Project Number	IST-2006-033789
Project Title	Planets
Title of Deliverable	Report on Comparison of Planets with OAIS
Deliverable Number	PP/7-D1
Contributing Sub-project and Work-package	
Deliverable Dissemination Level	External PU
Deliverable Nature	Report
Date	7th June 2007
Author(s)	KB-NL/BL

Contributors

Person	Role	Partner	Contribution
Barbara Sierman	PP7 Leader	KB-NL	Author

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1. Report on Comparison of PLANETS with OAIS

1.1 Introduction and aims

Digital preservation activities are expected to form a key part of digital repository operations. Processes such as the monitoring of technology, planning for preservation activities, and migrating obsolete digital objects will become essential if digital collections are to be kept accessible and usable. These processes are described in the Open Archival Information System which provides a high level digital repository framework. The Preservation Planning module of OAIS is the least well tested via practical implementation. There is therefore a degree of concern about the clarity and detail of these elements of the OAIS model.

The Planets Project is developing an array of technology to support a number of key digital preservation functions. These do not appear to be adequately described in OAIS. While the Planets approach is certainly not at odds with OAIS on preservation, there are some key areas where clarification is required and the level of detail needs to be expanded.

The aim of the Planets PP7 work package is to expand the preservation planning module of the OAIS model. More specifically, it will:

1. Develop and describe the Planets view of Preservation Planning within a repository
2. Identify any missing elements within the Planets Project in relation to the OAIS model
3. Provide well articulated and justified feedback to OAIS for future revisions of the standard.

1.2 Approach

The first phase of the work package has involved the development of the first iteration of a Planets expansion of the OAIS Preservation Planning Model, based on the Planets Description of Work (2006). This takes the form of a Functional View, roughly comparable to the Functional Model described in section 4.1.1.6 of OAIS. It includes the first mapping of this Planets Functional View to OAIS and from OAIS to Planets, and has drawn some initial conclusions. Two mappings have been performed in order to provide as complete a comparison as possible.

It is important to stress that the Planets Functional Model is an abstraction of the activities addressed in the various work packages of the Planets project and not a one-to-one translation of these activities. Some functionality may not be present in the Planets project, although we see it as essential for Preservation Planning.

The Planets Functional View has been developed by the PP7 participants who consulted with their local Planets teams and the Planets Coordinator. Consultation with the other Sub-Projects and work packages will not be made until phase 2. It is felt that consultation with the wider project will be more focused and effective if an initial Planets view has already been developed, which can act as a focus for discussion and debate. Phase 2 will enable feedback from the rest of the Project to be fully incorporated into the Planets Functional View. The second iteration of the mapping to OAIS will then be performed.

1.3 Notes on document conventions

Where terminology from Planets or OAIS is used in the text, it will be followed by the source of that terminology in brackets. E.g. Preservation Planning (OAIS). This is particularly crucial where there are terms from Planets and OAIS which have the same wording but different meanings. The name of the functions, interactions and repository actors or entities will begin with a capital letter.

2. The Planets Functional View

2.1 About the Functional View

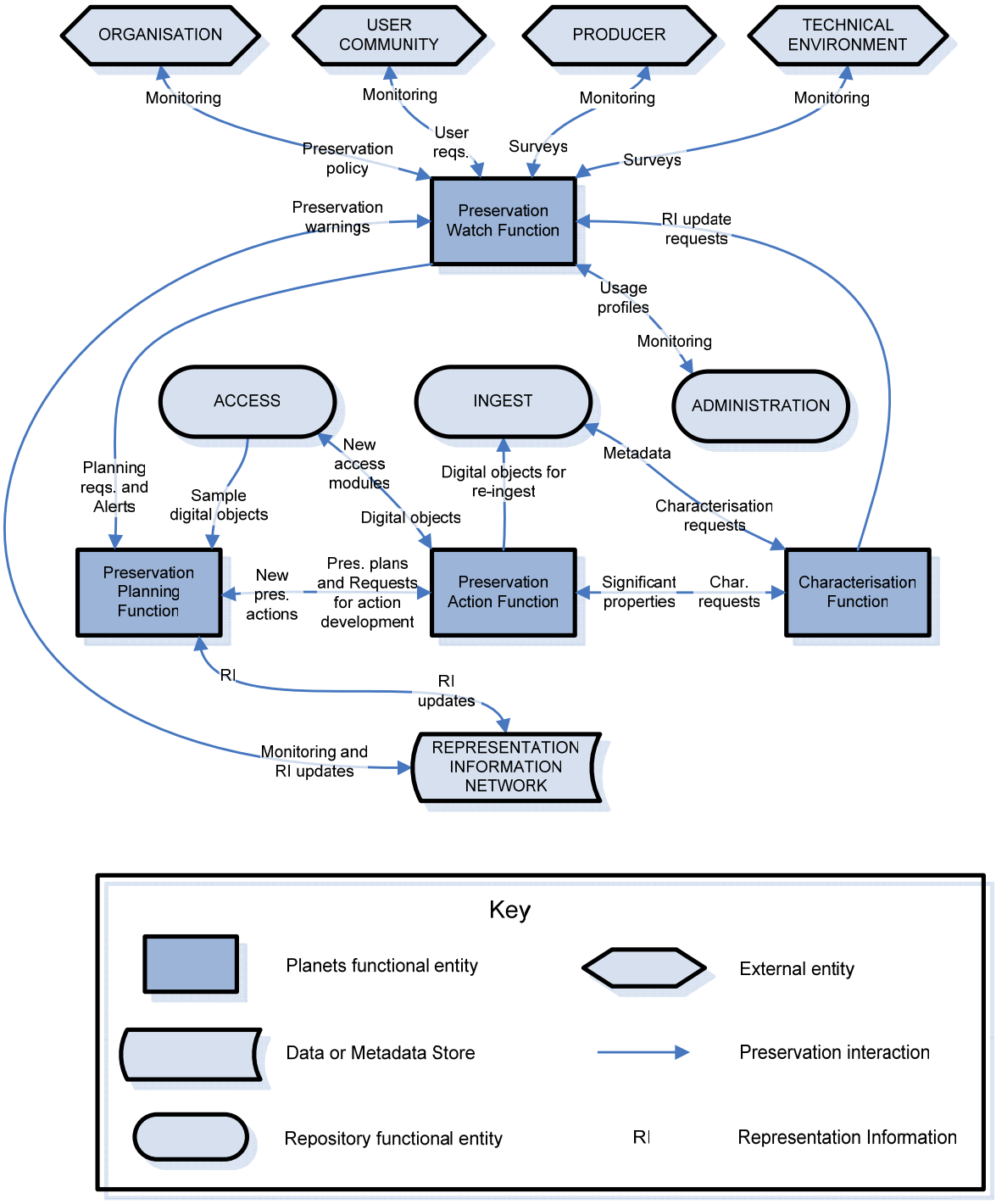
This section provides an overview of the preservation functions within a digital repository, as seen by Planets. Four high level functional entities have been identified that will be supported by the developments of the Planets project. This overview will focus only on the direct preservation of the digital objects.

