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Category:TG update

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This is the _category_-article for the **technical guidance on LPIS Update**. Update is one of the upkeep elements. This technical guidance supersedes the earlier draft **LPIS upkeep** guidance.

- A draft guidance MSword document was distributed and presented on the Direct Payments Management Meeting of May 20th, 2015.
- An revised version, is being circulated as pdf-document in December 2015.
- Important edits since that draft are coloured in maroon colours.
- The WikiCAP category represents the only live and updated version of the technical guidance. To browse or print this guidance, go to its start page TG update.
- The content of these technical guidance articles and online pdf-prints resides in a single so-called _template_-article. The template's history tag (https://marswiki.jrc.ec.europa.eu/wikicap/index.php?title=Template:TG_UD&action=history) tracks all content changes.

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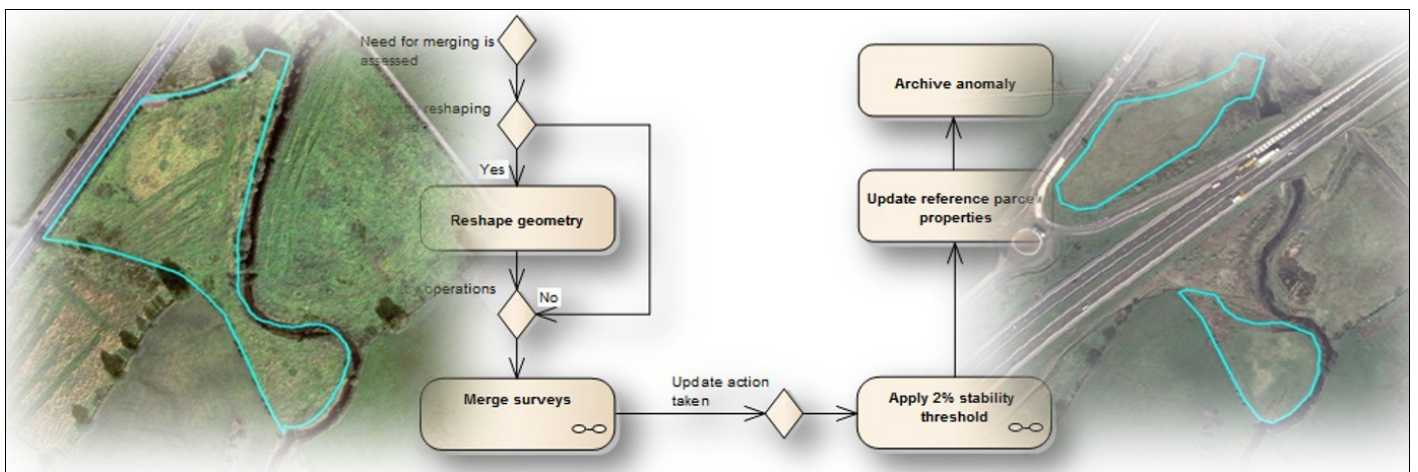
LPIS update

Update is the LPIS upkeep process
that deals with the changes of the land

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2015

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Abstract

3 TG update

This technical guidance describes the LPIS reference parcel update cycle. Update concerns the part of the database upkeep activities that deal with the changes of land over time.

You can print this technical guidance on the fly.

4 UPD Overview

4.1 Introduction

LPIS upkeep is the business process that is aimed at managing the spatial component of IACS. It is a continuous process that guarantees that the information system and the data residing in it allow the unique identification of its spatial features (reference parcels and EFA-elements) and the correct quantification of their area. It is an integral part of IACS, however, it runs quite separately from the annual process of farmer aid declaration or the LPIS quality assessment process.

The process of adapting the information system to the changes of the legal requirements or to the development of reference standards is called upgrade. The process of keeping data current is called update. Both can run in parallel with business processes that complete missing information or correct errors in general.

The use case of updating reference parcels involves the following generic process steps as described in the scenarios:

1. assess and categorise potential data sources,

2 .confirm anomaly

3. process the geometry in the LPIS

4. determine the validity for the new version

5. report lifecycle information and publish the new RP version

6. deal with the consequences (retroactive recovery)

This technical guidance also provides a set of instructions of technical activities that allow systematic collection of the necessary input. These are not necessarily linked to one particular phase of the upkeep process but can be applicable at several phases or even for other processes (OTSC, LPIS creation). They literally ?plug in? to many IACS use cases.

- Document anomalies,
- Perform visual inspection,
- Analyse manifest changes,
- Merge surveys,
- Assess pro-rata,
- Perform congruency test,
- Apply the 2% stability threshold criterion.

4.1.1 References

There is no corresponding DG Agri guidance document to the technical guidance.

4.1.2 Abbreviations

- **CwRS**: control with remote sensing

- **ETS**: Executive Test Suite

- **IACS**: integrated administration and control system

- **LC**: land cover

- **LPIS**: land parcel identification system

- **OTSC**: on the spot check

- **QA**: Quality Assessment

- **PG**: permanent grassland

- **RP**: reference parcel

- **UML**: unified modelling language

5 UPD Specification scope

The LPIS upkeep aims at maintaining such an information system that fully responds to the requirements, which means that data hosted in it is current and correct.

An update should be triggered when discrepancies arise between spatial data and the land features they actually represent. Changes on the land leading to discrepancies are detected in course of farmer declarations, inspections (OTSC, LPIS QA), or with involvement of third party data (other authorities, data companies) and are reported as anomalies. Therefore it is very important that anomalies can be coherently generated by any stakeholder and that they can be transmitted for further processing to the LPIS custodian in due time. In order to facilitate the exchange of anomaly and the subsequent cross checks after data updates, the anomaly feature type is introduced.

The methodology proposed in the LPIS update is based on anomaly processing and describes the detection of changes, the surveys and measurements to be applied, and the decision criterion (2% stability threshold) whether data update is necessary. The resulting effectiveness of LPIS update is assessed by the Member States performing the yearly Executive Test Suite (ETS) on data.

The following pages contain the recommendations of DG JRC of the European Commission concerning the maintenance procedure of the LPIS data. This document is the result of the revision of previous, draft technical documentation due to the CAP reform. Even though this technical guideline follows the logic of the business processes presented as UML use cases and activity diagrams, for sake of understanding detailed text descriptions, in depth explanations, and practical examples are given too. The purpose of this guidance is to provide a comprehensive view of the technical activities and interactions related to keeping an LPIS up to the specifications, which aims at removing the observed non-conformities.

A reference parcel does not always represent correctly the land that is subject of different payment schemes. A deviation from the business and technical rules is detected as non-conformity. Non-conformity can appear when:

- the IACS rules have changed, but the changes have not been applied,
- the local implementing regulations have changed, but they have not been followed,
- the physical land has changed, but the changes have not been reflected in the corresponding data,
- processing has been incomplete,
- erroneous processing has been performed.

The change of rules and regulation must be handled at the level of the information model (application schema) first, land changes, omissions and error are pure data questions that are handled in the update process. If a discrepancy between data and reality cannot be directly linked to any of the six above causes, further and deeper investigation in the design and procedures should take place.

The information carried by anomalies provides transparency and traceability and gives the managerial information needed for the appropriate planning, reporting, and analysis of the upkeep activities.

In principle, every confirmed anomaly or issue has to be resolved, which means that the erroneous instances of data (reference parcel) or information model elements have to be corrected. In order to keep the correction process traceable and provide a time stamp for validity of the affected elements, appropriate metadata has to be attached. The generic principle of assigning life-cycle metadata values is described in the common introductory part of upkeep.

6 UPD Data product identification

The update processes manage, among others, also the temporal aspects of data. These concepts therein are not domain specific but generic for all GI data. This chapter introduces the key concepts and principles, and explains:

- Feature level metadata ensure IT traceability over time
- the concept of data life cycles and feature state of currency
- the anomaly as vehicle to report discrepancies between data and reality

It is evident that MS would have already implemented many of these. This chapter on data structure is therefore merely informative and targets specifically the IT/GIS operator and system analyst. Feel free to skip this data structure chapter if you have no need for these technical details.

7 Feature level metadata

Feature level metadata gives generic information needed for traceable management of information in LPIS, as well as in IACS in general. As the name suggests, this metadata type is linked to feature types (for example reference parcel, EFA, anomaly, issue, etc.) to express additional properties. Feature level metadata records may carry a global identifier, but the most important are those properties (attributes) that clarify the validity and the status of the data. The status of data is connected with the life cycle of the data, which covers the creation, through various phases of updates, to its retirement (archival). Life-cycle information is related with data management within the information system. Therefore, it is a pure technical (IT) concept.

Validity is related to the business rules, in case of IACS to the validity for the processes. When an instance of a feature type, for example a reference parcel is valid, it can participate in all business processes: an application can be submitted on it, or can become subject of OTSC, etc. Obviously, this is not the case of an archived reference parcel, which is kept in the system for historical references. Archive data are needed, for example, for retroactive recoveries.

Although life-cycle and data status relate to data base characteristics, the purpose of all upkeep processes is to ensure that a given data base element is only valid when it correctly represents an object in the real world.

