SECONOMICS

D7.1 – Validation Plan

F. Quintavalli, V. Meduri, A. Tedeschi (DBL), Siv Hilde Houmb (SNOK), Silvia Castellvi Catala (ATOS), Michael Pellot (TMB), Ruprai Raminder (NGRID)

Pending of approval from the Research Executive Agency - EC

Document Information

Document Number	D7.1
Document Title	Validation Plan
Version	1.3
Status	Final
Work Package	WP7
Deliverable Type	Report
Contractual Date of Delivery	31.07.2012
Actual Date of Delivery	03.08.2012
Responsible Unit	DBL
Contributors	UNITN, SNOK, ATOS, TMB, NGRID
Keyword List	Case Studies, Validation
Dissemination level	PU

SECONOMICS Consortium

SECONOMICS "Socio-Economics meets Security" (Contract No. 285223) is a Collaborative project) within the 7th Framework Programme, theme SEC-2011.6.4-1 SEC-2011.7.5-2 ICT. The consortium members are:

1	UNIVERSITÀ DEGLI STUDI DI TRENTO	Università Degli Studi di Trento (UNITN) 38100 Trento, Italy www.unitn.it	Project Manager: prof. Fabio MASSACCI Fabio.Massacci@unitn.it
2	DEEPBLUE	DEEP BLUE Srl (DBL) 00193 Roma, Italy www.dblue.it	Contact: Alessandra TEDESSCHI Alessandra.tedeschi@dblue.it
3	Fraunhofer ISST	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Hansastr. 27c, 80686 Munich, Germany http://www.fraunhofer.de/	Contact: Prof. Jan Jürjens jan.juerjens@isst.fraunhofer.de
4	Universidad Rey Juan Carlos	UNIVERSIDAD REY JUAN CARLOS, Calle TulipanS/N, 28933, Mostoles (Madrid), Spain	Contact: Prof. David Rios Insua david.rios@urjc.es
5	UNIVERSITY OF ABERDEEN	THE UNIVERSITY COURT OF THE UNIVERSITY OF ABERDEEN, a Scottish charity (No. SC013683) whose principal administrative office is at King's College Regent Walk, AB24 3FX, Aberdeen, United Kingdom http://www.abdn.ac.uk/	Contact: Prof. Julian Williams julian.williams@abdn.ac.uk
6	TMB Transports Metropolitans de Barcelona	FERROCARRIL METROPOLITA DE BARCELONA SA, Carrer 60 Zona Franca, 21-23, 08040, Barcelona, Spain http://www.tmb.cat/ca/home	Contact: Michael Pellot mpellot@tmb.cat
7	Atos	ATOS ORIGIN SOCIEDAD ANONIMA ESPANOLA, Calle Albarracin, 25, 28037, Madrid, Spain http://es.atos.net/es-es/	Contact: Silvia Castellvi Catala silvia.castellvi@atosresearch.eu
8	SECURENOK	SECURE-NOK AS, Professor Olav Hanssensvei, 7A, 4021, Stavanger , Norway Postadress: P.O. Box 8034, 4068, Stavanger, Norway http://www.securenok.com/	Contact: Siv Houmb sivhoumb@securenok.com
9	SOÚ Institute of Sociology AS CR	INSTITUTE OF SOCIOLOGY OF THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC PUBLIC RESEARCH INSTITUTION, Jilska 1, 11000, Praha 1, Czech Republic http://www.soc.cas.cz/	Contact: Dr Zdenka Mansfeldová zdenka.mansfeldova@soc.cas.cz
10	nationalgrid THE POWER OF ACTION	NATIONAL GRID ELECTRICITY TRANSMISSION PLC, The Strand, 1-3, WC2N 5EH, London, United Kingdom	Contact: Dr Raminder Ruprai Raminder.Ruprai@nationalgrid.com
11	ANADOLU ÜNİVERSİTESİ	ANADOLU UNIVERSITY, SCHOOL OF CIVIL AVIATION Iki Eylul Kampusu, 26470, Eskisehir, Turkey	Contact: Nalan Ergun nergun@anadolu.edu.tr

Document change record

Version	Date	Status	Author (Unit)	Description
0.1	02/05/2012	Draft	A . Tedeschi (DBL)	Introduction and 1st Draft
0.2	15/06/2012	Draft	Silvia Castellvi Catala (ATOS), Michael Pellot (TMB), Ruprai Raminder (NGRID)	Case Study Specific Validation Plan
0.3	03/07/2012	Draft	V. Meduri, F. Quintavalli (DBL)	Document finalisation for internal review
0.4	18/07/2012	Draft	Slv Hilde Houmb (SNOK)	Review by SNOK
0.5	18/07/2012	Draft	F. Quintavalli, A. Tedeschi (DBL)	Document Ready for QC by UTN
0.6	19/07/2012	Draft	E. Chiarani (UNITN)	Quality check completed. Minor changes required
1.0	24/07/2012	Draft	F. Quintavalli (DBL)	Updated version
1.1	26/07/2012	Draft	E. Chiarani (UNITN)	Last quality check
1.2	30/07/2012	Final	F. Quintavalli (DBL)	Final version ready for submission
1.3	03/07/2012	Final	F. Massacci (UNITN)	Final check by the Coordinator before submission

INDEX

1. Executive Summary

The SECONOMICS project will deal with cross-domain and multi-perspective challenges, including policy, risk, economics and security. The multi-purpose dimension of the planned SECONOMICS framework and toolbox must be developed with care and in a step-by-step environment with realistic case studies and end-user driven development. The SECONOMICS project has therefore adapted a case study based development and evaluation approach. This document describes the SECONOMICS evaluation approach and validation plan, as well as outlines the detailed requirements and evaluation criteria for the three case study domains: airport, transport and grid. The document describe the validation objectives with respect to the expected project results and the way the evaluation and validation activities will be organised and carried out in order to address these objectives.

Essential for the success of the SECONOMICS project is a close interaction between the technical workpackages (WPs4, 5 and 6) and the case study workpackages (WPs1, 2 and 3). This interaction is supported by the case study based development and validation approach adopted by the project and WP7 focusing on cross-mission challenges and generalization of results across critical infrastructure domains. WPs7 and 8 will integrate results from the technical work packages into the SECONOMICS framework and toolkit respectively. Each case study will test and validate a dedicated part of the framework and toolkit and feedback from the validation will be directed into the development of the technical solutions in WPs4, 5 and 6.

The high-level validation objectives defined across the case studies are: user acceptability, domain suitability and technical usability. These high-level validation objectives are refined and adapted for each of the three case study domains, along with details on the various case study protocols. To cover a sufficient amount of the technical results, each case study focuses on different aspects of the SECONOMICS framework and toolkit. Together, the validation results will give input into the generalization of the SECONOMICS results across the three case study domains and across other critical infrastructure domains.

2. Introduction

The main objective of SECONOMICS is to develop innovative risk assessment techniques and tools that will support policy makers in security-related decisions by taking into account also social and economic factors. This is particularly challenging when considering both logical and physical security aspects and different domains in a pan-European perspective. The practical relevance of SECONOMICS research will be validated against three challenging domains: Airport, GRID and Urban and Local Transport. Together these domains offer diverse research challenges and relevant long-term business opportunities across critical infrastructures.

The complexity and the innovation of the proposed solutions make the process of validating the results a challenging task. Just as the security, social and economic issues, addressed by SECONOMICS, are heterogeneous, so are the results expected for each technical workpackage, ranging from theoretical models to policy guidelines and software toolkit for decision support. Therefore, it is necessary to perform different and customized Validation activities.

In order to mitigate the risk that each workpackage defines its own success criteria and goals independently of the others, with little or no interaction with the others layers of the SECONOMICS project, we will use the real-world Case-Studies as central in evaluating how SECONOMICS meets its main goals.

