



Executive summary

VARTAN Final Activity Report

Establishing and Automating Validation Reporting Templates in the E-OCVM Framework

Problem area

The document provides the Final Activity Report (D5) for EUROCONTROL Task Requirement Sheet (TRS) 062-2005 that was awarded to NLR in June 2005 and was subsequently entitled Validation Reporting Template Analysis by NLR (VARTAN).

The report is mainly concerned with the problem area of a consolidated validation methodology for Europe and its applicability for producing templates for validation result reports. These templates should include document automation for easily transferring validation report contents to the Validation Data Repository (VDR) of EUROCONTROL.

Description of work

The VARTAN project had to produce an analysis of the European Operational Concept Validation Methodology (E-OCVM) and related documentation, a description of reporting triggers within the life cycle of a concept, and a study about the implementation of automated interfaces for the input of

the contents of Validation Reporting Templates into the EUROCONTROL Validation Data Repository (VDR).

The deliverables consist of this report and the Validation Reporting Templates which were established on the basis of aforementioned studies. The templates are available separately from this report. Also the Java source code that demonstrated the feasibility of the proposed automation solution is available separately from the report. Guidance material is included both separately and as part of this report. Examples are given as part of the help text for the templates. As a consolidating step the position and role of both planning and reporting templates within the methodology is elaborated.

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Descriptor(s)

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Data Repository
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E-OCVM
Validation
Methodology
Operational Concepts
EATMP

Results and conclusions

In general, it was concluded that the E-OCVM clearly has the potential for complying with the overall objective of providing an appropriate concept validation framework. However, the analysis report also concluded that there are weaknesses in the methodology and parts that need refinement.

Suggestions were made to:

- Develop an easy approach to combine the different E-OCVM views and make the methodology more accessible to the less proficient user. This recommendation concerns the process itself, its applicability and comprehensibility for the validation experts and managers carrying out concept validation projects.
- Refine the description of the following elements of a validation process:
 - Role of stakeholders (focus on stakeholder goals)
 - Case-building process
 - Interrelations between cases
 - Uncertainty and different levels of quality and details in results

The assessment of reporting triggers gave suggestions for:

- Extension and clarification of the life cycle view
- Reporting structure and possible trigger points
- Basic template contents, such as:
 - Summary of the main parts of the planning document

- Differences between planning and actual achievements
- Confidence in the results, i.e. quality and significance
- Correlation between template contents, such as:
 - Correlation between conclusions/recommendations and objectives (at experiment and project level)
 - Each objective must be related to a key performance area
 - Traceability between experiment results, low-level objective or hypotheses and higher level experiment objectives
- Template contents for all applicable decision making levels (experiment, project and programme level)

Finally, the automation study looked at technical options for automation of the proposed templates, regarding both client support and communication technology. The study concluded that it is necessary to investigate further and define potential document automation to assist the author in writing the document. It was found that the automation in the template could be very helpful in terms of, for example, auto-filling, prompting summary and cross-reference tables. The communication architecture should take into account the preferred working methods of the VDR data administrator and VDR data collector and their way of working

and the tools they use must be incorporated in the process of accepting validation templates.

Applicability

This study identified important proposals for change for both the E-OCVM and the VDR. All recommendations for E-OCVM and VDR will be collected by the Validation Forum Supervisory Board of EUROCONTROL (including partners from the European Commission and EATRADA) and the most important change proposals will be submitted to the Joint Programme Board (JPB), which is formed by the European Commission and EUROCONTROL. The JPB has the final decision on how E-OCVM and VDR should evolve and what should be changed.

The technical part of this study identified potential processes for template automation and demonstrated that these processes can be achieved from a technical viewpoint. As a next step, it will be important to test the feasibility of the proposed automation and associated processes, in terms of user acceptability (document author, data collectors, administrators etc.) and the actual technical infrastructure at EUROCONTROL.



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VARTAN Final Activity Report

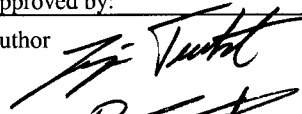


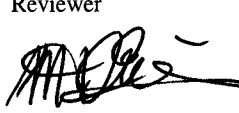

Establishing and Automating Validation Reporting
Templates in the E-OCVM Framework

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Summary

This document provides the Final Activity Report (D5) for EUROCONTROL Task Requirement Sheet (TRS) 062-2005 that was awarded to NLR in June 2005 and was subsequently entitled Validation Reporting Template Analysis by NLR (VARTAN).

This report encompasses an analysis of the European Operational Concept Validation Methodology (E-OCVM) and related documentation, a description of reporting triggers within the life cycle of a concept, and a study about the implementation of automated interfaces for the input of the contents of Validation Reporting Templates into the Eurocontrol Validation Data Repository (VDR).

Furthermore, it includes a description of the contents of the Validation Reporting Templates which were established on the basis of aforementioned studies and are available separately from this report. Also the Java source code that demonstrated the feasibility of the proposed automation solution is available separately from this document. Guidance material is included both separately and as part of this report. Examples are given as part of the help text for the templates. As a consolidating step the position and role of both planning and reporting templates within the methodology is elaborated.

In general, it was concluded that the E-OCVM clearly has the potential for complying with the overall objective of providing an appropriate concept validation framework. However, the analysis report also concluded that there are a number of weaknesses in the methodology and parts that need refinement. Suggestions were made to:

- Develop an easy approach to combine the different E-OCVM views and make the methodology more accessible to the less proficient user. This recommendation concerns the process itself, its applicability and comprehensibility for the validation experts and managers carrying out concept validation projects.
- Refine the description of the following elements of a validation process:
 - Role of stakeholders (focus on stakeholder goals)
 - Case-building process
 - Interrelations between cases
 - Uncertainty and different levels of quality and details in results

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- Correlation between template contents, such as:
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In general, it should be noted that the technical part of this study identified potential processes for template automation and demonstrated that these processes can be achieved from a technical viewpoint. As a next step, it will be important to test the feasibility of the proposed automation and associated processes, in terms of user acceptability (document author, data collectors, administrators etc.) and the actual technical infrastructure at EUROCONTROL.



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(111 pages in total)



1 Introduction

1.1 Document Context

This document provides the Final Activity Report (D5) for EUROCONTROL Task Requirement Sheet (TRS) 062-2005 that was awarded to NLR in June 2005 and was subsequently entitled Validation Reporting Template Analysis by NLR (VARTAN).

This report encompasses an analysis of the European Operational Concept Validation Methodology (E-OCVM) and related documentation, a description of reporting triggers within the life cycle of a concept, and a study about the implementation of automated interfaces for the input of the contents of Validation Reporting Templates into the Eurocontrol Validation Data Repository (VDR).

Furthermore, it includes a description of the contents of the Validation Reporting Templates which were established on the basis of aforementioned studies and are available separately from this report. Also the Java source code that demonstrated the feasibility of the proposed automation solution is available separately from this document. Guidance material is included both separately and as part of this report. Examples are given as part of the help text for the templates. As a consolidating step the position and role of both planning and reporting templates within the methodology is elaborated.

1.2 Project Description

The VARTAN project is concerned with the definition of Validation Reporting Templates containing the results of validation activities. The templates need to be defined in accordance with existing best practices from the (European) Operational Concept Validation Methodology (E-OCVM). The European Commission and EUROCONTROL collaboratively promote the use of the E-OCVM and apply the methodology in their Operational Concept Validation programmes and projects. On the experiment level the E-OCVM is based on the Master ATM European Validation Plan (MAEVA) guidelines.

In order to help define the Validation Reporting Templates an initial assessment of the E-OCVM will be performed. This effort shall lead to a refinement of the Operational Concept Validation Life Cycle model and the according Performance and Behavioural Views (also referred to as Case-based Views) as presented in the E-OCVM.

Furthermore, the project foresees in consolidating the existing Validation Plan Templates based on the changes proposed for the general methodology and offering a solid solution for

automated transfer of the contents of both Validation Plan and Validation Reporting Templates into the Validation Data Repository (VDR) of EUROCONTROL.

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1.4 Project Context

The European ATM Systems and Convergence business division (ESC) of the EATM Directorate ATM Strategies (DAS) supports establishing the high-level operational and technical framework for the EATM Programme. One of the foremost responsibilities of the division is the provision of the overall roadmap for change initiatives and maintenance of the Operational Improvements identified in the ATM Strategy for the years 2000+ [1]. This feeds directly into the work programmes of the contributing organisations (i.e. the EUROCONTROL Agency, European Commission, R&D Institutes, and Industry).

The decision making on the change initiatives is based on the available evidence of performance benefits to be achieved by the proposed change. Providing this evidence at an appropriate level of detail and confidence is the objective of Operational Concept Validation (OCV). OCV projects and programmes in the context of European Commission and EUROCONTROL collaboration apply the Operational Concept Validation Methodology (E-OCVM) [3] and the Validation Data Repository (VDR) [7].



The EATM ESC Unit is responsible for overall EATM Programme Validation Management and is therefore co-ordinating the development of the:

- Overall Validation Plan in support of the implementation of the ATM 2000+ Strategy [1],
- Operational Concept Validation Strategy (OCVSD) [4],
- Operational Concept Validation Methodologies (E-OCVM) [3],
- Validation Data Repository (VDR) [7].

ESC collects and maintains a centralised, overall view of the validation activities executed at domain and programme level and by other European partners in the VDR.

The VDR is a comprehensive suite of services provided by the EUROCONTROL Agency that supports structured approaches to validation by providing a flexible information management system for ATM validation. In particular the outputs from Operational Concept Validation activities are stored in a common structure and disseminated in the VDR.

The purpose of the E-OCVM is to rationalise the work and to achieve consistency between the different development stages in the concept lifecycle. Furthermore, its aim is to achieve consistency in the diverse projects supporting a strategic change.

The E-OCVM makes a distinction between:

- the **concept lifecycle view**, placing the operational concept in a timeframe and considering its maturity,
- the **stepped evaluation view**, looking at the specific objectives of a certain project and its experiments on a detailed level and applying the guidelines given by the Master ATM European Validation Plan (MAEVA) [2] and its stepwise approach to ATM validation, and
- the **case-based view**, gathering the information generated by various tests and experiments in a way that helps explain to stakeholders what can be expected in terms of performance and behavioural capabilities. From this information (addressing safety, capacity, economics, environment, human factors, workload, usability and hazards) costs and benefits can be derived.

In a previous effort (TRS 139-2004), templates for Validation Plans on the Strategy, Programme and Project Levels have been developed and demonstrated using realistic but artificial examples. The lifecycle phase level was split into a programme and a strategic level, however, no indication was given regarding the criteria for progressing from one lifecycle phase to the next. Furthermore, there has been no indication of what can be expected in terms of results for a specific lifecycle phase from particular case-based views.



Thus, in summary there is a need to:

- Refine the current model describing the Operational Concept Validation Lifecycle and the Performance and Behavioural Views (case-based views) in order to define the Validation Report templates,
- Review the validation reference documents in the light of the progress achieved in this effort,
- Identify the appropriate triggers to produce Validation Reports along the Operational Concept Validation Lifecycle,
- Develop and demonstrate templates for the identified Validation Reports at the different levels and stages of the Operational Validation Lifecycle,
- Consolidate the existing Validation Plan templates (see also [5] and [6]).

Considering that it is the intention of ESC to collect and maintain all important validation data in a centralised database, it is necessary to develop an automated solution for transferring the contents of both Validation Plan Templates and Validation Report Templates into the VDR. In a previous effort a relation between the planning data and the VDR was identified, however, a solution for automating the process was not developed.

The Validation Plan Templates and Validation Report Templates will therefore need to identify data structures and elements, which could be later formalised and used to allow easy transfer to the VDR.

Guidance to fill in the produced templates is required, and could be provided, for example, in the form of a manual and/or help facility. As the templates are aimed to support the entire ATM R&D community, they shall be on a generic level similar to the baseline documents.

1.5 Approach as Suggested in Project Proposal

In order to identify the issues related with the Operational Concept Validation Lifecycle and the Performance and Behavioural Views in the referenced baseline documents (OCVSD [4], EATMP Guideline [8], E-OCVM [3] and the VDR [7]) this material is analysed under consideration of additionally mentioned references, such as the ATM 2000+ strategy [1] and MAEVA [2].

Also close co-operation with the Co-operative Approach to Air Traffic Services (CAATS) project team will be sought. CAATS is responsible for harmonisation of validation activities within the European Commission 6th Framework Programme. The co-operation with CAATS will ensure that the development of the templates is in line with the work performed in CAATS.



The Validation Report templates will build on existing best practices. They will provide the structure of the documents in terms of headlines of the different chapters, sections and paragraphs. The templates will be developed in MS Word using the EATM style. From a user point of view only basic functionality of MS Word will be exploited so that contents can easily be incorporated without forcing the user to deal with layout issues. Within the MS Word document, other common tools (such as MS Excel and MS PowerPoint) will be used to integrate data and graphics.

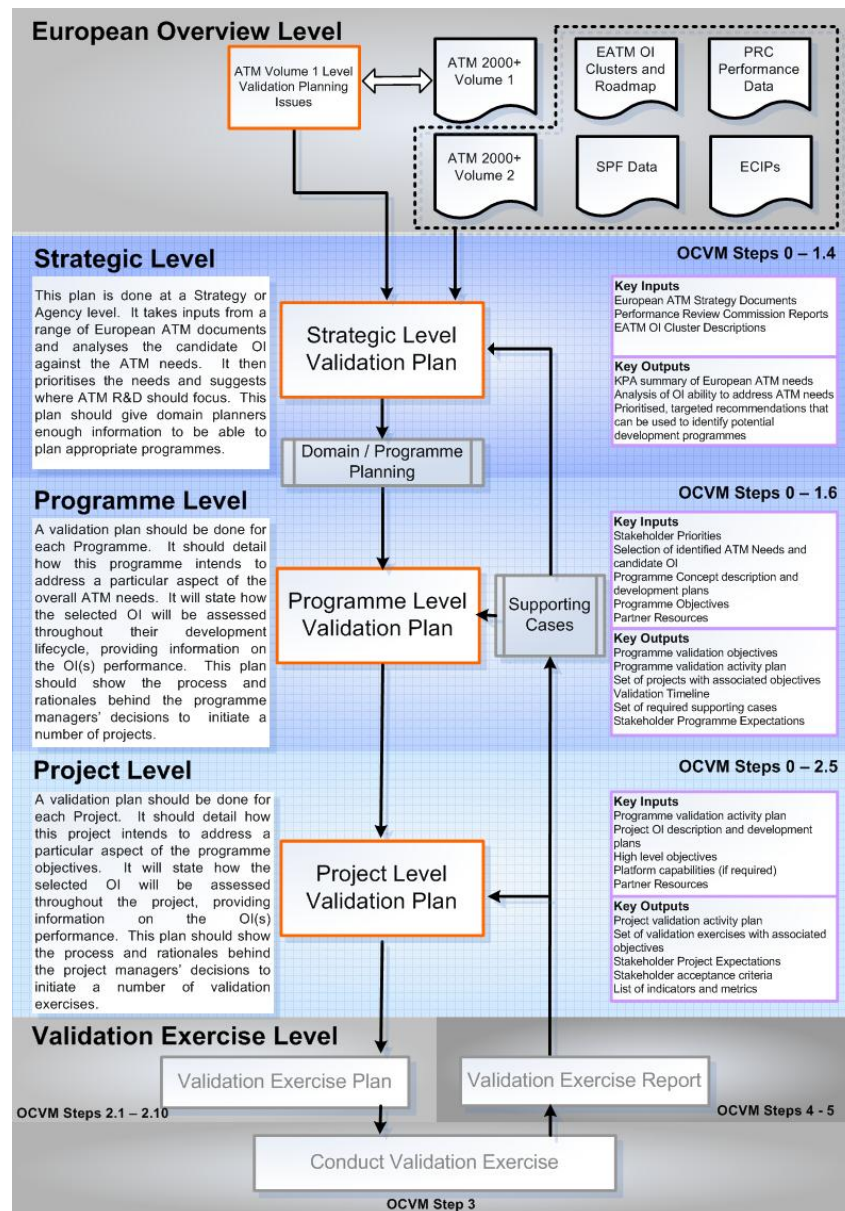


Figure 1-1: Validation Planning Process as proposed in TRS 139-2004



For the input of validation document content into the VDR, more sophisticated techniques will be used. Depending on the preference of the VDR team, the template document contents can be transferred to the VDR with the help of a combination of MS Office automation, Web Services, the Extensible Mark-up Language (XML) and further processing by the Extensible Stylesheet Language for Transformations (XSLT). The intention is to find a solution that will accommodate the transformation and transfer of the document contents minimising the intervention of the authors of the Validation Plans and Validation Reports.

Figure 1-1 shows the entire validation planning process as identified in the previous effort (TRS 139-2004) to develop Validation Plan templates. This model shows a structure in which strategic Concept Validation objectives are decomposed into more detailed lower-level objectives on the programme, project and experiment levels. Vice versa the resulting Validation Reports will have to aggregate and accumulate the results of the validation exercises step by step from the experimental level back to the strategic level.

As already shown in Figure 1-1 the supporting cases will have a major influence on the decision making process of the stakeholders and also deliver criteria that could be used to trigger a transition from one phase of maturity in the lifecycle model to the next.

In order to show this intricate relationship, Figure 1-2 combines the concept life cycle and case-based views. While this view relates to the progress in time and effort, the different strategic levels determine the level of detail.

Figure 1-2 is meant to show that the approach chosen in this project will extend above an analysis of the different levels of detail that can be found in the decision making process and will also cover the case-based view, i.e. the performance and behavioural capabilities of the concept under investigation and their interrelations and different levels of certainty. This might require adapting the previously defined Validation Plan templates so that the outlined approach is followed including a consolidation of previous work.

The E-OCVM and VDR will be regarded as the most important input to the analysis. In that regard NLR will intensify the already existing contacts with the E-OCVM and VDR development teams. Other documents will be considered as background information. The findings of the analysis will be presented and discussed with EUROCONTROL representatives at a working meeting. A synthesis of the analysis will become part of the final report.

Based on the analysis, initial drafts for the templates for each of the identified levels of detail and maturity will be developed and presented using already existing project data from the VDR

as an example for possible contents. The templates will explicitly cover all activities identified in the E-OCVM and being applicable to the respective reporting level. In particular, the relation to the concept lifecycle with milestones V1, V2 and V3 and the triggers for generating Validation Reports in that lifecycle will be elaborated.

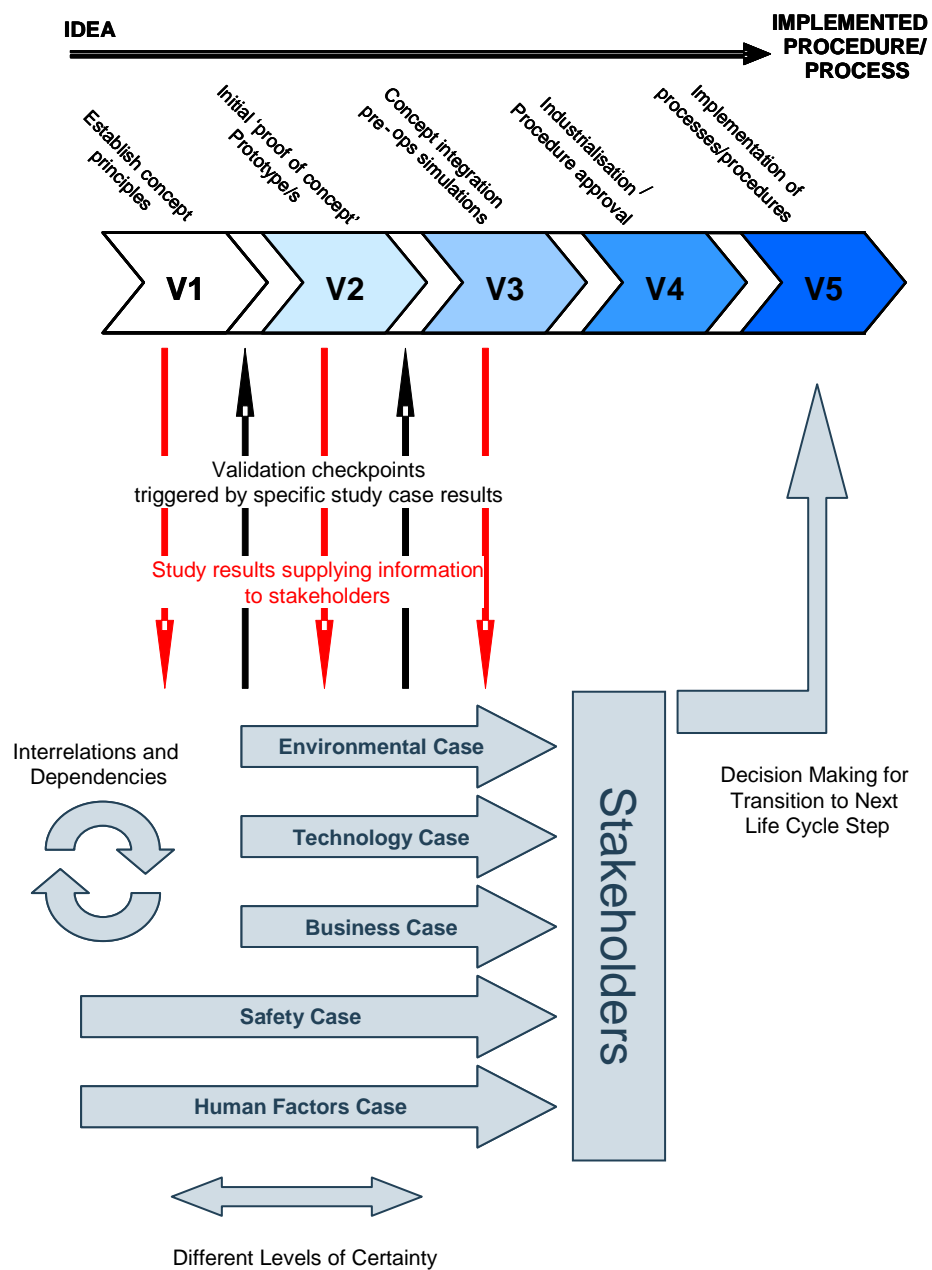


Figure 1-2: Relation between Concept Maturity, Study Cases and Stakeholders

In order to prepare automated transfer of template contents to the VDR the analysis results will also be used to identify data requirements (and/or possible structural changes) for the VDR.



Eventually, the developed templates will be produced. The possibilities for an automated process will be worked out. This process should translate an MS Word document into bits of text (and/or graphics) that can easily be transferred to the VDR based on the preferences of the VDR team and the possibilities for automation at EUROCONTROL.

Chapter 2 represents the report of the first activity carried out within the project, the analysis of baseline documentation. This activity has been based on the approach outlined above.

Chapter 3 describes the follow-up activity carried out within the project, namely the identification of appropriate triggers for producing validation reports along the life cycle of operational concept validation. In this chapter refinements of the life cycle model and the analysis of the E-OCVM are taken into account and the main conclusions are summarised. The conclusions are further clarified by giving an example for reporting triggers within the life cycle of a concept. The chosen example is based on experiences with the decision making process in such cases and reflects the anticipated results for each of the defined levels of detail and within each of the concerned life cycle phases. Above that this section also describes the consequences for the definition of validation reporting templates.

Chapter 4 describes the actual template contents and the client-side automation that was added to facilitate data transfer of template contents to the VDR. This section also gives recommendations concerning finalisation of the templates and instructions to the prospected users of the templates.

Chapter 5 is a study into document automation for easy input of template data into the VDR. This study focuses on both the description of a technical solution for data transfer and the description of the necessary actors and processes for data input automation.

The templates themselves are stand-alone documents which are not contained in this final report but will be distributed together with it.

The final chapter of this report, chapter 6, summarises the results of the VARTAN project and gives recommendations for future work.



2 Analysis of Baseline Documentation

2.1 Analysis Method

The first step in the approach described in the previous chapter is the analysis of the baseline documentation identified for the VARTAN project.

These documents are:

- The European Operational Concept Validation Methodology (E-OCVM) [3]
- The FAA/EUROCONTROL Operational Concept Validation Strategy Document (OCVSD) [4]
- The Introductory Guidelines for Validation in EATMP [8]
- The Validation Data Repository (VDR) at <https://www.eurocontrol.int/eatmp/vdr/>

The analysis activity puts specific emphasis on the question whether the E-OCVM, in conjunction with the additional material mentioned, covers a number of basic requirements from the point of view of the involved stakeholders expressed as analysis questions. These questions are posed in such a way that it will be possible to analyse whether the E-OCVM provides for an appropriate answer to the requirement or not, so that the refinements can be made.

The overarching analysis question can be formulated in the following way:

Overall Analysis Question
Does application of the E-OCVM (and related material) provide a framework to collect evidence of the expected performance benefits, behavioural capabilities and costs with the appropriate level of detail and confidence in order to fulfil the information needs for multiple (different) decision making bodies or actors?

Table 2-1: Overall Analysis Question

This overall question or requirement leads to a number of more specific questions which need to be considered during the analysis of the documentation:

Detailed Analysis Questions
1. Does application of the E-OCVM (and the related material) provide a framework to collect evidence that expected performance benefits can be attained by the proposed change initiative?



2. Does application of the E-OCVM help to determine whether the collected evidence contains the right level of quality (validity and accuracy of the results)?
3. Does the E-OCVM provide a framework that addresses properly the information needs at the different decision-making levels (strategic level, programme level, project level)?
4. Does the E-OCVM provide a framework that addresses properly the information needs of all decision makers (airlines, service providers etc.)?

Table 2-2: Detailed Analysis Questions

1. Does application of the E-OCVM (and the related material) provide a framework to collect evidence that expected performance benefits can be attained by the proposed change initiative?

This first analysis question stems from the general wish of the ATM community to let the performance of the ATM system improve over time. Typical performance wishes are increase in capacity, more efficiency, fewer delays, reduction of safety risks, reduction of noise et cetera. In order to express the performance of the ATM system in a structured way, so called Key Performance Areas (KPA) have been defined by ICAO and the EUROCONTROL Performance Review Commission (PRC), which have the intention to cover the most important performance areas for ATM in a unified way. The KPAs play an important role in the decision making process in the ATM community regarding the design and development of change initiatives. Additionally, there are areas not covered by the KPAs but nevertheless important for building relevant cases for decision making (such as user acceptability, legal issues). Thus, the tasks of the E-OCVM should be manifold:

- Identification of the areas (KPAs and others) which are applicable for the change initiative under investigation
- Guidance on the definition and formulation of what the expected performance benefits, behavioural capabilities and costs are per area
- Guidance on the delivery of evidence whether the change initiative meets the expected performance benefits, behavioural capabilities, and costs for the applicable area (case-building).

2. Does application of the E-OCVM help to determine whether the evidence contains the right level of quality (validity and accuracy of the results)?

Decision makers would not feel happy to make decisions based on evidence that has not the right level of quality. Therefore, the second question is about the quality of the produced evidence. Possible quality parameters are for example the level of detail and accuracy of the results, the investigated scope and the usage of recognised methodologies and standards (the



latter supporting the validity of the results). In that regard it should be noted that results can be very accurate but of low quality if not sufficiently supported by objective evidence. In the same way a less accurate result (a result with an error margin) may be of high quality if it is supported by objective evidence. Generally, the E-OCVM should provide guidance with regard to quality aspects of the produced evidence for performance benefits, behavioural capabilities and costs. It needs to be clear what is considered incomplete or insufficiently accurate by the respective stakeholder and the owner of the overall concept validation process. Additionally, considering aspects of interrelations and dependencies among the identified cases (performance areas) might help to anticipate problems that prevent one from attaining sufficient confidence in the results.

