detailed results for Plan.2

1	***Performed***	N	P	L	F		
1.1	**Process performance attribute**		x				
	Outcomes	N	P	L	F		NA
O.1	Context model instance (CMI) is refined and extended to reflect the needs of this process			x			
O.2	Preservation requirements are identified and documented			x			
O.3	Process context is abstracted where applicable				x		
O.4	Possible preservation approaches are identified, evaluated and documented in preservation plans		x				
O.5	Process Preservation Action Plans (PPP) are built and delivered to risk management as decision paper.		x				
	Base Practices						
BP.1	**Acquisition business process context for Digital Preservation (sub process)**			x			
BP.2	**Document preservation requirements**		x				
BP.3	**Abstraction of process context (sub process)**		x				
BP.4	**Develop Preservation Plan (sub process)**		x				
BP.5	**Build Preservation Action Plan**		x				

5.4.2.2.1 Plan.2.1 - Acquisition of business process context for digital preservation (sub process)

The purpose of the Acquisition of business process context for digital preservation process is to finalize the Context Model, enabling development of plan and execution of the digital preservation.

The aggregate process step performance is rated as "largely".

The results for the related Outcomes and Base Practices are shown in Table 8.

While the first attempt to gather the business process context (see 5.4.2.1) suffered from being executed before the tools supposed to support the process were ready for business, the second attempt was more successful. All but one Outcomes and Base Practices achieved their goals in full. The "partially" rating for the gathering of domain specific context, dependencies and models results from a focus on the organizational and technical aspects of the use case rather than aspects regarding data processed during process execution.

Table 8 Detailed results for Plan.2.1

1	*Performed*	N	P	L	F
1.1	**Process performance attribute**			x	
	Outcomes	N	P	L	F
O.1	Requirements of the stakeholders (concern) are known				x
O.2	Domain specific models of the context are gathered		x		
O.3	Context model instance (CMI) is finalized				x
O.4	CMI with views reflecting the needs of the stake-holders is developed				x
	Base Practices				
BP.1	**Identify Stakeholders**				x
BP.2	**Acquisition of context and dependencies**		x		
BP.3	**Context Model & Dependencies Modelling**				x
BP.4	**Create Views**				x

5.4.2.2.2 Plan.2.2 - Abstraction of business process context (sub process)

The purpose of the process “Abstraction of business process context” is to remove unnecessary implementation details from the CMI while preserving all necessary information for preservation and re-deployment.

The aggregate process step performance is rated as “partially”.

The results for the related Outcomes and Base Practices are shown in Table 9.

As mentioned in 5.4.2.2 this process was executed only partially. There was only one abstraction possibility (removing transitive dependencies from context model) identified and implemented. O.2 was rated “largely” nonetheless because all identified abstraction possibilities were implemented.

No formal verification of the resulting abstracted context model against the preservation requirements was conducted. However a basic verification was done using common sense. When taking into account that the preservation was done by virtualization, it is quite obvious that removing transitive dependencies doesn’t endanger the overall integrity of the context model. The decision to move on, based on the abstracted context model was made, but a subjective one. For this reason BP.4 and O.4 were rated “partially”.

Table 9 Detailed results for Plan.2.2

1	*Performed*	N	P	L	F
1.1	**Process performance attribute**		x		
	Outcomes	N	P	L	F
O.1	Abstraction possibilities are identified		x		
O.2	Possible abstractions are implemented			x	
O.3	Abstraction implementation is verified	x			
O.4	Decision about successful abstraction that fulfils all requirements is made		x		
	Base Practices				
BP.1	**Analyse context model instance**			x	
BP.2	**Perform abstraction**		x		
BP.3	**Verify abstraction**		x		
BP.4	**Decision**		x		

5.4.2.2.3 Plan.2.3 - Develop Preservation Plan (sub process)

The purpose of the process “Develop Preservation Plan” is to develop a valid preservation plan.

This sub process was performed in an ad-hoc manner using the DPES tool. At least the components to preserve were selected and the duration of storage was defined. The extent to which the remaining steps of this sub process were conducted is unknown. Since common sense dictates there cannot be a digital preservation without any form of planning, the overall rating for this sub process is “partially” although no details for the various steps of this sub process are available.

5.4.3 Process Group Preserve

5.4.3.1 Pres.1

The purpose of the process “Preserve” is to execute the actual preservation of the business process, including operational planning and quality assurance.

The aggregate process step performance is rated as “largely”.

The results for the related Outcomes and Base Practices are shown in Table 10.

This process was supposedly automated using the DPES tool. The ratings reflect the capabilities of DPES as far as they were discussed in the interviews. A presentation of the tool was postponed due to ongoing development and testing. However some elements of the process were already shown during Year three review.

Since this preservation was intended as a onetime proof of concept for tools and process no monitoring events were defined.

