BREIN

Business objective driven REliable and Intelligent grids for real busiNess

# VALIDATION SCENARIO DEFINITION

# D3.1.1

## WP 3.1 - Scenarios and Conceptualisation

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# Abbreviations

| | |
|---|---|
| 4PL | Fourth party logistics |
| BREIN | Business objective driven reliable and intelligent grids for real business |
| CFD | Computational Fluid Dynamics |
| DOE | Design Of Experiments, a technique used to systematically evaluate variations in design parameters. |
| DOW | Description of work |
| ERP | Enterprise resource planning |
| FEA | Finite Element stress Analysis |
| ICT | Information and communication technology |
| SLA | Service level agreement |
| VO | Virtual organisation |

# 1. Executive Summary

This document defines the two BREIN scenarios, Virtual Engineering and Airport Management. It summarises the business background to the scenarios, outlines the business vision (Visionary Scenarios), addresses the challenges with regard to existing technologies, and then describes the Validation Scenarios.

Both of the scenarios are based on requirements which could not be fulfilled using current Technology. If traditional business processes were to be used, they would require a lot of manual interactions, especially negotiations, between the various stakeholders. This would generate very high transaction costs, which would make the new business uneconomic. Existing middleware does not have the capability to automate either of these cases. Specifically:

- The Virtual Engineering Design Scenario aims to exploit new opportunities arising in the field of Engineering Design, to automate much more of the design process. This is underpinned by the availability of low cost computational resources available at marginal costs. If the costs of the services are high, engineers will continue to rely on the existing 'serial' design process, (look at a design, evaluate it, try a new idea…) rather than automating the design process, which will require much more computational resource. In addition, they might keep the automation processes in house, buying the required hardware and software, and not outsourcing the process. If Virtual Engineering Design succeeds, it will create new business opportunities for all the stakeholders in the Virtual Organisation. However, even if the costs are low enough, failures in security, in reliability and administration, high transaction costs (thus additional costs for maintaining the transaction) and delays will all compromise the potential new market.
- The Visionary Airport Management Scenario is based around the desire of Stuttgart Airport to create a new market as a hub for airlines that operate on a point-to-point basis. The underlying business case is that if the processes described can be automated reliably and securely, there is the potential for Stuttgart Airport to act as a so called 'virtual hub' for different carriers, and for it to be more competitive on a European scale. It will also have new opportunities for the carriers, to enable them to plug into virtual airline networks, but still retaining all the attendant benefits of operating in a point-to-point manner. Again, as the market currently does not exist, all the players in the virtual hub environment will benefit from the increased throughput in Stuttgart Airport. At the same time, incremental improvements in the existing capability will still give big benefits to Stuttgart Airport, enabling it to reduce costs and increase the reliability of its logistic operations.

# 2. Introduction

## 2.1 Business Basis: Visionary Scenarios

The BREIN project is underpinned by two cases, Virtual Engineering Design, Airport Management, [1], which are used as the basis for the project requirements, and to test the results. These have been defined through 'Visionary Scenarios' in a project internal report [2]. These Visionary Scenarios are descriptions of what the End User Organisations, ANSYS and Stuttgart Airport, would like to achieve as a result of the BREIN project in order to meet their internal business objectives. They are intended to provide a Vision to the project. '*This is really what we would like to see in an ideal world without constraints'*, and to drive the project in the direction of trying to achieve the vision. However, it is recognised that these are visions, and as such are not intended to be completely fulfilled by the end of the project's lifetime. The full scale of the Visionary Scenarios is therefore considered "desirable" and not "essential".

The two scenarios are summarised below, with more detail provided in subsequent sections.