3. Does the E-OCVM provide a framework that addresses properly the information needs at the different decision-making levels (strategic level, programme level, project level and experiment level)?

Furthermore, different levels of decision-making require different levels of detail of information, and sometimes even a different kind of information. Possible distinctions can be made between strategic, programme, project and experiment levels. The E-OCVM should provide guidance on how to produce the right information for the right decision making level. It must be identified what the key decision points are, who the relevant decision makers are and what kind of information they need. To this end the templates developed in the VARTAN project shall help identify these critical elements of the validation process.

4. Does the E-OCVM provide a framework that addresses properly the information needs of all decision makers (airlines, service providers etc.)?

As there are many stakeholders in ATM, like ANSPs, airports, airlines, regulators, manufacturers, but also society, passengers and politicians, it is very important to consider all stakeholders in the process in order to ensure that no critical aspects, which might lead to a rejection of the concept, are overlooked. It is not unusual that multiple stakeholders have conflicting goals, essentially different and conflicting performance criteria and even different definitions of seemingly identical performance criteria. Therefore, the E-OCVM should also provide guidance to address the (complex) issue of multiple stakeholders.

Finally, a general question that is crucial for success for each situation that deals with decision making about change initiatives is the comprehensibility and applicability of the methodology. A validation methodology that is easy to understand for everybody involved, is transparent in its way of working and is traceable in its description of how to build up evidence, can have many benefits, like uniformity in the methods applied, presentation format of results and confidence by decision makers. Therefore, the last general analysis question is formulated as:



Basic Analysis Question
Is the E-OCVM comprehensible enough for the less proficient user?

Table 2-3: Basic Analysis Question Considering Comprehensibility

Adding more comprehensibility to the methodology will enhance its use within the research community and improve the necessary transparency between the strategic level and the project level, the latter being mainly influenced by the detailed five-step approach introduced by MAEVA. This approach certainly does not lose its validity, yet it was especially designed with specific problems in mind rather than strategic goal-setting.

All the above-mentioned questions were considered when analysing the specified documentation. The following section will especially look at the E-OCVM but will also refer to the related material. The respective sections in the document which are believed to address the different questions above will be highlighted and judged by their profoundness and their ability to give an answer to those questions.

2.2 Analysis of Identified Material

Following the approach outlined above, the E-OCVM has been reviewed with regard to the analysis questions stated in the previous section. A number of observations could be made regarding the basic methodology and the processes described in the E-OCVM.

Basic improvements need to be considered regarding comprehensibility and applicability of the methodology. At this moment the E-OCVM is still unbalanced trying to close the gap between the stepped evaluation view, more or less dictated by the MAEVA methodology, and the more strategic views. It will be necessary to consider the different decision making levels as presented in earlier work [13].

Currently one of the anchor points of the E-OCVM is problem and stakeholder analysis. This activity is very much focused on describing a current or anticipated problem rather than specifying a goal for the future. There is an argument for starting the validation process like this, as an overview of current or anticipated system capabilities could be helpful, first of all in the identification of possible solutions and at later stages in the determination of the progress made. However, apart from an understanding of the problem there must also be an understanding of the necessary performance gains. This will force the validation team to focus more on the necessary technological and user-related requirements when performing the



stakeholder analysis and when discussing the operational concept idea (possible solution) with the stakeholders. Step 0 and step 1 of the E-OCVM need to be modified in this regard (cf. [3]).

Furthermore, the maturity of a concept or the life-cycle view is not clearly represented in the methodology. There is an attempt to consider different maturity stages when identifying high-level and low-level objectives for a project (activities 1.3 and 2.3), however, there still is no specific distinction as to the sometimes different goals (and therefore different objectives) that might need to be formulated in different maturity phases. Additionally, it should be considered that the project and experimental view at this time makes no clear distinction between phases V2 (mostly verification activities of technological and user-related requirements) and V3 (mostly performance-related validation activities). This should be changed or at least there should be a clear indication of the differences in the experiment or project view at different life cycle phases.

In summary, there should be a unified theory which combines all three views mentioned in the E-OCVM, namely the life cycle view, the case-based view and the stepped evaluation view. This requires improvements in both steps 0 and 1 but also in step 2.

Case-building is also not considered to full detail in the current E-OCVM. Steps 0 and 1 both talk about Key Performance Areas (KPA), however, these steps do not give guidance on what strategies to apply when building cases for achieving the set goals in the KPAs or other areas of interest. It should be differentiated between initial case-building in V1 which requires a thorough assessment of stakeholder interests and goals in order to determine conflicts and find ways to solve these conflicts (goal balancing) and later phases in which technical and user requirements (behavioural capabilities) and performance capabilities play a more dominant role.

It will also be important to refine the current methodology with a view on interrelations between the different cases. In the early phases of the life cycle it is very important to understand the coherences between the different areas of interest and the indicators that describe the set goals in these areas. Many examples for such interrelations can be found. The most evident one might be the dilemma between capacity and safety. Raising capacity within a sector or at an airport cannot be done limitlessly without infringing safety margins. Another example would be environmental restrictions. These restrictions could, for example, require different approach patterns at airports, which again could be infringing safety margins or could be detrimental for capacity figures.

Another element that is not considered in detail but was already worked out within earlier projects [13] is the fact that there are usually three levels of detail that need to be addressed and



that have specific needs regarding the formulation of goals and the reporting of results. They are the strategy level, the programme level and the project level. These levels of detail play a role in each of the life cycle phases, although due to the nature of these phases, different emphasis will be put on each of the different levels of detail depending on the maturity of the concept. Again changes will have to be made to step 1 to achieve integration of this element.

Different levels of detail or confidence might also be an issue for the steps concerned with determination of results (step 4 and 5). This means that it will be necessary to consider incomplete or insufficiently accurate information as result of validation activities and describe ways how to deal with such information in the general process outlined in the methodology (especially step 1.3).

2.3 Summary and Conclusions of Analysis

2.3.1 Basic Observations Regarding Comprehensibility

A first conclusion of the analysis is that, in general, the E-OCVM clearly has the potential for complying with the overall objective of providing an appropriate concept validation framework.

However, there seems to be a need for more transparency and comprehensibility regarding the different views described in the E-OCVM:

- the **concept lifecycle view**, placing the operational concept in a timeframe and considering its maturity,
- the **stepped evaluation view**, looking at the specific objectives of a certain project and its experiments on a detailed level and applying the guidelines given by MAEVA, and
- the **case-based view**, gathering the information generated by various tests and experiments in a way that helps explain to stakeholders what can be expected in terms of performance and behavioural capabilities.

When approaching the concept validation process in a more holistic manner it should be possible to better combine these different views. A basic principle that could be applied in that regard is the so-called Deming or PDCA-cycle as shown in Figure 2-1.

This model can be used for the ongoing analysis and improvement of almost anything, in this particular situation the validation of an ATM concept, and it contains the following four continuous steps: PLAN, DO, CHECK and ACT. These steps can be applied for the whole process of concept validation but also for a single aspect of the life cycle.

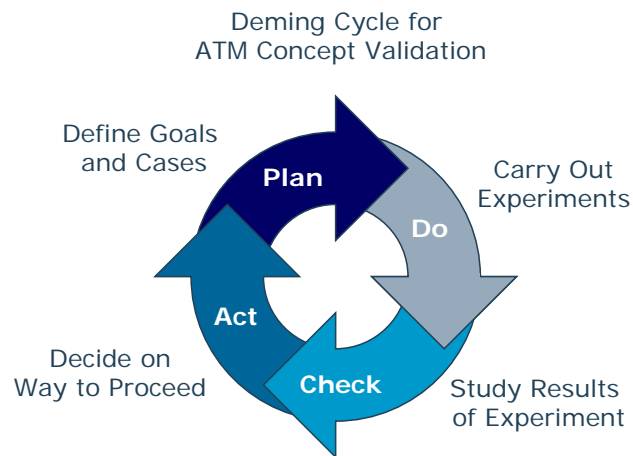


Figure 2-1: Deming or PDCA-Cycle

In the first step (PLAN) a problem is identified that is worthy of study to effect improvement. The specific, required changes are defined. After assessing the current status a numerical measure for the future goal or target must be specified. In the second step (DO) the plan is carried out. This means that the strategy to bring about the change must be implemented and tested. In the third step (CHECK), the effects of executing the plan are observed. The results are monitored and an assessment of what can be learnt from the improvement process can be performed. Trends and possible gaps, if any, can be identified. Should there be negative results, the plan can be amended and another cycle can be started. In the last step (ACT), the results are studied to determine what was learnt from the improvement process and what can be predicted for the future. If there are positive data results, the process or strategy could be standardised or be seen as a basis for further progress and improvement. For example, the reaching of a set goal, the accomplishing of a certain mission, could trigger a new phase in the validation life cycle.

By applying this simple view on the validation process it will be possible to combine all the mentioned views and to clarify the complete process in a step-by-step cookbook. A proposal for such a refinement of the methodology and a more detailed description of how the PDCA-cycle can integrate the three different views will be given in Section 2.4.1 of this document.

2.3.2 Role of Stakeholders in the Validation Planning Process

Another conclusion of the analysis concerns the stakeholders and the validation planning process. The planning activity needs to be more specific about how to assess and balance stakeholder goals that might be conflicting. Often decisions on stakeholder goals are taken separately from the validation activities and without consulting the validation team. Although it is not the task of the validation team to set these goals, the team should be consulted in order to find a realistic balance between different goals and to ensure that stakeholders adopt a realistic



attitude towards possible results. This should also increase the validity of the results. An example for conflicting goals and the way to balance them should be given in the E-OCVM as a reminder to the validation team to get involved in goal setting activities.

Furthermore, there should be more information and examples on what kind of levels of detail in reporting are required for different stakeholders. This should be clear at the very beginning of the process in order to better set the goals for a certain activity.

2.3.3 Uncertainty and Different Levels of Detail in Results

Depending on the activities performed within a certain life cycle phase in concept validation, different levels of detail and confidence might be achieved with respect to the performance benefits or performance indicators under investigation. Therefore, there should be guidelines and examples of how to deal with incomplete, less accurate, inconclusive and controversial results.

The prior two considerations regarding stakeholders, conflicting goals and inconsistent results have a major influence on the different cases to be established, addressing safety, capacity, economics, environment, and human factors, to name but the most important ones. In the current version of the E-OCVM there are insufficient guidelines as to the selection of appropriate evaluation models, techniques and methods that provide the necessary results and information and feed the different cases that need to be made. These guidelines do not need to be prescriptive but should give the reader ideas about and examples of how to start the case-building process.

Moreover, the interrelations and different levels of detail in the case-building process need to be outlined. Thus, there has to be a close description of the case-building process in general.

2.4 Proposal for Refinements

This section will give a definition of and a motivation for refined criteria for transition from one lifecycle to the next, and will anticipate approaches to meet them. This means that possible triggers for production of validation reports will be identified. Furthermore, change proposals for the underlying documents, and a number of typical examples for Concept Validation Lifecycles and the associated case-building process will be given in order to demonstrate the use of the criteria.



2.4.1 PDCA-Cycle Approach to Operational Concept Validation

As a first proposal the PDCA-cycle will be used as guideline for a concept validation cookbook encompassing all three views described in the E-OCVM. The following steps are envisaged in such a process:

Steps in the Holistic PDCA-Cycle	
0. Set agreed overall goals and set the initial intermediate goals within the lifecycle of concept validation (start the mission).	ACT (INITIATE)
1. Make a plan to reach the first intermediate goals and define the necessary cases considering possible interactions and levels of detail (plan the case-based views).	PLAN
2. Execute the plan, i.e. develop the cases and perform validation exercises (carry out the stepped approach).	DO
3. Check, evaluate and decide whether the first intermediate goals are met (decision whether the targets have been met).	CHECK
4. Make a decision on whether the mission was completed and determine ways of how to proceed (such as: set new goals and missions, proceed to next lifecycle phase or re-iterate within the current life cycle phase).	ACT

Table 2-4: PDCA-Cycle Steps for Operational Concept Validation

This means that it will be necessary to start with a goal setting strategy that looks at the wanted future situation rather than the making of a plan that is caused by constituting a deficiency or problem (see Step 0 in the E-OCVM). Thus, the acting phase is also the trigger phase, meaning that decisions will be made that determine whether the phase can be completed or whether there are still conflicts or open issues that need to be dealt with by planning and executing more validation exercises (programmes, experiments, assessments).

These triggers will differ for the different life cycle phases. Triggers, however, will be the topic in other parts of this document.

This integrated process with four basic steps combines the different views introduced in the E-OCVM. Each of these views is meant to address a different aspect of the evaluation process. By applying the same basic principles to different layers in the overall process, it will be possible to present a more unified methodology (see Figure 2-2).

PDCA-Cycle in the Unified Methodology (Simplified View)

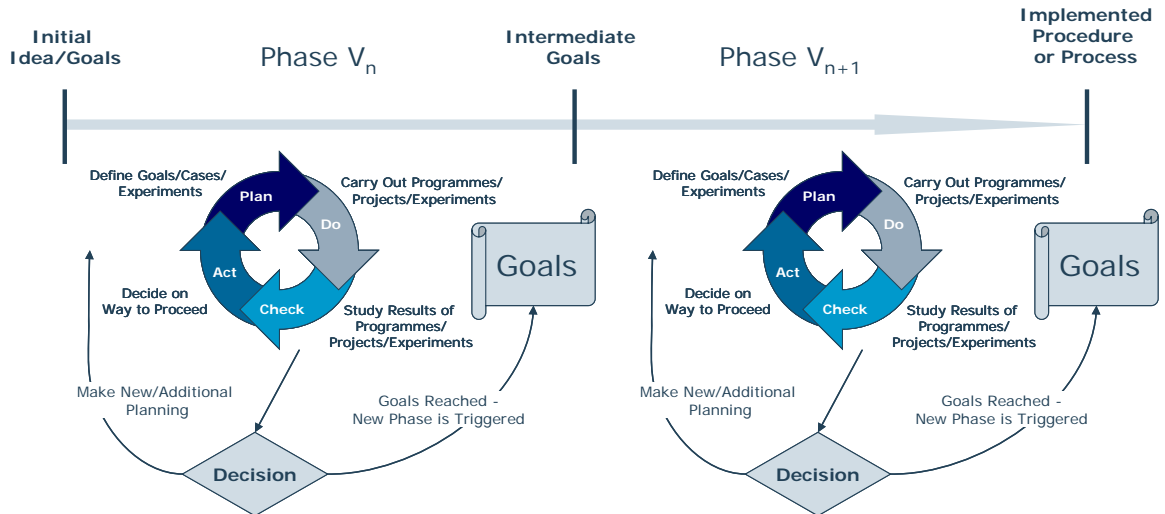


Figure 2-2: Simplified View of Unified Methodology

The concept life cycle view was introduced in order to place the operational concept in a timeframe that considers its maturity and ensures that expectations about project results are confined to results which pertain to that specific maturity phase. Such a timeframe could stretch several years. Both the Eurocontrol-FAA Action Plan 5 workshops [4] and the CAATS project [10] used the following view that describes the five major life cycle phases in more detail, from the initial idea of a concept to its implementation (see Figure 2-3).

Life Cycle View (Concept Maturity)

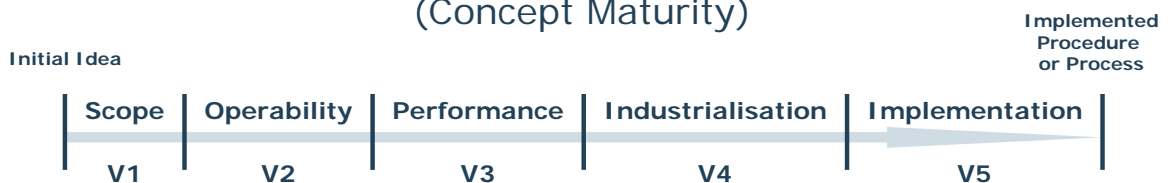


Figure 2-3: Life Cycle View (Concept Maturity)

While the latter two phases are mainly related to approval of established procedures, industrial implementation and application, the first three phases concern ATM R&D and are the focus of this analysis.

Thus, the first recommendation regarding a simplified initial step in the methodology (step 0 in Table 2-4) is to introduce overall goals and carefully select initial intermediate goals that have to be reached at the end of a life cycle phase. One of the goals that is common to each



operational concept and that can be mentioned explicitly is the timeframe. Usually, operational concepts are developed and goals for the development are set according to an implementation plan for the concept as a whole or for discrete parts of the concept. This time planning is one of the cornerstones of each validation activity. The determination of the time schedule for each component of the concept and the setting of other initial intermediate goals will have to be performed together with the stakeholders or by the stakeholders themselves. In that way it should be possible to get a clearer picture of possible conflicts regarding the identified goals (goal balancing), to find out whether the concept is in line with the corporate strategy and to determine whether there is sufficient support for the idea within the community. It must be noted, that innovative R&D probably requires a less restrictive approach. In general, however, the previously described step is the initiating planning activity on the strategic level.

This planning activity will lead to the establishing of research programmes that will define their own goals to the appropriate level and in such a manner that they fit in the overall strategy (PLAN). Therefore, these goals will address either a particular intermediate goal or several intermediate goals. The research programmes will eventually be carried out meaning that cases to support hypotheses considering the identified goals will need to be built and experiments will have to be carried out (DO).

When the research programmes have finished and presented their results, stakeholders need to verify whether the intermediate goals for the respective phase have been met or if there still is a need to establish further research programmes to cover previously unidentified or unconsidered areas that have an impact on the goals. If there is a considerable mismatch between programme results and set goals, it might also be necessary to check if the goals were chosen appropriately or if they need refinement (CHECK).

Eventually, stakeholders or decision makers have to decide whether the research programme results indicate that all goals have been met and that the concept can be considered mature enough to bring it to the next phase in its lifecycle. Thus, this activity deals with the necessary triggers for life cycle phases (ACT). Figure 2-4 depicts the previously worked out methodology steps.

Apart from the life cycle view the E-OCVM describes a case-based view. This view must be seen on the level of the research programmes. In research programmes different cases will have to be built that are supposed to support the achievement of a certain goal or target. The results for each case are meant to help explain to stakeholders what can be expected in terms of performance and behavioural capabilities. Costs and benefits, which represent another case, can be derived from this information.

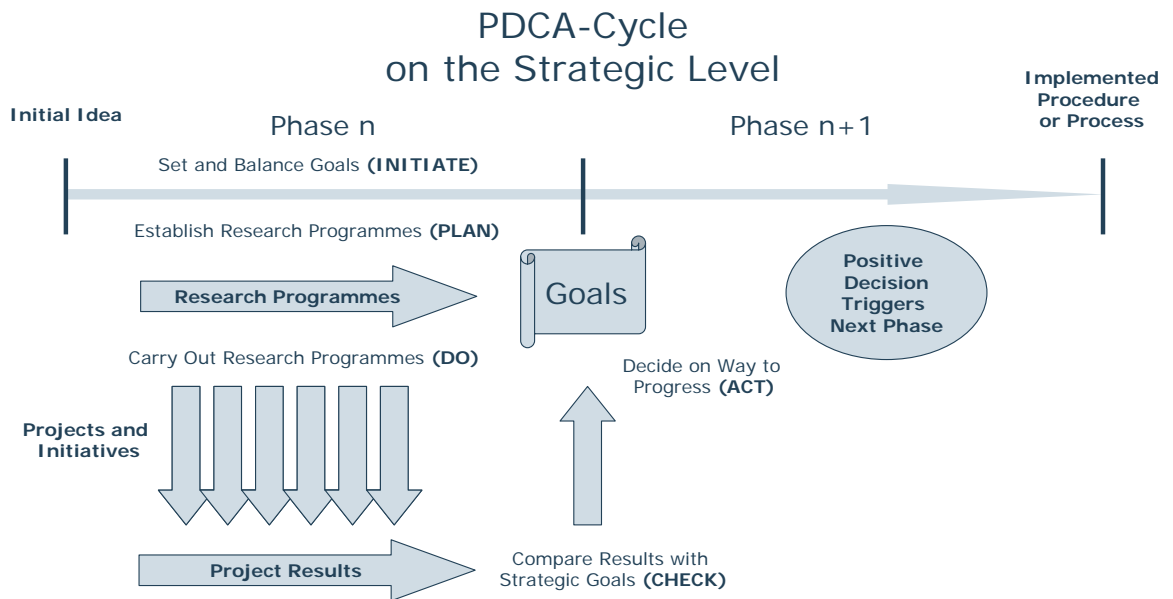


Figure 2-4: PDCA-Cycle on the Strategic Level

On the programme level cases need to be built and projects, that deal with the essence of these cases, have to be defined (PLAN). Each of these projects must consider different cases in such a way that the results for each case represent the same level of detail and that the working out of one case does not represent a major obstacle for finding results and arguments in one of the other cases (balanced case-building).

Eventually, the projects will be performed and will lead to results that need to be presented in such a way that it is possible to determine the level of detail that has been considered, the level of confidence that the results have reached and the consequences for interactions with other cases that were not considered in the project (DO). On the programme level the results will be consolidated (CHECK) and conclusions will be drawn as to the consequences for the goals that have to be reached in order to trigger another life cycle phase (ACT). Figure 2-5 depicts the PDCA-cycle on the programme level.

The final level that needs to be integrated into the previously described processes is the project level. This level is already very well described in the E-OCVM. In order to place it into the unified methodology it must be considered that the project level assumes the stepped evaluation view. This means that for each experiment or assessment being identified in the validation strategy and plan a series of experimental steps is defined. Together these experimental steps provide a logical structure to the evaluation of some part or all of the performance and behavioural characteristics of an ATM concept.

PDCA-Cycle on the Programme Level

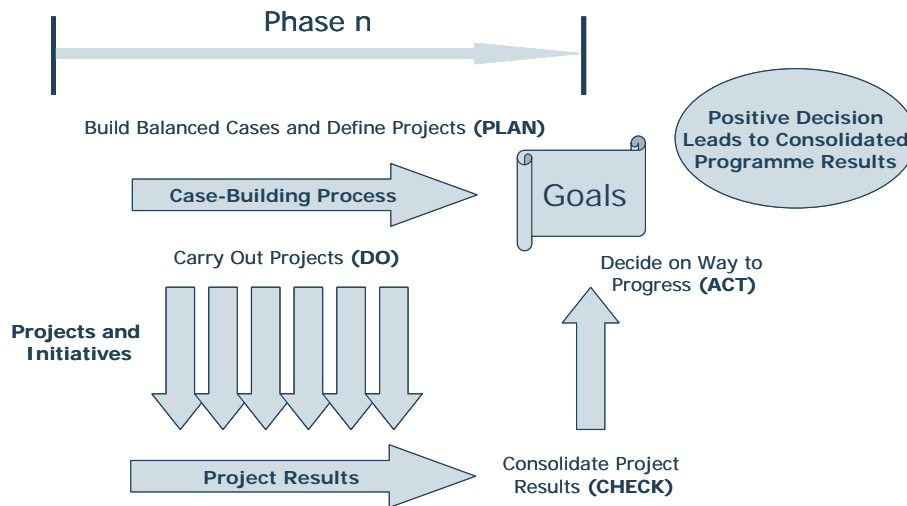


Figure 2-5: PDCA-Cycle on the Programme Level

On the project level the experiments and tests need to be defined in such a way that part or all of the identified cases of a programme are addressed properly. This means that experiments need to find answers to a number of hypotheses which are derived from aims and objectives specified on the programme level, thereby contributing to the goals of the considered project life cycle phase (PLAN). Experiments are carried out (DO) and results need to be monitored in order to decide whether the assumptions they are based on and the level of detail they encompass is comparable, within the project and, eventually, on a programme level (CHECK). If this is not the case the project validation managers need to consider different or additional experiments or at least make detailed recommendations about how to interpret the results (ACT). This means that validation managers are responsible for delivering conclusive results at a specified level of detail in order to contribute to the overall programme performance and behaviour assessment.

Since most of the process descriptions in the E-OCVM are based on the MAEVA methodology with its experimental and stepped evaluation view, the project level process resembles these process descriptions. It is depicted in Figure 2-6.

To conclude the analysis and the recommendations given for the basic methodology the life cycle phases V1 to V3 which are of major interest to ATM R&D will be described in more detail in the upcoming sections of this chapter. Examples will be given for the appropriate levels of detail within the different phases considering maturity of the operational concept and the audience addressed.

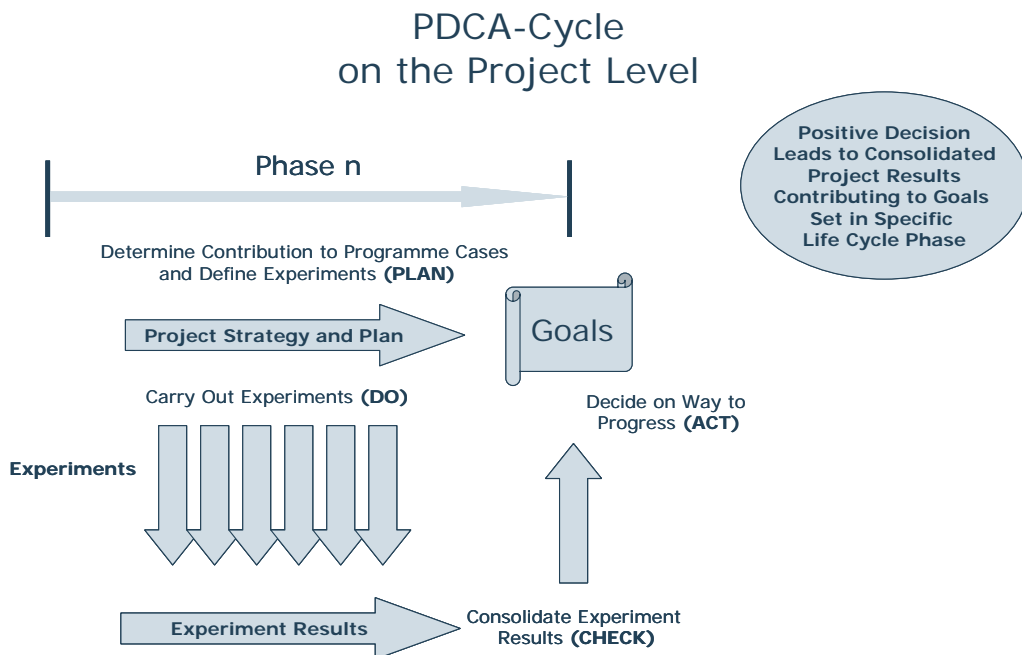


Figure 2-6: PDCA-Cycle on the Project Level

2.4.2 Refinements for Life Cycle Phase Description

The basic life cycles identified in AP5 and CAATS best practices (cf. [4] and [10]) are named Scope, Operability, Performance, Industrialisation and Implementation (see Figure 2-7). As has been mentioned in earlier sections of this document, the first three phases are particularly interesting for ATM R&D and will therefore be looked at in more detail in the following.

