



Deliverable D2.2.1

Preservation Process Modelling

(Including a Review of Semantic Process Modelling and Workflow Languages)



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Abstract	This report describes in a formalised way a comprehensive set of processes for digital preservation. These processes are drawn from a series of relevant projects and standards from the preservation community, including OAIS, TRAC, PLANETS and others. The result is intended to be used as a generic baseline that those interested in audiovisual preservation can refer to, extract and customise processes in order to fit with their specific AV preservation needs.
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Scope

The European Commission supported PrestoPRIME project (www.prestoprime.org) is researching and developing practical solutions for the long-term preservation of digital media objects, programmes and collections, and finding ways to increase access by integrating the media archives with European on-line digital libraries in a digital preservation framework. This result will be a range of tools and services, delivered through a networked Competence Centre.

This report uses Business Process Modelling Notation (BPMN) to describe in graphical way a comprehensive set of processes for digital preservation. These processes have been drawn from a series of relevant projects and standards from the preservation community, e.g. OAIS, TRAC, PLANETS and others.

The report is intended to be a generic baseline that those interested in audiovisual preservation can refer to, extract and customise processes to fit their AV specific needs.

The uses of preservation process descriptions are many, for example in preservation planning, cost modelling, automated preservation systems, recording the provenance of digital content and many others.

The processes covered in this report cover the full digital curation lifecycle including content selection, validation, agreement negotiation, transfer, SIP and AIP generation, archiving, migration, access requests, delivery, technology watch, risk assessment, capacity management and many more.

The document begins by introducing an extended version of the OAIS functional entity model: a functional phases model. Each particular process documented in this report is allocated to one of six functional phases (Preliminary Interaction, Formal Definition, Ingest, Preservation, Access and Administration).

Each process has been described in detail, in form of a BPMN diagram with all necessary activities. In addition, the participating actors and the resources needed have been listed.

This report includes a comprehensive set of generic processes – an update is planned for mid 2010 that will include adaptations and extensions that are specific to AV content.

In collecting together and analysing a wide range of processes, one conclusion is immediately apparent: it is essential to negotiate and establish agreements and policies at the beginning of a preservation project. In our functional model, it is the *Preliminary* and *Formal Definition Phase* that underpin all other activities. The procedures and policies established in these phases are then applied in the course of *Ingest*, *Preservation* and *Access*. The *Administration Phase* then serves to review and adjust this basis regularly, depending on changes in technology, community, law, strategy and other requirements.

Finally the document also provides a review of relevant process modelling languages and explains why BPMN had been chosen for the illustration of the processes covered.

Executive Summary

This report reviews several key resources on digital preservation, for example the OAIS standard and the work of the PLANETS project, and distils from them a comprehensive set of preservation processes that cover the full lifecycle of digital preservation.

The processes included in this document cover the activities of content selection, validation, agreement negotiation, transfer, SIP and AIP generation, archiving, migration, access requests, delivery, technology watch, risk assessment, capacity management and many more.

Each of the processes is presented in the context of a 'map' of preservation related activities. This map groups sets of processes together into functional areas (preparation, definition, ingest, preservation, access, and administration). These areas correspond to the main phases of the digital curation lifecycle and fit with the OAIS model. This 'map' of functional groupings is intended to make it easy to jump straight to the relevant set of processes for the part of the lifecycle that is of interest.

Each of the processes has been documented using Business Process Modelling Notation (BPMN). This provides human readable and diagrammatic way of inspecting and understanding the process. The objective here is to allow people to be able to rapidly assess and adapt each of the processes to fit their specific needs. In general, whilst many processes exist in digital preservation, they tend to be implicit or documented in the form of free flowing text. The use of BPMN provides a consistent and much more structured approach to preservation process description, yet still maintains a very accessible way to view and understand the processes described.

BPMN, being a formal process modelling notation, also ensures that the process description is unambiguous and can be exported in a 'machine readable' form, e.g. so it can be used in an automated preservation system. This duality of human and machine readable properties of BPMN is important as it allows preservation processes to be enacted by people, by software systems, or some combination of the two. Which approach to choose will depend on each specific archive and their needs, experience, tools and systems. There is a great variety here and hence it is important to cater for all needs.

We chose to use BPMN in this report, and recommend its use for describing digital preservation processes for the following reasons:

- It is relatively easy to understand by people due to a well-developed graphical notation.
- It offers more than enough constructs to fully describe the details of the processes involved in digital preservation.
- Processes described in BPMN can easily be exported in a machine-readable form.
- The BPMN standard is widely used in a variety of communities, which means there is a large body of experience and literature in how to apply and interpret BPMN.
- There is good tool support available, both commercially and including free tools^a

^a We used BizAgi in this report <http://www.bizagi.com/>

There are many other process modelling languages and tools that could have been used. It is also possible to convert between process modelling languages (provided that the semantics match). Therefore, included as an annex to this report is a short review of other workflow and process modelling languages that could be used.

At this stage of PrestoPRIME we have sought, as a first step, to collect together into one place a wide range of relatively generic processes for digital preservation. This report is the first time that we are aware of such a wide range of processes being pulled together in one place. The use of a single and consistent process modelling approach (BPMN) applied to all processes is also a significant step forward. Therefore, whilst this report is not AV specific it does represent a significant advance and it paves the way for further work that addresses the specifics of AV material.

The next stage of PrestoPRIME will be to build on this report by refining and extending the processes so they are tailored to the specifics of audiovisual content. This is of course the core focus of the project. These AV specific additions will form an update to this report that we anticipate being available mid 2010.

The benefits of having a set of well-defined preservation processes are manifold. We anticipate this report being useful for the following main purposes.

Planning Preservation

Preservation planning, as described in detail in PrestoPRIME deliverable D2.1.1 'Preservation Strategies' is a complex area and naturally includes the topics of cost and capacity. As argued in D2.1.1, a Total Cost of Ownership (TCO) approach is essential that considers all dimensions (people, equipment, space, utilities, etc.). This report describes in detail the activities and resources typically needed in digital preservation, so therefore provides useful input for detailed cost modelling and capacity planning.

There is much literature on preservation planning, especially from the digital preservation community, but much of this presents 'high level' models that focus on the overall steps of preservation, but they often don't descend into the details. However, it is these details that are essential when looking to do preservation in practice. There is a gap here. In this report, our intention is to provide process descriptions with a high level of detail in order to bridge the gap between top-level strategy and operational aspects of how to do preservation in practice. This approach will be extended in future versions of this report that include case studies and worked examples^b.

Finally we note that much work is underway in various projects, communities and commercial companies to design and develop the next generation of preservation systems. For example, in PrestoPRIME, ExLibris are developing an advanced migration-based preservation system^c and the project as a whole is developing an open reference architecture and PrestoPRIME integration framework^d. A detailed description of preservation processes provides important input to the activity of designing and developing preservation systems, e.g. to ensure their completeness.

^b PrestoPRIME deliverable D2.2.3 "Strategy for Use of Preservation Metadata within a Digital Library/ Preservation Process and Examples for documenting processes involved in audiovisual preservation"

^c PrestoPRIME deliverables D3.1.2, D3.1.3, D3.1.4 "First, second and final version of migration-based preservation system".

^d PrestoPRIME deliverable D5.2.1 "Architecture design of the Integration Framework".

Implementing Preservation

Well-defined process descriptions are useful in executing digital preservation for obvious reasons, e.g. providing guidelines for operators to follow. Although the process models in this deliverable are, as mentioned above, mainly intended for human readability, the BPMN models can easily be adapted into a machine readable form in order to automate preservation processes. Consequently the longer-term intention is to provide process descriptions that are of use when developing workflow tools or other automation mechanisms for data storage and processing policies^e and for the implementation of the PrestoPRIME integration framework^f.

Alongside the storage service specifications of D2.3.1^g and D3.4.1^h this deliverable can also help service providers in the establishment of Service Level Agreements (SLAs) or statements of practice. For the same reason it also provides input to the establishment of SLAs and service levels for the competence centreⁱ.

Finally, and one of the original reasons behind this report, the processes described in this deliverable can provide a structured way to record provenance of content as it undergoes preservation, since the processes can be used to describe unambiguously what was done, when it was done, why, how and where.

The rest of this report contains the following structures.

Section 1 reviews the various sources used to compile the processes described in this document.

Section 2 provides an overview of the processes covered by this report, including 'map' of how each individual process described fits into the overall curation lifecycle.

Section 3 reviews BPMN notation, and explains the parts needed to interpret the process diagrams.

Sections 4, 5, 6, 7, 8, 9 provide graphical presentations and notes on the individual preservation processes.

Section 10 reviews the major workflow and process modelling languages suitable for describing digital preservation processes and provides the basis of the recommendation we make to use BPMN.

A glossary is provided at the end of this report to explain some of the terminology used.

^e PrestoPRIME deliverable D3.4.2 "Rule engine and workflow tool for automating data storage and processing policies"

^f PrestoPRIME deliverable D5.2.2 "Prototype implementation of the Integration Framework and software module adapters"

^g PrestoPRIME deliverable D2.3.1 "Service-oriented models for audiovisual content storage"

^h PrestoPRIME deliverable D3.4.1 "Specification of online storage services for audiovisual preservation",

ⁱ PrestoPRIME deliverable D6.2.2 "Service and quality levels, negotiation guidelines and model SLA's for Archives, Service Providers and Experts"

1. Sources

1.1. *Reference Model for an Open Archive Information System (OAIS)*¹

The Reference Model for an *Open Archival Information System (OAIS)* is a well-known recommendation, which has been published by the CCSDS (Consultative Committee for Space Data Systems) first in 2002; a revised version has been released in 2009. The document provides a standard that identifies what is required for an *Archive* to provide permanent or indefinite long-term, preservation of digital information. The focus is especially on the functional organisation of the *Archive* and the structure of the involved information. The functional division of the superior phases^j as well as the content of many processes in this deliverable are based on the *OAIS* reference model.

1.2. *Recommendation for a Producer-Archive Interface Methodology Abstract Standard*²

Another recommendation, which builds on the *OAIS* reference model, has been released by CCSDS in 2004: the *Producer-Archive Interface Methodology Abstract Standard*. It describes in a very detailed way the interactions of the *Producer* of information and the actual *Archive (OAIS)* as the initial stages of the *Ingest Phase*. These initial stages are:

- the *Preliminary Phase*
- the *Formal Definition Phase*
- the *Transfer Phase*
- and the *Validation Phase*.

Chapter 2 explains in greater detail how these phases were integrated into the process model.

1.3. *Project PLANETS – Preservation and Long-term Access through NETworked Services*³

The primary goal for the project *PLANETS* is to build practical services and tools to help ensure long-term *Access* to our digital cultural and scientific assets. One result of the project is the preservation-planning tool *PLATO* that implements the preservation planning workflow identified by *PLANETS*, which also serves as a useful resource for the establishment of the preservation planning process in this deliverable^k.

1.4. *Preservation Management of Digital Materials: The Handbook*⁴

This digital preservation handbook, which is maintained by the Digital Preservation Coalition (DPC), provides an internationally authoritative and practical guide to the subject of managing digital resources over time and the issues in sustaining *Access* to them. It is supposed to be of interest to all those involved in the creation and management of digital materials. In this deliverable it has been used to establish and complement several

^j See especially chapter 2 Overview.

^k See especially chapter 7.8 Develop Preservation Strategies and Standards.

processes such as Content Selection or Validation^l.

1.5. *DRAMBORA – Digital Repository Audit Method Based on Risk Assessment*⁵

DRAMBORA is a repository audit method developed jointly by the Digital Curation Centre (DCC) and DigitalPreservationEurope (DPE). It presents a methodology for self-assessment, encouraging repository organisations to establish a comprehensive self-awareness of their objectives, activities and assets before identifying, assessing and managing the risks implicit within their organisation. The stages for Risk Assessment^m process have been adopted from DRAMBORA in this deliverable.

1.6. *Information Technology Infrastructure Library (ITIL) - Open Guide*⁶

The ITIL defines the organisational structure and skill requirements of an information technology organisation and a set of standard operational management procedures and practices to allow the organisation to manage an IT operation and associated infrastructure. In this document the guide has helped to establish the administrative processes of Service Level Management and Capacity Managementⁿ.

1.7. *DCC Curation Lifecycle Model*⁷

The Curation Lifecycle Model developed by the Digital Curation Centre (DCC) provides a high-level overview of the stages required for successful curation and preservation of digital data. In this deliverable it has been used to review the preservation lifecycle and provided the definition of the process Disposal^o.

1.8. *Project LIFE – Lifecycle Information for E-literature*⁸

The LIFE Project has developed a methodology to model the digital lifecycle and calculate the costs of preserving digital information for the long-term. The process User Support^p has been adopted from the LIFE methodology.

^l See chapters 4.1 Content Selection and 6.5 Manage the Validation / Quality Assurance.

^m See chapter 7.6 Risk Assessment.

ⁿ See chapters 9.2 Service Level Management and 9.6 Further Administrative Activities: Capacity Management.

^o See chapter 7.7 Disposal.

^p See chapter 8.4 User Support.

2. Overview of processes covered

Figure 1 provides an overview on the functional entities of an OAIS. The *Producer* of information submits a *Submission Information Package (SIP)*, which is received by the *Ingest* functional entity of the OAIS. The *SIP* contains typically *Content Information* and *Descriptive Information*, which are distributed separately to the functions Archival Storage and Data Management, whereas the *Content Information* is packed in an *Archival Information Package (AIP)*. The Archival Storage entity provides the services and functions for the storage, maintenance and retrieval of *AIPs* and the Data Management entity provides the services and functions for populating, maintaining, and accessing *Descriptive Information* and administrative data. The entity Preservation Planning provides functionalities for monitoring and planning the preservation activities and the *Administration* provides the services and functions for the overall operation of the *Archive* system. For the *Access* of the preserved information by a *Consumer* the functional entity *Access* combines the *AIP* and *Descriptive Information* to a *Dissemination Information Package (DIP)* as a response to an order. *Consumers* can also submit queries and retrieve result sets from the *Access* functional entity.

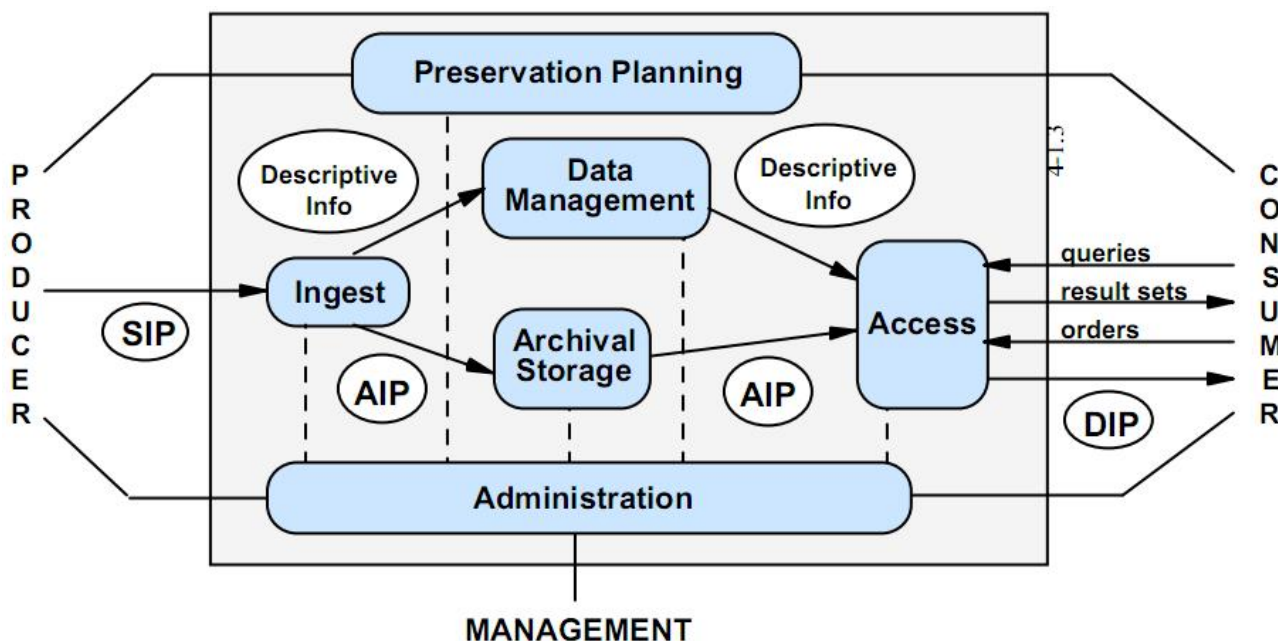


Figure 1: OAIS Functional Entities1

Figure 2 is based on the functional entity model of Figure 1 and illustrates which functional phases the process model in this document follows.

As already mentioned in chapter 1 the stages of the OAIS Producer-Archive Interface Methodology² have been integrated into the process model. Firstly the *Preliminary Phase* that describes the preliminary interaction between the *Producer* and the OAIS and results in a Preliminary Agreement. Secondly and based on this agreement, the *Formal Definition Phase* leads to a formal *Submission Agreement* between the two organisations. It has been assumed that such a preliminary interaction and formal definition also apply for the *Consumer-Archive-relationship*, which finally result in an *Order Agreement*.

Although the OAIS Producer-Archive Interface Methodology introduces two more stages, the Transfer and the Validation Phase, these have not been adopted directly as functional phases. They are rather seen as sub-processes of the next functional phase: *Ingest*. Like

in Figure 1 the *Ingest* functional phase of Figure 2 describes all processes necessary for receiving *SIPs* and producing *AIPs* and *Preservation Description Information (PDI)*. What is specified as Preservation Planning, Data Management and Archival Storage in Figure 1 has now been summarised in the functional phase *Preservation*. The phase receives the *AIP* and *PDI* from the *Ingest* Phase and sends both to the *Access* functional phase when needed. The *Access* Phase fulfils the same tasks as in Figure 1. Also similar to Figure 1 the *Administration* functional phase comprises processes for the overall operation of the *Archive* system.

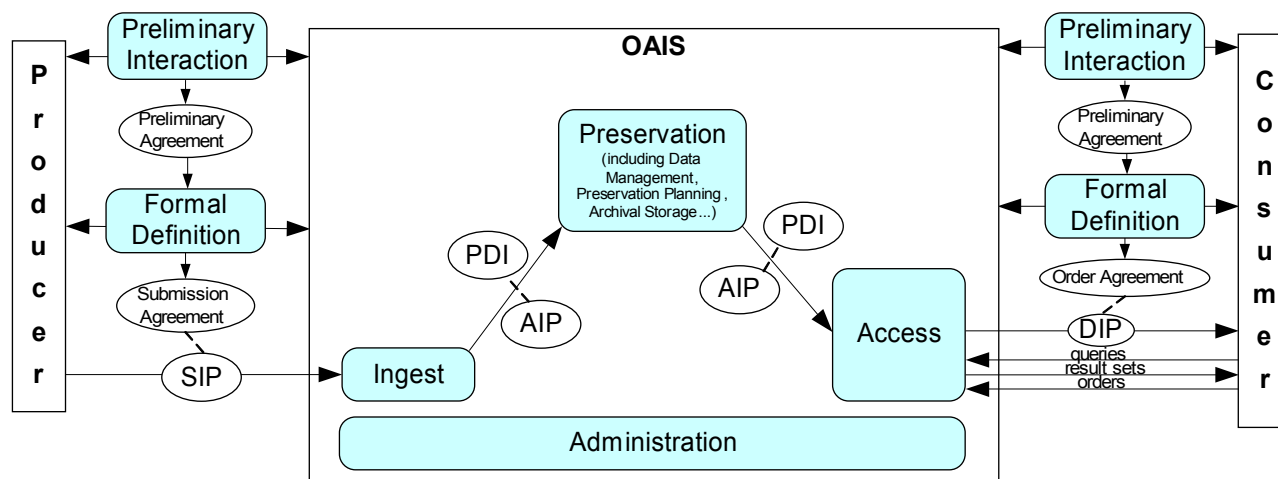


Figure 2: Extended model showing the functional phases of an OAIS project

Figure 3 provides an overview on the particular processes in each of the six identified functional phases. Different colours indicate the different actor organisation taking part in the process. Square corners indicate that a process is part of a chain of processes and rounded corners indicate stand-alone processes that are not carried out in a particular order.

When reading the rest of this document, it is important to refer to the reference sources listed above and in Section 1 for an explanation of the processes we model, including their context. This textual explanation is not included in this report for reasons of brevity. For example, the DPC handbook on digital preservation and DRAMBORA both explain in detail the need for Technology Watch and hence we do not repeat this as part of documenting this process (See section 7.2). Likewise, the processes associated with SIPs, AIPs and DIPs are already well explained in the OAIS specification. Each of the processes is marked with the source of further information.

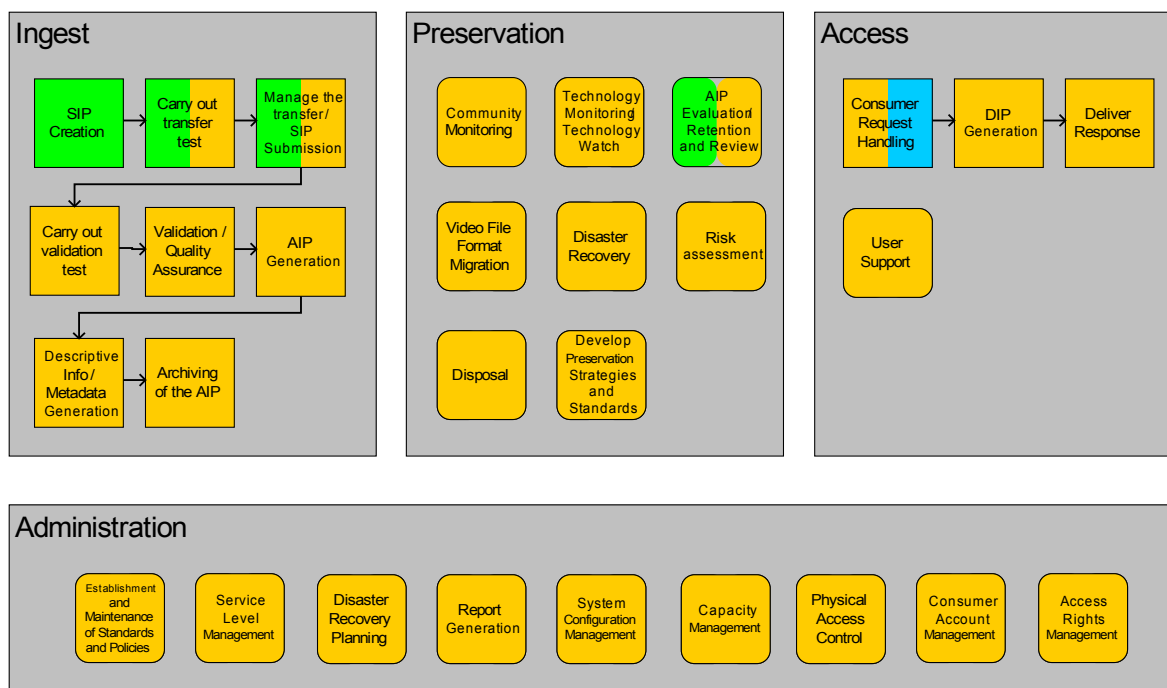
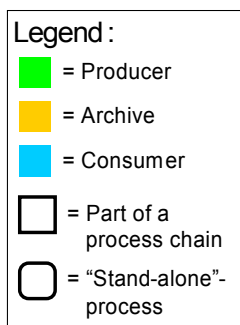


Figure 3: Process overview

The following chapters describe all of the illustrated processes in detail. In addition a detailed overview for each phase will be provided in the related chapter.

3. BPMN Notation

This section will give a brief explanation on the graphical notation of BPMN. However only the elements used for the modeling of the processes in this document are listed.

Start Event:

As the name implies, the Start Event indicates where a particular process will start. Start Events can have different triggers (see section “Event Types” below).

Intermediate Event:

Intermediate Events occur between a Start Event and an End Event. They will affect the flow of the process, but will not start or (directly) terminate the process. Intermediate Events can have different triggers or results (see section “Event Types” below).

End Event:

As the name implies, the End Event indicates where a process will end. End Events can have different results (see section “Event Types” below).

Activity:

An Activity is a generic term for work performed in a process. An Activity can be atomic or non-atomic (compound). The types of Activities that are a part of a process model are: Sub-Process and Task (see also section “Further Activity Types” below).

Data Object:

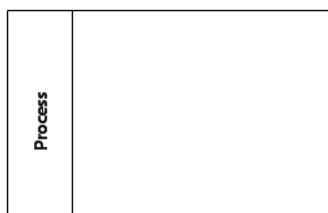
Data Objects provide information about what Activities require to be performed and/or what they produce. Data Objects can represent a singular object or a collection of objects.

Sequence Flow:

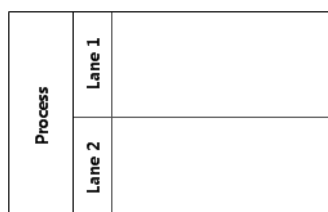
A Sequence Flow is used to show the order that Activities will be performed in a process.

Association:

An Association is used to link information and Artifacts with BPMN graphical elements. Text Annotations and other Artifacts (e.g. Data Objects) can be associated with the graphical elements. An arrowhead on the Association indicates a direction of flow, when appropriate.

**Pool:**

A Pool is the graphical representation of a participant in a collaboration. It is also acts as a “swimlane” and a graphical container for partitioning a set of Activities from other Pools, usually in the context of B2B situations.

**Lanes:**

A Lane is a sub-partition within a process, sometimes within a Pool, and will extend the entire length of the Process, either vertically or horizontally. Lanes are used to organize and categorize Activities.

Gateway (exclusive):

A Gateway is used to control the divergence and convergence of Sequence Flow in a process. Thus, it will determine branching, forking, merging, and joining of paths. Internal markers will indicate the type of behavior control.



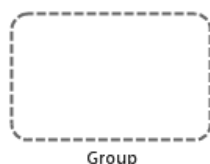
The exclusive Gateway controls exclusive decision and merging. It can be shown with or without the “X” marker (for further Gateway types see section “Further Gateway Types” below).

Conditional Sequence Flow:

The decisions for alternatives are based on conditional expressions contained within the outgoing Sequence Flow of an exclusive Gateway. Only one of the alternatives will be chosen.

Text Annotation:

Text Annotations are a mechanism for a modeler to provide additional text information for the reader of a BPMN diagram.

Group:

A Group is a box around a group of objects within the same category. This type of grouping does not affect the Sequence Flow of the Activities within the Group. The category name can appear on the diagram as the group label. Categories can be used for documentation or analysis purposes.

Further Gateway Types

Gateway (parallel):



BPMN uses the term “fork” to refer to the dividing of a path into two or more parallel paths (also known as an AND-split). It is a place in the process where Activities can be performed concurrently, rather than sequentially. A Parallel Gateway can be used to represent the forking.

BPMN uses the term “join” to refer to the combining of two or more parallel paths into one path (also known as an AND-join or synchronization). A Parallel Gateway is used to show the joining of multiple Sequence Flows.

Gateway (complex):



The Complex Gateway is used to illustrate complex conditions and situations. For example “3 out of the 5 outgoing sequence paths are chosen”. The description of these complex conditions can be below the Complex Gateway element.

Event Types

The Start and Intermediate Events can have “triggers” that define the cause for the Event. There are multiple ways that these events can be triggered. End Events may define a “result” that is a consequence of a Sequence Flow ending. Start Events can only react to (“catch”) a trigger. End Events can only create (“throw”) a result. Intermediate Events can catch or throw triggers. For the Events, triggers that catch, the markers are unfilled, and for triggers and results that throw, the markers are filled.

Timer:



A specific time-date or a specific cycle (e.g. every Monday at 9am) can be set that will trigger the start of the process or delay activities in the process. Since timer events are implicitly thrown End Events cannot trigger a timer.

Message:



Message Events can trigger the start of a process with the reception of a message (“catch”). During the process flow (intermediate) messages can be sent and received and also the outcome of a process can be a message (“throw”).

Link:



The Link Intermediate Events are only valid in normal flow, i.e. they may not be used on the boundary of an Activity. A Link is a mechanism for connecting two sections of a Process. Link Events can be used to create

looping situations or to avoid long Sequence Flow lines. Link Event uses are limited to a single Process level (i.e., they cannot link a parent process with a Sub-Process). Paired Intermediate Events can also be used as “Off-Page Connectors” for printing a process across multiple pages. They can also be used as generic “Go To” objects within the process level. There can be multiple Source Link Events, but there can only be one Target Link Event. Start and End Events cannot be marked with the link symbol.

Signal:

Similar to messages a Signal can be used to trigger the start of a process (“catch”), Signals can be sent and received during the process flow (intermediate), and also the outcome of a process can be a Signal Event (“throw”).



A Signal is for general communication within and across Process Levels, across Pools, and between Business Process Diagrams. A BPMN Signal is similar to a signal flare that shot into the sky for anyone who might be interested to notice and then react. Thus, there is a source of the Signal, but no specific intended target.

Conditional:



Conditional Events are triggered when a condition becomes true. This can happen at the beginning or during a process. Thus, End Events cannot throw a Conditional Event.

Further Activity Types

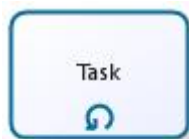
Embedded Sub-Process:



A Sub-Process is a compound Activity that is included within a process. It is compound in that it can be broken down into a finer level of detail (a process) through a set of sub-Activities.

The icon on the left shows the collapsed version of the Embedded Sub-Process, however the Sub-Process can also be shown expanded and the details (a process) are visible within its boundary. Sequence Flow cannot cross the boundary of a Sub-Process.

Loop Activity:



The attributes of Tasks and Sub-Processes will determine if they are repeated or performed once. A small looping indicator will be displayed at the bottom-center of the Activity.

**Attached Event:**

An Event can be attached to an Activity to indicate that it will be interrupted as soon as the Event is triggered.

**Reference Task:**

A little arrow in the corner of an Activity is used to indicate that the performed task is actually referring to another process, which should be defined, somewhere else.

Use of colour and formatting

In some of the process diagrams different colours and formatting may be used to emphasize or group elements due to a clearer readability.

Actors and resources

For each of the processes described, the actors and resources involved are identified as far as possible.

At the top level, actors are classified into producer, archive and consumer according to the OAIS model. Where a more specific role can be identified for the actor then we include it, e.g. 'archive project manager' or 'preservation project manager'. However, in most cases only the top-level classification is used. This is still very useful as it provides an indication of who is likely to be involved and in cases where there are more than one actor it also indicates the interactions that may be necessary.

When considering the resources used for each process, we include anything that might be needed by the actors in order to perform the activities of the process. The obvious resources are the AV data and metadata and the systems and tools needed to store, catalogue, manipulate and access it, but resources also include a multitude of other things such as plans, schedules, policies, timelines, agreements, and standards.

4. Preliminary Phase

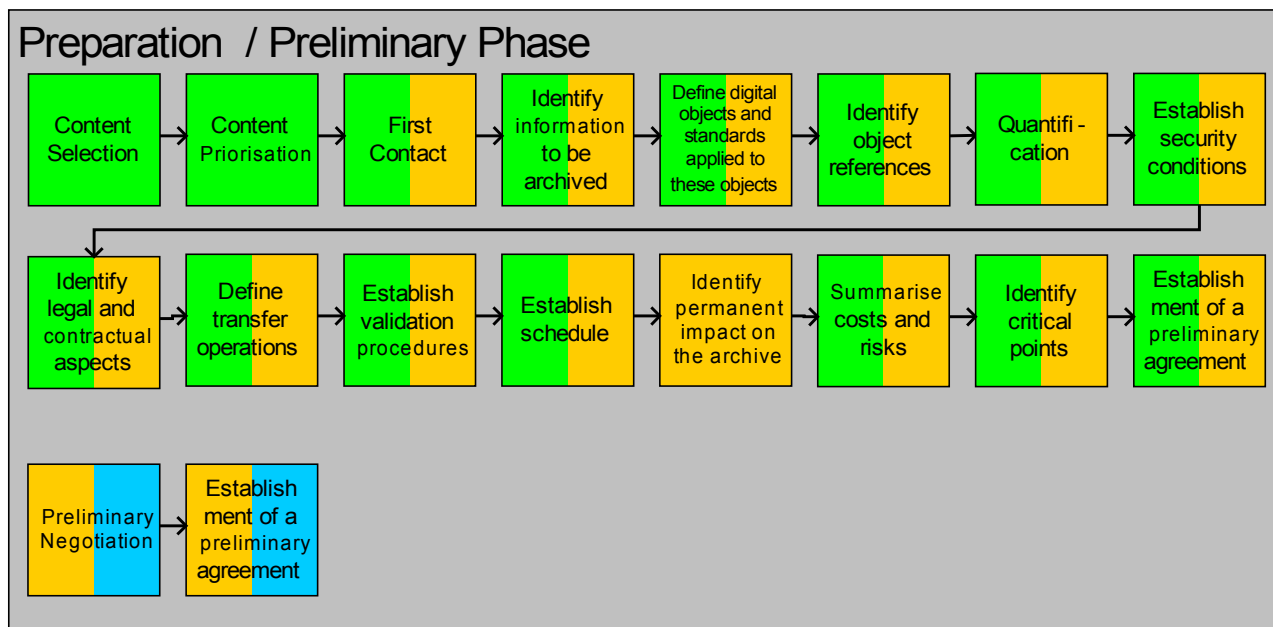


Figure 4: The processes of the Preliminary Phase

The *Preliminary Phase* includes the initial contact between the *Producer* and the *Archive* and any resulting feasibility studies, preliminary definition of the scope of the project, a draft of the *SIP/DIP* definition and finally a draft *Submission Agreement*. But also preliminary negotiations and agreements between *Consumer* and *Archive* are carried out in this phase. Figure 4 shows which processes are involved.

4.1. Content Selection⁴

Actors

- *Producer*: Management

Resources

- the content
- the content metadata.

Details

For better illustration, the process has been split up into four sub-processes:

- Selection of Version and Content,
- Rights and Responsibilities,
- Technical / Costs and
- Documentation & Metadata / Costs.