Functions necessary to ensure the longevity of the repository itself (software, standards, packaging designs) will be included in a subsequent phase of this work. This allows a focus on the content preservation issues, which are considered to be of most relevance to Planets.

Note that this document describes the Planets view of how preservation functions and processes should be implemented within a digital repository. It does not describe how the Planets Project itself should be structured! Although the original project design and structure aimed to mimic the solution space to an extent, it is clear that there are differences and it is noted this is not a problem in itself.

2.2 The Planets Functions

In this first attempt at describing the Planets functions, four high level functional entities have been identified, which are shown in the associated diagram "Planets Preservation Functions" and described below.[1]



Preservation Watch Function

Preservation Watch brings together the monitoring or surveying of a number of internal and external entities. It monitors digital objects, metadata, users, the preserving organisation and the wider technological environment in order to provide preservation requirements, update preservation

[1] It is important to emphasize that this model is an abstraction of the activities conducted in the various workpackages in the Planets project and not a one-to-one translation of the workpackages into the model.

metadata and provide alerts as to when preservation action needs to be taken. This monitoring is not necessarily an automated activity.
Preservation Watch provides Monitoring of a number of internal and external entities, resulting in feedback which is compiled and passed to Preservation Planning as Preservation requirements. This information (particularly from the Technical Environment) is also used to provide Representation Information updates to the Representation Information Network (for example adding information about file formats, or noting when tools or platforms are becoming unavailable due to technology obsolescence). The monitored entities include:

- The Organisation, resulting in the capture of the preservation policy.
- The User Community, resulting in the capture of user requirements for preservation and access to digital objects.
- The Producer, resulting in surveys on changes in the creation of digital objects that may be of relevance to preservation.
- The Technical Environment, resulting in surveys on changes to technology that may be of relevance to preservation.
- Digital objects and usage of digital objects via Administration, resulting in the capture of usage profiles.

Preservation Watch also provides Monitoring of the Representation Information Network, resulting in Alerts to Preservation Planning when digital objects are in danger of obsolescence and action needs to be taken.
Preservation Watch receives RI update requests from Characterisation, when formats are ingested that are not described in the Representation Information Network. This results in RI updates to the Representation Information Network**,** utilising survey information from the Technical Environment.
Preservation Watch has been proposed by PP7 as useful way of grouping some of the monitoring functions which have previously been considered as part of the Preservation Planning (Planets) process. While they remain clearly related and involved with Preservation Planning (and indeed will be supported and implemented via developments in the Planets Preservation Planning Sub Project) this separation aims to deliver a more clear and understandable functional model.

2.2.1 Preservation Planning Function

Preservation Planning evaluates requirements and selects the most appropriate preservation solution available. It requests development of new preservation actions when needed, and updates metadata describing new preservation actions.
Preservation Planning receives Alerts from Preservation Watch, highlighting when action needs to be taken to preserve digital objects. Preservation Planning will generate a Preservation plan based on Planning requirements gathered by Preservation Watch. Preservation plans are evaluated on Sample digital objects received from Access. Evaluated Preservation plans are passed to Preservation Action for execution.
When a suitable preservation approach is not available, Preservation Planning will pass a Request for action development to Preservation Action. Information describing New preservation actions developed by Preservation Action will be received back, and Preservation Planning will then update the Representation Information Network with a Representation Information update describing the new preservation action that has been developed.

2.2.2 Preservation Action Function

Preservation Action performs actions on digital objects to ensure their continued accessibility. It also develops new preservation actions (for example, migration tools, emulators).
Preservation Planning will request that preservation actions are performed which adhere to provided preservation plans. Digital Objects are first provided by Access. Preservation Action requests that the digital objects
Where Preservation Planning requires that a migration be performed, a Preservation Plan is passed to Preservation Action, describing the required process. The Digital objects are passed from Access. A Characterisation request is made to Characterisation which returns the Significant Properties[2] of the digital objects. The Digital objects are then migrated. Again, a request is made to Characterisation and the Significant Properties of the new digital objects are returned. Evaluation of the migration is performed, by comparing the Significant properties before and after migration. The resulting digital objects are then submitted for Re-ingest to Ingest.

[2] The term Significant Properties is used within this document to refer to the attributes of a digital object that are considered to be essential to retain when preservation action is taken.

Where Preservation Watch or Preservation Planning has identified a specific rendering or preservation need that does not exist, Preservation Action will receive a Request for action development from Preservation Planning. Where this results in a new rendering tool (for example an emulator or file viewer), a New access module[3] will be passed to Access. Details of any New preservation actions will be passed back to Preservation Planning (which will update the Representation Information Network to describe them).

2.2.3 Preservation Characterisation Function

Preservation Characterisation provides support to ingest activities and preservation action activities. When digital objects are ingested into a repository, Preservation Characterisation identifies file formats and extracts metadata. When a Preservation Action is performed, Preservation Characterisation characterises the digital objects before and afterwards to enable evaluation of the action.

As new digital objects are ingested into a digital repository, Preservation Characterisation will identify file formats, validate them and match this identification to entries in the Representation Information Network. If a matching entry is not found, Preservation Characterisation will request the creation of a relevant Representation Information Network entry, to the Preservation Watch function, which may perform further Monitoring (see above) before providing an RI Update to the Representation Information Network. It will also provide the ability to extract other metadata useful for preservation (or other) purposes. Preservation Characterisation returns Metadata (such as file format IDs and relevant Representation Information Network entries, format validation information and other extracted metadata) to the Ingest function.

Preservation Characterisation also supports the evaluation of preservation actions. Preservation Action will request that digital objects be characterised (typically before and after preservation actions are executed), and Metadata (namely, the significant properties) of the digital objects are returned.