Industrial scenarios will be used during the whole project lifecycle to support the research activities and they will cover three relevant domains of application, as shown in Figure 1. The aim of using Case Studies during the whole project lifecycle is twofold: on one side to focus *research ideas* and to support the identification of *solutions* using real examples that instantiate the problem investigated, on the other side to offer a living "*test-bed*" to evaluate the validity and quality of the intermediate and final project results.

This report defines a general and widely used Validation Process (i.e., the European Operational Concept Validation Methodology, customised for security-related R&D projects) to guide and coordinate the always critical evaluation tasks. E-OCVM forms the basis of the SECONOMICS Validation approach supporting Case Studies in the identification of the high-level validation objectives and in the description of the core Validation Plan. The E-OCVM approach will ensure a coherent evaluation of SECONOMICS results across Case Studies and will guarantee that Validation results can be generalized beyond the three specific Case Studies.

All case studies will follow the general validation plan, but will adapt and refine the validation plan to tailor the specific needs of its domain and the different analysed scenarios.

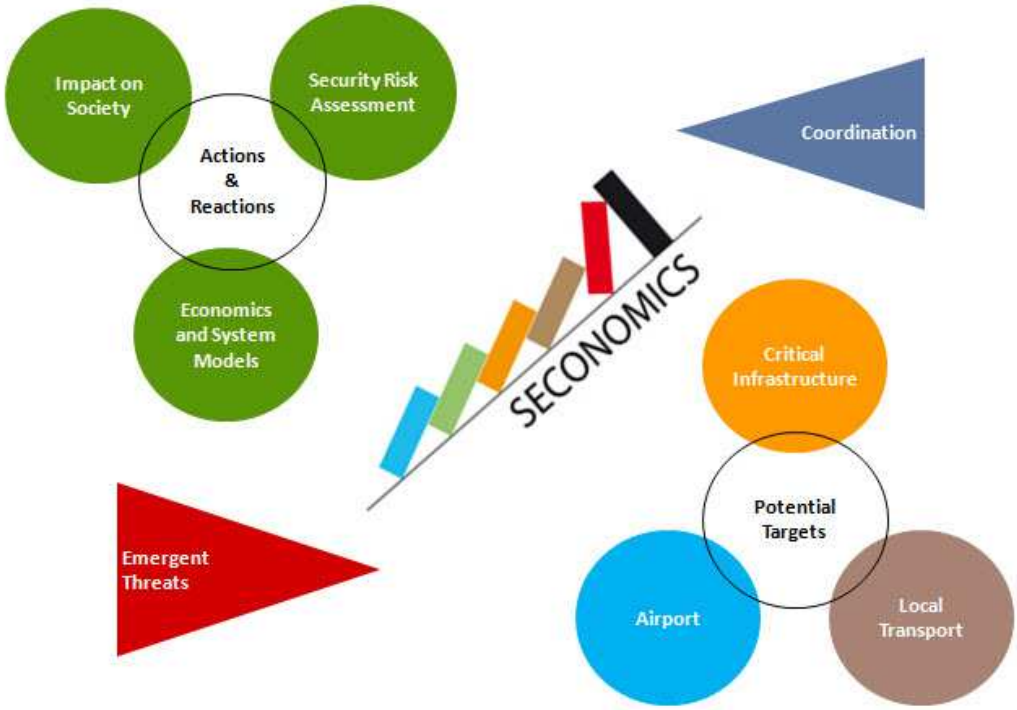

Figure 1 - Case Study Workpackage and other Workpackages.

Each technical workpackage will interact with each CaseStudy, according to main scopes and security characteristics of the Case Study itself. Thus a proper, realistic and coordinated workplan is crucial for the success of the Validation.

Techniques, methodologies and tools developed by the workpackage will be integrated and applied within the three Case Studies to specific scenarios highlighting the peculiarities, innovation and applicability of the SECONOMICS outcome under validation. Therefore, the Validation of the SECONOMICS will be designed and carried out by following a 'Case Study-oriented structure'.

2.1. Scope of Report

This document presents the validation strategy and plan for the SECONOMICS project. The validation plan consists of a set of common validation objectives and activities. The validation plan is developed to ensure that the validation activities are carried out in a coordinated and coherent manner across the three case study domains.
The validation plan is comprised of the following:

- Validation Objectives, including the gathering of inputs from WPs4, 5 and 6 and the Case Studies
- Validation Methodologies and Techniques, Indicators and Metrics
- Exercises Planning and comparative analysis of plans, according to the foreseen activities in WPs1,2 and 3
- Data collection material templates (questionnaires, scenarios, script for interviews) customised for each Case Study.

The Validation Plan also highlights and motivates the applicable differences between the three case studies.

2.2. Document Overview

In Chapter 3 we briefly recall the SECONOMICS Scientific Objectives and expected results. In Chapter 4 we describe the Validation approach and the high-level objectives of the Validation process are listed. In Chapters 5, 6 and 7, for each Case Study respectively, we report the specific Validation method(s) applied, the data gathering and result analysis methodology and describe the tests, simulations and evaluation session we would like to carry out, setting up a detailed workplan for each Case Study. All validation activities are coordinated and integrated with the delivery of the outcomes by technical Workpackages.

3. Project Aims and Expected Results

SECONOMICS goal is synthesizing sociological, economic and security science into a usable, concrete, actionable knowledge for policy makers and social planners responsible for citizen's security.
SECONOMICS is a collaborative project on the socio-economics of security, with a specific focus on the interplay between information security and physical security, driven by key case studies in critical infrastructure protection: in international air transportation (Anadolu's airport security), in local transportation (Barcelona's city transportation) and in energy distribution (the UK's National Grid). These sectors are all critical to the economic and social lives of EU member states.

Our scientific approach will integrate expertise into social, economic, system and risk modelling and will provide a basis for initial developments of decision-support methodologies and tools for policy makers.

The contribution of the project will be in developing and furthering the state of the art in modelling security problems in a technological and socio economic context and then applying state of the art risk assessments and analysis of the social context to develop optimal policies.

The outputs are twofold: first assessment of the future and emerging threats in the identified areas with rigorous modelling of the optimal mechanisms for mitigation within the policy domain. Second, and more crucially, a generalized policy "toolkit" that will assist decision makers in identifying and reacting coherently (within the appropriate social context) to future and emerging threats that may arrive long after the project has been completed.

Main SECONOMICS outcomes will be:

- Modelling Notations and Language for System Description
- Algorithms and Computation for Economics and Risk Assessment
- ToolKit for Policy Makers
- Methodology and Guidelines for Policy Makers

The initial task would be to identify the concrete issues in security missions for these case studies.
Once the menu of security missions has been characterized, our R&D work-packages (WP4, WP5, WP6), will then begin to characterize the threats and distillate socio-economic methodologies based on rigorous and well-developed methodologies from the social sciences, risk and operations research, and economics and systems models.

- WP4 will identify the qualitative societal impact scenarios, from the future or emergent threat. Quantification of the social cost is made by contingent valuation.
- WP5's role is in the identification of the outcome space and associated risk measures. In addition WP5 will analyze the threat environment and potential security measures and their effectiveness.

- WP6 develops economic and systems models of the policy interactions with the architecture of the physical and ICT system under threat and develops an optimal set of policy tools and control instruments designed to optimally deal with the future or emergent threats, subject to social cost constraints.

Once the various mechanisms identified to implement the policy objectives are determined, the concrete case studies will be pursued by means of empirical studies and feedback from citizens and decision makers (looping back into WPs1-3). This approach will generate a positive forward loop that will strengthen the results of the project as shown below. The security missions of the three case studies are limited a set of examples. It is therefore important to provide a general policy toolkit that is cross-mission and to provide guidance to decision makers on which types of legislative and regulatory instruments that are best suited to a particular emerging security threat. WPs7 and 8 address this aspect of the development.