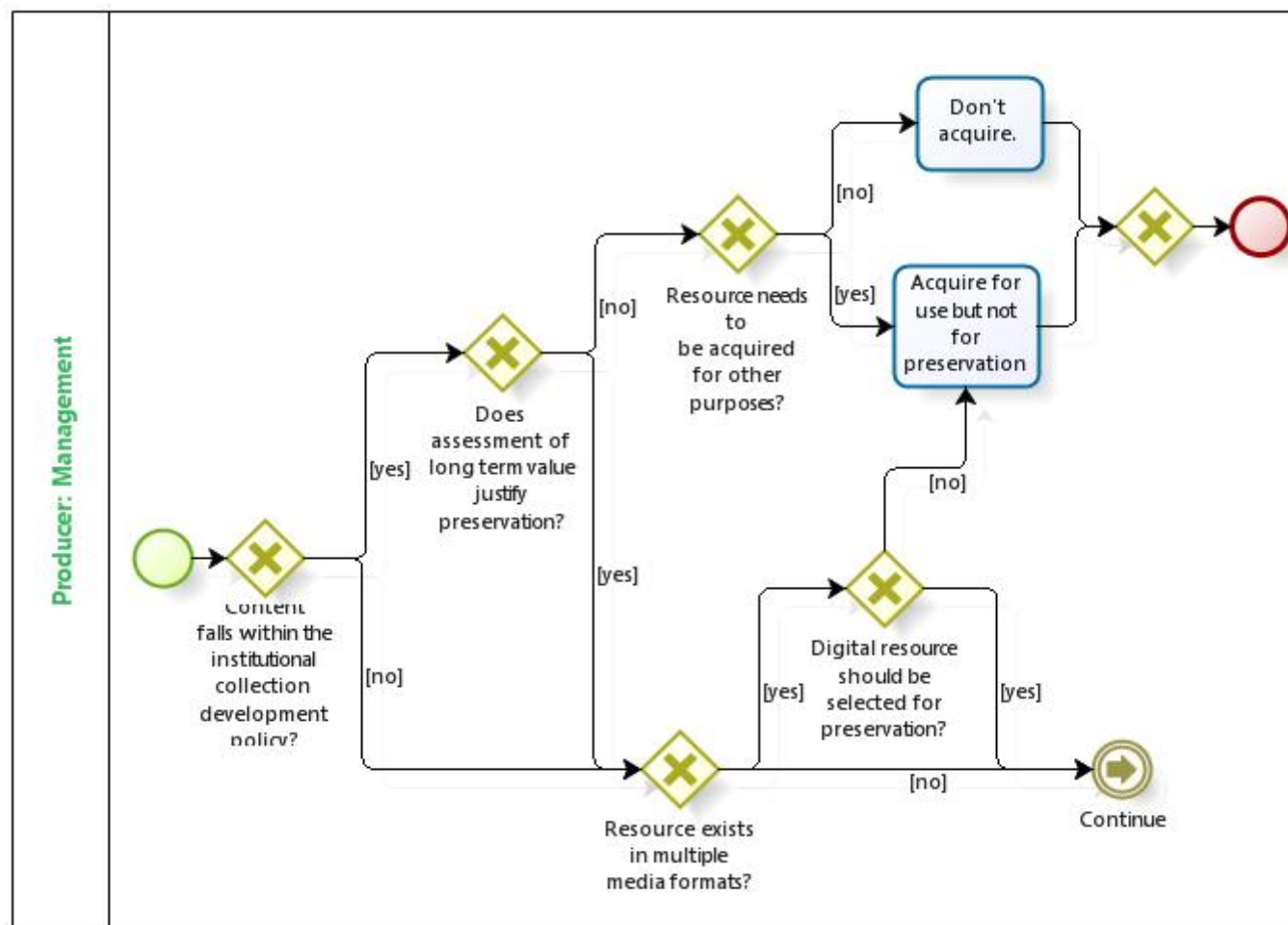


Figure 5: Sub-Process Selection of Version and Content

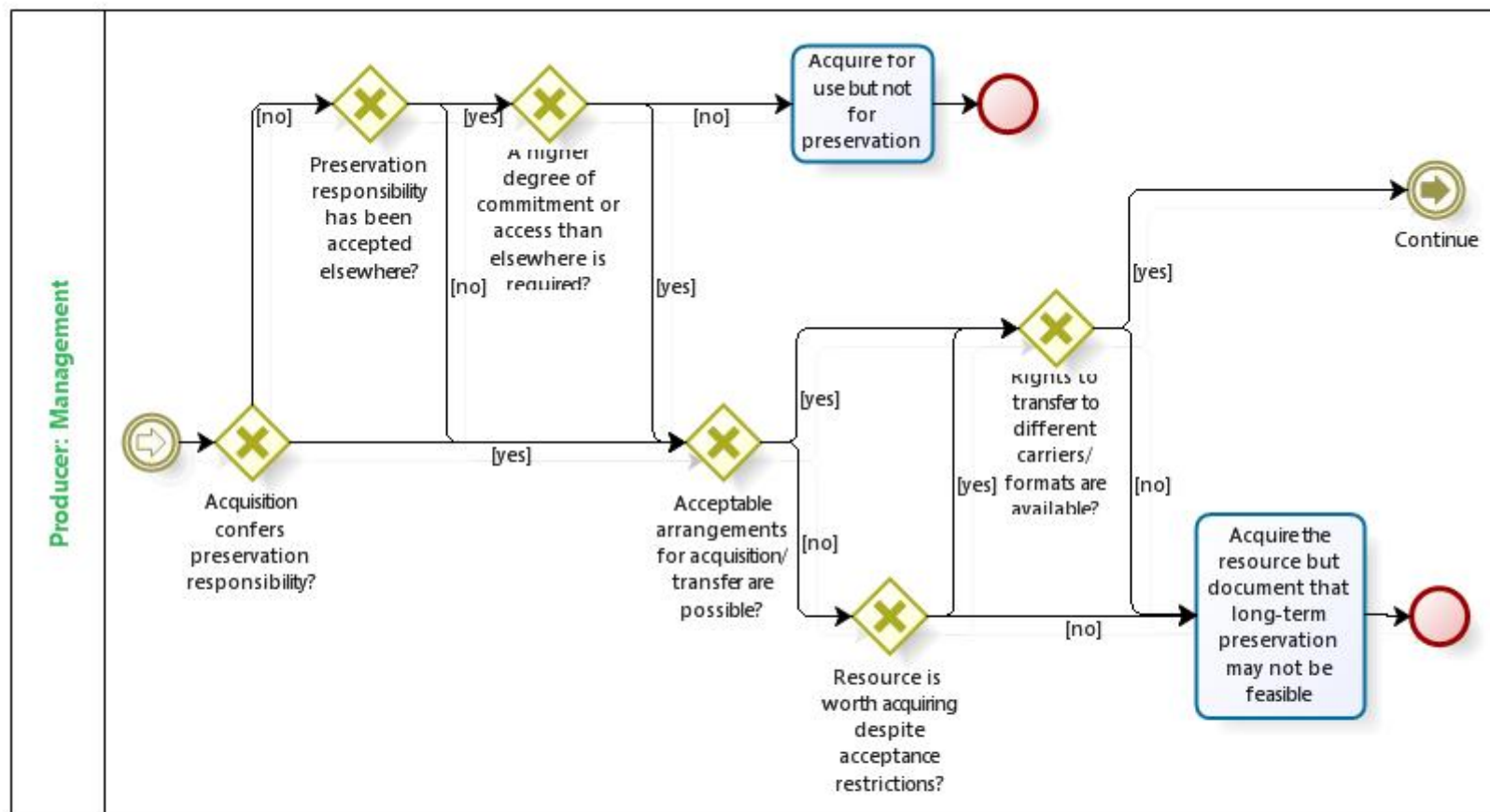


Figure 6: Sub-Process Rights and Responsibilities

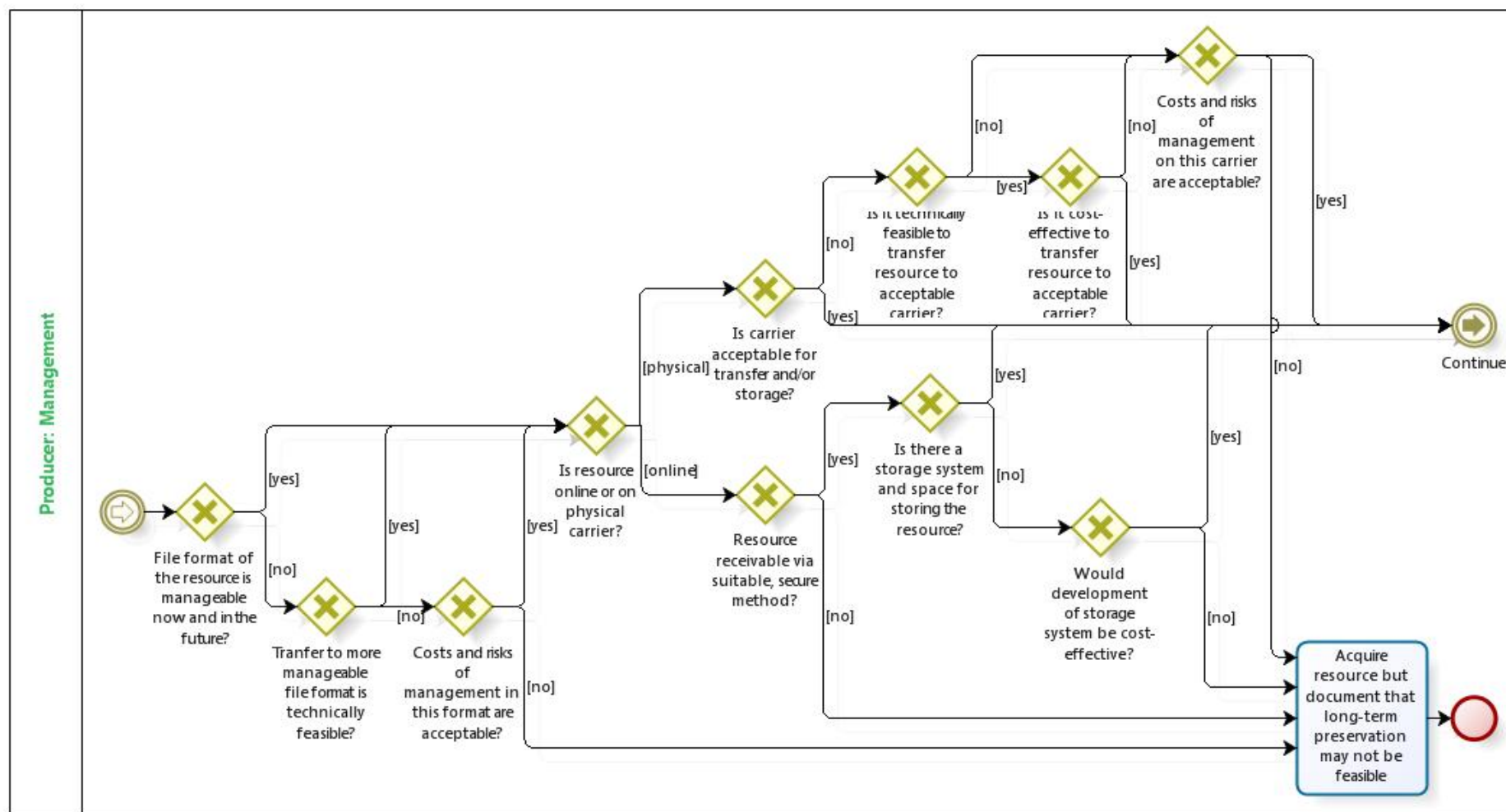


Figure 7: Sub-Process Technical / Costs

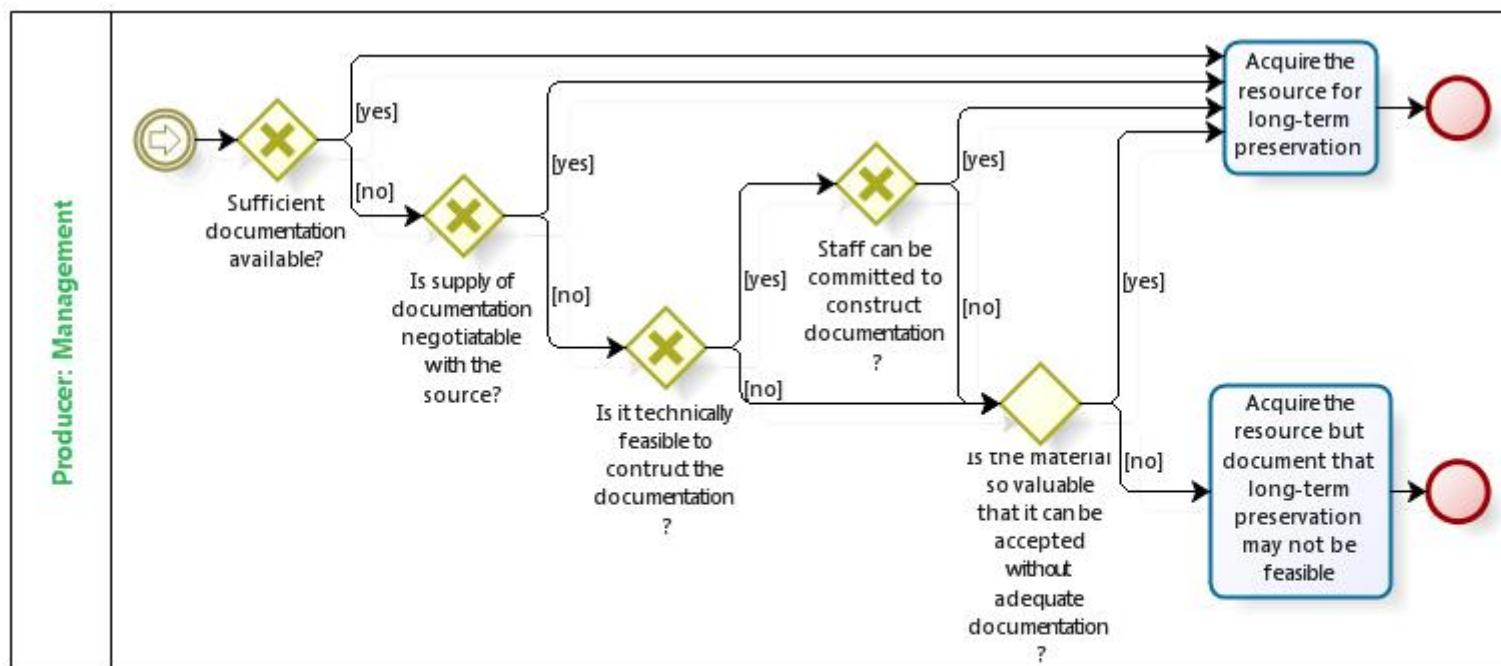


Figure 8: Sub-Process Documentation & Metadata / Costs

4.2. Content Prioritisation

Actors

- *Producer*: Management

Resources

- Prioritisation criteria, e.g.:
 - Usage statistics
 - Value: cultural, commercial, legal, administrative
 - Technical: decay, obsolescence
 - Genre
- Prioritisation rules/policy, e.g.:
 - Most valuable first
 - Worst condition first
 - Most affordable first
- The content

Details

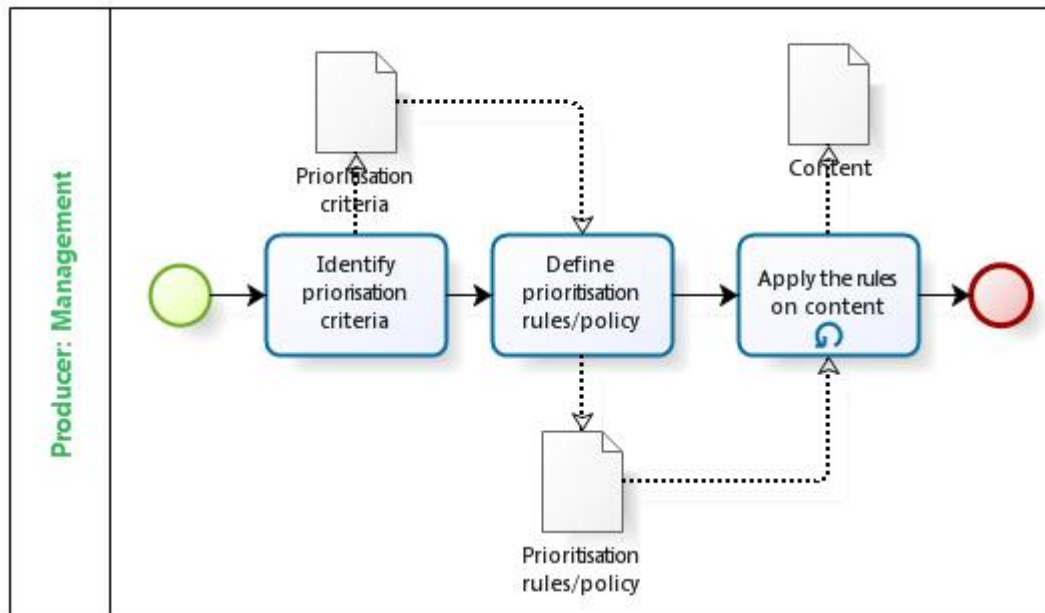


Figure 9: The process Content Prioritisation

4.3. First Contact²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Contact list (Main contacts & specialists)
- Work organizations
- General Information about
 - Content
 - *Designated Community*
 - *Archive details*
 - Phases, requirements, data models, advantages, constraints, service aids and tools
 - Any other useful information

Details

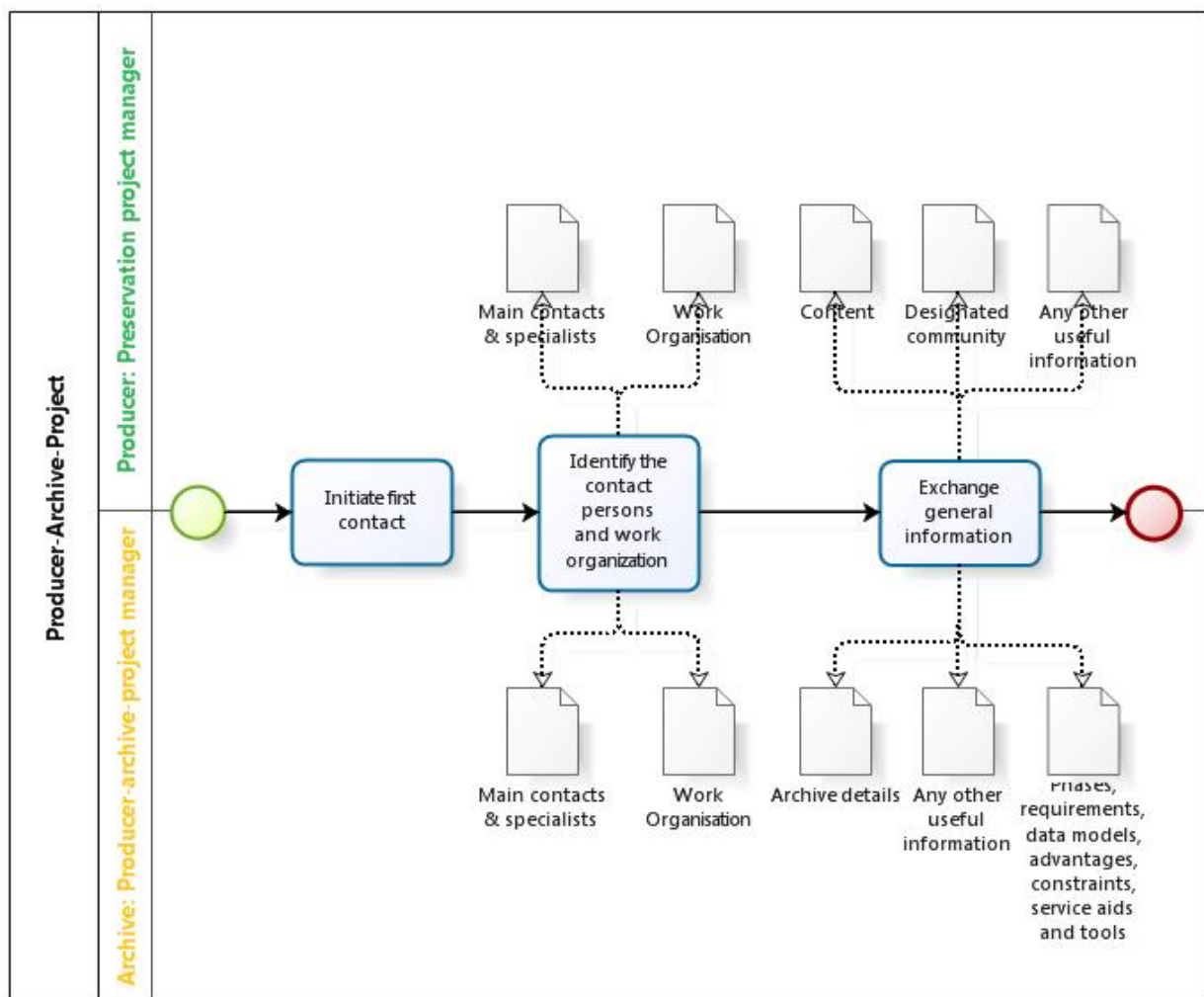


Figure 10: Process First Contact

Remark: The last two activities do not necessarily have to be carried out in the shown order.

4.4. *Identify Information to be Archived*²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Definition of the *Content Information*
- Definition of *Representation Information*
- Definition of *Preservation Description Information (PDI)*
- Definition of *Designated Community*
- Definition of *Consumer Access*
- Duration assessment (& successor information)
- Feasibility and costs studies

Details

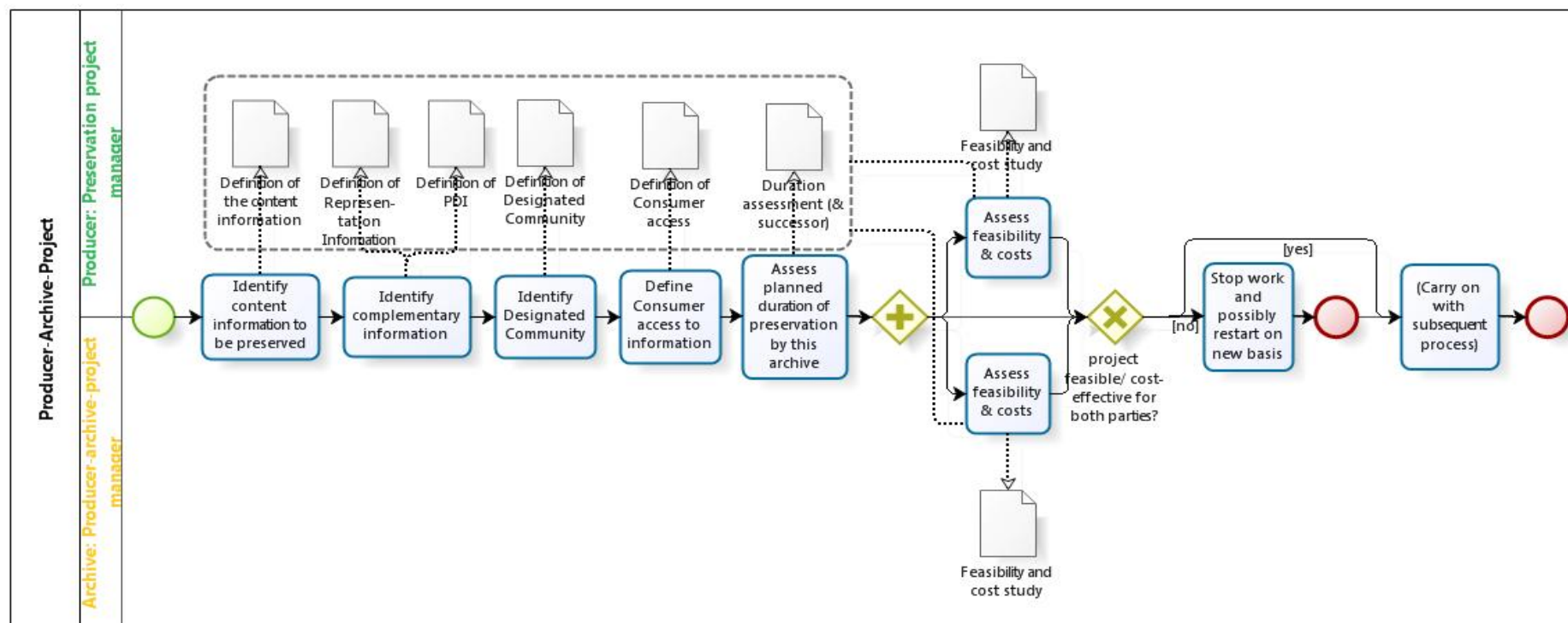


Figure 11: Process Identify Information to be Archived

4.5. Define Digital Objects and Standards Applied to These Objects²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Preliminary definition of *Data Objects*
- Rules
- Lists of standards
- Tools descriptions
- Study of possible solutions
- Efforts and cost studies

Details

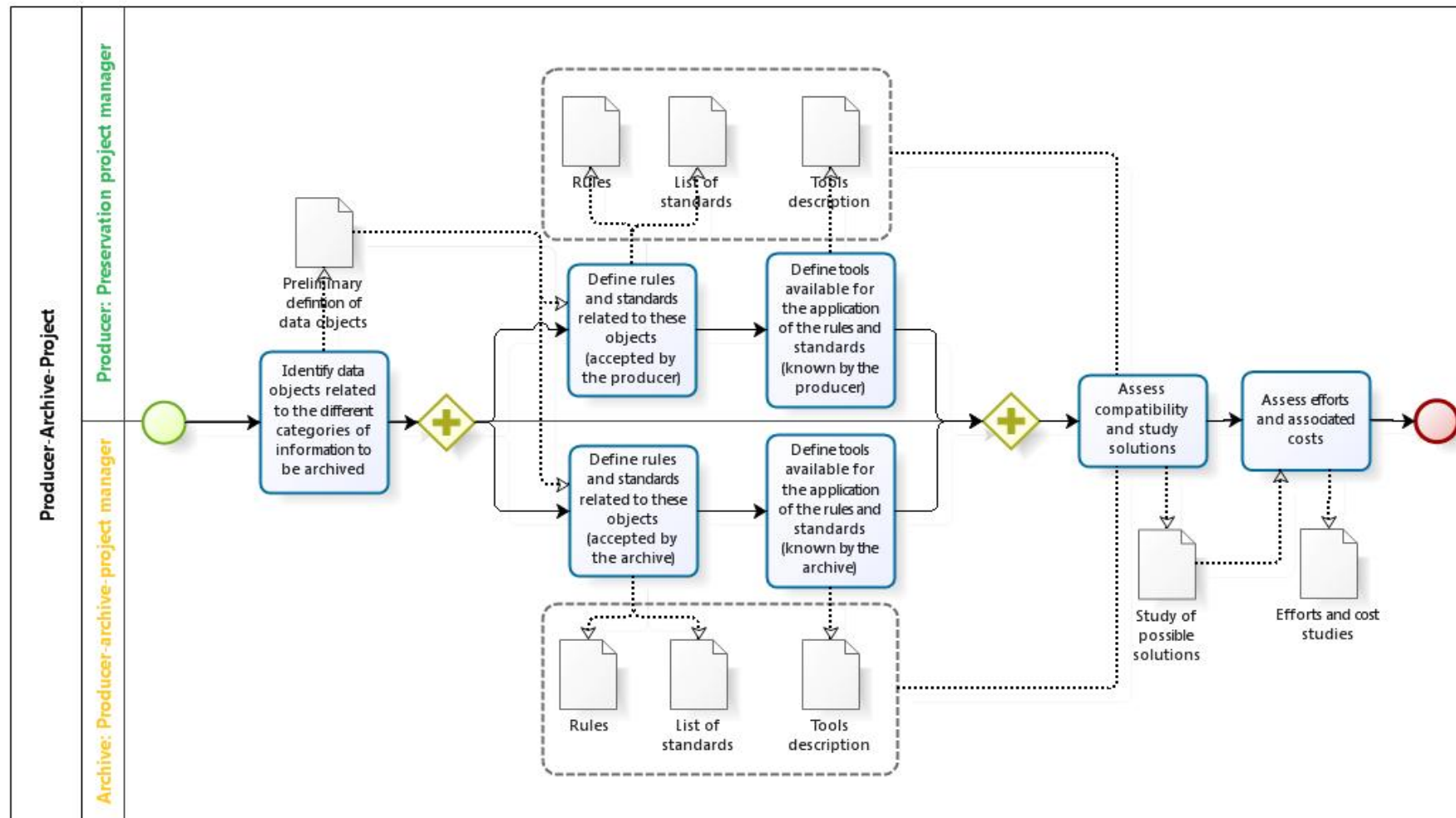


Figure 12: The process Define Digital Objects and Standards Applied to These Objects

4.6. Identify Object References²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- existing identification rules/ nomenclature
- legal provisions
- used standards
- rules applied within the *Producer-Archive Project*
- cost study

Details

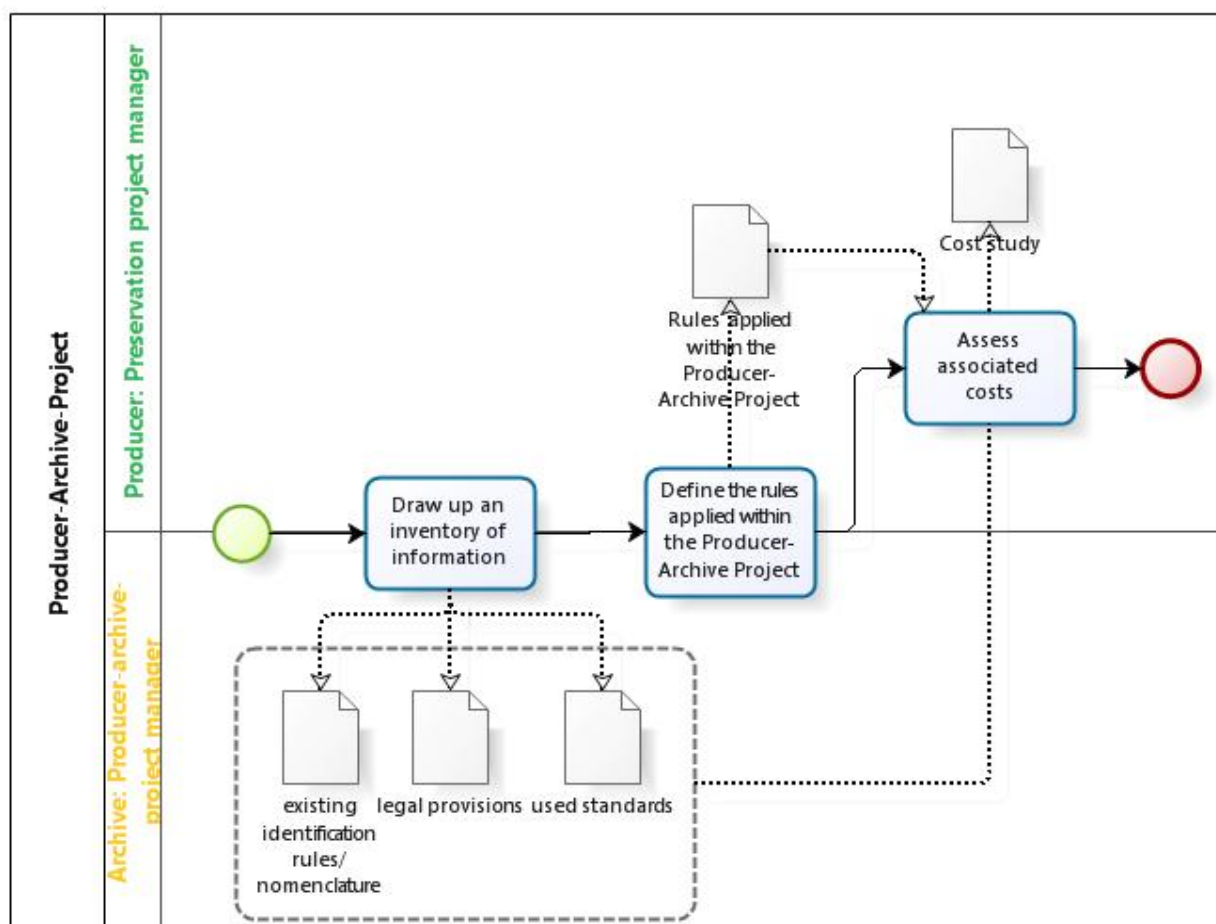


Figure 13: The process Identify Object References

4.7. Quantification²

Actors

- *Producer*: Preservation project manager

- *Archive: Producer-Archive Project manager*

Resources

- Data volume estimations, which means in detail the volumes to be transmitted in the short, medium and long term (global volume, minimum, average, and maximum planned size of files, number of files)
- Frequency of transfer sessions estimation
- Permanent global data volume estimation
- *Ingest* storage capability estimation
- Cost study

Details

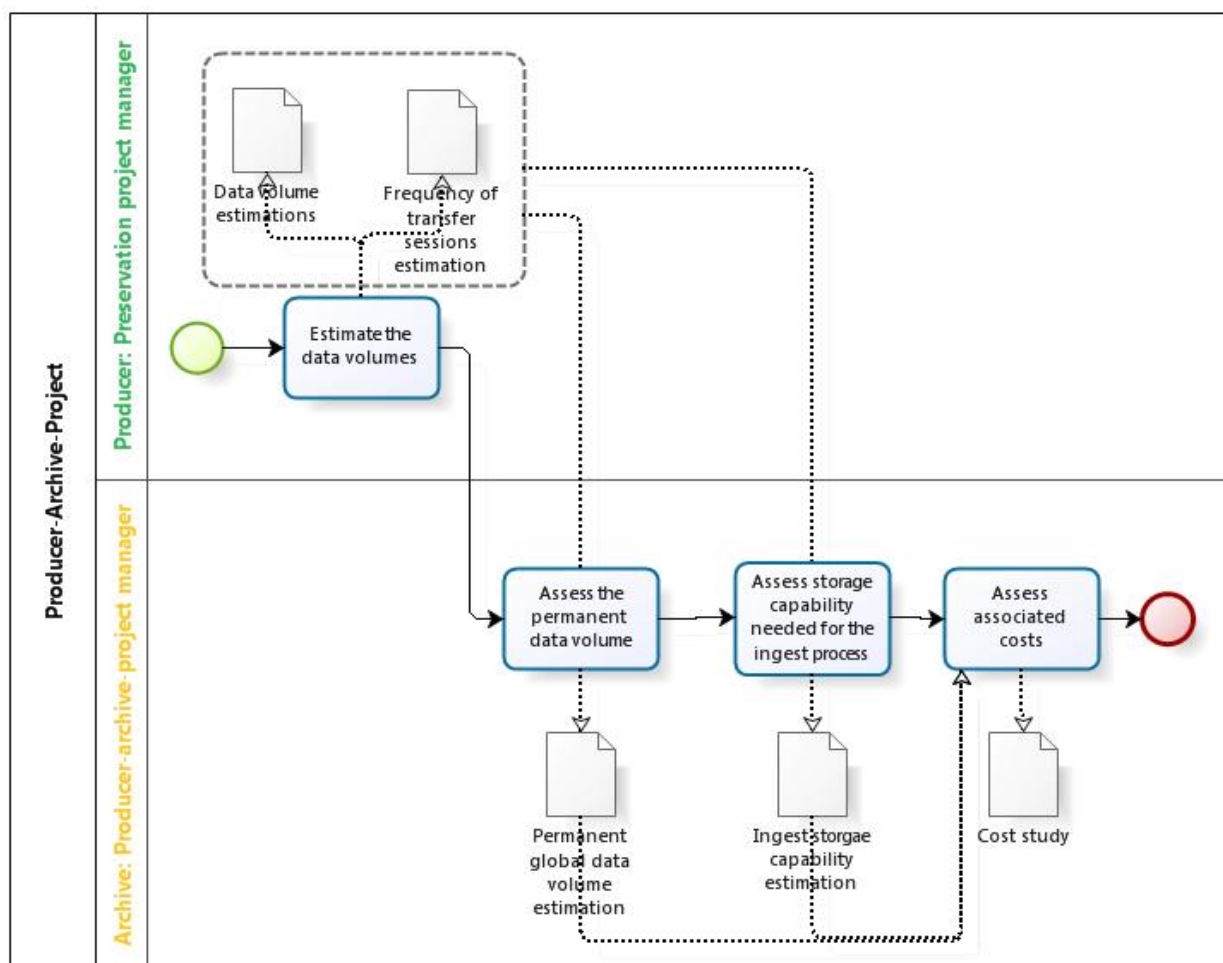


Figure 14: The process Quantification

4.8. Establish Security Conditions²

Actors

- *Producer: Preservation project manager*
- *Archive: Producer-Archive Project manager*

Resources

- Implementation of confidentiality measures (between *Producer* and *Archive*), e.g. encryption, secure transfer techniques
- Implementation of authenticity mechanisms (between *Producer* and *Archive*), e.g. encoding and signature mechanisms
- Implementation of security measures for the holdings, e.g. storage vaults, limiting physical Access, separation of master and copy
- Implementation of confidentiality measures (between *Consumer* and *Archive*), examples see above
- Implementation of authenticity mechanisms (between *Consumer* and *Archive*), examples see above
- List of standards and tools
- Cost studies

Details

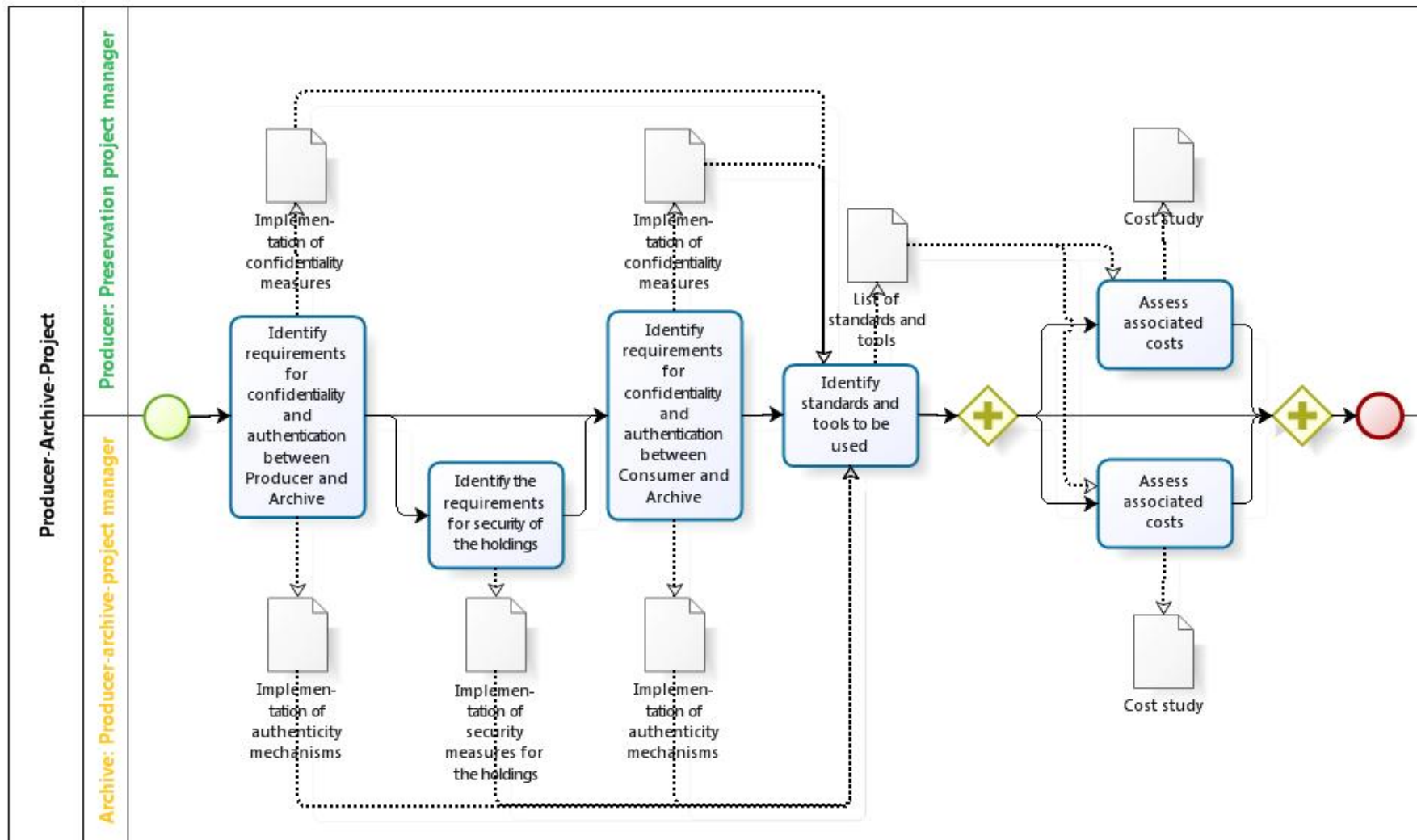


Figure 15: The process Establish Security Conditions

4.9. *Identify Legal and Contractual Aspects*²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Legal relationships definition (answering the questions: Does the *Producer-Archive Project* enter into the context of statutory government archiving? What are the consequences of this aspect of the project? If the relationship between the *Archive* and the *Producer* are of a contractual type, what is the aim of the contract and how are the responsibilities for the *Archive* defined within this contract?)
- Implied responsibilities
- Consequences of intellectual property rights for the *Archive*
- Transfer legalisation documents
- Data obligations of the *Archive*
- *Archive* obligations regarding information protection and Access
- Governance rules (e.g. authorized persons, immediate Access, or authorized after a legal lapse of time)
- *Archive* certification
- Applicable regulations
- Standard and tool specification
- Cost studies

Details

For better illustration, the process has been split up into two figures.

