



SASIG Long Term Archiving & Retrieval of Digital Product Definition Data Process Recommendation



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FOREWORD

Many companies are migrating or have migrated their product definition and lifecycle management authoring processes from traditional hard-copy, paper based document management processes to processes that highly leverage computer aided/digital information creation techniques. As a consequence of this activity, new processes must also be defined to archive digital information and preserve access to it, in compliance with business and regulatory requirements.

Certain classes of product definition data specify multi-decade retention periods. Over these time periods, changes in both the editing and storage technologies impact an organization's ability to retrieve and use product information. All organizations which use digital product information will need strategies and processes that maintain the usability of the information over multiple generations of technology.

The SASIG Long Term Archiving & Retrieval Project is developing a set of recommendations to guide companies to effective and efficient archival and retrieval practices. The recommendations are partitioned into four topic areas: 1) Format, 2) LTAR Process, 3) Time Period, and 4) Quality Assurance.

This document addresses the set of process recommendations. In particular this document aims to provide a company with the key activities, inputs, outputs, controls and mechanisms needed to fully support the long term archiving and retrieval of product definition information. Using the Consultative Committee for Space Data Systems (CCSDS) Recommended Practice 650.0-M-2 Reference Model for an Open Archival Information System (OAIS), Issue 2 (Consultative Committee for Space Data Systems, 2012) as the foundation framework, the SASIG Long Term Archiving & Retrieval Project developed seven comprehensive process flow models depicting the activities and data flows needed to support archival and retrieval from the automotive perspective.



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TABLE OF CONTENTS

FOREWORD	3
ACKNOWLEDGEMENTS	4
TABLE OF CONTENTS	5
FIGURES	5
TABLES	6
INTRODUCTION: LONG TERM ARCHIVING & RETRIEVAL (LTAR)	7
1.1 OVERVIEW	9
1.2 ALIGNMENT WITH OAIS	10
1.3 LTAR PROCESS FLOW MODEL	22
1.3.1 Introduction	22
2 DEFINITION OF ROLES	23
GLOSSARY (JAMA)	23
3 PROCESS OVERVIEW	24
3.1 PREPARATION	24
3.2 INGEST AND ARCHIVING	26
3.3 MONITOR ARCHIVAL STORAGE	28
3.4 UPDATE DI	29
3.5 MAINTAIN ARCHIVAL STORAGE.....	30
3.6 RETRIEVAL	31
3.7 DISCARD AIP.....	32
APPENDIX A – DATA FLOW DIAGRAM	34
APPENDIX B: IDEFO DIAGRAMS	35
B.1 HOW TO READ AN ACTIVITY DIAGRAM	35
B.2 IDEFO DETAILED DIAGRAMS	37
MAINTENANCE REQUEST	47

Figures

FIGURE 1: LONG TERM ARCHIVING AREAS OF RECOMMENDATION	8
FIGURE 2 - SWIM LANE DIAGRAM SYNTAX	22
FIGURE 3 - LTAR PROCESS OVERVIEW	24
FIGURE 4 - PREPARATION PROCESS FLOW COLLECT INFORMATION NECESSARY FOR LTAR.....	25
FIGURE 5 - INGEST AND ARCHIVING PROCESS FLOW	27
FIGURE 6 - MONITOR ARCHIVAL STORAGE PROCESS FLOW.....	28
FIGURE 7 - UPDATE DI PROCESS FLOW.....	29
FIGURE 8 - MAINTAIN ARCHIVAL STORAGE PROCESS FLOW	30
FIGURE 9 - RETRIEVAL PROCESS FLOW	31
FIGURE 10 - DISCARD AIP PROCESS FLOW	33



FIGURE 11 - ACTIVITY MODEL DECOMPOSITION.....	35
FIGURE 12 – IDEF0 A0 DIAGRAM – LTAR TOP ACTIVITY	38
FIGURE 13 - IDEF0 A0 DIAGRAM – PERFORM LTAR	39
FIGURE 14 - IDEF0 A1 DIAGRAM – PREPARE INFORMATION FOR ARCHIVE	37
FIGURE 15 - IDEF0 A13 DIAGRAM – PREPARE FOR LTAR	40
FIGURE 16 - IDEF0 A131 DIAGRAM – PREPARE TRANSLATED DATA	41
FIGURE 17 - IDEF0 A1312 DIAGRAM – CONFIRM TRANSLATED DATA.....	42
FIGURE 18 - IDEF0 A132 DIAGRAM – PREPARE SIP	43
FIGURE 19 - IDEF0 A2 DIAGRAM – PREFORM ARCHIVING ACTIVITIES.....	44
FIGURE 20 - IDEF0 A24 DIAGRAM – PERFORM MAINTENANCE ACTIVITIES.....	45
FIGURE 21 - IDEF0 A3 DIAGRAM – RETRIEVE INFORMATION	46

Tables

TABLE 1 - MAPPING TABLE SPECIFYING LTAR ICOM TO OAIS ICOM.....	21
TABLE 2 - DESCRIPTION OF ROLES	23
TABLE 3 - EXAMPLES OF 3D MODEL INFORMATION SUBJECT TO COLLECTION	25



INTRODUCTION: LONG TERM ARCHIVING & RETRIEVAL (LTAR)

In today's engineering and manufacturing organizations, paper based product design and analysis approaches have been or soon will be replaced by computer-based solutions that digitally store and manage the product definition information. New business processes, information architectures and models, and hardware/software infrastructures have been deployed within the OEM and supply communities to effectively leverage the initial usage of this newly created digital information.

However, the processes, models, and infrastructural designs for addressing the long term archival and retrieval of the digital information have not been widely deployed. Long term archival and retrieval has been a challenge because any solution requires alignment of storage media, data architecture, authoring/editing software, and hardware infrastructure. Such an alignment can be difficult to achieve because each of these components have their own unique lifecycle durations.

Until recently, the relative newness of digitally managed product definition and lifecycle information has afforded companies with the opportunity to ignore Long Term archival issues. However, many companies have now reached a level of maturity with digital product lifecycle information management so that issues pertaining to data archival and retrieval have become paramount with respect to their near-term business plans and economic viability.

The recommendations developed by this project have been designed to guide companies to effective and efficient archival and retrieval practices. Specific recommendations address Format, the LTAR Process, Time Period, and Quality Assurance. In addition, the project will develop a test bed capability for assessing an enterprise's LTAR capability.

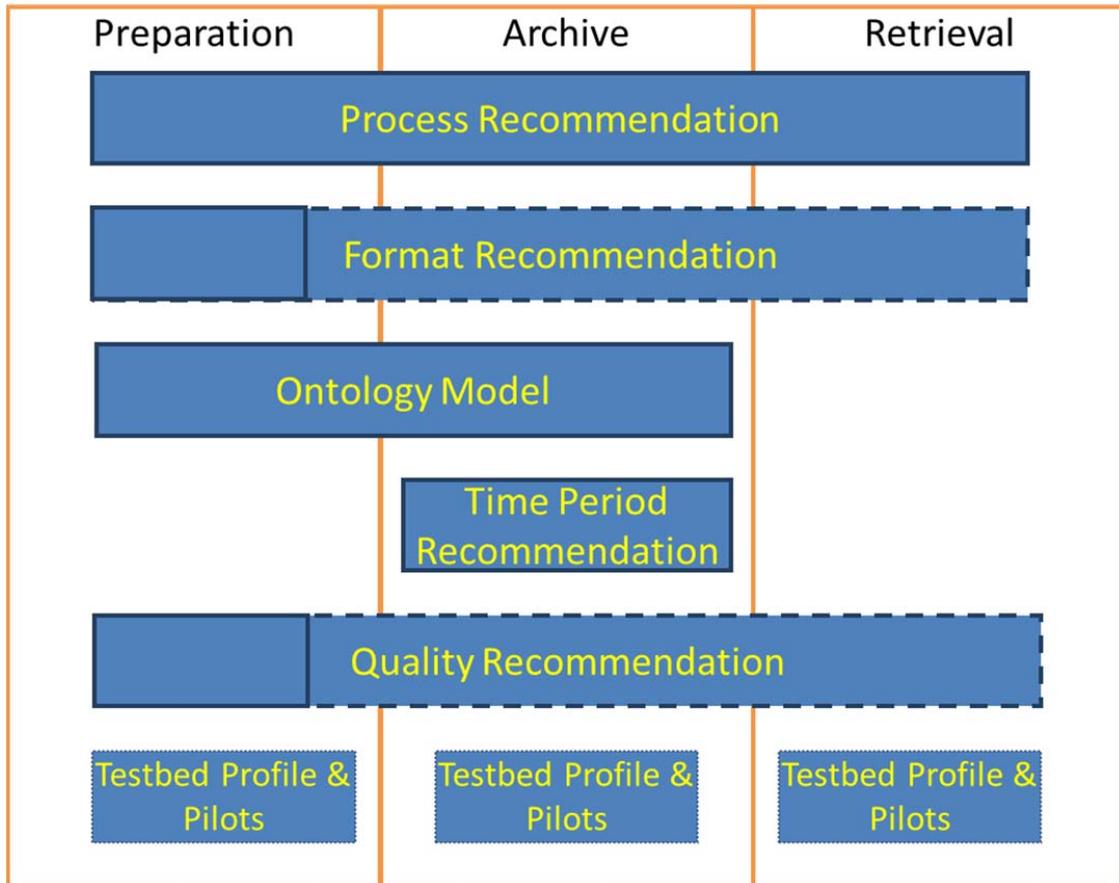


Figure 1: Long Term Archiving Areas of Recommendation

This document addresses the set of process recommendations. In particular this document aims to provide a company with the key activities, inputs, outputs, controls and mechanisms needed to fully support the long term archiving and retrieval of product definition information. Using the Consultative Committee for Space Data Systems (CCSDS) Recommended Practice 650.0-M-2 Reference Model for an Open Archival Information System (OAIS), Issue 2 (Consultative Committee for Space Data Systems, 2012) as the foundation framework, the SASIG Long Term Archiving & Retrieval Project developed seven comprehensive process flow models depicting the activities and data flows needed to support archival and retrieval from the automotive perspective. To aid in the understanding of the process models a data flow diagram and a set of IDEF0 activity models are included within the Process Recommendations appendix.



SASIG LTAR Process principles

1.1 Overview

OAIS Reference Model is well known as a model for long term archiving of digital information. The OAIS Reference Model starts with a data producer submitting an information package that is delivered by to the archival system for use in the construction or update of one or more archival packages and/or the associated descriptive information. This initial submission package is identified as a Submission Information Package (SIP). Since the data contained in the SIP can have different origins and maybe provided in different formats, SASIG decided to introduce in this recommendation a new process called Preparation. This process collects/gathers information from different locations to generate SIP and translation data. For example, in the engineering domain when 3D models are archived for a long time, the management information and product characteristic information should be collected from systems such as PDM or BOM in addition to a 3D model in order to generate SIP.

To facilitate the process flow development, an IDEF0 model was developed, and activities necessary for LTAR were defined. Each activity was assigned to a role and then, flow charts were made. Activity numbers in the flow charts correspond to those in the IDEF0 model. Refer to APPENDIX B – IDEF0 Diagrams for the IDEF0 model.

Preparation process may be started before the end of production of part, although LTAR time period starts at the end of production of part. In this case, the process started before the end of production of part does not need to be performed again after the end of production of part.

As a precondition to LTAR process, the information subject to LTAR, the archiving period of LTAR data and the LTAR format should be defined following each company's operational rules.