The first life cycle phase (V1) is concerned with the establishment of concept principles and concept designers will not yet have fully-fledged ideas about operational and technical requirements. Activities at this stage will be focused on understanding the potential of the concept and defining its scope. In that way it should be possible to eliminate poor design choices, identify critical elements that would lead to an abolishment of the initial ideas and elaborate potential benefits.

An important aspect in this phase is that during these initial stages the concept idea might not be very well known among stakeholders and the underlying principles might not be completely understood. Therefore, it will be task of the originator of the concept, either an ATM R&D company and/or one of the (interested) stakeholders, to promote the concept and make its basic principles known to both the research community and industry. Success on that matter will



depend on the question whether the concept idea has been worked out to an appropriate level to start the work under realistic conditions and whether its basic elements are in line with the corporate strategy of one or more of the concerned stakeholders.

Life Cycle View

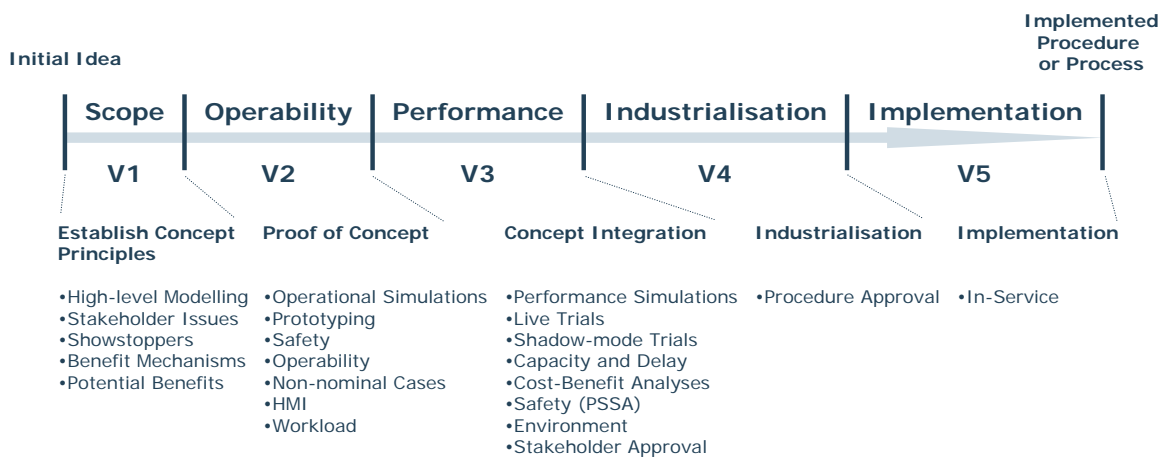


Figure 2-7: Life Cycle View (Outline)

In general, there already should be a good understanding of the necessary functionality, the operations involved, the data and information needs, the infrastructure to be used, and the impact on the main organisations and stakeholders.

In that regard it must also be considered that there could be multiple stakeholders, such as several developers of a certain concept and an associated technology. In that case it is very important to steer research (at the political level) from the very beginning by comparing different options in the applied principles of the concept. A common scope must be found in the first life cycle phase to be able to make this comparison. Unifying different concept ideas at the very beginning of the validation process will reduce further development costs and implementation costs.

For the case-building process this means that all issues must be considered in the beginning in order to identify potential showstoppers, such as required procedures of a concept that violate environmental regulations or that lead to excessive workload for controllers. Not identifying these showstoppers could have disastrous consequences for the later stages of concept validation. Much effort spent in later phases could already be used in this phase to find better alternatives for the concept and could also prevent the concept from being completely abolished. Apart from revealing possible showstoppers an initial identification of benefit mechanisms



might lead to the perception of potential benefits, thereby giving a clearer picture of affected stakeholders. From that it will also be possible to draw conclusions on different concept options.

The identified cases should support some basic goals which need to be balanced from the very beginning, meaning that it must be stated what the expected interactions between the different performance and behavioural indicators are. High-level modelling, as is applied during analytical assessments and fast-time simulations, is the predominant assessment method in this phase.

The next stage of concept validation (V2) concentrates on operability issues. Basic assumptions should have been tested through analytical modelling techniques and a basic design should have already been sketched in the previous phase including the identification of all applicable technologies. This phase will thus look at the very procedures and operations necessary for the prospected system to work meaning that both technical and user requirements will have to be established.

Especially the safety and human factors cases need to be built with more precision. Yet, the technology case must be considered in more detail as well, so that it becomes important again to elaborate the interrelations between these different cases in order to being able to more precisely identify the appropriate requirements for both systems and human user interfaces. The stakeholders in these three cases are the system developers, the system users, and the service providers. Again political decisions should ensure that the concept validation is approached in such a way that developed prototypes are basically identical in their functionality and in the procedures that need to be applied when working with them.

In this phase projects and experiments heavily rely on the state of development of the necessary technology. A first important step would be to define the technical and user requirements for the system and to build prototypes which are completely in line with these requirements. Experiments would usually be supported by real-life prototypes, and safety and human factors issues could be investigated by analysing objective and subjective data from the users of the prototype system. An important aspect in this regard is the testing of non-nominal cases or marginal capabilities (for both procedures and technologies). Risks could be identified in this process, the mitigation of which will be crucial for the success of this phase. Therefore, the elimination of the most apparent risks in non-nominal situations could be an important trigger for proceeding to the next phase.

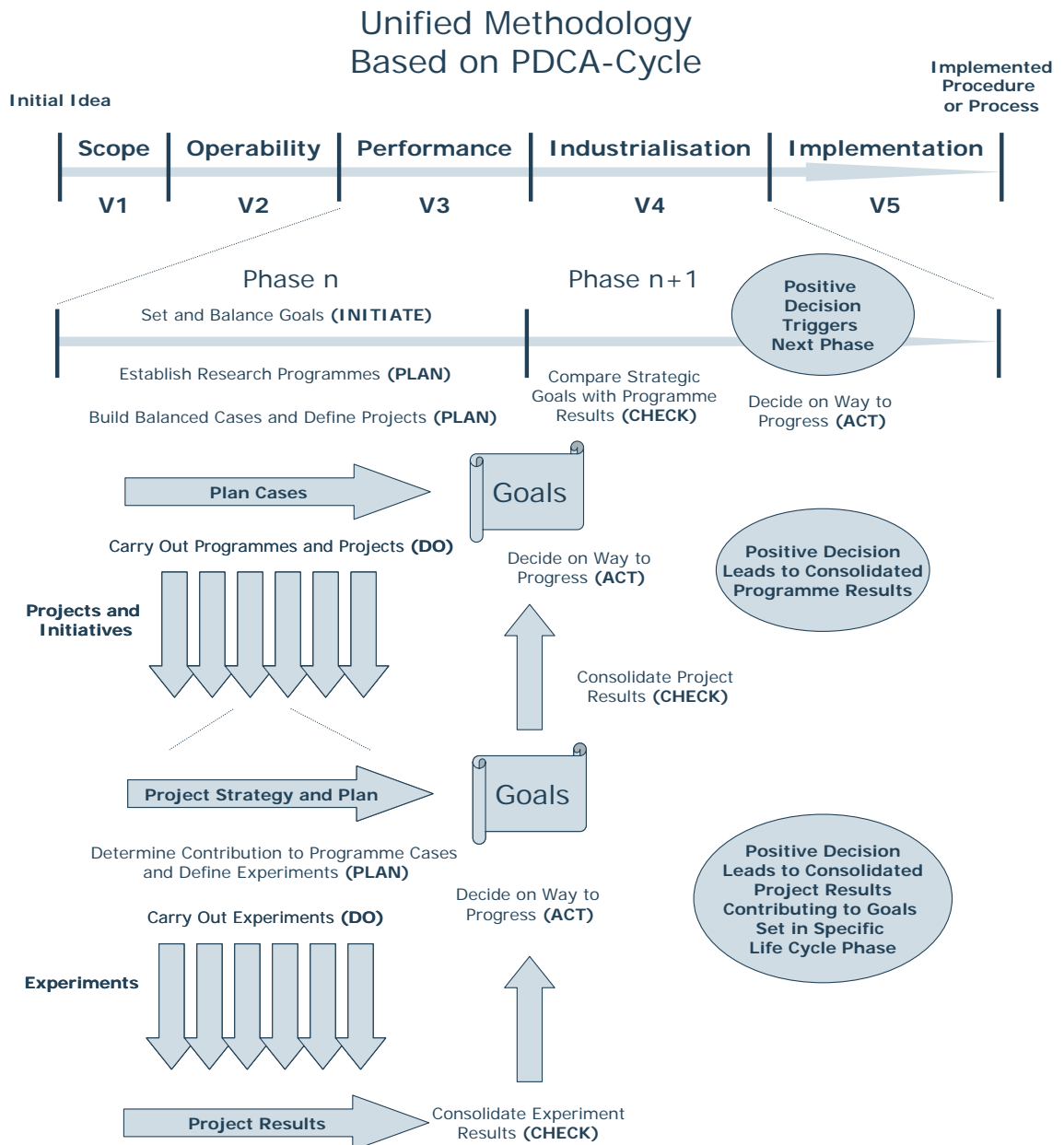


Figure 2-8: Unified Methodology

The results of the experiments could feed back into the definition process for user requirements and, if considered necessary, technical requirements. Therefore, it is very important that in this phase experiments are carried out as often as would be necessary to satisfy user expectations. Furthermore, it must be ensured that requirement testing is done with an appropriate level of quality meaning that there must be structured and standardised test plans for both system testing, safety and human factors. It will not be possible to find strict rules for this potentially



iterative process, though. So it is up to the validation managers of the different projects to decide whether the tested prototypes have been built to the satisfaction of all parties involved. Ultimately, these activities must result in a mature, stable concept design with an initial proof of operational feasibility of the concept.

In the final stage of concept development considered in this description (V3), cases will mainly be built around performance issues. A basic requirement for this phase is that the previous phase arrived at defining all necessary technical and user requirements to sufficient detail, and that the major risks identified are considered in this definition. Remaining risks need to be identified and quantified as regards their severity, their influence on the performance and associated costs. Experiments in this phase will therefore be rather large in numbers and time in order to allow for sufficiently significant data to be extracted from them. This data could then be used to make relevant assumptions about performance parameters of the whole system rather than prototype performance that was tested in the previous efforts of the operational phase.

The considered performance data would give indications for benefits at all aspects of the concept starting with workload and capacity (access and availability), efficiency, punctuality (delays), cost-effectiveness and environment. With all parts of the concept being simulated by high-reality simulation systems, it should also be possible to acquire data describing the level of safety reached with the newly developed concept and systems. Therefore, case-building must start with a clear identification of the key performance areas and the associated performance indicators. This process must be carried out carefully in order not to overlook performance areas that were identified as being critical during the first two validation phases.

In the end, demonstrators could be built in order to promote the new concept and systems among all the prospective stakeholders, especially those who could not take part in the validation effort, and in order to increase user acceptability and stakeholder approval for steps that would lead to industrialisation and deployment.

Finally, an overall picture is given for the suggested refinements in the basic methodology considering all life cycle phases. The PDCA-Cycle is applied through all life cycle phases and at all levels of detail of operational concept validation. A simplified picture of that process is given in Figure 2-8.

Although the different levels of detail for the different phases were mentioned above no detailed vision on the case-building process has been given. This will be the topic of the following section.



2.4.3 Refinements Considering the Case-Building Process

Another proposal for refinement is to better describe the case-building process considering interrelations between the cases, different levels of detail and different levels of confidence. Best practices for the case-building process regarding safety and human factors are being identified by CAATS (cf. Ref. [10], [11] and [12]) based on an analysis of the E-OCVM and practical experience. The current approach of specifying high-level and low-level objectives (in steps 1.4 and 2.2 of the E-OCVM) already talks about Key Performance Areas (KPA) and Areas of Interest but does not consider these areas as special cases, that have to be built based on a good and complete description of the ATM system and operational concept, and that address a certain goal of the overall strategy. Instead the distinction between high-level and low-level objectives in the E-OCVM seems to be aiming at incorporating some element of maturity of the concept.

Cases, however, should be looked at anew for each phase of the life cycle. Not all identified cases are usually applicable for each phase. For example, the cases in V2 and V3 are more or less subsets of the complete list of cases that should be looked at in V1 in order to balance stakeholder goals and performance and behavioural indicators.

Thus, from a refined methodology standpoint, steps 0 and 1 of the E-OCVM need to be revised and changes regarding the way experiments are placed in a life cycle phase and the way cases are built around identified stakeholder goals need to be addressed in the way described in the previous sections of this document. In the following this process is outlined again.

In the beginning of the life cycles it will be necessary to build cases on almost all issues that are considered to have a potential for being identified as showstoppers. The E-OCVM lists the following cases: environment, technology, business, safety, operations, and human factors. Other cases that might certainly need to be considered are user acceptance, regulations and standards, and legal responsibilities. Furthermore, the EUROCONTROL Performance Review Commission (PRC) identifies key performance areas differently in their documentation [9]. They talk about safety, delays and cost-effectiveness in the first category, predictability, access (of airspace, services, facilities), flexibility (accommodating changing user needs), flight efficiency, availability (of resources and services), and environment in the second category and equity (in treatment of flights) in the third category. Although some of these issues are either identical to or a part of one of the mentioned cases there needs to be a unified set for these cases based on as many standards and methodologies as possible. In the end, it will be important to split up the number of cases into as many areas of performance and interest as possible in order to find out about critical factors for progress, such as stakeholder conflicts, conflicting goals and benefit mechanisms.



The identified cases should support the basic goals expressed by the stakeholders. These goals need to be balanced from the very beginning, meaning that it must be stated what the expected interactions between the different performance and behavioural indicators are. Analytical assessments and fast-time simulations are means for modelling the concept on a rather rough level of detail so that these interrelations can be determined.

Case building in the second phase (V2) concentrates on initial capabilities and characteristics from both the technical and the user side. Especially the safety and human factors cases need to be built with more precision. Stakeholders in these three cases are the system developers, the system users, and the service providers.

Experiments would be carried out with the help of prototypes which are used to collect and set requirements. Eventually, these prototypes need to comply with the identified technical requirements, so that verification activities are necessary before the systems can be presented to the potential users. Then, safety and human factors issues are analysed by collecting objective and subjective data from the users of the prototype system. This analysis should potentially lead to several iterative steps in which user requirements are added or improved but also technical requirements are revised. This activity therefore follows the general systems development approach, often depicted as a V-shape.

Since simulations are carried out with prototypes in a completely simulated environment it will also be possible to test of non-nominal situations. For example, when a prototype of a Surface Conflict Alerting Tool is built, runway and taxiway incursion situations could be simulated, which usually is not possible in real operational environments. The same goes for marginal capabilities (for both procedures and technologies). For example, new procedures or procedures for extremely bad weather could be tested and compared.

In the final phase that is interesting for ATM R&D (V3), the focus is on performance data rather than behavioural capabilities. The results would give indications for benefits at all aspects of the concept starting with workload and capacity (access and availability), efficiency, punctuality (delays), cost-effectiveness and environment. It is expected that all parts of the concept are simulated by high-reality simulation systems based on the earlier developed prototypes. Thus, it should also be possible to acquire data describing the level of safety reached with the newly developed concept and systems.

Case-building should anticipate possible differences in level of detail and confidence for the different cases, so that programme and project validation managers can specify different projects or experiments dealing with the cases at the same level of detail or complementing one



another through iteration in reaching a common level of detail (e.g. exchanging data between real-time and fast-time simulation models).

Still MAEVA VGH and the E-OCVM are the only methodologies that give more detail on experiment set-up, even though the earlier mentioned aspects, such as life cycles and case building are not discerned. If the E-OCVM (together with MAEVA appendices) could be changed in such a way that steps 1 and 2 are more related to case-building it would improve comprehensibility and applicability of the methodology.

2.4.4 Recommendations for Validation Reporting Triggers

In the previous sections a unified methodology for validation of operational concepts has been proposed. In this proposal, the acting phase in a PDCA-cycle is seen as the decisive point where decision makers have to determine how they want to proceed. In the previous sections of this report, individual and specific triggers for validation reporting are identified. These specific triggers are summarised below by describing possible decisions:

1. Proceed to the next lifecycle phase with the same overall goals: goals are met and quality of evidence is good;
2. Proceed to the next lifecycle phase with updated overall goals: goals are almost met and quality of evidence is good;
3. Reiterate in the same lifecycle phase with the same (intermediate) goals: it is not clear whether goals can be met or not;
4. Re-iterate in the same lifecycle with updated (intermediate) goals: the quality of evidence is good but the evidence indicates that the goals cannot be (fully) met; and
5. Stop the process of further designing and development of the proposed change initiative: goals can in no way be met and quality of evidence is good.

In all the above-mentioned cases it will be necessary to monitor the progress of the investigations in order to take an immediate decision in case it is discovered that intermediate results appear to have a direct influence on further continuation. Such a decision is a management decision that should be triggered by a report describing the exceptional circumstances.

2.5 Overview and Practical Example

The analysis above gives several conclusions and recommendations for refinement of the E-OCVM, which are presented in the following table. For demonstration purposes each of the recommendations is complemented by an example when applicable. The example chosen considers a potential concept idea for runway and taxiway incursion alerting (RIA) based on real-life data and calculated probabilities. It should be noted though, that the example is purely



hypothetical and does not suggest that any of the mentioned possible results will actually come into effect. An important aspect of validation is that at any stage of the validation process it might be necessary to reconsider either parts of the concept or the concept as a whole. This could, for example, even lead to an abolishment of the concept after initial investigations have shown that there are insurmountable discrepancies between the basic expectations and the consequences of the concept.

Recommendation	Affected Sections and Steps in the E-OCVM	Example
Apply the PDCA-cycle approach to Operational Concept Validation thereby combining the three different views.	Section 2 (OCVM Overview), especially Section 2.1 (Concept Life Cycle View)	An example is not applicable. As concrete result one would expect a description of the simplified life cycle view as given in Section 2.4.1 of the present document and a consequent description of the different levels of detail, established as being the strategic, programme and project level of detail.
Apply the PDCA-cycle at the Strategic Level.	Section 2 (OCVM Overview), especially Section 2.2 (Stepped Evaluation View) and Section 2.3 (Case-based View)	<p>As described in Section 2.4.1 of the present document, the PDCA cycle should be applied to the three different levels identified: the strategic level, the programme level and the project or experiment level.</p> <p>For the strategic level and the suggested example this means that at any of the described phases of maturity of the concept research programmes could be started, depending on earlier results that might already have brought the concept to a certain maturity level. Each programme could deal with one specific aspect of the concept.</p> <p>In the first phase, the basic principles of the concept must be determined. Most importantly, programmes should have to look at showstoppers such as safety issues and expected benefits of the suggested concept for the airport(s) under consideration. Based on the outcome of this process and considering that the concept is fulfilling the basic expectations, programmes could look at different technology options that support the concept. For the RIA concept, these could be possibilities for algorithms, factors for calculating probability, options for visualisation, and alarm and warning thresholds.</p> <p>In the second phase, the selection of research</p>



		<p>programmes would concentrate on different and more detailed aspects of the concept, e.g. that a prototype of such a tool is built according to the necessary technical requirements that should be obtained on the basis of an analysis in the previous phase. Furthermore, there should be a programme to look at possible safety and human factors issues while controllers are presented with or even work with the prototypes of the system. Finally, in the third phase, the fully developed prototype of the system could be implemented in a real-time simulation or even a real-life environment in order to test the tool in operations and determine its performance.</p>
<p>Apply the PDCA-cycle at the Programme Level.</p>	<p>Section 2 (OCVM Overview), especially Section 2.2 (Stepped Evaluation View) and Section 2.3 (Case-based View)</p>	<p>On the programme level, projects could be started based on a case-building approach. A good example for the first life cycle phase is the building of a safety case for the suggested RIA concept. This safety case should give first indications on the expected improvements in safety (e.g. through increasing situational awareness of controllers). In order to identify potential showstoppers also the cost aspects and the human factors case should be looked at and interrelations between the cases should be elaborated, e.g. whether the proposed interface increases situational awareness as expected or whether it distracts controllers from other tasks. Some high-level modelling could help to get first indications on those questions.</p> <p>An example for the second phase would be the human factors case. Apart from the technical requirements, which could be determined during an analysis in the first phase, a prototype of a RIA system must also be built according to user requirements. These requirements could be established in an iterative approach in order to apply refinements which only become apparent after looking at interrelationships with other cases in the second phase, e.g. the technology or the safety case.</p> <p>In the third phase case-building could concentrate on the performance issues by looking at airport capacity and efficiency of operations. Again interrelations with the human factors or safety case are very important and should not be neglected.</p>



<p>Apply the PDCA-cycle at the Project or Experiment Level.</p>	<p>Section 2 (OCVM Overview), especially Section 2.2 (Stepped Evaluation View) and Section 2.3 (Case-based View), and Step 0 and 1.</p>	<p>In the following there is an example of a project for each of the three major life cycle phases.</p> <p>In the first phase, a project could concentrate on an analysis of existing concept ideas for runway incursion alerting and could also compare different technical approaches. For example, a project could look into safety aspects of RIA concepts in which a RIA tool is used as a safety net under bad weather conditions. Another project could look on a deeper level at the options for applying algorithms for calculating the probability that an aircraft will follow a certain path on the airport. As can be seen from such basic analysis, timing is also an important aspect, since technology options could have an enormous impact on the initial concept idea and the way to continue in later phases.</p> <p>In the second phase, a feasibility study could be performed looking at the procedures to be applied with the tool. For that purpose a prototype needs to be developed, which could happen in another project. The project looking at the procedures will address part of the human factors case and must be an integral part of a human factors plan for the programme. A realistic real-time simulation working environment could be used in order to assess possibilities for new procedures which could be applicable if the RIA tool works as a safety net under bad weather conditions.</p> <p>The third phase will look at performance issues, so that projects will investigate specific performance indicators, such as capacity and efficiency. The RIA tool will probably show performance improvements in the area of efficiency of operations under bad weather conditions. Thus, the application of new procedures could lead to more airport capacity and more efficient operations (in terms of fuel consumption during taxiing). A specific project could measure the difference in performance for both situations (bad weather operations with and without the tool and consequently with and without adapted procedures) in a real-time simulation environment.</p>
<p>Describe role of</p>	<p>Steps 0 and 1.</p>	<p>Try to define overall and intermediate goals</p>



<p>stakeholders in validation process more closely.</p>		<p>together with all stakeholders involved.</p> <p>Balance the goals and increase validity of the study by setting realistic goals as compared to effort and time available.</p> <p>Considering the RIA tool as an example, it should be determined in the first place if there are multiple stakeholders from the same area. For example, there could be several ANSPs or airports considering implementation of such a RIA tool. In that case the goals of these different stakeholders will need to be balanced as they could depend on the different localities in which the tool should become operable, meaning that realistic goals must be set for each airport. One possibility is that each airport has a different time schedule for implementation. The different schedules will need to be aligned.</p> <p>Another possibility is that there are different suppliers developing a RIA tool. The development activities will have to be co-ordinated, meaning that prototypes should contain the same basic functionality. More importantly, the different prototypes should be tested under the same circumstances, meaning that technical and user requirements must be the same (identical verification indicators) and validation should look at the same performance criteria. All these conditions might not always be applicable due to political and business circumstances. In that case, it could be one of the tasks of the validation activities to focus on the differences in performance in order to give more input to the decision makers on what to consider when making an investment decision.</p> <p>Finally, an example of conflicting stakeholder goals could be different timelines in the development of a RIA tool and the implementation, so that there are different goals for suppliers and ANSPs. Another example would be different goals in capacity between the airport and the ANSP or political decision maker at an airport that requires conservative procedures during bad weather conditions, not allowing the use of more efficient procedures with the new tool.</p>
<p>Describe the case-building process more</p>	<p>Steps 0, 1 and 2.</p>	<p>Start by describing the applicable key performance areas (ICAO and PRC) for each</p>



<p>closely giving realistic examples.</p>		<p>life cycle phase. For our example, such areas could be:</p> <ul style="list-style-type: none"> - Access and equity (all flights may operate under the same conditions and with the same access to control services, meaning that RIA can be expected to work for all flights to improve efficiency under bad weather conditions) - Capacity and delay (improvements could be made under bad weather conditions or due to an improvement of situational awareness among controllers using the tool as a safety net) - Cost effectiveness (this area is closely related to the previous KPA but should also consider the probability of accidents with and without the RIA tool) - Efficiency (again due to more efficient operations during bad weather or because of improved situational awareness) - Environment (for the RIA tool this area is closely related to efficiency and delay) - Flexibility (in the example this is closely related to the procedures used and therefore more flexibility could be expected under bad weather conditions) - Global interoperability (no specific technology is required on the airborne side, and on the ground side the service depends on the implementation status of the technology and the tool; this area is not applicable for the example as no consequences are expected for the stakeholder goals) - ATM Community Participation (this is always an issue and should be dealt with from the very beginning; cf. remarks on promotion of concept in Sections 2.4.1 and 2.4.2) - Predictability (not applicable for the example) - Safety (improvements are expected because of the expected increase of situational awareness of controllers) - Security (this is a rather difficult area, as it refers to the possibility of compromising a system; the major issue in this area for the
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		<p>example is the availability of radar data)</p> <p>Work out the relationships between the suggested cases (environment, technology, business, safety, human factors, and legislative) and the identified key performance areas. Determine the key indicators in each area and translate them into indicators for the cases, relating them to the goals set with the stakeholders for each of the cases.</p>
<p>Concentrate the case-building process and all other planning activities around stakeholder goals.</p>	<p>Steps 0, 1 and 2.</p>	<p>Reconsider how projects are placed in the life cycle phase and the way cases are built around the specific stakeholder goals.</p> <p>In the suggested example, look at the complete life cycle phase and consider implementation planning (timeframe) of political decision makers, ANSPs and developers, in particular. Build cases that allow taking decisions when there are conflicting overall goals, such as different developments with different technology or algorithms used.</p>
<p>Describe possible interrelations between the different cases.</p>	<p>Steps 1 and 2.</p>	<p>During case-building the interrelationships between all cases have to be established from the very beginning, in order to identify possible showstoppers as early in the validation process as possible.</p> <p>For the RIA example, such an interrelationship, among others, can be found between the technology and the human factors case. The specified technology, which is based on calculating probabilities, might not be intuitive for a controller, so that there are differences between the tool and the controller in identifying the urgency of a warning or an alert. A lot of parameter tuning might be necessary to reach a level of quality at which the controller will feel confident that the tool will work as a safety net.</p>
<p>Give suggestions of how to deal with uncertainty and different levels of quality and details in the results.</p>	<p>Steps 4 and 5.</p>	<p>Within a programme or a project there can be different levels of detail, quality and certainty as regards the results of the studies. Suggestions were made of how to deal with such differences. In 2.4.4 of the present document, five basic decision criteria are identified:</p> <ol style="list-style-type: none"> 1. Proceed to the next lifecycle phase with the same overall goals: goals are met and quality of evidence is good; 2. Proceed to the next lifecycle phase with



		<p>updated overall goals: goals are almost met and quality of evidence is good;</p> <ol style="list-style-type: none"> 3. Re-iterate in the same lifecycle phase with the same (intermediate) goals: it is not clear whether goals can be met or not; 4. Re-iterate in the same lifecycle with updated (intermediate) goals: the quality of evidence is good but the evidence indicates that the goals cannot be (fully) met; and 5. Stop the process of further designing and development of the proposed change initiative: goals can in no way be met and quality of evidence is good.
<p>Define triggers for validation reporting based on five possible decision criteria.</p>	<p>Step 5.</p>	<p>As described in 2.4.4 of the present document, five basic decision criteria were identified (see previous item in this table). The following list gives possible consequences for the RIA tool example. These could occur at different life cycle phases:</p> <ol style="list-style-type: none"> 1. A prototype of the RIA tool was developed and there were extensive human factors exercises to show that the tool has been adapted according to user requirements. Parameters (for geographical specialities or the timing of warnings and alerts) were set so that they correspond to the controllers' expectations. Verification exercises proved that the tool was built according to the technical requirements. Initial experiments in a real-time environment concerning additional or adapted procedures showed that controllers can work with the prototype in accordance with the identified procedures. Non-nominal situations were tested in order to ensure proper functioning of the tool under all conditions. Development of the prototype was performed according to standard methods for systems development. 2. The RIA tool may not be used with adapted procedures for bad weather at a certain airport. Expectations regarding the major performance KPAs have to be reconsidered. In this case overall goals need to be updated when stepping to the next phase. 3. The development activities of the prototype showed that more development



		<p>activities are necessary to produce such a tool to comply with user and technical requirements. It is not clear whether the expected timeframe can be met.</p> <ol style="list-style-type: none">4. The tool was tested in real-life operations but due to a lack of training of controllers it was not possible to show that the expected performance improvements due to an increase of situational awareness could be met. Implementation must occur at a later stage, so that intermediate goals change and real-life tests will have to be carried out again in order to show that the expected performance can be reached.5. A maximum budget was allocated to the development task. The RIA tool algorithm calculates the probability of an aircraft taking a certain path on the ground. The technical requirements and user requirements are restrictive concerning the tool parameters (e.g. time horizon, geographic complexity) and hardware. Analysis of airport complexity and required computing power show that neither the technical requirements nor the user requirements can be met with the choice of hardware that the budget allows for. Development activities must be stopped.
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2.6 Additional Considerations

In order to conclude this analysis it must be noticed that there were a number of additional considerations that did not concern the E-OCVM but the other two sources for analysis, namely the OCVSD and the VDR. The role of the current validation plan templates was looked at as well.