- WP7 will consolidate the results of the three case studies to cross-mission relevance results and will assist in consolidating the validation assessment between WP4, WP5 and WP6. Loosely speaking it will be "hand-booking" the results of the concrete case studies.
- WP8 will provide the necessary computer-aided support to manage real data, by providing tools that maps the research models either to collected or to simulated data (for instance backing out the policy parameters from structural models of economic risk and risk preferences).

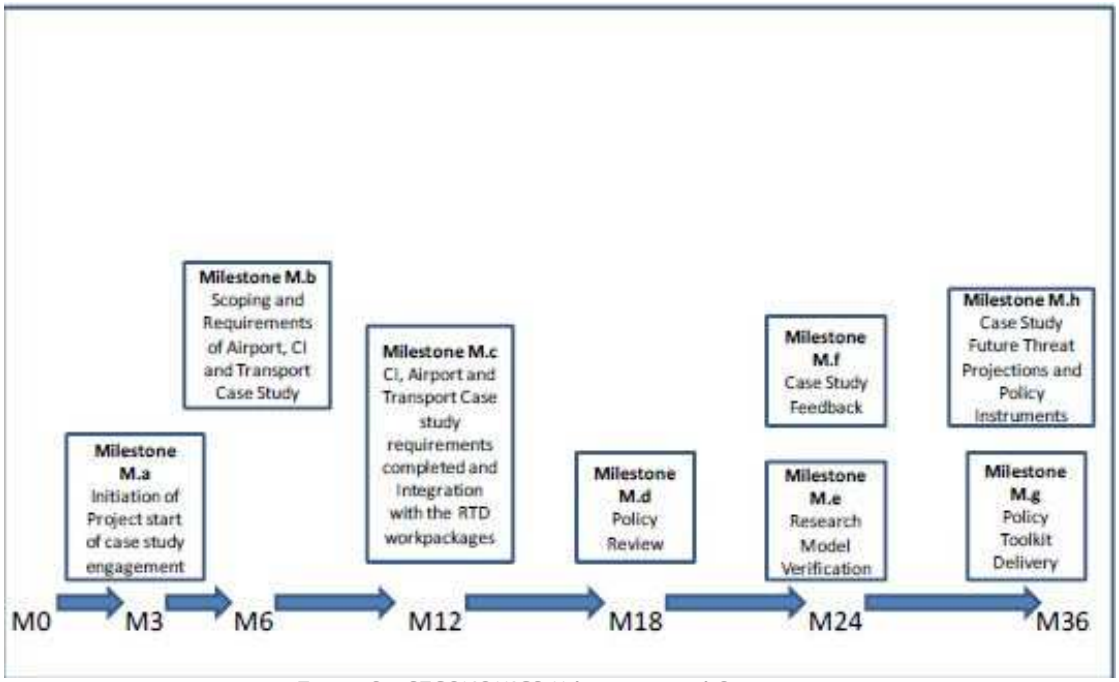

Figure 2 - SECONOMICS Milestones and Outcomes

4. The Validation Process

Validation is a generic term that has wide usage but with a diversity of interpretations. Even in one specific domain, such as software engineering, it may have different meanings and characteristics.

For our convenience, in SECONOMICS we define:

- **Verification**: process used to confirm that the software functional behaviour is correct. It answers to the question 'Are we building the system right?'.

- **Validation:** process used to prove that software complies with client high-level needs and preliminary requirements established at the moment of analyzing something to be developed. It answers to the question 'Are we building the right system?'

Validation is the process used to demonstrate how a system, a methodology or a new concept can function in real life conditions with the required level of performances, security and operability. Technical Verification and testing will be carried out in Technical Workpackages (i.e., WP4, 5, 6 and 8), while Validation will be carried out in WP7 in collaboration with the three Case Studies (WPs1, 2 and 3).
The Validation process may include a number of variables and may involve several feedback loops. An important aspect of Validation is the Validation criteria, validation process and measurements. In SECONOMICS, validation will be used as the vehicle of development and testing of technical results in the context of three critical infrastructure domains: airport, transportation and GRID. Validation results will also be used in the cross mission work and when generalizing the SECONOMICS technical results outside of the case study domains considered in SECONOMICS.

The Validation is concerned both with the identification of the operational needs of the stakeholders and the establishment of appropriate solutions (the operational concept). It follows an iterative process to ensure that the needs are properly understood, the solution is well adapted (the right system is being developed) and adequate supporting evidence has been gathered.
In SECONOMICS, validation plays a major role in the development of technical results and is a driving force of the SECONOMICS research and development process. This ensures a close collaboration between the technical work packages (WP4-WP6) and the case study work packages (WP1-WP3). In addition to validation, the process covers requirements management, concept refinement and solution development, testing and verification, development of a performance framework, etc.

Validation and case-based development of technical results is challenging. Identifying validation objectives and criteria is difficult and it is difficult to demonstrate that validation objectives of a project are achieved. Validation criteria are therefore developed in an interactive and step-wise process, starting with high-level Validation objectives, which are refined into detailed Validation criteria. The detailed Validation criteria have a direct influence on the more general Validation objectives and, being more detailed, are to some extent measurable. This process of decomposition has to be

repeated several times resulting in a hierarchical structure of objectives (Tree Model), as shown in Figure 3. The decomposition of objectives ends with the identification of basic indicators, which represent the 'leaves' of the 'leaf' in the tree model. Note that indicators can be quite diverse. For instance, some indicators can be measurable, whereas other indicators might highlight compliance with standards or development processes, adoption of development tools and so on. Indicators will then require different types of evaluations. **Errore. L'origine riferimento non è stata trovata.** shows a simple example of how to identify validation criteria and to refine these to fit a specific field trial. The validation criteria are derived by an iterative decomposition arriving at a set of criteria that can be used to evaluate observations and evidences gathered in the trial. Observations can be measured or evaluated both in a quantitative or qualitative way.

1. **Deterministic**: e.g., formal proof of compliance to a specification, demonstration of requirements, etc.
2. **Probabilistic**: e.g., quantitative statistical reasoning to establish a numerical level
3. **Qualitative**: e.g., compliance with rules that have an indirect link to the desired criteria (e.g. compliance with standards, staff skills and experience).

Note that the proposed evaluation and validation process is similar to other assessment processes. For instance, system assurance relies on the construction of safety cases for the judgment of the adequacy of system safety.

Indicators can provide information about the lower level of the detailed Validation objectives and they can be evaluated through measures taken during 'experiments' and trials carried out in different Validation Sessions. The evaluation of objectives at a lower level of the hierarchy should allow the evaluation of the objectives on the level above in the hierarchy. An iterative approach to evaluation will, therefore, move up the hierarchy. In practice, all leaves of the tree can be measured and, therefore, assessed. Their assessment allows the assessment of level n criteria, the assessment of level n criteria and other objectives at the same level allow the assessment of the level n+1 criteria and so on.