1.2 Alignment with OAIS

SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
SIP (Submission Information Package)	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Submission Information Package (SIP):	An Information Package that is delivered by the Producer to the OAIS for use in the construction or update of one or more AIPs and/or the associated Descriptive Information.
DIP (Dissemination Information Package)	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Dissemination Information Package (DIP):	An Information Package, derived from one or more AIPs, received by the Consumer in response to a request to the OAIS.
Information necessary for archive	The set of information that is to be prepared for archive (prior to SIP generation). The specific content is defined by Company Specific Rules / Standards.	No direct mapping	--
Archiving request	The trigger that the LTAR system preserve the data products created by the Producer. This event may be initiated by the Producer or LTAR Management. The Producer establishes a Submission Agreement with the LTAR system, which identifies the SIPs to be submitted and may span any length of time for this submission.	Request / Storage Request	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Company specific rules/standards	Set of information that establishes the organization's guidelines and policies that specify the criteria for ingestion of information.	Guidelines for ingestion of information and rules for dissemination and duplication	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)
Information necessary for maintenance activities	Set of information that establishes the organization's guidelines and policies that specify the criteria for maintenance of archival information package (AIP).	No direct mapping	--
Information to update DI	Set of information that identifies which AIPs need to be maintained according to listing and or updated rules that apply to one or more AIPs.	No direct mapping	--
Information to maintain Archival Storage	Set of information that identifies which LTAR system components require maintenance and the associated actions that are needed.	No direct mapping	--
Information to Discard AIP	Organization established guidelines and policies that specify the operation rules and process for LTAR AIP data whose archiving period has expired or otherwise deemed discardable.	No direct mapping	--



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Information for query	Organization established guidelines and policies specify a set of criteria for retrieval of information.	No direct mapping	--
Data Preparation	This mechanism identifies the section of OAIS that corresponds to the Prepare Information for Archive activity (A1)	Data Submission Session	A delivery of media or a single telecommunications session that provides Data to an OAIS. The Data Submission Session format/contents is based on a data model negotiated between the OAIS and the Producer in the Submission Agreement. This data model identifies the logical constructs used by the Producer and how they are represented on each media delivery or in the telecommunication session.
Ingest	This mechanism identifies the section of OAIS that corresponds to the Perform Archiving activity (A2)	Ingest Functional Entity	The OAIS functional entity that contains the services and functions that accept Submission Information Packages from Producers, prepares Archival Information Packages for storage, and ensures that Archival Information Packages and their supporting Descriptive Information become established within the OAIS.
Data Management, Archival Storage	This mechanism identifies the section of OAIS that corresponds to the Perform Archiving activity (A2)	Data Management Functional Entity	The OAIS functional entity that contains the services and functions for populating, maintaining, and accessing a wide variety of information. Some examples of this information are catalogs and inventories on what may be retrieved from Archival Storage, processing algorithms that may be run on retrieved data, Consumer access statistics, Consumer billing, Event Based Orders, security controls, and OAIS schedules, policies, and procedures.
Access	This mechanism identifies the section of OAIS that corresponds to the Retrieve Information activity (A3)	Access Functional Entity	The OAIS functional entity that contains the services and functions which make the archival information holdings and related services visible to Consumers.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Database, management ledger	Database record that characterizes the AIP	No direct mapping	--
Log of storage or update of DI	The tracking information associated with the storing or updating event.	Data Management Data:	The data created and stored in Data Management persistent Storage that refer to operation of an Archive
DI (Descriptive Information)	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Descriptive Information	The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers
Collected information	A set of information that is the original target of preservation prior to being validated for completeness and correctness.	No direct mapping	--
Error report	Result of validation or translation activity signaling that the collection/translation of information necessary for LTAR did not complete successfully.	No direct mapping	--
Information as source of archive	The Collected Information that has been validated from the perspective that all required items are included.	No direct mapping	--
PDI (Preservation Description Information)	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Preservation Description Information (PDI)	The information which is necessary for adequate preservation of the Content Information and which can be categorized as Provenance, Reference, Fixity, Context and Access Rights Information.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Translated data	Transformation knowledge regarding the converting of Information As Source Of Archive into LTAR format.	No direct mapping	--
Decision report	Result of data translation activity signaling that the collection of information necessary for LTAR completed successfully.	Report / QA Report	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)
Translation report	Documented transformation knowledge regarding the converting of Information As Source Of Archive into LTAR format.	Report / QA Report	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)
Check list, Threshold	The criteria for acceptance and the allowable variation for each criteria item.	No direct mapping	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Quality Assurance function validates (QA results) the successful transfer of the SIP to the temporary storage area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Verification rules	Guidelines and rubrics for performing verification activities that establish that an item is exact.	No direct mapping	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Quality Assurance function validates (QA results) the successful transfer of the SIP to the temporary storage area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors.
Validation report	Description that compiles the result of an comparison assessment to determine compliance with verification rules.	Potential error notification, Error Logs,	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Quality Assurance function validates (QA results) the successful transfer of the SIP to the temporary storage area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors.
Verification report	Description that compiles the result of an exactness assessment to determine compliance with verification rules.	Potential error notification, Error Logs	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Quality Assurance function validates (QA results) the successful transfer of the SIP to the temporary storage area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Decision report	Description that identifies an affirmative decision to ingest and create the SIP.	Potential error notification, Error Logs	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Quality Assurance function validates (QA results) the successful transfer of the SIP to the temporary storage area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors.
DI for new storage or update	Set of information describing meta data for identification of AIP.	No direct mapping	Descriptive Information: The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.
DI for reflecting results of maintenance activities	Set of information describing meta data necessary to update the AIP with regards to revised company LTA policies.	No direct mapping	Descriptive Information: The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.
DI for update	Set of AIP DI to be used for update.	No direct mapping	Descriptive Information: The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.
DI for reflecting results of maintenance of Archival Storage	Set of maintenance DI to be used for update.	No direct mapping	Descriptive Information: The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
DI for reflecting results of discard	Set of discard DI to be used for update.	No direct mapping	Descriptive Information: The set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.
Records of maintenance of Archival Storage	Documentation regarding infrastructure maintenance activities.	Reports and Logs	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Manage System Configuration function provides system engineering for the Archive system to monitor continuously the functionality of the entire Archive system and systematically control changes to the configuration. This function maintains integrity and traceability of the configuration during all phases of the system life cycle. It also audits system operations, system performance, and system usage. It sends report requests for system information to Data Management and receives reports; it receives operational statistics from Archival Storage. It summarizes those reports and periodically provides OAIS performance information and Archive holding inventory reports to Preservation Planning. It receives migration packages from Preservation Planning, based on which it sends change requests, procedures and tools to the Archival Information Update function. It receives system evolution policies from the Establish Standards and Policies function.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Monitoring report	Results of performing AIP monitoring activity.	Reports and Logs	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Manage System Configuration function provides system engineering for the Archive system to monitor continuously the functionality of the entire Archive system and systematically control changes to the configuration. This function maintains integrity and traceability of the configuration during all phases of the system life cycle. It also audits system operations, system performance, and system usage. It sends report requests for system information to Data Management and receives reports; it receives operational statistics from Archival Storage. It summarizes those reports and periodically provides OAIS performance information and Archive holding inventory reports to Preservation Planning. It receives migration packages from Preservation Planning, based on which it sends change requests, procedures and tools to the Archival Information Update function. It receives system evolution policies from the Establish Standards and Policies function.
Security policy	Organization constraints (access control, confidentiality, retrieval control, etc.) on queries about the archived data.	Security Policy	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Establish Standards and Policies function is responsible for establishing and maintaining the Archive system standards and policies...It will also determine security policies for the contents of the Archive, including those affecting Physical Access Control, such as DRM, and the application of error control techniques throughout the Archive.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Query results	Set of archival information returned corresponding to a set of inquiry criteria.	Query Response	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Perform Queries function (of Data Management) receives a query request from Access and executes the query to generate a query response that is transmitted to the requester.
Retrieval log	Tracking information associated with the retrieval of a specific DIP.	DIP Query Response Reports	Informal term, not defined within OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2) The Deliver Response (of the Access Functional Entity) function handles both on-line and off-line deliveries of responses (DIPs, query responses, reports and assistance) to Consumers. For on-line delivery, it accepts a response from Coordinate Access Activities and prepares it for on-line distribution in real time via communication links. It identifies the intended recipient, determines the transmission procedure requested, places the response in the temporary storage area to be transmitted, and supports the on-line transmission of the response. For off-line delivery it retrieves the response from the Coordinate Access Activities function, prepares packing lists and other shipping records, and then ships the response. When the response has been shipped, a notice of shipped order is returned to the Coordinate Access Activities function and billing information is submitted to Administration.
CAX equivalence validation	Describes how to compare and validate equivalence of CAX data in order to enable data reproducibility for a CAX data conversion. CAX data equivalence is classified into three categories, visual equivalence, shape equivalence and semantic equivalence.	No direct mapping	--



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Decision policy	Description that identifies the process and rules for determining whether to grant an affirmative decision to ingest and create the SIP.	No direct mapping	--
AIP (Archival Information Package)	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Archival Information Package (AIP)	An Information Package, consisting of the Content Information and the associated Preservation Description Information (PDI), which is preserved within an OAIS.
activity logs	The tracking information associated with performing maintenance activities.	No direct mapping	Error logs are monitored to ensure AIPs are not corrupted during transfers. These also provide operational statistics to Administration summarizing the inventory of media on-hand, available storage capacity in the various tiers of the storage hierarchy, and usage statistics.
Retrieval request	Retrieval request identifies the AIP into the set of operations and filenames needed to retrieve the AIP from the system used in archival storage, and then returns the Content Information and PDI for the requested AIP.	Retrieval Aid	An application that allows authorized users to retrieve the Content Information and PDI described by the Package Description. Retrieval Aid is generally part of the Archival Storage functional area. It translates from the unique identifier assigned by the OAIS to identify the AIP into the set of operations and filenames needed to retrieve the AIP from the file management system used in Archival Storage, and then returns the Content Information and PDI for the requested AIP.
Producer	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Producer	The role played by those persons or client systems that provide the information to be preserved. This can include other OAISs or internal OAIS persons or systems.



SASIG LTAR ICOM	SASIG definition	OAIS ICOM	OAIS definition
Consumer	Equal to OAIS (CCSDS RECOMMENDED PRACTICE 650.0-M-2)	Consumer	The role played by those persons or client systems, which interact with OAIS services to find preserved information of interest and to access that information in detail. This can include other OAISs, as well as internal OAIS persons or systems

Table 1 - Mapping table specifying LTAR ICOM to OAIS ICOM



1.3 LTAR Process Flow Model

1.3.1 Introduction

1.3.1.1 How to read a Process Flow diagram (AIAG)

A process flow model is a pictorial diagram that visually depicts the time phased or sequence of actions that are performed by a person, object, or computer system component in performance of a given procedure. They are typically used to document configuration management and process control requirements. There are multiple types of process flow models, each with their own syntax and symbol sets. The LTAR process flow models included in this recommendation are of the type known as a swim lane process flow models. Swim lane models identify organizational responsibility for a set of sub-processes. The model is portioned into multiple parallel regions or lanes, with each lane representing a different organizational responsibility or role. This role may be a person, group, system, or sub process. These types of process flow models are also known as cross-functional process map diagrams.

A swim lane may be arranged either horizontally or vertically and labels are used to identify the organizational responsibility for each lane. The LTAR process recommendation uses horizontal partitioning.

Activities comprising a particular sub process are shown as boxes and their layout is in a time phase or precedence sequence. Arrows connect the activity boxes together which implies how information or material is passed between activities (Data flow) within a sub process or between different role activities.