2.6.1 Operational Concept Validation Strategy Document (OCVSD)

The OCVSD is a document that is meant to establish a common understanding of validation in ATM. In particular, it shall harmonise the validation approaches between the FAA and EUROCONTROL. In that it is expected to provide the prerequisite for a better planning, re-use and exchange of validation results of all organisations using such a common approach.



The OCVSD is closely linked with all developments around the E-OCVM. A dedicated steering group within the concerted FAA-EUROCONTROL Action Plan 5 (AP5) for Validation is responsible for translating changes in the E-OCVM to a common basis that is represented by the OCVSD. Thus, it would be out of the scope of this project to make direct suggestions for improvement of the OCVSD. However, suggestions for improvement of the E-OCVM should be reflected in the OCVSD if considered necessary by the AP5 steering group.

2.6.2 Validation Data Repository (VDR)

From earlier experience with the VDR it was concluded by the authors of this document that it would be out of the scope of the VARTAN analysis to suggest improvements regarding the structure of the VDR database. The database itself is already structured in such a way that it contains the main elements for presenting results of ATM projects at the different decision making levels.

The question rather is how to align the reporting in the different ATM projects with such a clearly arranged structure. As a consequence, it will be important to suggest validation reporting templates, which contain sections addressing the main elements of a validation exercise. In particular, these are the results of these exercises and the different kinds of analysis steps which are necessary to come to consolidated conclusions and recommendations. Furthermore, the results (including their analysis, conclusions and recommendations) must be traceably connected with the validation objectives and requirements and the particular key performance area (KPA) under investigation.

2.6.3 Validation Plan Templates

In general, the validation plan templates that were established in an earlier project (see also Figure 1-1) were considered quite useful by the VARTAN project team. They provided information on all important key elements of validation planning and preparation. Above that, the view of the different levels of detail and decision making suggested in that project was adopted by the VARTAN team. This view provides a clear and realistic distinction between the different management levels usually encountered in European ATM validation projects.

There were two minor shortcomings though, which will only briefly be addressed. The first shortcoming concerns the fact that the planning templates are very much focused on the concept of operational improvements (OI). Operational improvements are seen as the main driver for concept development and are therefore already considered at the programme level without referring back to the key performance areas (KPA) mentioned at the strategic level. Thus, the relation between these areas, the ATM needs and the considered solution in the form of operational improvements might need to be worked out more clearly. Keeping this relationship



in mind when reporting on the results at the different levels, though, should offer enough traceability between the KPAs and the conclusions and recommendations made.

A second shortcoming is the absence of a more detailed planning template at the experiment level. At the time the templates were produced it was judged that such a template might be too prescriptive. However, two different views could be applied to this problem.

On the one hand, it is true that such a template could be perceived as being too prescriptive. Furthermore, all planning at such a detailed level usually is prone to (last minute) changes and the time span between making such changes and reporting on them is usually very short. On the other hand, it is very difficult to get a complete picture of the decision making process within a validation experiment without being able to compare the original planning, however sketchy it might be, with the actual execution of the experiment. As a compromise, it was considered to keep this dilemma in mind when producing the validation reporting templates rather than producing a dedicated template at the experiment level.

2.6.4 Conclusions on Additional Considerations

In conclusion of the abovementioned considerations it should suffice to say that the analysis of the E-OCVM, which together with the VDR and the OCVSD can be seen as a complementary set of tools to perform validation, will provide the necessary impulses to identify reporting triggers and producing templates for validation reporting that will fit in an overall methodology.

The major elements of this methodology as well as refinements in their definition are described in this report. Based on this knowledge it will be possible to continue the work and produce the required reporting templates as the upcoming sections should show.

3 Reporting Triggers for Validation Reports

3.1 Summary of General Conclusion of E-OCVM Analysis

The VARTAN analysis (in Section 2 of this report) gives a number of recommendations for improvement or rather refinement of the current European Operational Concept Validation Methodology (E-OCVM) as published by EUROCONTROL [3] in June 2005.

In summary, these recommendations concern:

- Application of the Plan-Do-Check-Act (short: PDCA) cycle approach to a refined lifecycle (V1 to V3) and planning level (strategic, programme, and project) model.
- Refinement of stakeholder role descriptions.
- Description of case-building process with realistic example.
- Focus on stakeholder goals rather than problem descriptions.
- Description of possible interrelations between the different cases.
- Examples of how to deal with uncertainty and different levels of quality and details in the results

The following paragraphs will give more details concerning these recommendations and will present proposals for refinements in the lifecycle and management level models.

Generally, the potential of the methodology was recognised. However, it was suggested to combine the three different views described in the E-OCVM in one holistic model that is based on the more simple Deming Cycle, which describes the basic steps within research activities, namely the Plan, Do, Check and Act phases. Based on this model the lifecycle approach is combined with the case-based view and the stepped evaluation view in the manner displayed in Figure 2-8.

In order to get a better view on the necessary decision processes within each lifecycle phase, the maturity model of the E-OCVM was described in VARTAN in more detail. The result of this effort is shown in Figure 3-1. Also a number of refinements for the case-building process were introduced. Eventually, the possible results of the decision processes that trigger validation reports at the transition point between the lifecycle phases were described.

In order to illustrate more closely what these decision processes might look like in reality, the following section will give an example, which is partly based on real-life experiences. In order to better understand the framework that was introduced in the previous analysis (see also Figure 2-8), the three levels of detail or rather the three planning levels, at which decisions are taken and reports will be produced, are described in more detail in the following paragraphs.



In an earlier project [13], templates for Validation Plans on the Strategy, Programme and Project Levels were developed that made a distinction on the same levels of detail as described in the VARTAN analysis, however, the lifecycle model was not defined in sufficient detail and there were no suggestions on the transition between the lifecycle phases. In order to be able to use at least some of the results produced in this earlier project the levels of detail (the three planning levels) will also be applied in the VARTAN project. For the new framework this means that for each of the three lifecycle phases considered (V1 to V3) there must be three planning levels at which research initiatives are executed.

Life Cycle View

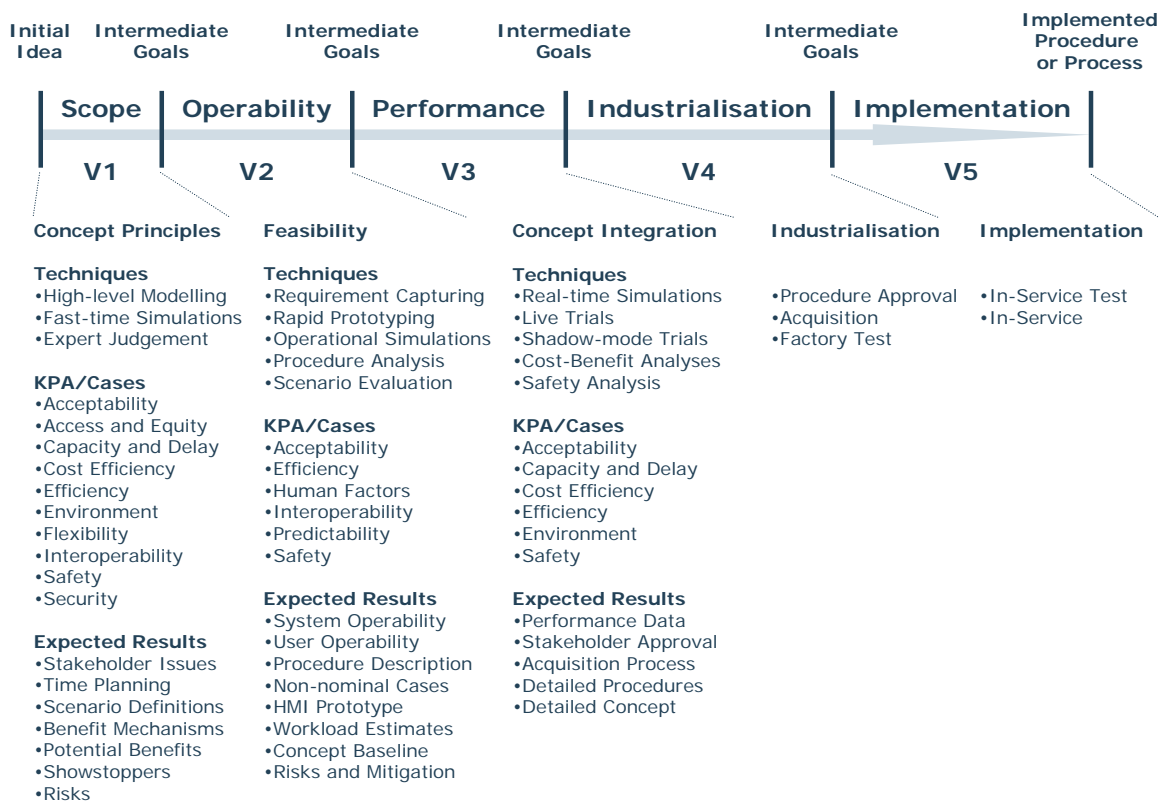


Figure 3-1: Lifecycle View (Detailed)

The Strategic Level is the highest management level in this model. At the strategic level decision makers will set overall goals and carefully select initial intermediate goals that have to be reached at the end of a lifecycle phase, however, there usually is no full-fledged plan at this level on how to reach these goals. One of the goals that is common to each operational concept and that can be mentioned explicitly is the timeframe. Usually, operational concepts are



developed and goals for the development are set according to an implementation plan for the concept as a whole or for discrete parts of the concept. This time planning is one of the cornerstones of each validation activity. Above that the strategic level will take decisions on what research programmes need to be established with an eye on the key performance areas (KPA) identified. Priorities regarding possibly conflicting stakeholder issues and ATM needs will be determined and thus considered in the planning activities.

At the Programme Level the established research programmes will define their own objectives at an appropriate level and in such a manner that they fit in the overall strategy defined at the strategic level. Therefore, these objectives will address either a particular intermediate goal or several intermediate goals. Usually, these goals pertain to a certain KPA defined at the higher level. Cases for investigation of the particular KPA and associated performance indicators (KPI) will be built not forgetting to consider possible interrelations between the performance areas and the identified cases themselves.

At the Project Level the cases to support hypotheses considering the identified goals for certain KPAs will be implemented and experiments will be carried out at the Experiment Level, which is the lowest level following closely steps 2 to 4 of the E-OCVM. The results of these experiments will be evaluated and a decision will be taken whether the quality and detail of the results corresponds with the planned levels of quality and detail at the higher level.

The same process is expected at the programme level, where a decision has to be taken whether the projects could successfully answer the research questions posed or not. Again different levels of quality and detail in the results of different projects as well as the assumptions that led to the results are considered in the decision making process.

Finally, the results of all research programmes are reported to the strategic level and stakeholders need to verify whether the intermediate goals for the respective phase have been met or if there still is a need to establish further research programmes to cover previously unidentified or unconsidered areas that have an impact on the goals. If there is a considerable mismatch between programme results and set goals, it might also be necessary to check if the goals were chosen appropriately or if they need a revision.

Planning Levels

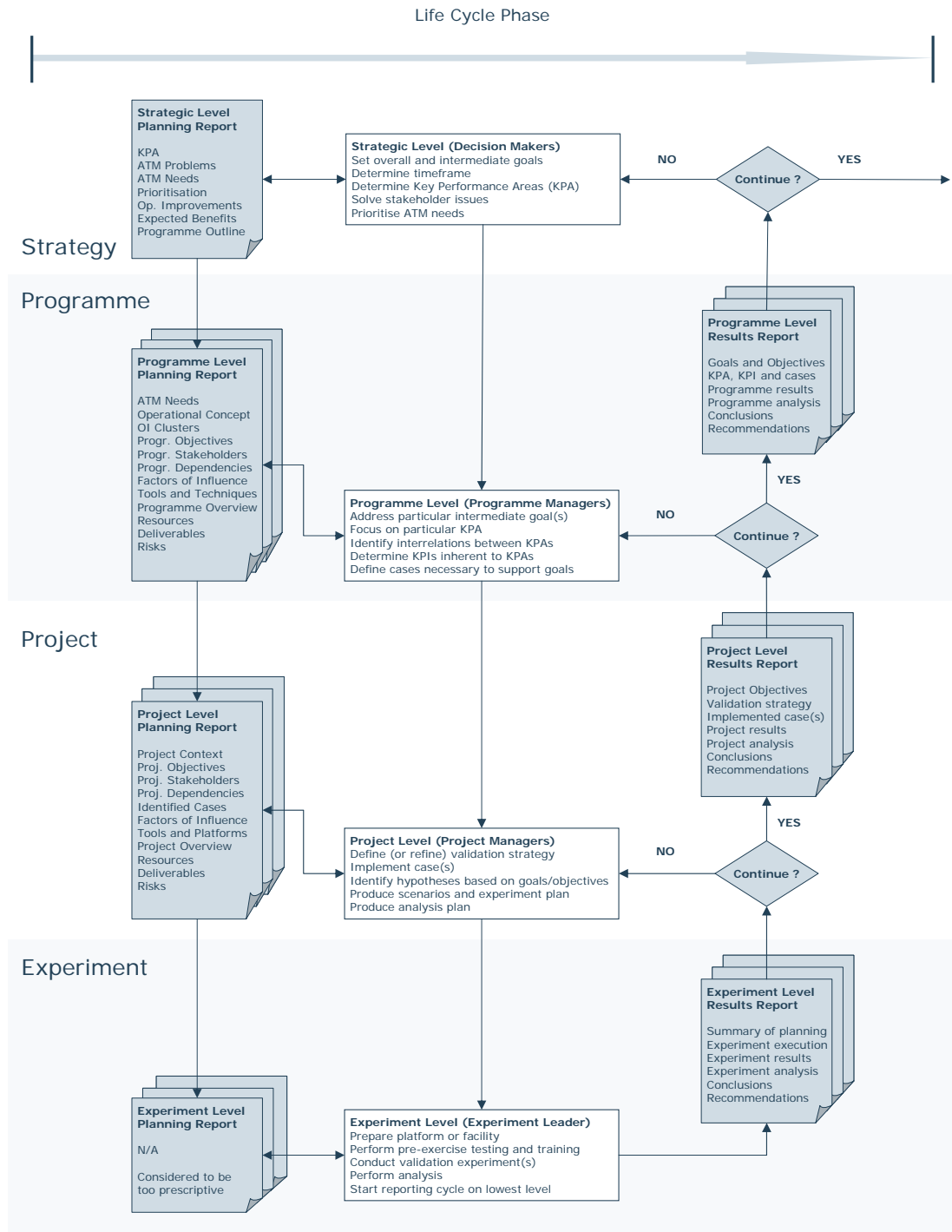


Figure 3-2: Reporting Structure at Different Planning and Decision Making Levels



The process described above will apply to all phases of the lifecycle. Figure 3-2 depicts the process for an arbitrary lifecycle phase. Within this process there are three clearly defined decision points at the project, programme and strategic level, which base their findings on the reports produced at the respective lower level. The decisions made are either triggered by the predefined reports themselves or by intermediate reports that programme management should require in case of non-conformances with the planning or irregularities in carrying out programmes, projects or experiments. As non-conformances or irregularities cannot be determined in advance and their reporting very much depends on the nature of the problem, the VARTAN project will not elaborate on report templates trying to describe such triggers. However, the current document will highlight major reporting triggers and VARTAN will produce the templates for anticipated reporting after execution of experiments and projects, thus, at the two lowest planning levels, where confined and finalised results for VDR input can be expected. A report template at the strategic and at the programme level is not foreseen as reporting procedures at these levels very much depend on the decision maker and are usually already in place.

3.2 Introduction of Example for Reporting Triggers

3.2.1 Basic Scope of Example

In the upcoming sections of this document an illustrative example for the development of a concept within the outlined lifecycle model will be given. For lifecycle phase V1, this example uses real-life experiences with the executed validation activities and the decision making processes which are typical for the stakeholders involved. Although being hypothetical in its prospects for later lifecycle phases, this example should help to understand what the expectations for reporting at each of the decision points in the lifecycle are. Note that this example should be considered as an illustration. It should not be used for other purposes like decision making or commercialisation.

3.2.2 General Description of Problem and Associated Goals

The director of Europort - an airport that is situated at an arbitrary location in Europe - wants to double the capacity of the airport within 15 years. The main plan to realise this ambitious goal, is to build a new runway in addition to the existing ones. The director of Europort explains his aims and ideas to the directors of the air navigation services provider (ANSP) at the airport, and the main airline operating from the airport. They both agree with the ideas of the airport director. Therefore, they set up a plan to work out the idea.

The main characteristics of this plan are:

- The directors of Europort, the ANSP and the airline want to follow three design phases before they decide to make the step to industrialisation and implementation, i.e. the construction of a new runway with all characteristics and consequences;
- At the end of each design phase, the directors want to decide together whether to proceed with the next design phase or not;
- During each phase, appropriate information must be supplied, so that the directors can take the right decisions at the end of each lifecycle phase; and
- The details of all aspects concerning the design of the new runway will be elaborated within the lifecycle phases of concept validation.

The following sections of this document are concerned with illustrating the example by explaining what the activities, decisions and relations are, for the three different management levels and within the three concept validation lifecycle phases before industrialisation and implementation.

During the analysis of the E-OCVM and related material the three different management levels were determined to be the Strategic Level, Programme Level, and Experiment Level as defined in [13]. As a consequence these levels will also be considered in the example.

The three phases of interest within the concept validation lifecycle are named Concept Principles (V1), Proof of Concept (V2), and Integration of Concept (V3) in the E-OCVM [3]. In the VARTAN analysis these phases were defined more closely considering the activities involved in each of these phases and consequently the maturity phases were named Scope (V1), Operability (V2) and Performance (V3). In order to avoid confusion, the phases will generally be referred to as V1, V2 and V3 in the following. Their contents will be closely related to the definitions given in the VARTAN analysis (see Section 2).

3.3 The Europort Example for Reporting Triggers

3.3.1 Determination of Concept Principles and the Basic Scope in V1

At the Strategic Level in V1 the main question that needs to be answered is whether there are showstoppers related to the idea of the new runway together with the desired future capacity figures in terms of:

- Safety (collision risk and third party risk);
- Environment (noise contours);
- Operational feasibility and acceptability (feasibility considering layout and wind conditions and acceptance from operational people such as controllers and pilots); and
- Cost benefits (for all the three parties)



Possible decisions after the first iteration in V1 using the results of Programme Level, Project Level, and Experiment Level activities during V1 are:

- Stop further development of the concept idea because at least one clear showstopper has been identified;
- Re-iterate V1 because it is not clear whether there are showstoppers. Additional or more accurate analysis is necessary;
- Re-formulate the (capacity) goals and go to V2; or
- Proceed with V2, since no clear showstopper has been identified.

At the Programme Level the main tasks during V1 are the following:

- Work out the main idea of a new runway to such an extent that the necessary analysis activities can be carried out. The details for the new runway idea are, for example: inbound/outbound procedures, equipment for ATC, taxiways from and to the new runway, runway layout of the whole airport, organisation of airspace around the airport, fleet mix, aircraft equipment et cetera.
- Make a plan and select appropriate methods/tools/techniques, so that the right type of analysis (i.e. building the cases) can be made with the right contents and level of quality. In that way the appropriate information can be supplied to the Strategic Level for decision making (i.e., for answering the question whether there are showstoppers). The cases must also be in line with expectations and requirements of authorities. Example methods/ techniques that can be used for the different cases are: qualitative safety assessment methodologies (safety), interviews with operational experts (safety, operational acceptability, human factors), analysis of meteorological statistics (operational feasibility), third party risk (safety) & analysis of fleet mix, traffic load and inbound/ outbound procedures (safety and environment);
- Before the Experiment Level experts start working out the plan, the Programme Level experts need to explain the headlines of the plan for V1 to the Strategic Level.
- During V1, Programme Level experts will monitor the activities at the Experiment Level.

At the Project and Experiment Level the main activity during V1 is:

- Build the different cases under consideration of the plan worked out at the Programme Level. Cases, such as the safety case, environment case, operational case, and business case are carried out using the selected methods/tools/techniques selected at the Programme Level. Results are fed back to the Programme Level.

3.3.2 Proof of Concept by Determination of Operational Acceptability in V2

At the Strategic Level in V2 the main questions that need to be answered at the end of the maturity phase are



1. how the detailed design of all characteristics of the new runway look like, i.e., a prototype defining all solutions including a clear description of the open issues like exact location of the runway; and
2. what the expected, detailed effects of the new runway are, in terms of:
 - Capacity (how many inbound/outbound flights per runway under which conditions?);
 - Safety (are collision risk and third party risk in line with applicable safety regulations?);
 - Environment (are noise footprints in line with national and international regulations?);
 - Operational acceptability (is the detailed design acceptable for operational people? communicate to and involve operational experts); and
 - Business (what are the monetary effects for the different stakeholders?).

Possible decisions after the first iteration in V2 using the results of Programme Level, Project Level, and Experiment Level activities during V2 are:

- Stop further development of the concept idea because at least one case does not yield beneficial results;
- Re-iterate V2 because it is not clear what the effects are. Additional or more accurate analysis is necessary;
- Fine-tune the capacity goals; or
- Proceed with V3, since all effects are promising and beneficial and support the ideas.

At the Programme Level the main tasks during V2 are the following:

- Define (and build) the prototype, i.e., work out the details of the new runway idea to such an extent that detailed safety, capacity, environment, operational and business analysis can be made.
- Make a plan and select appropriate methods/tools/techniques, so that the right type of analysis (i.e. further develop the details of the cases) can be made with the right content and level of quality. In that way, the appropriate information can be supplied to the Strategic Level for decision making (i.e., what are the operational effects of the different cases?). The cases must also be in line with expectations and requirements of authorities.
- Before the Experiment Level experts start working out the plan, the Programme Level experts need to explain the headlines of the plan for V2 to the Strategic Level.
- During V2, Programme Level experts will monitor the activities at the Experiment Level.

At the Project and Experiment Level the main activity during V2 is:

- Further develop the different cases under consideration of the plan worked out at the Programme Level and the results obtained in V1. Cases, such as the safety case, environment case, operational case, and business case are carried out using the



methods/tools/techniques selected at the Programme Level. Results are fed back to the Programme Level.

3.3.3 Integration of Concept by Assessment of Concept Performance in V3

At the Strategic Level in V3 the main question that needs to be answered at the end of the maturity phase is what the best strategy for the acquisition process is. Exemplifying topics that need to be addressed are:

- What is the best acquisition strategy to fulfil the specifications for all elements that are relevant for the new runway (e.g. new equipment, new procedures, new training, architecture et cetera)? Options are to set out tenders or to fulfil specifications in-house; and
- Get the detailed design approved by the authorities.

At the end of V3, the approval of the authorities should be arranged and the decision how to fulfil the specifications should be made.

At the Programme level the main tasks during V3 are the following:

- Define which specifications for the details of the new runway should be developed and arrange the approval process with the authorities.
- Before the Experiment Level experts start working out the plan, the Programme Level experts explain the headlines of the plan for V3 to the Strategic Level.
- During V3, Programme Level experts will monitor the activities at the Experiment Level.

At the Project and Experiment Level the main activity during V3 is:

- Define all relevant and necessary specifications and update the cases based on the latest insights and details of the new runway design.

3.4 Conclusions and Recommendations for Validation Reporting Templates

3.4.1 Conclusions and Recommendations Concerning Template Contents

The following sections will describe the considerations for the contents of Validation Reporting Templates at the three different planning levels (programme, project, and experiment level) and within the three different maturity phases of the concept (V1 to V3). The conclusions are based on the VARTAN analysis of the E-OCVM in Section 2 and the description of criteria for reporting triggers in the previous sections of this document. While in a first step the general contents at the different planning levels is considered, in a second step the contents of the templates will be looked at from the lifecycle point of view.



All templates, irrespective of the lifecycle phase or the management level, are expected to start with an introductory part, explaining the document purpose, the audience addressed, and the scope of both the described work and the document. Generally, all higher level documents, from both the perspective of the level of detail and the level of maturity, are expected to reference lower level documents. This means that general conclusions reported in lower level documents are summarised and, if necessary, compared with each other to build a basis for conclusions and decision making on the higher level. In that way it must be ensured that possible triggers for follow-up activities (re-iteration within a lifecycle, transition to the next lifecycle) are not overlooked.

3.4.1.1 Experiment Level Contents

Starting from the experiment level it can be concluded on the basis of the E-OCVM analysis that it will be necessary to start from experiences of earlier projects in reporting simulation results. This means that a template in which project results are described, will start with a brief summary of the experiment plan. This is especially important considering the fact that an experiment plan is concerned with the goals of the project and describes the steps that were taken in the planning phase to be able to meet the identified goals at the end of the project. Furthermore, the experiment plan will usually make a reference to higher level goals and objectives and will therefore place the project in the broader context.

Eventually, it will be necessary to report any differences between what was planned and what was achieved, so that such a summary of experimental planning is a necessity for reporting on validation activities.