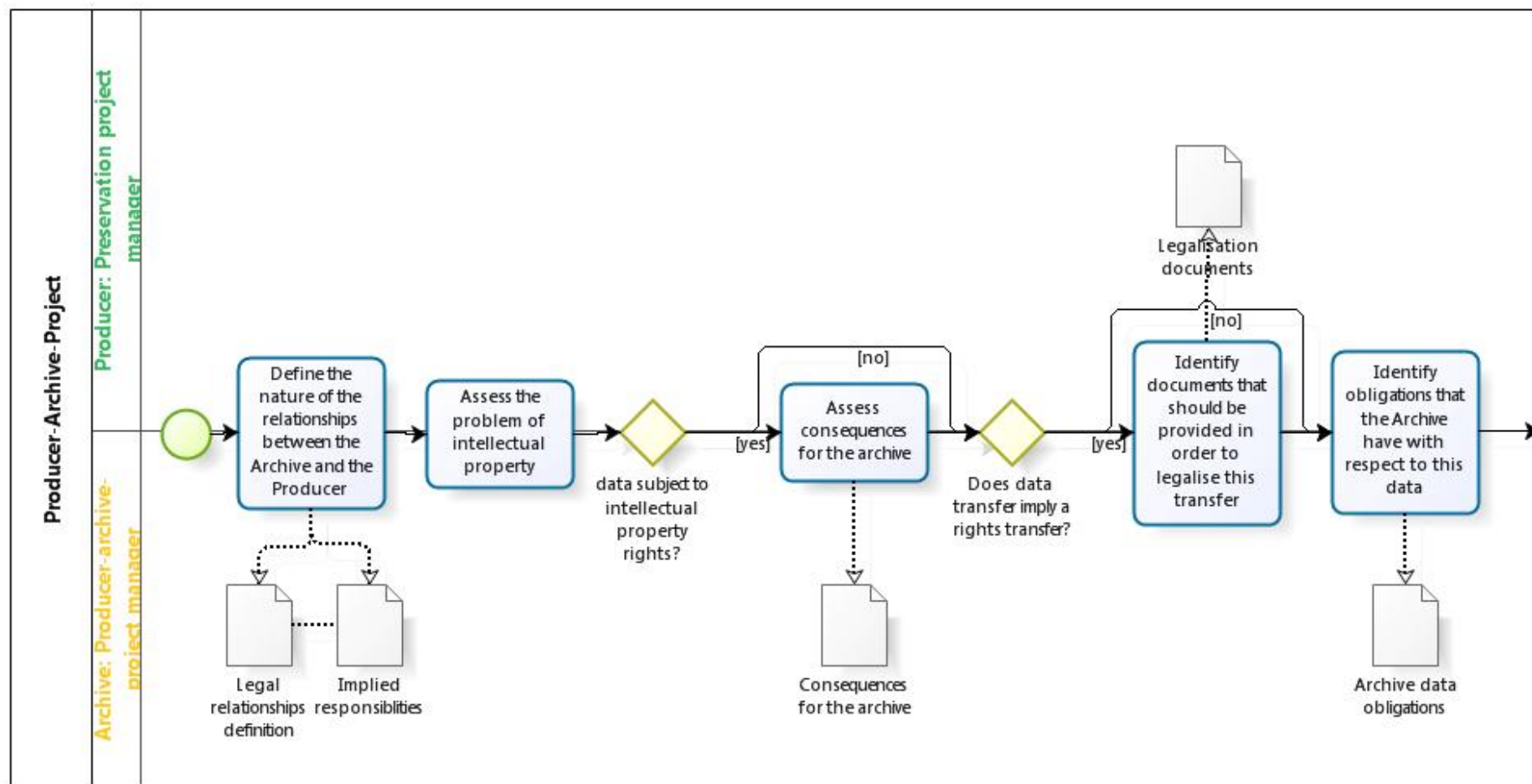


Figure 16: The process Identify Legal and Contractual Aspects (part one)

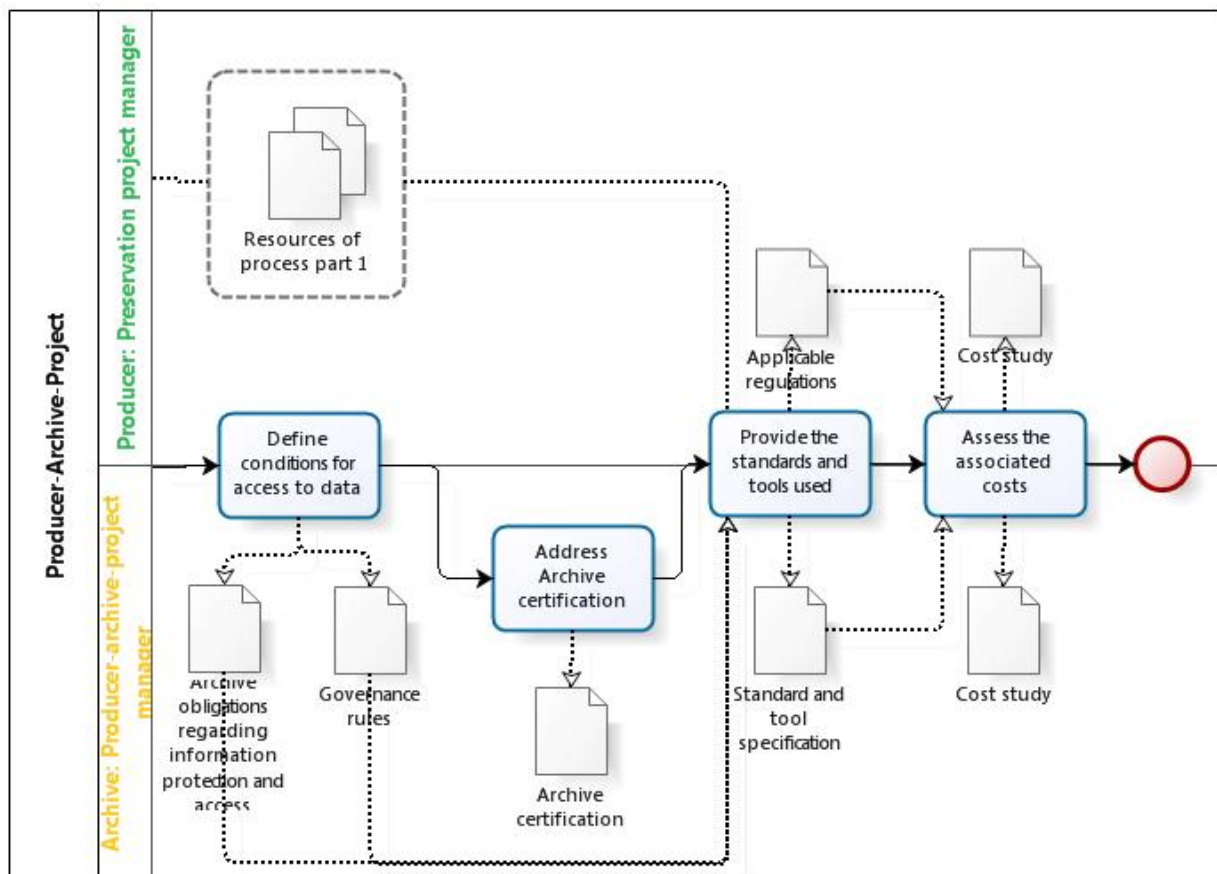


Figure 17: The process Identify Legal and Contractual Aspects (part two)

4.10. Define Transfer Operations²

Actors

- *Producer:* Preservation project manager
- *Archive:* Producer-Archive Project manager

Resources

- Preliminary *SIP* definition
- Transfer constraints and requirements
- Study of possible solutions
- Cost studies

Details

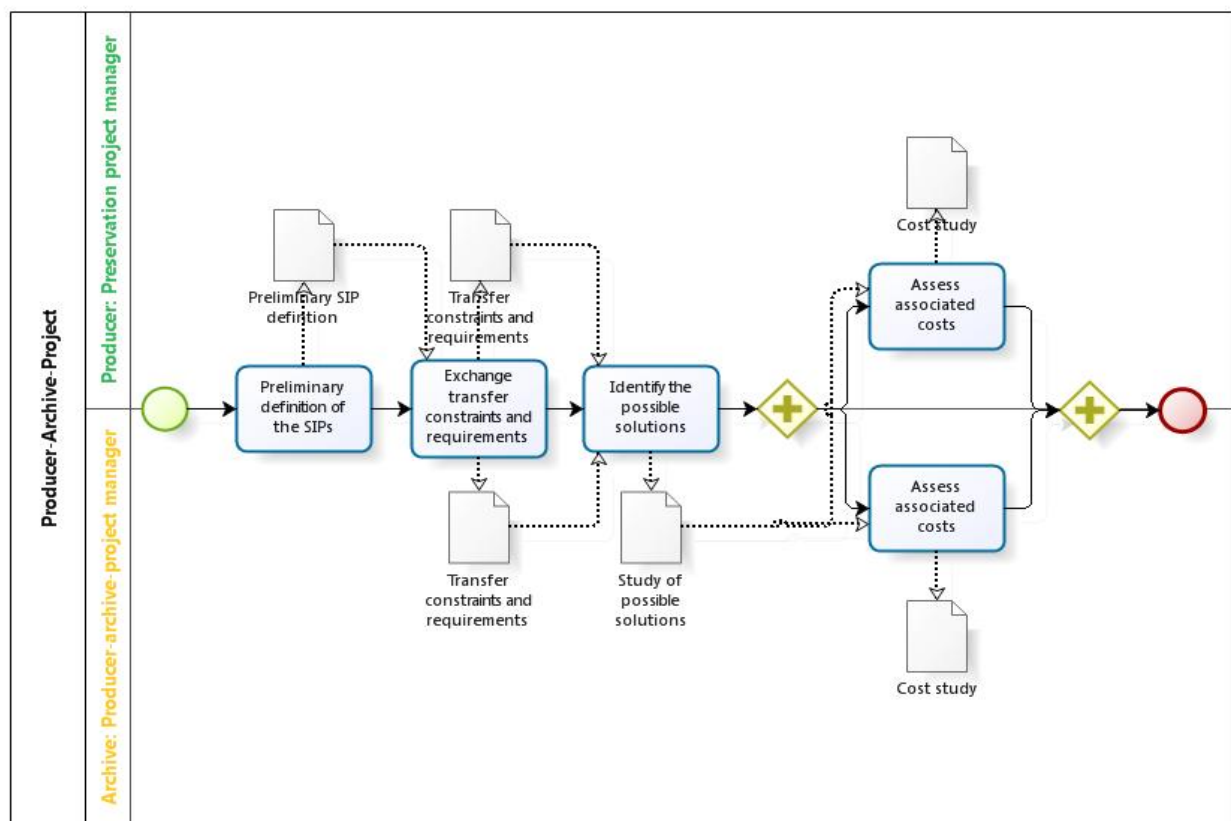


Figure 18: The process Define Transfer Operations

4.11. Establish Validation Procedures²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- SIP validation procedures
- Reject procedures
- Validation tools
- Change study
- Adapted validation tools
- Study of quality methods and tools
- Cost studies

Details

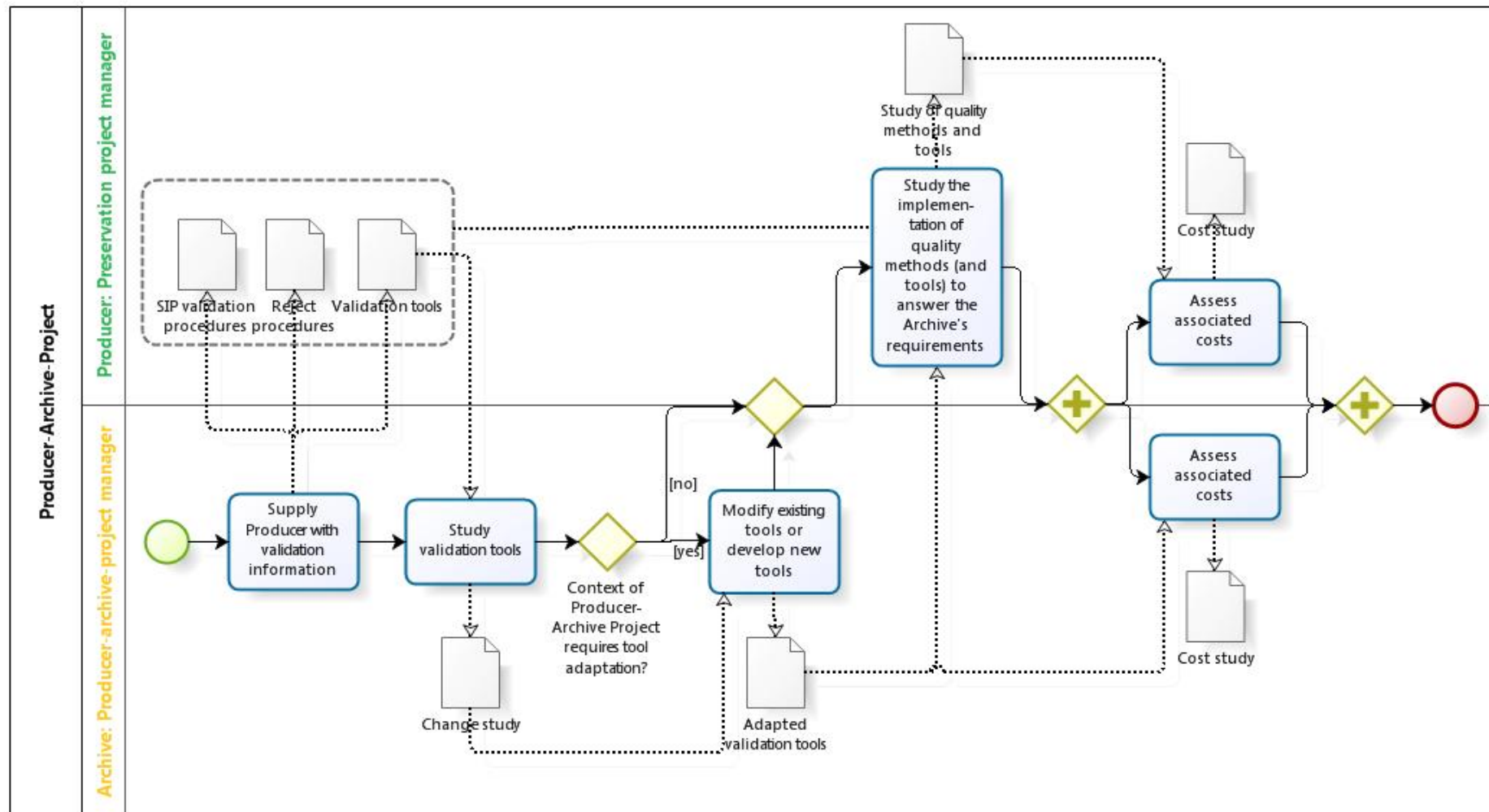


Figure 19: The process Establish Validation Procedures

4.12. Establish Schedule²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Schedule elements (data production, transfer, validation, data archiving, and data availability)
- Preliminary schedule

Details

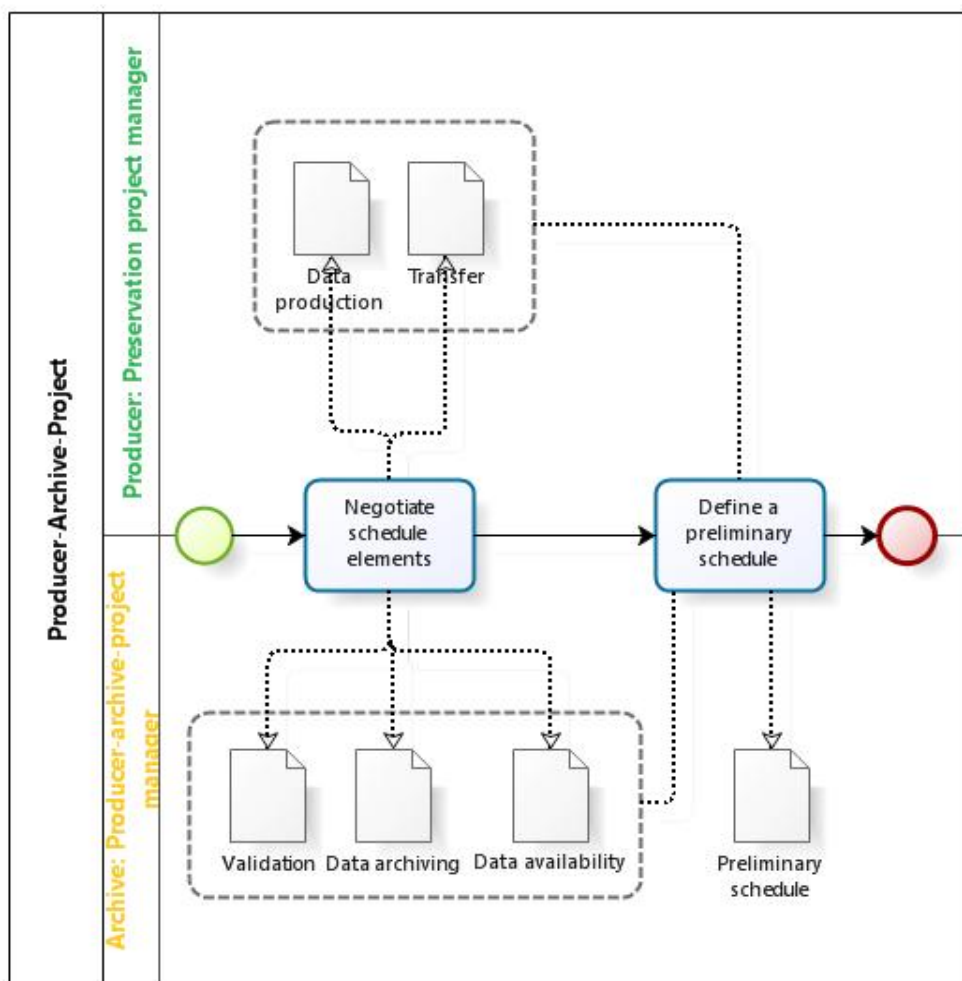


Figure 20: The process Establish Schedule

4.13. Identify Permanent Impact on the Archive²

Actors

- *Archive*: Producer-Archive Project manager

Resources

- Data volume estimations (from process Quantification)
- Long-term preservation actions (media renewal, duplication, re-packaging, and transformation of information, plans for transfer to another *Archive* in the case of closure)
- Measures to avoid data loss (e.g. copying data to another *Archive*)
- Conditions/ implementations established in process Establish Security Conditions
- Long term impact study
- Cost model

Details

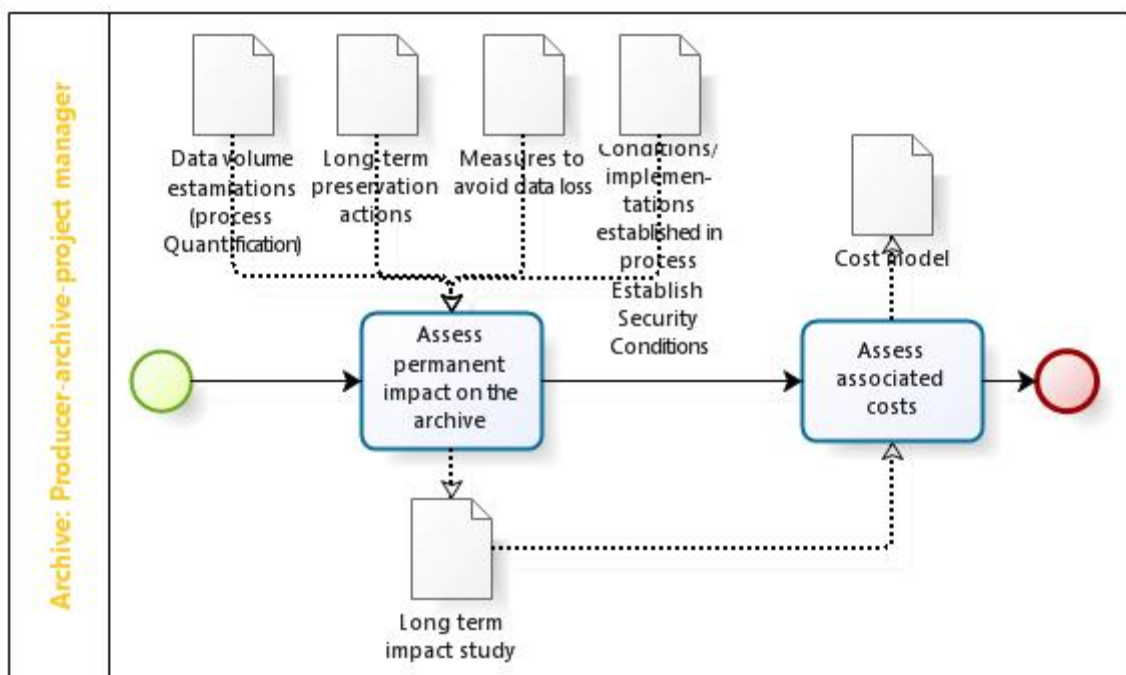


Figure 21: The process Identify Permanent Impact on the Archive

4.14. Summarise Costs and Risks²

Actors

- *Producer*: Preservation project manager
- *Archive: Producer-Archive Project manager*

Resources

On both the *Producer* and the *Archive* side:

- Cost studies of the previous processes
- Cost summaries
- Possible changes on either side
- Available resources and means (human and material)

- Risks on either side
- Available budgets
- Cost and risk summaries

Details

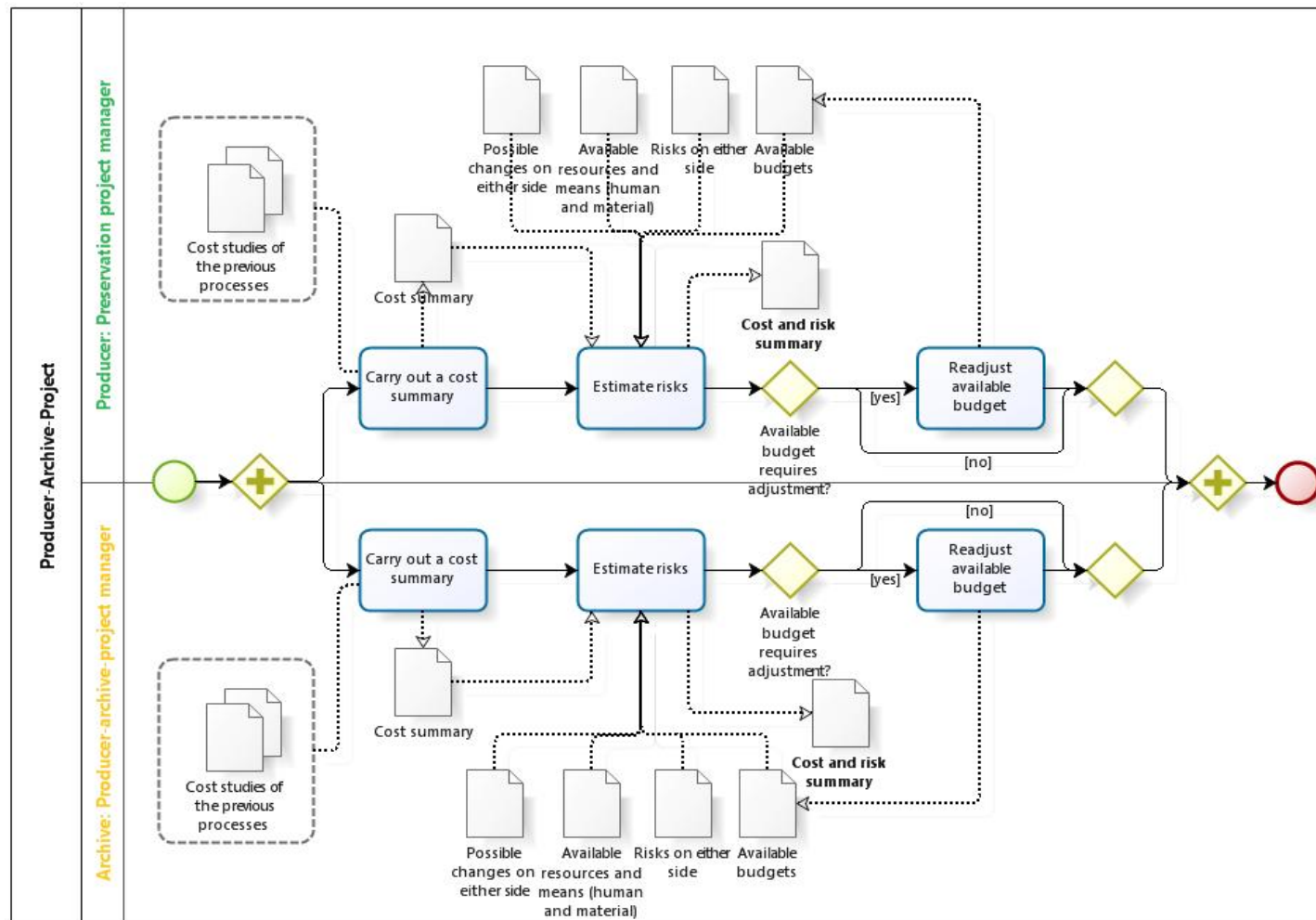


Figure 22: The process Summarise Costs and Risks

4.15. Identify Critical Points²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Risks already identified in previous process
- List of critical points

Details

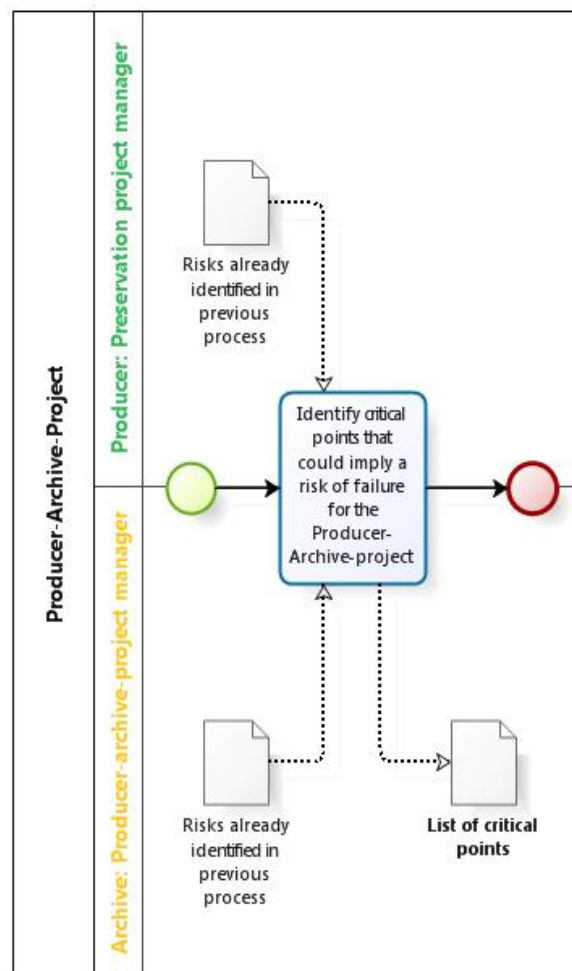


Figure 23: The process Identify Critical Points

4.16. Establishment of a Preliminary Agreement²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Studies and findings of all previous phases
- Summary document with feasibility recommendation
- Preliminary agreement, including:
 - The *SIP* content (*Content Information*, *PDI*, *Packaging Information*, *Descriptive Information*) and data model
 - First submission timetable
 - Data access restrictions
 - Validation procedures
 - Revision and re-negotiation clauses

Details

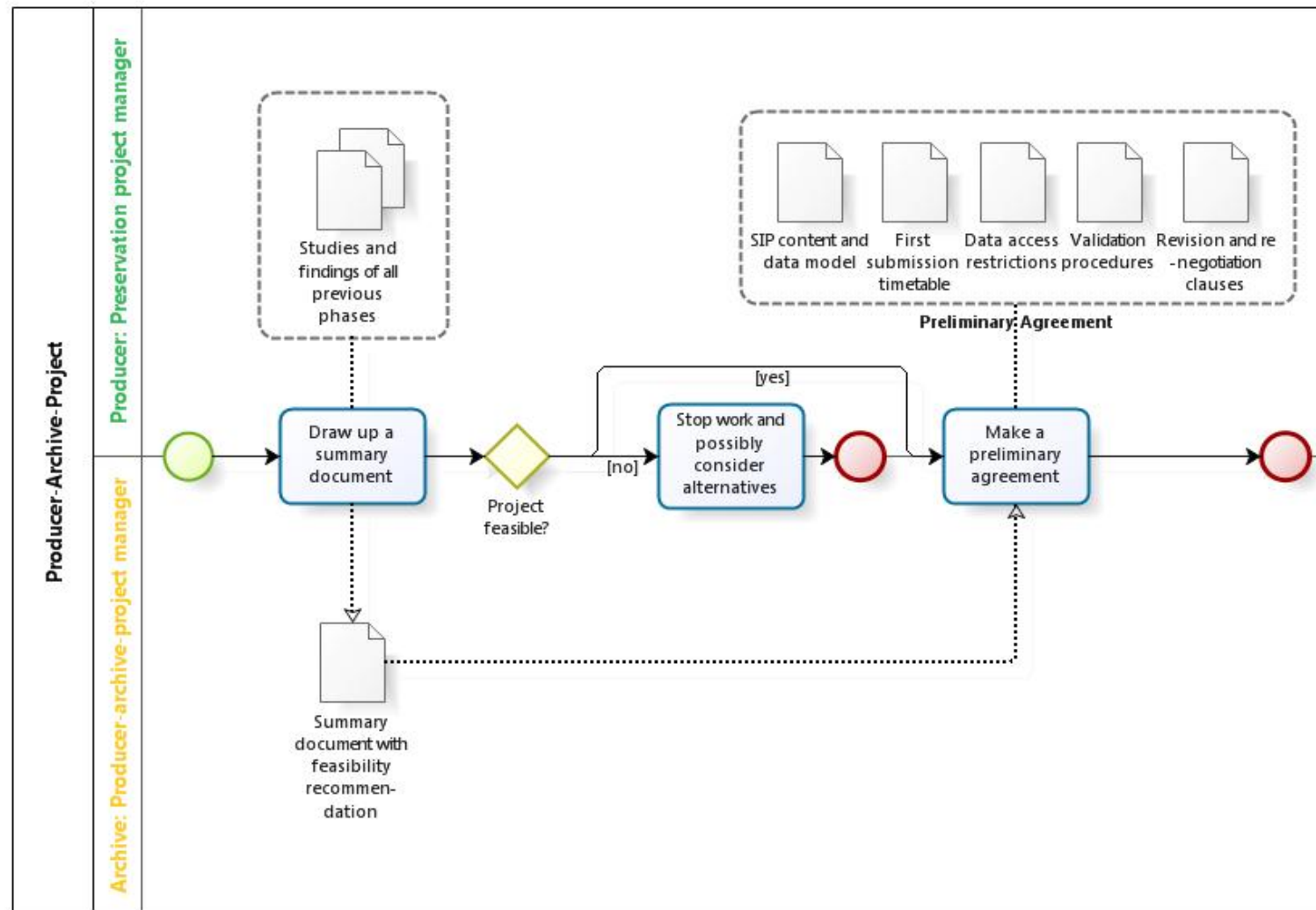


Figure 24: The process Establishment of a Preliminary Agreement

4.17. Consumer-Archive: Preliminary Negotiation

Actors

- Consumer
- Archive: Consumer-Archive-project manager

Resources

- Preliminary definition of *DIP* packaging procedures
- Preliminary definition of data dissemination procedures
- Preliminary pricing agreements

Details

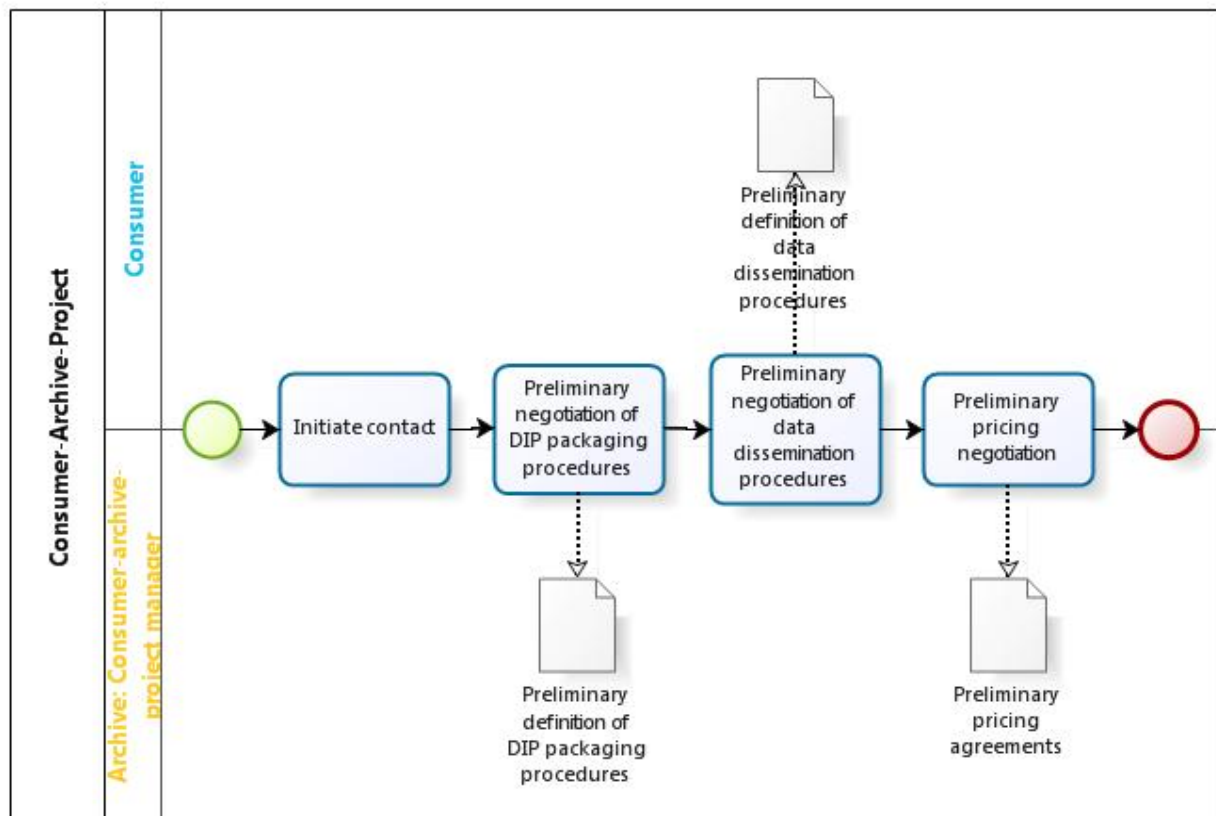


Figure 25: The process Consumer-Archive: Preliminary Negotiation

4.18. Consumer-Archive: Establishment of a Preliminary Agreement

Actors

- Consumer
- Archive: Consumer-Archive-project manager

Resources

- Preliminary definition of *DIP* packaging procedures (see Consumer-Archive: Preliminary Negotiation)

- Preliminary definition of data dissemination procedures (see Consumer-Archive: Preliminary Negotiation)
- Preliminary pricing agreements (see Consumer-Archive: Preliminary Negotiation)
- Preliminary Agreement

Details

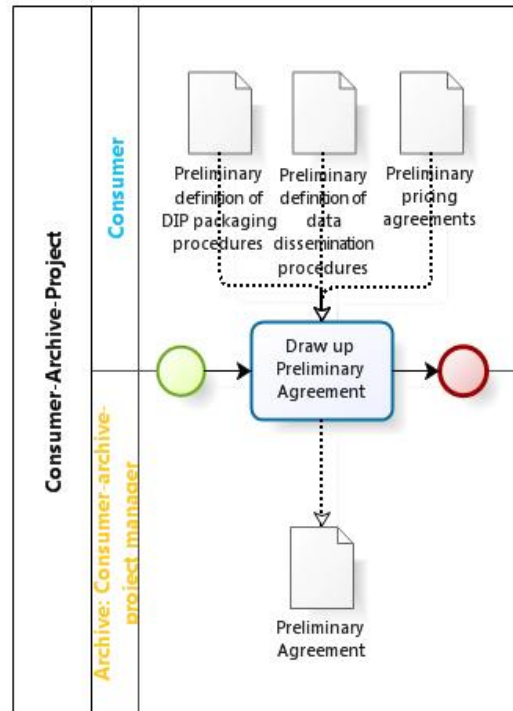


Figure 26: The process Consumer-Archive: Establishment of a Preliminary Agreement

5. Formal Definition Phase

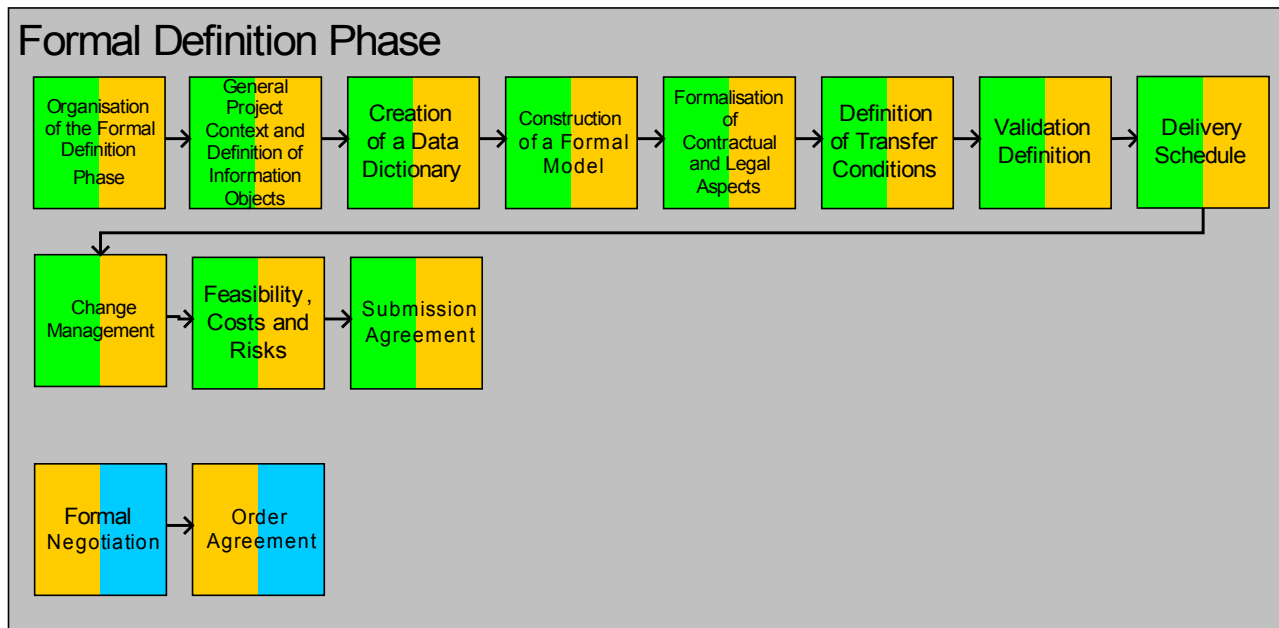


Figure 27: The processes of the Formal Definition Phase

The *Formal Definition Phase* includes completing the *SIP* design with precise definitions of the digital objects to be delivered, completing the *Submission Agreement* between *Producer* and *Archive* with precise contractual transfer conditions such as restrictions on *Access* and establishing the delivery schedule. But also the *Order Agreement* between *Consumer* and *Archive* is established in this phase. Figure 27 shows which processes are involved.