2.3 Repository and external functional entities

The text above references a number of repository functions. These are described below:

Functional entities	Description
INGEST	The function which manages the ingest of digital objects into the repository (see OAIS).
REPRESENTATION INFORMATION NETWORK	A Representation Network provides the information required to understand and make use of a particular digital object. This might include information about how to render a digital object as well as information explaining how to understand, interpret or re-use the digital object. Planets is interested specifically in the question of how to render digital objects. Its technical registries describe some of the key elements necessary in rendering a digital object such as file formats, the preservation or access tools that render or transform those file formats, and the computing environments or platforms upon which the preservation or access tools run. We look to the developments of the CASPAR Project for the provision of tools and techniques for preserving the meaning of digital objects, which enables them to be understood, interpreted or re-used. For the purposes of this document, we broadly equate the Planets technical registries with (an element of) the OAIS term: Representation Network. The concepts under development by Planets to record and utilise representation information describing how to render digital objects was first developed by the Cedars Project[4], based on the original concept introduced by

[3] This is considered to be a package of software tools, and any other necessary components to render a particular format of digital object (eg. an emulator or file viewer). ACCESS will utilize this to render content for users or provide the pack for the user to render the content themselves.

[4] "A blueprint for Representation Information in the OAIS model", Holdsworth, D and Sergeant, D, http://esdis-it.gsfc.nasa.gov/MSST/conf2000/PAPERS/D02PA.PDF

	OAIS.
ACCESS	Provides access to digital objects from the archival store (see OAIS).
ORGANISATION	The Organisation that is the custodian of the digital objects being preserved.
USER COMMUNITY	The community or communities of external actors that are expected to be users of the digital objects. [5]
TECHNICAL ENVIRONMENT	An abstract entity representing the current state of the art of the technical environment that the Producers and the User Community operate within. Key elements are computing platforms, application software and file formats.
PRODUCER	The Producers of the digital objects being preserved. This might represent the actual creator and/or the actor supplying the digital objects to the repository.
ADMINISTRATION	The services and functions needed to control the operation of the other functional entities on a day-to-day basis.

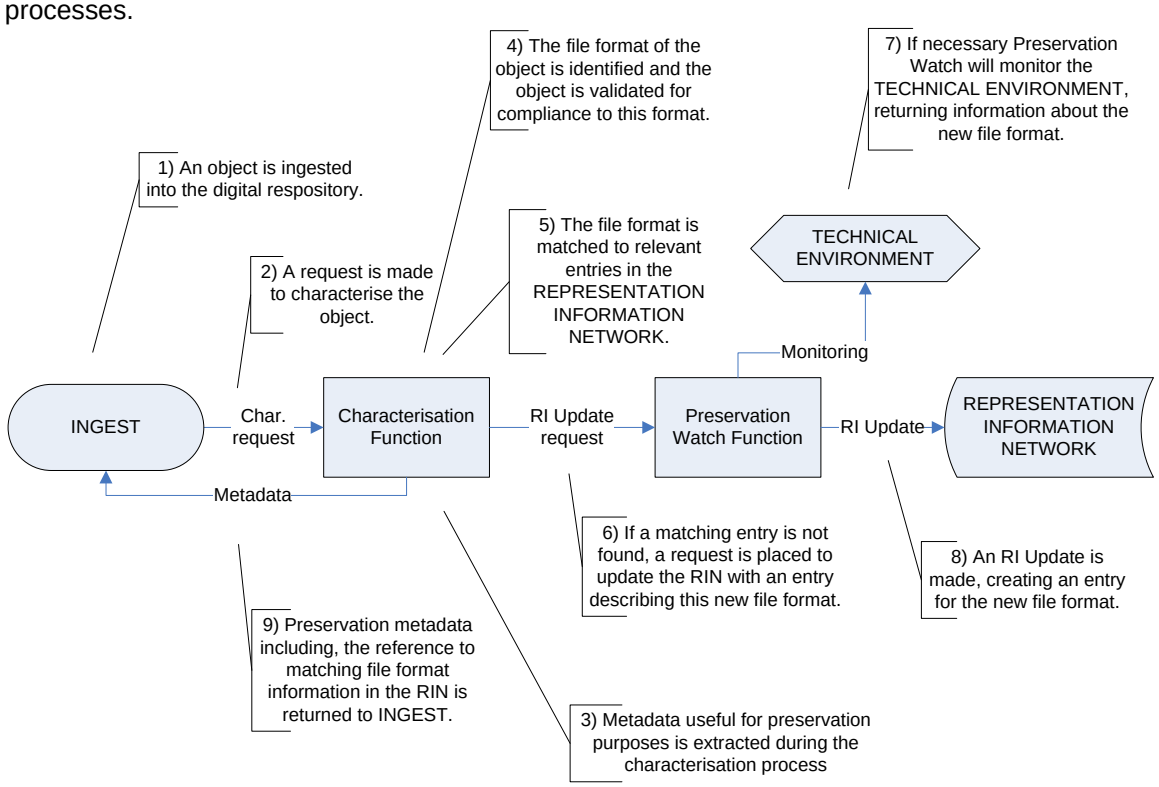
[5] We will use the term User Community for now. Later we will investigate the possible use of the term Designated Community (OAIS), and look at the work of the CASPAR project with respect to this topic.

2.4 Scenarios

This section provides scenarios which illustrate particular parts of the Planets Functional Model. These worked examples show how particular functions interact with each other as the key preservation processes are executed.

2.4.1 Object ingest

This scenario follows the key preservation processes that occur when a new object is ingested into a repository. Note that many of the operations generally associated with ingest are not described, as they are considered to be out of scope for this work. The focus is purely on preservation processes.