Major parts of the document will reference E-OCVM processes as described in this methodology (steps 2 to 4) and will therefore give a summary of decision processes for experiment assumptions and refinements to the application of tools and techniques. They will also need to address agreed indicators and metrics and their definition and anticipated evaluation as described in the Measurement and Analysis Specification (MAS) that was proposed in the E-OCVM and in the MAEVA guidelines. Finally, the results need to be presented in reference to this specification and the significance of the results within the context of experiment assumptions has to be explained when drawing conclusions and making recommendations to the higher level.

3.4.1.2 Project Level Contents

On the project level essentially the same contents (report on planning, differences between planning and execution, report on results) are expected as on the experiment level with the major difference that the focus is put on integration of results of the different experiments rather



than description of single results. Furthermore, the decision processes as described in step 2 of the E-OCVM will be illuminated. The project strategy, its schedule and the scope and context of the different experiments within that strategy will be revisited. The results of the different experiments and the achieved level of quality will be looked at before conclusions and recommendations will be given to the higher level.

Already at this level a decision could be taken to re-iterate on certain experiments to allow for better (more realistic) or more conclusive results for the project.

3.4.1.3 Programme Level Contents (Suggestion)

On the programme level the results of the different projects must be studied and possible gaps between original planning and execution of the projects must be considered. This means that the programme plan and schedule needs to be explained and possible discrepancies between the planning, in this case the case building process and the definition of projects, and the execution of the projects within the programme have to be mentioned in order to report possible consequences for higher level interpretation of the programme results.

This also means that differences in the achieved level of quality of the results must be considered. Another caveat is that seemingly comparable studies might bring conflicting results, so that the reason for this needs to be investigated. Again at this level a decision could be taken that there is a need to repeat certain parts of a programme as project results might be inconclusive (e.g. no statistical significance of results) or to broaden the scope of the programme due to previously overlooked aspects. Finally, conclusions and recommendations must consider all these possible differences within the cases or between the cases identified at the programme level.

Due to the fact that some programmes might need internal re-iteration steps there might be problems within the general timeframe considered in the strategic planning. The templates should report on these differences and place the programme results in the broader context, evaluating case results under consideration of possible differences in the achieved quality and detail. A very important aspect is, that it must be determined whether the set goals were reached or not. Eventually, the consequences of that evaluation might be a re-iteration within the lifecycle (for one or more projects and programmes) or the decision to proceed to the next lifecycle. This decision will eventually have to be taken on the strategic level.

As it is not expected that a template at the programme level will be detailed enough for meaningful input into the VDR, and since the VDR structure is mainly based on projects and experiments, such a template will not be produced, though.



3.4.1.4 Maturity Level Viewpoint

The general contents of Validation Reporting Templates as described above needs to have a special focus within the different maturity phases identified. This means that, on the lowest technical level, simulations might have a different focus (benefits in the first phase, operational tests and prototype validation in the second phase, and performance benefit simulations in the third phase) and might be executed with different levels of detail.

The same goes for the programme level where cases will be built according to the level of detail that the overall goal on the strategic level requires.

Eventually, the templates for the strategic level will differ in the way that the possible triggers for proceeding to a higher maturity phase are described, as these triggers require different qualities of data and levels of detail within each of the phases.

In any of the templates, however, it will be most important to state both the goals and the assumptions to reach the goals for every planning level. This finally leads to the draft contents tables for validation reporting templates, which are described in the upcoming section.

3.4.2 Summary of Conclusions and Preliminary Template Contents

As a result of the discussion above, the following high-level draft template contents was suggested considering only the different levels of detail. The reason for only looking at these templates is that the templates in their basic structure will largely be determined by the levels of detail. The lifecycle phases are much more determining the contents of the templates, so that templates will only marginally differ for the different lifecycles. A more thorough analysis of document contents will be carried out in the following stages of the VARTAN project. Help sections and template guidelines will be produced as a result of this analysis.

The most comprehensive template will be necessary at the experiment level. It will contain information about the planning phase (test plan summary), execution of the simulation, deviations from the planning, and analysis of results.

- INTRODUCTION
 - Experiment Background and Context
 - Concept Overview
 - Purpose of Document
 - Scope and Structure of Document
 - References
 - Acronyms



- **SUMMARY OF EXPERIMENT STRATEGY AND PLANNING**
 - Experiment Aims, Objectives and Hypotheses
 - Experiment Constraints and Assumptions
 - Experiment Preparation
 - Choice of Metrics and Measurements
 - Choice of Methods and Techniques
 - Scenario Specifications
 - Planned Experiment Schedule
- **CONDUCT OF VALIDATION EXERCISE RUNS**
 - Participants and Training Issues (if applicable)
 - Executed Experiment Schedule
 - Deviations from the Planning
- **ANALYSIS OF EXPERIMENT RESULTS**
 - Quality of Results of Experiment
 - Significance of Results of Experiment
 - Unexpected Experiment Results
 - Analysis of Results on the Basis of Determined Hypotheses
 - Analysis of Consequences of Results for Experiment Objectives
- **CONCLUSIONS AND RECOMMENDATIONS FOR PROJECT LEVEL**
 - Summary of Planning Deviations
 - Summary of Quality and Significance of Results
 - Possible Consequences for Progress

A planning document template at this level was not yet produced (cf. [13]), as it was argued that such an experiment plan very much depends on the type of experiment, and a template might be too prescriptive and not generic enough to cover all possible contents.

As explained before the contents of the template on the project level will be similar to the contents of templates at the experiment level with the major difference that the project report will concentrate on the decision processes in step 2 of the E-OCVM and integration of results from different experiments.

- **INTRODUCTION**
 - Project Background and Context
 - Concept Overview
 - Purpose of Document
 - Scope and Structure of Document
 - References
 - Acronyms



- **SUMMARY OF PROJECT STRATEGY AND PLANNING**
 - Stakeholder Requirements
 - Supporting Cases
 - Project Aims and Objectives
 - Project Constraints and Assumptions
 - Decision Processes in Experiment Definition
 - Experiment Context and Planning
 - Measurement Analysis Specification
- **CONDUCT OF VALIDATION PROJECT**
 - Executed Experiments
 - Deviations from the Planning
- **ANALYSIS OF PROJECT RESULTS**
 - Quality of Results of Different Experiments
 - Significance of Results of Different Experiments
 - Unexpected Project Results
 - Analysis of Consequences of Quality and Significance of Results
 - Analysis of Results on the Basis of Determined Hypotheses
 - Consequences of Results for Project Objectives
- **CONCLUSIONS AND RECOMMENDATIONS FOR PROGRAMME LEVEL**
 - Summary of Planning Deviations
 - Summary of Quality and Significance of Project Results
 - Possible Consequences for Project Progress

On the programme level the results of the different projects are studied and again deviations from the planning (which is based on step 1 of the E-OCVM) and the execution of the projects within the programme have to be investigated. For the programme level the most important planning aspect is the case building process and the definition of the projects. Thus, any possible differences in the achieved level of quality of the results and conflicting results within and in-between the projects and defined cases have to be elaborated and consequences need to be reported to the higher level.

- **INTRODUCTION**
 - Programme Background and Context
 - Concept Overview
 - Purpose of Document
 - Scope and Structure of Document
 - References
 - Acronyms



- **SUMMARY OF PROGRAMME STRATEGY AND PLANNING**
 - Project Stakeholders
 - Programme Aims and Objectives
 - Identified Cases
 - Key Performance Areas and Indicators
 - Programme Constraints and Assumptions
 - Decision Processes in Project Definition
 - Project Context and Planning
- **CONDUCT OF VALIDATION PROGRAMME**
 - Executed Projects
 - Deviations from the Planning
- **ANALYSIS OF PROGRAMME RESULTS**
 - Quality of Results of Different Projects
 - Significance of Results of Different Projects
 - Unexpected Programme Results
 - Analysis of Consequences of Quality and Significance of Results
 - Analysis of Results on the Basis of Programme Goals
 - Consequences of Results for Programme Objectives
- **CONCLUSIONS AND RECOMMENDATIONS FOR STRATEGIC LEVEL**
 - Summary of Planning Deviations
 - Summary of Quality and Significance of Results
 - Consequences for Programme Progress



4 Template Contents and Automation Options

4.1 Consequences of Project Findings for Template Contents

As a consequence of the analysis and the suggestions made for template contents in Section 3.4, the details for both the project level and the experiment level templates were worked out. The templates were implemented within the current EATMP document template as an example. This is not a necessity though and it should be seen as one possibility of combining existing templates with the validation reporting templates produced by the VARTAN project.

The following sections will reflect on the templates by briefly describing the expected contents for each section and its relation to the E-OCVM. The corresponding text is also included in the templates themselves as help text. This text is simply formatted as hidden text and can be viewed using the basic Microsoft Word functionality to show or hide so-called hidden fonts. For more information on this the Word Application Help can be referenced.

As a final guide to using the templates the end of this section will deal with the automation part that was introduced as an example in the experiment level template. This part of the automation is based on straightforward Microsoft Visual Basic (for Applications) code that allows to either store basic data in the template itself or add data structures to the template that are necessary to collect summary data from certain sections of the document for easy transfer to the VDR.

4.2 VARTAN Validation Reporting Template Contents

4.2.1 Project Level Template Contents

Generally, the template starts with a number of document fields that are determined by the EATMP document styles in use. All functionality, however, that the EATMP template contained for producing such a first document section or updating it and providing help functions with its own data entry fields, has been removed. This has been done in order to prevent unforeseen conflicts between specific corporate template code for producing company documents and the code contained in the VARTAN templates.

The recommended procedure is to produce an empty document from the company specific template and copy the resulting pages and the document styles into the VARTAN template. In that way, there will be no corruption of the VARTAN code and the layout will follow the styles copied from the company template. For the procedure to copy document styles from one document template to another document template or document, the help section of the Microsoft Word Application should be referenced.



Apart from a document change record and the table of contents, each document should contain an executive summary, which is an important part of information for the VDR. Automation issues regarding the executive summary are dealt with in later sections of this document.

4.2.1.1 Project Level Template - First Chapter

The first chapter consists of an introduction, which contains sections about the project background and context, the concept overview, the purpose of the document, and the scope and structure of the document. Furthermore, it contains a section on references and acronyms and abbreviations.

When describing the project background and context, the document is positioned within the framework of activities within the respective programme. Information should be obtained from other project or programme documents, such as the Project Proposal, Management Plan or Description of Work (DOW), as far as available.

The concept overview should start with a general description as provided on the programme level and should get more detailed in the course of the section in order to focus in on the details of the part of the concept under investigation in the project. Information on the subject should be obtained from other project or programme documents, such as Operational Service Environment Descriptions (OSED), Operational Concept Documents (OCD) or Operational Requirement Documents (ORD). The more high-level descriptions should be available in management documents such as a Description of Work (DOW).

The next section describes the purpose of the document. Generally, the purpose is simply to report the consolidated results of the performed experiments. Thus, this section should also briefly reflect on its position in the general reporting structure of the programme and the consequences it might have for decision processes at higher levels. In that regard it could be helpful to look for descriptions of the purpose of the document in higher level documents (DOW, Management Plan, and Technical Annex) and refer to that information.

In the section describing the scope and the structure of the document it should be reported what will be included in the document and what will be either left out or only referenced. Furthermore, the content of each of the upcoming paragraphs of the document is briefly described.

At the end of the first chapter an example for entering references and referring back to them in the text is given. Furthermore, recommendations are made for which websites are helpful in creating a list of acronyms and abbreviations.



4.2.1.2 Project Level Template - Second Chapter

The second chapter of the template is supposed to give a summary of the project strategy and any planning issues that were mentioned in earlier documents. It has to be remembered, though, that this section should only give a summary and not an abundant report.

The first section summarises the different stakeholder requirements which have been aggregated and prioritised at the programme level. Consequences for execution of the project and the set-up of experiments should be discussed in this section as well.

The second section describes the supporting cases for the project and should list the key performance areas associated with these cases. Possible interrelations between the cases should be highlighted and consequences for the project schedule and experiment set-up should be elaborated. At the end of this section a summary must be presented in the suggested tabular form. The format for this table is mandatory, but the general layout can be changed. The template could support generation of such a structure. An example for the automated support is given in later sections of this document (see Section 4.3.2) for a similar section of the experiment level template.

The third section of this chapter deals with both the expected outcomes and objectives of the project. A description of the expected outcomes usually identifies investigated performance areas and summarises the various objectives which are related to these areas. Steps 1.3 and 1.4 of the E-OCVM should be consulted for a more detailed description of what is expected in this section. At the end of this section there is a special subsection for a summary that has to extract the main message from the previous subsection for easy reference and entry into the VDR. The format for this summary section is mandatory, but the general layout can be changed. Since more than one expected project outcome is usually applicable, it will be necessary to add identifiers for each of the expected project outcomes. The template supports generation of such a structure and as mentioned before this automation option will be described in later parts of this document (see Section 4.3.2) for the experiment level template.

Project objectives should be formulated in such a way that there is a direct correlation with the identified performance areas. Step 1.4 of the E-OCVM can be referenced for further details. Regarding the format and the summary the same options are possible for the objectives as for the project outcomes.

The fourth section of this chapter describes and justifies the decision processes made when defining the validation experiments of a project. This includes the definition of validation needs, scope of the project, project planning and the overall strategy. The findings of the previous



chapters, i.e. stakeholder requirements, expected outcomes and project objectives will have to be considered. Furthermore, the choice of methods and techniques to achieve the objectives formulated for the different performance areas must be justified. Steps 1.5, 1.6 and 1.7 of the E-OCVM give additional details on the subject.

The fifth section describes and gives a tabular overview of the project schedule, i.e. the timeframe, resources and attributed effort. A Gantt chart example for the time schedule is given in the template as an example. Resource and effort overviews could either be given separately or in combination with such a Gantt-Chart. This activity is described as part of step 1.5 in the E-OCVM.

This final section of this chapter describes the expected results from the different experiments, gives an overview of the way the results are analysed and shows the correlation between the different experiments. This activity is described in detail in step 2.7 of the E-OCVM for a particular experiment but should be addressed in this section in such a way that the overall project strategy for result analysis becomes apparent. Thus, the project analysis strategy is rather part of step 1.7 of the E-OCVM.

4.2.1.3 Project Level Template - Third Chapter

This chapter deals with execution of all experiments and deviations from the previously described project planning. Thus, in the first section the actual project schedule and the execution of experiments are described. This is also part of the activity described in step 1.7 of the E-OCVM.

Furthermore, in the second section, all events and decisions that led to a deviation from the planned activities should be noted, including possible mitigating actions or expected consequences for project results. Step 3.2 of the E-OCVM describes such an activity as unexpected effects or behaviour of an experiment. This section, however, should address deviations from the project plan and strategy.

4.2.1.4 Project Level Template - Fourth Chapter

In this chapter the results of all experiments are presented. Generally, this topic is described in step 4 of the E-OCVM. However, the E-OCVM puts more emphasis on the analysis of the results and on single experiments rather than the overall project results.

In the first section, the results of the different experiments should be presented per key performance area and high-level objective. The proposed table added at the end of this section is meant to provide a summary and for easy integration of complex results into the VDR. The



format for this table is mandatory, due to traceability, meaning that there should be a direct link from the results to objectives and key performance areas described earlier. However, the general layout can be changed. The template could support generation of such a structure as mentioned for other parts of the template. A table must be produced for each experiment.

The second section of this chapter deals with confidence issues regarding the results of the different experiments. First, all issues concerning the quality of the results achieved in the different experiments must be described. In that regard quality could refer to both the accuracy of results and the confidence in the results, which might be influenced by decisions, constraints, and assumptions made at the experiment level. Secondly, significance of the results is looked at. Significance refers to statistical and operational significance. Statistical significance will be based on the number of independent variables of the different experiments and the number of experiment runs carried out. Operational significance concerns operational realism of the different experiments which depends on a number of factors which are very much dependent on the chosen environment.

The last section of this chapter deals with unexpected project results. Unexpected project results must be reported immediately and should be documented well as they might have significant consequences for related projects or programmes and to the validation process as a whole (e.g. identification of showstoppers). The E-OCVM elaborates on this subject in step 3.2 for a single experiment.

4.2.1.5 Project Level Template - Fifth Chapter

This chapter deals with the consolidation of the results obtained from the different experiments of the project. The topic is covered in steps 4.1 and 4.2 of the E-OCVM. However, the E-OCVM puts more emphasis on single experiments rather than the overall project results.

The first section reflects on the consequences of different quality and significance of evidence between different experiments. It investigates in how far significant differences in accuracy, detail and/or statistical evidence have an impact on overall project objectives and results.

The second section looks at the consequences of experiment results for project objectives. Project results must lead to either acceptance or rejection of project hypotheses which are deduced from the high-level objectives. Thus, the different experiment results and their contributions to reaching high-level objectives must be compared. Apart from looking at the results per high-level objective the results of a project must also be analysed per key performance area. The analysis sections will therefore also have a look at the consequences of



the results for the different areas and investigate the interrelations between objectives in different areas.

4.2.1.6 Project Level Template - Sixth Chapter

The main part of the document ends with conclusions and recommendations for the programme level. This topic is covered in step 5.2 of the E-OCVM.

The first section gives a summary of the conclusions per key performance area and related high-level objectives and thereby summarises the analysis of the different experiment outcomes. It must contain a tabular overview at the end for easy integration into the VDR. The format for this table is mandatory. However, the general layout can be changed. The template could support generation of such a structure in the same way as has been implemented in the example for the experiment level template (see Section 4.3.2).

The second section contains the recommendations per key performance area and related high-level objective. Recommendations are especially expected in case one or more experiments were unsatisfactory as regards the quality of evidence or in case of deviations from the planning. Possible recommendations could include the changing of project objectives and repetition or continuation of certain experiments. The recommendations should also concern progress on the programme level including possible relations with other projects and planning issues.

Again there must be a tabular overview at the end or easy integration into the VDR. The format for this table is mandatory. However, the general layout can be changed. The template could support generation of such a structure in the same way as has been implemented in the example for the experiment level template (see Section 4.3.2).

4.2.1.7 Project Level Template - Final Chapters

Chapter 7 of the template can be used to present the tables of figures and tables. If captions for figures are generated with the standard functionality in the Microsoft Word Application, the tables provided in Chapter 7 should be filled in automatically after a document refresh.

The final section of the report can contain appendices, i.e. data related with results which is too complex to be included in the main part of the document.

4.2.2 Experiment Level Template Contents

Generally, the template starts with a number of document fields that are determined by the EATMP document styles in use. All functionality, however, that the EATMP template contained for producing such a first document section or updating it and providing help



functions with its own data entry fields, has been removed. This has been done in order to prevent unforeseen conflicts between specific corporate template code for producing company documents and the code contained in the VARTAN templates.

The recommended procedure is to produce an empty document from the company specific template and copy the resulting pages and the document styles into the VARTAN template. In that way, there will be no corruption of the VARTAN code and the layout will follow the styles copied from the company template. For the procedure to copy document styles from one document template to another document template or document, the help section of the Microsoft Word Application should be referenced.

Apart from a document change record and the table of contents, each document should contain an executive summary, which is an important part of information for the VDR. Automation issues regarding the executive summary are dealt with in later sections of this document.

4.2.2.1 Experiment Level Template - First Chapter

The first chapter consists of an introduction, which contains sections about the experiment background and context, the concept overview, the purpose of the document, and the scope and structure of the document. Furthermore, it contains a section on references and acronyms and abbreviations.

This first section contains the description of the experiment background and context. The document thereby is positioned within the framework of activities within the project and/or programme. Information should be obtained from other project documents, such as the Project Proposal, Management Plan or Description of Work (DOW), as far as available.

In the second section an overview of the concept is given, starting with a general description as provided on the project and/or programme level and getting more detailed in the course of the section in order to focus in on the details of the part of the concept under investigation in the experiment. Information on the subject should be obtained from other project documents, such as Operational Service Environment Descriptions (OSED), Operational Concept Documents (OCD) or Operational Requirement Documents (ORD). The more high-level descriptions should be available in management documents such as a Description of Work (DOW).

The third section describes the purpose of the document. Generally, the purpose is simply to report the results of the performed experiment. Yet, this section should also briefly reflect on the position of the document in the general reporting structure of the project and/or programme and the consequences it might have for decision processes at a higher level. In that regard it could be



helpful to look for descriptions of the purpose of the document in higher level documents (DOW, Management Plan, and Technical Annex) and refer to that information.

In the section describing the scope and the structure of the document it should be reported what will be included in the document and what will be either left out or only referenced. Furthermore, the content of each of the upcoming paragraphs of the document is briefly described.

At the end of the first chapter an example for entering references and referring back to them in the text is given. Furthermore, recommendations are made for which websites are helpful in creating a list of acronyms and abbreviations.

4.2.2.2 Experiment Level Template - Second Chapter

The second chapter of the template is supposed to give a summary of the experiment strategy and any planning issues that were mentioned in earlier documents. It has to be remembered, though, that this section should only give a summary and not an abundant report.

The first section contains a description of the expected outcomes, objectives and hypotheses of the experiment.

At first the expected experiment outcomes must be described. A description of these outcomes usually identifies investigated performance areas and summarises high-level experiment objectives which are related to these areas. Steps 1.3 and 1.4 of the E-OCVM should be consulted for a more detailed description of what is expected in this section. However, it should be noted that the description must be related to the experiment in question rather than the complete validation exercise performed in the project.

Furthermore, this section must describe the experiment objectives (usually high-level objectives). Experiment objectives should be formulated in such a way that there is a direct correlation with the identified performance areas. Usually, there should be one performance area per objective. Step 1.4 of the E-OCVM can be referenced for further details, but it should be kept in mind that the description is purely related to the experiment under consideration.

The last part of this section must describe the experiment hypotheses. Experiment hypotheses should be formulated in such a way that there is a direct correlation with identified objectives (usually low-level objectives) meaning that a hypothesis actually performs the test whether the (low-level) objective was achieved or not. Step 2.2 of the E-OCVM can be referenced for



further details, but it should be considered that low-level objectives at the experiment level must always be related to a measurable hypothesis.

At the end of each of the subsections for outcomes, objectives and hypotheses, there is a special subsection for a summary that has to extract the main message from the previous subsection for easy reference and entry into the VDR. The format for this summary section is mandatory, but the general layout can be changed. Since more than one expected outcome, one objective or one hypothesis is usually applicable, it will be necessary to add identifiers for each of these data items. The template supports generation of such a structure and as mentioned before this special but representative automation option will be described in later parts of the document (see Section 4.3.2).

The second section describes all metrics and measurements made. It clearly relates to step 2.4 of the E-OCVM. If it should be necessary to explain events and procedures that are necessary to define the metrics, this should preferably be done with an illustration. Metrics and measurements, however, should be described in tabular form in order to show the relation with objectives and indicators. An example for such a table is given in the template document. Automation for such a table is not provided as it can be expected that the structure changes depending on the number of metrics and indicators and their mutual relation.

The third section briefly describes all methods and techniques used in the experiment to obtain the measurements. Eventually, the chosen platform is described here as well. Step 2.9 of the E-OCVM partially describes this process. A table at the end of this section must summarise this section. The format for this table is mandatory, but the general layout can be changed. The template could support generation of such a structure as in the previously mentioned example for outcomes, objectives and hypotheses. An example is given in the template document.

The fourth section of this chapter should contain all information concerning scenarios. As the result report will only be a summary most parts of this section have probably already been described in either the test plan report or related platform preparation and design documents. Nevertheless, the following paragraphs should be considered: Architectural Design of Experiment (including component design), Traffic Samples Characteristics, Geography and A/S (A/P) Design, and Scenario Parameters. This section is related to step 2.5 of the E-OCVM.

The final section of this chapter describes the experimental design which is based on the different control variables (independent variables) of the experiment. Although steps 2.6, 2.7 and 2.8 of the E-OCVM describe the overall process of experiment design and can be consulted for that purpose, the eventual detailed design needs to be determined by an expert group of



validation specialists. As a summary, independent variables, constants and the design type must be presented in the suggested tabular form at the end of this section. The format for this table is mandatory, but the general layout can be changed. The template could support generation of such a structure as in the previously mentioned example for outcomes, objectives and hypotheses. An example is given in the template document.

4.2.2.3 Experiment Level Template - Third Chapter

The third chapter generally deals with the conduct of the validation exercise runs.

Its first section should describe the activities necessary to prepare the experiment and especially concerns the environment and its preparation for executing the experiment according to the design. The environment includes experiment participants and training. Furthermore, the necessary activities for assuring measurement of the determined metrics should be described. More details can be found in steps 2.10 and 2.11 of the E-OCVM.

The second section must describe the executed experiment schedule. For more information on conducting a validation exercise step 3.1 of the E-OCVM can be consulted.

The third section must describe deviations from the planning. At this point all events and decisions that led to a deviation from the planned experiment schedule or other planned activities should be noted, including possible mitigating actions or expected consequences for experiment results. If applicable, participant roles and possible training issues should be discussed at this point. This also includes all actions to mitigate problems concerned with learning effects that might influence experiment results. Furthermore, stability issues can be described concerning both the platform and tool functionality. Step 3.2 of the E-OCVM touches this point but does not elaborate on the different deviation sources described above.

4.2.2.4 Experiment Level Template - Fourth Chapter

In this chapter the results of the experiment are presented. Generally, this topic is described in step 4 of the E-OCVM. However, the E-OCVM puts more emphasis on the analysis of the results.

The first section should concentrate on the measurements made. A summary of these measurements must be given at the end of this section in tabular form. The format for this table is mandatory, due to traceability, meaning that there should be a direct link from the results to objectives and hypotheses described earlier. However, the general layout can be changed. The template could support generation of such a structure as in the previously mentioned example for outcomes, objectives and hypotheses. However, it is expected that the table structure will be



very much dependent on the special relation between results, measurements and objectives and should therefore not be standardised. An example is given in the template document.

The second section of this chapter deals with confidence issues regarding the results of the experiment. First, all issues concerning the quality of the results achieved in the experiment must be described. In that regard quality could refer to both the accuracy of results and the confidence in the results, which might be influenced by decisions, constraints, and assumptions made. Secondly, significance of the results is looked at. Significance refers to statistical and operational significance. Statistical significance will be based on the number of independent variables of the experiment and the number of experiment runs carried out. Operational significance concerns operational realism of the experiment which depends on a number of factors which are very much dependent on the chosen environment.

The last section of this chapter deals with unexpected experiment results. Unexpected experiment results must be reported immediately and should be documented well as they might have significant consequences for related experiments or projects and to the validation process as a whole (e.g. identification of showstoppers). The E-OCVM elaborates on this subject in step 3.2.

4.2.2.5 Experiment Level Template - Fifth Chapter

This chapter deals with the analysis of the experiment results. The topic is covered in steps 4.1 and 4.2 of the E-OCVM.

The first chapter looks at the outcomes on the basis of determined hypotheses. Results must lead to either acceptance or rejection of hypotheses, usually represented by a threshold value. This section should compare results with the hypotheses and give an indication to which extent the hypotheses could be accepted or rejected considering the respective levels of quality of the evidence. This section should be structured in such a way that it describes the analysis per determined hypothesis.

The second section relates the accepted or rejected hypotheses with the corresponding high-level and low-level objectives and will therefore report on the consequences of the evidence for reaching the experiment objectives, i.e. it must be determined which parts of the experiments were successful and which parts might need further study. This section should be structured in such a way that it describes the analysis per determined experiment objective.