Table 10 Detailed results for Pres.1

1	*Performed*	N	P	L	F		
1.1	**Process performance attribute**			x			
	Outcomes	N	P	L	F		NA
O.1	Preservation is planned from an operational perspective	x					
O.2	The data regarding the business process is gathered				x		
O.3	The verification data regarding the business process is gathered				x		
O.4	Preservation action defined in the Preservation Action Plan (PPP) are performed				x		
O.5	Quality Assurance measures are performed on the preserved process		x				
O.6	Decision if preservation was successful is made				x		
O.7	Preserved Process is stored in archive				x		
O.8	Monitoring events for re-evaluation of the preserved business process are defined	x					
	Base Practices						
BP.1	**Operational planning of preservation execution**						X
BP.2	**Acquisition of process data**				x		
BP.3	**Acquisition of validation and verification data**				x		
BP.4	**Perform preservation action**				x		
BP.5	**Perform quality assurance**		x				
BP.6	**Archival storage**				x		
BP.7	**Define monitor events**	x					

5.4.4 Process Group Redeploy

5.4.4.1 Depl.1

The purpose of the Redeployment process is to deploy an archived business process into a new environment. This includes preparing the target environment as well as verifying the redeployment against the previously collected verification data.

The aggregate process step performance is rated as “partially”.

The results for the related Outcomes and Base Practices are shown in Table 11.

As mentioned before the preservation was done by virtualization of the production machine into a virtual machine which was stored in an archive until re-deployment which was done by copying the virtual machine into the re-deployment environment. This special approach explains some of the base practices not being performed and their outcomes not being achieved.

Capturing the redeployment environment, analyzing it for gaps and assessing alternative solutions to fill the gaps was obviously not necessary for a successful redeployment. The same applies to setting up the environment for the process as it already was set up inside the archived virtual machine.

In order to as well make use of the whole process and save storage space the initial idea was to capture all necessary information and create a fitting virtual machine automatically from scratch during redeployment. That idea was abandoned because, as it turned out the capturing tools are not yet sophisti-

cated enough to acquire all the necessary information. In addition the re-deployment tools do not offer fully automated creation of a virtual machine based on the captured context information.

The steps of extracting the preserved process from the archive and redeploying it to the target environment were carried out.

When it comes to preforming a re-execution of the process and verifying the results the idea was to do this instrumenting the vFramwork for automatic re-execution and result verification. These two steps were partially conducted because the vFramework is still under development and doesn't cover all the aspects previously defined for verification of the redeployed process yet.

Table 11 Detailed results for Depl.1

1	***Performed***	N	P	L	F		
1.1	**Process performance attribute**		x				
	Outcomes	N	P	L	F		NA
O.1	Description of the preserved Process is retrieved from archive	x					
O.2	A model of the redeployment environment is developed		x				
O.3	Gaps between the needed redeployment environment and the actual are identified	x					
O.4	Alternatives to close identified gaps are evaluated						X
O.5	Data associated with the preserved process is extracted from the archive				X		
O.6	Preserved Process is deployed into the target environment				X		
O.7	Preserved process is re-executed to test the redeployment		x				
O.8	Results of the re-execution are verified against verification data stored with the process		x				
O.9	Decision to proceed or repeat assessment of re-deployment alternatives is made				x		
	Base Practices						
BP.1	**Retrieve business process from archive**						X
BP.2	**Capture redeployment environment**	x					
BP.3	**Gap analysis**	x					
BP.4	**Assessment of redeployment alternatives**	x					
BP.5	**Retrieve data from archive**				x		
BP.6	**Setup environment**	x					
BP.7	**Perform re-execution**		x				
BP.8	**Verify results**		x				

5.4.5 Process Group Monitoring

5.4.5.1 Mon.1

The purpose of the Monitoring of business process context in source environment process is to recognize changes in a preserved process' context.

The aggregate process step performance is rated as “partially”.

The results for the related Outcomes and Base Practices are shown in Table 12.

This process was not fully executed, due to the proof of concept nature of the preservation. But since several attempts were necessary especially in the earlier phases, some of the outcomes and base practices have been executed “by the way”. A first attempt to continually monitor the business process was presented during the Year three review. Basically a special server is receiving a constant stream of events generated by the business process. These events are processed in a dynamic fashion, identifying the structure of the business process (this is done by using genetic algorithm). If the process is changed, then the stream of events also changes. After “a while” the mining server is picking up a difference between the previous a new business process to which the preservation manager can react.

Since this doesn’t take into account changes to data, hardware, software, responsibilities etc. this attempt is only a first step but doesn’t solve the problem completely.