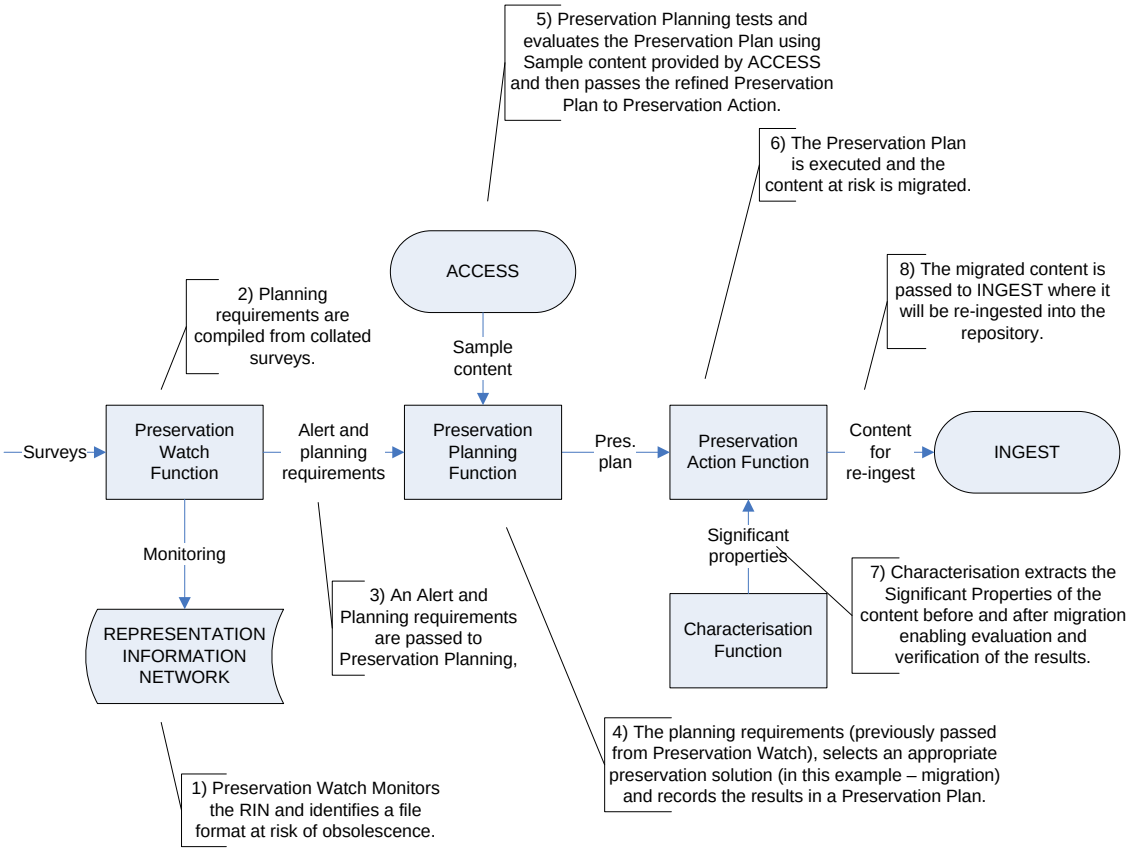
The processes shown above follow the characterisation of a new object during ingest. The Characterisation Function itself performs a range of characterisation processes. It extracts a range of metadata useful for preservation purposes. It also identifies the file format of the object, validates it to the format specification and attempts to match it to an entry describing that format in the Representation Information Network (RIN).

If a matching entry is not found in the RIN, this is a format the repository has not ingested before: an unknown file format. A request is passed to Preservation Watch which may pursue specific Monitoring of the Technical Environment in order to seek details of this new file format. An update is then made to the RIN.

Finally, the Metadata describing the characterised object (including a reference to the relevant file format information in the RIN) is passed back to the Ingest function.

Obsolescence and migration

This scenario follows a particular process when some digital objects are found to be in danger of obsolescence. In this example, the outcome is the migration of the digital objects. Note that the capture of surveys and requirements from the various internal and external entities has been left off this diagram due to space and readability issues. These are summarised with the “Surveys” interaction at the extreme left of the diagram.



The processes shown above follow the identification of digital objects in danger of obsolescence and subsequent actions taken to address this. The Preservation Watch Function is situated in the repository environment and it is supposed that this Preservation Watch Function is able to obtain detailed information about what type of objects (file formats etc.) are in custody in the repository. The Representation Information Network is constantly updated with new information as the result of monitoring of external entities by Preservation Watch. This could include updates on the obsolescence of a particular platform or tool. If this is the case, certain formats may be left with no method of rendering on current computing platforms. Monitoring of the RIN by Preservation Watch will identify formats at risk. Digital objects in danger are identified, and Preservation Watch will construct a set of Planning Requirements including factors such as the Usage Profile, the Organisation's Preservation Policy and any legal requirements. These are passed, along with an Alert, to Preservation Planning. Preservation Planning identifies possible preservation solutions and selects the most appropriate based on the Planning Requirements (in this example, a migration solution is selected). This decision is encapsulated in a Preservation Plan. This Plan is evaluated using Sample digital objects, refined if necessary, and then passed to Preservation Action for execution. Preservation Action requests Significant Properties before and after the Action to allow evaluation of the migration process. Finally the digital objects are re-ingested into the digital repository.

3. The OAIS functional view of Preservation Planning

In the OAIS model, Preservation Planning is clearly present as a separate entity at the top of the model.

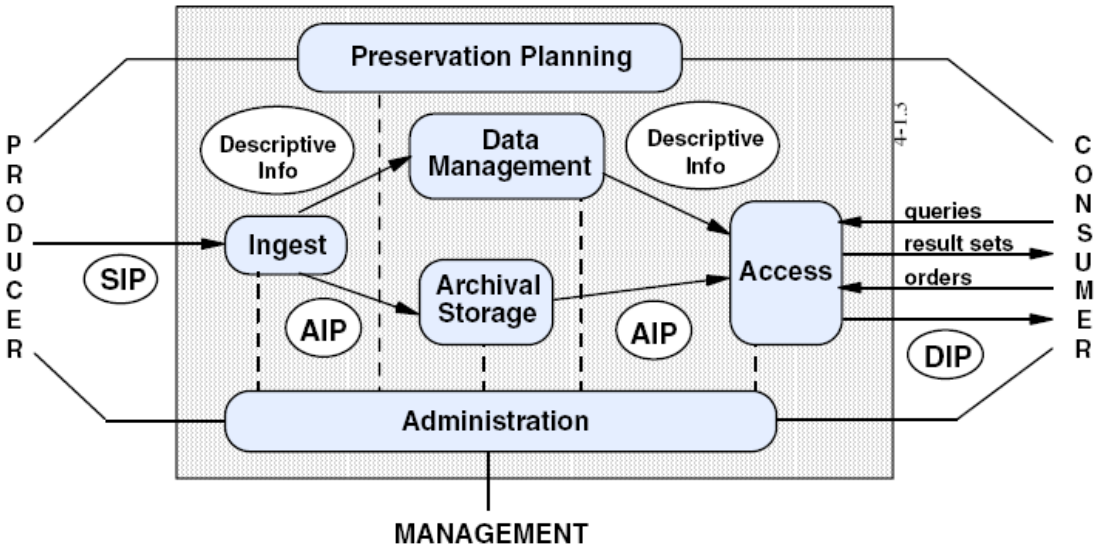


Figure 4-1: OAIS Functional Entities

As the drawing shows, there is not only a relation (dotted line) between Preservation Planning and Administration. There are also connecting lines between the Producer and Consumer and Preservation Planning.
Chapter 4 of the OAIS model describes the OAIS functions in detail. Only two pages are dedicated to the description of the Preservation Planning functionality (page 4-13 and 4-14). Preservation Planning is clearly not an isolated function and has more relations with other activities in the OAIS archive than described in those two pages. Scattered over the rest of the document there is more information to find and this adds to the better understanding of the Preservation Planning function.
We can distinguish two ways of looking at Preservation Planning in the OAIS model:

1. A view restricted to the actual function Preservation Planning, as described in chapter 4.
2. A view that combines the requirements you need in order to perform Preservation Planning, as hinted at in various places in the OAIS document.