5.1. Organisation of the Formal Definition Phase²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Roles and responsibilities
- Plan of archiving stages (production, transfer, *Ingest*, validation)
- List of documents to be produced
- Points to be examined in greater depth

Details

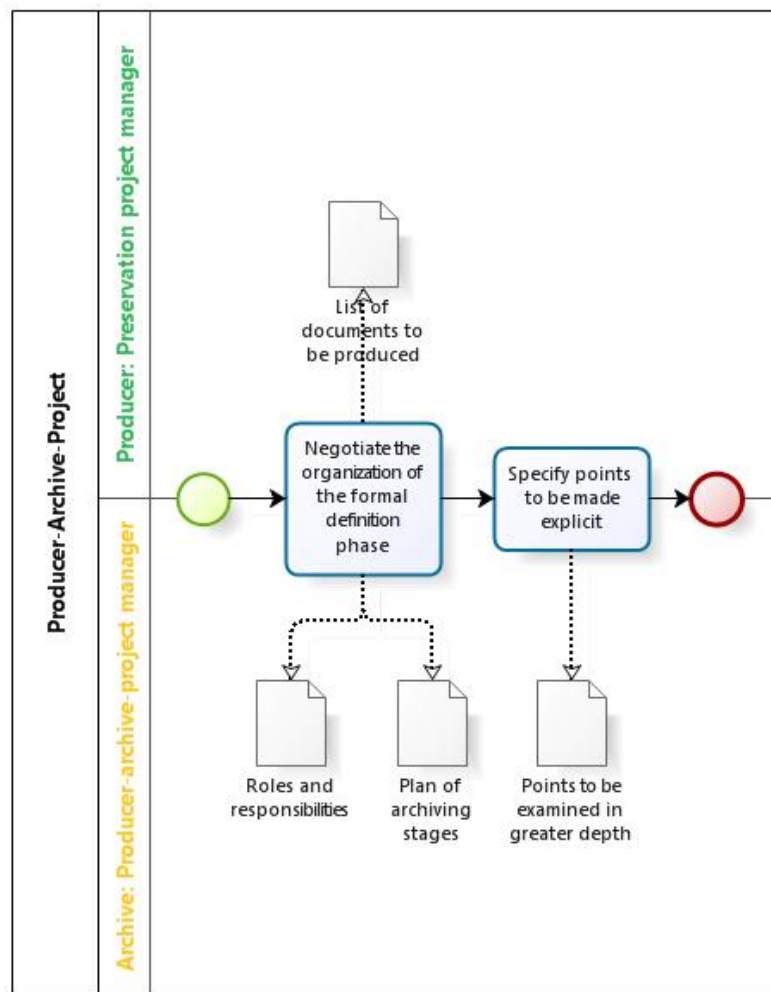


Figure 28: The process Organisation of the Formal Definition Phase

5.2. General Project Context and Definition of Information Objects²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Information from the Preliminary Agreement (see Establishment of a Preliminary Agreement) on:
 - the *Designated Community*
 - Access conditions
 - formats, coding rules and standards
 - object references
- Definition of *Data Objects* and *Representation Information*
- Definition of *Preservation Description Information* (provenance, context, reference,

fixity)

- Definition of *Descriptive Information*
- Definition of formats
- Definition of coding rules
- Definition of standards
- Volume indicators definition (e.g., estimated total volume to be archived and also granular information on the volume of Content Data, mean and maximum size of a file)
- Definition on object references
- Definition of tools to be installed by the *Producer* (to aid with data production, production of descriptors, document production, etc.)
- Description of *Information Objects*, referring to data dictionary and model (defined in subsections 5.3 and 5.4)

Details

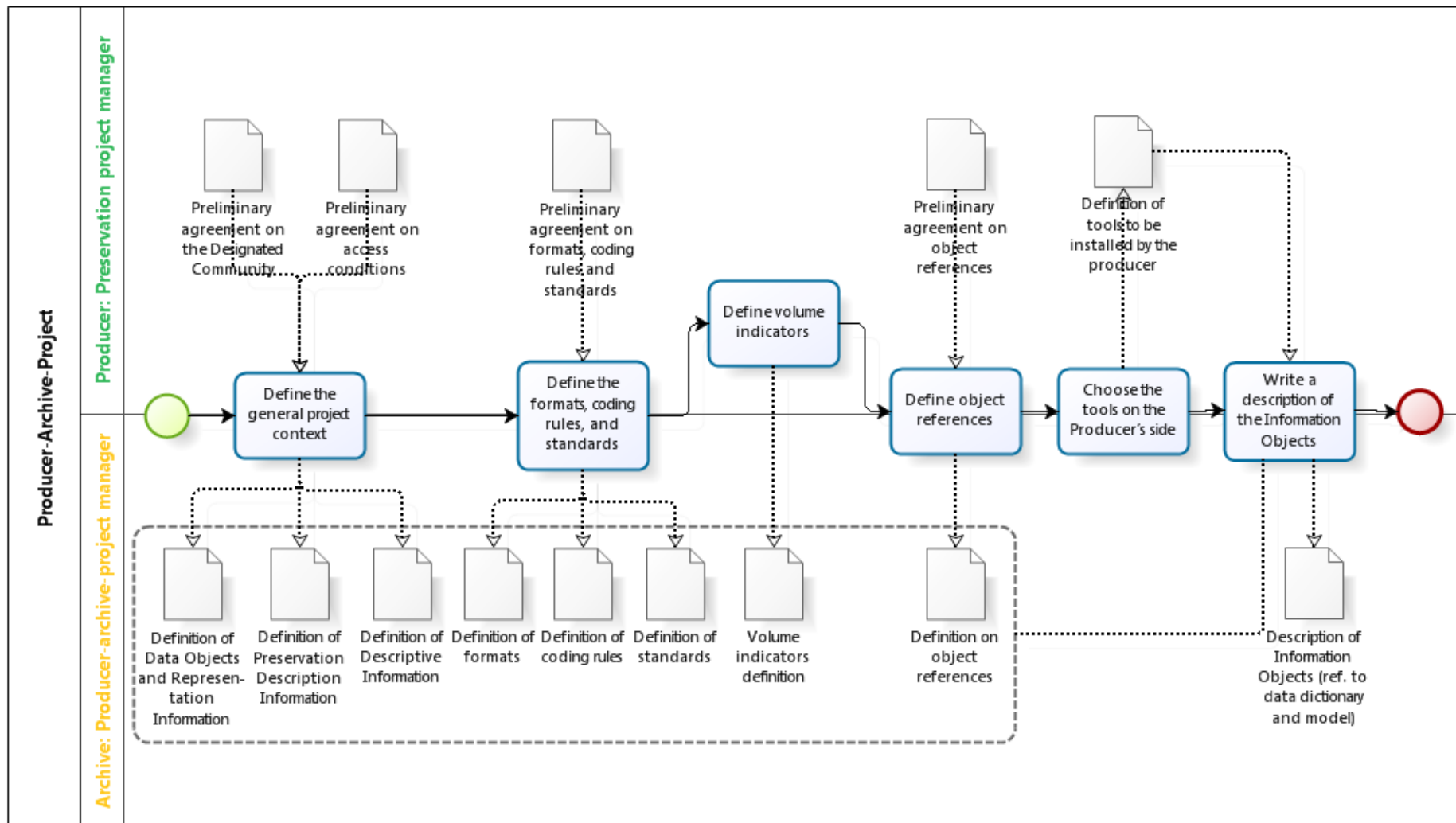


Figure 29: The process General Project Context and Definition of Information Objects

5.3. Creation of a Data Dictionary²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Description of *Information Objects* (from process General Project Context and Definition of Information Objects)
- Data Dictionary
- Data Dictionary (coded)

Details

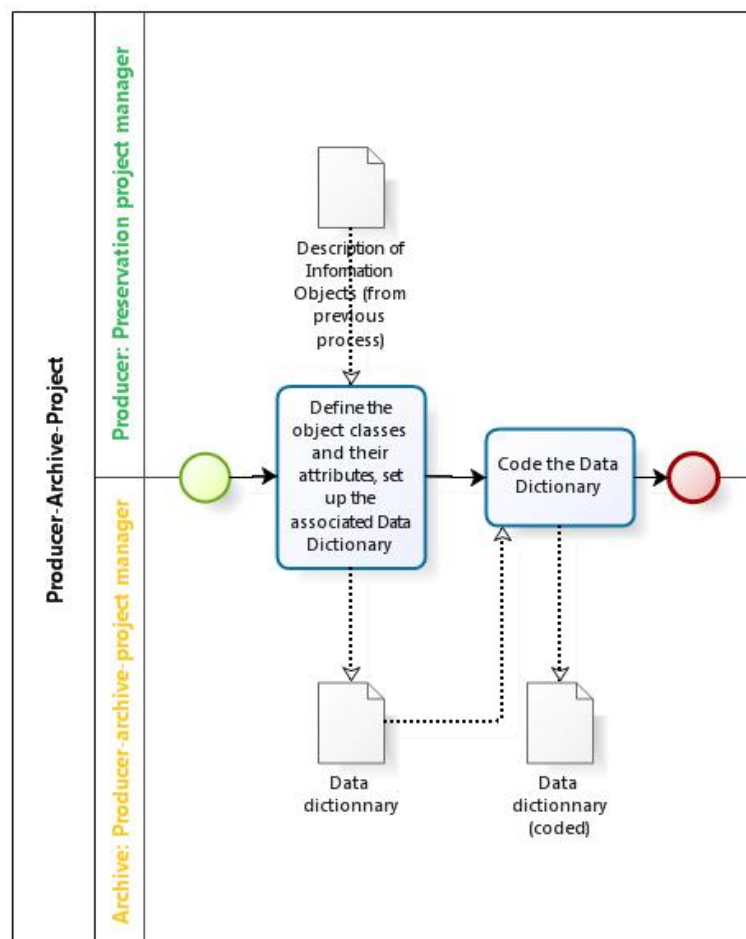


Figure 30: The process Creation of a Data Dictionary

5.4. Construction of a Formal Model²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Data dictionary (from process Creation of a Data Dictionary)
- Formal data model
- Formal model representation
- Accompanying text document

Details

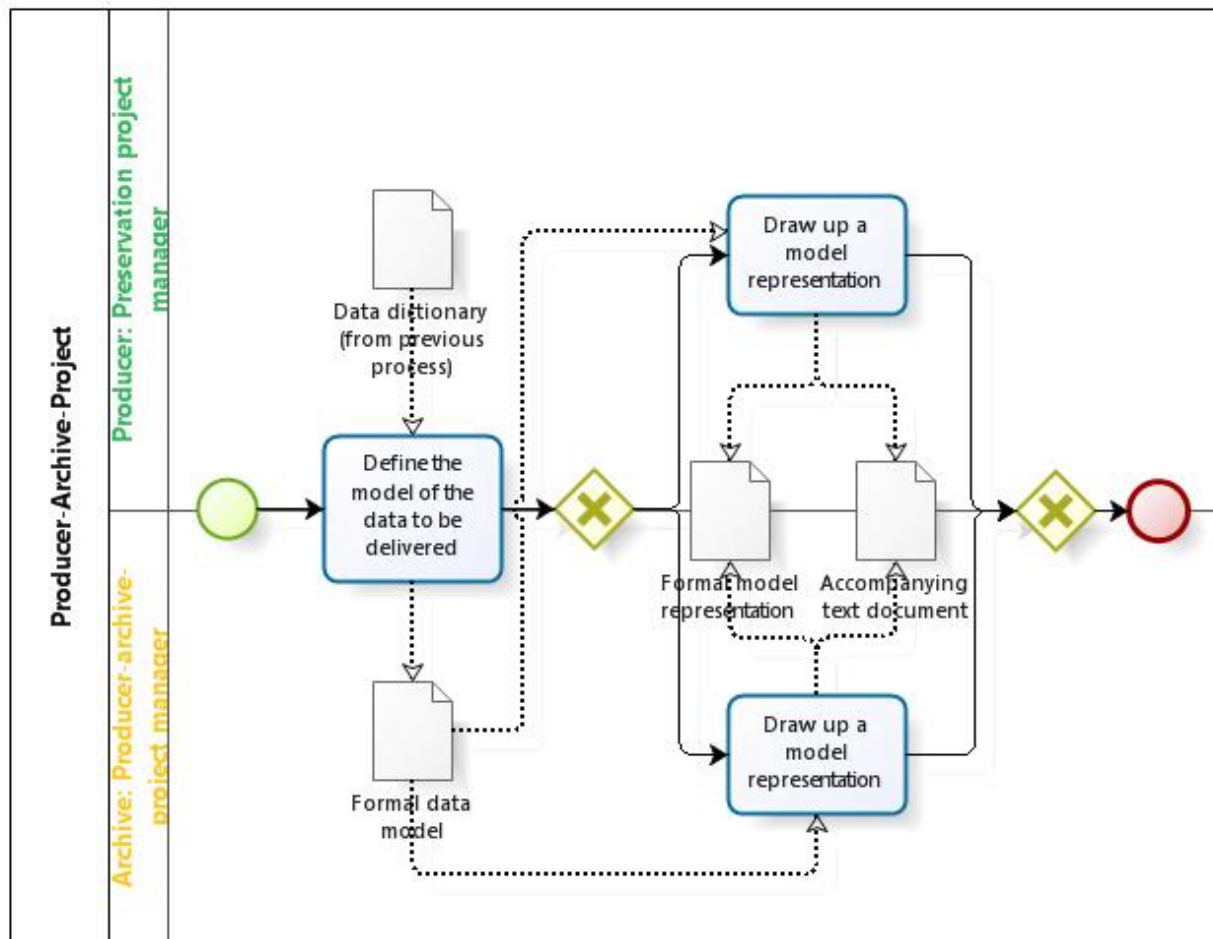


Figure 31: The process Construction of a Formal Model

5.5. Formalisation of Contractual and Legal Aspects²

Actors

- *Producer:* Preservation project manager
- *Archive:* Producer-Archive Project manager

Resources

- Legal and contractual aspects raised in *Preliminary Phase* (process Identify Legal and Contractual Aspects)
- Formal agreement of legal and contractual aspects

- Possibly conditions and date of intellectual property transfer

Details

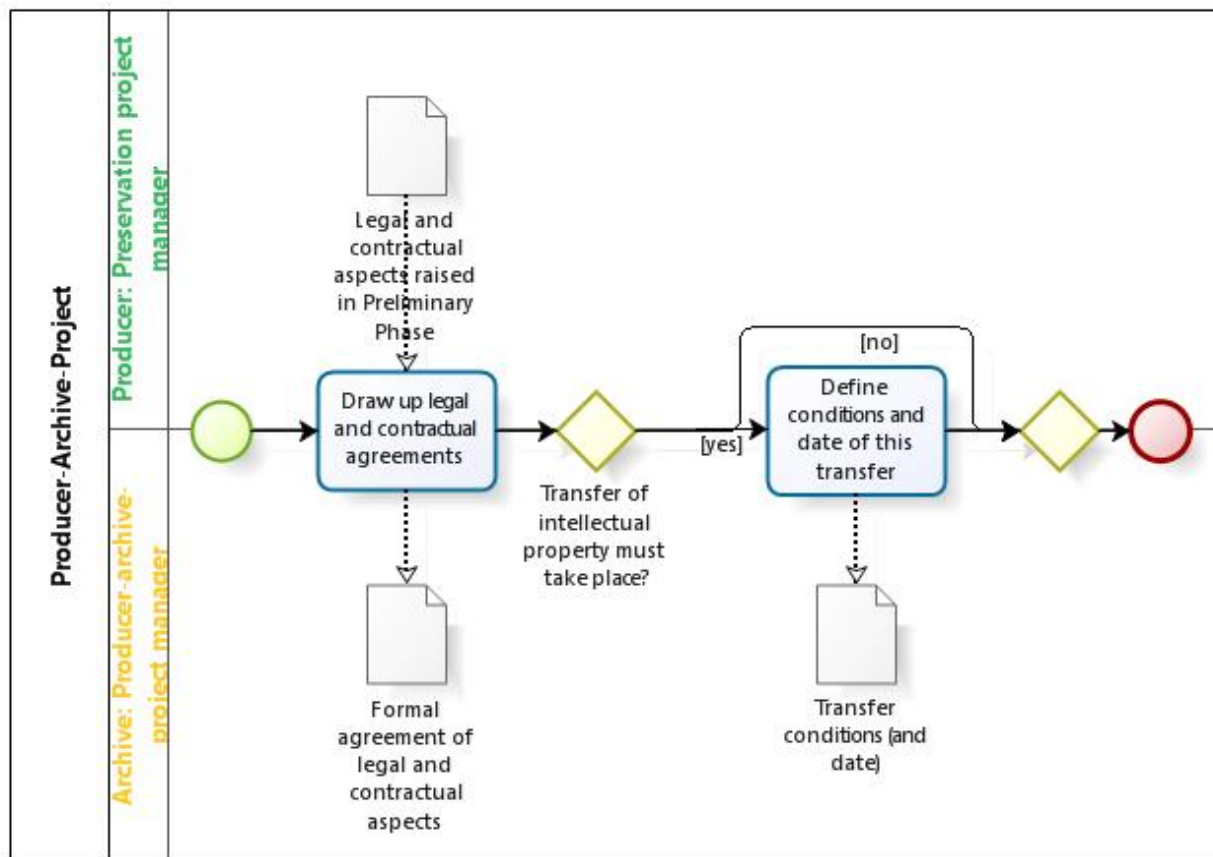


Figure 32: The process Formalisation of Contractual and Legal Aspects

5.6. Definition of Transfer Conditions²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Data volume estimations (from process Quantification)
- Security conditions (from process Establish Security Conditions)
- Preliminary studies (process Define Transfer Operations)
- Communication procedures
- *Packaging Information* definition
- Functional structure of a session
- Time-related structure of a session
- Procedure for sending/ receiving messages
- Definition of test *SIPs*

- Definition of transfer tests (the nominal functioning of the transfer and procedures in the event of breakdown)
- List of tools
- Transfer procedures description

Details

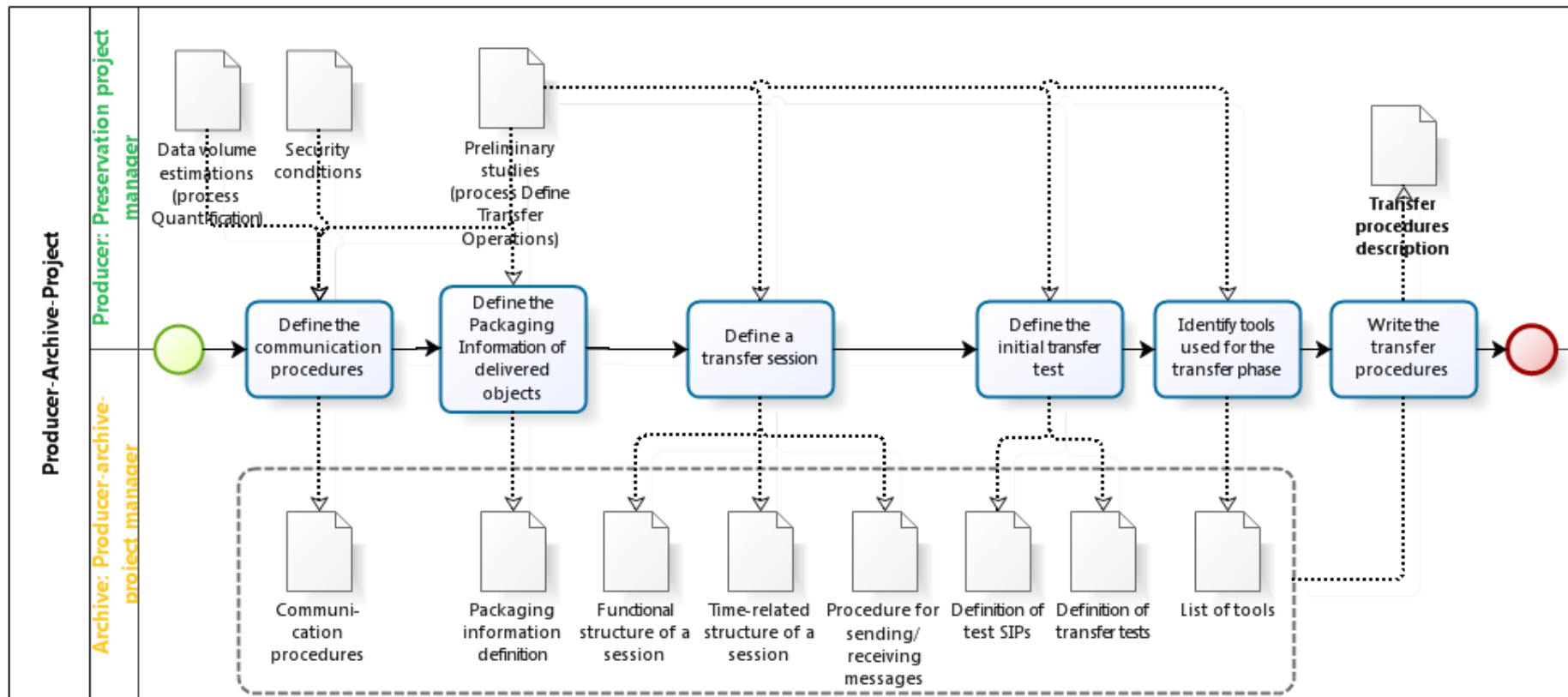


Figure 33: The process Definition of Transfer Conditions

5.7. **Validation Definition²**

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Preliminary procedures/ studies (from process Establish Validation Procedures)
- Systematic validation plan (Consider completeness, integrity and conformity to the data model)
- In-depth validation plan (including automatic and manual checks)
- Procedures for rejection, re-transfer, object acceptance (for both systematic and in-depth validation)
- Definition of test *SIPs*
- Definition of validation tests (for testing validation means and conformity to the test *SIPs* received)
- List of validation tools to be used
- Description of the validation procedures

Details

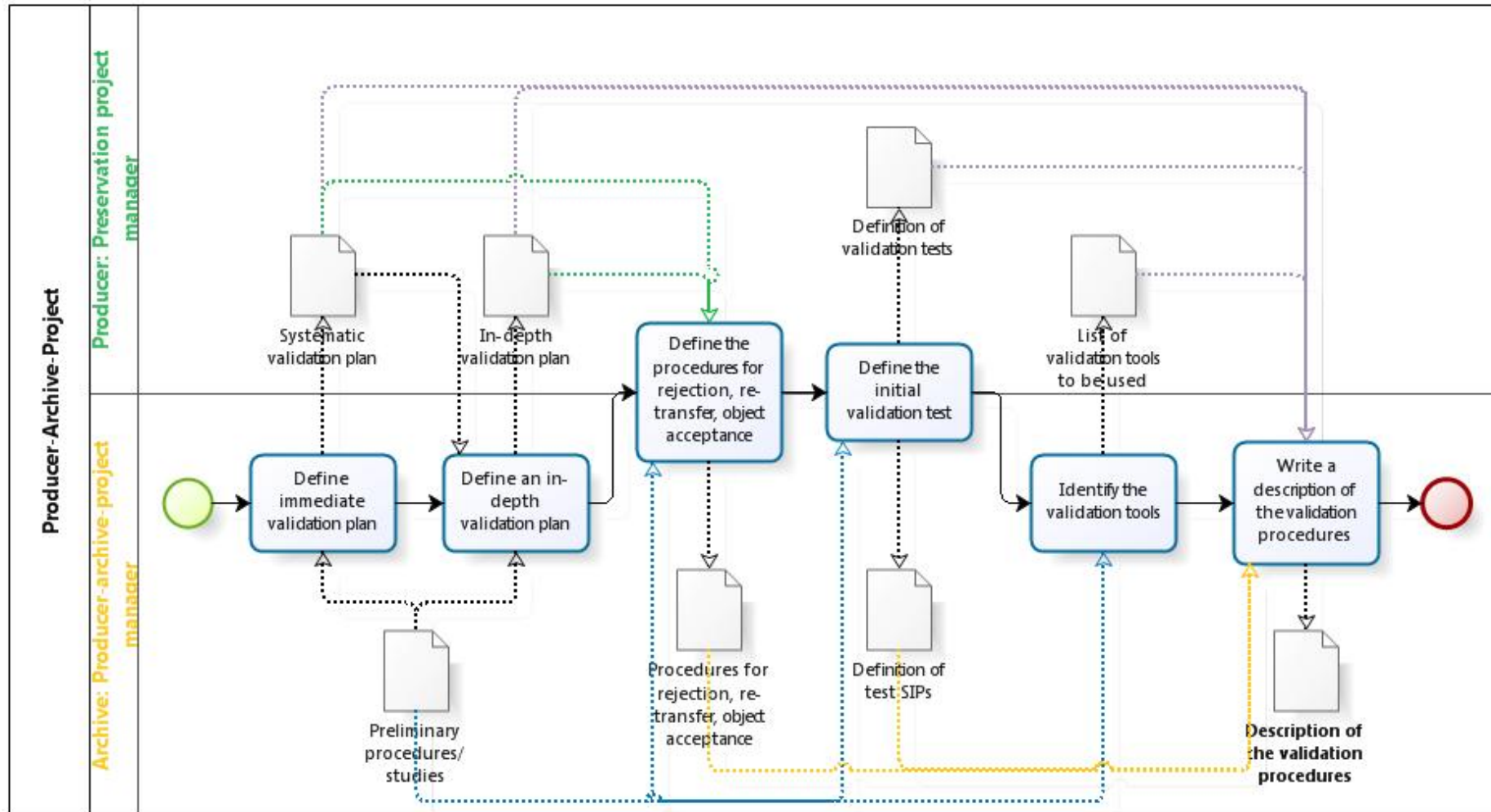


Figure 34: The process Validation Definition

Remark: Some arrows in this process diagram have been colorized for a clearer readability.

5.8. Delivery Schedule²

Actors

- *Producer*: Preservation project manager
- *Archive*: Producer-Archive Project manager

Resources

- Preliminary schedule (from process Establish Schedule)
- Reference delivery schedule
- Procedure to follow in the event of divergence (the schedule must be regularly revised and the reasons for any divergence must be analysed)

Details

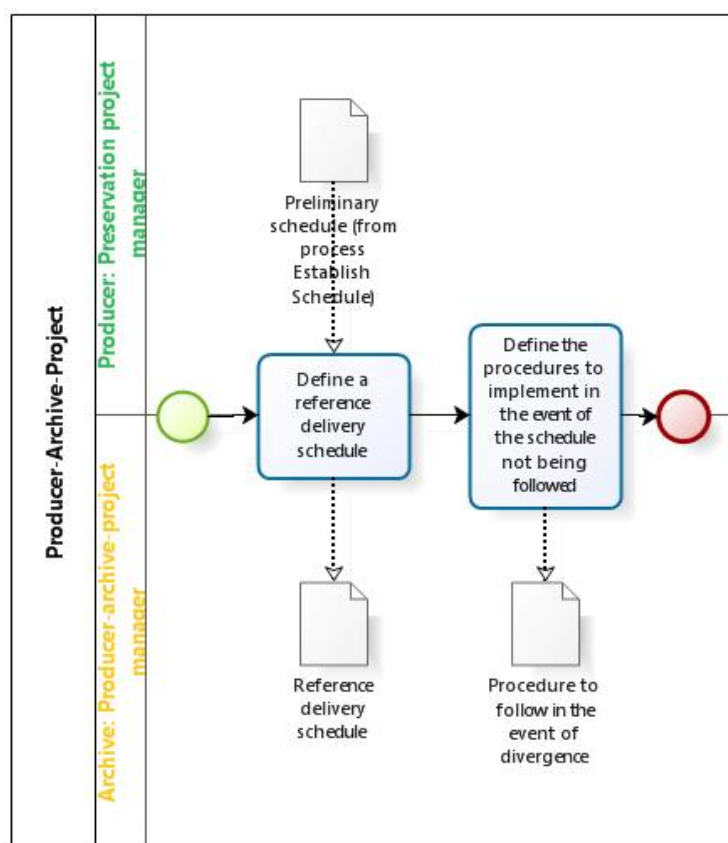


Figure 35: The process Delivery Schedule

5.9. Change Management after Completion of the Submission Agreement²

Actors

- *Producer*: Preservation project manager

- *Archive: Producer-Archive Project manager*

Resources

- List of categories of causes (e.g. infrastructure, information, resources and legal)
- Impact scenarios
 - Impact on *Data Objects*
 - Impacts on the transfer procedure
 - Impacts on the validation procedure
- Cost and feasibility study (should also include impact on delivery schedule, *Consumers*, tooling, human resources and the *Archive* in the long term)
- *Submission Agreement*
- Action plan

Details

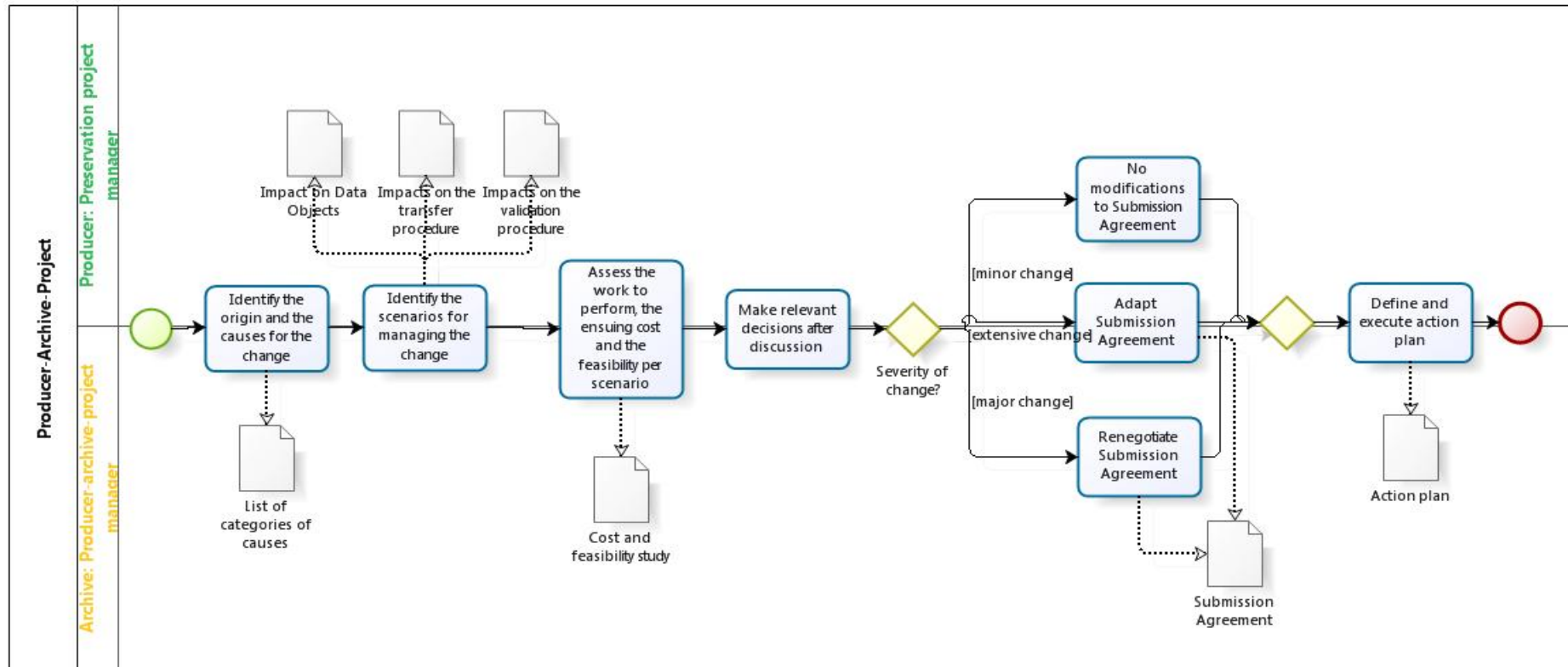


Figure 36: The process Change Management after Completion of the Submission Agreement

5.10. Feasibility, Costs and Risks²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Feasibility recommendation (preliminary [see process Establishment of a Preliminary Agreement] and adjusted)
- Cost summaries on both sides (preliminary [see process Summarise Costs and Risks] and adjusted)
- *Archive* impact study (preliminary [see process Identify Permanent Impact on the Archive] and adjusted)
- Quantification cost study (preliminary [see process Quantification] and adjusted)
- Risk studies on both sides (preliminary [see process Summarise Costs and Risks] and adjusted)

Details

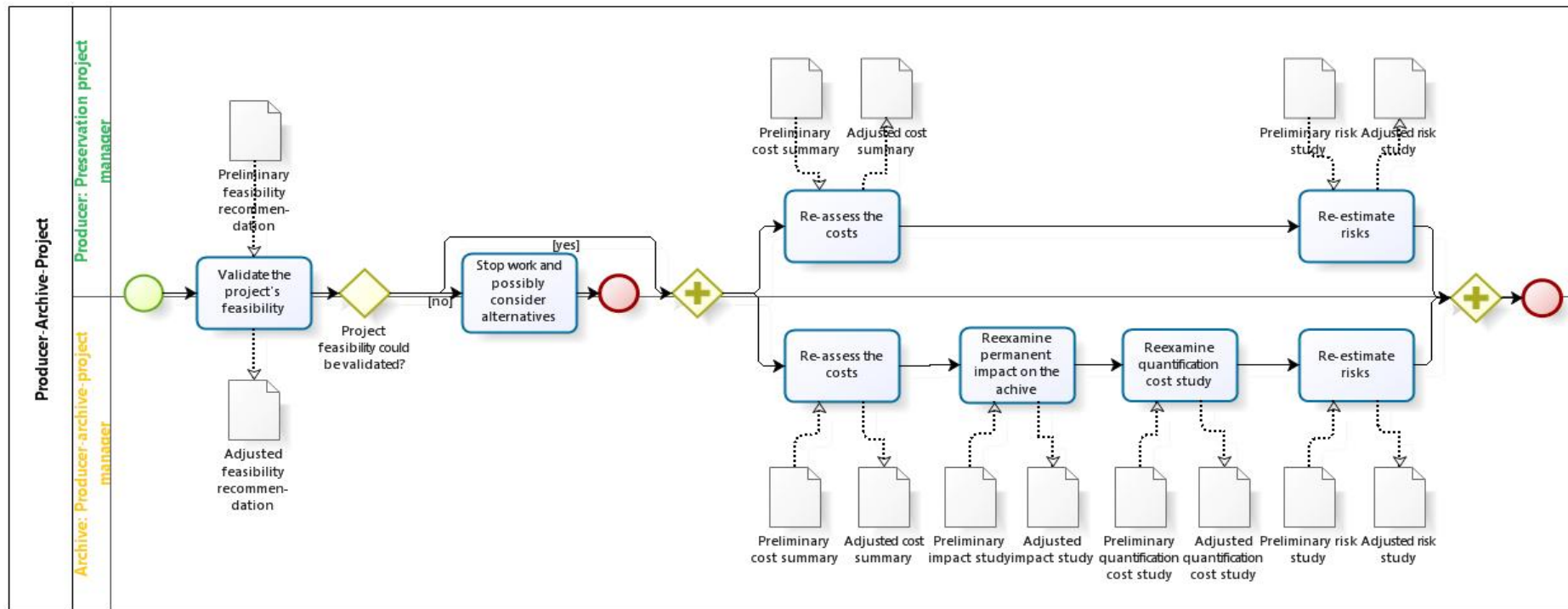


Figure 37: The process Feasibility, Costs and Risks

5.11. Submission Agreement²

Actors

- *Producer*: Preservation project manager
- *Archive*: *Producer-Archive Project* manager

Resources

- Preliminary Agreement (see Establishment of a Preliminary Agreement)
- Description of the Information *Objects* (see General Project Context and Definition of Information Objects)
- Data Dictionary (see Creation of a Data Dictionary)
- Formal model representation (see Construction of a Formal Model)
- Formal agreement of legal and contractual aspects (see Formalisation of Contractual and Legal Aspects)
- Transfer procedures description (see Definition of Transfer Conditions)
- Description of validation procedures (see Validation Definition)
- Reference delivery schedule (see Delivery Schedule)
- Schedule divergence procedure (see Delivery Schedule)
- Change management procedures (see Change Management after Completion of the Submission Agreement)
- *Submission Agreement*

Details

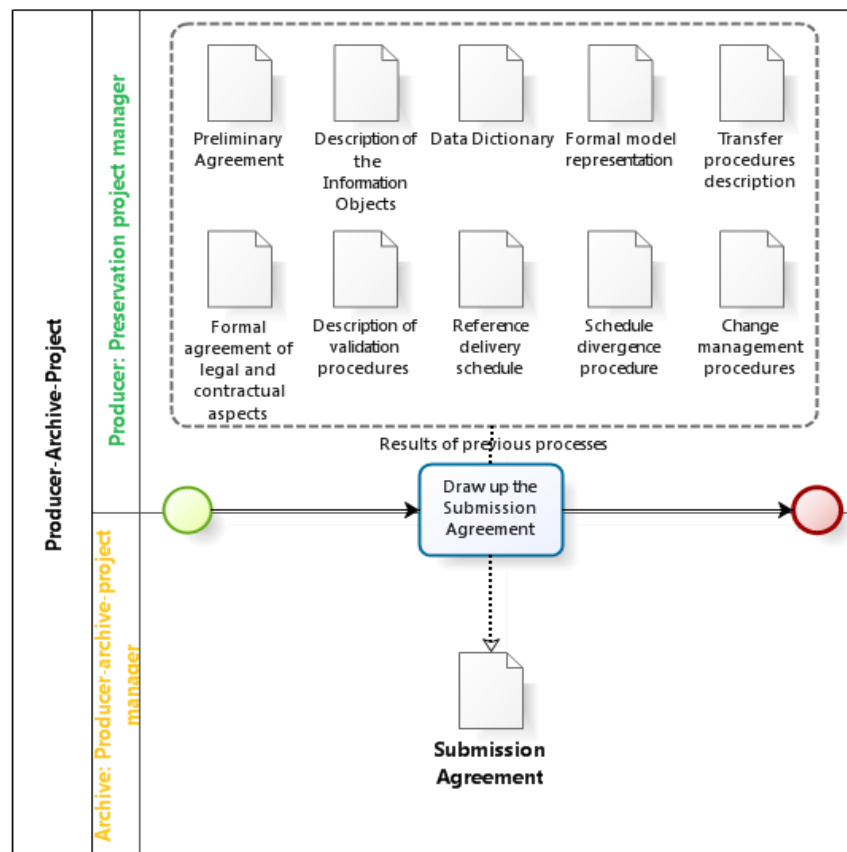


Figure 38: The process Submission Agreement

Remark:

There are further inputs to the *Submission Agreement*, which have not been considered by [2]: in particular Quality of Service (QoS) terms and pricing terms. This is also related to the establishment of Service Level Agreements (SLAs) between *Producer* and *Archive*, which are discussed in the PrestoPRIME project deliverable D3.1.