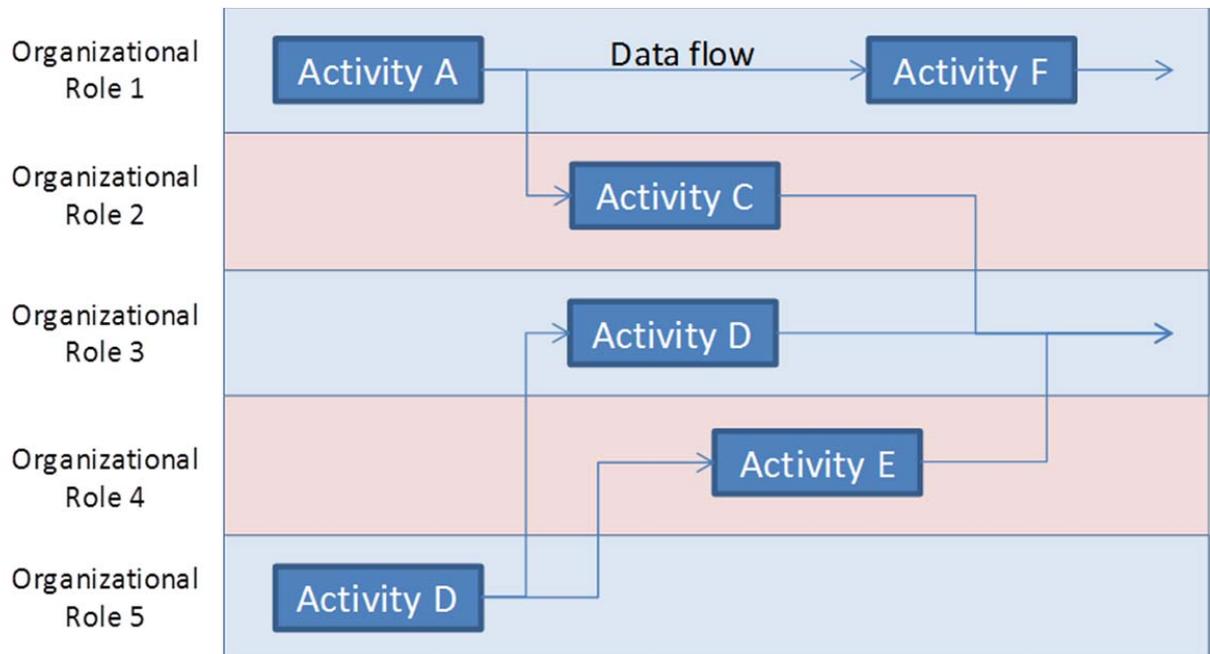


Figure 2 - Swim Lane Diagram Syntax



2 DEFINITION OF ROLES

This chapter describes the roles that appear in the LTAR process.

Table 2 lists the descriptions of roles.

Role	Description
Data Arrangement System	Refers to a system (generic name of workforce, IT system and operation) for collecting information for LTAR. Plays a role to collect information necessary for LTAR and translate it to generate SIP.
Quality Evaluation System	Refers to a system that evaluates the quality of data to be submitted to Archiving System. Plays a role to confirm whether data to be submitted meet the required standard (such as PDQ criteria) and to validate the equivalence of data before and after translating the formats
Data Approver	Refers to a person who approves LTAR data ingestion. Plays a role to decide whether to ingest data as LTAR data, based on the result of equivalence validation of data before and after translating to LTAR format and the standard defined by each company.
Archiving System	Refers to a system to archive LTAR data. Plays a role to ingest, archive and retrieve LTAR data.
Administrator	Refers to a person who administrates LTAR system Plays a role to request audit, update, maintenance and discard for Archiving System, and confirm the result..
Consumer	Refers to a person who receives services of LTAR system. Refers to LTAR data.

Table 2 - Description of Roles

Glossary (JAMA)

Activity Definition : see the Process Flow Model section that provides activity definitions.



3 PROCESS OVERVIEW

This chapter describes the overview of the LTAR process.

Figure 3 shows the overall view of the LTAR process.

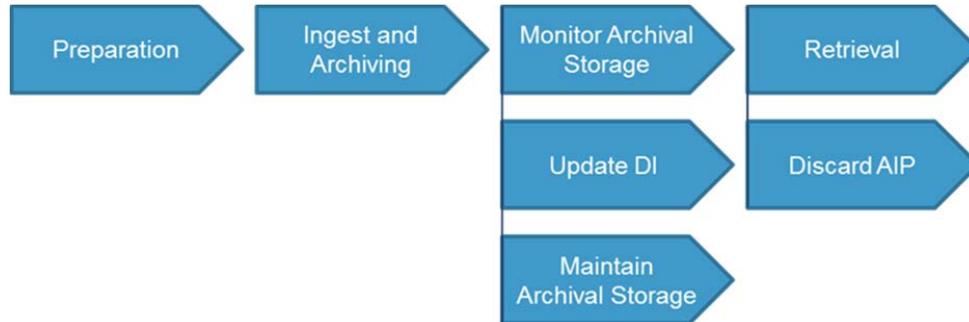


Figure 3 - LTAR Process Overview

The LTAR process is composed of seven processes detailed in this guideline.

The first process is the Preparation process. The process collects necessary information, translates data, and then generates SIP. The generated SIP is submitted to the next Ingest and Archiving process.

In the Ingest and Archiving process, AIP is generated from SIP and then archived in the Archival Storage. After archiving, the LTAR system monitors AIP to prevent unauthorized access and illegal alteration (Monitor Archival Storage process). Then, to maintain confidentiality and search ability, meta-information is updated (Update DI process), and to maintain archive ability, system environment and data are replicated and system environment is replaced (Maintain Archival Storage process).

In the Retrieval process, Consumer refers to the archived data. Lastly, in the Discard AIP process, Archiving System discards the LTAR data whose archiving period was expired.

The details of the relations among each process are presented in a data flow diagram (see APPENDIX A – Data Flow diagram).

3.1 Preparation

This chapter describes the Preparation process. This process prepares to start LTAR. It collects information to be archived, generates SIP and submits it to Archiving System. Translation is also performed in this process.

Figure 4 shows the Preparation process flow.

Each activity in the Process flow is described in the following pages.

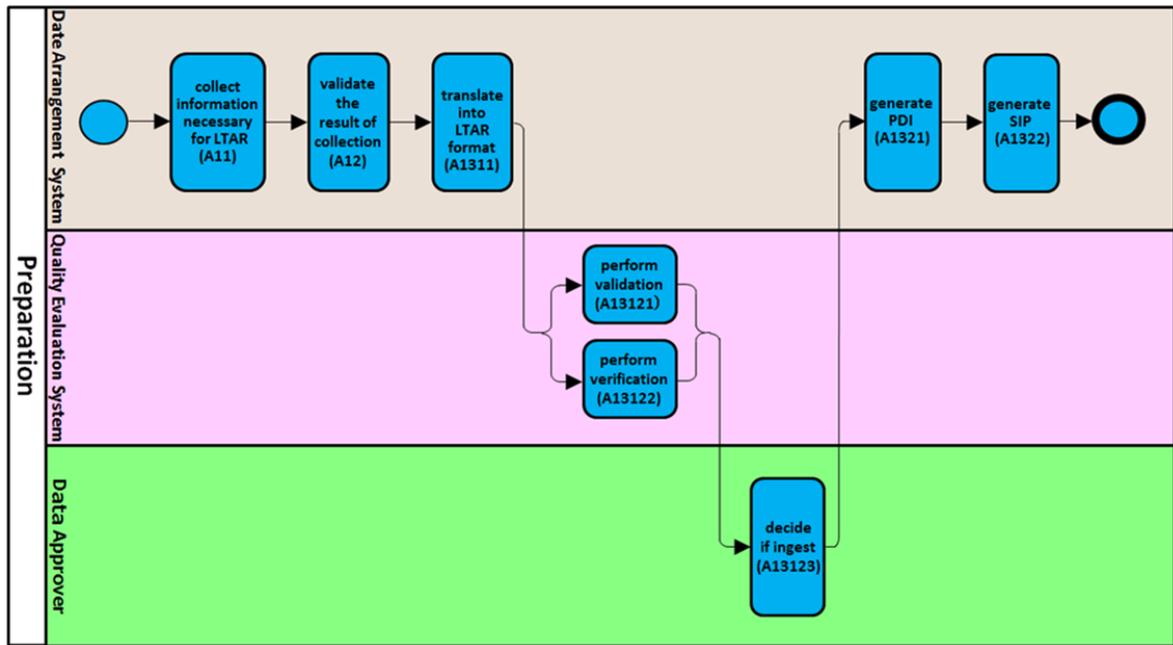


Figure 4 - Preparation Process Flow collect information necessary for LTAR

(1) collect information necessary for LTAR

Usually, the data to be archived consists in a master data that needs to be completed with complementary data that are stored in other systems.

Data Arrangement System collects complementary data from several sources that will be added to the master data to provide a unique and self-defining container. Table 3 provides an example of 3D model to be archived with several kinds of complementary data.

Classification	Example
Product geometric information	3D shape, cross-sectional shape, etc. Source : PDM
Product characteristics information (PMI)	Dimensions, tolerances, annotations, etc. Source PDM
Management information	Part name, part number, etc. Source : BOM
Information specific to 3D models	View information which manages show/no show display, associative information between elements, etc. Source : PDM

Table 3 - Examples of 3D model information subject to collection

**(2) validate the result of collection**

Data Arrangement System validates whether the information collected in (1) complies with the standard defined by each company.

(3) translate into LTAR format

Data Arrangement System translates the information collected in (1) into LTAR format.

(4) perform validation

Quality Evaluation System validates the equivalence of data before and after translating into LTAR format following the operation rules defined by each company. It generates a set of values for validation from the translated data. The details of validation are described in "Guidelines for Data Equivalence Validation in CAx Data Conversion".

(5) perform verification

Quality Evaluation System validates the information prepared in (1) and (3) that it complies with the standard defined by each company (PDQ items, LTAR rules, etc.).

(6) decide if ingest

Approver decides whether to proceed to the next Ingest and Archiving process, based on the results of (4) and (5).

(7) generate PDI

Data Arrangement System generates PDI from the information collected in (1). PDI contains Provenance, Reference (e.g. identifiers such as part number), Fixity, Content and Access Right Information. Information used for Fixity Information is the fixity value.

(8) generate SIP

Data Arrangement System assembles the prepared information such as PDI and LTAR data into one package (SIP) and submits it to Archiving System.

3.2 Ingest and Archiving

This chapter describes the Ingest and Archiving process. This process receives SIP generated in the Preparation process, generates AIP and archives it in Archival Storage.

Figure 5 shows the Ingest and Archiving process flow.