Both viewpoints will offer valuable input for the activities of this work package. Section 3.1.2 provides a summary of the citations in the OAIS document in relation to Preservation Planning. After that the description of the Preservation Planning Function will be cited integrally.

3.1.1 Requirements to perform preservation planning

In chapter 2 the OAIS concepts are described. The OAIS itself is described as an archive which performs a long-term information preservation and access function. The data object combined with its related Representation Information leads to the Information Object, which is the subject of this preservation and access function and, as a consequence, of the Preservation Planning function. The creation of the necessary Representation Information is a result of several other functions elsewhere in the model (Ingest for example) and is related with functions like characterization, SIP and AIP control, file format checks etc.
In chapter 3 of the model, several responsibilities of an OAIS archive are described. These responsibilities, among the above mentioned functions, contribute to the actual completion of the requirements needed to perform Preservation Planning. For example the rule named on p. 3-1 "*Obtain sufficient control of the information provided to the level needed to ensure Long term Preservation* "(leading to correct SIPs and AIPs) and the rule "*Follow documented policies and procedures which ensure that the information is preserved against all reasonable contingencies, and which enable the information to be disseminated as authenticated copies of this original or as traceable tot the original*"(leading for example to authentication indicators and other metadata).

3.1.2 Summary of related Preservation Planning references

Scattered in the OAIS model document. several references are made to functionality related to preservation, while this is not explicitly mentioned as a preservation function. As this information might be of interest in the scope of this work package, this information was collected and summarized in the following table. The first column represents the OAIS source, the second column gives the relation to the functions mentioned in the Planets model on page 6.

OAIS references	**Relation to Planets preservation function**
The extra information required to preserve look & feel of an object, page 2-4	Characterization
OAIS mandatory responsibilities in relation to Preservation planning (p 3-1 etc), including references to legal issues, copyright, authority to change Representation Information and responsibilities to ensure information is preserved for the Designated Community.	Preservation Planning
The Audit submission function of Administration, as described on page 4-11, contributes to the correctness of SIPs and AIPs.	Preservation Planning.
Page 4-22 discusses the preservation of Access software and Representation Rendering Software.	Preservation Planning, Preservation Action.
4.4.6. mentions the preservation process history information that tracks the migration of AIPs, including media replacements and AIP transformations.	Preservation Planning, Preservation Action, Representation Information.
Page 4.51 mentions the responsibility of the archive to maintain an active copy of the software or careful documentation of the internal formats so the data can be transferred to other systems in the future without loss of information.	Preservation Action, Representation Information.
Chapter 5 describes Preservation Perspectives in more detail, mainly about several Migration types (5.1).	Preservation Action.
Chapter 5.2 describes Access service preservation.	Preservation Action, Representation Information.
Chapter 5.2 describes emulation.	Preservation Action.

3.1.3 The OAIS functional description of Preservation Planning

This section quotes the entire 4.1.1.6 Preservation Planning chapter from OAIS, for easy reference in this document:

The functions of the Preservation Planning entity are illustrated in figure 4-6.

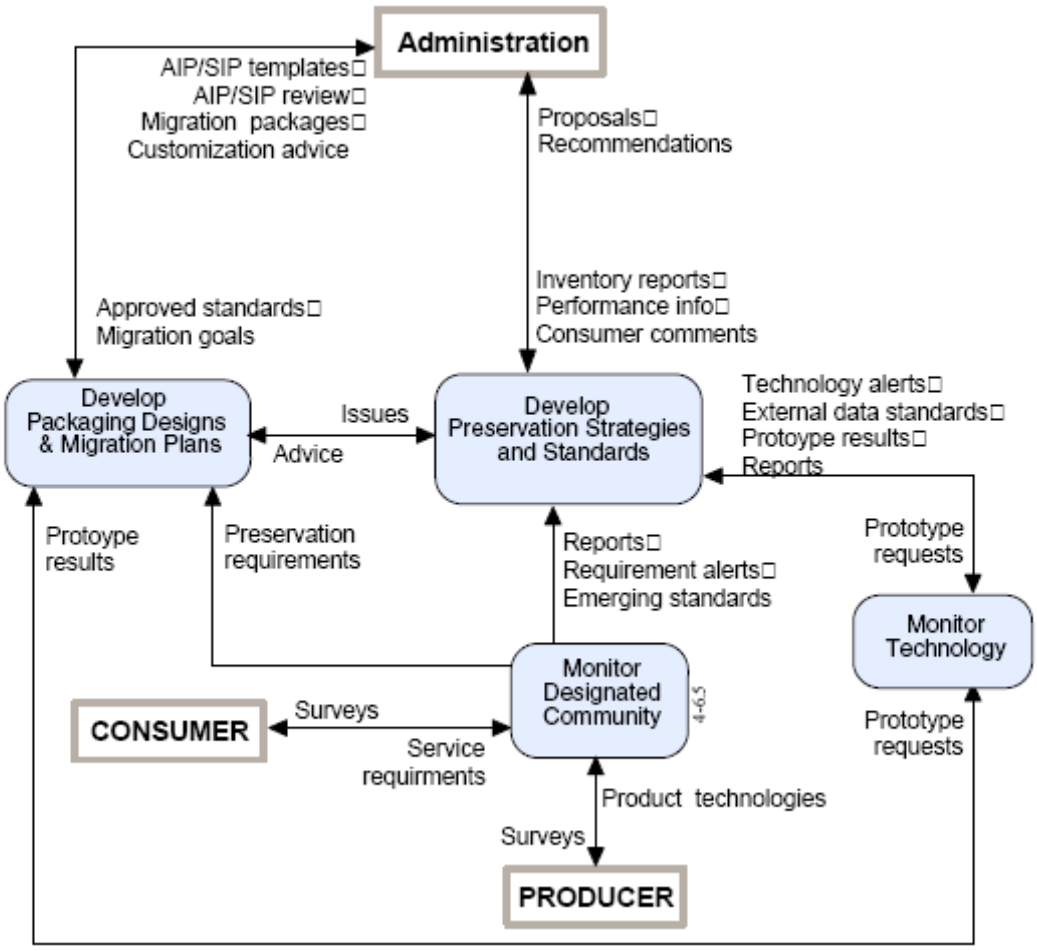


Figure 4-6: Functions of Preservation Planning

The **Monitor Designated Community** function interacts with archive Consumers and Producers to track changes in their service requirements and available product technologies. Such requirements might include data formats, media choices, preferences for software packages, new computing platforms, and mechanisms for communicating with the archive. This function may be accomplished via surveys, via a periodic formal review process, via community workshops where feedback is solicited or by individual interactions. It provides reports, requirements alerts and emerging standards to the Develop Preservation Strategies and Standards function. It sends preservation requirements to Develop Packaging Designs.