5.12. Consumer-Archive Formal Negotiation

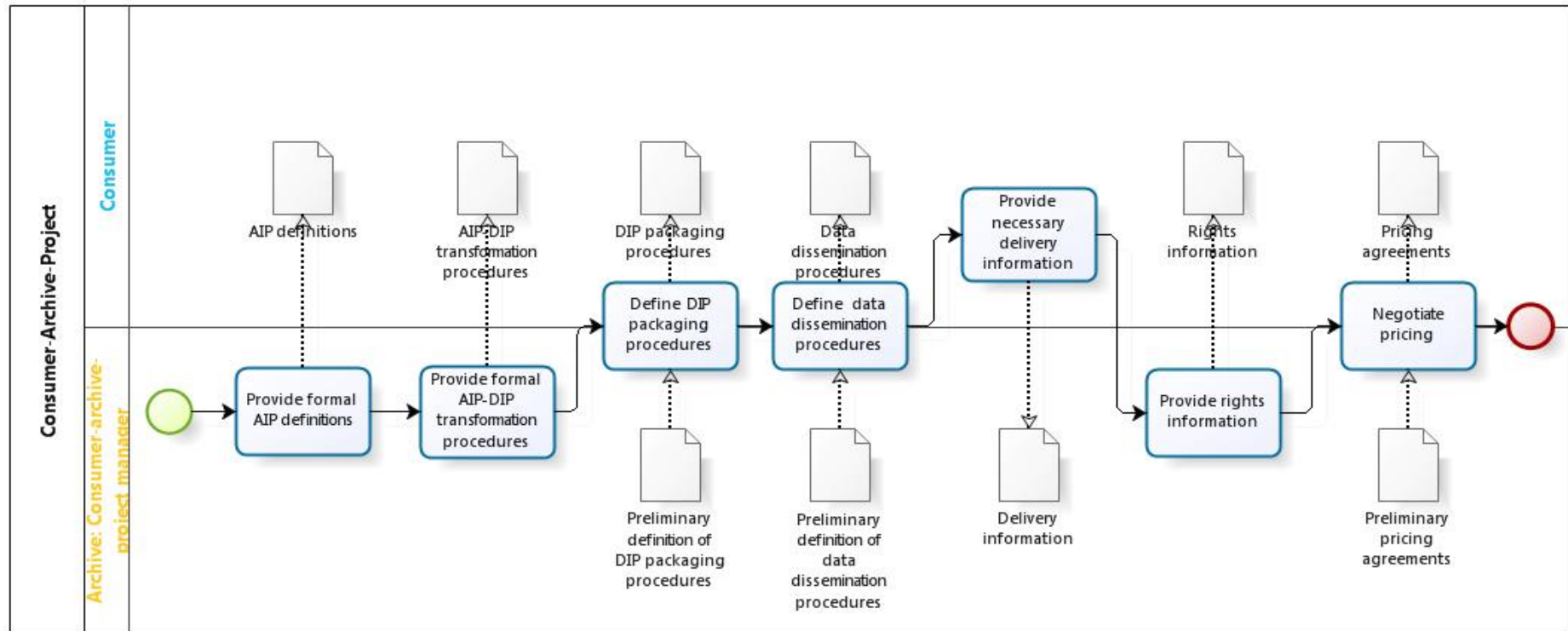
Actors

- *Consumer*
- *Archive: Consumer-Archive-project manager*

Resources

- *AIP* definitions
- *AIP-DIP* transformation procedures
- *DIP* packaging procedures (preliminary [see Consumer-Archive: Preliminary Negotiation] and final)
- Data dissemination procedures (preliminary [see Consumer-Archive: Preliminary Negotiation] and final)
- Delivery information

- Rights information
- Pricing agreements (preliminary [see Consumer-Archive: Preliminary Negotiation] and final)

Details**Figure 39: The process Consumer-Archive Formal Negotiation**

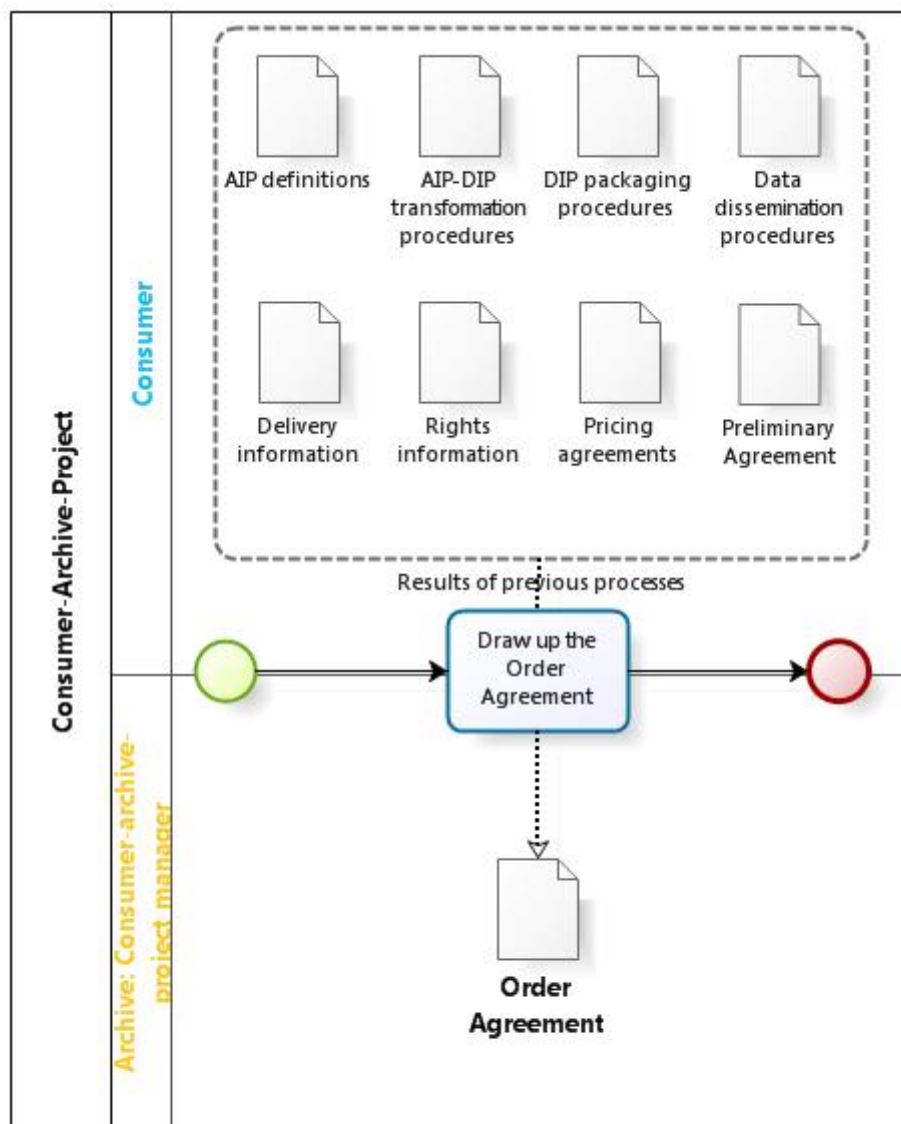
5.13. Order Agreement¹

Actors

- *Consumer*
- *Archive: Consumer-Archive-project manager*

Resources

- from previous processes (see Consumer-Archive: Preliminary Negotiation and Consumer-Archive: Establishment of a Preliminary Agreement):
 - *AIP* definitions
 - *AIP-DIP* transformation procedures
 - *DIP* packaging procedures
 - Data dissemination procedures
 - Delivery information
 - Rights information
 - Pricing agreements
 - Preliminary Agreement
- *Order Agreement*

Details**Figure 40: The process Order Agreement**

Remark:

There are further inputs to the *Order Agreement*, which have not been considered by [1], in particular schedule/quantities and Quality of Service (QoS) terms. This is also related to the establishment of Service Level Agreements (SLAs) between *Consumer* and *Archive*, which are discussed in the PrestoPRIME project deliverable D3.1.

6. Ingest

In the *Ingest Phase* content in the form of *SIPs* is placed into the *OAI/S*. This includes also the validation of the content and the generation of the *AIPs* and *Descriptive Information* to be archived. Figure 41 shows in detail which processes are involved in this phase.

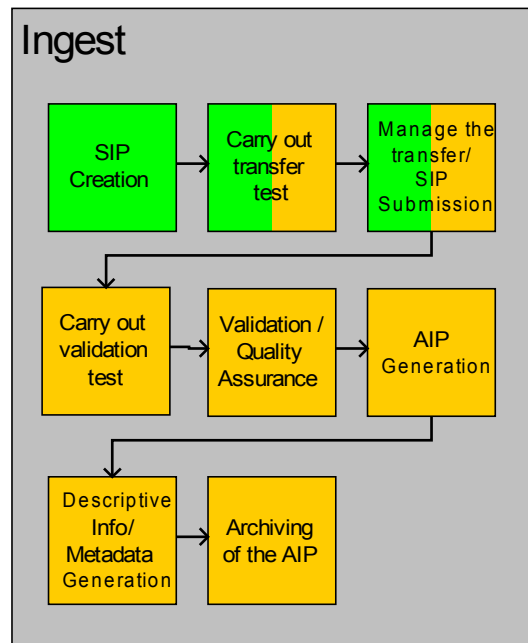


Figure 41: The processes of the Ingest Phase

6.1. *SIP Creation*¹

Actors

- *Producer*

Resources

- *Submission Agreement* (as established in process Submission Agreement)
- *Content information*
- *Preservation Description Information*
- *Packaging Information*
- *Package Description* information
- *SIP*

Details

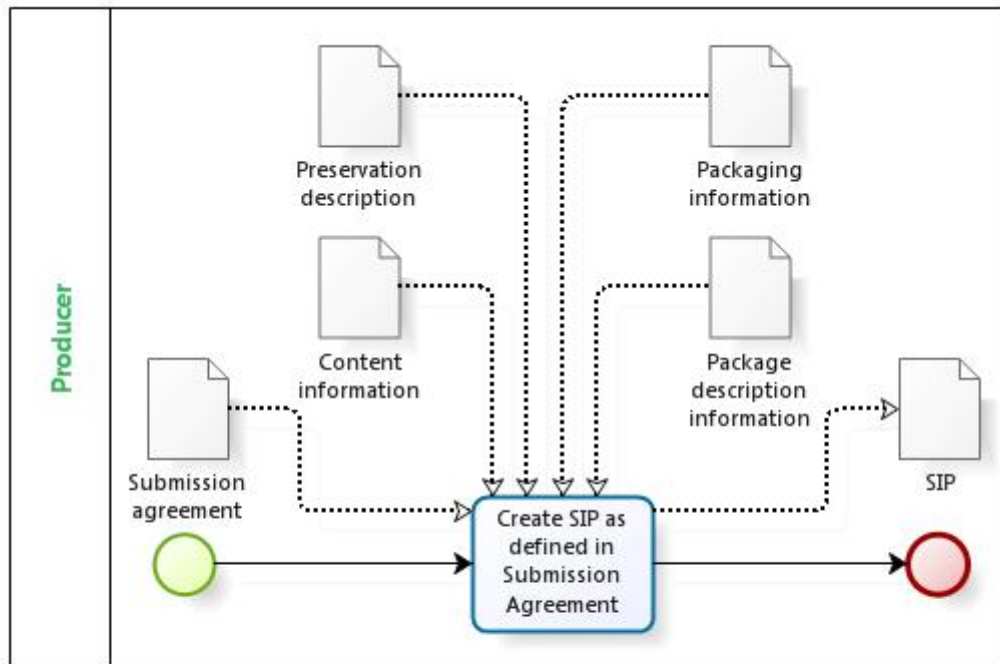


Figure 42: The process SIP Creation

As a note, PrestoPRIME is doing considerable work on what a SIP means in the context of AV content. This section will be updated to explode the simple process above into the multiple stages needed in practice for AV SIP creation.

6.2. Carry Out Transfer Test²

Actors

- *Producer*
- *Archive*

Resources

- Test data
- Operating parameters
- Test results
- *Submission Agreement* (as established in process Submission Agreement)

Details

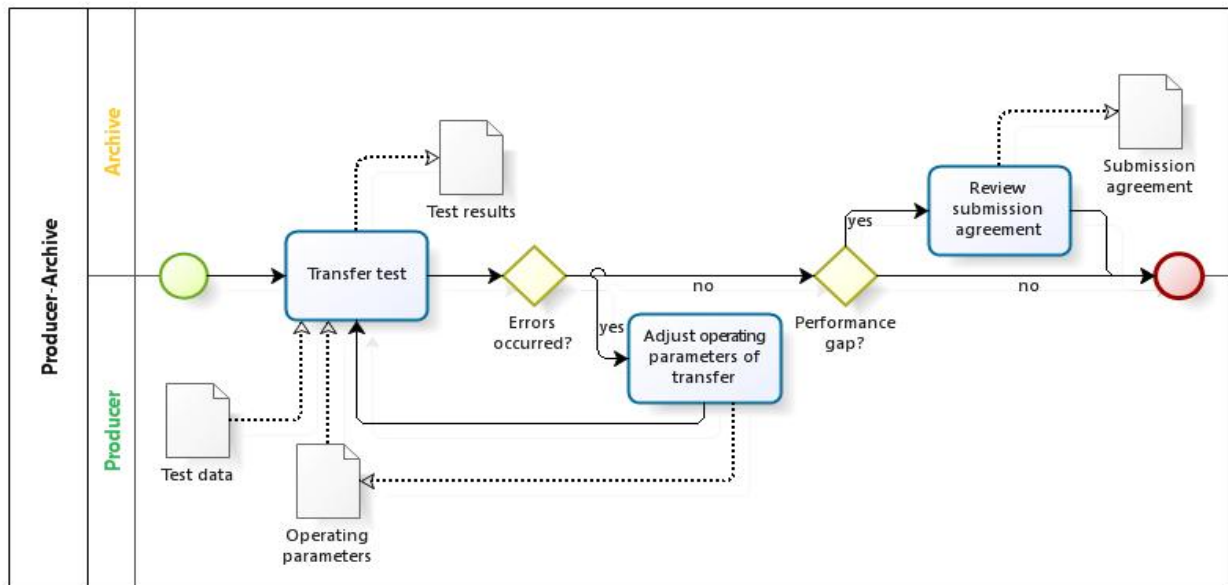


Figure 43: The process Carry Out Transfer Test

To ensure full agreement on both sides, some initial submissions should be performed on the 'test data' before the beginning of the data delivery. After these tests have been carried out, the anomalies arising must be corrected and the operating parameters of the transfer must be adjusted. It can then be determined whether the differences between the performance shown and the expected performance require a review of the agreement or the schedule.

(A test transfer may not be necessary for each new *Submission Agreement*. The *Archives* may not require a test transfer from a *Producer* with which the *Archive* has a good working relationship and has had no prior transfer or data validation problems.)

All of these tests must be carried out before the start-up of the actual transfer operations.

6.3. Manage the Transfer²/SIP Submission¹

Actors

- *Producer*
- *Archive*

Resources

- Transmission timetable
- Formally agreed submission procedures
- *SIPs*

Details

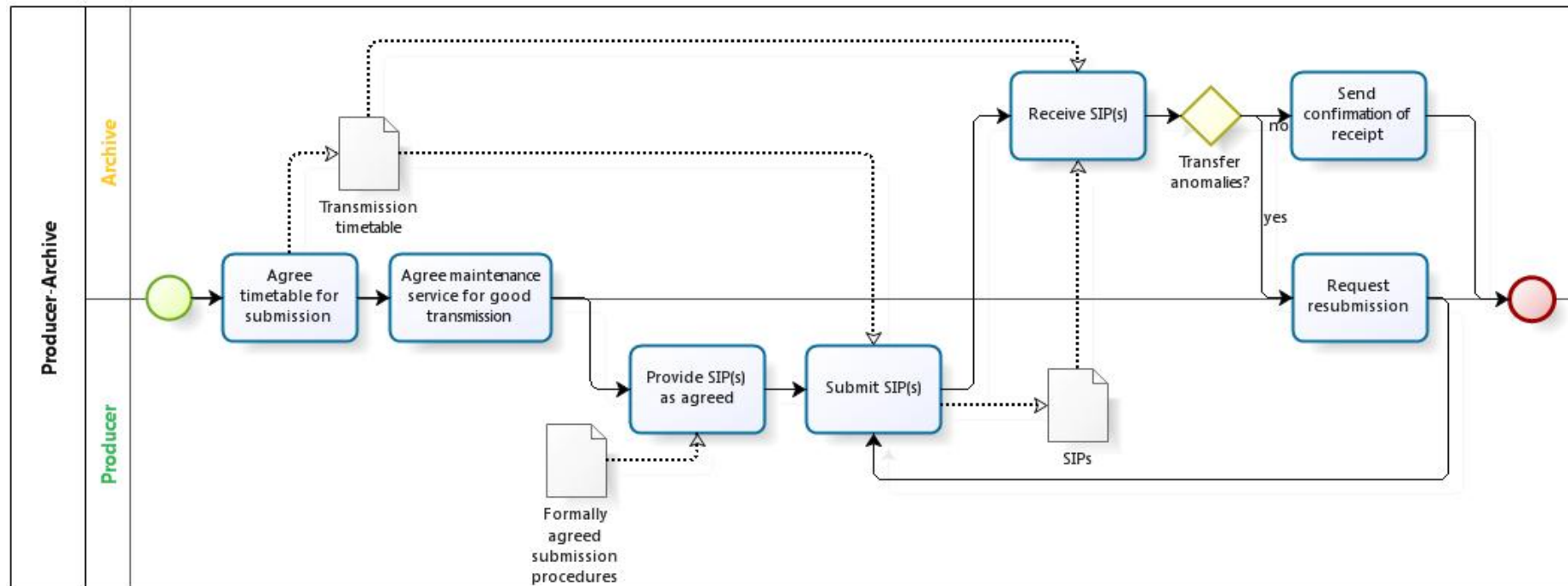


Figure 44: The process Manage the Transfer/SIP Submission

6.4. Carry Out Validation Test²

Actors

- Archive

Resources

- Test data
- Test plan
- (Information categories)

Details

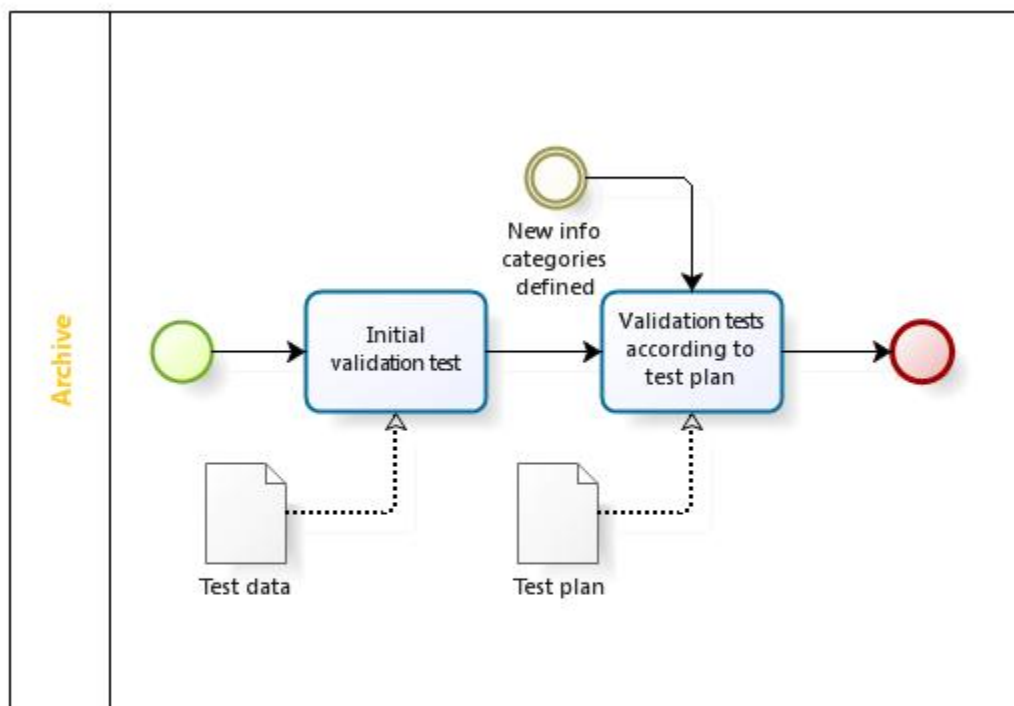


Figure 45: The process Carry Out Validation Test

6.5. Manage the Validation² / Quality Assurance^{1,4}

Remark: There are two different process diagrams according to different sources since it would not have made sense to merge them into one diagram.

Actors

- Archive

Resources

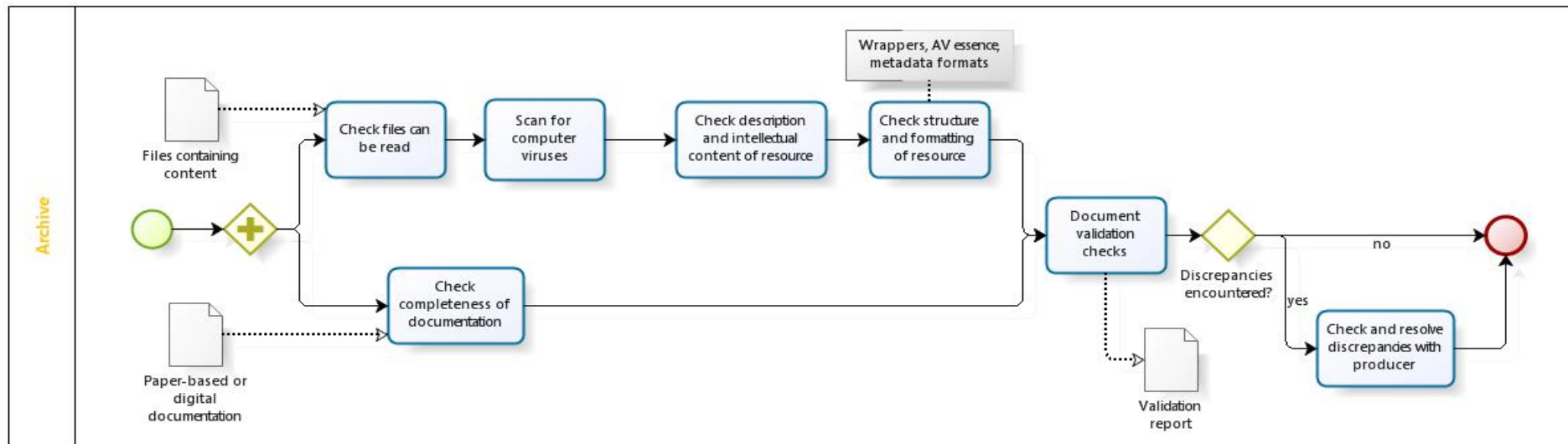
In the process according to [4]:

- Files containing content
- Paper-based or digital documentation

- Validation report

In the process according to [2]:

- Systematic validation plan
- In-depth validation plan
- Acceptance acknowledgement
- Irregularity form
- Anomaly form

Details**Figure 46: The process Validation / Quality Assurance (according to [4])**

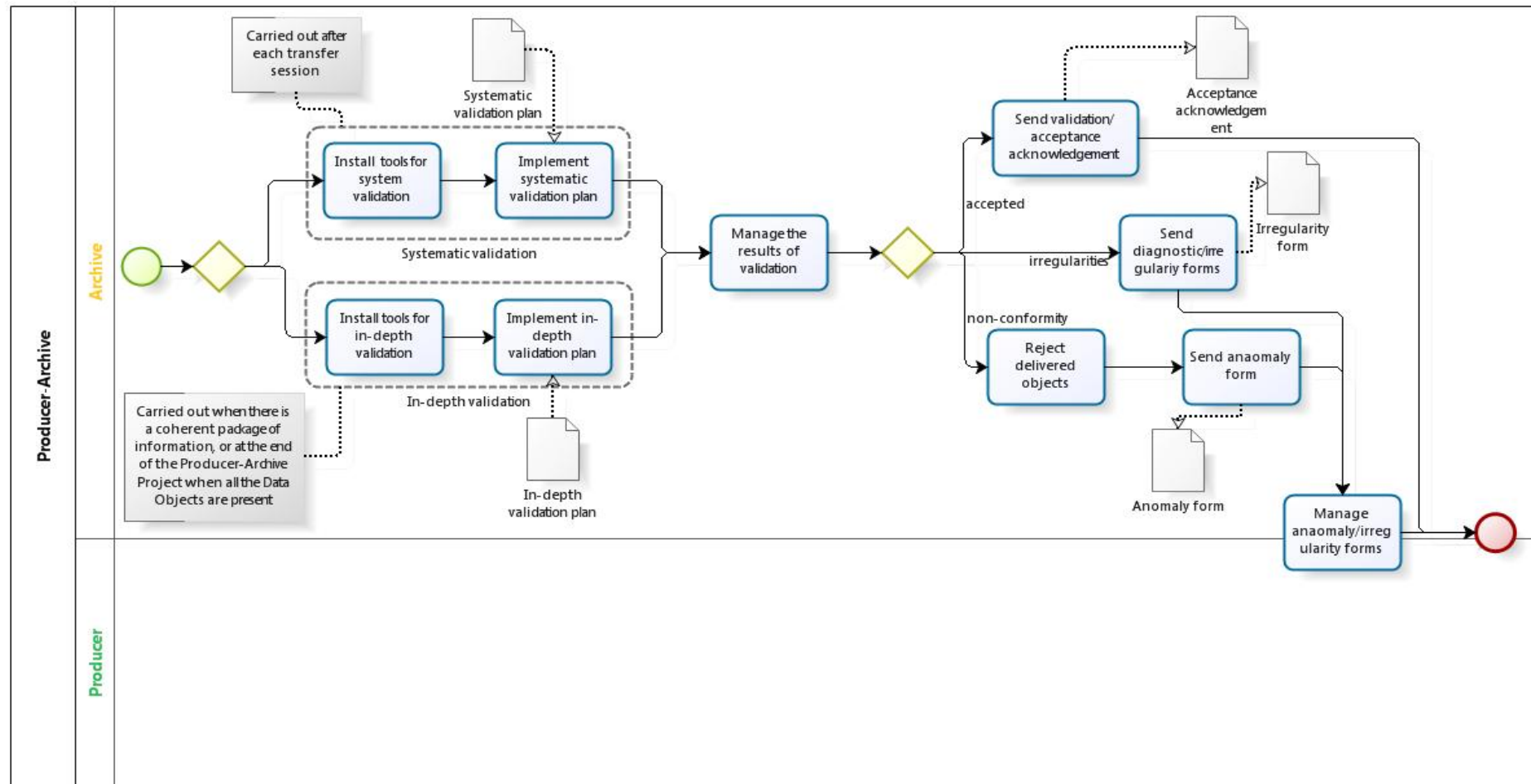


Figure 47: The process Validation / Quality Assurance (according to [2])

6.6. AIP Generation¹

Actors

- *Archive*

Resources

- *SIPs*
- *AIPs*
- *Audit report*

Details

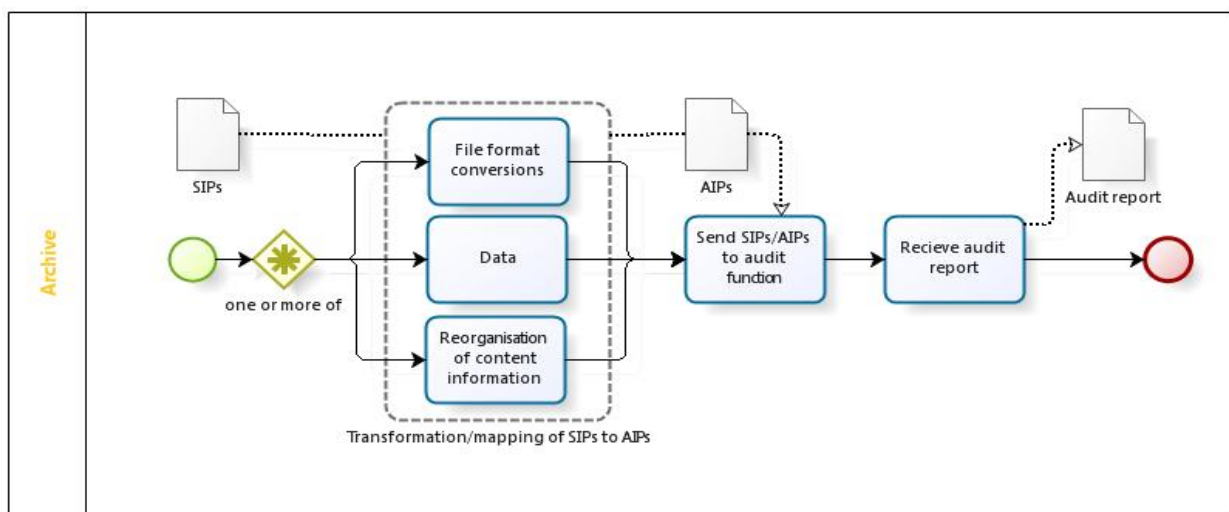


Figure 48: The process AIP Generation

Remark:

The diagram shows the process of *AIP* Generation when the decisions which file format to use and how to map an *SIP* to an *AIP* have already been made. These decisions are part of the file format migration process of chapter Video File Format Migration.

6.7. Descriptive Information/Metadata Generation¹

Actors

- *Archive*

Resources

- *AIPs*
- *Descriptive Information*

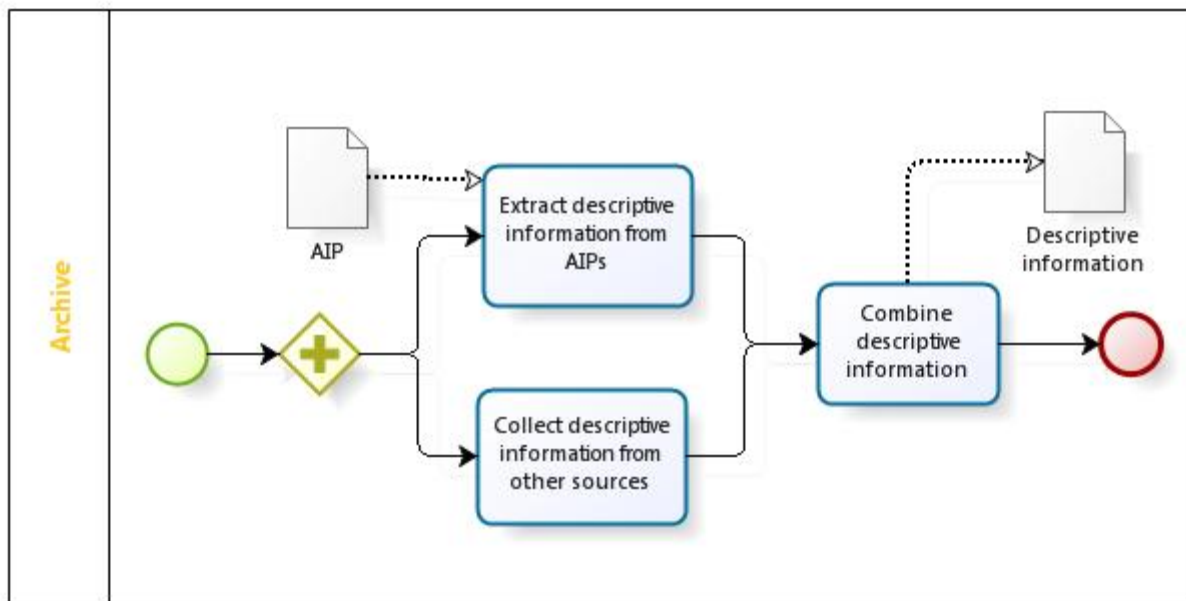
Details

Figure 49: The process Descriptive Information/Metadata Generation

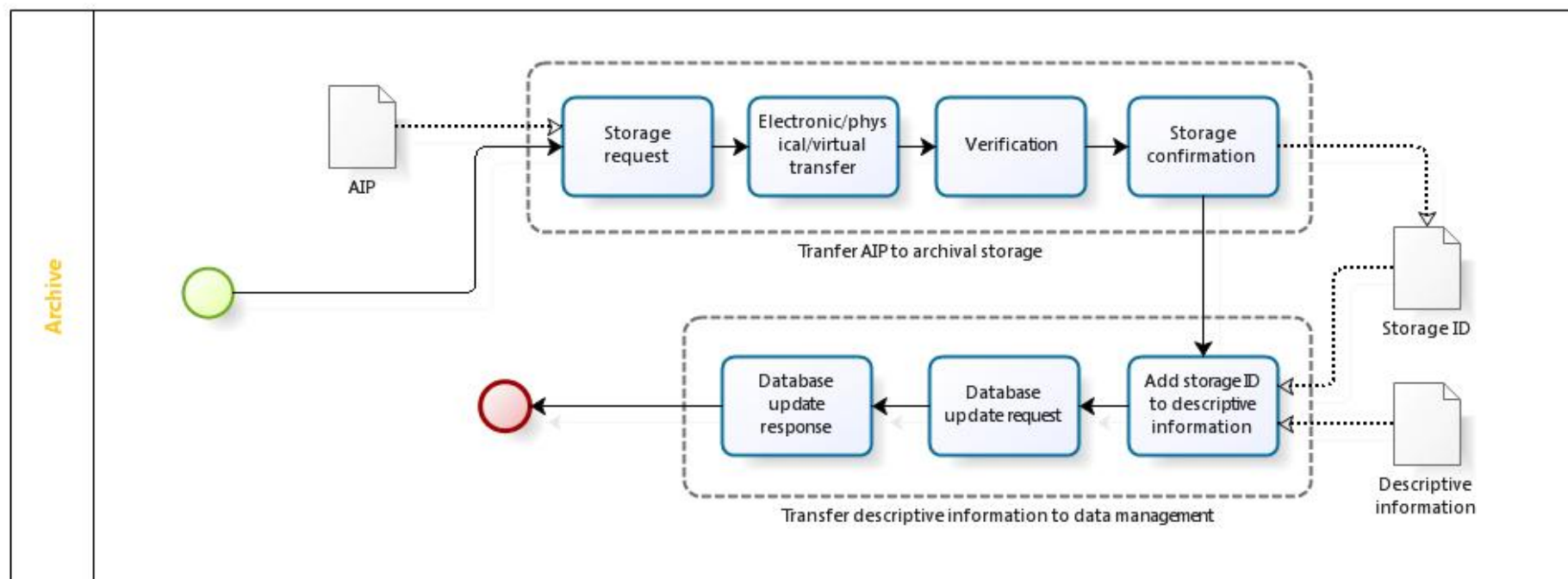
6.8. Archiving of the AIP¹

Actors

- *Archive*

Resources

- *AIP*
- *Storage ID*
- *Descriptive Information*

Details**Figure 50: The process Archiving of the AIP**

7. Preservation

When content is preserved there are processes that must be undertaken to ensure that it remains useful. These processes are part of the *Preservation Phase*. As already mentioned activities of Preservation Planning, Data Management and Archival Storage are also included in this phase. Figure 51 shows in detail which processes have to be carried out.