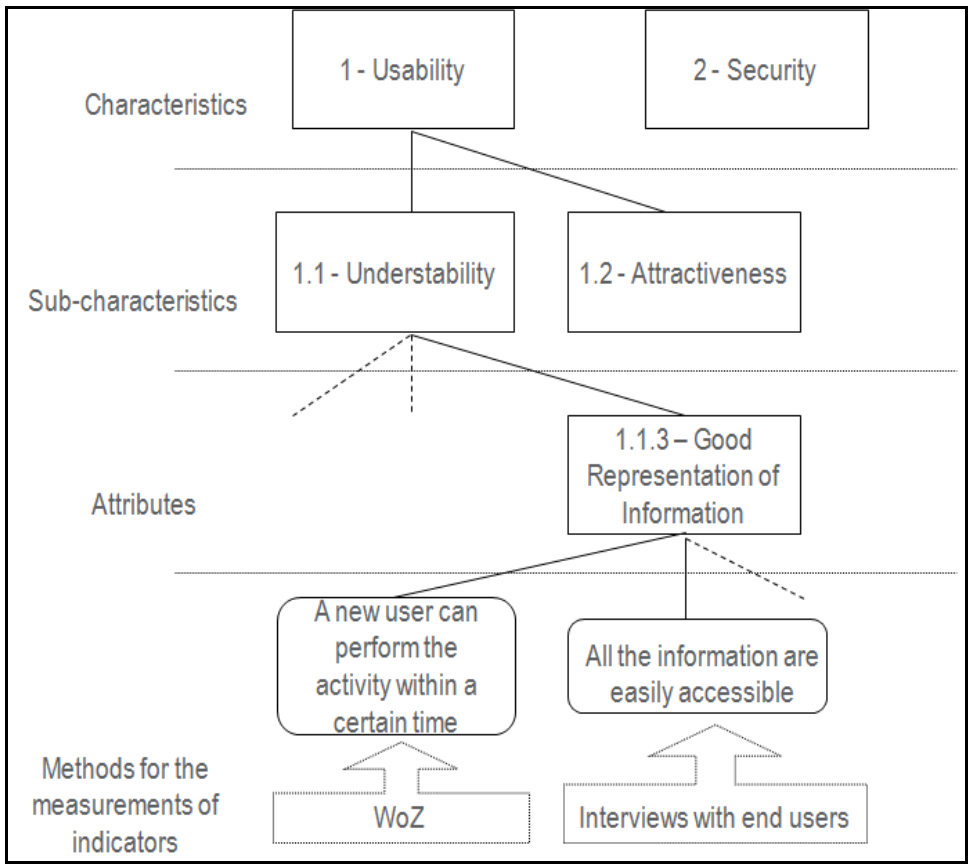

Figure 3 - Example of Validation Criteria decomposition and appropriate Validation Methods identification

The measurement of an element through its 'decomposition' into more measurable entities is a common approach in science, and a very similar approach has been successfully used, for example, in software engineering to measure the Quality of Software [1] or in the Air Traffic Management domain through the development of the European Operational Concept Validation Methodology (E-OCVM) [2] or in Safety Assessment [3].

The main steps in our iterative process, inspired by the ones proposed in the E-OCVM Methodology and reported in Table 1, encompassing both operational Validation and technical Validation and Verification, can be summarized as:

1. Set the evaluation strategy:

a) Identify the user of the project outcome

b) Identify the outcome usage and purpose

c) Identify the general objectives of the Validation

d) Identify what criteria are to be used

2. Determine the trial:

a) Decompose the criteria iteratively, in order to obtain evidences

b) Decide how they will be evaluated (e.g., measured, analysed, etc.)

c) Set out a plan of how the trial will be conducted

3. Conduct the trial:

a) Go through the various evaluation methods (e.g., tests, formal verifications, simulations, application into case studies, Wizard of OZ Simulations, users interviews, expert walkthrough, etc.)

4. Determine the results:

a) Assess the evaluation results (e.g., analysis of the measurements taken, expert judgements, etc.)

b) Summarize and compare the results

c) Prepare the Validation Report

Table 1 - The E-OCVM Validation Process

Step	Sub-step	Name
0. State Concept and Assumptions	0.1	Understand the Problem
	0.2	Understand the Proposed Solution(s)
1. Set Validation Strategy	1.1	Identify the Stakeholders, their Needs and Involvement
	1.2	Identify the existing information, including Current and Target Levels of Maturity
	1.3	Describe Validation Expectations and outline Cases – outcomes, products, what success will look like
	1.4	Identify Programme Validation Objectives in Key Performance Areas
	1.5	Establish Initial Validation Requirements and draft Validation Strategy
	1.6	Select Validation Tools and Techniques
	1.7	Define Validation Strategy
2. Determine the exercise Needs	2.1	Identify Stakeholders' Acceptance Criteria and Performance Requirements
	2.2	Identify Project and Exercise Validation Objectives

Step	Sub-step	Name
	2.3	Refine Validation Strategy
	2.4	Identify Indicators and Metrics
	2.5	Specify Validation Scenarios
	2.6	Produce Validation Exercise Plan
	2.7	Prepare the Platform or Facility
	2.8	Conduct Pre-Exercise Testing and Training
3. Conduct the Exercise	3.1	Conduct Validation Exercise
	3.2	Assess for Unexpected Effects or Behaviours
4. Determine the Results	4.1	Perform Analysis as specified in the Analysis Specification
	4.2	Prepare Analysis Contributions
	4.3	Prepare Validation Report

The proposed Validation process also supports the identification of the Maturity of the SECONOMICS results [4] and shows a body of evidence that relates to the overall project maturity with respect to the different Validation criteria identified.

A Maturity Assessment supports the underlying decision making process. It analyses key results from concept validation activities to assess progress through the concept lifecycle.

An initial maturity assessment is conducted at an early stage in a concept validation project to identify within what phase a concept element is situated and what work remains to be done. Maturity assessment is then conducted systematically to incorporate emerging validation results and to monitor progress. This allows both the development of effective validation planning and the basis for estimating effort and activities required to completion.

The maturity assessment aims to structure understanding and expectations on what evidence should become available and when. It shows how the different system development processes relate to each other within a common framework.

It supports the setting of appropriate validation objectives based on the R&D needs, reflecting the achieved maturity and the quality of existing evidence.

Concept development is the process of designing, describing, constructing and testing of working procedures and human technology integration. This is achieved with the support of models, hardware and software capabilities that mimic the behaviour of the potential end system.

Figure 4 shows the lifecycle progression through all eight phases from the identification of a need to improve ATM performance (V0) through to operational use (V6) and eventual decommissioning (V7).

It is expected that scopes and objective of the Validation are likely to mature in line with the advancing maturity of the concept. As the concept becomes more mature, the Validation activity must become more focussed, rigorous and realistic. Validation Exercises becomes more extensive and the scope and objectives of these exercises and their objectives becomes more complex and exhaustive.

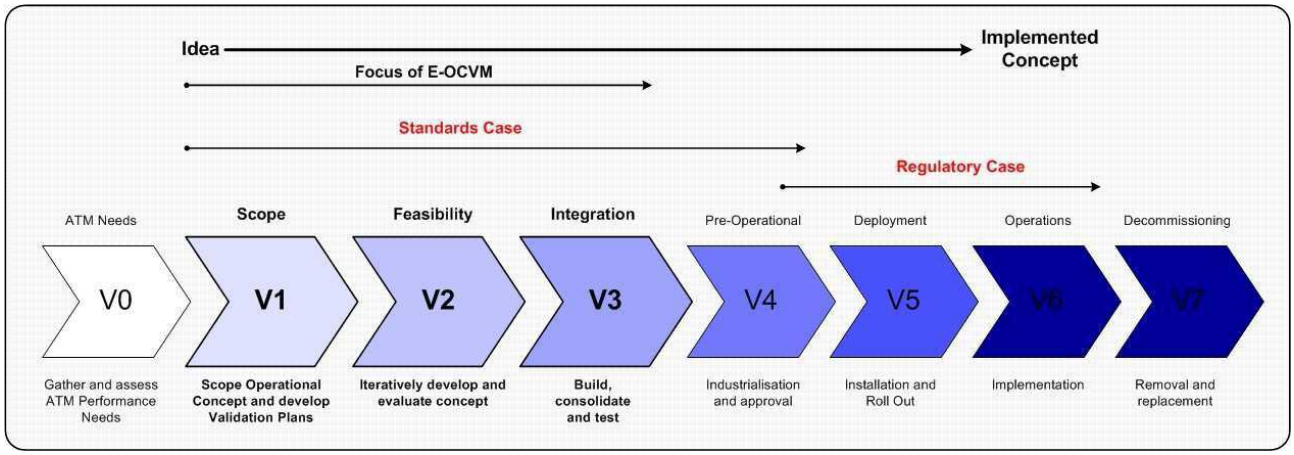

Figure 4 - Case Study Workpackage and other Workpackages.