The **Monitor Technology** function is responsible for tracking emerging digital technologies, information standards and computing platforms (i.e., hardware and software) to identify technologies which could cause obsolescence in the archive's computing environment and prevent access to some of the archives current holdings. This function may contain a prototyping capability for better evaluation of emerging technologies and receive prototype requests from Develop Preservation Strategies and Standards and from Develop Package Designs and Migration Plans. This function sends reports, external data standards, prototype results and technology alerts to Develop Preservation Strategies and Standards. It also sends prototype results to Develop Package Designs and Migration Plans.

The **Develop Preservation Strategies and Standards** function is responsible for developing and recommending strategies and standards to enable the archive to better anticipate future changes in the Designated Community service requirements or technology trends that would require migration of some current archive holdings or new submissions. This function receives reports from the Monitor Designated Communities and Monitor Technology functions, and it receives performance information, inventory reports and summarized consumer comments from Administration. This function sends recommendations on system evolution to Administration. This function also receives external data standards from Monitor Technology and produces profiles of those standards that are sent to Administration as proposals on their potential usage. This function also receives issues from Develop Packaging Designs and Migration Plans in the case of unanticipated submission requirements, and responds with advice to handle the new requirements.

The **Develop Packaging Designs and Migration Plans** function develops new IP designs and detailed migration plans and prototypes, to implement Administration policies and directives. This activity also provides advice on the application of these IP designs and Migration plans to specific archive holdings and submissions. This function receives archive approved standards and migration goals from Administration. The standards include format standards, metadata standards and documentation standards. It applies these standards to preservation requirements and provides AIP and SIP template designs to Administration. This function also provides customization advice and AIP/SIP review to Administration on the application of those designs. If this function encounters submissions that are not covered by existing standards and procedures, it can send issues to Develop Preservation Strategies and Standards and receive advice, including new standards, to assist in meeting the new submission requirements. The migration goals received by this function tend to involve transformations of the AIP, including transformations of the Content Information to avoid loss of access due to technology obsolescence. The response to the migration goals may involve the development of new AIP designs, prototype software, test plans, community review plans and implementation plans for phasing in the new AIPs. This process may call on expertise or resources from other functions within Preservation Planning, such as prototype development from the Monitor Technology. This effort also will require consultation from the other functional areas and from the Designated Community. Once the migration plan, associated AIP designs, and software have been tested and approved, this function will send the entire migration package to Administration, which will schedule and perform the actual migration

4. Comparison: Planets to OAIS

The following sections represent the first comparison of the Planets Functions with the OAIS model. The intention is to identify elements in OAIS that may be missing, or inadequately articulated. The Planets Functions have been broken down into more specific functions where necessary. These have then been compared with OAIS, making particular reference to section 4.1 Detailed Description of Functional Entities, while also referring to other sections where sufficient detail was not available. An initial conclusion is then provided as to what changes might be needed in the OAIS model. This should be considered an initial indication only, and will be verified and refined by further activities within PP7, as noted above.

4.1 Preservation Planning

Planets function	Interactions	OAIS function	Conclusion
On receiving an alert from Preservation Watch, Preservation Planning evaluates requirements and develops a plan for preservation. This could result in a Preservation Action, an update to the rendering solution in the Representation Information Network, or a request to Preservation Action to develop a new Preservation Action.	Receives Planning requirements and Alerts from Preservation Watch. Receives Sample digital objects from Access. Sends RI Updates to RIN and receives RI back. Sends Preservation Plans and Requests for action development to Preservation Action and receives New preservation actions back.	There appears to be considerable overlap with the Develop Preservation Strategies and Standards function and the Develop Packaging Designs and Migration Plans (particularly the latter which results in Migration packages being sent to Administration). A lack of definition, explanation or clarity of these functions and interactions is problematic.	The process of planning for future preservation actions is not well described in OAIS. It is suggested that the terms used are defined and explained more clearly.

4.2 Characterisation

Planets function	Interactions	OAIS function	Conclusion
Characterisation of ingested data (identification of file format, validation of file format, extraction of other miscellaneous preservation metadata)[6]	Receives Characterisation requests from Ingest and returns Metadata. Sends RI update requests to Preservation Watch.	Although Representation Information is discussed in some detail, no specific mention is given to the process of characterising digital objects or extracting preservation related metadata in order to either populate RI networks or match digital objects to RI network entries. Generate Descriptive Info is identified as a function of Ingest, specifically for extracting descriptive metadata. This appears to indicate that extracting other kinds of metadata and more widely characterising digital objects has been omitted as	This function appears to be in keeping with the intentions of the OAIS authors, but has not been articulated clearly in OAIS. It is suggested that at the very least, the Generate Descriptive Info is expanded to cover preservation metadata.

[6] Characterization might have happened even before INGEST, for example Archives might (pro-actively) ask their suppliers to do Characterization before sending the objects to the Archive

		a key function of Ingest or Preservation Planning.	
Characterisation of object in order to extract Significant Properties before and after performing Preservation Actions in order to facilitate evaluation of those actions.	Receives Characterisation requests from Preservation Action and returns Metadata. Sends RI update requests to Preservation Watch.	This is not described as a specific function in OAIS, but is hinted at. The discussion around Access Software and source code availability (5.2.2.1) mentions the "need to establish mechanisms to verify that no preserved information has been lost." and the requirement that "...criteria have been established to clearly define what constitutes the Content Information...". Section 5.1.3.4 on Transformation discusses Reversible and Non-Reversible Transformations. It notes that this useful distinction may be difficult to establish with complex formats but offers no suggestion of alternative approaches to migration evaluation.	As with the first Characterisation function described above, this function appears to be in keeping with the intentions of the OAIS authors, but has not been articulated clearly in the 4.1.1.6 Preservation Planning. Adding a new Characterisation function would provide needed emphasis, and at the very least this should be referenced as part of an enhanced Archival Information Update that describes the Preservation Action process (including evaluation of the action) in more detail.