Table 12 Detailed results for Mon.1

1	***Performed***	N	P	L	F
1.1	**Process performance attribute**		x		
	Outcomes	N	P	L	F
O.1	Business process description is retrieved from archive	x			
O.2	Current business process context is gathered		x		
O.3	Gaps between archived and current context are identified		x		
O.4	Process Assessment of preservation approaches is triggered in case of Gaps	x			
	Base Practices				
BP.1	**Retrieve business process from archive**	x			
BP.2	**Acquisition business process context**		x		
BP.3	**Gap analysis**		x		

5.4.5.2 Mon.2

The purpose of the Monitoring of business process is to actively monitor dependencies and requirements of a preserved process in order to ensure the capability to redeploy it. This is done by attempting to redeploy the process and analysing gaps and problems during this process as well as looking for alternatives to solve arising issues.

This process was not performed due to the proof of concept nature of the use case.

6 Conclusion

In an overall view the TIMBUS process was applied to the assessed use case in an incomplete manner for a number of reasons.

The biggest challenge turned out to be the fact that this business pilot could only be assessed in an anonymised simulation instead of the original environment. This led to an assessment of an already abstracted environment which offered little chance to use the abstraction mechanisms inherent in the notion of context models and digital preservation in general to their fullest. Additionally, this fact prevented a full implementation of systematic risk management. In particular, the quantification of risks as well as mitigation effort has not been conducted.

Despite this “virtual” nature of the use case and the prototypical character of tools, many parts of the TIMBUS process could be executed successfully. The context model was implemented to the full extent possible, albeit requiring considerable manual effort.

The tools developed as part of the TIMBUS project could be used and integrated as part of this use case, demonstrating that the tools have reached a maturity appropriate for a research prototype. More work will be necessary in this field to productize the TIMBUS tool chain. The evaluation of preservation alternatives has shown considerable need for additional calibration input concerning the cost models and costs involved in digital preservation. The ongoing research in other projects in this field will provide welcome data to be used in this step of the TIMBUS process.

The data gathered during the assessment of the monitoring processes suggests that these could not be successfully executed in this use case due to the fact that this has been the first attempt at preserving the underlying business processes. A final evaluation of the basal issues has not been in scope for this assessment and, thus, will remain as a future research challenge.

Additionally, during the work on this use case some impressive approaches were developed. One good example is the idea to monitor events issued by the process in order to detect changes to it. That approach does not adhere to the defined process of monitoring the business process context in the source environment, but has the potential to solve this necessity for some key aspects in an automated convenient manner.

The overall incomplete application of the TIMBUS process makes it difficult to definitely determine whether the process as it is currently implemented and in its current state of maturity is suitable for this specific use case. Still the assessment delivered some indications for improvement potential as well in the process itself as in the way execution of the process is supported.

In summary the assessment could not prove the suitability and usability of the TIMBUS process for the use case in full. Nonetheless it showed that many parts of the process can already be preserved using the TIMBUS results and there are indications that most parts of a business process could be preserved once the identified gaps are filled.

7 Recommendations

The Assessment of the eHealth Use Case results in a couple of recommendable areas for future improvement.

There are two main areas on which future improvement seems recommendable: the TIMBUS process itself and the tools supporting the process. This results in four recommendations:

1. For the area of tools it is recommended to further increase automation and maturity in order to make the application of the TIMBUS process more scalable and reduce the error prone and expensive need for manual intervention.
2. The lack of an established and formalised Risk Management in this use case shows that Risk Management is not necessarily the only possible driver for digital preservation. In fact, in this use case digital preservation was integrated as part of product lifecycle management. We recommend to farther research the possibility to integrate digital preservation into product lifecycle management.
3. It seems advisable to look into tailoring options for the preservation and re-deployment processes. As this assessment revealed that some parts of those processes are not fully compatible with the chosen approach to fully virtualise the source environment.
4. Since the monitoring processes could not be evaluated in the context of this assessment it is recommended to further research whether those parts of the TIMBUS process are suitable for the intended cause. This should include the attempt to productize the aforementioned approach to automatically monitor the business process in its' original environment for changes.

Annex

A Work product characteristics

“Work product characteristics listed in this Annex can be used when reviewing potential inputs and outputs of process implementation. The characteristics are provided as guidance for the attributes to look for, in a particular sample work product, to provide objective evidence supporting the assessment of a particular process. A documented process and assessor judgment is needed to ensure that the process context (application domain, business purpose, development methodology, size of the organization, etc.) is considered when using this information. Work products are defined using the schema in Table B.1. Work products and their characteristics should be considered as a starting point for considering whether, given the context, they are contributing to the intended purpose of the process, not as a check-list of what every organization must have.

Work product identifier #	An identifier number for the work product which is used to reference the work product.
Work product name	Provides an example of a typical name associated with the work product characteristics. This name is provided as an identifier of the type of work product the practice or process might produce. Organizations may call these work products by different names. The name of the work product in the organization is not significant. Similarly, organizations may have several equivalent work products which contain the characteristics defined in one work product type. The formats for the work products can vary. It is up to the assessor and the organizational unit coordinator to map the actual work products produced in their organization to the examples given here.
Work product characteristics	Provides examples of the potential characteristics associated with the work product types. The assessor may look for these in the samples provided by the organizational unit.