The information content of feature level metadata and the code list describing life-cycle status values are presented in Figure 1.
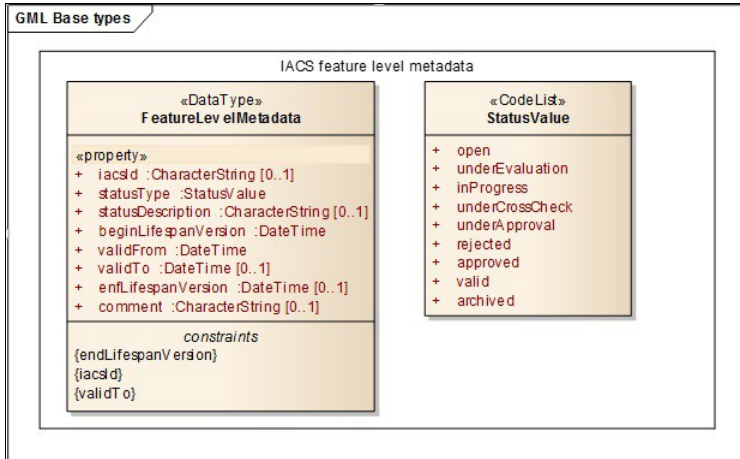

Figure 1: Feature level metadata and code list for tracing life-cycle information of reference parcel and LPIS information model

Name	Mnemonic name	Description
IACS identifier	iacsId	Universally unique identifier of object / feature. An object identifier (UUID as GlobalID) is a unique object identifier maintained by the responsible body. The identifier is a unique identifier of the object / feature within the IACS system, therefore it is not an identifier of the real-world phenomenon; therefore it is not a thematic identifier either. NOTE. Reference parcel identifier is not necessarily a global identifier; it may be a thematic identifier (e.g. cadastral ID) too. However, it is highly recommended to use unique IDs within the IACS.
Status type	statusType	Information about the life cycle status of the data or feature type. Validity/update status of feature / object / schema, values depend on implementation choice. The LCM proposes the following values of status type: • open • under evaluation • in progress • under cross check • under approval • rejected • approved • valid • archived NOTE. It is not mandatory to implement all the values. The list is exemplar to express different possible scenarios in updating, cross checking, verifying, etc. processes.
Status description	statusDescription	Narrative description of the status. Additional text commonly used to display the extended description of status of object / feature.
Begin life span version	beginLifespanVersion	Date and time at which this version of the feature was inserted or changed in the **dataset**.
Valid from	validFrom	Official date and time when the object / feature has been (will be) in situ or legally established. NOTE. In case of reference parcel it is the date from which the reference parcel can enter into the application process with those properties that it has. It is a legal category.
Valid to	validTo	Official date and time at which the feature in situ (or legally) ceased (will cease) to be used. NOTE. It is a legal category
End life span version	endLifespanVersion	Date and time at which this version of the feature was superseded or retired in the dataset. It is a database (IT) concept
Comment	comment	Text commonly used to display the extended description of particular feature.

8 Life-cycle management

In order to illustrate the life-cycle of a data instance, let?s take the example of a reference parcel that resides in the LPIS of the current campaign year, which is therefore valid. Suppose that during some routine operation, a discrepancy, for example the unexpected presence of a water body has been found. The operator opens an anomaly. From this moment the update process starts that will affect the status of two instances: the anomaly and the reference parcel.

The statuses of anomaly and reference parcel will be described in terms of the pre-defined code list according to the following scenarios:

Scenario 1: in course of processing the anomaly is confirmed that triggers a need to update the geometry and the reference area of the related reference parcel.

Event	Status of anomaly	Status of the reference parcel
Farmer?s application	n.a.	Valid
Staff Member discovers, what he believes, a non-conformity (water body)	Open	Under evaluation
LPIS operator confirms anomaly	In progress	In progress
LPIS operator corrects the geometry in the LPIS	Under cross check	In progress
LPIS data manager collects evidences (imagery) from previous years to determine the time of the change on the land	Under cross check	In progress
LPIS data manager provides information to the paying agency	Under cross check	In progress
The Paying agency takes measures for retroactive recovery and send feedback to LPIS custodian	Under approval	In progress
LPIS data manager approves the change	Approved	In progress
LPIS data manger finishes the update workflow	Valid	Old geometry archived New geometry valid

Scenario 2: in course of processing the anomaly is not confirmed

""*Event*	Status of anomaly	Status of the reference parcel
Farmer?s application	n.a.	Valid
Staff member discovers what he believes to be a non-conformity (water body)	Open	Under evaluation
LPIS operator on all available imagery founds that there ist no permanent water body and suspects that the parcel was flooded	In progress	Under evaluation
LPIS data manager collects further evidences (hydro-meteorological data, RFV). The hypothesis of flooding confirmed.	Under cross check	Under evaluation
LPIS data manager rejects the update request	Rejected	Valid
LPIS data manager finishes the workflow	Archived	Valid

The different life-cycle statuses and the transitions between them are presented in Figure 3.
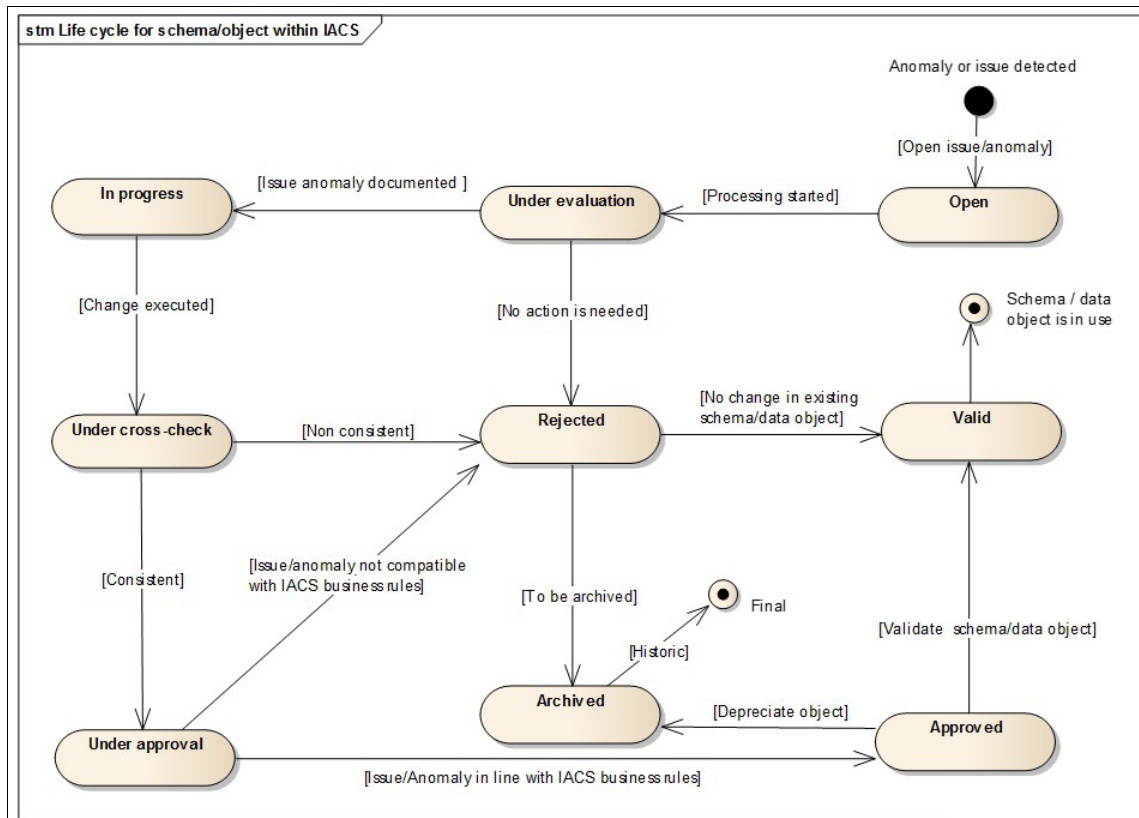

Figure 2: Life-cycle management: statuses and transitions between them

It should be noted that upgrading a schema element of the information model can be performed in a similar way. The only difference is that the feature type used for monitoring the status of the upgrade is called an issue.

9 The anomaly feature type

In the LPIS context, an **anomaly** materialises a message originating from stakeholders? observation stating that "something is different from what it is supposed to be". The anomaly is an observation of a data discrepancy or a potential non-conformity.

This message will start a process to resolve the discrepancy or non-conformity. An anomaly can be originated from various stakeholders, from example:

- **OTSC inspectors** who reports and confirms non-conformity of the determined area of the position of the affected boundary segments of the reference parcel. It is expected that not only the non-conformity is reported and confirmed, but supplementary data (for example boundary measurements) are also provided.
- **LPIS QA inspectors**. In the course of inspecting the parcels, non-conformities expressed as values of the applicable data quality measures (area, critical defect, and contamination) might be found. Beyond reporting, confirming and categorising the non-conformity, additional input data, for example precise location of non-conformity i.e. of critical defect or contamination) may be provided as well.
- **Farmers** may report anomalies in terms of the reference parcel and, especially in the context of geospatial application, the location of agricultural parcels included in the reference parcel. The declarations of farmers and the related cross checks may trigger launching an anomaly thread. It should be noted, that the input data, as they do not come from professional sources, should be treated with special care.
- **Third parties** - (datasets of partners and contractors, open data) ?can reveal non-conformities, especially by spatial intersecting their data with LPIS. An appearance of a new road or building, when third party data is more current than the last imagery provides a valuable input for updates.

The completeness of the anomaly description and its status varies depending on the stakeholder. In all cases it very important to define, whether it affects one or more reference parcels.