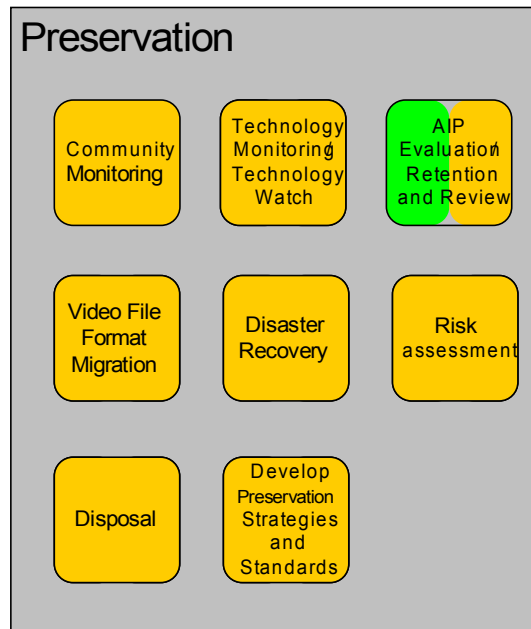


Figure 51: The processes of the Preservation Phase

7.1. Community Monitoring¹

Actors

- Archive

Resources

- Community Monitoring results

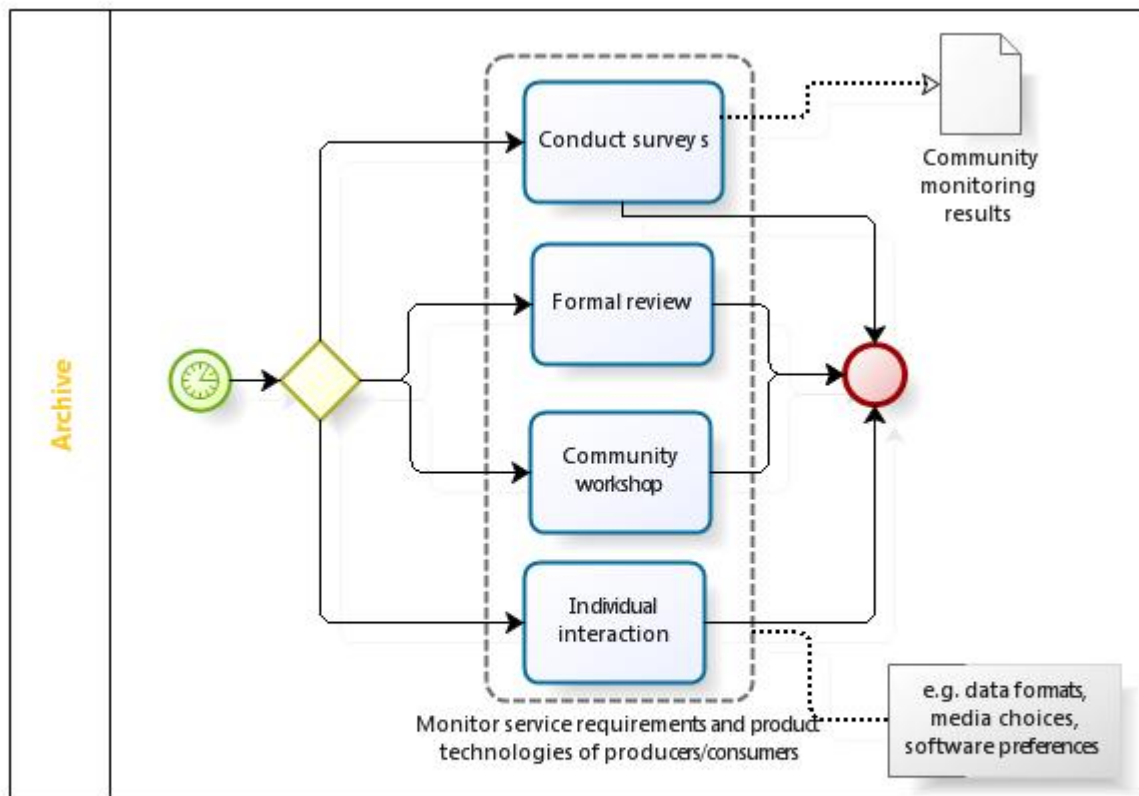
Details

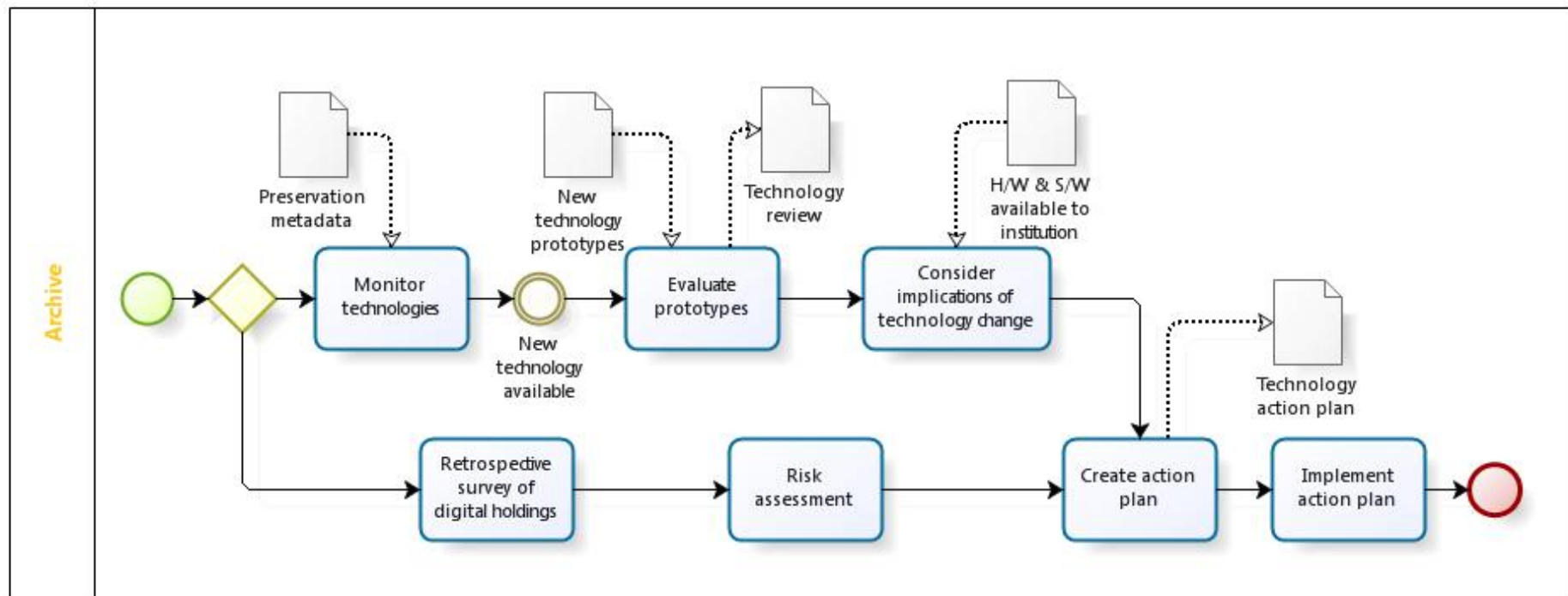
Figure 52: The process Community Monitoring

7.2. Technology Monitoring¹/Technology Watch⁴**Actors**

- *Archive*

Resources

- Preservation metadata
- New technology prototypes
- Technology review
- Hardware and software available to institution
- Technology action plan

Details**Figure 53: The process Technology Monitoring**

7.3. AIP Evaluation/ Retention and Review⁴

Actors

- Archive

Resources

- AIPs
- Evaluation and selection criteria
- Retention strategy

Details

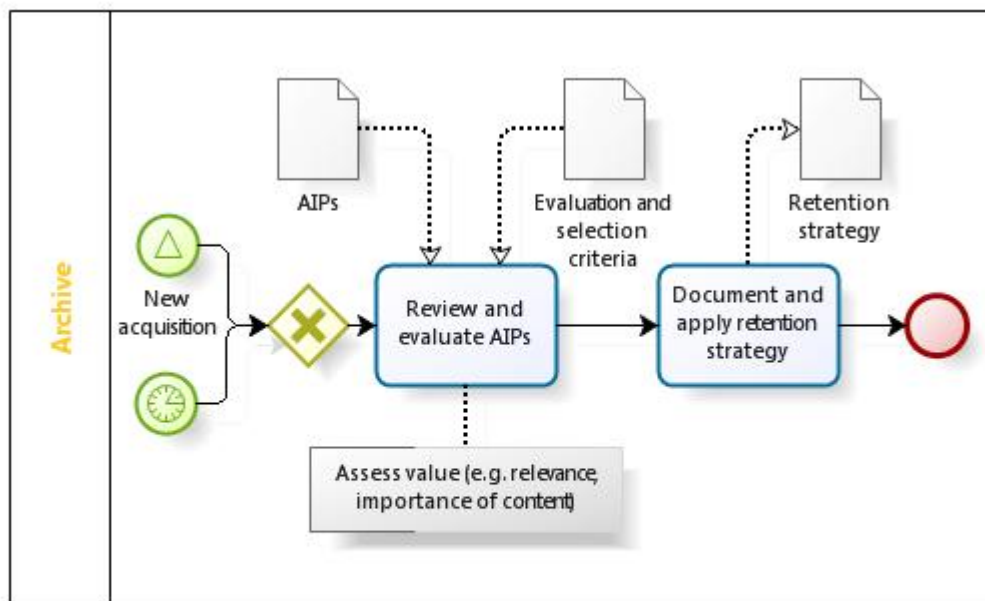


Figure 54: The process AIP Evaluation/ Retention and Review

7.4. Video File Format Migration

Actors

- Archive

Resources

- Essence
- Technical metadata

Details

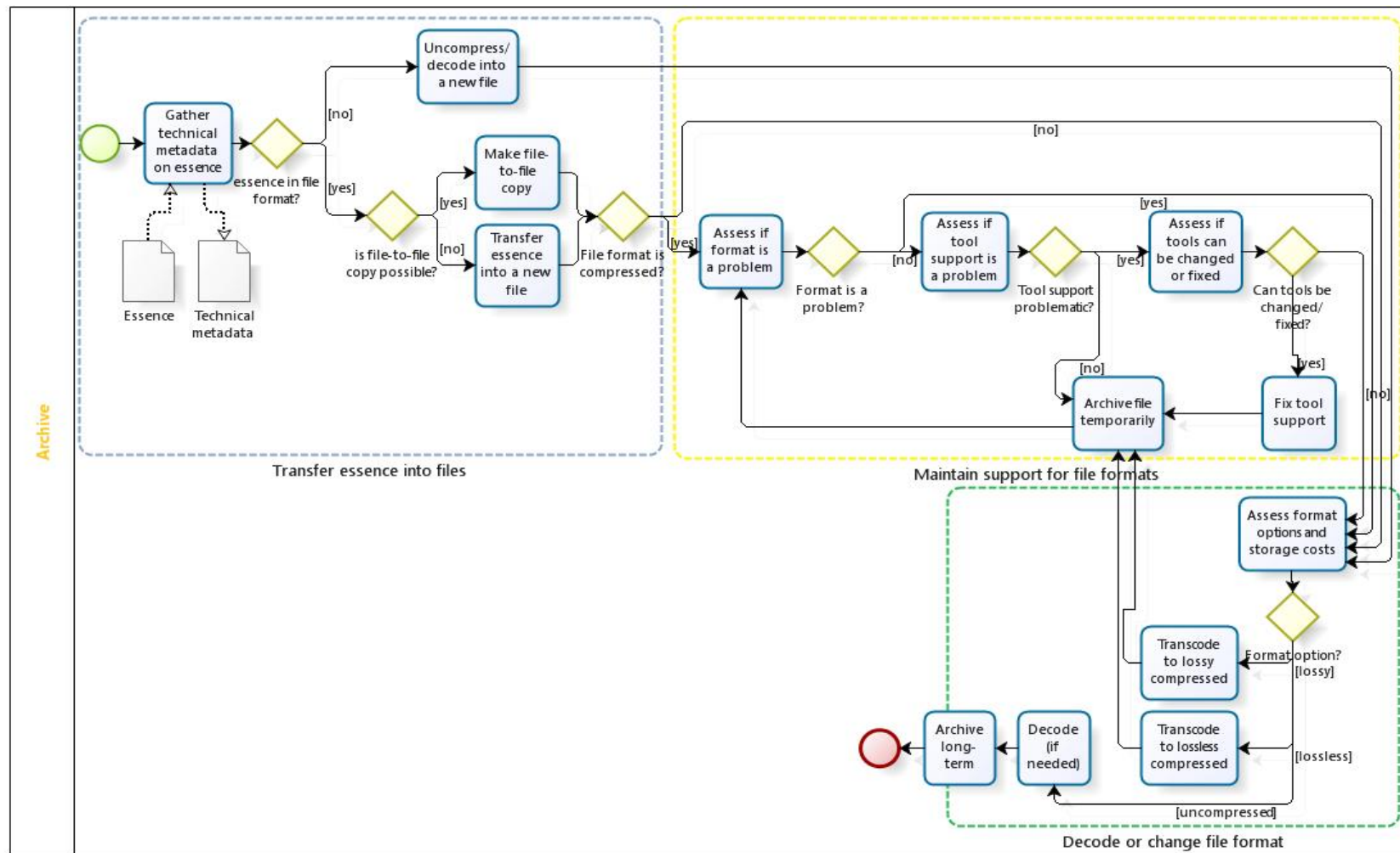


Figure 55: The process Video File Format Migration

The diagram models preservation of video essence where migration takes place between file formats. It is assumed that any corresponding audio will be stored uncompressed from the outset and hence no format migrations are needed.

The process described in is extracted from PrestoPRIME D2.1.1 as an example of how the 'devil is in the detail' in many case for AV preservation. What is conceptually simple from a generic preservation standpoint (a file format needs migrating) can have major implications and complex process when applied to AV materials.

The diagram shows only the migration between file formats. However migration can also take place between wrappers, media, storage systems and there is the possibility of a multivalent approach. For more details see PrestoPRIME project deliverable D2.1.1.

7.5. Disaster Recovery¹

Actors

- Archive

Resources

- Disaster recovery policy (as determined by the process Disaster Recovery Planning)

Details

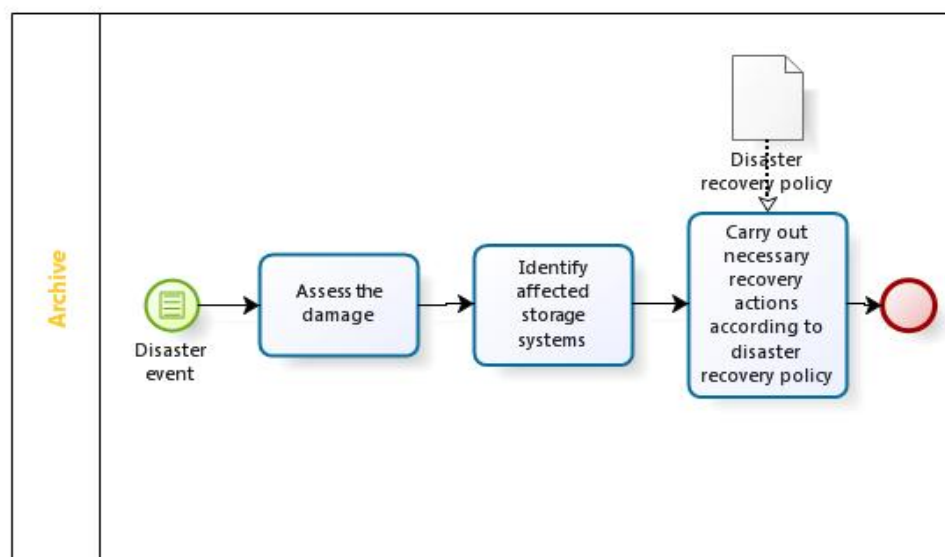


Figure 56: The process Disaster Recovery

7.6. Risk Assessment⁵

Actors

- Archive

Resources

- Organisational context definition

- Policy and regulatory framework documentation
- List of activities, assets and owners
- Risk register
- Risk assessment
- Risk acceptance and prevention/migration strategy
- Preservation strategy

Details

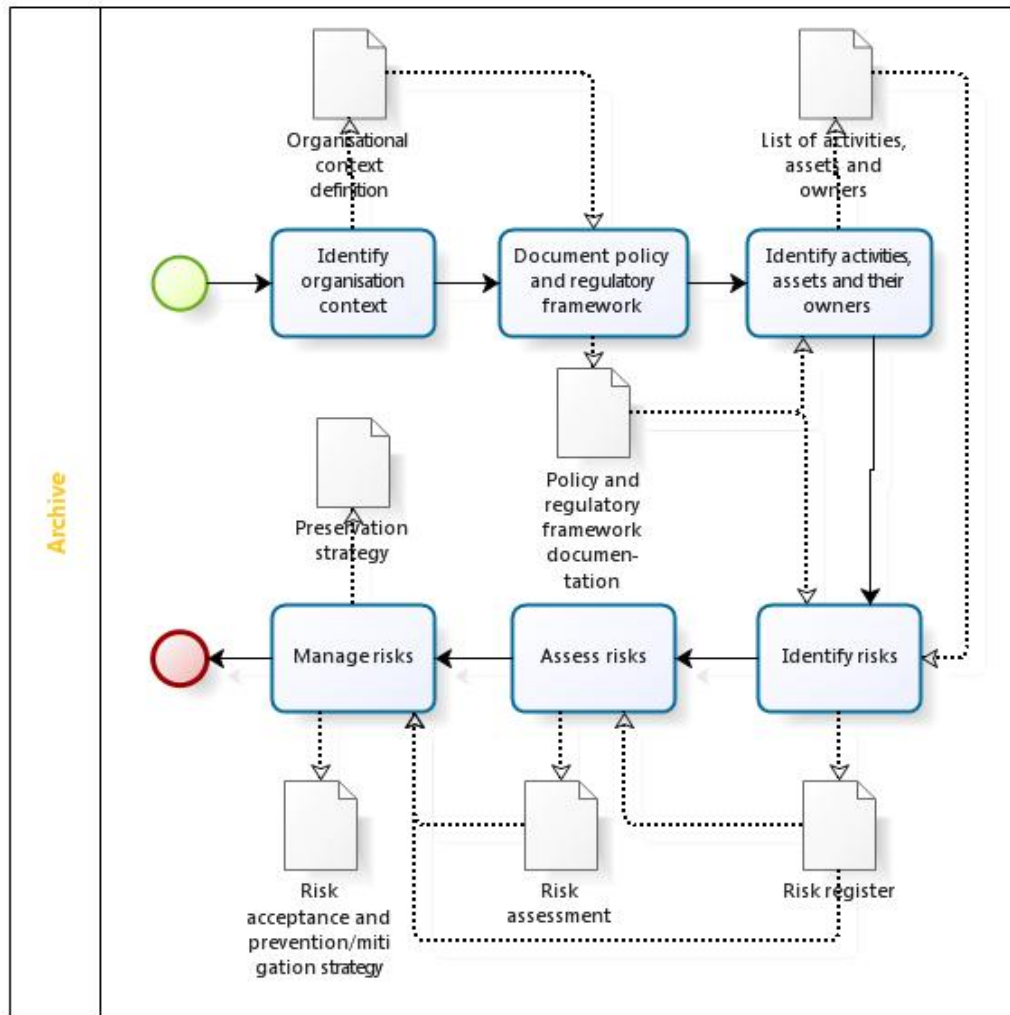


Figure 57: The process Risk Assessment

7.7. Disposal

Actors

- Archive

Resources

- Disposal policy
- the content/file

- the media

Details

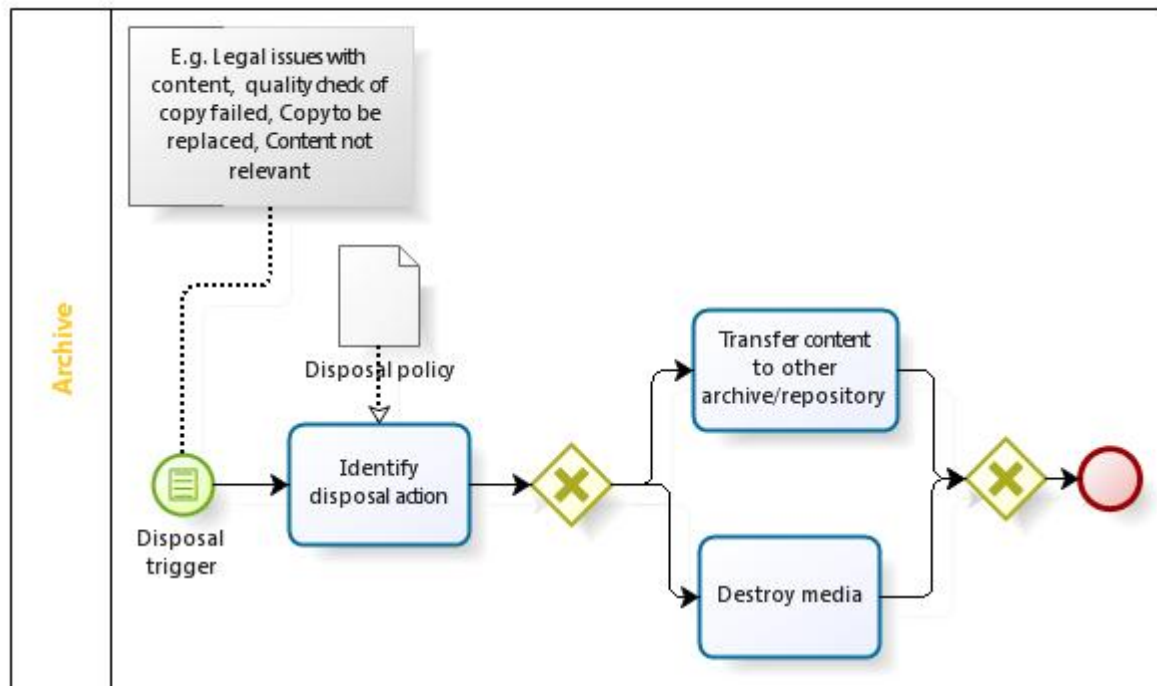


Figure 58: The process Disposal

7.8. Develop Preservation Strategies and Standards^{1,3}

Actors

- Archive

Resources

- Alerts (as process triggers):
 - New file format alert
 - New requirement alert
 - Revision alert
- Policy framework
- Collection profile
- Usage requirements
- Available tools, formats, technologies
- Alternatives definition
- Experiment plan
- Experiment results
- Preservation action recommendation
- Preservation plan

Details

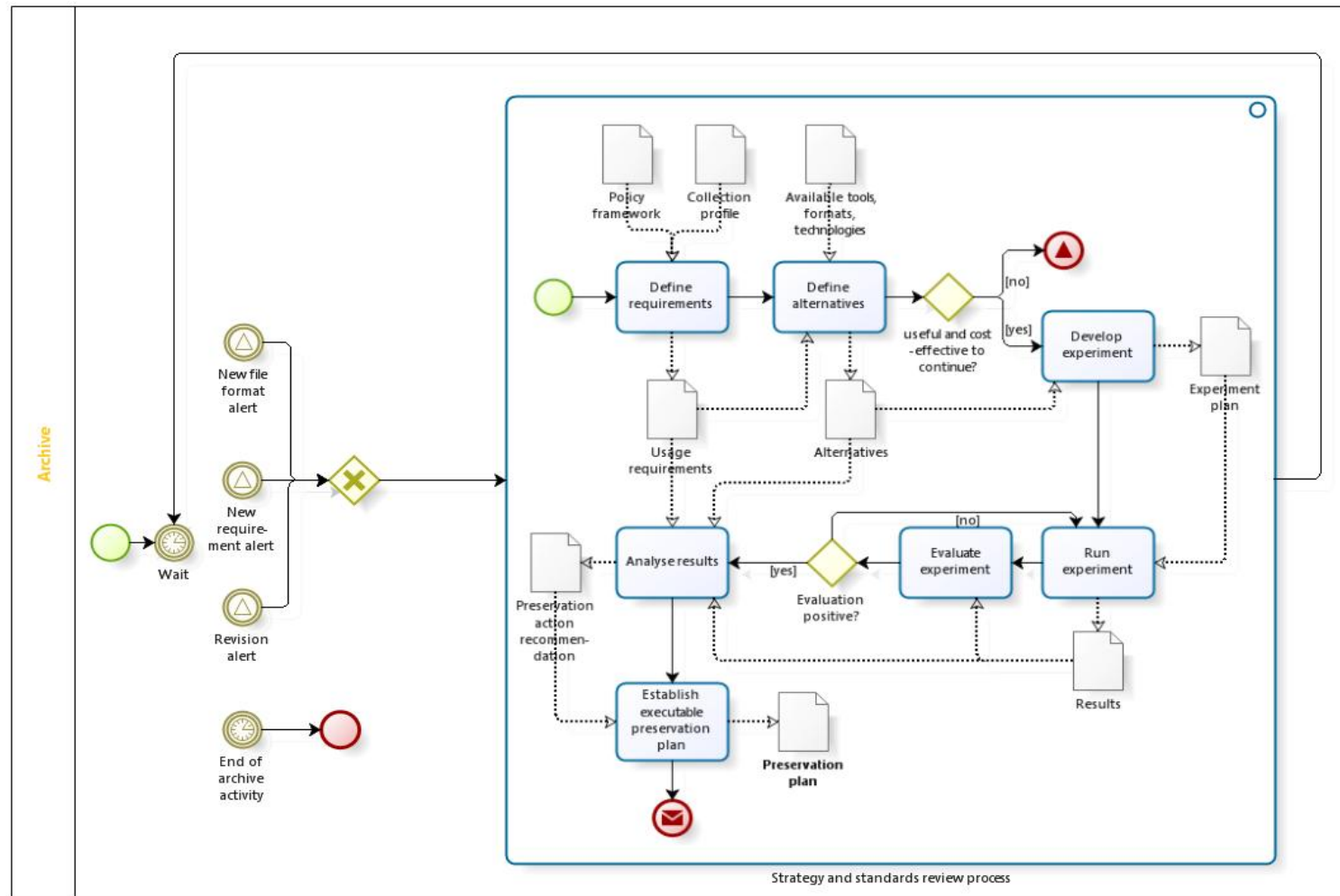


Figure 59: The process Develop Preservation Strategies and Standards

Remark on how to read the diagram:

The process begins with waiting for one of three possible trigger events (alerts), which all trigger the sub-process “Strategy and Standards review process”. The sub-process will either return a signal to indicate that a strategy change would not be feasible, or a message with the newly developed preservation plan. Either way, when the sub-process is finished, the sequence flow will redirect to the “Wait” timer. Consequently a new alert could trigger another execution of the sub-process, and so on. The process is finished when the *Archive* stops its activity.

8. Access

When the *Consumer* accesses content, their requests must be handled and the archived *AIPs* have to be transformed into *DIPs*. Figure 60 shows which processes are part of the *Access Phase*.

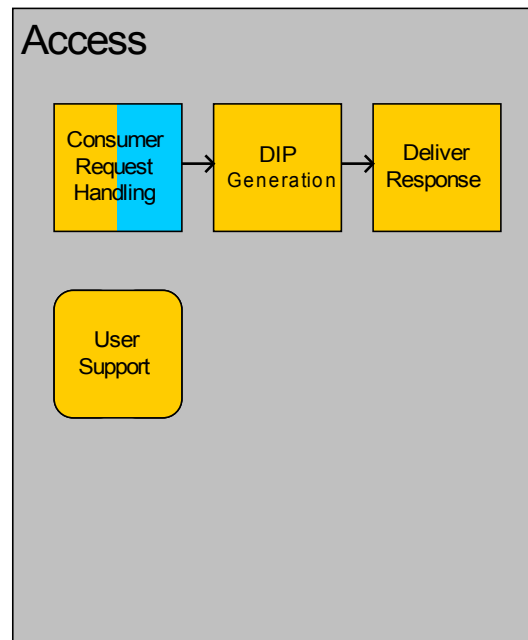


Figure 60: The processes of the Access Phase

8.1. *Consumer Request Handling*¹

Actors

- *Archive*
- *Consumer*

Resources

- Request
- Response

Details

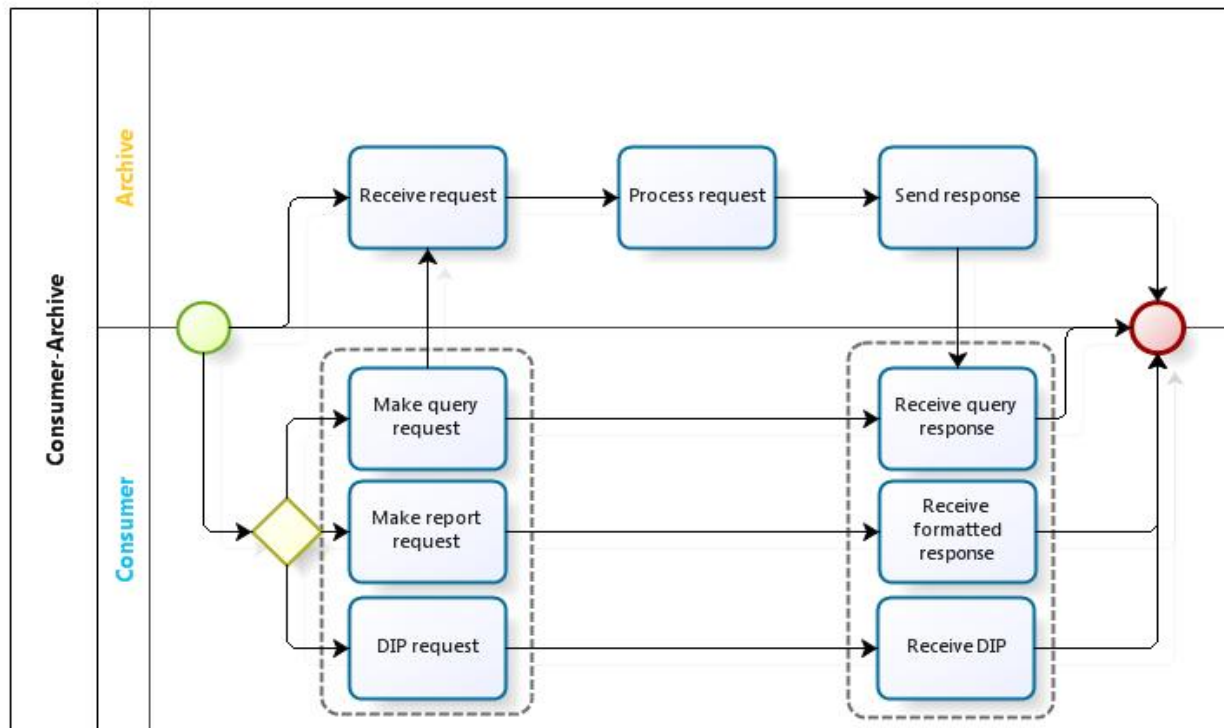


Figure 61: The process Consumer Request Handling

8.2. DIP Generation¹

Actors

- *Archive*

Resources

- Dissemination request
- *AIP*
- *Descriptive Information*
- *DIP*

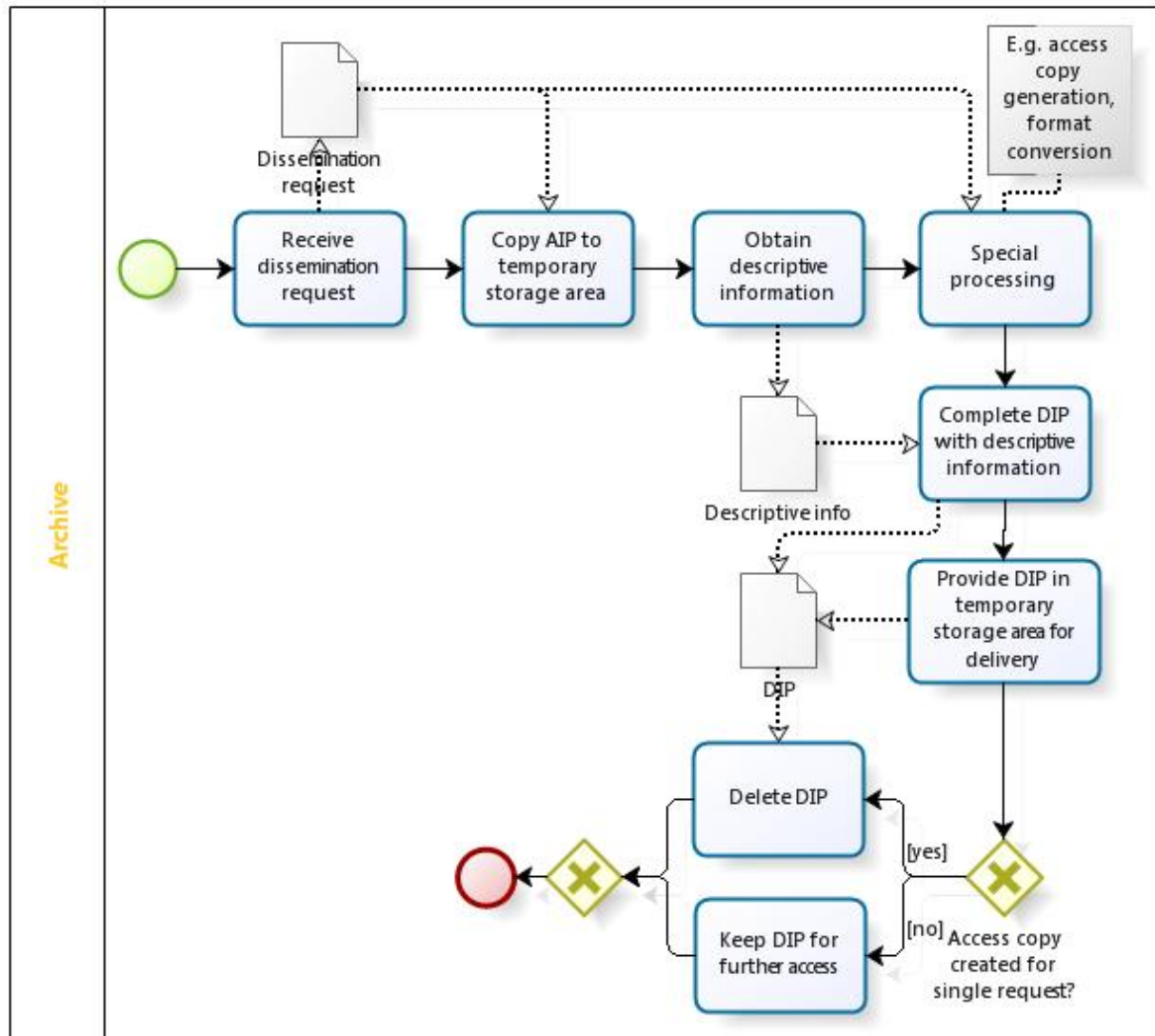
Details

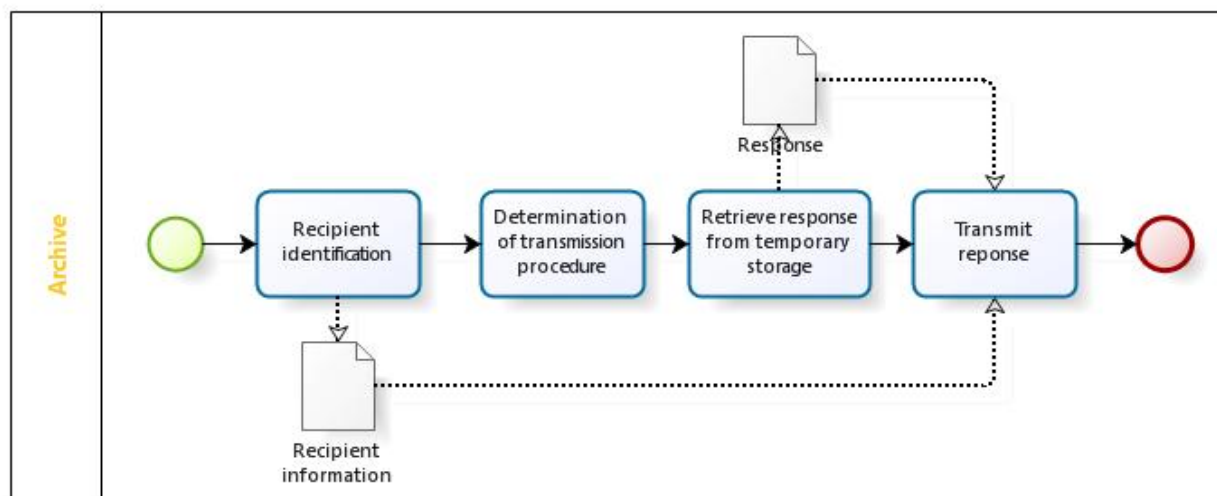
Figure 62: The process DIP Generation

8.3. Deliver Response¹**Actors**

- Archive

Resources

- Recipient information
- Response

Details**Figure 63: The process Deliver Response****8.4. User Support⁸****Actors**

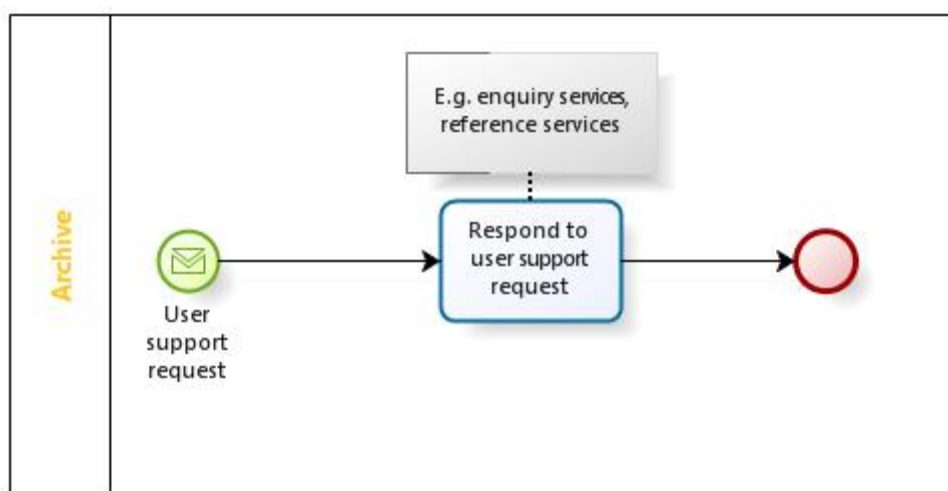
- Archive

Resources

none

Details

Any activity covered under enquiry services, reference services and user support under correspondence (telephone, email, etc).