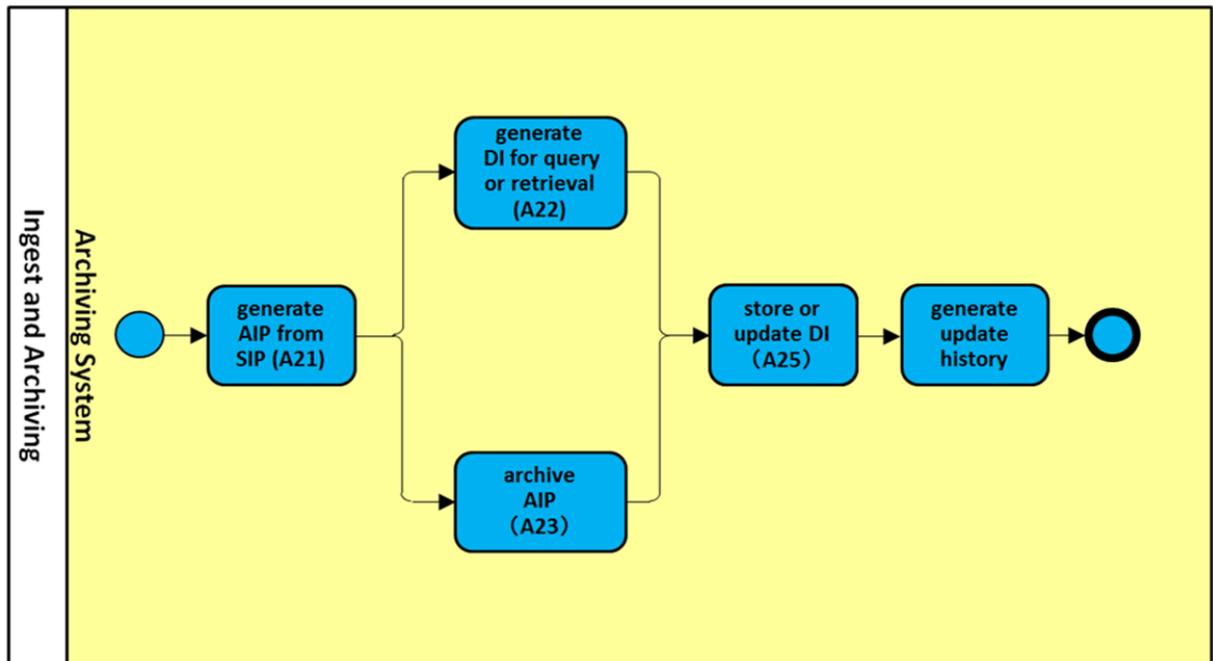


Figure 5 - Ingest and Archiving Process Flow

(1) generate AIP from SIP

Archiving System generates an information package (AIP), which meets the requirements to be archived in Archival Storage, from SIP generated in the Preparation process. At this time, it generates a value for Fixity Check and compares it to the original value stored in PDI.

(2) generate DI for query or retrieval

Archiving System extracts information (part name and part number, etc.) from SIP and generates DI. The information is necessary for LTAR data to be queried and retrieved, and is necessary for its access right to be set. Search criteria for Archiving System and information necessary for retrieving data should be defined in advance by each company.

(3) archive AIP

Archives AIP in Archival Storage. Archiving System generates DI from the archival information (date, storage location, etc.).

(4) store or update DI

Archiving System stores DI generated in (2) and (3) to the management ledger or database to make it available when querying and retrieving LTAR.

(5) generate update history

In order to be able to detect illegal alteration in a timely manner as well as to perform audit easily, Archiving System records information such as "updater, updated time and date, and updated part in the management ledger or database".



3.3 Monitor Archival Storage

This chapter describes the Monitor Archival Storage process. In this process, Archival Storage is monitored in terms of confidentiality under the instruction of Administrator. The results of monitoring is recorded and reported to Administrator.

Figure 6 shows the Monitor Archival Storage process flow.

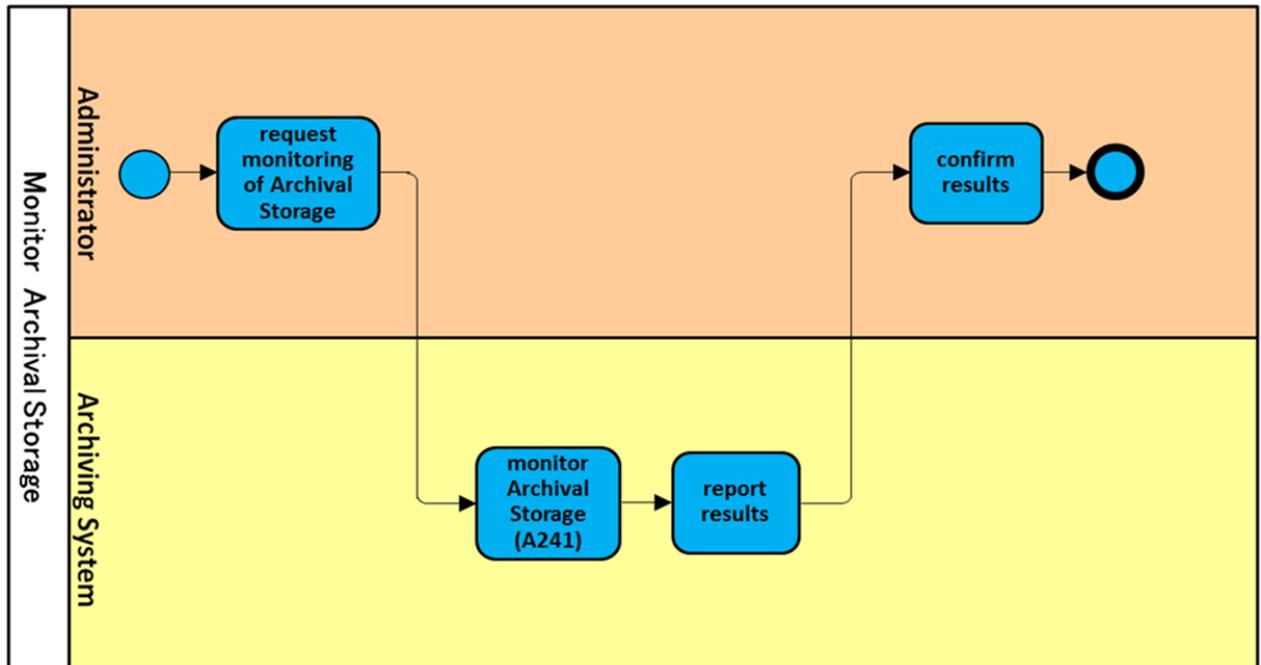


Figure 6 - Monitor Archival Storage Process Flow

(1) request monitoring of Archival Storage

Administrator requests monitoring (periodic monitoring / audit) of Archival Storage in order to avoid loss, damage, illegal alteration, or unauthorized access to LTAR data. Note that the frequency and method of monitoring should be defined in advance by each company.

(2) monitor Archival Storage

Archiving System monitors Archival Storage under the instruction of Administrator. Following are examples of monitoring:

- It manages the Fixity Checks report.
- It helps in problems detection.
- In order to prevent unauthorized access, it makes an inventory of user IDs and access rights.
- In order to detect unauthorized use, it verifies whether there is a trace of unauthorized access such as retrieving large quantities of data by monitoring the access log of LTAR data.

(3) report results

Archiving System records the results of monitoring and reports them to Administrator.



(4) confirm results

Administrator confirms the results of monitoring. If a problem arises, it is addressed following the handling methods and contact system predefined by each company.

3.4 Update DI

This chapter describes the Update DI process. In order to maintain confidentiality and search ability, update of stored DI such as changes in owner or access privilege of data according to an organization change, may be necessary. If such a case occurs, it is dealt using this process.

Figure 7 shows the Update DI process flow.

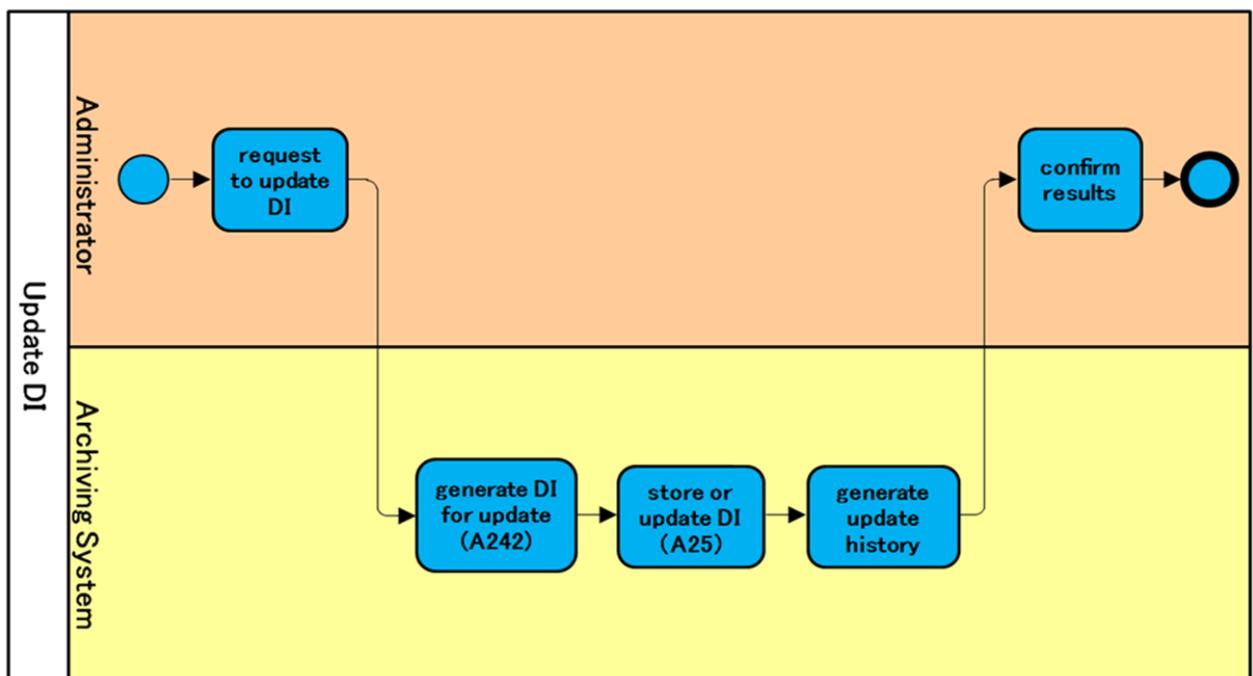


Figure 7 - Update DI Process Flow

(1) request to update DI

When DI update is required while each company implements LTAR process of data, Administrator requests Archiving System to update DI. For example, the cases where an access privilege for AIP changes or DI is added for improving search ability.

(2) generate DI for update

Archiving System generates the DI for updating under the instruction of Administrator.

(3) store or update DI

Archiving System updates the DI generated in (2) to the management ledger or database.

(4) generate update history

See 2.3.4 (5).



(5) confirm results

Administrator confirms that DI is successfully updated.

3.5 Maintain Archival Storage

This chapter describes the Maintain Archival Storage process. For maintaining archive ability, this process replicates system environment and data, and replaces system environment under the instruction of Administrator.

Figure 8 shows the Maintain Archival Storage process flow.

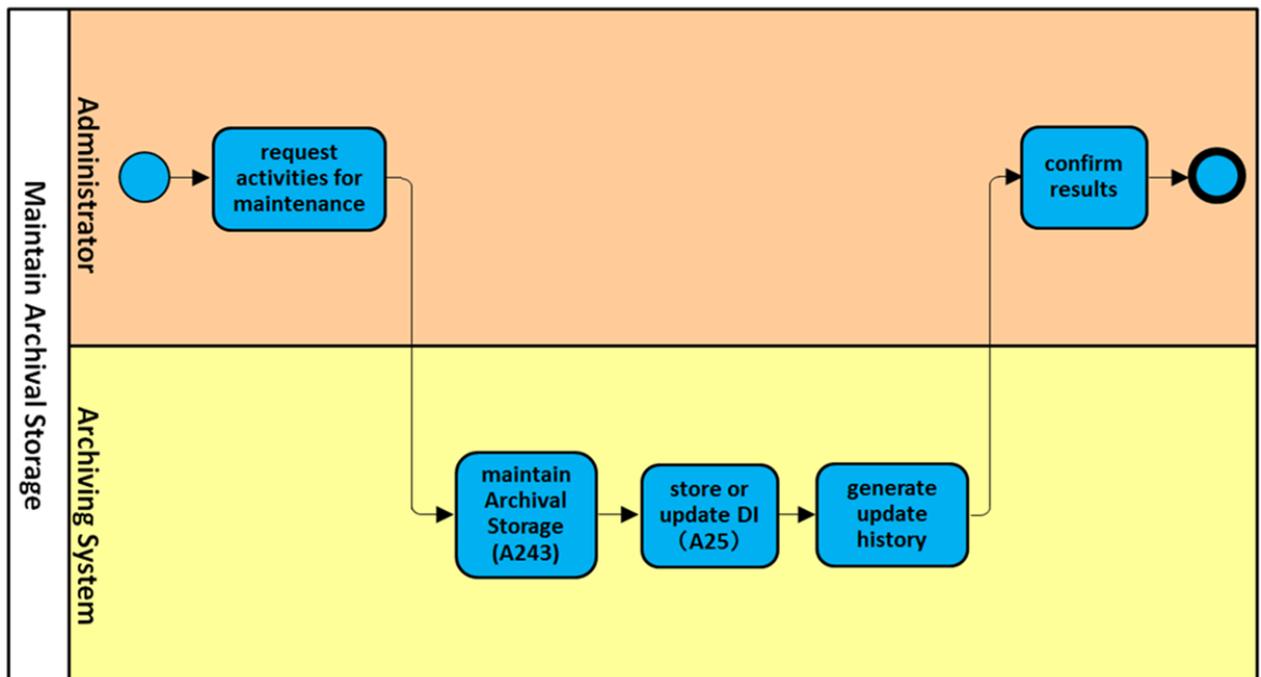


Figure 8 - Maintain Archival Storage Process Flow

(1) request activities for maintenance

Administrator requests activities necessary for maintaining Archival Storage.