The information needed for managing the update process is included in the following concepts:

- Anomaly (the core feature type)
- Values for cause of anomaly
- Status of anomaly

These concepts, represented in Figure 3 as UML classes, specify the information that has to be recorded by the processing of an anomaly. They also help the users to monitor the status of the update workflow.
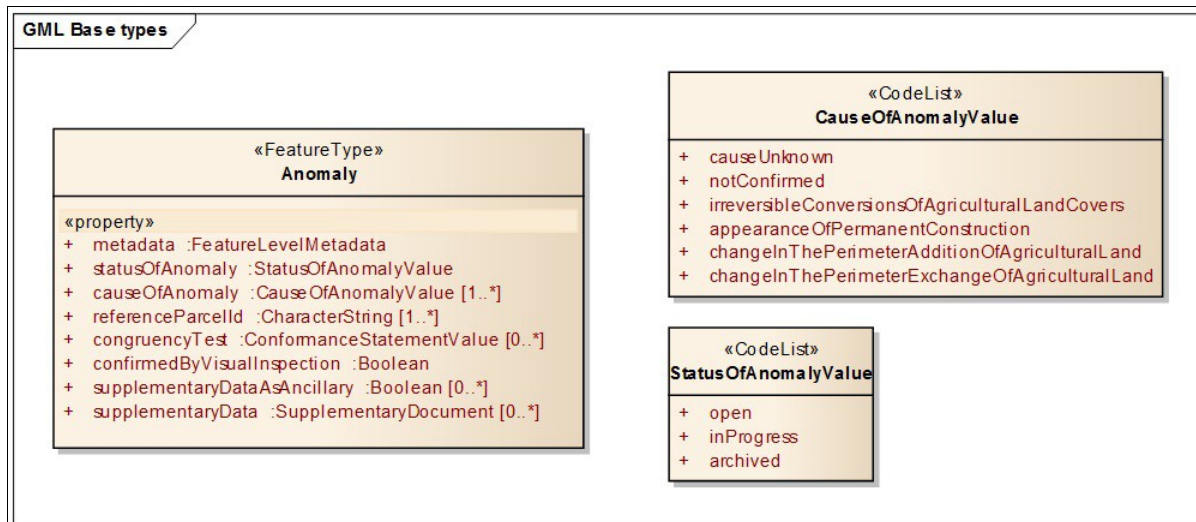

Figure 3: UML classes describing the main concepts of the anomaly

Name	Mnemonic name	""*Description*
Metadata	metadata	Feature level metadata can include information about the life-cycle, status, data quality, usability, responsible entity, etc.
Status of anomaly	statusOfAnomaly	Status of the anomaly at a given stage of its life ?cycle. The stages are defined in terms of the related code list, such as • Open • In progress • Archived
Cause of anomaly	causeOfAnomaly	Change in the real world that causes a non-conformity. The possible reasons are taken from the related code list: • Cause unknown • Cause not confirmed • Irreversible conversion of agricultural land covers • Appearance of permanent constructions • Change in the perimeter because of addition of agricultural land • Change in the perimeter because of exchange of agricultural land
Reference parcel ID	referenceParcelId	Unique thematic ID of the reference parcel or the reference parcels where the non-conformity has been observed.
Confirmed by visual inspection	confirmedByVisualInspection	Statement whether a reported anomaly is confirmed after the visual inspection in course of the updating process. NOTE: The input data comprises imagery and vector data. They are fit for update when the parcel(s) involved in the anomaly are fully represented by the image and vector data (completeness of input) and they are congruent. In addition, the imagery should be not older than that one that has been used for detecting anomaly. Otherwise the changes are not visible.
Congruency test	congruencyTest	Conformance statement about the result of the optional congruency test. **"Congruent"** refers to a situation where two polygons (parcel representations) have the same shape and dimension. This condition is fulfilled when • the position of the two geometric representations coincides

		• there is no coincidence between the geometric representations, but the shape and the dimension is the same. In fact, in this case there is a shift between the two geometries. NOTE: Congruency test is very rarely needed, only when visual inspection leaves a distinct doubt
Supplementary data as ancillary	supplementaryDataAsAncillary	Ancillary value is assigned to those non-conforming supplementary data that can contribute to the update process, but alone, do not allow complete processing..
Supplementary data	supplementaryData	Reference to the data source that is evaluated as fit for update. Such data sources are selected for resolving an anomaly. It can be one or more dataset, imagery, measurement vectors, etc.

Go up to the main update page

10 UPD data capture

Update is the process of addressing non-conformities of the spatial data due to the changes on the land. It involves all the operations and database interventions necessary to give an up-to-date alphanumeric and geometric attribute reference parcel values to a reference parcel.

This workflow describes in detail what happens after picking up an anomaly thread; which represents a data change requests for subsequent processing. That process results in modified or ?updated? instance data values and life cycle attributes.

Even though the data update process described in this document is focused on reference parcels, it is, in principle, applicable to any spatial feature type (EFA-element, agricultural parcel).

11 UPD data sources

To make the update meaningful, it is necessary to assess all source data to verify that they are both current and suitable for processing the change. Even though many different data can be used as input, the process relies most of all on using of aerial or satellite imagery.

The usefulness of this process relies on the simple condition that the potential data sources can be discovered (the operator be aware of their presence). In ideal cases, catalogues and geoportals within the national/regional SDI are available that provide metadata records about the quality, currency, and accessibility of the available data. If no SDI has been put in place, the necessary information has to be collected and integrated in the LPIS itself.

The process should guarantee that the selected data must be interoperable with LPIS (reference system, resolution, scale, quality, etc).

A number of reported anomalies are based on observations from other data sources, rather than imagery. They may carry attributes values of the reference parcel with or without geospatial component:

- An OTSC inspector can provide a valid reference area value.
- A part of the boundary can originate from topographic surveys.
- An appropriate "as built" plan can be delivered from a third party partner.

Depending on the particular conditions, such data from non-image sources might be more appropriate than the most recent image. This is especially the case when such data is more current than imagery.

The workflow of assessing and categorising potential data sources is illustrated with the following activity diagram Figure 6.
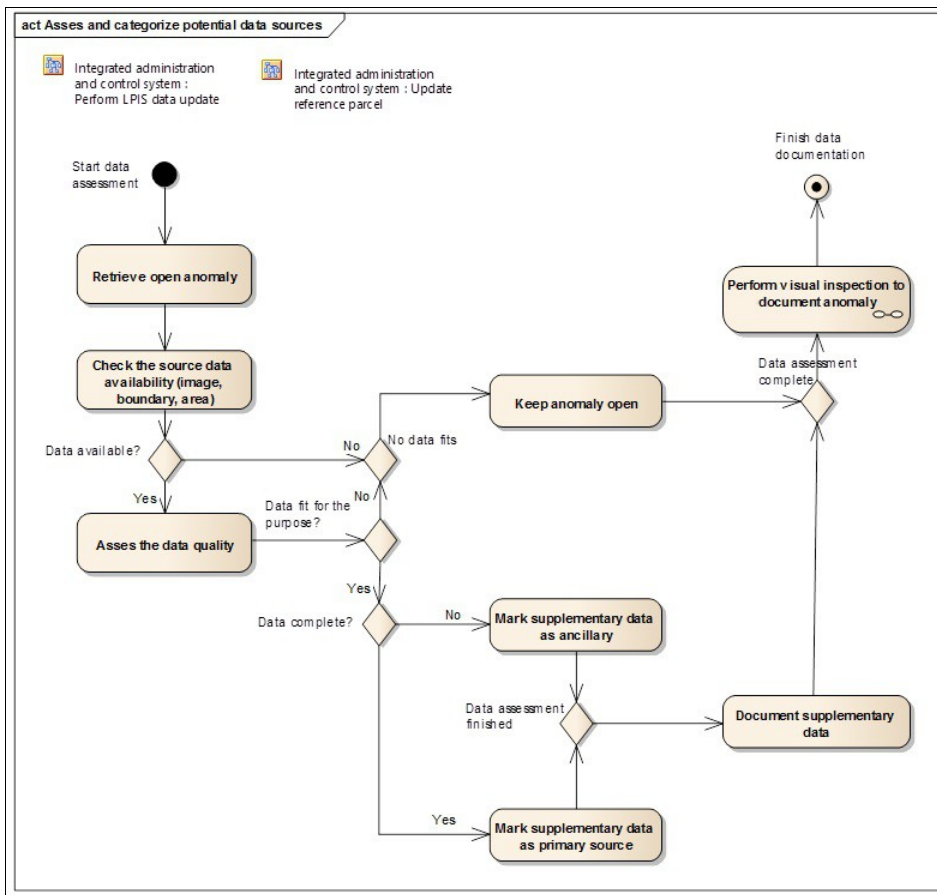

Figure 4: *Workflow of assessing and categorising the potential data sources*

The assessment process involves:

1. Start the assessment by retrieving an open anomaly; each anomaly informs what the problem is and so sheds some light on what data might be necessary for processing.
2. Check the source data availability (image, RP boundary geometries, RP area). This yields an initial decision about availability of data based on the metadata and preview of the source data. Availability involves existence, specifications as well as access.
3. Make a more detailed analysis whether the quality of the available source data is fit for resolving the anomaly. This involves
   - Checking its completeness: the whole area of the reference parcels concerned by the anomaly should be covered by the same imagery. Likewise, other third party data (transport, hydrology, etc.) have to support all parcels that are related to the anomaly in question. If the data isn?t complete, it can be still used, but only as ancillary data (additional data supporting decisions).
   - Checking its currency: older imagery may not reflect the most recent state of the land, but, if no manifest change occurred, the multi-temporal dimension still provide valuable clues of the nature of that land.
4. If suitable source data has been found, it should be used without delay for further anomaly processing,
5. If no suitable sources data, but only ancillary data have been identified, it should be recorded and the processing of the anomaly should be postponed until sources become available. Document the anomaly appropriately.