“([3] Part 5)

A.1 Generic Work products

WP ID	WP Name	WP Characteristics
WP.01	Risk Assessment Report (RAR)	RAR is the result of the Risk Assessment Management process (as described in Section 3.3.1.1). It evaluates the risks of a specific business process setting according to their expected likelihood and impact.
WP.02	Context model instance (CMI)	CMI specified the context of a specific business process including technical, organisational and legal aspects.
WP.03	Process Preservation Plan (PPP)	The Process Preservation Plan (PPP) specifies actions to digitally preserve a business process. It includes • A specification of the significant properties of the process, • methods to acquire the relevant data from the source system, • preservation actions for the components of the business process • validation and verification mechanisms including measurement points and data • archival storage format for the business process • redeployment procedure • evaluation of the plan against the preservation requirements • monitoring events for review of the preservation plan.
WP.04	Validation and Verification Plan	The V&V plan specifies the validation and verification procedure for the preserved and redeployed business process. The Goal of the V&V Plan is to provide measurements to check whether the significant properties of the process were preserved over time.
WP.05	Business Process Specification	Specifies the business process to be preserved and contains for example: • Models • Descriptions
WP.06	Source Environment	The environment in which the original process resides
WP.07	Requirements of the stakeholders (concern)	Requirements on digital preservation of the process imposed by the stakeholders. (Mainly based on concerns related to risk management)
WP.08	Domain specific information of the context	The business domain specific informations before they are modelled.

WP.09	Domain specific models	The business domain specific models of a process or context
WP.10	CMI with views	WP.02 Context model instance (CMI) with Views for different Stakeholders. For more information about context models refer to the corresponding deliverables of the TIMBUS project.
WP.11	Preservation Requirements	List of Requirements for the digital preservation of a business process. (in distinction to WP.07 not ordered by Stakeholder)
WP.12	Evaluated preservation plan	A preservation plan that has been evaluated.
WP.13	Evaluated Process Preservation Action Plan (PPP)	A PPP that has been evaluated.
WP.14	Selected preservation strategy	Preservation strategy to be performed on the business process. Strategy is selected by Risk Management.
WP.15	Execution plan for preservation of the business process	Document that describes how the preservation is to be performed from an operational perspective.
WP.16	Captured data	Captured software, data and configuration from live system (e.g. current snapshot of data bases).
WP.17	Validation and Verification data for the preserved business process	Captured data for validation and verification purposes during execution of the preservation and to verify successful redeployment.
WP.18	Preserved business process	Contains: • CMI • Data • Software, configurations • Documentation of performed preservation action • Etc.
WP.19	Results of QA	Results of the quality assurance step. Includes decision if preservation was successful.
WP.20	AIP (Archival information packages)	Format in which the preserved process will be stored in the archive.
WP.21	Monitor Events	Defined Parameters for re-evaluation of preserved business process.
WP.22	Archive	Archive where preserved business processes are stored.
WP.23	Business process description	Description of a preserved business process. (CMI)
WP.24	Redeployment environment	Environment in which a dearchived process will be deployed.
WP.25	CMI of the redeployment environment	Context Model Instance of the redeployment environment.
WP.26	Gap report	Contains a list of gaps between needed and actual redeployment environment.
WP.27	Redeployment plan	Describes how to do the redeployment of an archived business process.
WP.28	Retrieved business process data	Data associated with the process including • software • configuration

		• and working data (such as database tables with business data)
WP.29	Instantiated environment	Redeployment environment which has been set-up with a dearchived process.
WP.30	Redeployed business process	Business process that has been deployed and executed in the redeployment environment.
WP.31	Monitoring measurements	Taken during re-execution after initial redeployment.
WP.32	Validation result	Result of the comparison between the results of a redeployed process and it's verification data
WP.33	List of identified risks	A list with identified risks for a specific business process.
WP.34	Report about likelihood and impact of identified risks	A Report about likelihood and impact of identified risks.
WP.35	Suggestions for Abstractions	List of process context contents that could be abstracted.
WP.36	Results of verify abstraction	A Document or statement whether the abstracted business process context still contains all necessary information for preservation and redeployment.
WP.37	Decision	A decision what to do next or whether a process step was successfully performed or not.
WP.38	Preservation Knowledge Base	Knowledge base containing and providing information related to the past and ongoing preservation work.
WP.39	Results of evaluation of the preservation approaches against the preservation requirements	Results of evaluation of the preservation approaches against the preservation requirements.

References

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3. ISO/IEC 15504 (2012) Information technology — Process assessment Parts 1-5