(2) maintain Archival Storage

Archival system performs activities for maintaining archive ability under the instruction of Administrator. Main activities are replicating system environment and data, and replacing system environment.

Replication of system environment and data means copying them to prepare for restoration in case of an accidental disaster, a breakdown of data archiving equipment or a human error.

Replacement of system environment means replacing archival media or archiving equipment (hardware), or migrating OS/system (software) in order to prevent the environment from being obsolete. It also includes the migration of formats for maintaining reproducibility and continuity of data. Format migration is performed in the Preparation process by starting with the translate into



LTAR format activity and the Ingest and Archiving process. Archiving System generates DI for updating when the system environment is replaced, and then DI must be updated.

It is preferred that these activities can be performed independently.

(3) store or update DI

Archiving System stores/updates DI generated in (2) in the management ledger or database.

(4) generate update history

See 2.3.4 (5).

(5) confirm results

Administrator confirms the results of maintenance operations.

3.6 Retrieval

This chapter describes the Retrieval process. In this process, Consumer searches expected data and retrieves LTAR data from Archival Storage.

Figure 9 shows the Retrieval process flow.

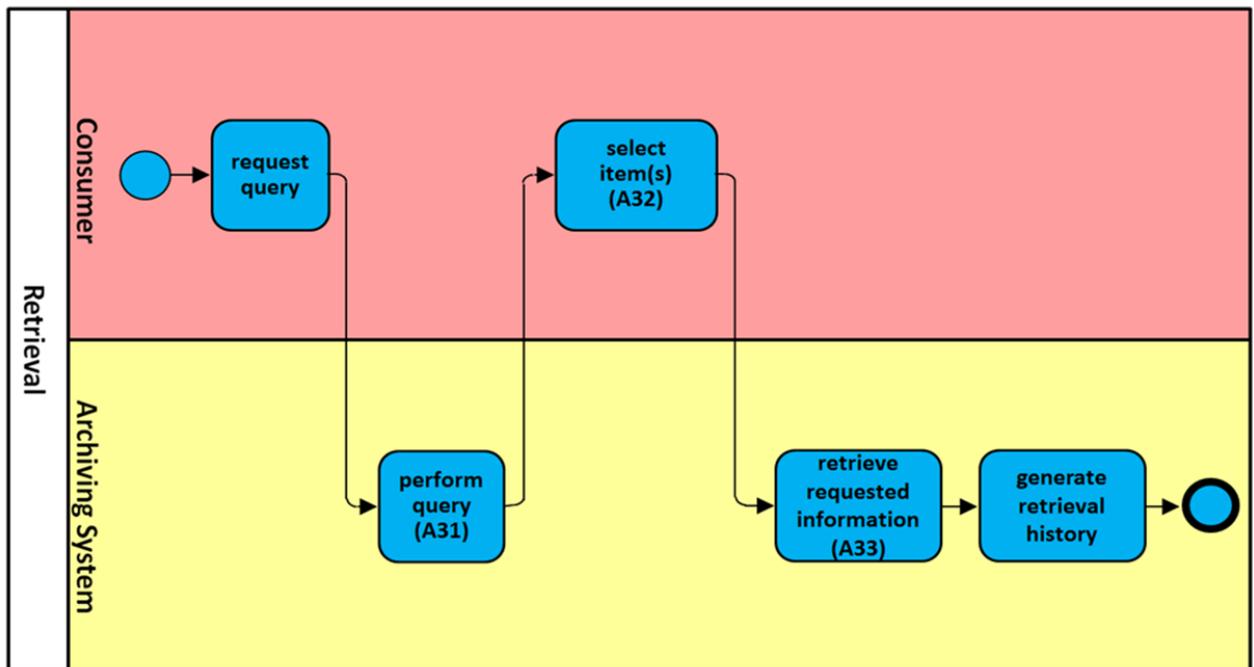


Figure 9 - Retrieval Process Flow

(1) request query

Consumer prepares information necessary for querying and retrieving LTAR data (part name, part number, etc.), and requests Archiving System to query.

**(2) perform query**

Archiving System searches LTAR data with query criteria requested by Consumer, and confirms the access privilege (access range, access right, etc.) of Consumer who has launched query. After that, it compares the access condition of Consumer and the condition of LTAR data, then shows the query results which are allowed to be disclosed to Consumer.

(3) select item(s)

Consumer selects expected data from the query results shown by Archiving System, and requests the retrieval of LTAR data.

(4) retrieve requested information

Archiving System generates DIP from appropriate AIP for the request in (3), and provides it to Consumer.

(5) generate retrieval history

Archiving System tracks every Consumer access (who), retrieval time and date (when), and retrieved data (what). This information may be used to detect whether or not there is an unauthorized use of data in a timely manner as well as to perform audit easily.

3.7 Discard AIP

This chapter describes the Discard AIP process. In this process, LTAR data whose archiving period is expired are discarded following the operation rules defined by each company.

Depending on company policy, Discard AIP process may have 2 consequences:

- The archived data will be definitively removed from the LTAR system, and the LTAR system will no longer validate the integrity of the additional copies of the data in the company.
- The archived data will be definitively removed from the LTAR system, but may be transferred to another LTAR system (for example : legal archival system to historic archival system). In that case, the data will still exist in the context of the company, but in another archival system.

Figure 10 shows the Discard AIP process flow.

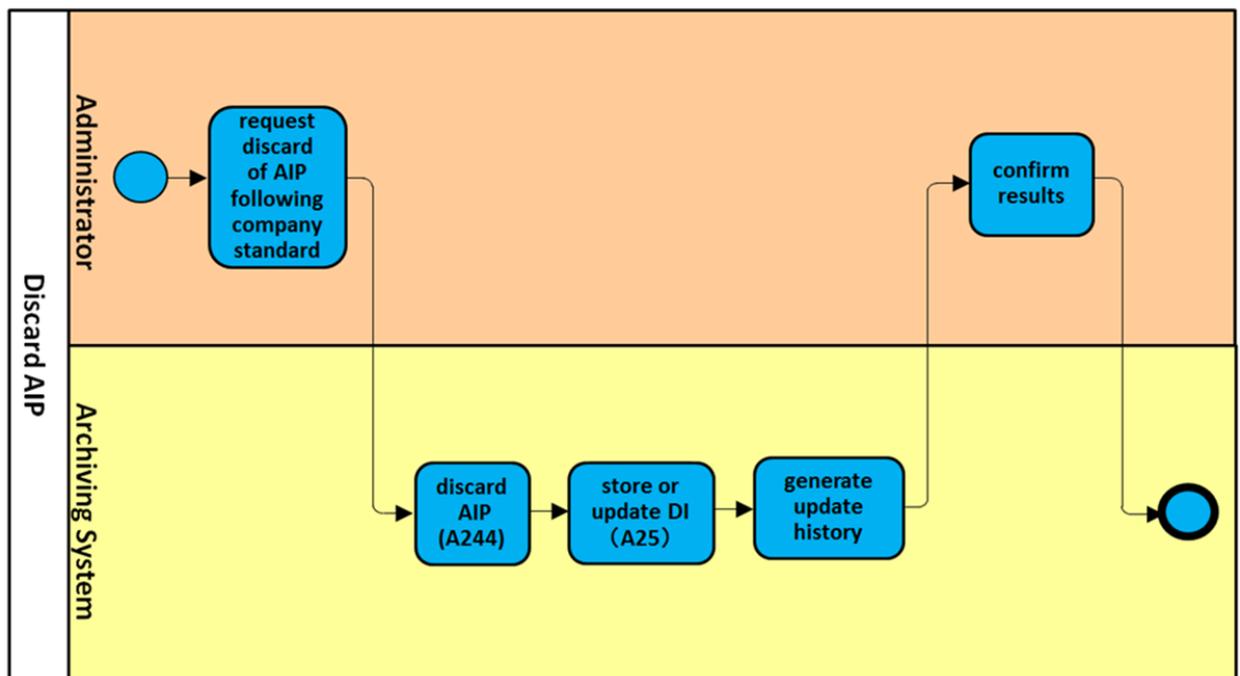


Figure 10 - Discard AIP Process Flow

(1) request discard of AIP following company standard

Administrator requests the discard of LTAR data whose archiving period is expired following the operation rules defined by each company.

(2) discard AIP

Archiving System queries and discards LTAR data to be discarded. After discarding, it confirms that the data has been surely discarded from Archival Storage and generates DI for reflecting the results.

(3) store or update DI

When Consumer tries to access (query or reference) the LTAR data which were discarded from Archival Storage, he/she should be clearly informed that the data are no longer available in the Archiving System.

Therefore, Archiving System updates DI generated in (2) into the management ledger or database.

(4) generate update history

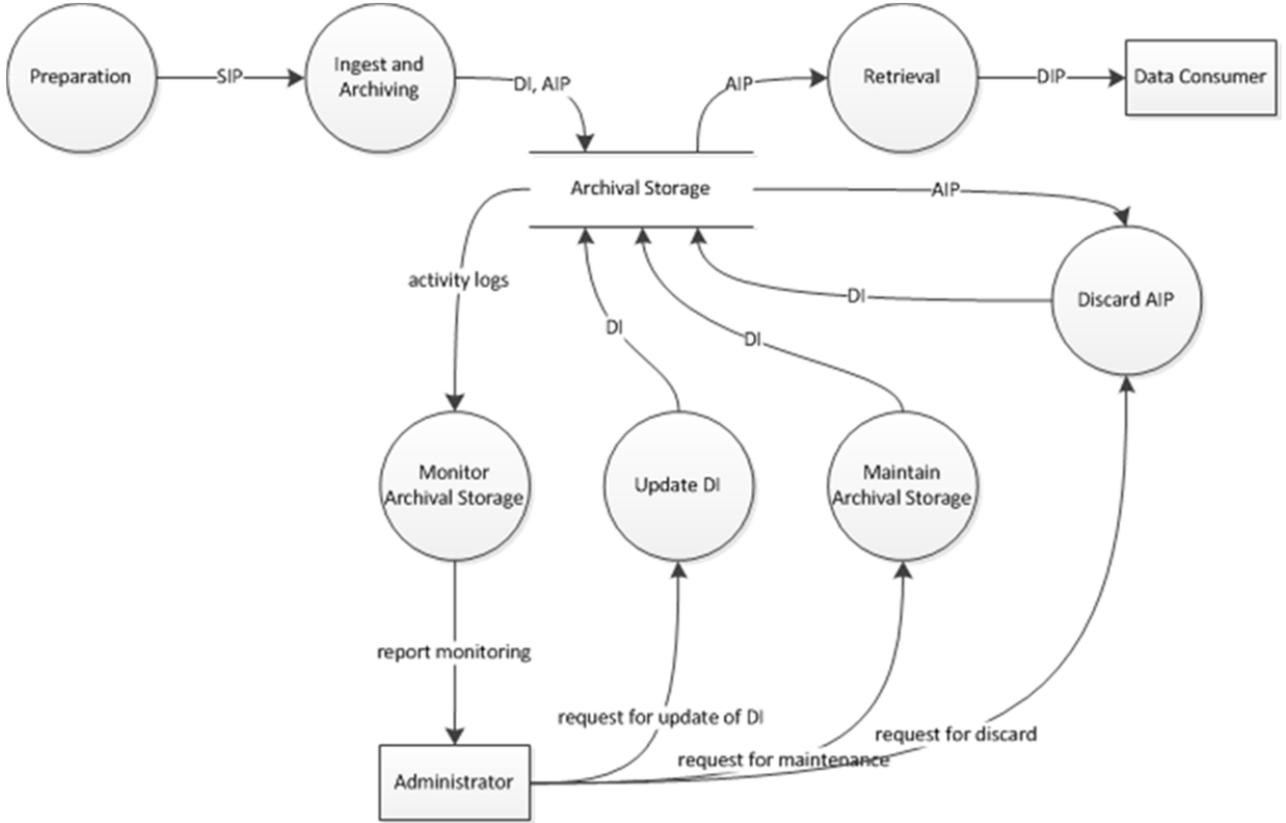
See 2.3.4 (5).