Even if the proposed approach is very general and can be effectively applied to different domains, the identification of the specific Validation Criteria and of the Methods to be used in their assessment, strongly depends on the nature of the particular result under evaluation.

4.1 High-level Validation Objectives

As for E-OCVM, high-level validation objectives should cover both the operational needs of the stakeholders and the establishment of appropriate solutions to the problems and issues identified.

The high-level Validation dimensions taken into account to define the SECONOMICS validation process are:

1. **User Acceptability**, technical and scientific soundness of the proposed solution, ease of use and effectiveness of the SECONOMICS framework for supporting cognitive task requirements, job satisfaction and acceptability for various types of users and stakeholders.

2. **Domain Suitability**, the suitability of the reasoning techniques supported, content and completeness of information, display representation and system functionalities for the selected applicative domains, their work-practices, internal procedures and policies.

3. **Technical Usability**, the property of the SECONOMICS modelling framework and Decision Supporting tool to be effectively used, understood and learnt by the people for

which it has been designed, including look and feel aspects of the prototype as well as on the way the users will be requested to interact with it.
Four key aspects of the technical usability are:
a) Usability and Memorability: How easy is it for users to accomplish tasks of different level of complexity? How easy can proficiency be established/re-established?
b) Efficiency: Once users have learned the design, how quickly can they perform tasks?
c) Errors: How many errors, how severe are these errors, and how easily can users recover from the errors?
d) Look and feel: how is the tool HMI design, use of colors, shapes, layout (the "look"), and how they relate to the behaviour of dynamic elements such as buttons, boxes, and menus (the "feel")?

These three dimensions are used as the basis for defining the process and plan for validation to support all important validation aspects and categories of users/validators. Users and validators vary across validation phases and include Consortium Partners (Domain Experts and End-Users), Domain Stakeholders, Policy Makers (National Regulators and EU Organisations Representatives). Each phase make use of specific techniques depending on the validation dimension and the type of validators selected.

Phase 1. Stakeholders' Operational Needs Identification. Identify the Domain Security Stakeholders and Policy Makers involved in the Validation Process. Define the application Scenarios and Validation Criteria.

Phase 2. Models Validation. Iterative and Incremental Modeling Activities will be carried out to evaluate both models consistency and validity from an operational point of view and the Modeling Language expressiveness and completeness. Models will be presented and discussed with relevant stakeholders, then refined iteratively.

Phase 3. Framework and ToolKit Validation. Prototype Evaluation will be used to steer the tool in the right direction in early stages of Phase 3. The final Validation will ensure that the final version of the tool satisfies the users' needs expressed by the Validation Criteria. Live trials will be set up whenever feasible for the final validation.

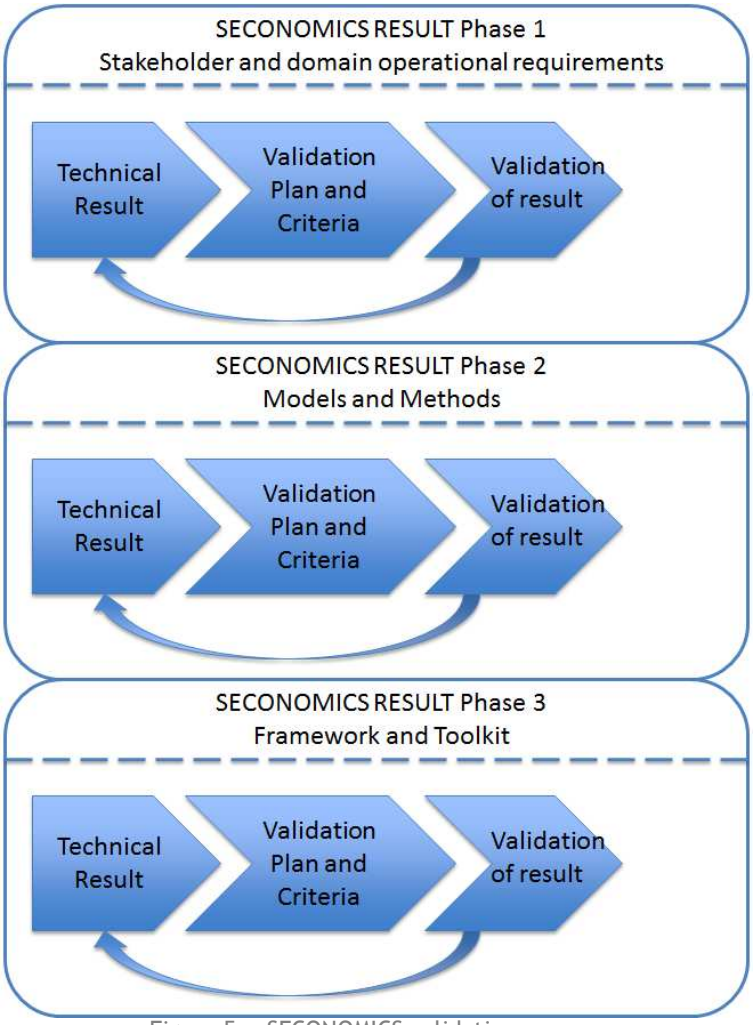

Figure 5 - SECONOMICS validation process

4.2 Validation Methodologies and Techniques

Many different evaluation and assessment methodology can be used for user validation. The SECONOMICS validation approach supports the following approaches: Expert Evaluation Techniques, Task Analysis and Direct Observation of Users Activities, Users Feedback Collection complemented by System Data Collection.

We hereby provide a short survey of the most common evaluation methods of innovative concepts and methodologies that can be implemented by means of scenarios:

Ethnographic approach / contextual enquiry

The ethnographic approach [5] emphasises the understanding of behaviour in context through the participation of the investigator in the situation being studied as an active member of the team of users involved in the situation. It provides a descriptive report, utilising a range of approaches, mainly informal interviews and observational techniques. The ethnographic approach is essentially the traditional systems analysis approach enriched by contact with sociology and social anthropology.

Interviews

Interviews are commonplace techniques where domain experts are asked questions by an interviewer in order to gain domain knowledge. Interviewing is not as simple as it may appear and comes in 3 types: unstructured interviews, semi-structured interviews and structured interviews. The type, detail and validity of data gathered vary with the type of interview and the experience of the interviewer. Interviewing is still the most widely used and abused method of finding out what users want [6][7].

Focus groups

A focus group brings together a cross-section of stakeholders in an informal discussion group format. Views are elicited by a facilitator on relevant topics. Meetings can be taped for later analysis. Focus group is useful early in requirements specification and stakeholders needs identifications [8]. It helps to identify issues which may need to be tackled and provides a multi-faceted perspective on them.

Wizard of Oz

This approach [9] involves a user interacting with a computer system which is actually operated by a hidden developer - referred to as the 'wizard'. The wizard processes input from a user and simulates system output. During this process the user is led to believe that they are interacting directly with the system. This form of prototyping is beneficial early in the design cycle and provides a means of studying the user's expectations and requirements. The approach is particularly suited to exploring design possibilities in early stages of validation to inform developers.

Expert walkthrough

A walkthrough is a process of going step by step through a system design getting reactions from relevant staff, typically users or experts role-playing the part of users. Normally one or two members of the design team will guide the walkthrough, while one or more users will comment as the walkthrough proceeds [10][11]. This technique is most often used where there is a very innovative and controversial concept, a relatively unstable prototype or written procedural specification.