4.3 Preservation Action

Planets Function	Interactions	OAIS Function	Conclusion
Performing preservation actions on digital objects.	Receives Preservation plans from Preservation Planning and receives Digital objects from Access. Sends Characterisation requests to Characterisation and receives Metadata back. Sends Digital objects for re-ingest to Ingest after the preservation action has been performed.	This appears to be covered by the OAIS Administration function, termed Archival Information Update. Very little information is provided on this function, although the broader concept of migrating data is discussed elsewhere in detail. As noted above, some reference is made to basic approaches to verifying that data has not been lost during migration. This is not discussed in much detail and is not clearly expressed as a key preservation function. One interpretation of the way this function is described in OAIS is that once a Preservation Plan (OAIS) has been developed, executing it is considered an	A range of options are available, and the option to be recommended by Planets requires further investigation: 1. Archival Information Update continues to fulfil this function but is described in more detail with reference to preservation actions and verification of those actions by analysis of the content (characterisation) 2. This function, as a key preservation process, is moved to (OAIS) Preservation Planning and articulated more clearly as a preservation activity. 3. Archival Information Update interacts with a Preservation Action function within Preservation Planning.

		Administrative function. The Planets view is that this is still an involved process which should remain within Preservation.	
Developing a new preservation action solution.	Receives Requests for action development from Preservation Planning, returning New preservation actions and sending New rendering modules to Access.	This is not expressly identified as a key OAIS function. Develop Preservation Strategies and Standards appears to cover this function, but this is unclear. OAIS seems to imply that that the developed "Preservation Strategies" are at a high level, as they result in proposals, rather than any concrete tools or solutions. The term "Preservation Strategy" is not well defined. This function sends "Migration packages" to Administration, but it is not clear what these are. The need to develop new Access Software is touched on in section 5.2.2 but this does not specifically mention migration or other preservation action tools or solutions.	This would appear to quite naturally fit within OAIS as a sub-function of Develop Preservation Strategies and Standards. Indeed, the OAIS authors may have intended this to be the case, but it is currently unclear from the existing description. The function needs to be described in more detail. It also needs to adequately cover forms of preservation action other than just migration.

4.4 Preservation Watch

Planets function	Interactions	OAIS function	Conclusion
Monitor User Community	Preservation Watch performs Monitoring of User community, returning User requirements.	This function maps quite simply to the Monitor Designated Community function in OAIS. A significant input to the Preservation Planning Function in Planets is to understand and take into account user requirements. This reflects the OAIS function well.	OAIS focuses on monitoring the Producer and Consumer only. There is some value in combining these functions with the other entities that will feed into the preservation planning process, as suggested in the Planets approach (Preservation Watch).
Monitor Organisation	Preservation Watch performs Monitoring of the Organisation, returning Institutional policy.	This does not appear to be specifically articulated within OAIS.	
Monitor Producer	Preservation Watch performs Monitoring of the Producer, returning Surveys.	This function maps broadly to the Monitor Designated Community (Producer) in OAIS.	
Monitor Technical Environment	Preservation Watch performs Monitoring of the Technical	This function maps broadly to the Monitor Technology Function in OAIS.	

	Environment, returning Surveys.		
Monitor Representation Information Network (and updating of Representation Networks)	Preservation Watch performs Monitoring of the Representation Information Network, returning Preservation warnings.	This function is not represented within the functional model in OAIS. The Planets view follows the Cedars approach in more clearly articulating the OAIS view of Representation Networks to describe the rendering as well as the meaning of digital objects (see Representation Network definition, above). OAIS describes the Manage System Configuration function as sending “OAIS performance information” and “inventory reports” to Preservation Planning. This could be related to this function, but this is unclear.	Monitoring of digital objects or (as in the Planets view) monitoring of the representation information which describes how the digital objects can be rendered, must be performed in order to trigger preservation actions when obsolescence occurs. This does not seem to be clearly articulated in OAIS. Expanding the OAIS view on Representation Information to follow the Cedars perspective (as noted on the left) would be useful. This is hinted at in OAIS in 4.2.1.3.2 with mention of Access Software.

5. Comparison: OAIS to Planets

In the following tables a first attempt has been made to compare the Planets Functional View with the OAIS Preservation Planning functions, described in par. 4-13 and 4-14 of the OAIS model. At this stage no attention is given to "hidden preservation planning information" located elsewhere in the OAIS model.
Key subjects of study were the inputs and outputs of the OAIS functions. These were matched with the interactions between the Planets functions.

5.1 Develop Preservation Strategies and Standards

OAIS Function	Interactions and detail	Planets Function	Conclusion
Develop Preservation Strategies and Standards			
This function develops and recommends strategies and standards to enable the archive to better anticipate future changes in the Designated Community service requirements or technology trends that would require migration of some current archive holdings or new submissions.	• Receives reports from Monitor Designated Community • Receives reports from Monitor Technology • Receives external data standards from Monitor Technology	Preservation Watch Function receives surveys based on monitoring the Technical Environment, the User Community and the policies of the Organisation and Producer.	The Planets model seems to cover the same information gathering as OAIS. OAIS does not speak explicitly about Monitoring the Organisation, as in Planets, but this may be considered to be implicit in the Administration function (where repository issues are monitored).
	Receives issues from DPDM Sends advice to DPDM		See 5.2
	Sends recommendations for system evolution to Administration		OAIS uses the term "system evolution" in this context. The current Planets model concentrates on the digital objects to be preserved; this topic will be dealt with in the next phase..
	Sends profiles of external data standards to Administration as proposals on their potential usage		The Preservation Watch function monitors the Technical Environment and will keep track of "external data standards". The OAIS terminology however is not clear in this respect.

5.2 Develop Packaging Designs and Migration Plans

OAIS function	Interactions and detail	Planets Function	Conclusion

Develop Packaging Designs and Migration plans			
Develops new IP designs and detailed migration plans and prototypes, to implement Administration policies and directives			
	- Receives Migration Goals from Administration - Receives Archive Approved Standards (format standards, metadata standards, documentation standards) from Administration	Preservation Watch Function will deduce the requirements from the Monitoring activities.	Again, clarification is needed as to the roles of these “Standards”. Use of the word Standard appears to be misleading.
	Provide customization advice and AIP/SIP review to Administration Sends advice on application of new IP designs (AIP/SIP template designs) to Administration	The current model of Planets will be augmented with repository preservation functionality in the next phase, as noted above.	It is not clear what OAIS means by “customization advice”
	Sends Migration Packages to Administration	Preservation Planning functions offers several strategies based on requirements from Preservation Watch, and will send these to Preservation Action	See the discussion in 4.3
	Send issues to Develop Preservation Strategies & Standards and receives advice from Develop Preservation Strategies & Standards regarding new submissions	Preservation Watch Function monitors the Producer and will update the Representation Information Network as required.	