(5) confirm results

Administrator confirms that the data which should be discarded was really discarded.



APPENDIX A – DATA FLOW DIAGRAM





APPENDIX B: IDEF0 DIAGRAMS

B.1 How to Read an Activity diagram

Activity diagrams depict a summarization of the process flow model sub processes and data flows from a time independent perspective. Each activity depicted within a given diagram is found to be a lower level decomposition of a higher level activity. An activity is any task or group of tasks that takes an input, adds value to it, and provides an output to an internal or external customer. Thus, the diagrams show the interactions of all the steps that could possibly be performed in doing the higher level action.

An activity can be defined as a process, operation, action, or transformation that occurs over time and produces recognizable results. It is identified by an active verb or verb phrase and is represented as a node on the node tree, a box on the interaction diagram, and is defined in the activity glossary. The interactions are shown by depicting the input and output data requirements, as well as the people and/or equipment that performs each activity.

Explanation of node index is proved in Figure 11.

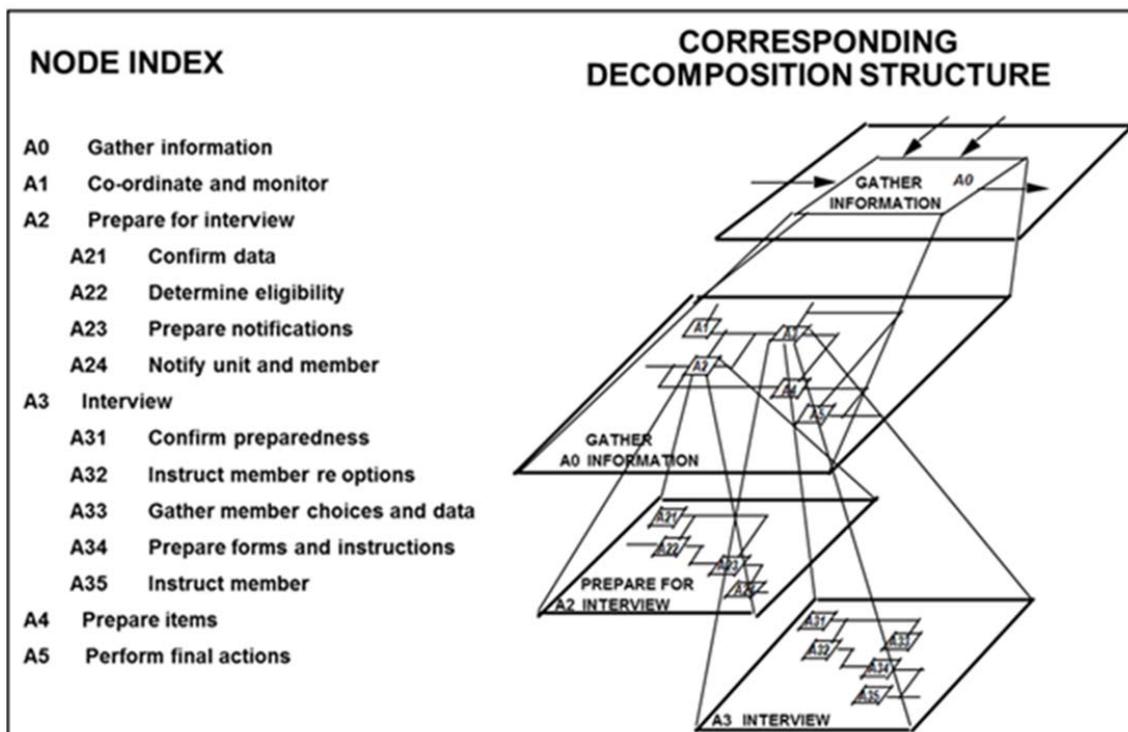


Figure 11 - Activity model decomposition

The activity diagram arrows identify information roles. There are four specific roles and the arrow's position with respect to the side of an activity box is critical for identifying the role associated with the diagram activity.

D-37

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- **Input:** Identifies what undergoes a process or operation, and is typically transformed. These always are depicted as arrows entering the left side of the activity box.
- **Control:** Identifies what influences or determines the process of converting inputs to outputs. These always are depicted as arrows entering the top side of the activity box.
- **Output:** Identifies what results from or is produced from the process. These always are depicted as arrows exiting the right side of the activity box.
- **Mechanism:** Identifies what or who performs a process or operation. These always are depicted as arrows entering the bottom side of the activity box.

These four roles are usually called ICOM.



B.2 IDEF0 DETAILED DIAGRAMS



Figure 12 - IDEF0 A0 diagram – LTAR top activity

D-37

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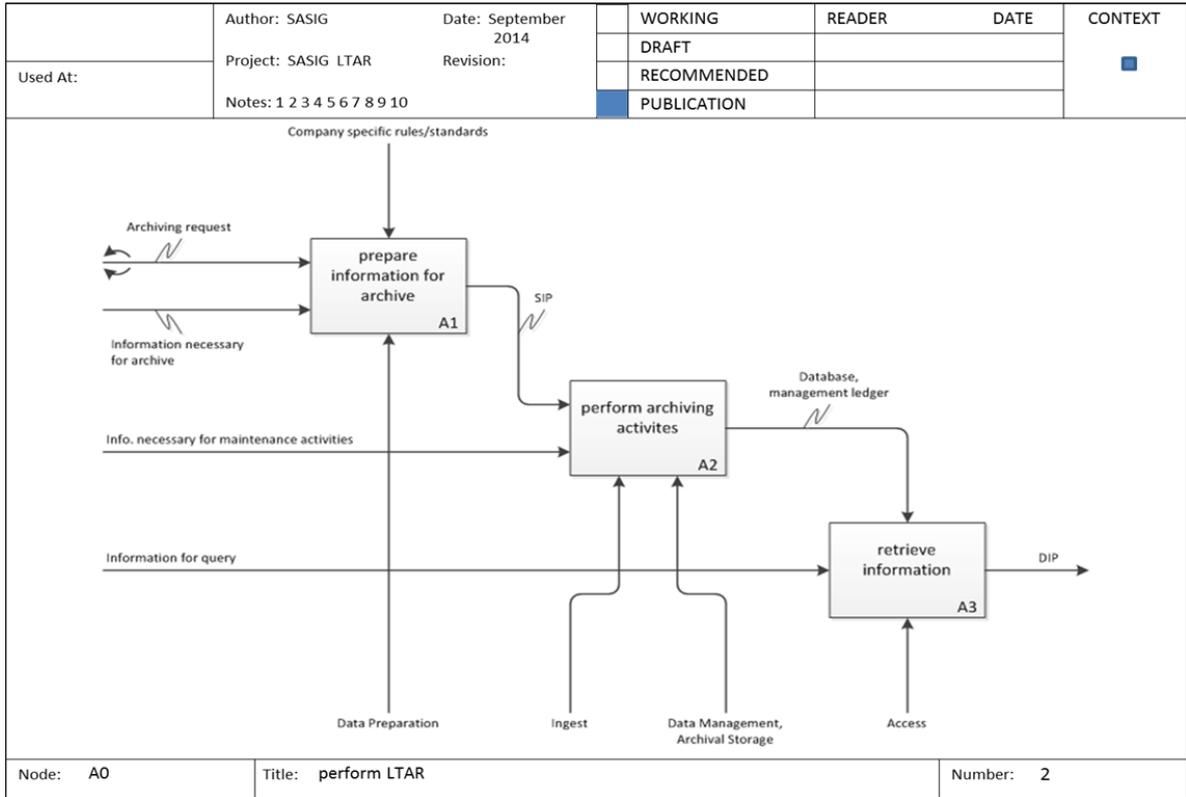