4.2.2.6 Experiment Level Template - Sixth Chapter

The main part of the document ends with conclusions and recommendations for the project level at which the results of the different experiments are consolidated. This topic is covered in step 5.2 of the E-OCVM.

The first section gives a summary of the conclusions per experiment objective and thereby summarises the analysis of the experiment outcomes. At the end of the section there must be a tabular overview. The format for this table is mandatory, but the general layout can be changed. Since more than one objective is usually applicable, it will be necessary to add identifiers for each of the objectives. The template supports generation of such a structure as in the case of the earlier mentioned structure for outcomes, objectives and hypotheses (see Section 4.3.2). The underlying automation should ensure that there is a direct link in the data between the results and conclusions and the respective experiment objectives.

The second section contains the recommendations per experiment objective. This includes the mentioning of possible consequences of the conclusions for the complete experiment. Recommendations are especially expected in case parts of the experiment were unsatisfactory as regards the quality of evidence. Possible recommendations could include the changing of objectives and repetition or continuation of certain elements of the study. Finally, this section should also give recommendations for progress on the project level including possible relations with other experiments and planning issues. Again, at the end of the section there must be a tabular overview that links each recommendation with an experiment objective. The format for this table is mandatory, but the general layout can be changed. Since more than one objective is usually applicable, it will be necessary to add identifiers for each of the objectives. The template supports generation of such a structure as in the case of the earlier mentioned structure for outcomes, objectives and hypotheses (see Section 4.3.2). The underlying automation should ensure that there is a direct link in the data between the recommendations and the respective experiment objectives.

4.2.2.7 Experiment Level Template - Final Chapters

Chapter 7 of the template can be used to present the tables of figures and tables. If captions for figures are generated with the standard functionality in the Microsoft Word Application, the tables provided in Chapter 7 should be filled in automatically after a document refresh.

The final section of the report can contain appendices, i.e. data related with results which is too complex to be included in the main part of the document.

4.3 Basic Client-side Document Automation Examples

As mentioned above, this section presents an example of how templates could be provided with automated functions to help the user store basic project information in the document and to create the data structures needed for easy transfer of summary information into the VDR. The experiment level template has been used for the example.

It is worth noticing, that all functions used to demonstrate automation are part of the standard MS Word software package and do not require any additional software to be loaded onto the PC of the document author.

4.3.1 Static Document Information

This section describes the use of a form to enter basic project/experiment data and user data in the document. The given example contains basic data, such as user name, password, project acronym, and project name (see Figure 4-1).

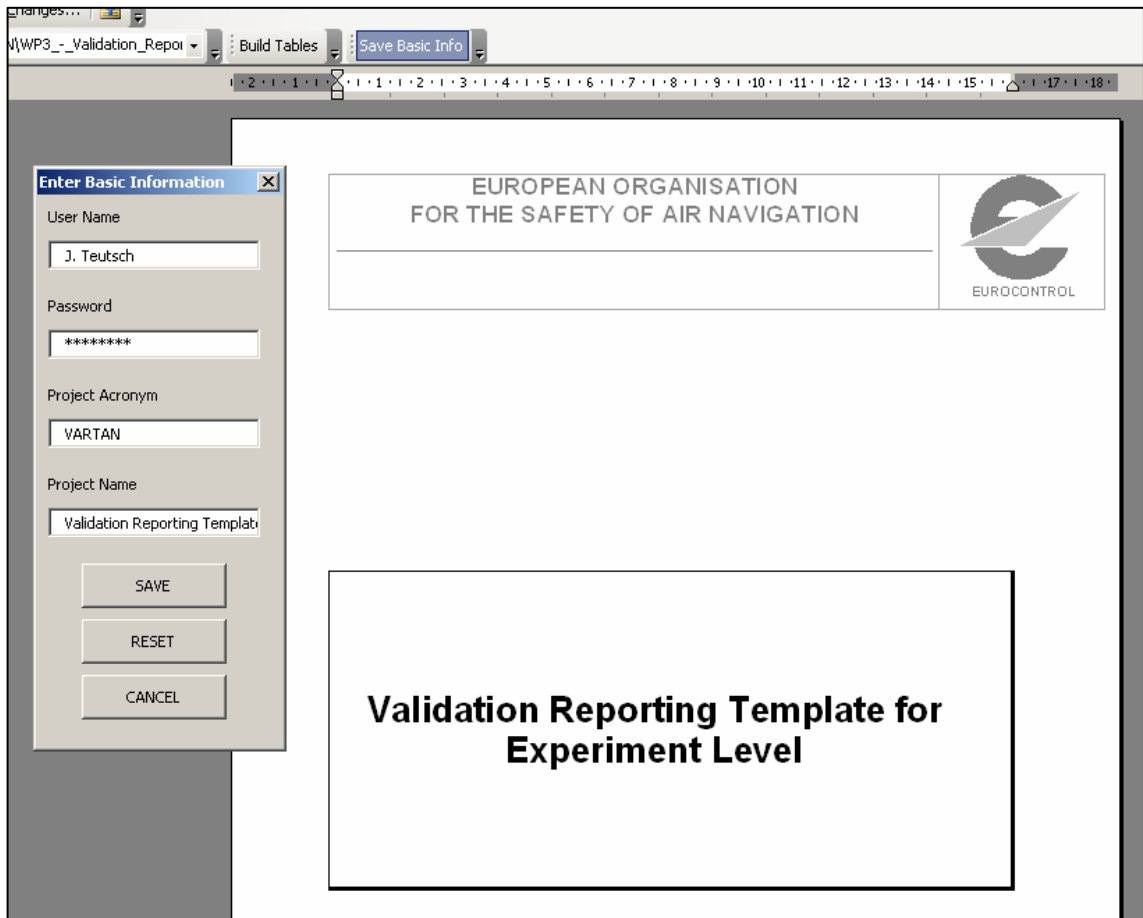


Figure 4-1: Form for Basic Data Input



Should more information be necessary, additional fields can be implemented in the suggested form as desired.

The form for entering the data is opened by pushing the button SAVE BASIC INFO in the toolbar section of the Word document. The underlying Visual Basic for Applications (VBA) code of the Microsoft Word Application can be applied to store that basic information in the custom property fields of the Word document itself.

If the required property fields already exist, their contents will be displayed in the form fields. If they do not exist, the form fields will be empty. In order to enter data into the fields all form fields will have to be filled in. When pushing the SAVE button custom properties will either be added or, if the custom fields already exist, the data on the form will be entered into the custom property fields. Pushing the RESET button all form entries will be emptied. A push on the CANCEL button will close the form.

In this example a number of issues were not dealt with and might be necessary to consider when building templates with complete functionality and according to agreed data requirements:

- The VDR data team might require more static data to be entered in the database.
- The static document information data entered into the VDR needs to be of a special format or needs to be encrypted (for example, the password).
- The data needs to be preformatted or obtained from an existing list of data items.
- The data from built-in properties needs to be available for entry into the VDR.
- A password must be supplied for changing or entering data.

Solutions for all described cases can be found with the suggested set-up of the form, however, it should be noted that conflicts are possible if document authors use their own style templates that make use of built-in or custom Word document property fields. Thus, the final templates should require a list of property fields in use (including the formatting options) to indicate to the users that there are fields in the document which must not be used otherwise. If they are used otherwise their content will be overwritten by the code provided in the example to make sure that the provided automation works under all circumstances.

4.3.2 Chapter Summary Information Fields and Tables

Two further automation examples concern the suggested summary table structure in the document and the summary field content that is extracted from the document by the communication services (see Section 5.2).

As an example the table structures suggested for expected outcome, objectives and hypotheses of the experiment in chapter 2.1 of the experiment level template have been automated (see Figure 4-2 and Figure 4-3). In order to include the necessary table structure the author needs to push the button BUILD TABLES in the toolbar section of the Word document for the input form to open.

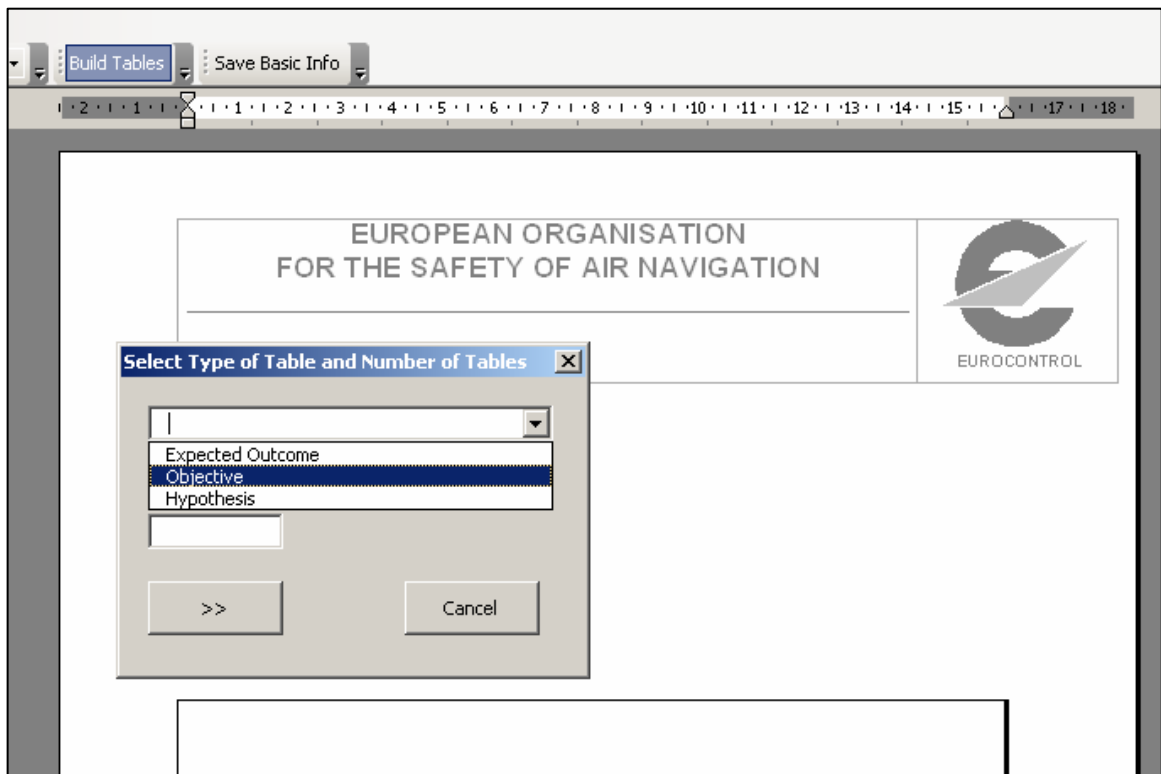


Figure 4-2: Input Form for Building Table Structures and Form Fields for Data Transfer

The input form allows for selecting the kind of table structure that should be added to the document. In the example, this could either be expected outcomes, objectives or hypotheses. The field under the selection box can be used to enter the number of tables that should be added according to the number of expected outcomes, objectives or hypotheses. For demonstration purposes, the valid values have been selected to be larger than zero and not larger than 10.

To start the building of table structures the SUBMIT button (button with double arrows) must be pushed. To return to the document without any changes the CANCEL button must be pushed.

In order to add tables at the required position in the document the VBA code will look for bookmarks that were set in the document. The table structures will be added in protected

sections of the document (see Section 4.3.3) as they contain Word Application form fields that only work in protected mode. These fields are necessary for easy transfer of data since they have reference names.

Another part of the example concerns related structures, such as the structures of objectives and the related conclusions and recommendations. As an example related structures are generated whenever objectives are generated. Thus, when selecting objectives not only the tables in section 2.1 but also the related tables in section 6 of the experiment level template are generated.

2.1.2 Summary of Expected Experiment Outcomes

This is a form field for entering summary data.

ID	Expected Outcome for Experiment:
A1	This is also a form field for entering data.
	Associated Key Performance Areas:
	This is another form field for entering data.

ID	Expected Outcome for Experiment:
A2	
	Associated Key Performance Areas:

Figure 4-3: Example for Summary Table Structure with Form Fields

In this example a number of issues were not dealt with and might be necessary to consider when building templates with complete functionality and according to agreed automation requirements:

- More structures need to be generated for VDR entry (this is obvious though as automation has only been added as an example).
- More complex relations between structures are necessary (depends on what data relation is absolutely necessary).
- Protection of bookmarks.
- Protected mode for more than the suggested sections.
- A rollback procedure for all automated changes needs to be available.



Solutions for all described cases can be found with the suggested code, however, it should be noted that conflicts are possible, if document authors use their own style templates that make use of other VBA code, document protection issues or bookmarks. Thus, the final templates should require a list of bookmarks that cannot be changed or deleted, a description of how to work with protected documents, and some suggestions of how to use the templates in conjunction with other templates. This should make sure that the provided automation works under all circumstances.

4.3.3 Document Protection

For easy transfer of document contents to the VDR it is necessary to define form fields in protected sections of the document that must be filled in. Later the contents of these fields can be retrieved easily by the code that communicates with the VDR.

For the form fields (see grey fields in Figure 4-3) to be available for input, the document must be used in protected mode. Protected mode comes with a password that allows the user to switch to unprotected mode. For the example no password was defined, but it is suggested to use such an approach for the final templates.

The protection will only have an influence on the sections that are marked as protected sections. These sections are automatically generated by the code for all form fields added to the document and they already exist in the template for existing form fields (such as the first field in Figure 4-3).

As a consequence of the above it is suggested that the final templates are distributed in protected mode with a password. In this mode the users will still be able to change the document and its layout in all unprotected sections. Only the summary sections and table structures cannot be changed. In these protected sections only the mandatory form fields can be filled in.

4.3.4 Help Text

Help text was included in the document as hidden text. This text can be made visible by selecting the TOOLS/OPTIONS/VIEW menu of the Word Application or by selecting the SHOW/HIDE toolbar button that is part of the standard Word toolbar. The text contains notes on the contents of the different sections, the corresponding chapter that can be referenced in the E-OCVM and useful examples for entering data structures (like the structures shown in Section 4.3.2).



5 Study into Document Automation for VDR Input

5.1 VDR Interface Proposal

This section describes a proposed interface specification for inserting VDR templates into the EUROCONTROL VDR database. First, the objective is briefly described and the constraints with regards to the objects. After that, the proposed workflow will be presented both from a business level and from a process level including the actors involved.

5.1.1 Objective

The Validation Data Repository (VDR) is an information management resource for the ATM R&D community. It is a repository of information about validation exercises with their objectives, methods, design, metrics, results and findings [7].

In order to support this resource, templates for validation reporting will be delivered by the VARTAN project. These templates will be placed on the EUROCONTROL VDR website for download (see Figure 5-1).

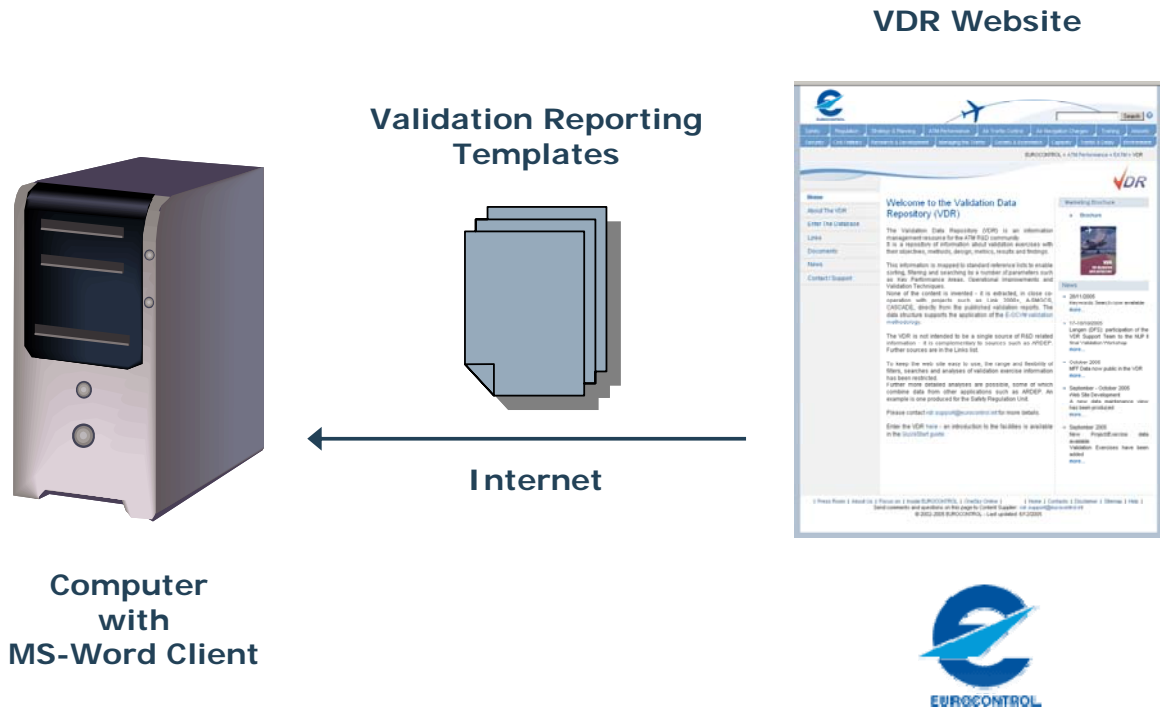


Figure 5-1: Obtaining Validation Reporting Templates from the VDR Website

Furthermore, the technical feasibility must be examined to automate the transfer of filled-in templates from the author (for example, a project manager performing a EUROCONTROL validation project) to the Validation Data Repository of EUROCONTROL.

The user will fill in the Validation Reporting Templates according to instructions given to him. This will be done using Microsoft Word with templates provided by EUROCONTROL on the publicly accessible EUROCONTROL VDR and Validation Forum websites.

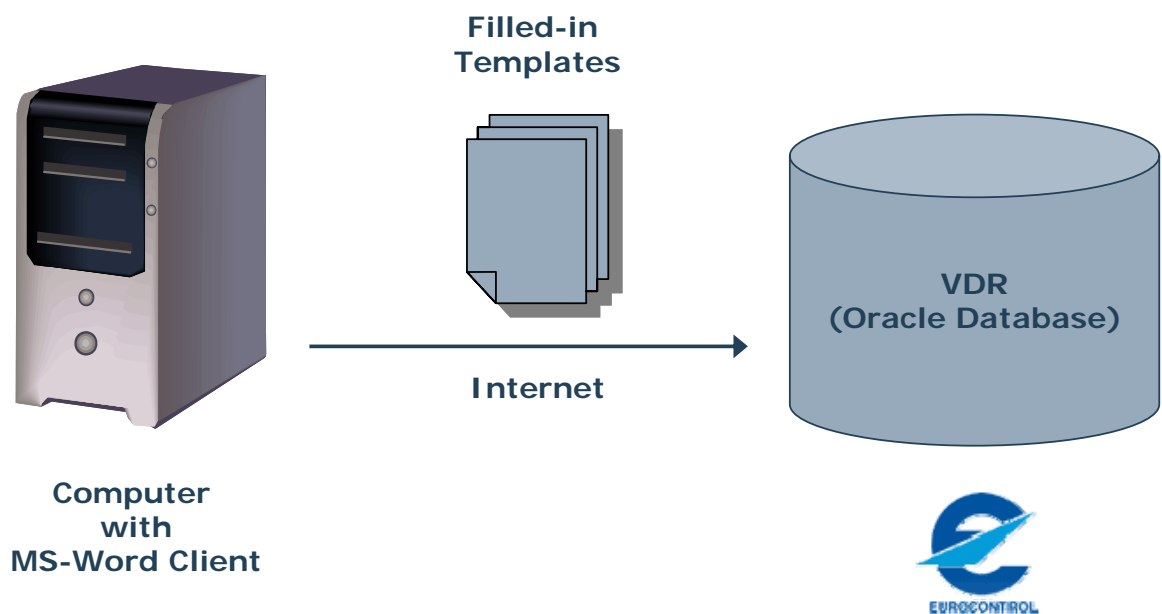


Figure 5-2: Transferring Filled Validation Reporting Templates to the VDR

The goal of this solution is to provide a means to transfer this data to the EUROCONTROL VDR database (see Figure 5-2). This information can later be accessed by means of an internet-based access method (website-based), already available at EUROCONTROL. Note that validation data from a template data can either be *publicly* available (to anyone with access to the VDR) or *restricted* to specific members of a project. The *author* shall have the means to specify whether the template is available *publicly* or *restricted* available (and to whom).

This solution shall emphasize on *automating* redundant work at EUROCONTROL, such as cutting and pasting text from VDR templates to the VDR database and will *not* present a *fully* automated (100%) solution as it would put excessive burden on the development of the automation process.



5.1.2 Constraints

Some constraints and additional requirements for the solution have been identified.

These are:

- Reducing user effort to publish the validation results.
- Allow the user to make use of Microsoft Word.
- Making use of and ensure compatibility with current EUROCONTROL technical solutions. Although there is no current standard solution, it is noted that SOAP (see Section 5.1.5) is being trialled as a potential technology for this type of application.
- A backup solution for the author may exist where the author can send the filled-in templates to a EUROCONTROL e-mail address, if the required technology is not available.
- EUROCONTROL will also need a copy of the (MS-Word) filled-in template document.

5.1.3 Business-level Scope

This section describes the process to deliver a (filled) VDR template from a EUROCONTROL author to the VDR database at EUROCONTROL.

5.1.3.1 Actors

Before a description is given, the following *actors* can be identified:

- EUROCONTROL *author* (a person) who will fill in VDR templates,
- *VDR administrator* (a person) from EUROCONTROL who checks (accepts or rejects) templates before they are further processed by the *data collector* (see further on),
- *VDR database* (a storage medium) that stores current and future validation data on projects and is the source to extract data from to the validation web interface, and
- *VDR Website* (internet accessible interface) that stores the (empty) VDR templates and shows information stored in the VDR database to third parties.
- *VDR Data Collector* (a person) who will add additional linking (to *VDR reference sets*) and classification to the template information (manually) required for the VDR database.

Other actors will be introduced when they become applicable.

5.1.3.2 Template Lifecycle

The VDR template can have any of the following six (logical) states, see Figure 5-3:

- Empty template
- Filled template
- Received template
- Accepted template
- Prepared template
- Approved template

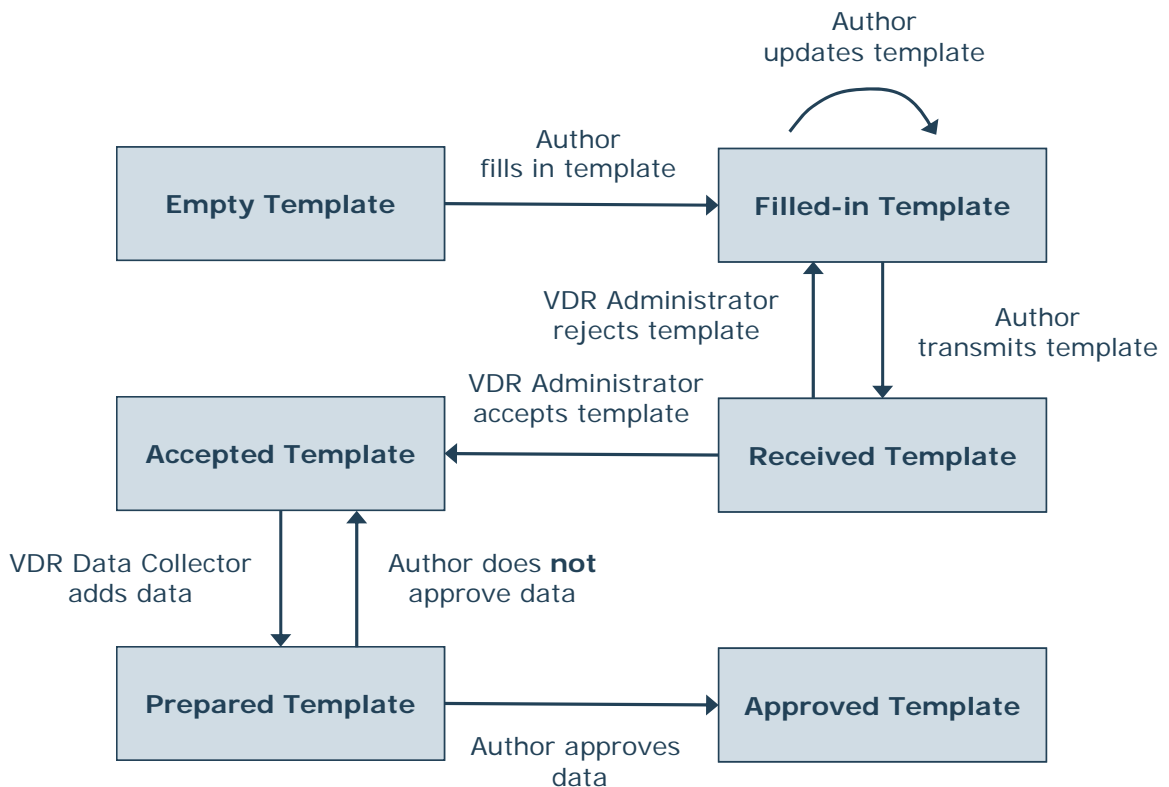


Figure 5-3: Lifecycle of a VDR Template

First, a client will load the template from the VDR Website and fill it in. It will then have the state *filled template*. After that, it is transmitted to EUROCONTROL where it will be stored in a temporary place until the VDR Administrator has time to look at it. This administrator will check whether the template has sufficient quality (i.e. it does not miss important information) to be further processed. If the template is accepted by the administrator, it will get the state *accepted* and it will be assigned to a *data collector*. The role of the data collector is to add additional data to the VDR for *linking* and *classification* purposes. This is done manually and he may do so by contacting the author directly by phone or by e-mail (note that this step is not modelled here). When the data collector has done his job, the original author will be informed and verifies if the presented data is a *true reflection* of the validation work done. He then accepts or rejects the data as it is prepared by the data collector.

Note that the representation of the template can differ from state to state: An *empty template* can be stored at the EUROCONTROL website, a *filled template* is a MS-Word document, an *accepted* and *prepared template* is the template as it is stored in a temporary location (see the process-level section), while the *approved template* is the validation data as stored in the VDR database.

In this initial set-up, the *data collector* will add additional *classification* and *linking* data (required) for the VDR database. This is a specific and specialised task and is now already performed at EUROCONTROL for each new project in the VDR. This will be done manually and the work will be checked by the *author* before the data becomes (publicly) available. A *derived* requirement is that this (manually added) data will not be lost after the author does an update of the template. However, an update by the author may trigger the data collector to make additional updates for the *classification* and *linking* of the data.