12 UPD triggers

This process step is an obvious one: If no change has happened to the reference parcel, no further processing is required.

Some anomalies are, by default confirmed notably those who originated from trusted professionals:

- LPIS change requests issued by OTSC inspectors
- Non-conformities detected during the LPIS quality assessment
- Updates from authentic registries from third party partners (e.g. new buildings is the cadastre, new roads from the transport ministry.
- Anomalies that report a manifest change

For anomalies generated by other sources, it?s worth filtering out the irrelevant reports. To do so, one basically applies the same tools that the in-house professionals use to detect an anomaly.

- Perform a visual inspection to confirm absence of a manifest change
- If still in doubt, perform a congruency test.
- Where applicable check whether the 2% stability threshold applies. For more guidance, please refer to section 5.6.

If an anomaly is filtered out, document and archive it appropriately.

13 UPD geometry processing

Whenever non-conformity of the spatial attributes of one or more reference parcels has been confirmed, the geometry needs to be processed.

The processing of geometries is the core GIS function of LPIS and therefore the central activity in the LPIS upkeep process:

- modelling real world units of agricultural land or boundaries in reference parcel feature types,
- complying with the homogeneous standard equivalent to a cartographic scale of at least 1:5000 (although a larger scale could also be used).
- populating and combining spatial feature types.

So for the purpose of the upkeep, where the final objective is to reliably determine an updated geometric area, it suffices to call on the several particular instructions that help meeting best practices for spatial operations. Hence, the operator should have:

- respected the GIS best practices and interoperability guidance,
- tested and verified suitability of all source data,
- applied the congruency test to correct any local coordinate shift between aerial imagery and survey data on one hand and reference vectors on the other hand before a merger of surveys.

After a new geometry and geometric area has been established, he may apply the 2% stability rule to control with the difference between a measured geometric area and legacy reference area.

14 Reference parcel validity

Once the update geometries and geometric areas have correctly been established, the question of their validity arises.

By definition, the reference parcel is valid on the date when the main source data (orthoimage or survey) was acquired.

One should assume that the reference parcel version should -as much as possible- still be valid on the time the update is implemented in the LPIS. This assumption should be assured by minimizing the delay between the capture of the source data and the processing of the anomaly. For this, the Commission services suggest following:

- With the current state of technology, it should not take more than 3 months to create a unit of orthoimagery product (cartographic map sheet, photographic tile) after all relevant raw image captures for that unit of product have been acquired. If the processing is not done in house,, product delivery schedules should strive to:

- either accommodate this three month delivery delay for regular deliveries or
- ensure that products from raw imagery taken from February of the previous year to January of the current year are delivered by May of the current year.

The aim is to make the new images ready and available to be used by in the geo-spacial aid application process

- To support the reporting of anomalies in good faith, the delivered orthoimagery should within a month upon receipt be made available to all farmers, inspectors and other personnel, even for zones not yet processed in the LPIS refresh cycle or project.

The start of validity of the updated reference parcel version (i.e. the date when the change affected the reference parcel in field and also the end of validity for the previous version), cannot be determined by the main data source alone. One can search for clues in ancillary data or third party data but such data might not be available or practical.

By contrast, systematic review cycles based on periodic image acquisition strongly reduce any adverse effects of this uncertainty as it enables observations on the one before last image. So, the Commission Services suggest that for the systematic review cycle or a refresh project, the system's imagery should support retroactive recovery up to three years. In other words for any year N, image acquisition dates should precede January 1 of year N-3.

If the reference parcel feature type is derived from third party data (e.g. cadastral parcel), timely data exchanges with all necessary metadata should organised with that third party.

15 Attribute value update

Based on the detailed documentation of the anomaly and the analysis of the manifest changes, the reference parcels involved are ready for value updating. In course of value updating the following properties of the reference parcel can be modified:

- geometric representation,
- reference area,
- global and thematic identifier,
- feature level metadata (comprising life-cycle and validity).

A change of the geometric representation of the parcel may be required by:

- irreversible conversion of agricultural land (e.g. appearance of forests, water bodies, land abandonment etc.) that are bigger than the minimum mapping unit. Practical considerations and technical recommendations for the implementation of this requirement are given in relevant guidance documents of DG AGRI (DSCG/2014/33) and DG JRC (DS-CDP-2015-10).
- excluding ineligible objects (permanent man-made constructions),
- change of the boundary between two reference parcels ,
- inclusion of additional agricultural land in the area of a single reference parcel.

For the reference parcel feature type topology rules apply. Any new geometry might impact on the neighbouring reference parcels, which in turn, will be subject to update. Therefore, while documenting the anomaly, the identifiers of all affected reference parcels have to be processed. This ensures that the necessary geometric operations are consistently performed from one parcel to another.

The value of the reference area can be updated as a result of:

- The change in the geometric representation of the parcel
- Assigning another pro-rata class value to permanent grassland.

Any change in any property value of the reference parcel involves the change of the global unique identifier. The usage of global unique identifiers in LPIS is considered a best IT practice and also allows traceability and subsequent re-verification of the changes. However, LPIS custodian may choose this solution to be in line with generic requirements of the local spatial data infrastructure as it facilitates the life-cycle management of features.

A change of any characteristic element of the reference parcel as a unit of agricultural land should, in the opinion of the EC services, involve the change of the RP ID. However according to best practice solutions the thematic RP-ID should not be ?recycled? upon a reassignment of agricultural land between reference parcels transaction, (splitting, merging).

In all cases the feature level metadata, especially those that provide information on life-cycle (?beginLifespanVersion? and ?endLifespanVersion? attributes) and/or validity of the parcel (?validFrom?and ?validTo?attributes) have to be updated too.

When the new attribute and geometry values have been entered into the system:

- a processed and documented anomaly has to be and archived,
- the updated properties of the reference parcel has to be propagated to appropriate other subsystems of IACS (e.g. it should appear in the pre-printed form of declarations).

16 Manifest change detection

The concept of manifest changes serves a simple methodology to discriminate between meaningful changes and variations in appearance of the land.

The appearance of agricultural land changes all the time and so does the land cover that was delineated for LPIS purposes. Of these, many observed changes actually represent dynamic phenomena that are inherent to the agricultural land cover but that do not alter the character of that land:

> • Arable land has an annual cycle of crop and bare soil,
> • Hedges grow large for some years and are then trimmed back.
> • Agricultural land may be occasionally flooded

Such dynamics represent normal behaviour of the agricultural land covers. Neither do they affect the LPIS, nor do they require an update. Manifest changes are those other true changes of the agricultural land that are readily perceived and recognized by the sense of sight.

As their adjective ?manifest? suggests, these changes should be easily and intuitively detected. The protocol below offers a more systematic way to ensure proper detection of true changes applicable to all conditions.

The detection of a manifest change automatically confirms the anomaly that documents it.
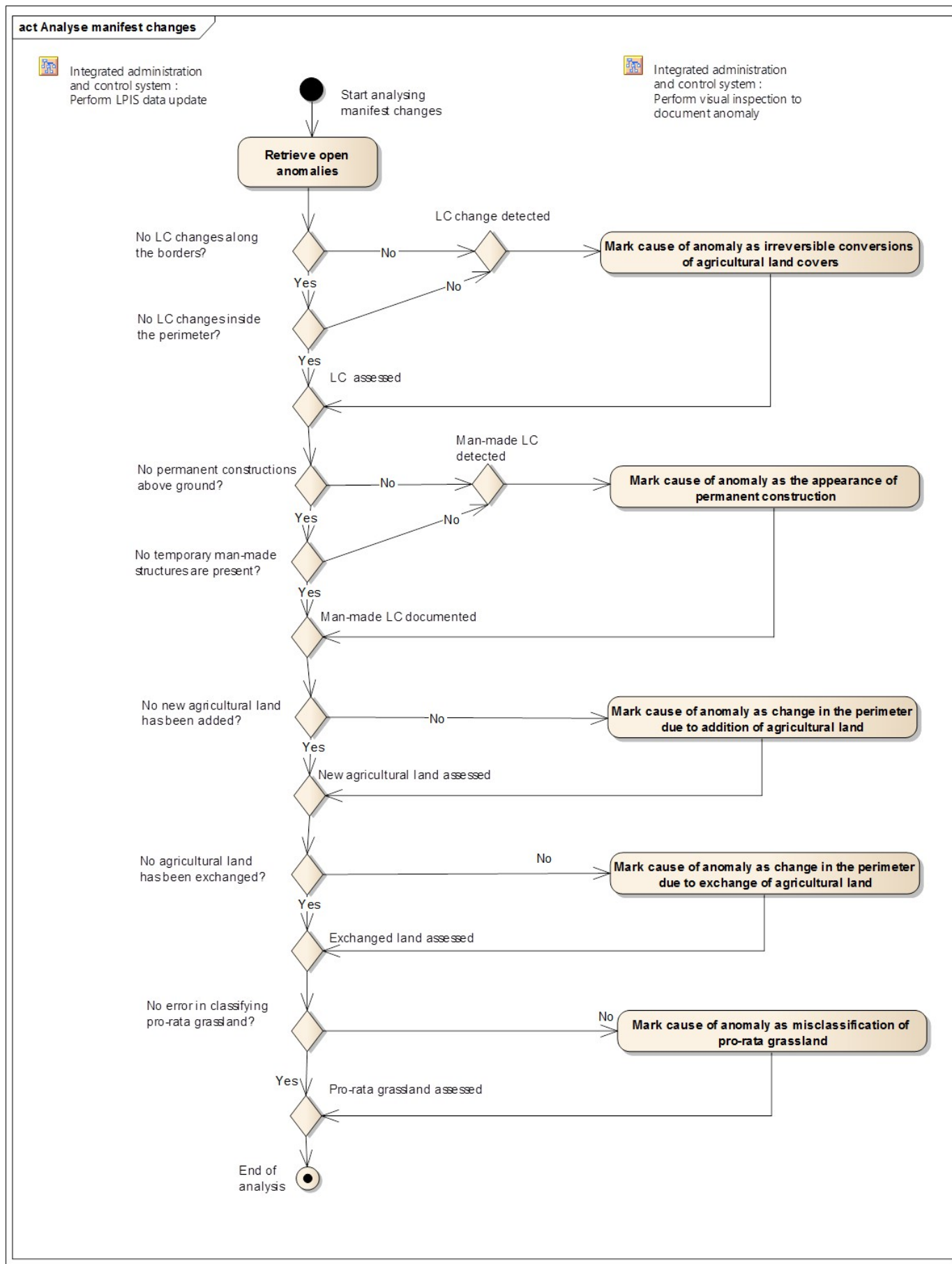
Figure 6 Analyse manifest changes