**Figure 64: The process User Support**

9. Administration

There are various administrative processes to be carried out in order to create and maintain an OA/IS. Figure 65 shows which processes and activities exactly are part of the *Administration Phase*.

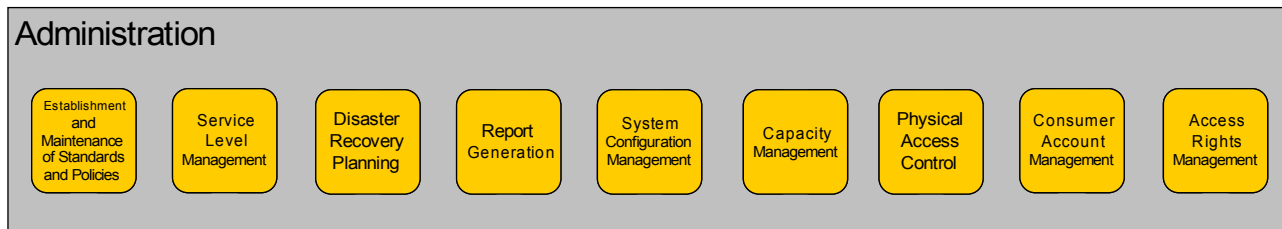


Figure 65: The processes of the Administration Phase

9.1. *Establishment and Maintenance of Standards and Policies*¹

Actors

- *Archive*

Resources

- Budget information
- Policies (input), e.g. OA/IS charter, scope, resource utilization guidelines, and pricing policies
- Standards:
 - Format standards
 - Documentation standards
 - Approved preservation standards
 - Migration goals
- Policies (output):
 - *Ingest* procedures
 - Storage management policies (migration and database administration policies)
 - Disaster recovery policies
 - Security policies (physical access control)
- Recommendations for *Archive* system enhancement
- Proposals for new *Archive* data standards
- Periodic risk analysis reports
- Performance information
- Inventories
- Periodic management reports

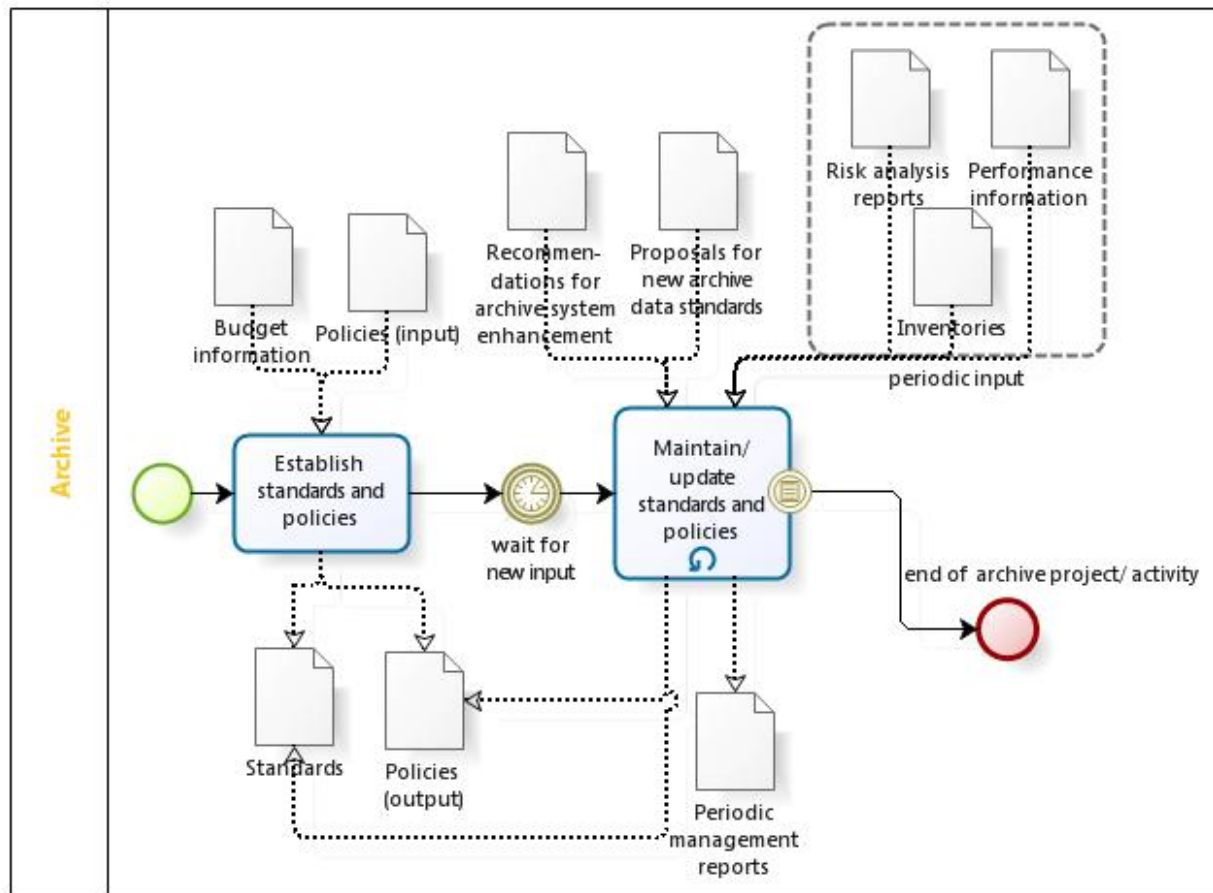
Details

Figure 66: The process Establishment and Maintenance of Standards and Policies

9.2. Service Level Management⁶**Actors**

- *Archive*

Resources

- IT services definition
- IT service requirements
- IT service catalogue
- Service Level Agreements (SLAs)
- Operational Level Agreements (OLAs)
- Underpinning Contract service requirements (UCs)
- Service improvement recommendations
- Management information

Details

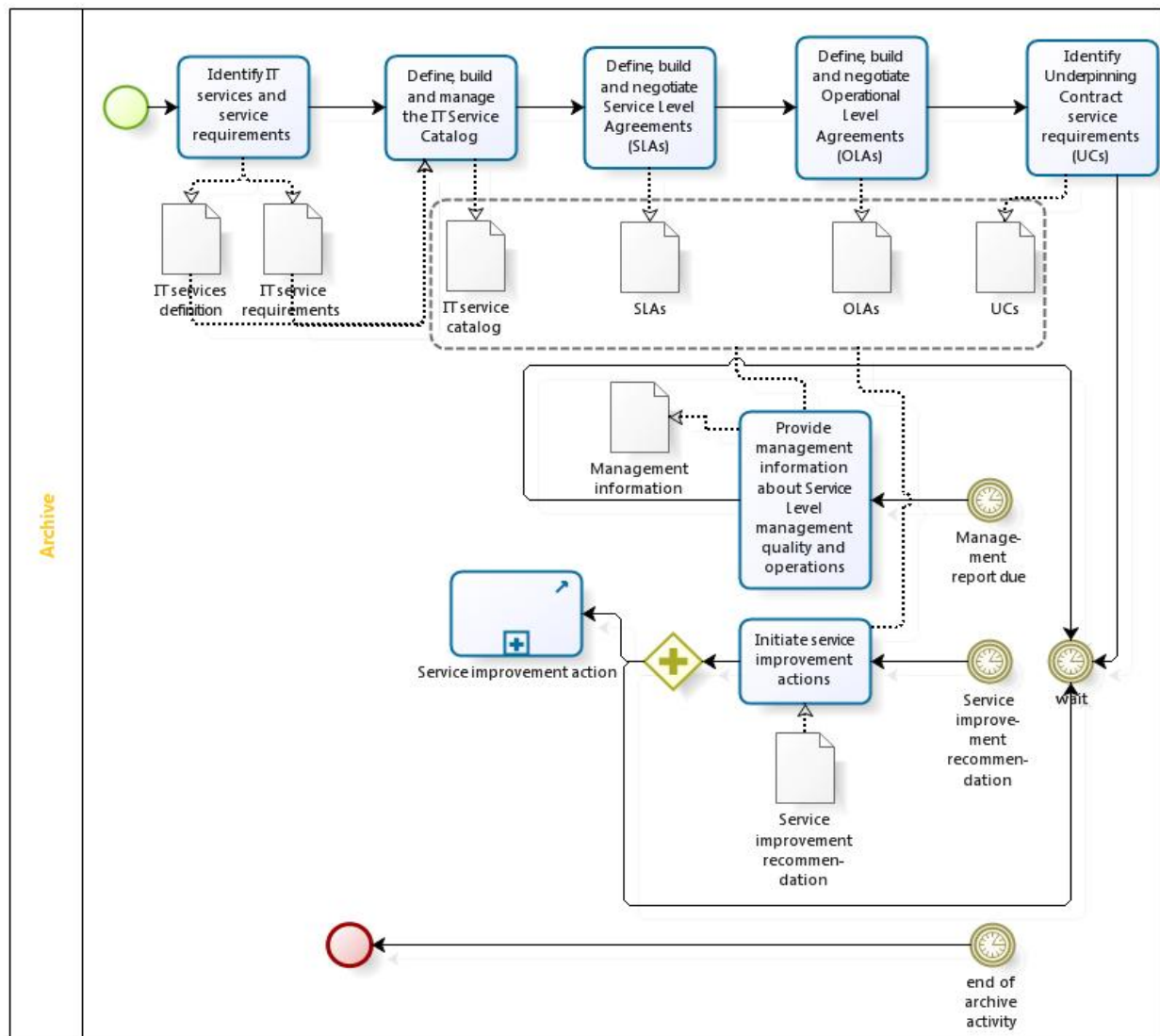


Figure 67: The process Service Level Management

Remark on how to read the diagram:

The first five activities concerned with the establishment of the IT service catalogue, the SLAs, OLAs and UCs are to be seen as initial activities. The subsequent timer event indicates that some time passes and the process waits until one of three possible events happen:

- the next management report is due (periodical report): information on service level quality and operations will be extracted from the IT service catalogue, the SLAs, OLAs and UCs and will be provided for the management. Then the sequence flow redirects to the “Wait”-timer, indicating that the process goes on and the activity can be repeated.
- a service improvement recommendation has been received (e.g. from the management): Service improvement actions will be initiated, followed by a parallel split of the sequence flow. One arrow directs to the reference process of the service improvement action, which will have been defined by the previous activity. The

other arrow redirects to the “Wait”-timer, to indicate that the process goes on and the activity can be repeated.

- the *Archive* stops its activities one day and the process is finished.

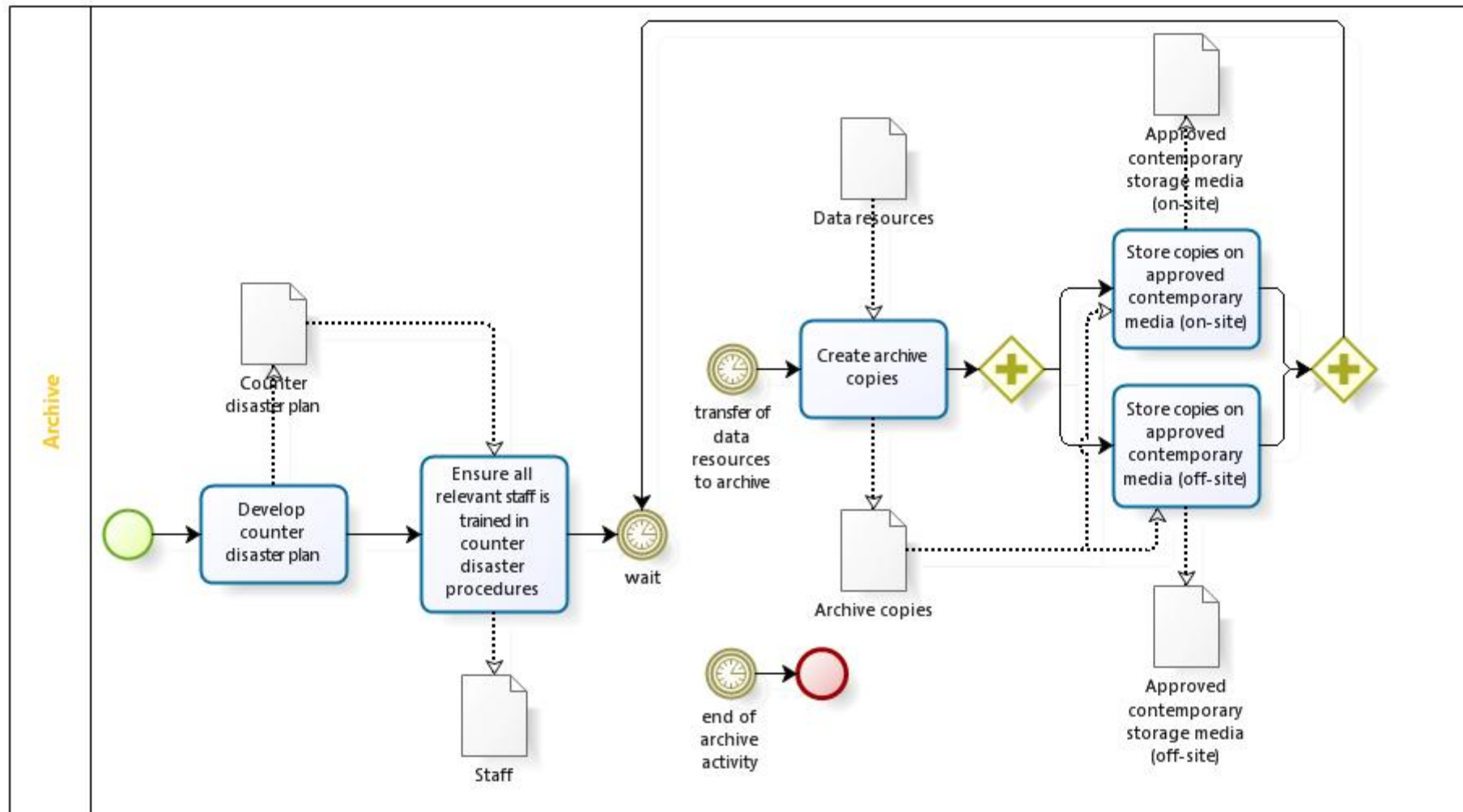
9.3. *Disaster Recovery Planning*⁴

Actors

- *Archive*

Resources

- Counter disaster plan
- *Archive* staff
- Data resources
- *Archive* copies
- Approved contemporary storage media (on-site)
- Approved contemporary storage media (off-site)

Details**Figure 68: The process Disaster Recovery Planning**

Remark on how to read the diagram:

The first two activities “Develop counter disaster plan” and “Ensure all relevant staff is trained in counter disaster procedures” are to be seen as initial activities. Then the process stays inactive (waits) until data resources are transferred to the *Archive* and subsequently further actions are carried out. This event can happen more than once, which is why the sequence flow redirects to the “Wait”-timer. The process will only end, when the *Archive* stops its activities.

9.4. Report Generation¹

Actors

- *Archive*

Resources

- Report request
- Report query
- Result set

Details

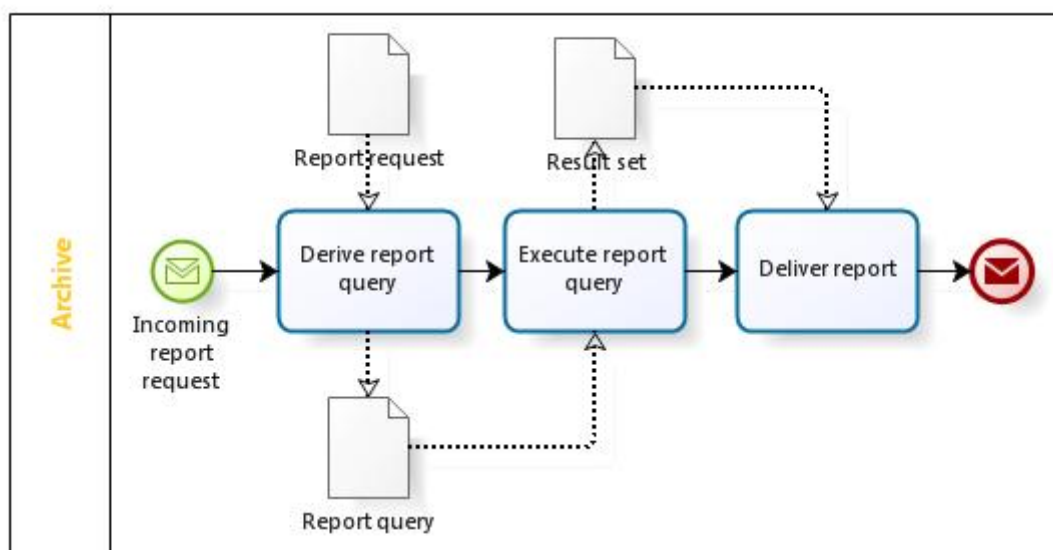


Figure 69: The process Report Generation

Typical report contents can be:

- *Archive* holdings summary
- Usage statistics
- *AIP* descriptive info

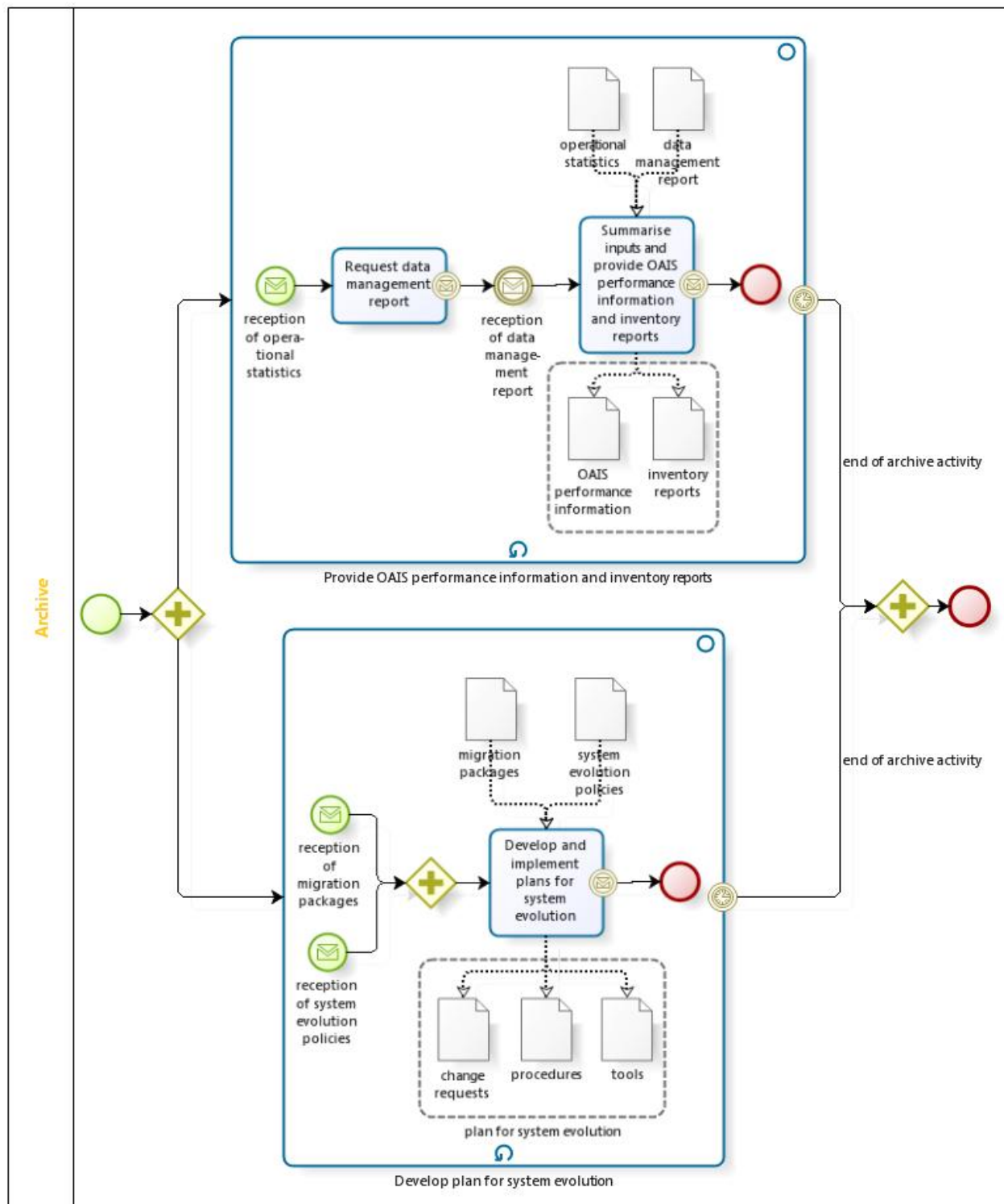
9.5. System Configuration Management¹

Actors

- *Archive*

Resources

- Operational statistics
- Data management reports
- OA/S performance information
- Inventory reports
- Migration packages
- System evolution policies
- Plans for system evolution, including:
 - Change requests
 - Procedures
 - Tools

Details**Figure 70: The process System Configuration Management**

Remark on how to read the diagram:

The process consists of two sub-activities, which are carried out parallel and independently. Both activities are periodic activities; this is indicated through the loop signs on the sub-process-frames. Both activities are interrupted at the same time when the *Archive* terminates its activities and the process ends.

9.6. Further Administrative Activities

There are some activities, which comprise an actual process but several sub-activities that are rather carried regularly or continuously.

Capacity Management⁶

Actors

- *Archive*

Resources

- Capacity plans
- Capacity management reports
- Capacity resources

Details

Key Activities:

- Perform demand management for business, service and resource capacity activities
- Perform modelling for business, service and resource capacity activities
- Provide application sizing for business, service and resource capacity activities
- Provide capacity plans for business, service and resource capacity activities
- Perform capacity monitoring, analysis and tuning activities
- Implement capacity-related changes
- Control storage of capacity data for capacity activities
- Provide management information about Capacity management quality and operations.

Physical Access Control¹

Actors

- *Archive*

Resources

- *Archive* policy for physical access control
- Further resources depend on the policy

Details

Mechanisms to restrict or allow physical access (doors, locks, guards) to elements of the *Archive*, as determined by *Archive* policies (see chapter 9.1).

Consumer Account Management¹

Actors

- *Archive*

Resources

- *Consumer* accounts
- Accounts policy

Details

Create, maintain and delete *Consumer* accounts.

Access Rights Management

This section is provided as a placeholder for work that is currently under development in PrestoPRIME on audiovisual rights management. Rights and the enforcement of rights is a complex area that will be included in updates to this report.

10. Workflow Languages

The focus of this report has mostly been on a consistent, unambiguous and graphical (human understandable) description of a wide range of preservation processes. As noted earlier, the ability to also have a ‘machine readable’ form is useful where attempts will be made to build automated systems. For example, an archiving service provider might want to encapsulate and provide “archiving as a service” and in doing so it may choose to automate some or all steps of the process to satisfy its customers. In this case, the ability to describe and execute an unambiguous set of activities would be invaluable. To do this, the service provider requires a means to represent the activities carried out, whether in sequence or in parallel, by machine and human actors, as well as the decision points that determine which path of the workflow is executed. Such a description of workflow should also identify the necessary inputs to each step of the process and the resources that result from executing it.

This section reviews some of the main candidates for workflow/process modelling that support both a graphical presentation for human consumption and a machine-readable form for software execution.

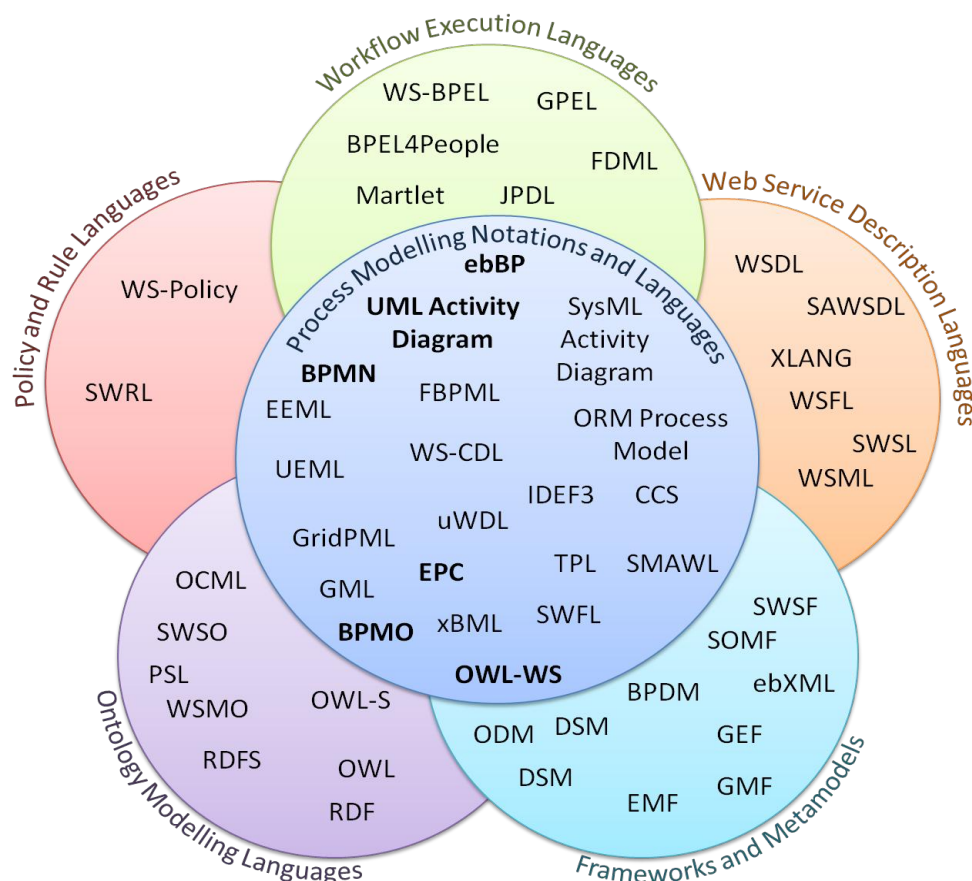


Figure 71: Process Modelling Notations and Related Technologies

Annex A provides a list of process modelling and related technologies that have been surveyed. These are shown in diagrammatic form in Figure 71. The most relevant and mature candidates are described in more detail below. The focus of the review is on tool support and maturity of the technology.

10.1. BPMN

Process-oriented organisations are interested in modelling their core business (and supporting activities) as a set of processes that begin with the customer's need and end with that need having been fulfilled. Such processes are typically at a high level of abstraction and are called business processes.

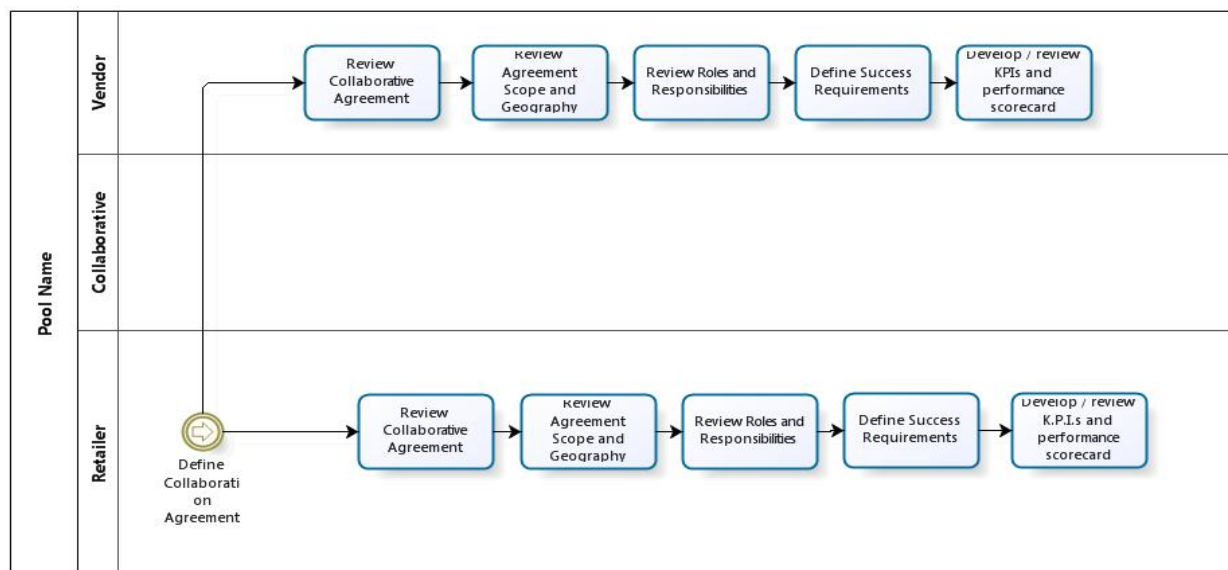
A widely used specification for the graphical representation of business processes is BPMN⁹. This is used during the design phase of process modelling. BPMN was initially developed by the Business Process Management Initiative (BPMI). The first release was made available in May 2003. Since 2005, BPMN is maintained by the Object Management Group (OMG). The current release of BPMN, as of January 2009, is version 1.2, while work on version 2.0 is in progress.

BPMN is designed for business people to design, manage, and monitor business processes. The standard comprises a set of graphical elements (flow objects, connecting objects, swimlanes, artefacts), that are used to visualise business processes as a flowchart.

Furthermore, BPMN provides a mapping to the execution language BPEL4WS. Currently, the mapping is defined for a single (internal) business process, and not for a collaboration process, where the interactions between two or more business entities are modelled.

BPMN has been widely adopted and therefore benefits from extensive tool support. There are commercial, open source, free and non-free tools for drawing BPMN diagrams, such as BizAgi, MagicDraw (with the Cameo Business Modeler plugin), as well as MS Visio stencils. BPMN is also often used in software suites that manage business processes from design to implementation, such as Oracle's BPM suite (BPMS), ActiveVOS, and Intalio|Works BPMS.

BPMN is also used in ProcessWiki¹⁰, an online repository of business process models that are submitted and edited collaboratively. ProcessWiki uses diagrams generated from BizAgi to visualise BPM and emphasises the use of XPD L — a language for the exchange of business processes. Figure 72 shows an example of a BPMN process diagram describing a process to define a logistics agreement between a retailer and a vendor.

Figure 72: Example BPMN Process¹⁰

10.2. BPEL

BPEL¹¹ provides a language for specifying business processes at a lower level of abstraction than BPMN. It can be used to specify an executable process, i.e. a workflow that describes a set of interactions between external actors using Web Services. BPEL has its origins in the specifications XLANG and WSFL, which were developed by Microsoft and IBM, respectively. Microsoft and IBM combined these two standards and submitted BPEL 1.0. In April 2003, BPEL became an OASIS standard, called BPEL4WS 1.1. In September 2004, the standard was renamed to WS-BPEL 2.0¹².

WS-BPEL is an XML-based language and is built on Web Service standards, using WSDL to describe the entities in the business process. WS-BPEL is designed to be extensible. Extensions to WS-BPEL could include anything ranging from new attributes to new elements. BPEL is very widely used and there are a lot of products, both commercial and open source, which implement the BPEL standard. Representatives of open source projects are ODE (Orchestration Director Engine) from Apache, ActiveBPEL, and BPEL SE from Sun. Free products with implementations of BPEL are Intalio|BPMS Server and JBPM, which is part of JBoss. Commercial products are offered by Oracle (BPEL Process Manager), IBM (WebSphere) and Microsoft (BizTalk Server). Figure 73 gives an example of an XML-serialised BPEL process describing a shipping service.

```

<process name="shippingService"
  targetNamespace="http://example.com/shipping/"
  xmlns="http://docs.oasis-open.org/wsbpel/2.0/process/abstract"
  xmlns:plt="http://example.com/shipping/partnerLinkTypes/"
  xmlns:props="http://example.com/shipping/properties/"
  xmlns:ship="http://example.com/shipping/ship.xsd"
  xmlns:sif="http://example.com/shipping/interfaces/"
  abstractProcessProfile="http://docs.oasis-
open.org/wsbpel/2.0/process/abstract/ap11/2006/08">

  ...

  <sequence>

    <receive partnerLink="customer"
      operation="shippingRequest"
      variable="shipRequest">
      <correlations>
        <correlation set="shipOrder" initiate="yes" />
      </correlations>
    </receive>

    <if>
      <condition>
        bpel:getVariableProperty('shipRequest',
          'props:shipComplete')
      </condition>
      <sequence>
        <assign>
          <copy>
            <from variable="shipRequest"
              property="props:shipOrderID" />
            <to variable="shipNotice"
              property="props:shipOrderID" />
          </copy>
          <copy>
            <from variable="shipRequest"
              property="props:itemsCount" />
            <to variable="shipNotice"
              property="props:itemsCount" />
          </copy>
        </assign>
        <invoke partnerLink="customer"
          operation="shippingNotice"
          inputVariable="shipNotice">
          <correlations>
            <correlation set="shipOrder" pattern="request" />
          </correlations>
        </invoke>
      </sequence>
    <else>
      ...
    </else>
  </if>

</sequence>

</process>

```

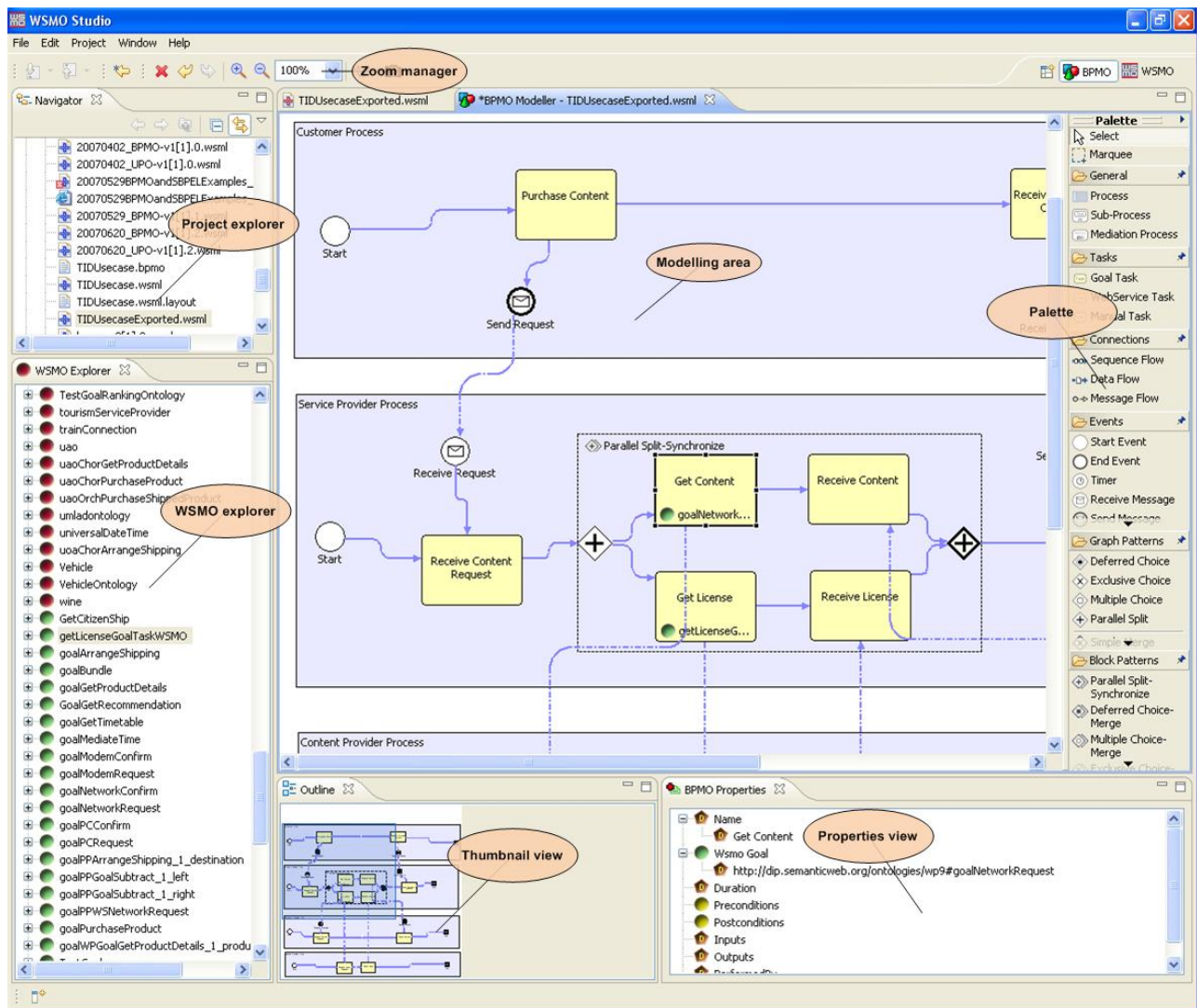
Figure 73: Example BPEL Process¹²

An extension of the WS-BPEL language that supports human interactions is the BPEL4People, which is currently being developed by OASIS. BPEL4People define a new type of basic activity that will allow human tasks, including their properties and behaviour, to be defined, as well as the operations used to manipulate those tasks. A BPEL4People coordination protocol will control autonomy and life cycle of service-enabled human tasks in an interoperable manner. According to the supporters of BPEL4People it will “fill major holes in the area of human interaction that existed within the original WS-BPEL 2.0 specification”¹³.