Direct Observations during Live Trials

Users will be observed by Human Factors and Validation experts during Live Trials in which they will use the SECONOMICS policy toolkit. Proper metrics (e.g. numbers of attempts, errors, execution time, etc.) will be defined during the development of the evaluation process [5][7].

5. Airport Case Study

The validation objectives and criteria of the Airport Case Study concerns the acceptance of SECONOMICS models and by Airport domain experts (e.g. Security Managers in Airport Organizations, Airlines, Air Navigation Service Providers and Regulators) and potential end-users (e.g. Airport Organizations and Policy Makers). The validation activities have been tailored for the airport case studies and related artefacts. This is to take into account the different nature of the artefacts (e.g. methodologies and guidelines, modelling languages, tools). Moreover, it has been necessary to support different developmental paths of the artefacts. All SECONOMICS artefacts delivered by the Airport Case Study-related WP, have been validated by subsequent activities in order to support their developments through subsequent refinements (i.e. adjustments due to feedback).
Each validation activity will involve Airport domain experts in order to assess SECONOMICS artefacts from a practitioner viewpoint and to identify opportunities for exploitation of project results within the Aviation and Airport Security domain. The Airport case study identifies specific user needs and expectations for the Airport Security industrial domain. In particular, the WP1 validation highlights how SECONOMICS solutions can be used in the application domain and expected improvements to comply with industry practices.

5.1 Validation Methodologies and Techniques

In the Airport Case Study we will apply state-of-the-art validation methods, like the European Operational Concept Validation Methodology (EOCVM) that can be used for all the various contributions and results of any R&D Projects. EOCVM methodologies are integrated with User Centred Design approach and techniques, and customised for Security and ICT-oriented projects.

The main validation activities in the Airport Case Study fall into four major categories: Focus Groups and Interviews with Stakeholders, Methodology Evaluation through modeling activities, Walkthrough and Tool Live Demo with Airport Stakeholders and Policy Makers.
Focus Groups and Interview will be used for identifying Airport Security Scenarios to be analysed and modeled, the Stakeholders security requirements and risk perception, their economical constraints and societal impacts.
Methodology evaluation consists of modelling exercises focusing on specific scenarios and security requirements in order to refine and consolidate the underlying modelling languages and risk assessment methodologies, respectively.
Walkthrough activities involve step-by-step evaluation of the SECONOMICS framework with Airport domain experts. This allows to assess the proposed methodologies with domain experts and to identify alternative usages (with respect to current practices within the Airport Security domain).
Finally, tool live demo activities, Wizard of Oz simulations and live trials allowed the validation (in terms of usability and acceptance by Airport Stakeholders and Policy Makers) of the software tools and guidelines supporting the SECONOMICSs theoretical framework (modeling and analysis methodologies).

5.2 Validation Criteria, Indicators and Metrics

The high-level principles of user acceptability, domain suitability and technical usability, described in Chapter 4 guide the airport case study validation process. Subsequently, specific criteria have been identified that further specialize general principles. The detailed criteria are also specific for the various project outcomes and could be customized with the different maturity levels reached during the project lifecycle.

Key validation indicators to measure progress for the SECONOMICS framework will be defined, like for instance in the following Table 2:

Table 2 - Key validation indicators in Airport case study

SECONOMICS CUSTOMERS			
	User Acceptability	**Domain Suitability**	**Technical Usability**
Modelling Notations and Language for system Description	- Consistency rules of constructs	- Operational consistency of constructs and models -Non-expert user does not need to understand other artefacts than the one he needs to model the specific aspects	- Models are clear and easy to interpret -Models are graphically pleasant - Computer -aided support for model consistency
Algorithms and Computation for Economics and Risk Assessment	- Mechanisms of computations are well defined -Effective computation - Fully automatic or interactive implementation of the algorithms - Formal evidence of efficiency and effectiveness of algorithms	-Operational evidence of computation and risk assessment efficiency - Risk Assessment algorithms are compliant with Risk Assessment standards in aviation (SAM, ESARR4, etc)	- The result of the computation are clearly defined and interpretable - All the relevant information is presented in a clear and usable manner.
Toolkit	- Predictive power of the tool - Degree of monitoring and control on the key trade-offs - Support to avoid local minima - Clear and complete representation of information	-Number of stakeholders' perspectives represented - Degree of integration of the security, economic and social perspectives	- HMI Look and feel - Memorability - Efficiency -Errors
Methodology and Guidelines for Policy Makers	- Computer-aided steps - Explicit linkage with produced artefacts - Multi-view perspective	- Compliance with actual policies, procedures and workpractice in the Air Transport domain	- Well defined, non-redundant and clear methodology steps - Learnability of methodology in

		-Phraseology and terminology consistent with the one used in the domain -Non-expert users can apply effectively the methodology for their scopes	producing and linking various artefacts

5.3 Test Description and Workplan

The work plan shown in Table 3 below gives a description of the activities and the engagement with stakeholders during the course of the SECONOMICS project to validate outcomes of the Airport Case Study.
The work plan will be refined and updated according to project needs and milestones.

Table 3 - Work Plan in Airport case study

Year 1					
Stakeholders Needs Identification					
M1-M3	M4	M3-M6	M5-M6	M5-M6	M6-M9
Stakeholders Identification and Preliminary Contacts- Literature and document Review, Interviews with Airport Stakeholders	Airport Operational Security Needs Definition - Focus Group with Airport Stakeholders	Scenarios Definition - Consortium Partners (End Users and Doman Experts)	Scenario Validation and Refinement - Contextual Enquiry, Ethnographic Observations	High-level Requirements Definition - Consortium Partners (End Users and Domain Experts)	Scenario and High-level Requirements Review - Airport Stakeholders and End User Consortium Partner
Year 2					
Model Validation					
M13-M17	M18	M18-M21	M22		M23-M24
Modelling Activities - Consortium Partners (Technical Partners, Domain Experts and End-Users)	Modelling Language and Models Walktrough - Workshop with Airport Stakeholders	Models and Modelling Language Refinement - Consortium Partners (Technical Partners, Domain Experts and End-Users)	Final Evaluation of Modeling Language - Modelling Sessions with Airport Stakeholders and End Users - Direct Observation and Interviews in a 2-days Dedicated Workshop	Result Presentation to high-level Policy Makers - jointly with exploitation activities	Modelling Activities - Consortium Partners (Technical Partners, Domain Experts and End-Users)

Year 3		
Tool and Guidelines Validation		
M25-M28	M25 – M32	M34
Tool Non-interactive Prototype Evaluation – Consortium Partners (Domain and Human Factors Experts)	Tool and Guidelines Validation trough usage and application to the Scenarios Consortium Partners (Technical Partners, Domain Experts and End-Users)	Tool Live Trials for Guidelines Production and Refinement with Airport Stakeholders and Policy Makers – Direct Observation and Interviews in a 2-days Dedicated Workshop

6. Critical Infrastructure Case Study

The Critical Infrastructure case study (also referred to as the Critical National Infrastructure or CNI case study) has a different set of validation objectives and criteria to the other case studies.

The CNI case study (WP2) will focus on the security aspects of a countries electricity transmission network otherwise referred to as an electricity grid. The transmission part of electricity delivery to end users only covers electricity delivery between generators and substations. Therefore the end users of electricity are out of scope of the case study.

Therefore the validation methodologies, criteria, indicators and metrics focus on the stakeholders internally within a CNI operator, nationally in which the CNI operates and supranationally i.e. at the European level.

6.1 Validation Methodologies and Techniques

The CNI case study, WP2, will produce a number of outputs including detailed security scenarios affecting CNI, security risk models and optimal regulatory policy frameworks. The methodologies and techniques to determine the validity of these deliverables will be used as feedback into the development process to ensure that they add the most value to the appropriate stakeholders.