In the checks below, changes in agricultural land cover relate to either:

- Changes from agricultural land into non-agricultural land or vice versa
- Changes from one agricultural land cover type into another regarding these basic groups: arable land, permanent grassland, permanent crop, each type of grassland with scattered ineligible features,

The methodological steps are:

1. Check for land cover (LC) changes along the borders: Observe, whether there are changes of agricultural land cover at the RP border in a strip wider than 2,5 m. If there are, document the cause as irreversible conversion of agricultural land cover.
2. Check for LC changes inside the perimeter by observing any LC change that is bigger than 100 m2. If such eligible LC type has been changed into a non-eligible one then also document an irreversible conversion of agricultural land cover
3. Check for permanent constructions above ground: buildings, roads or other processing, infrastructure facilities or any storage structures, stable at least 3 years, If found, document as appearance of permanent construction
4. Check if new agricultural land has been added from outside the system. If there is, report a change in the perimeter due to addition of agricultural land.
5. Check if agricultural land has been exchanged between reference parcels: If there is, record this change in the perimeter due to exchange of agricultural land,

The above procedure leads to the reported detection and classification of the nature of a manifest change, provided one is present. There is absolutely no need to document individual steps or outcomes where no manifest changes were detected. Below are some examples of manifest changes:

Figure 7: Conversion of agricultural land inside the parcel perimeter. In this case from agriculture to natural habitat. Note the disappearance of the road and appearance of creeks.

Figure 8: Conversion of agricultural land crossing the parcel perimeter

Figure 9: Irreversible conversion of agricultural land. Appearance of roads. In this case the new construction pushes the existing road into the reference parcel.

Figure 10: Example of splitting caused by the same construction.

Note that the reference parcel on the left has reached the end its life-cycle, it no longer represents a single unit of land. From the update onwards, two new reference parcels start their life cycle.

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"""**Figure 11:** Example of merging. Land consolidation has caused the merger and it can make good sense to proceed with a single, new reference parcel in the future.

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17 Visual inspection procedure

If a manifest change is not or not all that manifest, visual inspection can often determine if a land change anomaly does indeed represent a true non-conformity. It offers a quick and simple stepwise method for inspecting LPIS reference parcels by searching for the not so obvious occurrence of a manifest change. There are three possible outcomes of this workflow:

- The parcel has been stable and there is no need for update.
- The parcel has indeed changed and further update is needed.
- The change cannot be unambiguously confirmed or discarded by visual inspection and the parcel can be subjected to a subsequent congruency test.

To be able to perform this workflow correctly, the operator must be familiar with the specific ancillary data and metadata and can access these during the inspection:

- the life cycle of the vegetation
- the boundary delineation precision of the LPIS
- an indication of the scene view angle or approximate camera position
- an estimation of distance and area on the working scale

As indicated above, this visual inspection procedure can "*mutatis mutandis*" also be applied for application during the OTSC, measuring an agricultural parcel that wholly occupies one reference parcel.

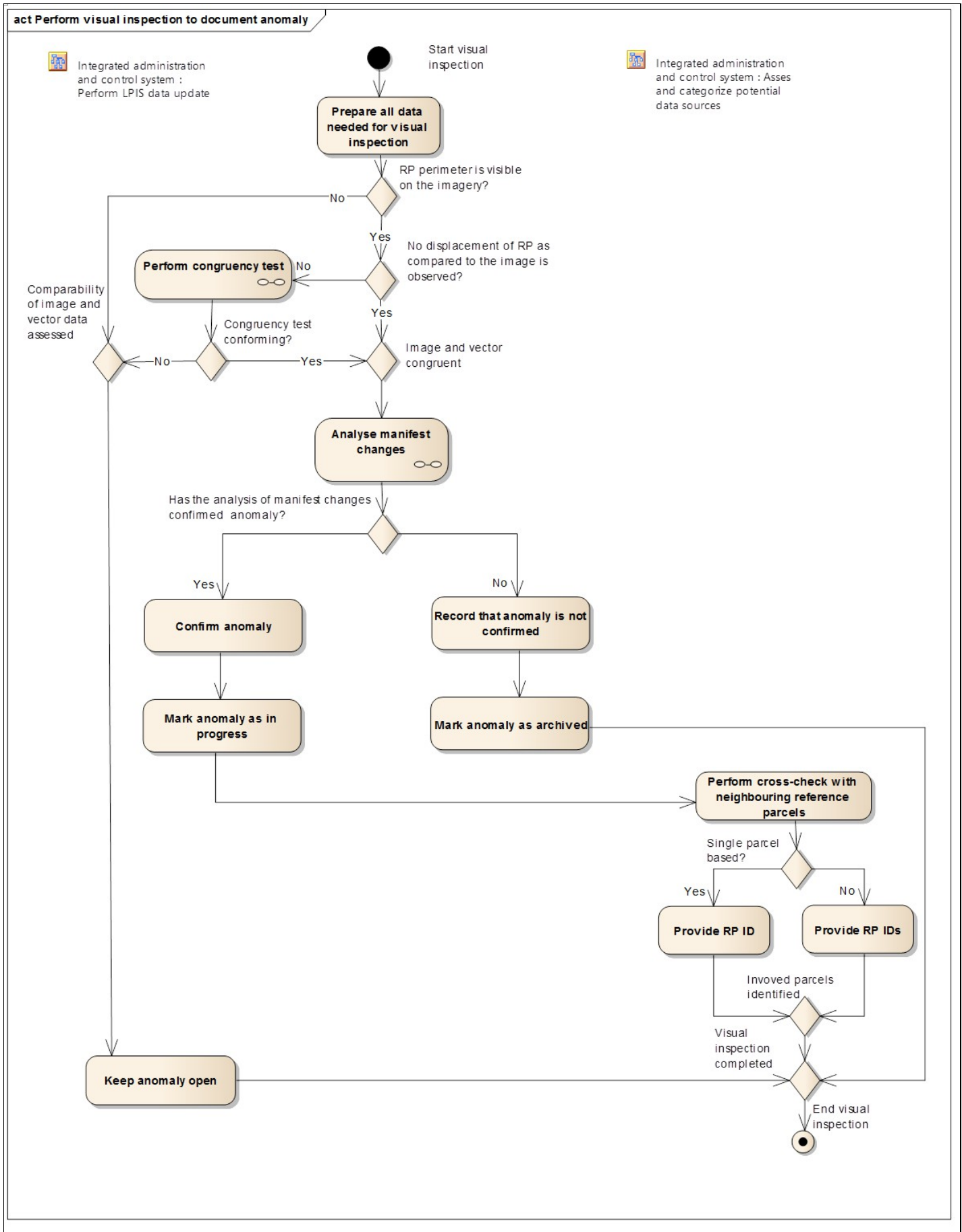The process of visual inspection is illustrated in Figure 13.

Figure 13: Visual inspection to document anomaly

Steps in this visual inspection process are:

1. Prepare all data needed for visual inspection, i.e. documentation of the anomalies, relevant orthoimage, reference parcel geometries from the current LPIS, etc.

2. If there is no problem with viewing the whole RP perimeter on the orthoimage, one may proceed. Else, keep the anomaly open as it is not possible to observe/measure the reference parcel on the given imagery. Process the anomaly appropriately in due time.
3. If the observed displacement (RP vs orthoimage) of four, well identifiable ground level perimeter points in each of the four cardinal directions (N-E-S-W) is above 1.25 m, one may consider to perform an optional congruency test if the overall condition prevents to discard absence of change on sight. Else, continue.
4. Check for the presence of manifest changes inside the reference parcel as described in the appropriate workflow (low level use case).
5. If manifest changes have been found or the congruency test has failed, indicate in the documentation that the anomaly is confirmed and mark the anomaly ?in progress?. Else record that anomaly as not confirmed.
6. Perform a spatial cross-check with the neighbouring reference parcels by visualizing their inter-relations from geometries. Analyse the extent of the change affected, and determine how many reference parcels are involved in the anomaly.
7. Indicate in the anomaly documentation, the unique ID number of the reference parcel and, if appropriate, the unique ID numbers of the reference parcels affected in the neighbourhood.