Figure 13 – IDEF0 A0 diagram – Perform LTAR

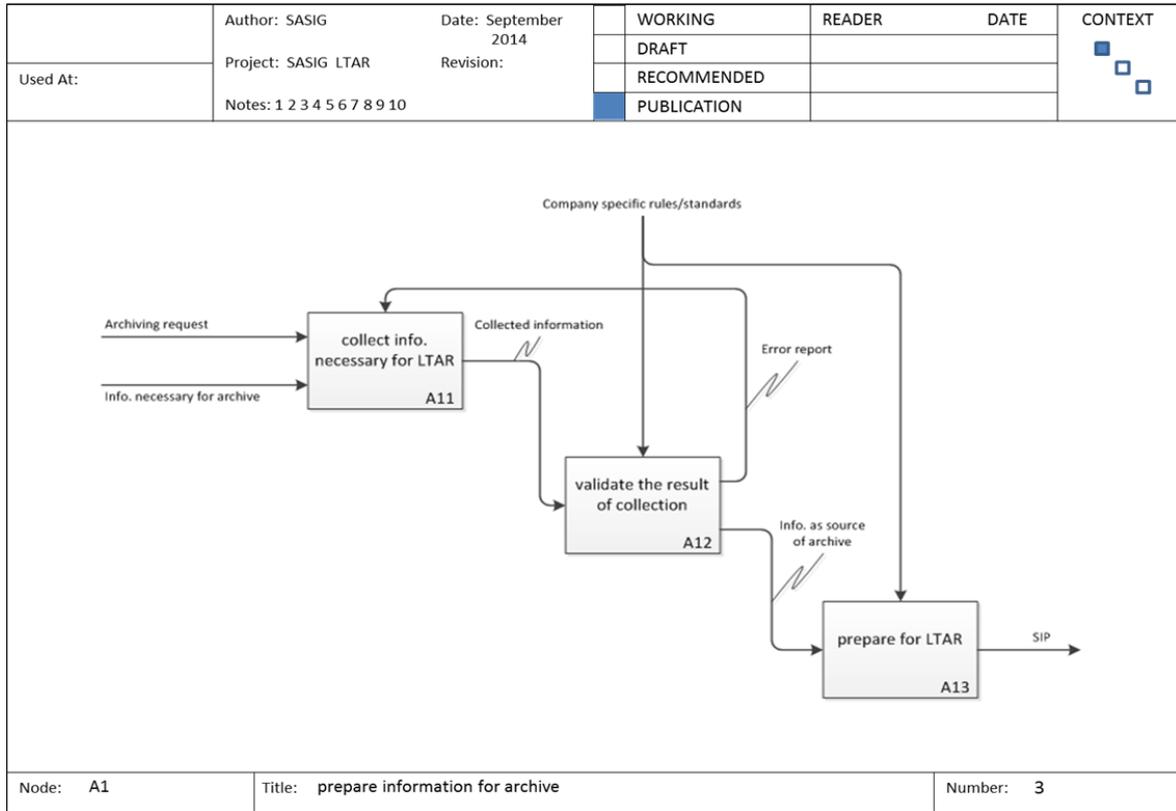


Figure 14 - A1 diagram – Prepare information for archive

D-37

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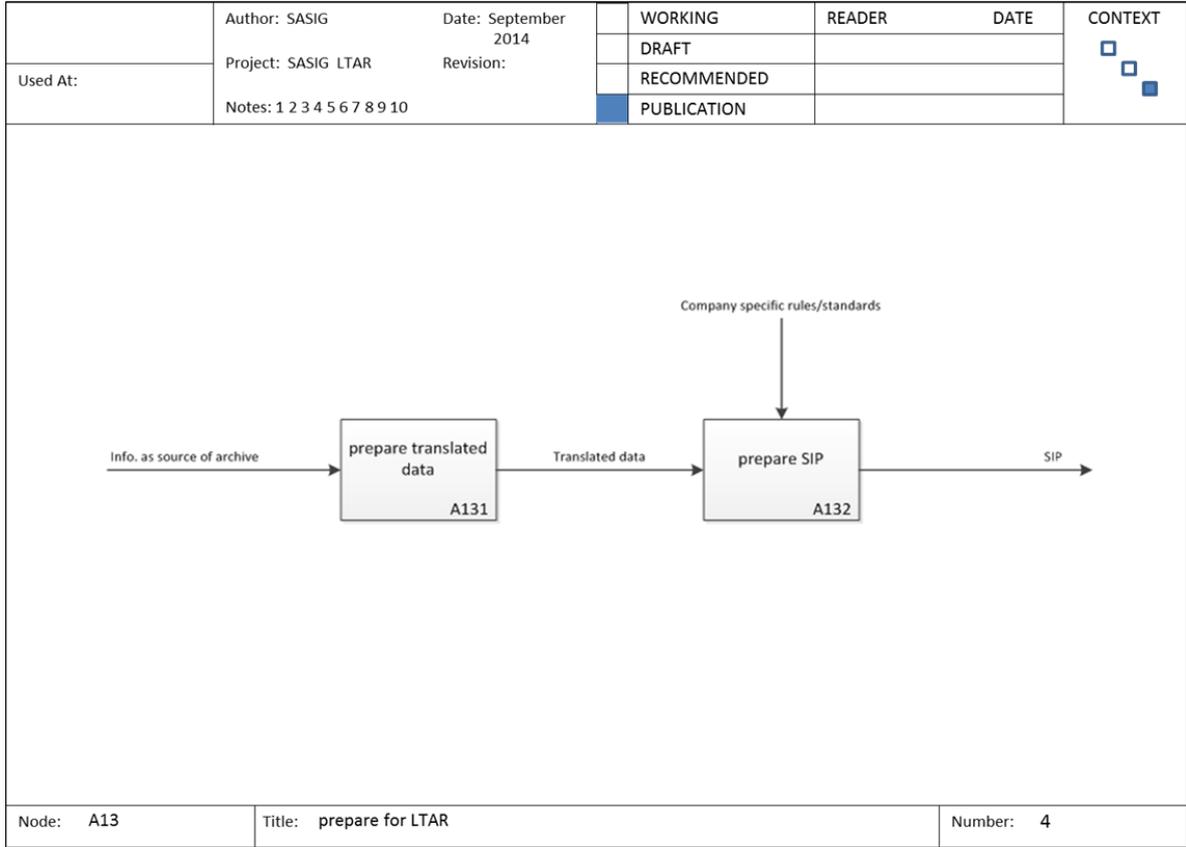