5.3 Monitor Designated Community

OAIS Function	**Interactions and detail**	**Planets function**	**Conclusion**
Monitor Designated Community			
Interacts with archive Consumers and Producers to track changes in their service requirements and available product technologies			

	Accomplished via surveys, via a periodic formal review process, via community workshops or by individual interactions	Preservation Watch Function monitors the User Community and the Producer	No changes needed.
	Provides reports, requirements alerts and emerging standards to the Develop preservation Strategies and Standards functions.	Preservation Watch Function sends Alerts and Planning Requirements to the Preservation Planning Function.	Planets and OAIS are broadly aligned here, but again there is some doubt of over the use of the term “standards”.
	Sends Preservation requirements to Develop Packaging Designs	Preservation Watch Function sends Planning requirements to Preservation Planning Function. The topic of Packaging Designs will be dealt with in the next phase of PP7.	

5.4 Monitor technology

OAIS function	Interactions and detail	Planets Function	Conclusion
Monitor technology			
Responsible for tracking emerging digital technologies, information standards and computing platforms to identify technologies which could cause obsolescence in the archive’s computing environment and prevent access to some of the archive current holdings.		The Preservation Watch Function monitors the Technical Environment.	This is equivalent to the Monitoring of the Technical Environment by Preservation Watch in the Planets Functional View.
	May contain prototyping capability for evaluation of emerging technologies Receive prototype requests from Develop Preservation Strategies and Standards Receive prototype requests form Develop Package Designs and Migration Plans Send prototype results to Develop Package Designs and Migration plans	This appears to touch on a number of aspects of Planets. Development of new approaches to preservation lies within Preservation Action and is supported by a Testbed facility. Evaluation of alternative preservation approaches can be found within Preservation Planning. Preservation Watch monitors the Technical Environment and	Planets may need to identify a specific prototyping or evaluative function, which might lie within Preservation Watch or Preservation Planning. This needs further investigation.

		updates metadata describing new preservation capabilities.	
	Sends reports, external data standards, prototype results and technology alerts to Develop Preservation Strategies and Standards		See 5.1

6. Conclusions

1. Although the OAIS model is a widely adopted ISO standard, it is clear that there are a number of issues with the Preservation Planning concepts and their articulation. These issues are highlighted when a comparison is made with work based on more recent digital preservation thinking, such as Planets. OAIS lacks explicit definitions of key terms and does not include sufficient description of the Preservation Planning functions.
2. While the main focus on preservation is found in chapter 4.1.1.6, key preservation concepts are discussed in other chapters. At the time OAIS was authored, these concepts were based predominantly on theory and consequently were not been clearly defined. Further research and practical experience have progressed preservation practice since this time. It should now be possible to draw together what were theoretical concepts into clearly articulated functions and processes. Ideally this should also extend to the requirements for OAIS compliance.
3. Key preservation processes within OAIS currently lie outside of the scope of the Preservation Planning functional entity, for example Migration (in Administration). Further consideration needs to be given to this arrangement and the possibility of moving these to the Preservation Planning function.
4. The interactions between preservation functions and mechanisms for managing preservation metadata (Representation Information Networks) need to be described, as these appear to be quite integral to the key preservation functions.
5. Important preservation functions appear to have been omitted from OAIS. In some cases this is because implicit notions have not been made explicit. For example Characterisation can be seen as a result of the OAIS rule “Obtain sufficient control of the information provided to the level needed to ensure Long term Preservation”.
6. OAIS places too much emphasis on migration, and not enough on other preservation strategies. Subsequent phases of PP7 may be able to explore how other preservation strategies such as migration on request or emulation can be adequately represented within the OAIS model. Modelling preservation actions that occur at the point of access requires further thought, and careful coordination with the Preservation Action sub project.
7. The use of the term “standards” within section 4.1.1.6of OAIS requires clarification.
8. The Preservation Watch Function brings together several monitoring functions and in this way will be able to combine this information into an appropriate set of requirements for Preservation Planning purposes. In the OAIS model such a coordinating function seems not to be present. Further investigation of this possibility, informed by the practical experiences of the PP work-packages, is required.
9. The Planets scope is tightly focused on supporting the preservation of digital objects, while the OAIS model also pays attention to the preservation of the repository itself. This topic needs some further investigation, which will be conducted in the second phase of PP7 (as noted above).
10. The OAIS model refers to (re-)defining packaging designs as a result of Preservation Planning actions. This is an area which has not been addressed in Planets.
11. The Planets Functional View may place too much emphasis on Characterisation as a key preservation function. Further thought needs to be given to incorporating Characterisation functions elsewhere. Characterisation of newly ingested objects could be moved to an expanded Generate Descriptive Info function within Ingest. Extraction of significant properties metadata to facilitate evaluation of Preservation Actions could be subsumed into the Preservation Action function (preliminary thinking from PA4 work-package matches this conclusion).
12. Planets should consider identifying a specific prototyping capability, in line with an element of the OAIS Monitor Technology function. This might draw together elements of Preservation Watch, Preservation Planning and the Planets Testbed facility.

7. Next Steps

Following this deliverable, PP7 will continue to review and refine the Planets Functional View and the mappings to OAIS. Continued review will ensure that the practical experiences of implementing preservation technology and applying it to the preservation of real collections will be reflected in this work. Further refinement will expand the detail of the Planets Functional View and incorporate feedback from project partners and external experts to ensure the work reflects best practice thinking.

A number of functional areas have not been considered in detail as part of this first deliverable. Subsequent work will incorporate analysis of these areas, developing the level of detail and placing the Planets developments in the context of other related work. This includes areas such as Representation Networks and File Format Registries, Packaging Designs

The wider scope of the work-package will also be expanded during the next phase. PP7 will explore which other standards might be influenced by the work of Planets. This will at first take the form of a scoping exercise. Subsequent phases of the work will develop mappings and comparisons to selected standards.

Key tasks to be explored during the next phase of PP7:

1. Consultation and review process with Planets Project partners
    a. This will focus on communicating the Planets functional view to the various sub-projects and work-packages and gathering feedback
2. Revision of Planets functional view
    a. Incorporation of feedback from the wider Planets Project
    b. Addition of detailed views of each Planets function, identifying and describing sub-functions
3. Addition of elements not supported by Planets technology.
    a. This will include a focus on support for the preservation of the repository and not just the digital objects, as is currently covered by OAIS
4. Analysis of other functional areas, such as Representation Networks
    a. This will place Planets developments within the wider context of related work, focusing on terminology, function and synergy
5. Perform second comparison between Planets and OAIS
6. From OAIS to Planets and Planets to OAIS, utilising the revised Planets view and further thinking on other functional areas
7. Review results
    a. Ensuring progress and approach is appropriate
8. Scoping of additional preservation or archival standards for further consideration
9. Production of second deliverable, including:
    a. Revised Planets Functional View
    b. Analysis of additional functional areas
    c. Revised comparison between Planets and OAIS