As the end users of CNI are out of scope of the CNI case study the evaluation methods of the output of WP2 will be limited to interviews and stakeholder groups:

Interviews

Within the context of the CNI case study, to gather knowledge of the security scenarios and assessment of current regulatory security policies, all types of expert interviews will be carried out with technical security professionals within NGRID, technical personnel operating CNI and regulatory stakeholder personnel amongst others.

Stakeholder groups

There are a number of stakeholders that have interests in the CNI case study. In particular, there are a number of stakeholder groups at the national and supranational level. These groups will provide a 'sounding board' to discuss ideas for scenarios and the variety of policy frameworks. In addition, these stakeholder groups will be the forums for receiving the output of WP2 and also the most to benefit from it.

6.2 Validation Criteria, Indicators and Metrics

As this case study focuses on CNI users which end users have limited interaction with, the user acceptability validation criteria centres around the acceptance by stakeholders. Domain suitability refers to validating the outcomes of the work package against the

needs of the CNI domain, in this instance the electricity transmission networks industry. The technical usability validation criteria will test whether the outcomes of the work package are technically accurate, usable and actionable by the appropriate stakeholders.

In the following Table 4 we present the outcomes of the CNI case study and the indicators and metrics that these will be judged against these three validation criteria.

Table 4 - Key Validation Indicators in CNI case study

SECONOMICS OUTCOMES			
	User Acceptability	**Domain Suitability**	**Technical Usability**
CNI security scenarios	- Discussions and brainstorming with national and supranational stakeholders - Level of acceptance by stakeholders	- Acceptance with NGRID's business of security scenarios - Appropriate stakeholder perspectives are represented - Agreement of suitability by main national and supranational stakeholders	- Accurate scenarios given available threat information - Usable across the electricity transmission network supranationally
Security risk, socio-economic and system models	- All models are well defined and built upon formal evidence - Models are clear and easy to interpret by the stakeholders - Level of acceptance by regulator principally and other stakeholders	- All models built upon evidence of appropriate examples in the area of CNI - Degree of integration of the security, economic and social perspectives - Agreement of suitability by main national and supranational stakeholders	- Degree of monitoring and control on the key trade-offs - The result of the models are clearly defined and interpretable - All the relevant information is presented in a clear and usable manner.
Evaluation tools for providers and policy papers on future and emerging threats and regulatory frameworks.	- Explicit linkage with security scenarios and models produced - Multi-view perspective - Dissemination of the policy results to the relevant stakeholders - Acceptance and agreement by stakeholders	- Policies suitability to the CNI industry and judged successfully by stakeholders -Phraseology and terminology consistent with those used in the CNI domain -Non-expert users can potentially apply the tools and policies within their scopes	- Well defined, non-redundant and clear methodology steps - Technically actionable by stakeholders and others within the industry

6.3 Test Description and Workplan

As the CNI case study will not directly engage with end-users of electricity our main method of gathering information and presenting it will be via the relevant stakeholder and stakeholder groups internally within NGRID, nationally and supranationally.

The work plan in Table 5 below gives a description of the activities and the engagement with stakeholders during the course of the SECONOMICS project to validate outcomes of the CNI case study. However, the work plan does not describe the regular meetings that we will have with stakeholders so these are listed below:

- Ad-hoc formal and informal meetings with internal NGRID stakeholders
- Monthly meetings with national stakeholder groups such as CPNI and DECC Smart Metering Security Technical Experts group
- Quarterly meetings with supranational stakeholder group such as the European Network of Transmission System Operators for Electricity (ENTSO-E).

Table 5 - Work Plan in CNI case study

Year 1			
Security Scenarios & Requirements			
M1 – M3	M4 – M6	M7 – M9	M10 – M12
Identification of CNI stakeholders and preliminary contacts.	Scenario definition in collaboration with SECONOMICS partners. Scenario refinement through discussions with stakeholders.	High-level requirements definition in collaboration with SECONOMICS partners.	Requirements refinement through discussions with national and supranational stakeholders.
Year 2			
Model Development & Refinement			
M13 – M15	M16 – M21	M22 – M24	
Modeling activities with SECONOMICS partners and domain experts.	Presentation of draft models to appropriate stakeholders to gain expert opinions. Modeling refinement with SECONOMICS partners	Final evaluation of models with SECONOMICS partners and presentation to stakeholders.	
Year 3			
Policy Paper Development, Validation & Publication			
M25 – M27	M28 – M32	M33 – M36	
Drafting of policy paper with SECONOMICS partners and input from stakeholders	Tools and policy validation through application to scenarios with SECONOMICS partners and further input from appropriate stakeholders	Finalisation of policy paper. Dedicated workshop with internal stakeholders to get approval and publication to the wider stakeholders.	

7. Local and Regional Transport Case Study

7.1 Validation Methodologies and Techniques

Validation of the new urban public transport methods and tools and how these work in real life is a difficult task. It is indicated in the 'guidance-for-transport-impact-evaluations' of the UK government: "One of the main challenges in undertaking impact evaluations of transport interventions is the ability to demonstrate that the observed outcomes and impacts have been caused by the intervention, confidently ruling out the influence of external factors"1.
The Urban Public Transport case study (WP3) will focus on the security aspects of underground network where future and emergency threats and economical and social aspects related security will be evaluated. For this purpose the validation methodologies and techniques proposed for Urban Public Transport Case Study has the objective to evaluate that security-related activity and the SECONOMICS models developed in WP4-WP5-WP6.

Ethnographic approach / contextual enquiry

In the Urban public transport the ethnographic approach is an important method to evaluate users behaviour in the security scenarios. It will emphasises the understanding of behaviour in context through the participation of the sociology and social anthropology in the situation being studied as an active member of the team of users involved in the situation. The result will be a descriptive report, utilising mainly informal interviews and observational techniques.

Interviews
In urban public transport use case different interviews will be carried out to define security scenarios requirements and assessment of current regulatory and decision-making policies.

Focus groups

Within the context of urban public transport use case, several focus groups will be carried out to bring together different stakeholders in an informal discussion group format. Views will be elicited by a facilitator on requirements specifications and stakeholders need identification, security models evaluation and toolkit validation. It helps to identify issues which may need to be tackled and provides a multi-faceted perspective on them.

7.2 Validation Criteria, Indicators and Metrics

The high-level validation criteria: user acceptability, domain suitability and technical usability, described in Chapter 4 guide the transport case study validation process. The user acceptability validation criteria center around the acceptability of the SECONOMICS framework for various types of users and stakeholders.

[1] http://www.dft.gov.uk/publications/guidance-for-transport-impact-evaluations/

Key validation indicators to measure progress for the SECONOMICS framework will be defined, like for instance in Table 6:

Table 6 - Key Validation Indicators in Public Transport case study

SECONOMICS OUTCOMES			
	User Acceptability	**Domain Suitability**	**Technical Usability**
Public transport scenarios Description	- Discussions and brainstorming with national and European stakeholders. - Level of acceptance by stakeholders	- Verification TMB scenarios - Users perception considered. - Stakeholders perspectives represented	- Scenarios give information about TMB threats. - economic and social impact information -
Security risk and socio-economic model	- Models are well defined -Effective computation - Models are easy to interpret by the stakeholders and accepted. - Formal evidence of efficiency and effectiveness of models	-Models are developed based on defined scenarios - Acceptable level of integration of the security, economic and social dimension of scenarios	- Monitor and control of the key indicators. - The results of models are clearly interpretable. - All the relevant information is presented in a clear and usable manner.
Evaluation tools for transport operators and Guidelines for Policy Makers	- Dissemination of the evaluation tools and guidelines to the relevant stakeholders. - Evaluation and acceptance by stakeholders. - Multi-view perspective	- Compliance with actual policies, procedures and work practice in the public Transport domain -Phraseology and terminology consistent with the one used in the domain -Non-expert users can apply effectively the tools and the methodology for their scopes	- Well defined, non-redundant and clear methodology steps - Learnability of methodology in producing and linking various artefacts

7.3 Test Description and Workplan

The work plan below (Table 7) describes of the activities and the engagement with stakeholders during the course of the SECONOMICS project to validate outcomes of the Local and Regional Transport Case Study.
The work plan will be refined and updated according to project needs and milestones.