Figure 15 - IDEF0 A13 diagram – Prepare for LTAR

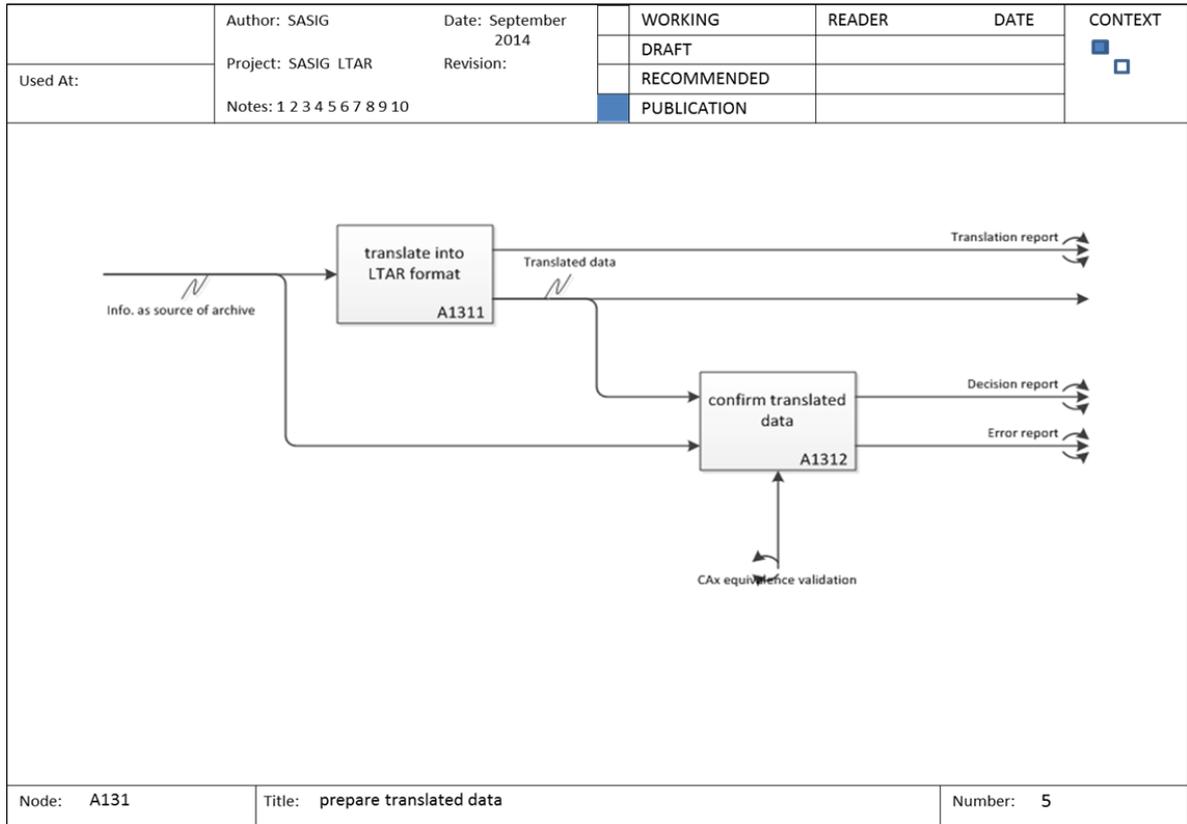


Figure 16 - IDEF0 A131 diagram – Prepare translated data

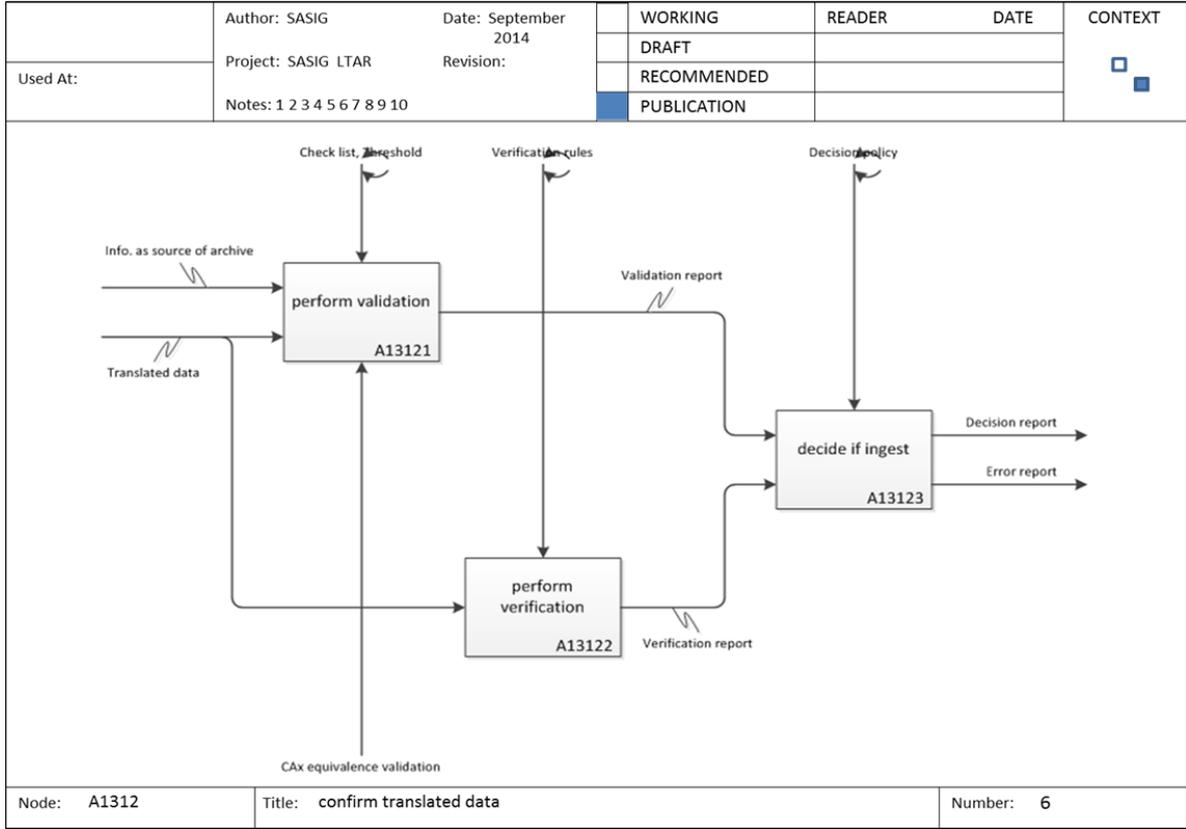


Figure 17 - IDEF0 A1312 diagram – Confirm translated data

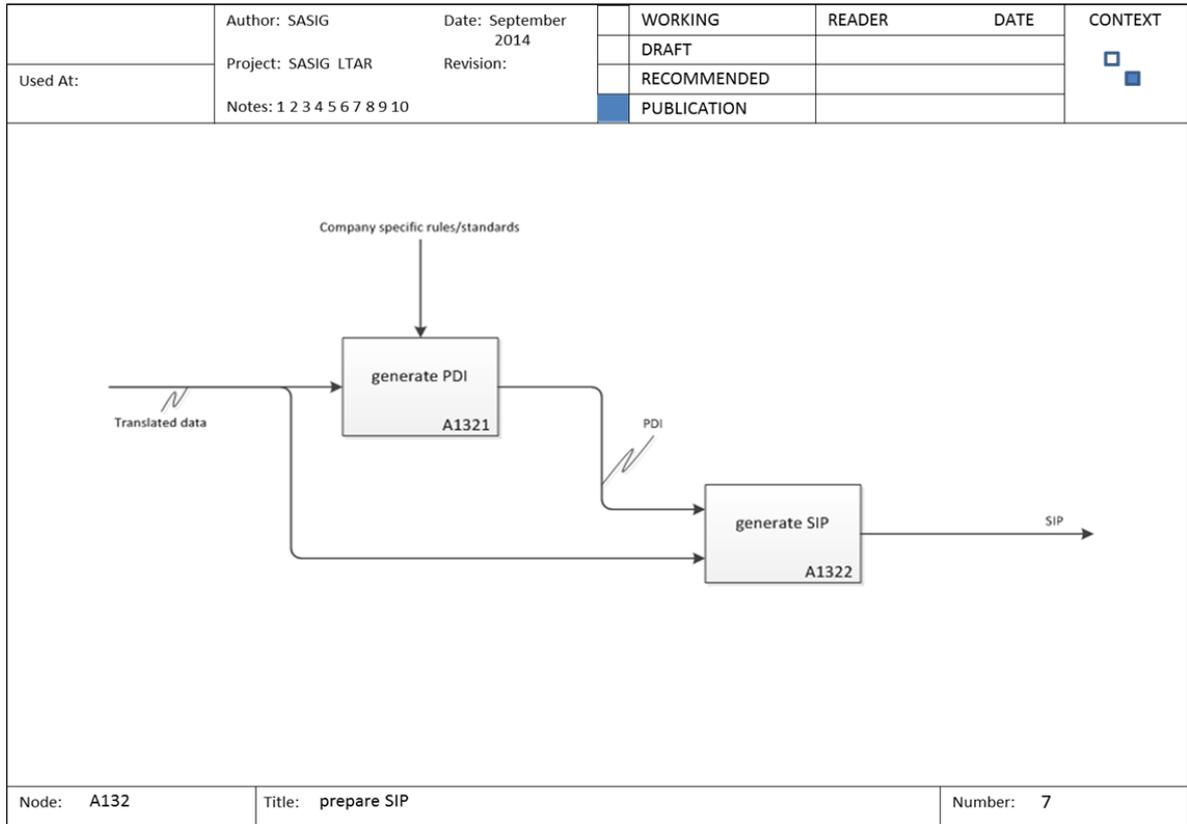


Figure 18 - IDEF0 A132 diagram – Prepare SIP

D-37

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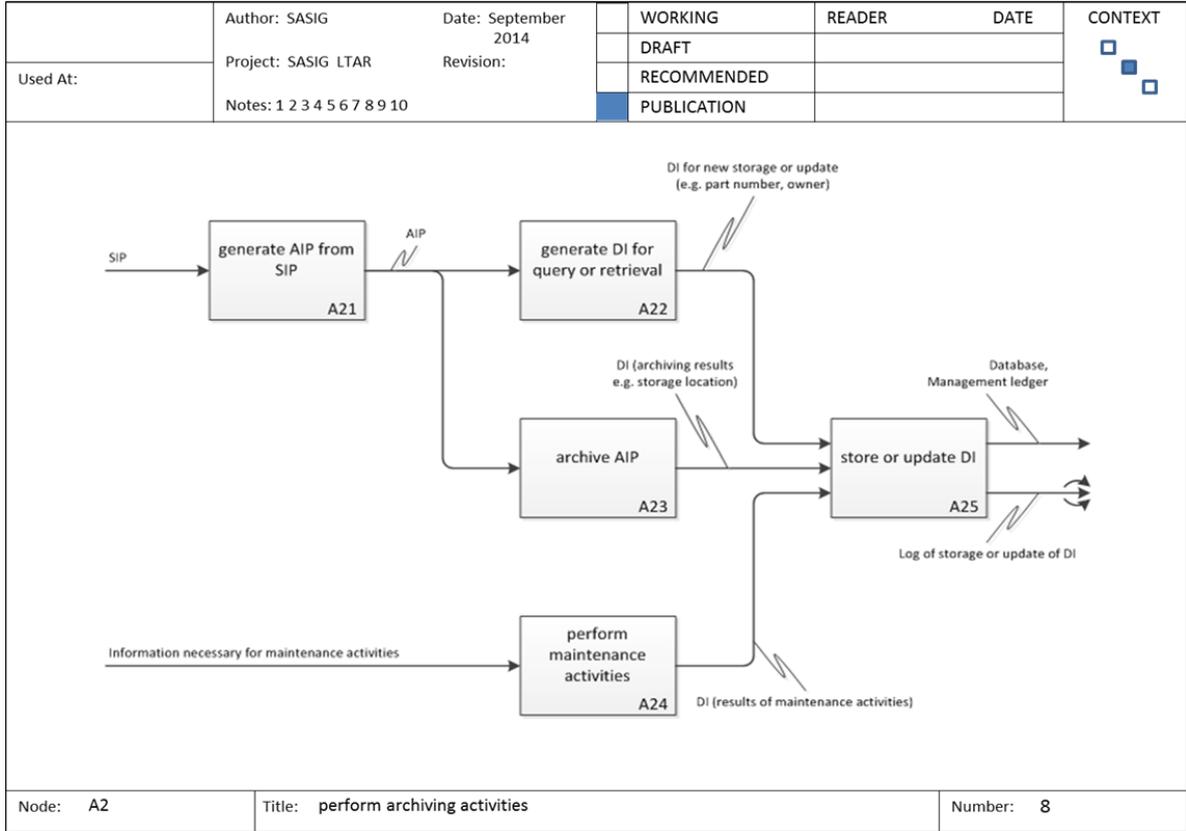


Figure 19 - IDEF0 A2 diagram – Preform archiving activities

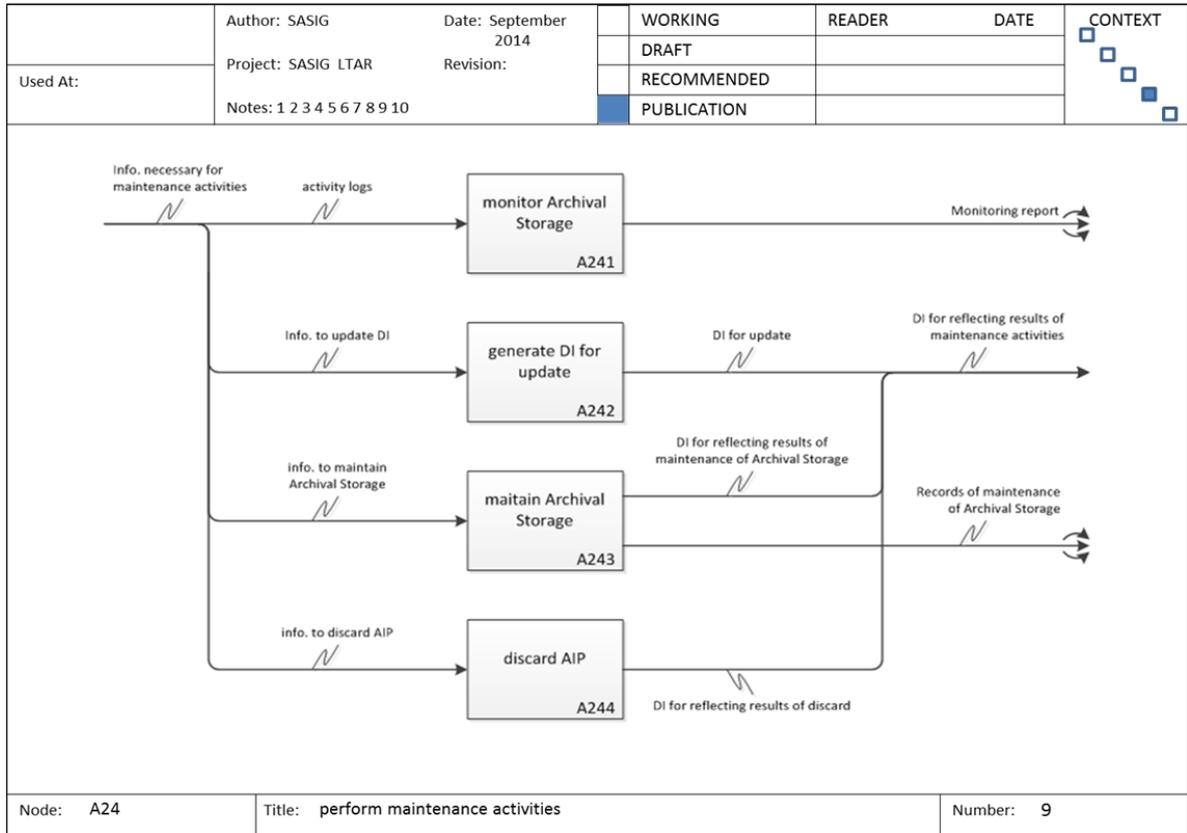


Figure 20 - IDEF0 A24 diagram – Perform maintenance activities

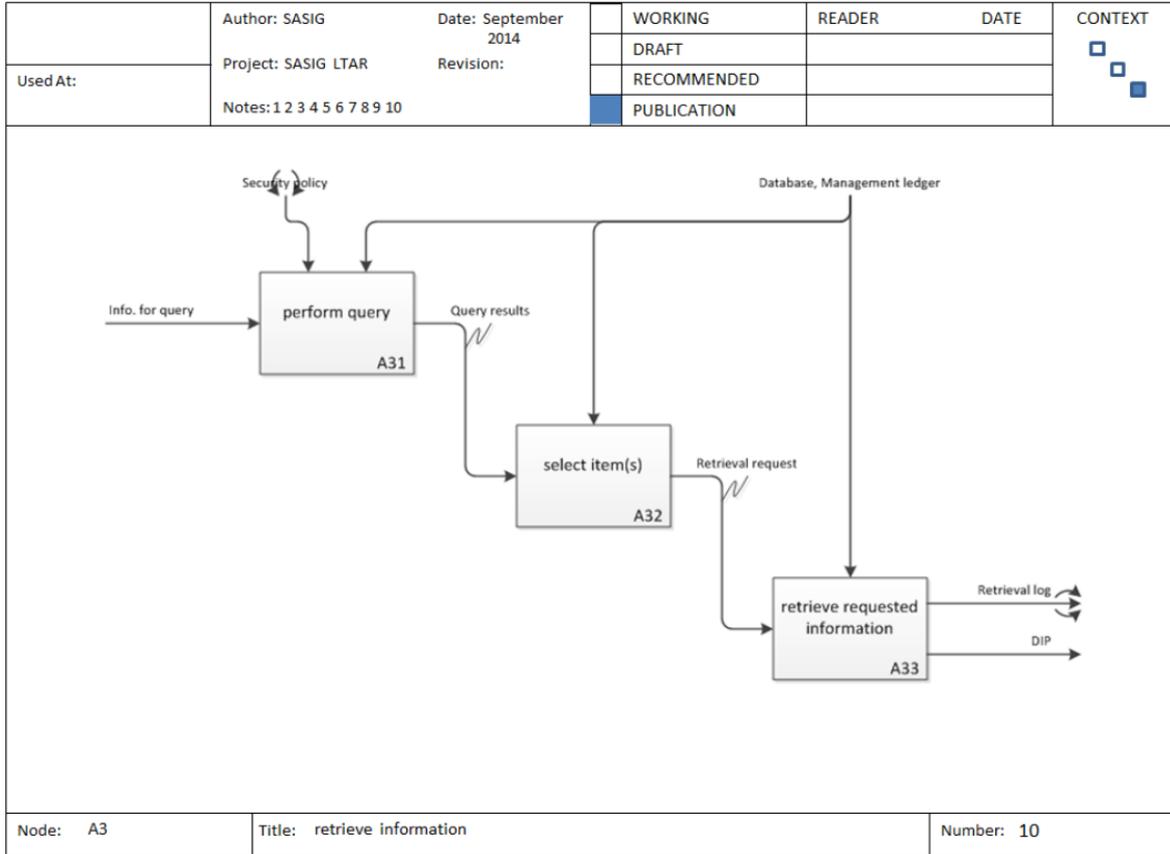


Figure 21 - IDEF0 A3 diagram – Retrieve information



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