The above procedure offers one possible systematic sequence of checks in support of detection and reporting of changes to one or more reference parcels. There is absolutely no need to document individual steps. MS may operate an alternative procedure that leads to similar findings.
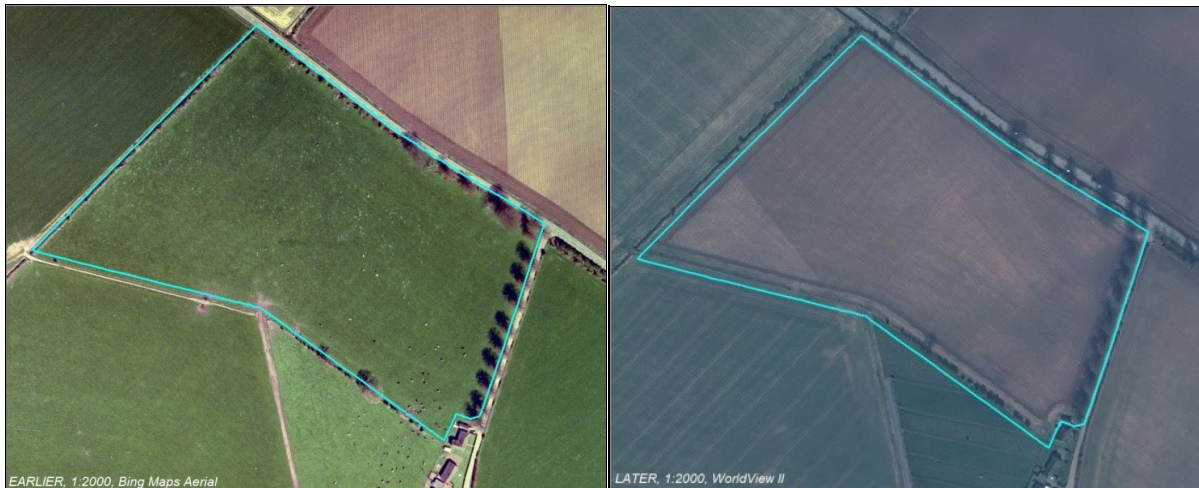

Figure 14: discovering the need for a congruency test in course of visual inspection

The figure above provides a case illustration of this decision thread:

1. the overall situation makes sense
2. the parcel perimeter can be visualized
3. the perimeter is still valid
4. no constructions appear,
5. no conversion into non-agricultural land occurs,
6. no part of the boundary is subject to displacements (the tree base is visible).
7. the displacement of the corners is larger than 1.25: "YES" and a congruency test can provide a final verdict on any remaining doubts

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18 Congruency testing

In very rare cases, the visual inspection or evaluation on sight may not relieve remaining doubts that the state of the parcel represented in the LPIS is still identical to the one that can be observed on the imagery. Such situation can occur in case of shifts (displacement) of imagery of a parcel, even if all data are well within specifications. Such a shift could cause a dirt road bordering the parcel?s perimeter, become portrayed inside that perimeter on a more recent image. The test could allow to discard the shifted portrayal as a regrettable but inevitable technical artefact, not as a real change.

As this technical test is much more complicated and cumbersome than the other procedures, it is strictly reserved for exceptional cases where discussion between stakeholders has already arisen. The Commission services do not expect the congruency test to be applied on a regular basis, but merely propose a tool of last resort that could be used on voluntary basis.

"Congruent" refers to a situation where two polygons (parcel representations) have the same shape and dimension.

As a result, all their corresponding sides (perimeter segments) have the same length, and the angle between any two corresponding segments has the same value. In a simplified form, this concept is used for two purposes:

Vindication of a reported change. When the visual inspection could not detect alleged changes on the land, this congruency test offers a way to demonstrate that no change has occurred. The test does not check the full perimeter or the interior of the reference parcel as these were investigated by the prior visual inspection. It relies on (the lack of) displacements on well identifiable ground points in each cardinal direction.

Calculation of coordinate shift between two shapes. The congruency test procedure and formulas can also be used to determine the length and direction of the local translation (coordinate shift) between two congruent representations of a single object. For instance between:

- The object?s vector and orthoimage representation
- Two separate orthoimages covering that object.

Performing the congruency test obviously requires that relevant orthoimagery, and vector representation of the parcel (that can come from a new measurement too) are available and referenced to a common Coordinate Reference System.

Any test on the full reference parcel perimeter (all sides and vertices of the polygon) would result in numerous tests of shapes, sides, angles and dimension, so this test compares a simplified representation of the reference parcel with a corresponding representation on more recent or other alternative source. The simplified representation is provided by the axis aligned bounding box (AABB) that envelopes the complete reference parcel perimeter. The four cardinal points coordinates of each AABB are mapped for each representation in the test.

The actual test involves three steps:

- Construct the AABB for one representation (LPIS RP) and calculate its parameters
- Construct the AABB for the other representation (orthoimage) and calculate its parameters.
- Compare the two derived vector parameter sets for the absence of scale variation and rotation.

A well performed congruency test ensures that:

- if the result is conforming, the geometry of the parcel should not be changed and the anomaly can be archived.
- if non-conforming, the parcel indeed has a problem with the geometry, and the anomaly processing has to be continued.
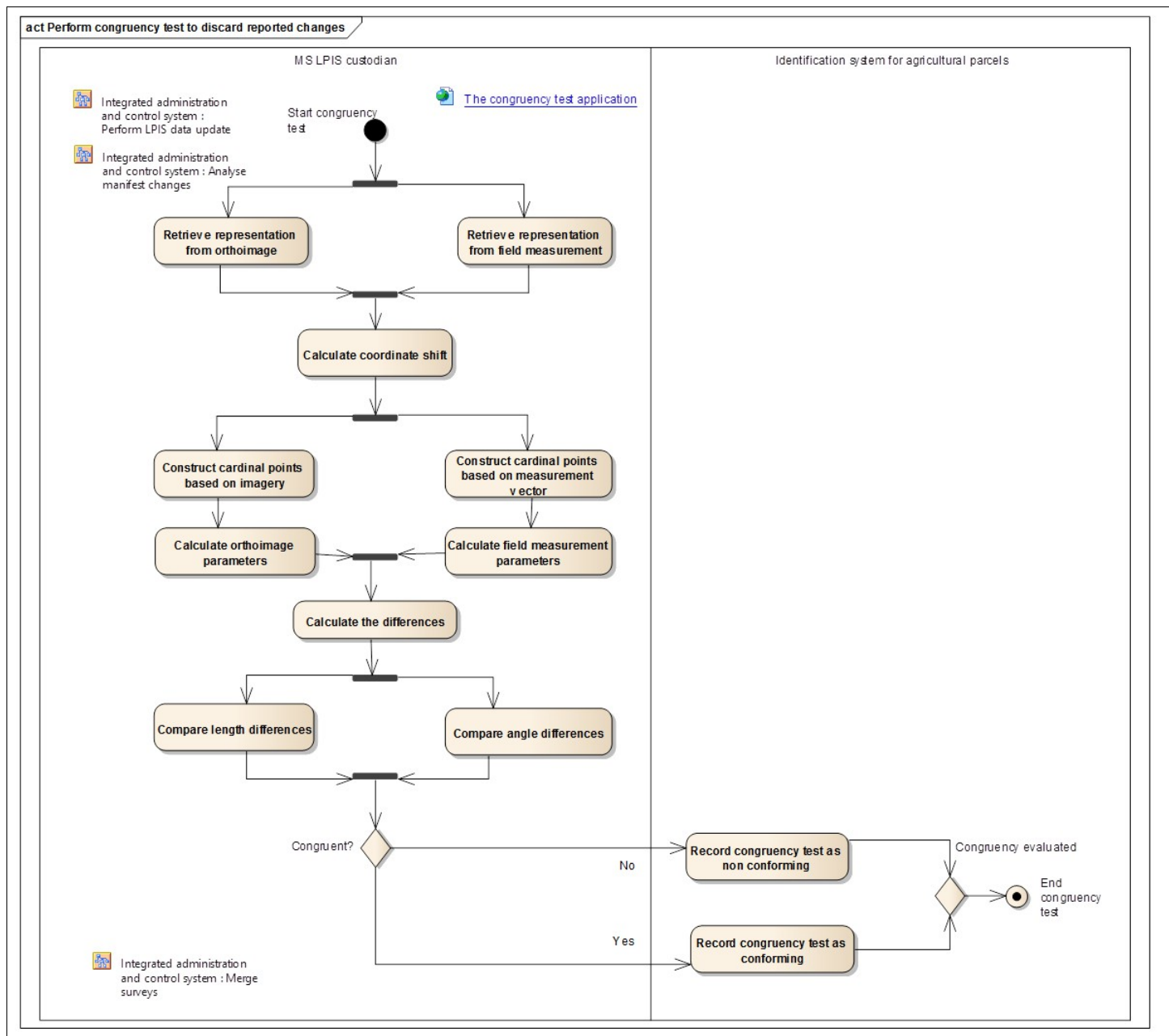
Figure 14: Workflow in the congruency test

The congruency test steps are:

1. Start by retrieving the reference (RP vector) data produced and retrieve the measurement data produced in the field either from the farmer, inspector and/or operator
2. Construct the reference AABB (e.g. via orthoimage) through cardinal points, and calculate reference (e.g. orthoimage) parameters.
3. Construct the AABB to be tested (e.g. from the field measurement) through cardinal points, and calculate alternative (e.g. field measurement) parameters
4. Calculate the differences between reference and alternative AABB?s as described http://139.191.148.147/wikicap/index.php/Upkeep_-_Congruency_test
5. Compare the differences in length and in angle rotation between the two AABB?s vectors as described http://139.191.148.147/wikicap/index.php/Upkeep_-_Congruency_test
6. If the difference of AABB?s angles >1 degree AND diagonal differences >2.5 m the congruency test result is nonconforming and the anomaly is confirmed, so update processing is needed.) A conforming result indicates the anomaly can be ignored; document the result and archive the anomaly.
7. Calculate coordinate shift between two representations from the image and from the field.