Table 7 - Work Plan in Public Transport case study

Year 1

Stakeholders Needs Identification					
M1-M3	M4-M5	M3-M6	M5-M6	M7-M9	M10-M12
Stakeholders Identification and Preliminary Contacts-	Urban public transport Security Needs Definition – Focus Group with transport Stakeholders	Scenarios Definition – Interviews with TMB Stakeholders, Literature and projects Review.	Scenario Validation and High level requirement definition	High-level Requirements Definition – Consortium Partners (End Users and Domain Experts) Ethnographic approach.	High-level Requirements Review - Interviews and focus groups with Public transport Stakeholders and End User Partner
Year 2					
Model development and validation					
M13-M17		M18-M21		M22-M24	
Modeling Activities with Consortium Partners (Technical Partners, Domain Experts and End-Users)		Models evaluation. Presentation of first version of models to appropriate stakeholders Refinement - Consortium Partners (Technical Partners, Domain Experts and End-Users)		Final models evaluation and validation. Focus groups with transport Stakeholders and End Users – Direct Observation and Interviews in a Dedicated Workshop	
Year 3					
Tool and Guidelines Validation					
M25-M28		M25 – M32		M34	
Tool Non-interactive Prototype Evaluation – Consortium Partners (domain and social experts)		Tool and Guidelines Validation trough usage and application to the Scenarios. Consortium Partners (Technical partners, domain experts and End-Users)		Tool Live Trials for Guidelines Production and Refinement with transport stakeholders and policy makers – Direct observation, interviews and dedicated Workshops	

8. Summary and Conclusions

The SECONOMICS project will deal with cross-domain and multi-perspective challenges, including policy, risk, economics and security. The multi-purpose dimension of the planned SECONOMICS framework and toolbox must be developed with care and in a step-by-step environment with realistic case studies and end-user driven development. The SECONOMICS project has therefore adapted a case study based development and evaluation approach. This document described the SECONOMICS trans-domain evaluation approach and coordinated validation plan, as well as outlined the detailed requirements and evaluation criteria for the three case study domains: airport, transport and grid. The document described the validation objectives with respect to the expected project results and the way the evaluation and validation activities will be organised and carried out in order to address these objectives.

9. ANNEX – Data Collection Templates

Here we report examples of Interviews Scripts and Questionnaires for the User Needs collection and SECONOMICS results evaluations.

Semi-structured Interviews for Stakeholders' Identification and Airport Security Requirements Collection

The interviews will be carried out using a semi-structured questionnaire, adapted for the specific situation of the interviewee. The interviews aim at developing a rich description of the security practices in the airline industry (focusing mainly on three cases chosen by Deep Blue), including:

1) The main concerns in the fight against security risks
2) The processes of each security measures
3) The relationship with other players
4) The costs and benefits associated with the use of each security measure

The following framing questions will help us to address these four broad areas:

1. Please describe your current role at [name of organization]?
2. Please describe the historical development of security in this organization:
    a. Who are the main stakeholders?
    b. What are the substantial efforts in the fight against security threats?
    c. What are the main foci of your activities?
    d. Any big success stories? Failures? Why?
3. What has been your role in any security efforts?
    a. In developing security standards (industry-wide?)
    b. Within your own organization (e.g., adopting and implementing particular security measures)
4. What factors do you believe have contributed to the development of security environment?
5. What factors do you believe have inhibited the enhancement of sound security environment?
6. What are the main benefits likely to be of security in the airline industry?
7. Which types of stakeholders will benefit?
8. Which, if any, types of stakeholders may not experience these benefits?
9. What are the prospects for the uptake of the given security measures in your organization? What airports will adopt them first? What airports will wait?
10. Will the use of the given security measures have any influence on the way business is conducted in your organization and in the airline industry?
11. How has your own organization been involved in the adoption of the given security measures?
    a. What are the barriers, if any, to participation? to adoption and use?
    b. Has your organization benefited? How? If not, why not?

Questionnaire for the evaluation of modeling languages and supporting tools

Criteria for the Modelling Language:

Coverage

- The defined set of socio-technical systems is representable in the model
- The defined set of security and trust requirements is representable in the model

Analyzability of the developed model

- The model is analyzable by using reasoning techniques or other expert-oriented techniques.
- The model supports Risk Assessment techniques.

Applicability

- The modeling language can be applied on the case study for modelling and reasoning on case study requirements.
- Both functional and security requirements characterizing case study design can be modelled using modeling language concepts.
- The security requirement modelling is computer aided.

Human effort

- The modelling of security requirements in the case study can be conducted with less effort than by using state of the art requirements modelling languages or techniques.

System Usability Scale for the Evaluation of the SECONOMICS SW Framework

This questionnaire collects data, which helps to assess the usability the SECONOMICS tools. Please fill out the questionnaire by marking the following statements on a scale from "strongly disagree" to "strongly agree".

	Strongly disagree 1	2	3	4	Strongly agree 5
I think that I would like to use this tool frequently.	☐	☐	☐	☐	☐
I found the tool unnecessarily complex.	☐	☐	☐	☐	☐
I thought the tool was easy to use.	☐	☐	☐	☐	☐
I think that I would need the support of a technical person to be able to use this tool.	☐	☐	☐	☐	☐
I found the various functions in this tool were well integrated.	☐	☐	☐	☐	☐

I thought there was too much inconsistency in this tool.	☐	☐	☐	☐	☐
I would imagine that most people would learn to use this tool very quickly.	☐	☐	☐	☐	☐
I found the tool very cumbersome to use.	☐	☐	☐	☐	☐
I felt very confident using the tool.	☐	☐	☐	☐	☐
I needed to learn a lot of things before I could get going with this tool.	☐	☐	☐	☐	☐

10. References

[1] B. Kitchenham, S. Linkman, A. Pasquini, V. Nanni, The SQUID approach to defining a Quality Model. Software Quality Control, Volume 6, Issue 3, 1997.

[2] EUROCONTROL, European Operation Concept Validation Methodology (E-OCVM), Version 1.0, 2005.

[3] P.G. Bishop, R. E. Bloomfield, A Methodology for Safety Case Development. In Proceedings of the Safety-critical Systems Symposium, 1998.

[4] http://www.hq.nasa.gov/office/codeq/trl/trl.pdf

[5] Blomberg, J., Giacomi, J., Mosher, A. & Swenton-Hall, P. (1993) Ethnographic field methods and their relation to design. In: Schuler, D. & Namioka, A. , Participatory Design: Principles & Practices. New Jersey: Lawrence Erlbaum.

[6] Fowler, FJ (Jr), Mangione, TW (1990) Standardised Survey Interviewing. Sage Publications, Newbury Park.

[7] Good, M (1989). Seven experiences with contextual field research. SIG-CHI Bull, 20(4) 25-33.

[8] Caplan, S (1990) Using Focus Group methodology for ergonomic design. Ergonomics, 33.5, 527-537.

[9] Maudsley, Greenberg & Mander (1993) Prototyping an intelligent agent through Wizard of Oz. Interchi '93 Conference Proceedings, pp 277-284.

[10] Isensee, S, & J Rudd (1966) The Art of Rapid Prototyping. International Thomson Computer Press, London.

[11] Androile S (1991) Storyboard Prototyping. QED Information Sciences, Wellesley, MA.