5.1.3.3 Business Use Cases

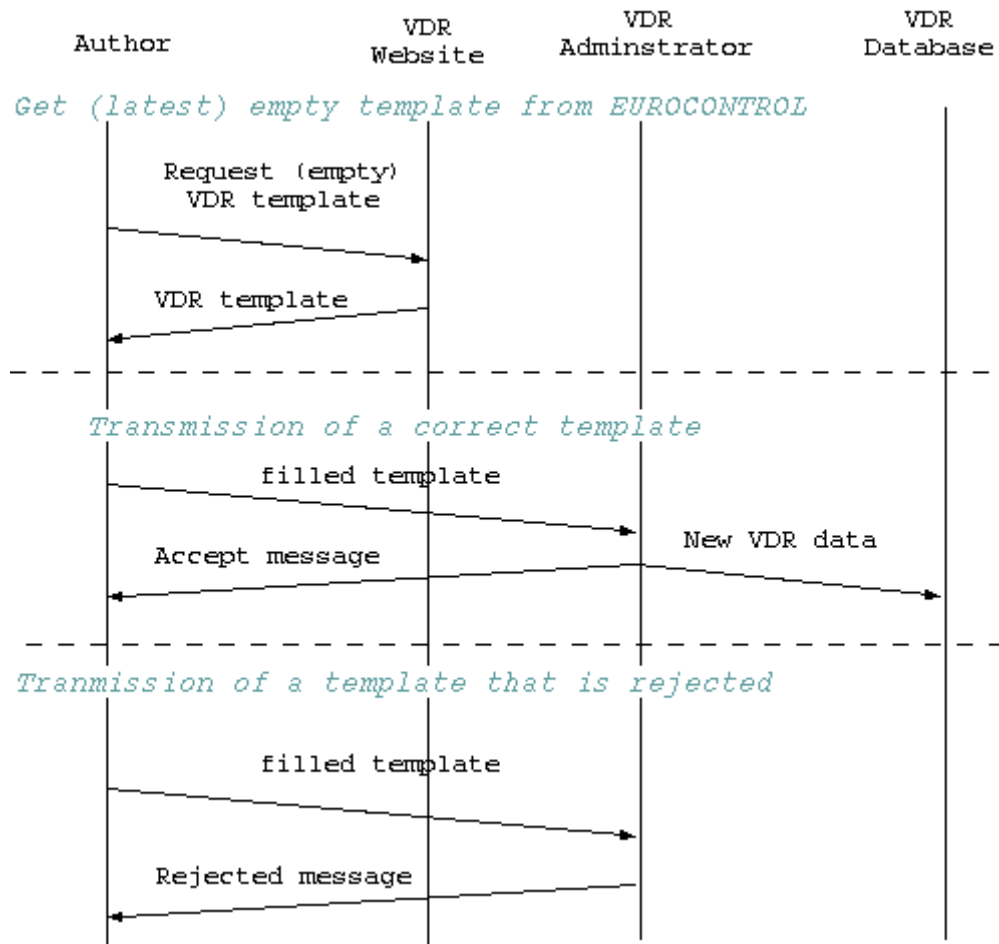


Figure 5-4: Business Case for Author - Administrator Interaction

Figure 5-4 shows sequence diagrams for the following cases:

1. *Get (latest) empty template from EUROCONTROL*. This is a straight-forward web-based retrieval of a new validation template for a project. Project-specific data shall be entered (manually) by the author.



2. *Transmission of a correct template.* When an author successfully filled in the fields of a template it will be transmitted to EUROCONTROL. At EUROCONTROL, an appointed VDR administrator will examine this data and decides that is correctly filled in. Then, the data will be inserted into the VDR database and the *data collector* will be informed that a template is ready for further processing (see following business case).
3. *Transmission of a template that is rejected.* If the author fills in the template and transmits it to EUROCONTROL, the VDR administrator may find it insufficient for acceptance. Reasons for rejections may be lack of information inserted into the template, incorrect information or low-quality of filled in template. In this case, the data will NOT be entered into the database, but instead, a rejection message is transmitted to the author indicating the reason of rejection.

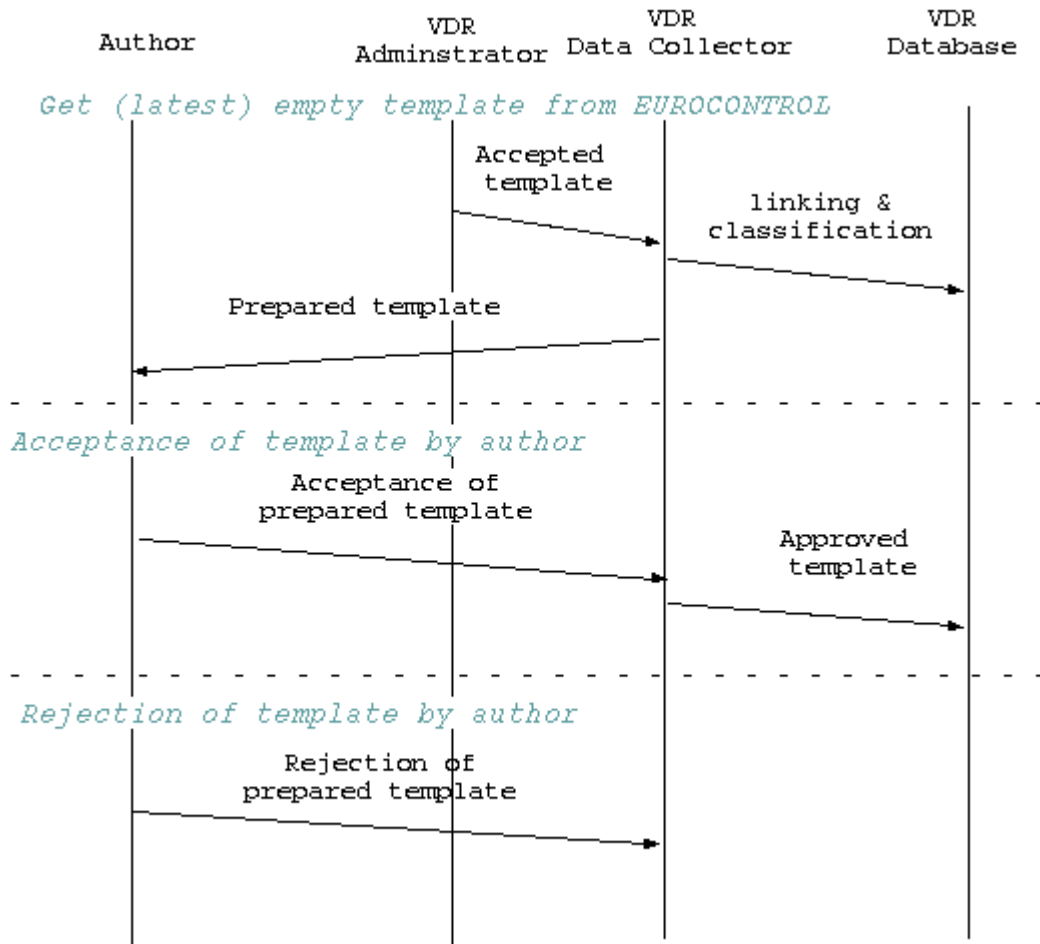


Figure 5-5: Business Case Author - Data Collector Interaction

In this Use Case, no difference is made between a *new* template that is filled in and a *revision* of previously filled in template. For both occasions, the same Use Case can be applied.



However, in case of a revision, an *assumption* is made that modified templates are only inserted in the database by this same method and not via an alternative interface that acts on the VDR database. This assumption is made as there is no (or not yet) feedback from the VDR database to the filled MS-Word template file stored at the author.

When a template is accepted by the VDR administrator, a data collector will be informed of an accepted template. He will examine this template and add additional *linking* and *classification* data. When doing this, the data collector may contact the original *author* (via phone or e-mail) to clarify and understand the data in the template. This extra interaction is not modelled in the business case above as it is optional and may not always be needed.

When the *data collector* has done his work, the *author* will be informed and will get an overview of the prepared template. Based upon this template, he can either accept or reject the template. Alternatively, not displayed in the use case, the author may find the presented data not sufficient and may issue an update of the template (that will then be processed by the VDR administrator again).

5.1.4 Process-level Scope

5.1.4.1 Introduction

The process-level scope describes the interaction between *actors* on a level where all *processes* are defined. In addition to the actors that were defined at the business-level, some actors need to be split up in accordance with the processes that can be identified.

At the author side, the following actors can be identified:

1. the *author* as the person who fills in the templates, and
2. the *MS-Word* application as the process that connects to the Web Service at EUROCONTROL.

At the EUROCONTROL side, the following actors can be identified:

1. the *Web Service servlet*, which is the server application that listens to requests from the author,
2. the *VDR intermediary Database*, where intermediate data can be stored upon approval by the VDR Administrator,
3. the *VDR Administrator* is the person who approves new or modified templates before they are stored in the VDR database, and
4. the *VDR Database*, which stores all accepted validation data and can be accessed by an already existing Web Interface,



- the VDR Data Collector is the person who adds additional linking and classification to the information provided by the author.

A new actor that is introduced here and needs some additional addressing is the VDR *intermediary Database*.

As the author is the initiator of the VDR interface, the interactions will all be *author-driven*. This means that the *author* will always start an interaction, as the server (EUROCONTROL) has no direct means to contact the author, i.e. it cannot force the author to start-up MS-Word. An exception to this rule (where the VDR Administrator needs to inform the author of a reject), with a work-around, will be discussed shortly.

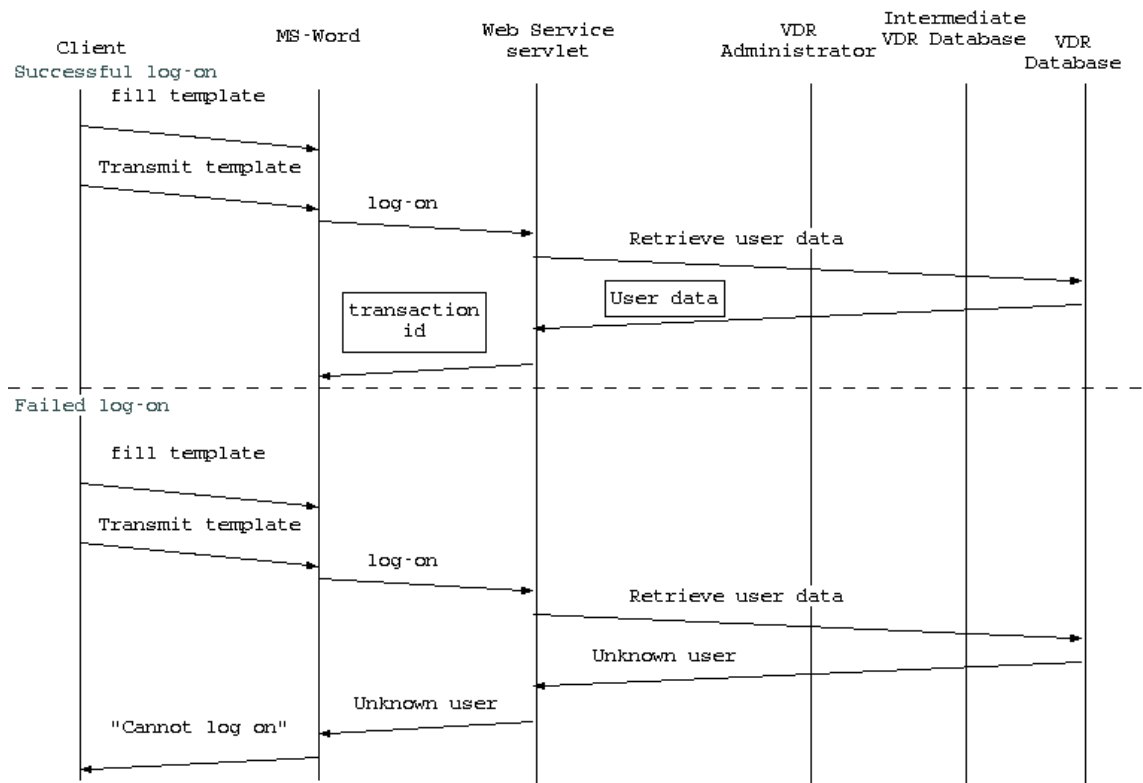


Figure 5-6: Log-on Procedure

5.1.4.2 Author-VDR Log-on Use Case

To transmit VDR data from a template to EUROCONTROL, first a log-on procedure is initiated. This procedure will start identification of the user and will return a unique transaction identifier that can be used until the end of the transaction. Already existing log-on functions to



EUROCONTROL restricted applications, such as the OneSky Online extranet facilities, could be used for that purpose.

The log-on procedure is displayed in Figure 5-6. Under normal circumstances, the author will initiate a template transmission after the template has been filled. The user and password data of this author will be transmitted to the servlet where it will be checked against known records of the author. When everything checks out fine, a unique transaction identifier is sent as confirmation.

If there is a failure with respect to the provided author user data, an error will be returned and the author will get an error message indicating a failure.

5.1.4.3 Author-VDR Transmission use case

The transmission of template data is the only asynchronous action, see Figure 5-7.

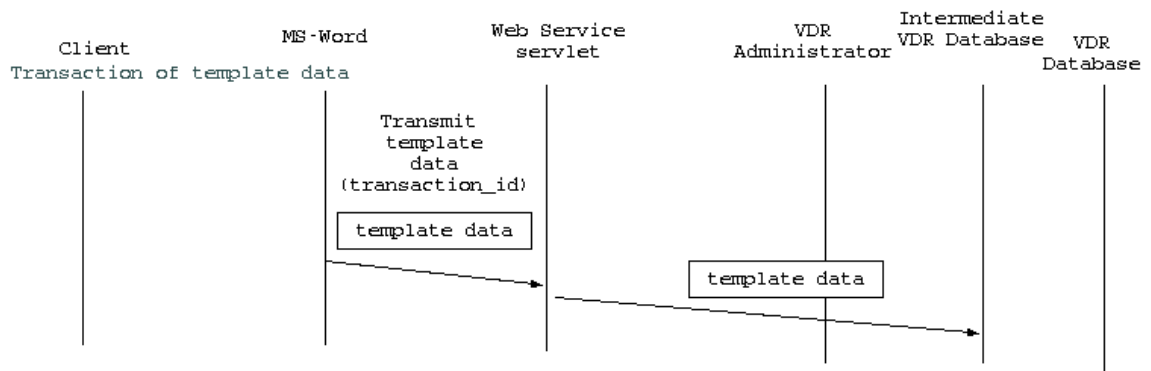


Figure 5-7: Transaction Use Case

The transaction identifier, supplied by the log-on process, is used as reference for the involved template. Note that no message is returned, but in case of an error, the error state is stored internally for the log-off process discussed in the next paragraph.

5.1.4.4 Author-VDR Log-off Use Case

The final log-off procedure shall do error handling and shall inform the author of the result, as displayed in Figure 5-8.

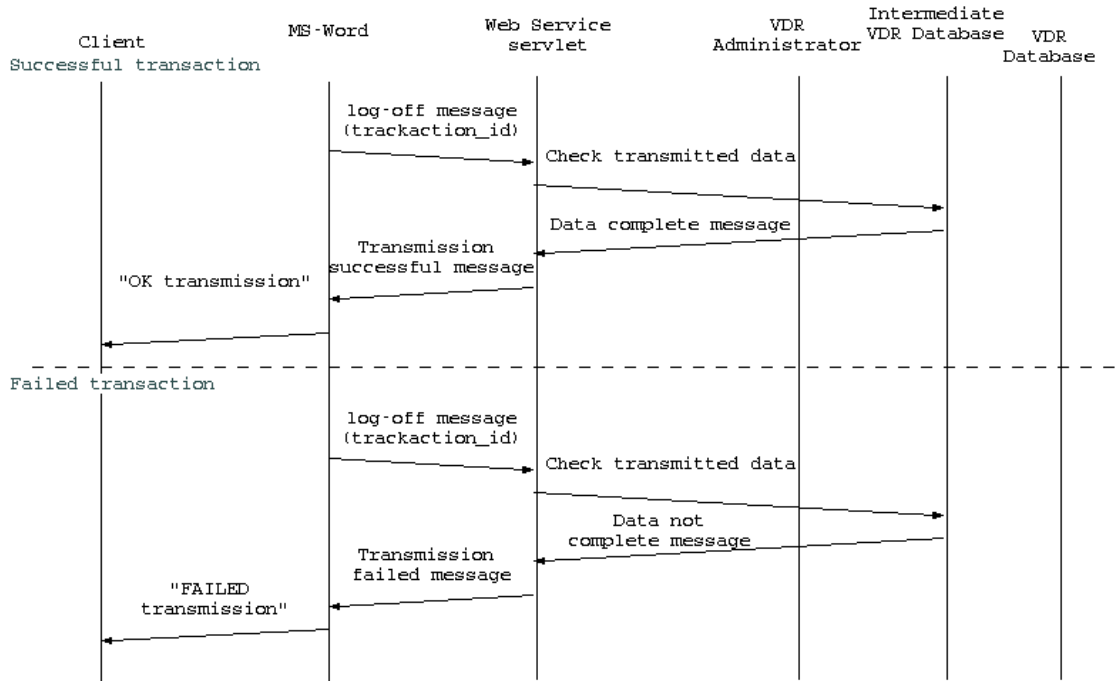


Figure 5-8: Log-off Use Case

5.1.4.5 VDR Administrator Acceptance Procedure

At EUROCONTROL, the VDR administrator shall be triggered by notices that new or updated templates have been submitted. These notices will be generated from the *Web Service servlet*, and can have any of the following forms:

- E-mail message indicating new or updated templates
- An informational (internal) web-page displaying all open requests for acceptance.
- A small application that can be started to display open request.

The administrator shall verify their contents and shall either accept or reject the template, after which the *author* needs to be informed (see Figure 5-9).

A proposed template is stored in the intermediate VDR database, before it is either accepted or rejected. When a decision is made, the (temporary) proposed template is clean up.

As this procedure is assumed to be internal to EUROCONTROL, Web Service interaction is not necessary (although it can still be applied here).



The informational message to the author cannot be done with a Web Service as the author may have closed MS-Word at the time the rejection is done. Therefore, this can be handled in different ways, where using e-mail to inform the author may be the most viable alternative.

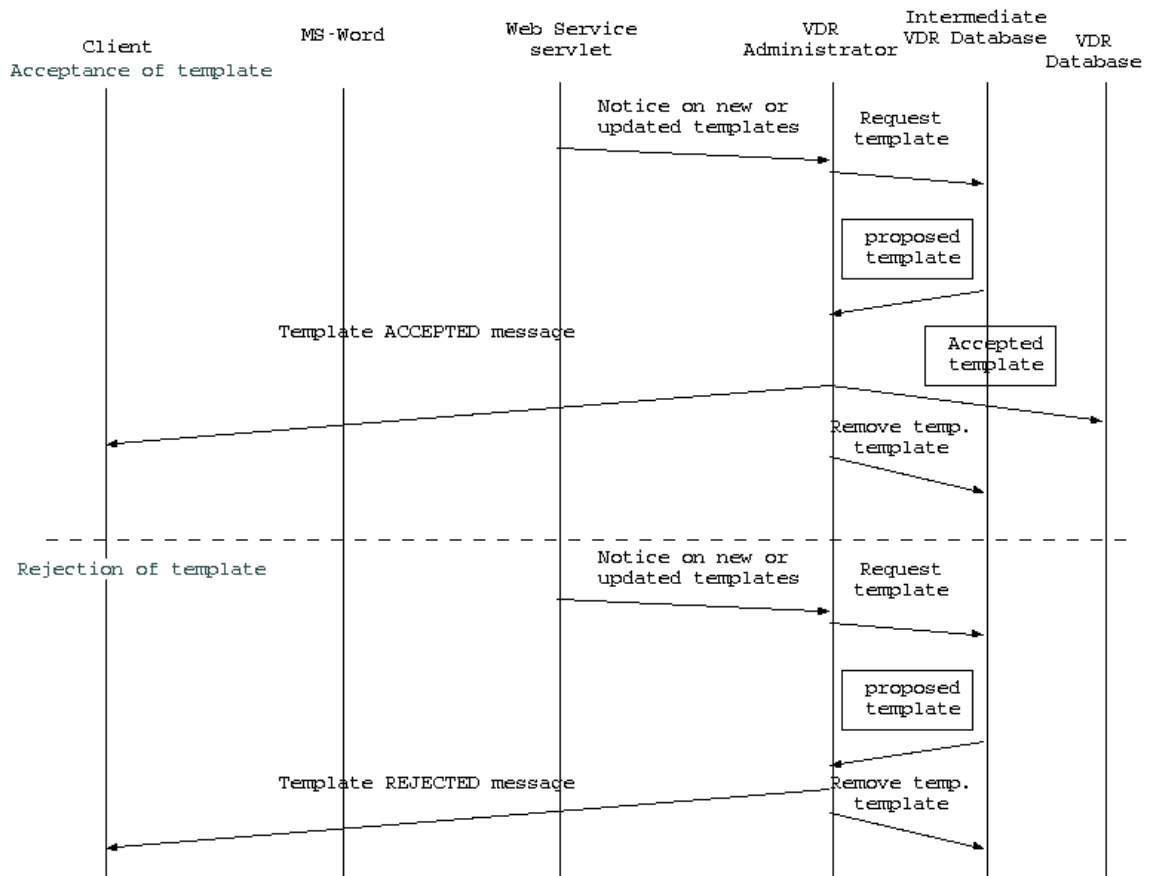


Figure 5-9: VDR Administrator Acceptance Use Case

5.1.4.6 VDR Data Collector Procedure

The VDR data collector shall have a primary role in the business case displayed in Figure 5-10.

The *data collector* is triggered by the VDR administrator who has accepted a template from the *author*. The *data collector* will examine the data and add additional information that is required for the VDR database. This includes classification of data and linking to known *reference sets* that are available in the database. During this process, the *data collector* may (informally) contact the author for clarification.

When the *data collector* is finished, the author will be signalled that a prepared template is ready. This template will become available on the VDR website under restricted conditions for



the author only. The author can examine it and decides whether the data is ready for acceptance or not. If he accepts, the data collector will be informed and he will forward a request to the VDR administrator to make the template available.

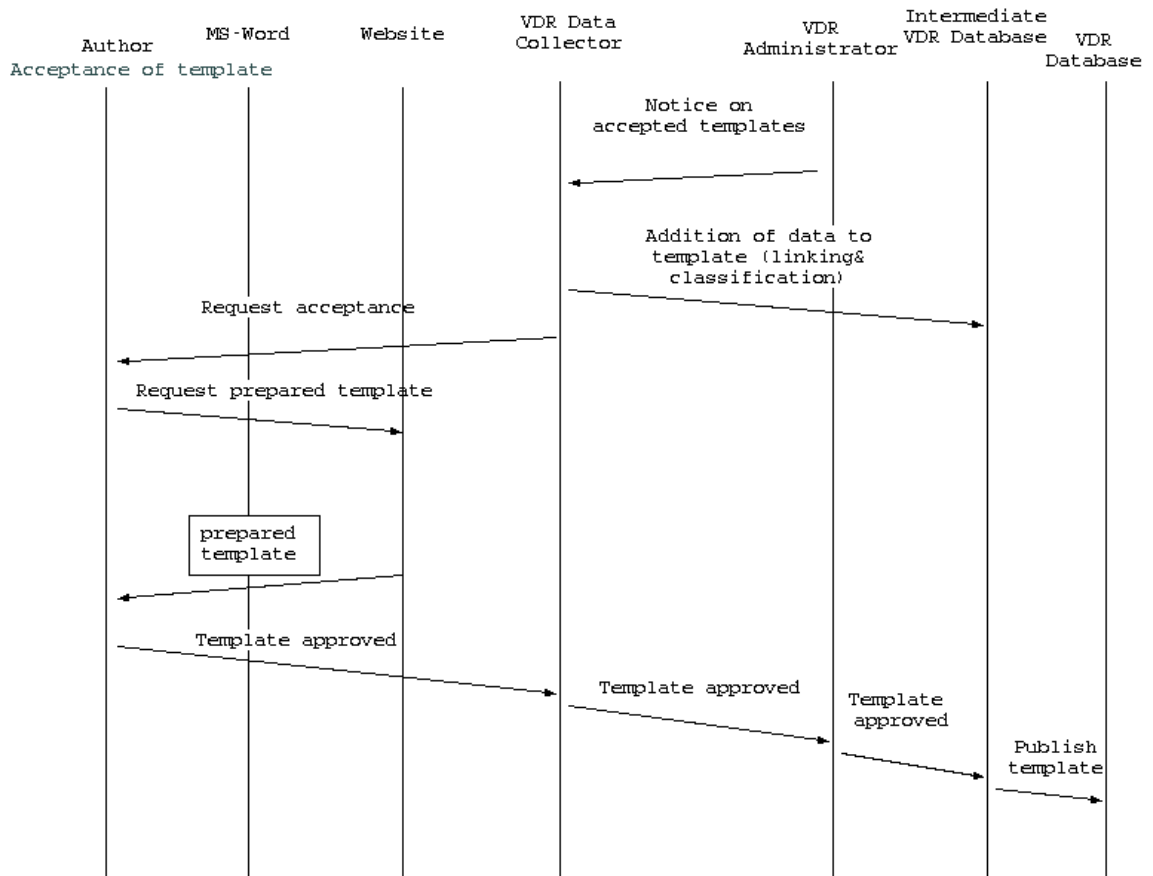


Figure 5-10: VDR Data Collector Business Use Case

Of course, the final template will be available according to the rights that have been assigned by the author, which can be:

1. Publicly available for all users of the VDR
2. Restricted to a specific group of people (For instance, members of a specific project).

If a template is approved, a copy of the template data will remain in the VDR intermediary database. This copy can be used later if updates are made by the author.

5.1.5 Technical Architecture

This chapter will discuss the architecture and a possible implementation for the solution of delivering data to the EUROCONTROL VDR database. The solution is based on Web Services, sometimes in literature also referred to as Service Oriented Architecture (SOA).

5.1.5.1 Architecture

Transmission of filled-in templates from an author to the VDR is the main objective of the technical solution. The author has Microsoft Word 2003 available (which of the older versions of Word are also supported should be examined) and the server has an (Oracle) database available.

An overview of the proposed infrastructure is given in Figure 5-11. The key element of the infrastructure that is used in this set-up is called Web Services. These Web Services will be discussed in the next section.

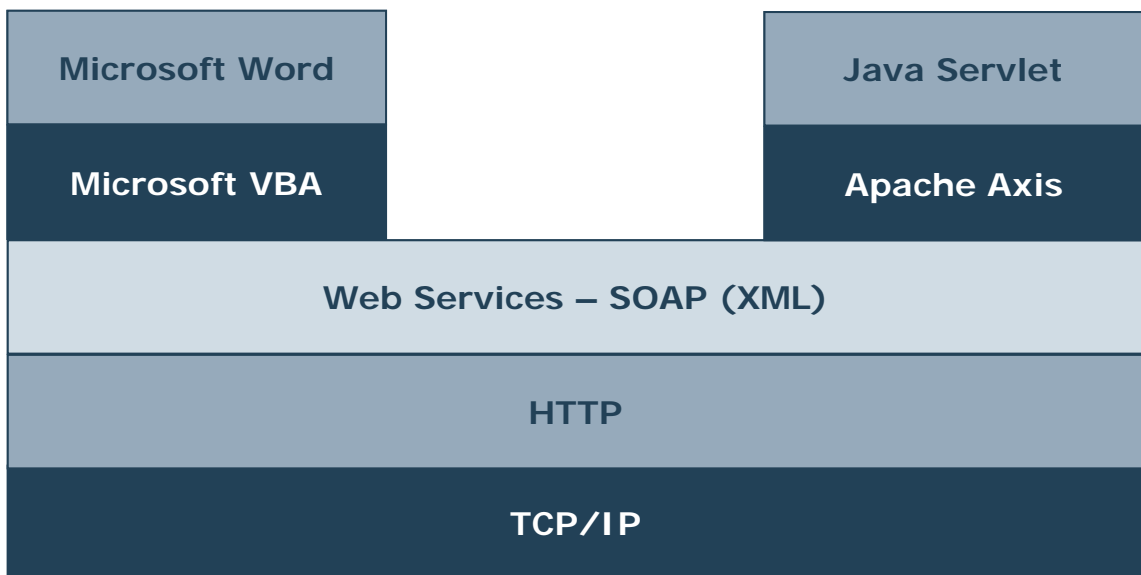


Figure 5-11: Example Network Infrastructure for VDR Communication

5.1.5.2 Network Infrastructure

Web Services is a state-of-the-art, standardised, platform and vendor-independent technology, to allow internet-wide transport of data (see [16] and [17]). It is based upon standard internet communication protocols (TCP/IP, HTTP, and SOAP) and therefore is the best candidate to be used in business solutions such as the VDR infrastructure. Web Services is a client-server based



technology, where a client requests or sends data to a server. In this solution, the project manager filling in the templates is considered the client, while the VDR is considered the server.