Constructing each axis aligned bounding box involves

- Select the 2 vertices on the reference parcel perimeter that represent the most distant from each other. These vertex points should be ground level points (i.e. not on an elevated positions as tree tops, hedges, walls) and clearly visible (i.e. the view should not be obstructed by a nearby object.)
- Record the (x, y) coordinates of each of these opposite vertexes and visualize the long diagonal on screen (A and C)
- Select the vertex on one side of this long AC-diagonal axis that has the largest Euclidean distance perpendicular to that diagonal (the most distant corner) t l, record the (x, y) coordinates (B)
- Select the most distant vertex of the other side of the long diagonal and record the (x, y) coordinates (D).
- The AABB is constructed as the rectangular box that connects all points ABCD and with the longest sides aligned with the axis AC.

EXAMPLE: http://139.191.148.147/wikicap/index.php/Upkeep_-_Examples_congruency_test

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A by-product of the congruency test procedure and formulas is the exact length and direction of the local translation (coordinate shift) between any two congruent representations of a single feature. For instance between:

- The object?s vector and orthoimage representation
- Two separate orthoimages covering that object.

Knowing these parameters is essential to remove the local coordinate shift, in particular when merging surveys.

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19 UPD pro rata assessment

Categories of various pro-rata grasslands are separate land cover classes in the eligibility profile. Misclassification between various pro-rata classes has an impact on the reference area, since this latter should assess that potentially eligible agricultural land. As a result, classification errors of pro-rata PG has to be treated as anomaly/non-conformity.

For detailed description of pro-rata concept please refer to the dedicated technical guideline:
https://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPIS_TG_PR
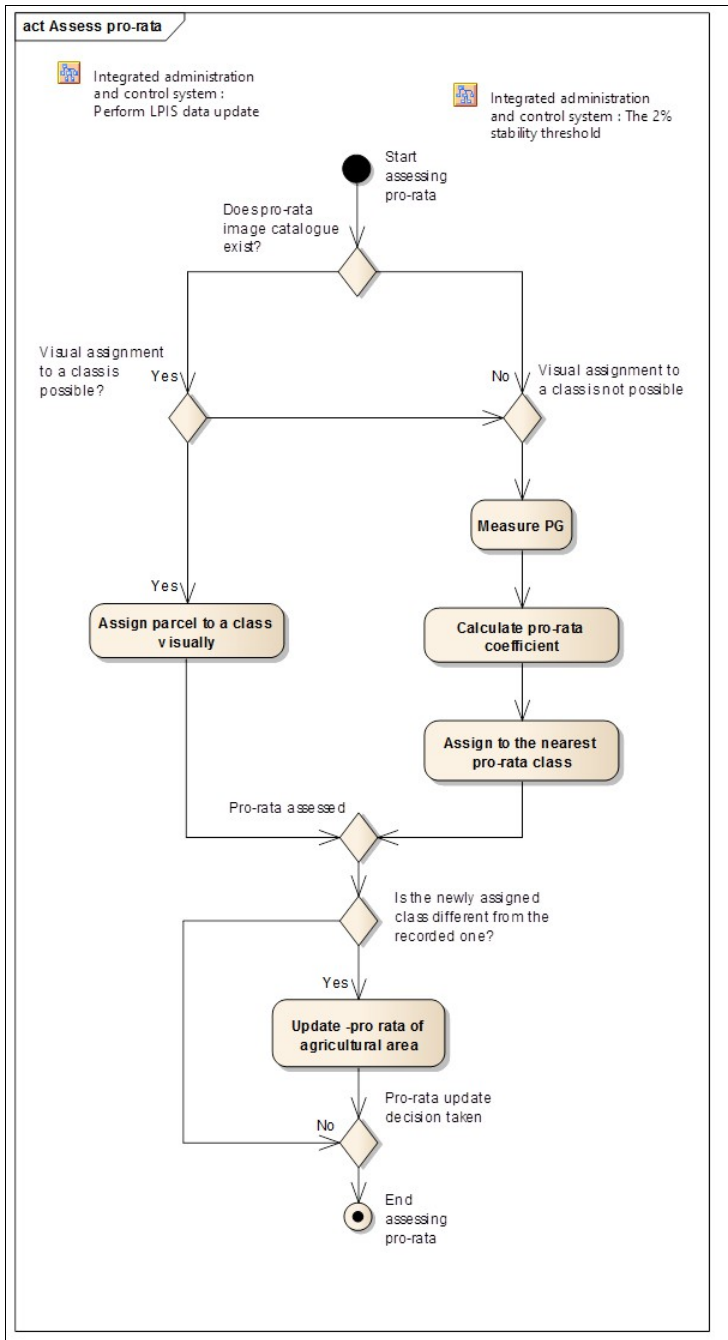
Figure 15: *Assessing pro-rata in course of LPIS update*

The workflow of pro-rata assessment in the update process is presented in Figure 10 and involves:

1. Pro-rata is inherently risky; in order to consistently assign permanent grassland to pro-rata classes MS/Regions may/should have created a photo interpretation catalogue with images, qualitative, statistical, and other quantitative descriptors.
2. Using the image catalogue the operator should decide whether based on the similarities, the inspected item can be assigned to a class whenever the instance of the assessed PG is similar to an image instance in the catalogue
3. Without a clear catalogue or when no visual confirmation is possible, a pro rata assessment needs to be performed. This involves mapping the PG, assessing its pro rata coefficient and determining the pro-rata category.
4. If the observed result is different from the values recorded in LPIS, update the values in the LPIS

20 Merging surveys

20.1 Merge surveys

The operation of merging surveys is applicable in the following cases:

- The geometry of one or more reference parcels in one field has been updated by one or more separate CAPI surveys.
- The updated geometry comes from field surveys (GNSS).
- The updated geometry comes from reliable third party data (mapping agency, road authority, etc.).

This process generates a new polygon and thus a potentially a new reference area. Before updating that reference area, the 2% stability rule has to be applied.
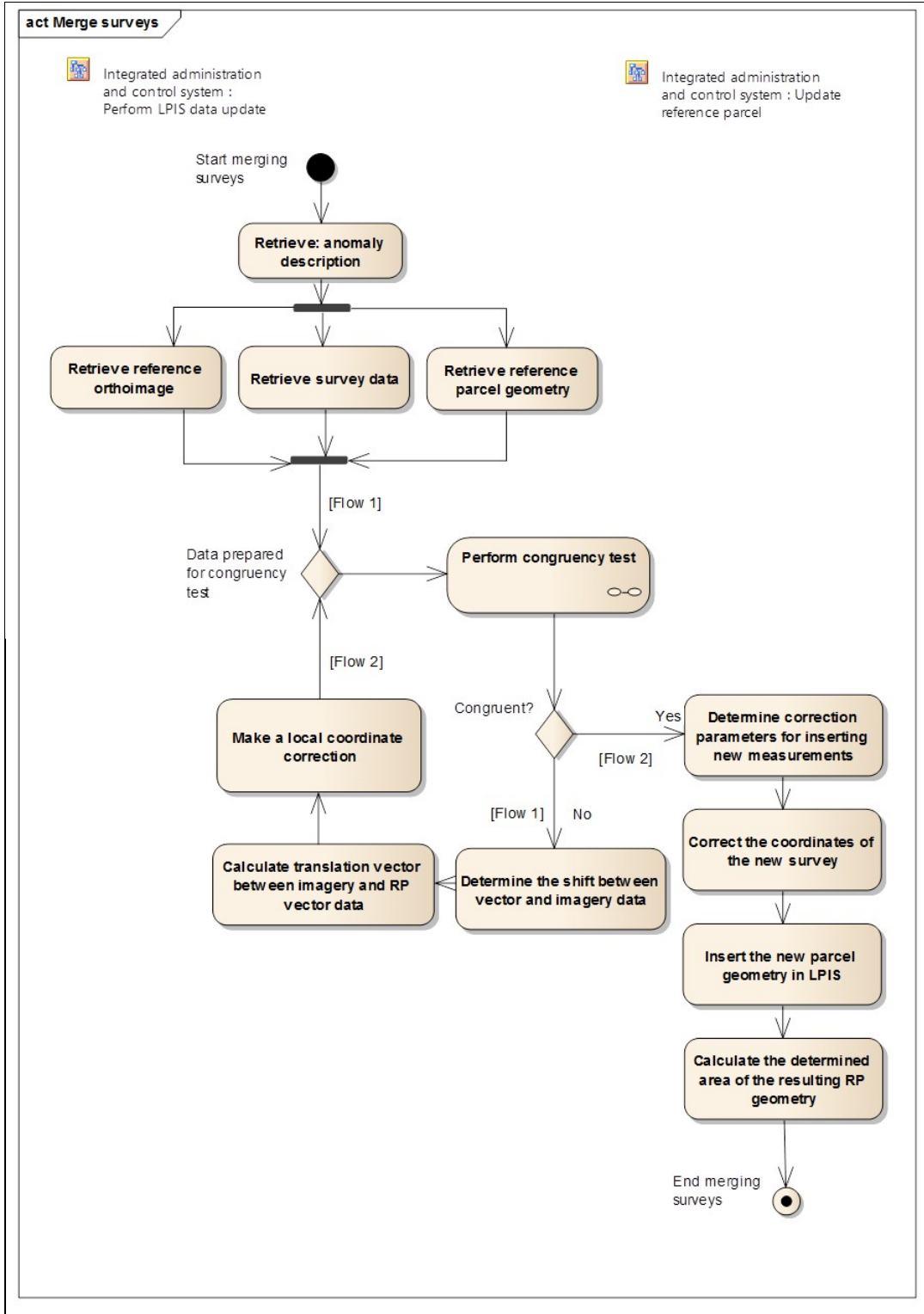
Figure 16: Merge surveys