10.3. BPMO

BPMO is based on WSMO and provides a framework comprising the elements needed for defining business processes. BPMO was developed under the SUPER research project¹⁴. In essence, BPMO is not a process modelling language in itself. Instead, it extends an Upper Process Ontology to provide an abstraction over different modelling notations, such as BPMN and EPC. At the lowest level of the ontology stack, ontologised versions of BPMN, EPC and WS-BPEL are provided. This enables existing BPMN and EPC process models to be semantically annotated with reference to domain ontologies¹⁵.

Tool support for BPMO exists in WSMO Studio (through third-party extensions), which allows users to add semantic annotations to existing business process models and to create new semantic models. However, at the time of writing, the tool support is not mature. Figure 74 shows an example BPMO process in the BPMO Modeler plugin for WSMO Studio. Note in the diagram that the ‘Get Content’ activity is annotated with a reference to the WSMO goal ‘goalNetworkRequest’.

Figure 74: Example BPMO Process¹⁶

10.4. OWL-WS

OWL-WS extends OWL-S, an ontology used to semantically describe a Web Service, in order to specify a workflow over a number of services. The NextGRID and BREIN projects developed OWL-WS for Next Generation Grids. OWL-S was extended with the concept of an Abstract Process, which allows a process to be defined not through the Service Grounding (details of how to access the service), but through a Query Profile, which defines search terms for as yet unknown services to be discovered. A Query Profile provides constraints on the capabilities of the service, which typically include constraints on the information exchanged with it, the functionality required, and constraints on QoS.

The workflow language and authoring tool development in NextGRID¹⁷ was led by Eltag Datamat. The software is known as the Semantic Workflow Designer. This tool supports graphical authoring and execution of workflows in OWL-WS.

Workflows can also be enacted using an OWL-WS enactor developed by IT Innovation, which uses the Workflow Designer as a user interface for supplying inputs, monitoring progress and retrieving outputs. Figure 75 shows an example OWL-WS workflow.

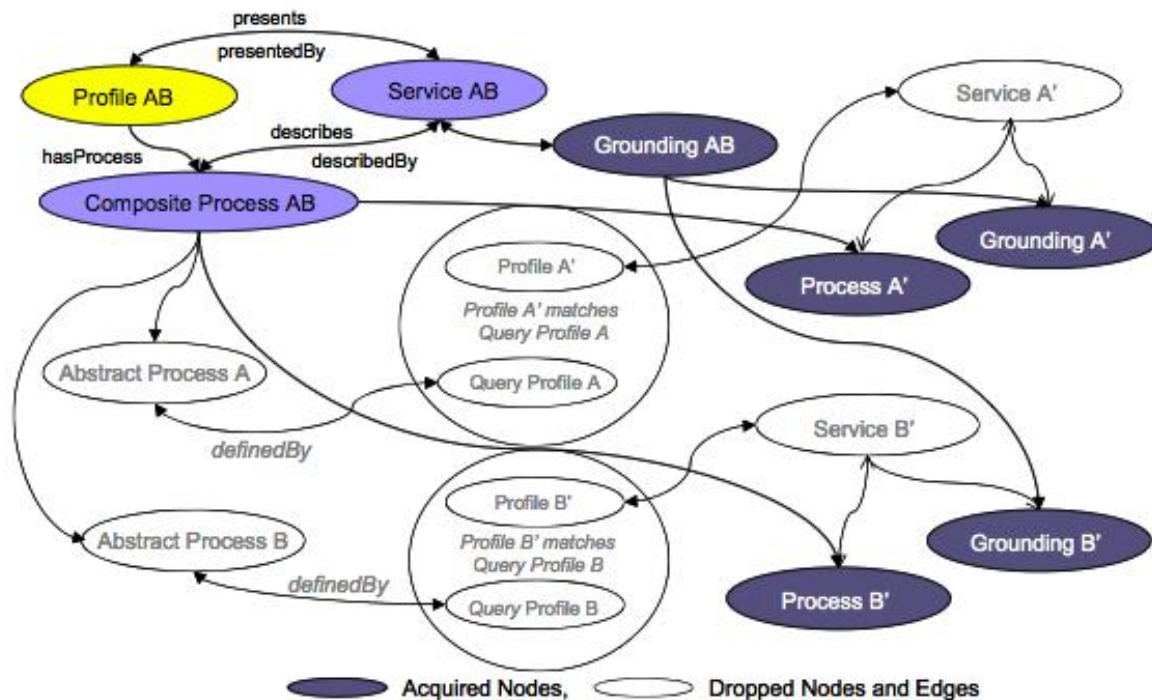
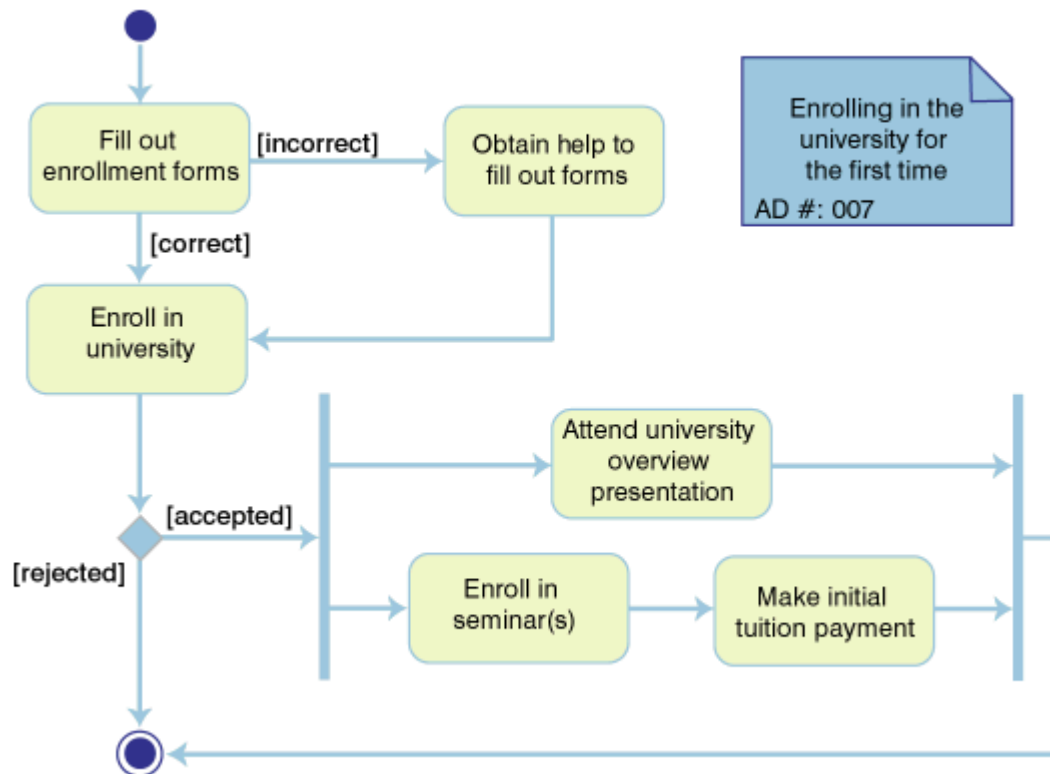


Figure 75: Example OWL-WS workflow

10.5. UML/SysML Activity Diagrams

The UML specification, maintained by OMG and currently at version 2.0, defines a number of diagram types: structure, behaviour and interaction diagrams. Activity diagrams are a kind of behaviour diagram and are the most suitable for describing a business process. It is a common misconception that UML diagrams are only suitable for representing software-centric processes. Indeed, SysML extends UML 2.0 activity diagrams to deal with ‘continuous’ systems — which may describe the flow of material and energy, not just information — and probabilistic state transitions.

Even plain UML activity diagrams can describe business processes with little or no software-intensive steps. The diagram is used to communicate to stakeholders what the (future) system will do and cannot be used to describe exactly how it will do it. Figure 76 shows the process for enrolling in a University.

Figure 76: Example Activity Diagram¹⁸

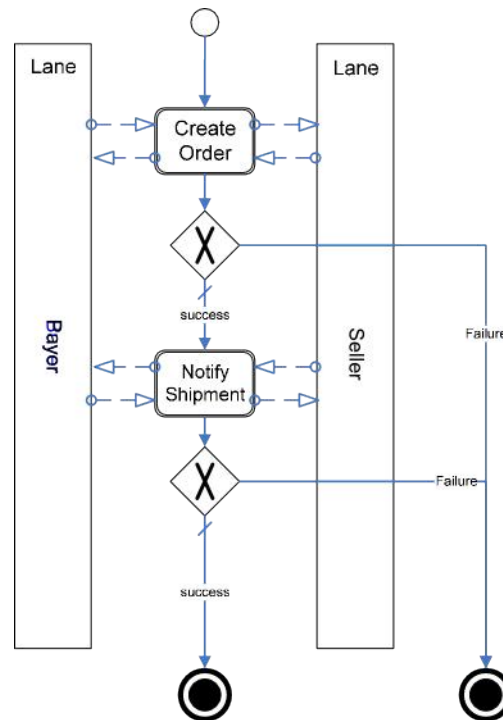
Nick Russell et al consider the suitability of UML 2.0 activity diagrams to model business processes¹⁹ and conclude that while they “have merit”, activity diagrams emphasise control- and data-flow, and have poor support for representing resource-related and organisational aspects of business processes, such as interaction with the environment. However, the authors admit that this is a limitation of other business process languages too.

10.6. ebBP (part of ebXML)

ebBP²⁰ is part of the XML based family of standards known as ebXML. Its full name is eBusiness Extensible Markup Language (ebXML) Business Process Specification Schema (BPSS). The ebXML standards are sponsored by OASIS and UN/CEFACT with the aim to provide an open, XML-based infrastructure that enables the global use of electronic business information in an interoperable, secure, and consistent manner by all trading partners. The development of ebXML was started in 1999. The currently available version is ebBP 2.0.4²¹, which was published in December 2006.

ebBP describes a business process as a Business Collaboration, which is a set of roles interacting through a set of choreographed Business Transactions. A Business Transaction is a set of “Business Document Flows between Requesting and Responding parties performing roles”.

Figure 77 shows an example ebBP process for ‘Product Fulfilment’ business collaboration.

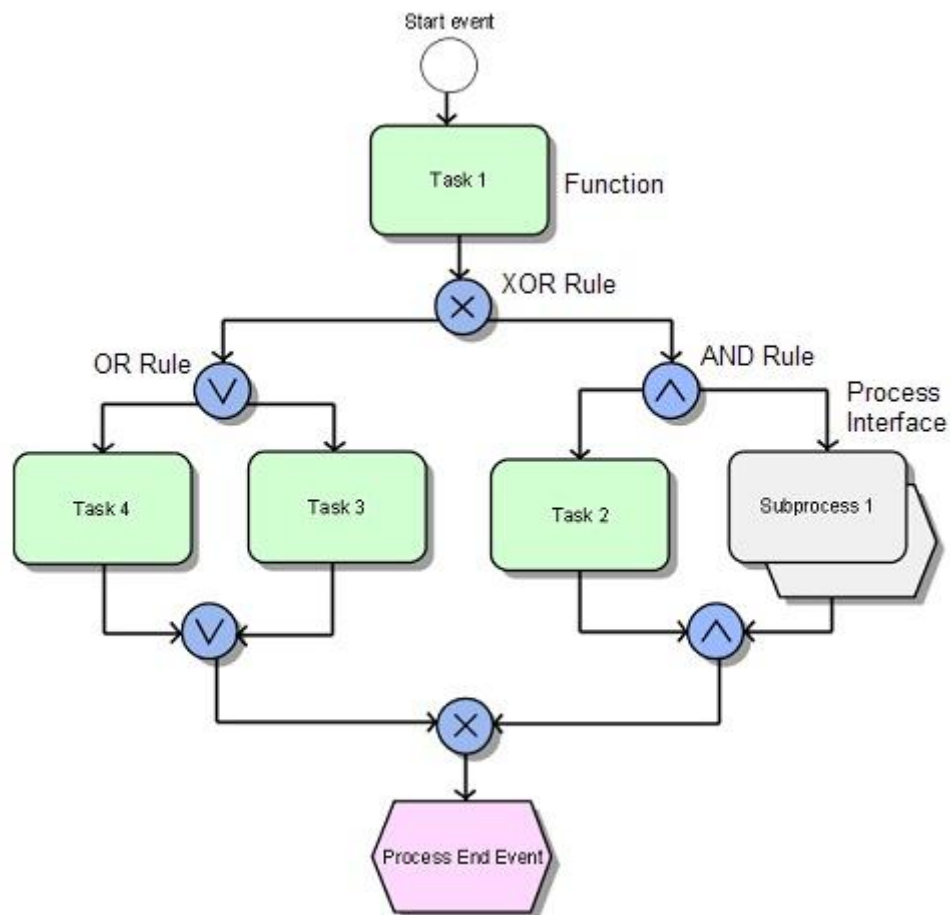
Figure 77: Example ebBP Process²²

10.7. Event-driven Process Chains (EPC)

Event-driven Process Chains²³ are another commonly used workflow description language. It was originally used with SAP R/3 modelling, but nowadays it is much more widely adopted. A number of tools are able to manage EPC diagrams, such as the ARIS Toolset from IDS Scheer, ADONIS from BOC Group, and Microsoft Visio (using stencils).

EPC diagrams represent workflow using events and functions. Events are passive elements that describe the initiating conditions and resulting state of functions. Functions are active elements that describe the transformation from initiating conditions to the resulting state. Logical connectors (AND, OR, XOR) between events and functions describe branching and merging of a process. Each function has inputs and outputs. Organisational units may be connected to a function, for which they are responsible.

Figure 78 shows an example generic EPC process.

Figure 78: Example EPC Process²⁴

10.8. Conclusion on Workflow Languages

For its ease of comprehension, clear presentation, rigorous specification and wide-ranging tool support, we have chosen BPMN.

We have justified this assertion by using BPMN in practice to model the processes described in this report.

BPMN has the added advantage of being able to map to BPEL or more semantically rigorous forms, e.g. sBPMN as done by the SUPER project, which in turn enable machine automation of preservation.

In this report, we used the BizAgi Process Modeler to document the processes involved in preservation.

11. Glossary

Term	Definition
Access Aid	A software program or document that allows <i>Consumers</i> to locate, analyse, order or retrieve <i>Archival Information Packages</i> of interest.
Access (Phase)	The phase that includes processes of retrieving data from an <i>Archive (DIPs)</i> .
Administration (Phase)	Comprises the administrative processes that have to be carried out in order to create and maintain an <i>OAIS</i>
Archival Information Package (AIP)	An <i>Information Package</i> , consisting of the <i>Content Information</i> and the associated <i>Preservation Description Information (PDI)</i> , which is preserved within an <i>OAIS</i> .
Archive	An organization that intends to preserve information for <i>Access</i> and use by a <i>Designated Community</i> .
Consumer	The role played by those persons, or client systems, who interact with <i>OAIS</i> services to find preserved information of interest and to access that information in detail. This can include other <i>OAISs</i> , as well as internal <i>OAIS</i> persons or systems.
Content Data Object	The <i>Data Object</i> , that together with associated <i>Representation Information</i> , comprises the <i>Content Information</i> .
Content Information	A set of information that is the original target of preservation or that includes part or all of that information. It is an <i>Information Object</i> composed of its <i>Content Data Object</i> and its <i>Representation Information</i> .
Data Dissemination Session	A delivery of media or a single telecommunications session that provides data to a <i>Consumer</i> . The <i>Data Dissemination Session</i> format/contents is based on a data model negotiated between the <i>OAIS</i> and the <i>Consumer</i> in the request agreement. This data model identifies the logical constructs used by the <i>OAIS</i> and how they are represented on each media delivery or in the telecommunication session.
Data Object	Either a physical object or a digital object.
Data Submission Session	A delivery of media or a single telecommunications session that provides data to an <i>OAIS</i> . The data submission session format/contents is based on a data model negotiated between the <i>OAIS</i> and the <i>Producer</i> in the <i>Submission Agreement</i> . This data model identifies the logical constructs used by the <i>Producer</i> and how they are represented on each media delivery or in the telecommunication session.
Descriptive Information	The set of information, consisting primarily of <i>Package Descriptions</i> , which is provided to the <i>OAIS</i> data management functional entity to support the finding, ordering, and retrieving of <i>OAIS</i> information holdings by <i>Consumers</i> .
Designated Community	An identified group of potential <i>Consumers</i> who should be able to understand a particular set of information. The <i>Designated Community</i> may be composed of multiple user communities. A <i>Designated Community</i> is defined by the <i>Archive</i> and this definition may change/evolve over time.
Dissemination Information Package (DIP)	An <i>Information Package</i> , derived from one or more <i>AIPs</i> , received by the <i>Consumer</i> in response to a request to the <i>OAIS</i> .
Formal	The phase of the preservation process in which the <i>Submission</i>

Term	Definition
Definition Phase	<i>Agreement</i> is established between the <i>Archive</i> and the <i>Producer</i> . In addition the <i>Consumer</i> and <i>Archive</i> may negotiate an <i>Order Agreement</i> in this phase.
Information Object	A <i>Data Object</i> together with its <i>Representation Information</i> .
Information Package	Composed of optional <i>Content Information</i> and optional associated <i>Preservation Description Information</i> . Associated with this <i>Information Package</i> is <i>Packaging Information</i> used to delimit and identify the <i>Content Information</i> and <i>Package Description</i> information used to facilitate searches for the <i>Content Information</i> .
Ingest (Phase)	The phase that includes processes of adding data into an <i>Archive</i> (<i>SIPs</i>).
Open Archival Information System (OAIS)	An <i>Archive</i> , consisting of an organization, which may be part of a larger organization, of people and systems, that has accepted the responsibility to preserve information and make it available for a <i>Designated Community</i> . It meets a certain set of responsibilities as defined in [1].
Order Agreement	An agreement between the <i>Archive</i> and the <i>Consumer</i> in which the physical details of the delivery, such as media type and format of data, are specified.
Package Description	The information intended for use by <i>Access Aids</i> .
Packaging Information	The information that is used to bind and identify the components of an <i>Information Package</i> . For example, it may be the ISO 9660 volume and directory information used on a CD-ROM to provide the content of several files containing <i>Content Information</i> and <i>Preservation Description Information</i> .
Preliminary Phase	The phase of the preservation process that includes the initial contacts and negotiations between <i>Producer</i> and <i>Archive</i> and also <i>Consumer</i> and <i>Archive</i> .
Preservation Description Information (PDI)	The information which is necessary for adequate preservation of the <i>Content Information</i> and which can be categorized as provenance, reference, fixity, context and <i>Access rights</i> information.
Preservation (Phase)	Summarises the activities of the functions Preservation Planning, Data Management and Archival Storage.
Producer	The role played by those persons or client systems, which provide the information to be preserved. This can include other <i>OAISs</i> or internal <i>OAIS</i> persons or systems.
Producer-Archive Project	A <i>Producer-Archive Project</i> is a set of activities and the means used by the information <i>Producer</i> as well as the <i>Archive</i> to ingest a given set of information into the <i>Archive</i> .
Representation Information	The information that maps a <i>Data Object</i> into more meaningful concepts. An example of representation information for a bit sequence which is a FITS file might consist of the FITS standard which defines the format plus a dictionary which defines the meaning of keywords in the file which are not part of the standard.
Submission Agreement	The agreement reached between an <i>OAIS</i> and the <i>Producer</i> that specifies a data model, and any other arrangements needed, for the <i>Data Submission Session</i> . This data model identifies format/contents and the logical constructs used by the <i>Producer</i> and how they are represented on each media delivery or in a telecommunication session.

Term	Definition
Submission Information Package (SIP)	An <i>Information Package</i> that is delivered by the <i>Producer</i> to the <i>OAI/S</i> for use in the construction or update of one or more <i>AIPs</i> and/or the associated <i>Descriptive Information</i> .

12. Annexes

12.1. Annex A

The following list gives a quick overview on all process modelling and related technologies that have been surveyed. Their classification in graphical form as well as a detailed description of the most relevant ones can be viewed in chapter 10.

ARIS²⁵:

- **Architecture of Integrated Information Systems**
- Is more a holistic framework for enterprise modelling, but workflows are included
- 4 perspectives (data, control, functions and above organisational)
- Uses EPC for process modelling

BPDM²⁶:

- **Business Process Definition Metamodel**
- is a standard definition of concepts used to express business process models
- from OMG in 2008
- is defined by XSD (XML Schema) and XMI (XML for Metadata Interchange)
- defines concepts, relationships, and semantics for exchange of user models between different modelling tools
- is an alternative to XPDL

BPEL²⁷:

- **Business Process Execution Language**
- Is the same as WS-BPEL and BPEL4WS
- XML-based
- Is an OASIS standard executable language for specifying interactions with Web Services from 2003
- is an Orchestration language, not a choreography language
- messaging facilities depend on the use of WSDL
- BPMN is supposed to serve as front-end for BPEL, however the mapping is not always accurate

BPEL4People²⁸:

- **Business Process Execution Language for People**
- Is an extension of BPEL from 2007 (by SAP, IBM, Oracle, Adobe etc)
- Emerged from the problem that BPEL doesn't support human interactions, but only web services → BPEL4People supports role based human activities
- Status: BPEL4People is currently being standardized by OASIS

BPEL4WS:

- **Business Process Execution Language for Web Services**
- See BPEL

BPMN²⁹:

- **Business Process Modelling Notation**
- most widely used process modelling standard today
- supports more common workflow patterns than UML
- is supposed to serve as front-end for BPEL, however the mapping is not always accurate

DEDSL³⁰:

- **Data Entity Dictionary Specification Language**
- Used by Centre Des Données De La Physique Des Plasmas (CDPP) to specify dictionaries which describe semantics for a collection of data entities
- Is related to PVL

DSM³¹:

- **Domain-specific Modelling**
- Is more a concept that involves the creation and use of domain specific modelling language (DSL) and code generators by an organization
- most tool support for DSM languages is built based on existing DSM frameworks or through DSM environments (e.g. Eclipse Modelling Project)
- apparently increasing popularity

ebXML³²:

- **Electronic Business XML**
- Is a modular framework of XML business specifications for communication and exchange between e-business companies
- Developed by OASIS in 1999
- Delivered 5 specifications for the layers: business processes, core data components, collaborating protocol agreements, messaging and registries and repositories

EEML³³:

- **Extended Enterprise Modelling Language**
- Enterprise modelling across 4 layers: process modelling, data modelling, resource modelling, goal modelling (see also GRL) → 4 sub-languages, with well-defined links across these languages
- Developed by EU project EXTERNAL in late 1990s

EMF³⁴:

- **Eclipse Modelling Framework**
- From eclipse from 2003
- is a modelling framework and code generation facility for building tools and other applications based on a structured data model
- Models can be specified using annotated Java, UML, XML documents, or modelling tools, then imported into EMF

EPC³⁵:

- **Event-driven Process Chain**
- mainly used for analysing processes for the purpose of an enterprise resource planning (ERP) implementation
- especially used in Germany
- is used by ARIS for process modelling

EPML³⁶:

- **Event-driven Process Chain Mark-up Language**
- XML based
- supports data and model interchange for EPC in the face of heterogeneous Business Process Modelling tools

FBPML³⁷:

- **Fundamental Business Process Modelling Language**
- From Southampton in 2003
- Uses concepts of IDEF3 and PSL
- covers fundamental process concepts that minimise complexity
- machine readable but also understandable for humans (→ graphical notation)
- would be suitable for mapping of BPM and ontologies/semantics

FDML³⁸:

- **Flow Description Mark-up Language**
- is a now obsolete XML language from IBM used for making executable business process models
- has been replaced by BPEL

GEF³⁹:

- **Graphical Editing Framework**
- From eclipse
- allows developers to take an existing application model and quickly create a rich graphical editor

GMF⁴⁰:

- **Graphical Modelling Framework**
- Based on EMF and GEF
- provides a generative component and runtime infrastructure for developing graphical editors

GML⁴¹:

- **Generative Modelling Language**
- Is a very specialised language for modelling the processing of 3D geometrical objects

GPEL⁴²:

- **Grid Process Execution Language**
- based on BPEL4WS (2005)
- the paper describing GPEL is not available for free

GridPML⁴³:

- **Grid Process Modelling Language**
- XML-based, from 2005
- supports basic control flow constructs adopted from Web Service composition languages with features for invoking Grid Services
- only one paper, not accessible for free

GRL⁴⁴:

- **Goal-oriented Requirements Language**
- is designed to support goal-oriented modelling and reasoning about requirements especially the non-functional requirements
- comprises intentional elements, intentional relationships and actors
- belongs to EEML
- apparently only supported by one tool

IDEF0⁴⁵:

- **Integration Definition for Function Modelling**
- designed to model the decisions, actions, and activities of an organization or system
- derived from the functional modelling language SADT by the US Airforce in the 1980s

IDEF3⁴⁶:

- **Integrated Definition for Process Description Capture Method**
- is a business process modelling method complementary to IDEF0

- it is a scenario-driven process flow description capture method intended to capture the knowledge about how a particular system works
- want to offer alternative descriptions of the same process from multiple viewpoints on the process
- represents process flow descriptions and object state transitions
- has a graphical notation

JML⁴⁷:

- **Java Modelling Language**
- is a behavioural interface specification language for Java modules
- provides semantics to formally describe the behaviour of a Java module, removing potential ambiguity with regard to the module designers' intentions
- these specifications can be written as annotations in Java program files, or stored in separate specification files
- tools: e.g. a plug-in for eclipse: JMLEclipse

JPDL⁴⁸:

- **JBPM Process Definition Language**
- used to define processes for the JBPM (JBoss Business Process Management) framework
- XML-based, can be seen as alternative to BPEL

Martlet⁴⁹:

- a Scientific Workflow Language for Abstracted Parallelisation from 2007
- implements a programming model that allows users to write parallel programs and analyse distributed data without having to be aware of the details of the parallelisation
- very specialised for distributed/GRID applications with a high level of abstraction
- graphical notation only in form of abstract syntax trees

NIAM/CogNIAM⁵⁰:

- **Natural Language Information Analysis Method** (CogNIAM =Cognition enhanced)
- Has been developed in the 1970s
- ORM evolved from it

OCML⁵¹:

- **Operational Conceptual Modelling Language**
- For the construction of knowledge models (ontologies and problem solving methods)
- It allows the specification and operationalisation of functions, relations, classes, instances and rules

- Several projects (such as SUPER and LHDL) are using it
- There's one specific tool for it

ODL⁵²:

- **Object Description Language**
- used to encode data labels for the Planetary Data System (PDS) and other NASA data systems
- describing files/datasets and its contents with data labels
- → not relevant for process modelling but maybe for metadata in an *Archive*

ODM⁵³:

- **Ontology Definition Metamodel**
- Is an OMG specification
- links Common Logic (CL), the Web Ontology Language (OWL), and the Resource Description Framework (RDF)
- goal is to make the concepts of Model-Driven Architecture applicable to the engineering of ontologies

ORM⁵⁴:

- **Object Role Modelling**
- is a fact-oriented method for performing systems analysis at the conceptual level
- conceptual design may include data, process and behavioural perspectives
- evolved from NIAM
- has a rich graphic notation and moderate tool support
- seems to be specialized on database design and business rules capturing

OWL⁵⁵:

- **Web Ontology Language**
- one of the fundamental technologies underpinning the Semantic Web
- W3C endorsed
- family of knowledge representation languages for authoring ontologies
- 3 sublanguages (OWL Lite, OWL DL and OWL Full)
- OWL Lite is not widely used (because it's not so lite as it should be)
- OWL DL (Description Logic) includes all OWL language constructs, but they can be used only under certain restrictions
- OWL Full is designed for compatibility with RDFS, but too extensive
- → OWL DL seems to be the most convenient

OWL-S⁵⁶:

- **Web Ontology Language – Semantic**
- Based on OWL
- for describing Semantic Web Services

PSL⁵⁷:

- **Process Specification Language**
- is an ontology for description of basic manufacturing, engineering and business processes from 2004
- purpose of PSL is to support manufacturing processes in the whole life cycle
- Apparently no graphical representation and no tool support

PVL⁵⁸:

- **Parameter Value Language**
- human-readable, machine-processable language for naming and expressing data values
- used by Centre Des Données De La Physique Des Plasmas (CDPP) for describing metadata

RDF⁵⁹:

- **Resource Description Framework**
- Is a W3C standard
- A metadata data model, but also a general method for conceptual description or modelling of information that is implemented in web resources
- Subject, object, predicate descriptions of resources
- Expressed in XML

RDFS⁶⁰:

- **Resource Description Framework Schema**
- Is an extensible knowledge representation language
- providing basic elements for the description of ontologies (RDF vocabularies)
- intended to structure RDF
- predecessor of OWL

SA-WSDL⁶¹:

- **Semantic Annotations for Web Service Description Language**
- Goal is to resolve ambiguities in Web services descriptions (e.g. 2 services have similar description but meaning is totally different)
- does not specify a language, but provides mechanisms by which concepts from the semantic models that are defined either within or outside the WSDL document can be referenced from within WSDL components as annotations

sBPMN⁶²:

- **semantically enhanced Business Process Modelling Notation**
- is an BPMN-based ontology developed in the SUPER project from 2007
- adds a meaning to the BPMN process elements and makes them machine readable (since BPMN – BPEL translation isn't always correct)
- Web services (or their composition) can be automatically assigned to each task
- Tools apparently available as SUPER project results

SMAWL⁶³:

- **Small Workflow Language**
- Based on CCS (Calculus of Communicating Systems), from 2005
- Was developed to simplify the CCS formalism, but to still support the 20 workflow patterns
- Graphical notation was derived from the abstract syntax tree
- Can be compiled to CCS

SOMF⁶⁴:

- **Service Oriented Modelling Framework**
- is a service-oriented modelling language for software development that employs disciplines and a universal language to provide tactical and strategic solutions to enterprise problems
- comprises 4 sections: practices, environments, disciplines, and artifacts

SWFL⁶⁵:

- **Services Workflow Language**
- is an extension of WSFL from 2003
- represents jobs composed of interacting services
- supports Java-oriented conditional and loop constructs, to permit sequences of more than one service within conditional clauses and loop bodies
- tools: WFL2Graph (converts an SWFL document into Java FlowModel object) and Graph2Java (converts from FlowModel into executable Java code)

SWRL⁶⁶:

- **Semantic Web Rule Language**
- Is a Semantic Web rules-language, combining OWL DL and Lite with RuleML (Rule Mark-up Language)
- Several tools support SWRL, but they do not support the full specification because the reasoning becomes undecidable (however there are 3 possible approaches to convert SWRL into other languages/logics)

SWSF⁶⁷:

- **Semantic Web Services Framework**
- Is a framework of the SWSI (Semantic Web Services Initiative) from 2005
- Includes the SWSL and SWSO

SWSL⁶⁸:

- **Semantic Web Services Language**
- Belongs to SWSF
- 2 sublanguages (SWSL-FOL and SWSL-Rules)
- SWSL-FOL: is a full first-order logic language, which is used to specify the ontology of the web service (SWSO)
- SWSL-Rules: a rule-based sublanguage, which can be used both as a specification and an implementation language
- both sublanguages share a common and useful core
- possible to translate SWSL-FOL specifications into SWSL-Rules with "minimal loss".

SWSO⁶⁹:

- **Semantic Web Services Ontology**
- Belongs to SWSF
- enable reasoning about the semantics underlying Web (and other electronic) services, and how they interact with each other and with the "real world"
- rather an abstract semantic model of the web service
- refines aspects of PSL with Web service-specific concepts and extensions

SysML⁷⁰:

- **Systems Modelling Language**
- is a general-purpose modelling language for systems engineering applications
- is an extension of a subset of UML
- potential advantage compared to UML: more flexible and expressive, smaller, easier to learn, two more diagrams: requirement and parametric diagrams
- issued by OMG in 2007
- tool support: many vendors start to deploy plugins for existing software (e.g. IBM)

TPL⁷¹:

- **Temporal Process Language**
- is a process calculus, extension of CCS (Calculus of Communicating Systems)
- adds an abstract timer function to CCS

UEML⁷²:

- **Unified Enterprise Modelling Language**

- Is the result of the further development of EEML from 2003
- Is intended as an intermediate language through which different languages can be connected, thereby facilitating a web of languages and of models expressed in those languages
- Is supposed to serve as a basis for interoperability within a smart organisation or a network of enterprises

UML⁷³:

- **Unified Modelling Language**
- Relevant for process modelling: Activity Diagram
- Very widespread
- supports fewer common workflow patterns than BPMN

uWDL⁷⁴:

- **ubiquitous Workflow Description Language**
- is a workflow language that describes the situation information of ubiquitous environments as a rule-based service transition condition
- seems to be irrelevant, there's only one paper about it which is not even accessible

WSBPEL:

- **Web Service Business Process Execution Language**
- See BPEL

WS-CDL⁷⁵:

- **Web Services Choreography Description Language**
- Is a W3C Candidate Recommendation from 2005
- describes peer-to-peer collaborations of participants; ordered message exchanges result in accomplishing a common business goal
- Based on pi-calculus and XML, for WS-interoperability, contract-like mechanisms

WSDL⁷⁶:

- **Web Services Description (formerly: Definition) Language**
- is an XML-based well established language that provides a model for describing web services
- defines services as collections of network endpoints, or ports
- the abstract definition of ports and messages are separated from their concrete use or instance
- WSDL is often used in combination with SOAP and an XML Schema to provide web services
- a client program connecting to a web service can read the WSDL to determine what operations are available on the server

WSFL⁷⁷:

- **Web Services Flow Language**
- is obsolete because it had been combined together with XLANG from Microsoft to form BPEL

WSML⁷⁸:

- **Web Services Modelling Language**
- is a formal language that provides a syntax and semantics for the WSMO
- WSML provides means to formally describe the WSMO elements
- Based on description logic
- Different variants (WSML Core, WSML-DL, WSML-Flight, WSML-Rule and WSML-Full)

WSMO⁷⁹:

- **Web Service Modelling Ontology**
- provides an ontology based framework, which supports the deployment and interoperability of Semantic Web Services
- by the ESSI WSMO working group (since 2004)
- 4 components necessary to define Semantic Web Services (Goals, Ontologies, Mediators and Web Services)
- Goals: The client's objectives when consulting a Web Service
- Ontologies: A formal Semantic description of the relevant aspects of the domains of discourse, machine readable
- Mediators: Connectors between components with mediation facilities, handles interoperability problems between different WSMO elements.
- Web Services: Semantic description of Web Services, may include capabilities, interfaces and internal working.

WS-Policy⁸⁰:

- **Web Services Policy Framework**
- a general purpose model and syntax to describe and communicate the policies of a web service
- has been developed by IBM, Microsoft, BEA and SAP in 2006
- defines a base set of constructs that can be used and extended by other Web services specifications to describe a broad range of service requirements and capabilities

xBML⁸¹:

- **Extended Business Modelling Language**
- xBML is registered trademark of BusinessGenetics, Inc.
- it consists of a notation and formal sets of syntactic and semantic rules that govern

the use of the notation (in order to simplify modelling)

- it is partitioned into six dimensions (What, Who, Where, When, Which and How)
- can be used by many BPM applications
- it is kind of a simplified “front-end” for modelling

XCL:⁸²

- **Extensible Characterisation Language**
- From 2008
- Purpose is the automatic evaluation of format conversions
- → support a toolset for the creation of machine readable format descriptions that allow an automatic translation into a normalised representation
- 2 sublanguages: XCEL and XCDL

XLANG:⁸³

- **Extended Language**
- is an XML-based extension of WSDL from Microsoft
- is obsolete because it had been combined together with WSFL from IBM to form BPEL

XPDL:⁸⁴

- **XML Process Definition Language**
- Is a standardized format of business process definitions
- Purpose is the interchange of process definitions between different workflow products (such as modelling tools and management suites)
- supports both, the graphics and the semantics of a workflow (in contrast to BPEL which focuses on the executable aspects)
- is currently best file format for exchange of BPMN diagrams

YAWL:⁸⁵

- **Yet Another Workflow Language**
- workflow language based on the Workflow patterns
- has been developed together with an open source software system (which is by the way the only tool support)
- the software includes execution engine, a graphical editor and a worklist handler
- XML-based and based on petri-nets
- Seen as alternative to BPEL, but: BPEL has more tool support and is standardized; however YAWL supports also human (“physical”) tasks which BPEL doesn’t sufficiently

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