A server implementing a Web Service can provide methods that are asynchronous (one-way), synchronous (two-ways) or even subscription-based (one-way from client to server, and after that multiple messages from server to client). For the VDR architecture, an asynchronous solution is sufficient for now, but it can be extended to synchronous solutions to allow error handling.

5.1.5.3 Author Infrastructure

Microsoft Word allows the use of XML and XSLT technology (see [14] and [15]), to extract data from a (Microsoft Word) document. This technology is useful to gather the right information from a given template.

Visual Basic for Applications (VBA) [21] is a technology in Microsoft Word to allow automation and can also be used to connect to so-called Web Services on a server elsewhere on the internet. VBA can be instructed to extract data from the current document, to convert it to the right format as is required for the Web Service, and to send it to the Web Service. To develop such a service, the Microsoft Web Services Toolkit for Microsoft Office is required [20]. However, the toolkit is not required for making use of the result of this development activity. Therefore, an author using a Validation Reporting Template does not need to install additional resources on the local PC.

5.1.5.4 Server Infrastructure

A Web Service to receive template data from an author can be implemented using a Web Service server. Apache Axis [18] is a Web Services framework that allows generation and implementation of Web Services using Java. In combination with a servlet (short for a server application) written in the Java programming language [19], it can perform further actions, such as storing the received data, or updating the VDR database.

Apache Axis is only one of the many choices for implementing Web Services at the server side. Other well-known implementations are IBM WebSphere, Microsoft .NET, BEA WebLogic, and many others (cf. <http://www.webservices.org/>). Apache Axis is chosen for this project as it is free to use (Open Source software) and has the required functionality for the task at hand. Figure 5-12 shows the server part of the solution.

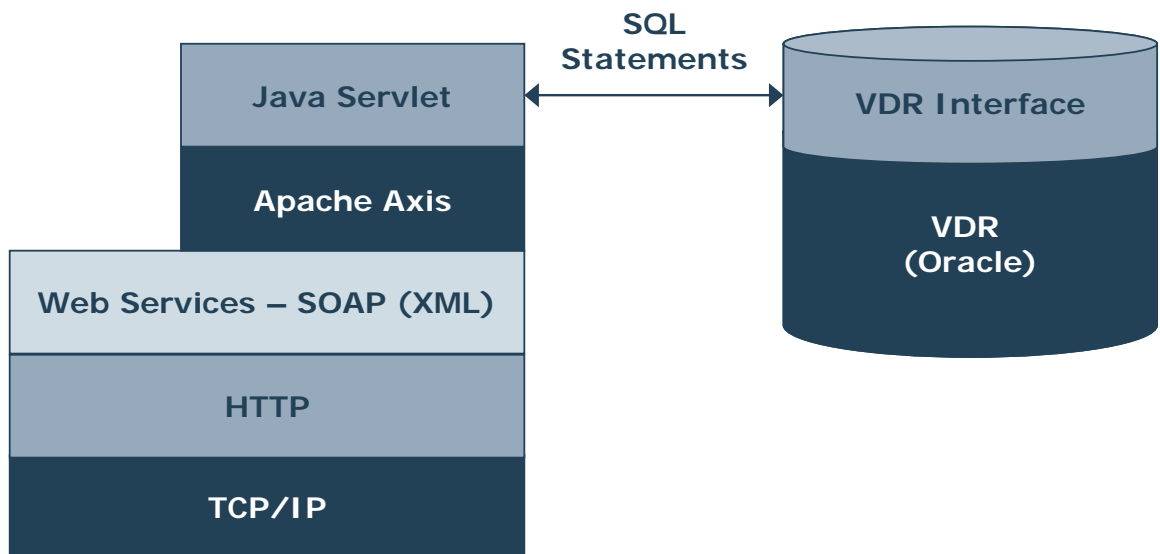


Figure 5-12: Server-side Internal Architecture

5.1.5.5 Backup Solution

In some circumstances, the author may not be able to transmit the filled-in templates to EUROCONTROL according to the process that is described above.

Possible causes are:

- The user does not have a recent Microsoft Word application installed on the local machine.
- The user has limited Internet access.
- The VDR infrastructure is unavailable (because of maintenance or technical problems).

In these cases, a simple backup solution can be provided, where the author can send the filled-in templates as standard Microsoft Word documents to a specific EUROCONTROL e-mail address. EUROCONTROL will then (internally) send these templates to the VDR database by using an up-to-date Microsoft Word application (and under the assumption that the VDR infrastructure is available again).

5.1.6 Discussion and Recommendations

The proposed interface is an example and technical viable solution for data interchange between EUROCONTROL authors and EUROCONTROL itself to share validation data. The world wide adoption of the use of Web Services by the ICT industry is a good indication of the promising future of this technology, and it is therefore a good candidate for EUROCONTROL to use as well in this case. It also shows that Web Services can be used both on the author (user) side as well as on the server (system) side and is platform independent (of both software and hardware solutions).



5.2 Technical Implementation for Automated VDR Template Transaction

5.2.1 Introduction

This chapter describes the prototype implementation for transferring filled-in VDR templates from the author to EUROCONTROL. The main requirement for this solution is that data from the Microsoft Word validation reporting templates can be transferred over the internet (or intranet at EUROCONTROL) to the VDR database.

This prototype introduces a technology called Web Services. Web Services are platform-independent and allow different applications to share common, structured data without being limited to one platform. They are useful here as the VDR author will generally have a different platform (Windows) than EUROCONTROL uses to maintain the VDR (Unix-based, Oracle database). Furthermore, in the IT-industry, Web Services become more and more common and they adhere to the EUROCONTROL strategy to use accepted standards for new solutions.

For the VDR author, a Microsoft-provided Web Services Toolkit is used to generate Visual Basic for Applications (VBA) code. VBA code can be incorporated in the Microsoft Word validation reporting template documents and does not set additional requirements for the VDR author on his or her system. This basically means that the user of EUROCONTROL templates does not need much more than the right version of Microsoft Word and the right templates and does not have to install extra software or additional hardware.

For the EUROCONTROL server part, the apache axis Web Services server is used. This server does not require additional licensing costs and it has a low threshold for a Web Service developer to implement Web Services as is shown later in this chapter. In combination with the JAVA programming language and a JDBC database connection (also available without licensing costs), the final connection to the VDR database can be completed.

5.2.2 Scope of Solution

This solution will demonstrate the technical feasibility to transfer data from a client to the database. However, compared to a commercial end-to-end-solution, the following issues are not fully explored yet:

1. Security between client and server is not addressed here. But as Web Services are based upon the HTTP protocol, the use of secure socket layer (SSL) technology allows for improved security. Furthermore, no connection is made to a EUROCONTROL system that checks registration data of users (username/password).



2. Manual or automatic validation of transferred data and insertion into the VDR database: Extensive knowledge is required about the functionality of the Oracle-based VDR database, and EUROCONTROL should decide on the level of automation of the template data.
3. E-mail feedback to the involved parties: this would require knowledge of the participants and of the e-mail system in use at EUROCONTROL.
4. Compatibility: Compared to the demonstrated prototype, the circumstances for usage at EUROCONTROL might be different: users may use other Microsoft Word versions (or other text processors), and EUROCONTROL may decide upon another Web Services framework (other than Apache axis). This requires additional study. The same is true for the database engine, but due to the SQL standardisation no risks are expected (when using Oracle instead of MySQL).
5. Adjustment of templates according to user experience: to accommodate the automatic process of transmitting template data, the VDR templates have been adapted so that input fields are generated based upon the project that is described. User experience may request additional changes to the supplied templates.

5.2.3 Web Service Interface

Web Services are so-called client-server interfaces. This means that there is always one party (the server) that provides an interface to the other (the client). In this solution, EUROCONTROL will be the server that will also run a Web Services-server and the VDR author that uses Microsoft Word to contact these Web Services will be the client.

The Web Service for the VDR transaction is presented in Table 5-1. Four different calls are presented:

- The AuthorLogon call initiates a transmission and uses a pair of username and password to the server and it returns a transaction identifier that can be used to identify this connection when data from the template is transmitted.
- The TransmitData call is used to transfer data items from the template of the client to the server.
- The AuthorLogoff call finishes the transaction and is the signal for the server to process all received data (by means of TransmitData calls) and return a message back to the user whether the initial transmission was successful or not.
- An optional GetError call can be used during or after the transmission to get information on the progress. This call will not be used for now, but might be useful in the future to get intermediate results of the transmission (before all data is transmitted), or to get more extensive error information.



This interface can be translated into an interface description for Web Services (called a WSDL file) using the Apache Axis Java2WSDL tool. The resulting WSDL file is presented in the appendix, Section 7.4.

```
package vdr;

public interface vdrtransaction {

    // AuthorLogon: log-on for template transmission
    //
    // returns: > 0 : succesful logon, transaction id returned
    // returns: < 0 : failure
    public int AuthorLogon(String authorName, String authorPassword);

    // TransmitData: transmit data fields of template
    // transactionId: id as required from AuthorLogin
    // dataItemName: identifier for data item that is transmitted
    // dataItemIndex: (optional) value if multiple items are transmitted
    //
    //         If not required, specify '0'.
    // content: Content of data item as it is identified by
    //         dataItemName together with dataItemIndex
    public void TransmitData(int transactionId, String dataItemName,
                             int dataItemIndex, String content);

    // Author log-off
    // returns : Empty string if everything went okay or contains
    //         error message of what went wrong.
    public String AuthorLogoff(int transactionId);

    // Additional request for Error information
    public String GetError(int transactionId);
}
```

Table 5-1: Java Interface Description for VDR Transaction

After the WSDL is created, the Web Service must be implemented. Generating the Java interfacing code by hand can be quite cumbersome and that is why the Apache Axis



WSDL2Java tool can also be used to generate this so-called stub code. One of the stub code files is a template where the actual implementation for the server part can be filled in. This template can be found in Table 5-2.

```
/**
 * VdrtransactionSoapBindingImpl.java
 *
 * This file was auto-generated from WSDL
 * by the Apache Axis 1.2RC2 Jul 22, 2005 (04:35:59 CEST) WSDL2Java
emitter.
 */

package vdr.ws;

public class VdrtransactionSoapBindingImpl implements
vdr.ws.Vdrtransaction{
    public int authorLogon(java.lang.String in0, java.lang.String in1)
throws java.rmi.RemoteException {
        return -3;
    }

    public void transmitData(int in0, java.lang.String in1, int in2,
java.lang.String in3) throws java.rmi.RemoteException {
    }

    public java.lang.String authorLogoff(int in0) throws
java.rmi.RemoteException {
        return null;
    }

    public java.lang.String getError(int in0) throws
java.rmi.RemoteException {
        return null;
    }
}
```

Table 5-2: Generated Template for Server Implementation



5.2.4 Java Server Implementation

The server will first store received data in a temporary database. Only after the final `authorLogoff` is received, this data will be examined and transferred to the VDR database. In this way, partially transmitted templates or templates that have some structural errors that can automatically be detected are not polluting the database.

The temporary database is called `VDRTransaction` and the table layout is display in the SQL command listing that generates this database (see Table 5-3). For each transaction (as display in the use cases), a row in the `VDRTransaction.TRANSACTION` is inserted. After that, each specific data item from the template (for instance, a project name, an objective description, a result) will be inserted into the `VDRTransaction.SESSIONDATA` table. The index (`DATAITEM_IDX`) has the value `-1` for a normal value that appears only once in the template, or has an index value to indicate which one it is (for instance, objective name 2, or result number 3).

After the template has been transmitted and the `AuthorLogoff` is performed, the data will be processed into the actual VDR database and this transaction will be removed from the temporary database.

```
GRANT ALL ON VDRTransaction.* TO vdr@localhost IDENTIFIED BY
'sqlvdrpassword';

CREATE DATABASE VDRTransaction;

CREATE TABLE VDRTransaction.TRANSACTION
(
  TRANSACTION_ID  INTEGER NOT NULL,
  USERNAME        VARCHAR(32),
  PASSWORD        VARCHAR(32),
  ERRORMSG        VARCHAR(128)
);

CREATE TABLE VDRTransaction.SESSIONDATA
(
  TRANSACTION_ID  INTEGER NOT NULL,
  DATAITEM_NAME  VARCHAR(64),
  DATAITEM_IDX   INTEGER,
```



```

  CONTENT          TEXT
);
  
```

Table 5-3: SQL Command to Generate Temporary Database

5.2.5 Template Database Mapping

To set the right value in the VDR database, fields from the MS-Word template shall first be sent to the Web Services-server using a data item identifier, and after the `AuthorLogoff` they will be inserted into the VDR database. Table 5-4 displays the mapping that is used.

Template Field	Temporary Database Data Item	VDR Database Table/Field
Project Name	PRJ_NAME	T_VAL_PRJ.PRJ_NAME
Project Summary	PRJ_SUMMARY	T_VAL_PRJ.PRJ_ABSTRA
Number of Objectives	OBJ_NUMBER	N/A
Objective Name	OBJ_NAME	T_COM_OBJ.OBJ_NAME
Objective Description	OBJ_DESCR	T_COM_OBJ.OBJ_DESCRI
Exercise Name	EXE_NAME	T_DAT_EXE.EXE_NAME
Exercise Description	EXE_DESCR	T_DAT_EXE.EXE_DESCRI
Conclusion Name	CON_NAME	T_DAT_SYN.SYN_TITLE
Conclusion Description	CON_DESCR	T_DAT_SYN.SYN_SUMMAR
Recommendation Name	REC_NAME	T_DAT_SYN.SYN_TITLE
Recommendation Description	REC_DESCR	T_DAT_SYN.SYN_SUMMAR

Table 5-4: Template Field and Database Mapping

In some cases, reference tables should also be filled with linking information. This mapping is displayed in Table 5-5:

Mapping between		Table
Objective	Project	T_DAT_POB



Objective	Conclusion	T_DAT_OSY
Objective	Recommendation	T_DAT_SLK

Table 5-5: Linking Information

5.2.6 Microsoft Word Client Web Service Implementation

To access the Web Service from a Microsoft Word document, the Visual Basic for Applications (VBA) scripting language of Word shall be used. Before a Web Service can be accessed, first the Microsoft Web Services Toolkit (2.0) should be installed. After that, one must open the document that will use the Web Service and open the Visual Basic editor by choosing Tools/Macro/Visual Basic Editor from the menu bar (or press Alt-F11). Then, choose Tools/Web Services References from the menu bar. Then, select the Web Service URL radio box and fill in the text entry the address where the Web Service can be found. For this example we use:

```
Data046u1:8080/axis/services/vdrtransaction?WSDL
```

Data046u1 is the hostname, 8080 is the port (usually 80 to circumvent firewalls), and after that the address of the web server where the Web Service is presented.

After pressing search, the Web Service will be found and by clicking the CHECK button and the ADD button, VBA-code to access the Web Service will be added.



6 Overview of VARTAN Results

This final chapter gives a summary of the VARTAN results as regards proposed changes for the E-OCVM and automation options for both the produced Microsoft Word Templates for Validation Reporting and VDR communication with these templates.

Chapter 2, the analysis of baseline documentation, concentrated on giving recommendations on how to progress with the validation methodology as described by the E-OCVM. These recommendations are consolidated in the following:

- Apply the PDCA-cycle approach to Operational Concept Validation thereby combining the three different E-OCVM views (life cycle, stepped, and case-based view):
 - Apply the PDCA-cycle at the Strategic Level.
 - Apply the PDCA-cycle at the Programme Level.
 - Apply the PDCA-cycle at the Project or Experiment Level.

This recommendation concerns the process itself, its applicability and comprehensibility for the validation experts and managers carrying out concept validation projects. Examples and extensive process descriptions were given in the analysis section of this document.

- Describe role of stakeholders in validation process more closely.
- Describe the case-building process more closely giving realistic examples.
- Concentrate the case-building process and all other planning activities around stakeholder goals.
- Describe possible interrelations between the different cases.
- Give suggestions on how to deal with uncertainty and different levels of quality and details in the results.
- Define triggers for validation reporting based on five possible decision criteria.

While all the above recommendations were extensively dealt with in the report describing the analysis, the last item needed some more study, so that a special report was written on reporting triggers containing a dedicated example (Europort). This report with all its conclusions and recommendations is contained in Chapter 3 of this final report. The main recommendations were:

- The life cycle view needs to be extended and clarified. Suggestions were given in Figure 3-1.
- The reporting structure and possible trigger points must be clarified. Suggestions were given in Figure 3-2.



- There must be a pre-defined introductory part for the document templates. An example was given.
- A brief summary of the main parts of the planning document should be contained in the result documents.
- Differences between the planning and the actual achievements must be highlighted.
- The consolidation of results needs to consider confidence in the results, i.e. their quality and significance.
- There needs to be a direct correlation between experiment conclusions and experiment objectives and between experiment recommendations and experiment objectives.
- There needs to be a direct correlation between project conclusions and project objectives, between project recommendations and project objectives and between project results and project objectives. Each objective must be related to a key performance area.
- Experiment results should directly be linked to low-level objective or hypothesis and must be related to a higher level experiment objective.

From a technical point of view recommendations were given regarding the client-side implementation in Chapter 4. They were:

- Define and implement data requirements for all static data to be added to the custom property fields of the template documents.
- Define all data to be retrieved from existing built-in property fields of the template documents and implement an automated solution.
- Define and implement all data formats that need to be considered (both for static data and entered summary data) in the template documents.
- Define necessary encryption standards for passwords and implement a solution.
- Define preformatted data or existing lists of data items that need to be considered in the templates and implement an automated solution.
- Define data protection modes and protected sections of the document
- Define all structures needed to be generated for VDR entry including their mutual relations and implement an automated solution for all these structures.
- Investigate further and define potential document automation to assist the author in writing the document, as it was found that the automation in the template could be very helpful in terms of, for example, auto-filling, prompting summary and cross-reference tables (see also previous bullet).
- Make a list of all property fields, bookmarks and macros in use by the automated solution and provide this to the user to avoid conflicts with other templates.
- Define rollback mechanisms for all automated changes.



Chapter 5, the study into document automation for VDR input, provides the following recommendations:

- Decide whether the automated solution shall be provided to the client or whether it will be used within EUROCONTROL only.
- Choose a Web Services platform for implementing the final solution: a high performance is not required due to low traffic of the service (not more than 100 validation reports per day expected), so a choice should be made considering preferences and currently implemented ICT technology at EUROCONTROL. In this exercise, no limitations were found for the Apache Axis web services platform.
- Review the preferred (future) working methods of the VDR data administrator and VDR data collector. Their way of working and the tools they use should be incorporated in the process of accepting validation templates.
- Examine how security technology like SSL and username/password verification can be used for Web Services and how it may be combined with existing authentication systems (e.g. OneSky Online extranet) used within EUROCONTROL.
- Decide whether or not the validation templates should retrieve information directly from the VDR database to facilitate data entry by the author. If so, the set of defined Web Services should be extended to make these information retrievals possible.
- Evaluate how the *temporary database* shall be structured: as a separately structured database, as a copy of the current VDR database structure, or incorporated in the current database with a marked state.
- Make an up-to-date description of the VDR database structure: describe what tables and fields are used, how they are used, how relations are stored, and describe the database triggers and procedures that act on the VDR database.
- Make an implementation plan for the EUROCONTROL ICT infrastructure to support the automated validation template solution.

In general, it should be noted that the technical part of this study identified potential processes for template automation and demonstrated that these processes can be achieved from a technical viewpoint. Thus, as a final recommendation, it will be important to test the feasibility of the proposed automation and associated processes, in terms of user acceptability (document author, data collectors, administrators etc.) and the actual technical infrastructure at EUROCONTROL, in a next step.



7 Appendices

7.1 Abbreviations

Abbreviation	Description
A/P	Airport
A/S	Air Space
ANSP	Air Navigation Service Provider
AP	Action Plan (FAA-Eurocontrol Working Groups)
ATM	Air Traffic Management
CAATS	Co-operative Approach to ATS
D	Deliverable
DAS	Directorate ATM Strategies
DOW	Description of Work
EATM	European Air Traffic Management
EATMP	European Air Traffic Management Programme
E-OCVM	European Operational Concept Validation Methodology
ESC	European ATM Systems and Convergence
EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration
HTTP	Hypertext Transport Protocol
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
JAVA	Internet Application Technology Language
JDBC	JAVA Database Connectivity
KPA	Key Performance Areas
KPI	Key Performance Indicators
MAEVA	Master ATM European Validation Plan
MAS	Measurement and Analysis Specification
MS	Microsoft



Abbreviation	Description
NLR	Nationaal Lucht- en Ruimtevaartlaboratorium
OCD	Operational Concept Document
OCV	Operational Concept Validation
OCVSD	Operational Concept Validation Strategy Document
OI	Operational Improvements
ORD	Operational Requirements Document
OSED	Operational Service Environment Definition
PC	Personal Computer
PDCA	Plan Do Check Act
PRC	Performance Review Commission
R&D	Research and Development
RIA	Runway Incursion Alert
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SQL	Standard Query Language
SSL	Secure Socket Layer
TCP-IP	Transport Control Protocol - Internet Protocol
TRS	Task Requirement Sheet
VARTAN	Validation Reporting Template Analysis by NLR
VBA	Visual Basic for Applications
VDR	Validation Data Repository
WSDL	Web Services Description Language
XML	Extensible Mark-up Language
XSLT	Extensible Stylesheet Language for Transformations



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7.4 VDR Transaction WSDL File

This is the program listing for the VDR Transaction WSDL file:

```
<?xml version="1.0" encoding="UTF-8"?>
<wsdl:definitions targetNamespace="urn:vdr" xmlns:impl="urn:vdr"
xmlns:intf="urn:vdr" xmlns:apachesoap="http://xml.apache.org/xml-soap"
xmlns:wsdlssoap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/">
<!--WSDL created by Apache Axis version: 1.2RC2
Built on Jul 22, 2005 (04:35:59 CEST)-->

  <wsdl:message name="AuthorLogoffRequest">
    <wsdl:part name="in0" type="xsd:int"/>
  </wsdl:message>

  <wsdl:message name="TransmitDataRequest">
    <wsdl:part name="in0" type="xsd:int"/>
    <wsdl:part name="in1" type="xsd:string"/>
    <wsdl:part name="in2" type="xsd:int"/>
    <wsdl:part name="in3" type="xsd:string"/>
  </wsdl:message>

  <wsdl:message name="AuthorLogonResponse">
    <wsdl:part name="AuthorLogonReturn" type="xsd:int"/>
  </wsdl:message>

  <wsdl:message name="GetErrorResponse">
    <wsdl:part name="GetErrorReturn" type="xsd:string"/>
  </wsdl:message>

  <wsdl:message name="TransmitDataResponse">
  </wsdl:message>

  <wsdl:message name="GetErrorRequest">
    <wsdl:part name="in0" type="xsd:int"/>
  </wsdl:message>
```



```
<wsdl:message name="AuthorLogoffResponse">
  <wsdl:part name="AuthorLogoffReturn" type="xsd:string"/>
</wsdl:message>

<wsdl:message name="AuthorLogonRequest">
  <wsdl:part name="in0" type="xsd:string"/>
  <wsdl:part name="in1" type="xsd:string"/>
</wsdl:message>

<wsdl:portType name="vdrtransaction">
  <wsdl:operation name="AuthorLogon" parameterOrder="in0 in1">
    <wsdl:input name="AuthorLogonRequest"
message="impl:AuthorLogonRequest"/>
    <wsdl:output name="AuthorLogonResponse"
message="impl:AuthorLogonResponse"/>
  </wsdl:operation>
  <wsdl:operation name="TransmitData" parameterOrder="in0 in1 in2 in3">
    <wsdl:input name="TransmitDataRequest"
message="impl:TransmitDataRequest"/>
    <wsdl:output name="TransmitDataResponse"
message="impl:TransmitDataResponse"/>
  </wsdl:operation>

  <wsdl:operation name="AuthorLogoff" parameterOrder="in0">
    <wsdl:input name="AuthorLogoffRequest"
message="impl:AuthorLogoffRequest"/>
    <wsdl:output name="AuthorLogoffResponse"
message="impl:AuthorLogoffResponse"/>
  </wsdl:operation>

  <wsdl:operation name="GetError" parameterOrder="in0">
    <wsdl:input name="GetErrorRequest" message="impl:GetErrorRequest"/>
    <wsdl:output name="GetErrorResponse"
message="impl:GetErrorResponse"/>
  </wsdl:operation>

</wsdl:portType>
```



```
<wsdl:binding name="vdrtransactionSoapBinding" type="impl:vdrtransaction">

    <wsdlsoap:binding style="rpc"
transport="http://schemas.xmlsoap.org/soap/http"/>
    <wsdl:operation name="AuthorLogon">
        <wsdlsoap:operation soapAction=""/>
        <wsdl:input name="AuthorLogonRequest">
            <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr"/>
        </wsdl:input>

        <wsdl:output name="AuthorLogonResponse">
            <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr"/>
        </wsdl:output>
    </wsdl:operation>

    <wsdl:operation name="TransmitData">
        <wsdlsoap:operation soapAction=""/>
        <wsdl:input name="TransmitDataRequest">
            <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr"/>
        </wsdl:input>

        <wsdl:output name="TransmitDataResponse">
            <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr"/>
        </wsdl:output>
    </wsdl:operation>

    <wsdl:operation name="AuthorLogoff">
```



```
<wsdlsoap:operation soapAction="" />
  <wsdl:input name="AuthorLogoffRequest">
    <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr" />
  </wsdl:input>

  <wsdl:output name="AuthorLogoffResponse">
    <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr" />
  </wsdl:output>
</wsdl:operation>

<wsdl:operation name="GetError">
  <wsdlsoap:operation soapAction="" />
  <wsdl:input name="GetErrorRequest">
    <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr" />
  </wsdl:input>
  <wsdl:output name="GetErrorResponse">
    <wsdlsoap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:vdr" />
  </wsdl:output>
</wsdl:operation>

</wsdl:binding>

<wsdl:service name="vdrtransactionService">
  <wsdl:port name="vdrtransaction"
binding="impl:vdrtransactionSoapBinding">
    <wsdlsoap:address
location="http://localhost:8080/axis/services/vdrtransaction" />
  </wsdl:port>
</wsdl:service>
</wsdl:definitions>
```