The method recognizes the following steps

1. As usual, start by retrieving the documented anomaly and analysing the description.

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2. NOTE. When the update process is performed in one go (i.e. all the use cases are performed one after another), this step can be omitted, since all workflows were driven by the same anomaly and the operator is likely to know the anomaly description very well.
3. Retrieve the reference orthoimage and put it as a background to display with the rest of the information.
4. Retrieve the survey data and overlay it with the reference orthoimage.
5. Retrieve the reference parcel geometry subject to editing and overlay it with the reference ortoimage and survey data. Check the right reference coordinate system. Reference parcel is now ready for perimeter editing.
6. Perform the congruency test whenever a coordinate shift is apparent between any of the data sources (reference parcel, image, new survey), perform the congruency test as described above, always considering the RP vector as reference.
7. Determine the coordinate shift between the new survey and those present in LPIS and apply the correction to the coordinates of the imager and/or new survey before inserting the new geometry in LPIS.
8. Insert the new parcel geometry in LPIS by replacing any old perimeter segment with corresponding, locally corrected new survey segments.
9. Calculate the area of the resulting reference parcel polygon.

The series below illustrates how a segment of RP boundary, measured with field survey, is inserted in the reference parcel perimeter. Procedure ensures that all data involved respect the homogenous standard of the LPIS.

In order to proceed with merging all input data has to be in the same coordinate reference and projection system. When this is not the case some of the input data has to be translated.

The same georeferencing process has to be performed for the newly surveyed boundary section too.
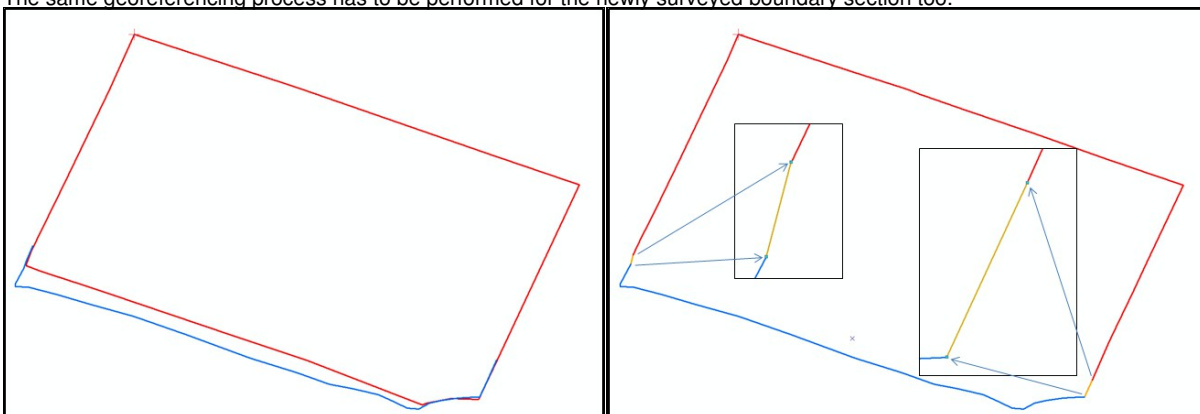
Insertion of new geometry segment: The dangling segments beyond confirmed primary vertices are removed from both original perimeter and new survey vector.
Figure 17: Illustration of the merger of surveys

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21 UPD applying the 2 percent rule

The 2% stability threshold is the criterion to decide whether the value of the reference area of a parcel (?referenceArea? attribute) has to be updated after a geometry operation or measurement. The area values that can be derived from the geometric representation is compared to the value of the reference area recorded in LPIS. A technical tolerance of 2% is applied for the ratio of the two area values. When the difference of the ratio is bigger than 2%, the reference area value of the parcel has to be updated.

Member States should ensure that the maximum eligible areas for the relevant schemes and support measures per reference parcel is correctly quantified within a margin of maximum 2% (the 2% stability threshold), by taking into account the outline and condition of the reference parcel. This 2% stability threshold does not apply to any clear change. It only applies when parcels did not change in reality but the change is caused by delineation differences due to fussy boundaries. In those cases changes compared to the existing parcel up to 2% do not necessarily have to be processed as they are caused by the outline and condition of reference parcels.

The topic is also relevant to decide whether a reported anomaly, only based on area values without other source data, needs to be processed at all.

Measures should be taken to propagate the eventually updated reference area value to the other subsystems of IACS. In particular, it should appear in the pre-printed form for the next application year.
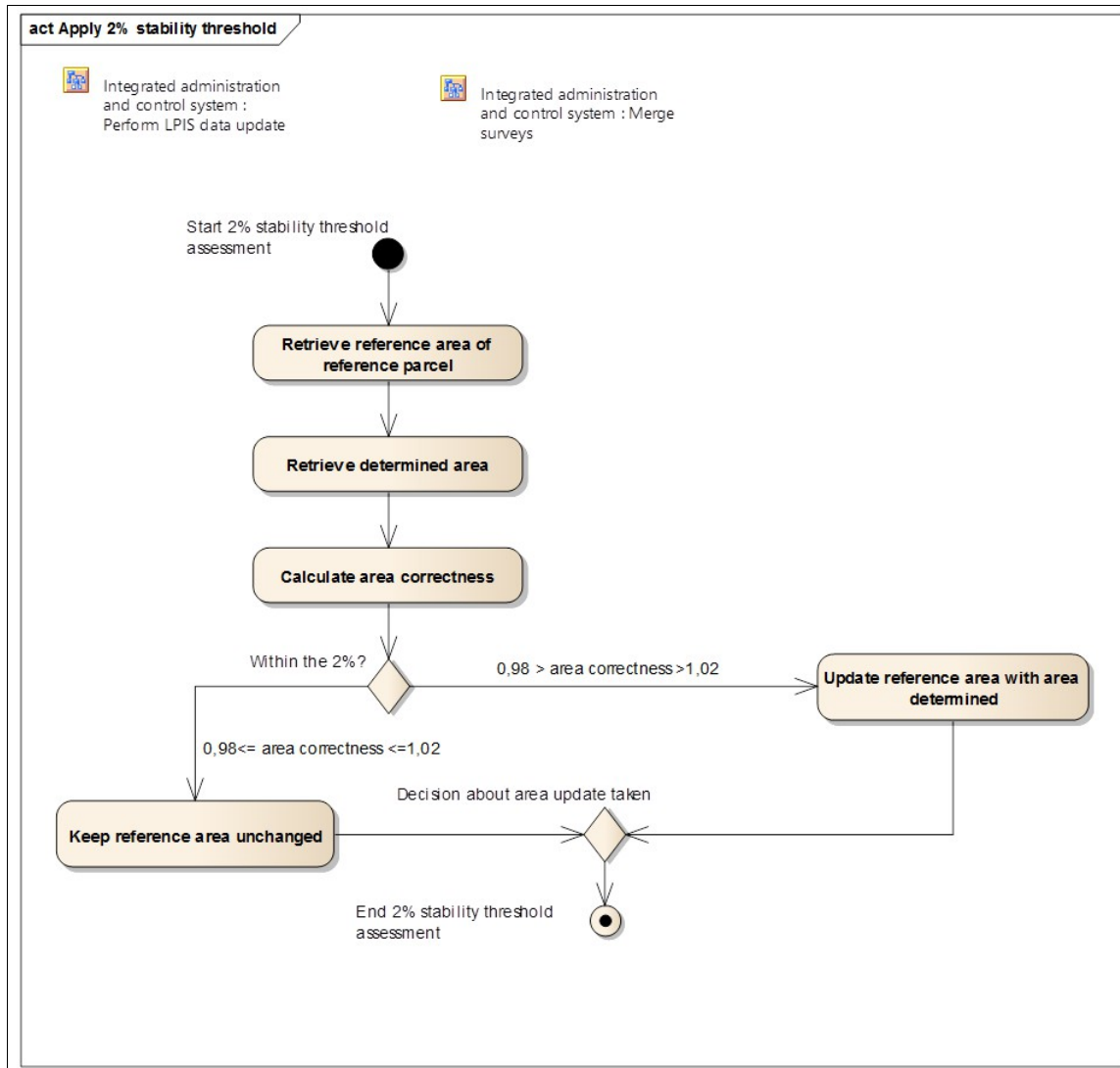

Figure 12: Application of the 2% stability threshold criterion

To apply the 2% stability rule:

1. Start by retrieving the reference area of the parcel, which is available as attribute of the ReferenceParcel feature type
2. Retrieve the area that has been determined/measured/captured in course of update process (reported, changed as a result of new geometry insertion, or applying a new pro-rata class).
3. Calculate the ratio between determined area from the previous step and reference area recorded in IACS to check the area correctness.
4. Control the area correctness ratio: If the area correctness ratio is between 0.98=< ratio=< 1.02, you can choose not to change the reference area. Else, update the reference area in LPIS with the area determined.

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