- The Virtual Engineering Design Scenario. New opportunities are arising in the field of Engineering Design, to automate much more of the design process. These are underpinned by the ready availability of low cost computational resources available at marginal costs. If the costs of the automation are high, engineers will continue to rely on the existing 'serial' design process, (look at a design, evaluate it, try a new idea…) rather than automating the design process, which will require much more computational resource. In addition, companies might keep the automation processes in house, buying the required hardware and software, and not outsourcing the process. If Virtual Engineering Design succeeds, it will create new business opportunities for all the stakeholders in the Virtual Organisation. However, even if the costs are low enough, failures in security, in reliability and administration, high transaction costs (thus additional costs for maintaining the transaction) and delays will all compromise the potential new market.
- The Visionary Airport Management Scenario. This is based around the desire of Stuttgart Airport to create a new market as a hub for airlines that operate on a point-to-point basis. The new business opportunity is that if the processes described can be automated reliably and securely, there is the potential for Stuttgart Airport to act as a so called 'virtual hub' for different carriers, and for it to be more competitive on a European scale. It will also have new opportunities for the carriers, to enable them to plug into virtual airline networks, but still retaining all the attendant benefits of operating in a point-to-point manner. Again, as the market currently does not exist, all the players in the virtual hub environment will benefit from the increased throughput in Stuttgart Airport. At the same time, incremental improvements in the existing capability will still give big benefits to Stuttgart Airport, enabling it to reduce costs and increase the reliability of its logistic operations.

Both of these cases are based around activities which are currently not feasible using existing technology. If the traditional business processes were to be used, they would be paper based, with a lot of manual interactions, especially negotiations,

between the various stakeholders. This would generate very high Transaction Costs, which would make the new business uneconomic. Existing middleware does not have the capability to automate either of these cases. The results from the BREIN project are therefore important as an Enabling Technology, to enable new business opportunities to be created.

In addition, because of their different nature, these two scenarios complement each other to test and evaluate the results from the BREIN project.

## 2.2 Nature of the Virtual Organisations

Each of these scenarios involves a number of organisations, the stakeholders, collaborating to exploit the new business opportunities, through a set of business relationships. While there is a common objective to exploit the new business opportunities created, the relationships between the stakeholders can be dynamic and encapsulated within a series of 1-1 and ad-hoc contracts and understandings. Within this document, the term Virtual Organisation is used to refer to the set of stakeholders within a particular scenario. This differs from some of the more formal definitions used, see for example http://en.wikipedia.org/wiki/Virtual_organization

## 2.3 Virtual Engineering Design

This scenario has been specified by one of the End Users in the project, ANSYS Europe Ltd, who are part of ANSYS, Inc. a major software provider in the field of Engineering Analysis software, www.ansys.com, in applications such as Computational Fluid Dynamics (CFD) and Finite Element Stress Analysis (FEA).

### 2.3.1. Vision Statement

The vision underpinning this case is to generate significant new business opportunities in software and services by exploiting the capability of GRID computing to analyse large numbers of independent design solutions quickly, cheaply and in a secure fashion.

### 2.3.2. Virtual Engineering Background

With the growth in the availability of Computing Power, Engineering Design is considering the use of techniques such as Design Optimisation, Design of Experiments (DOE) and Design for Six Sigma, see for example http://en.wikipedia.org/wiki/Design_of_experiments [3]. These techniques rely on varying input Design Parameters, and sampling the Solution Field in a structured manner, to obtain response surfaces which summarise how a particular objective, the Goal, varies as a function of these parameters. This information can be used for design optimisation, or used to asses how a design may perform ‘off design’. This is an ideal application for the GRID, since each sample is independent of other samples.

Each Design of Experiments study utilises a Workflow, which may change from case to case. For the Engineering Analysis world it could consist of several software components, each providing data to the next component in the chain. Some of these are assembled using different Commercial-Off-The-Shelf (COTS) components, or they may be contained within one simulation environment, such as the ANSYS Workbench (see www.ansys.com).

In a particular workflow the supply chain could consist of the following components:

- Design System controlling the activity and the Statistical Analysis
- Geometry generation
- Mesh generation
- Definition of Simulation Parameters and generation of Problem 'Definition' file.
- Submission to Compute Servers
- Data Extraction (the Goal)
- Further data analysis tools.

### 2.3.3. Business Background

The underlying business justifications, constraints and considerations are:

- The market is too diverse to provide generic software to cover all requirements.
- No one organisation has the expertise and resources to provide a complete solution
- Design Calculations require heavy resources during several phases of the design / product life cycle.
- Each End User Company may only wish to access the service occasionally, and not wish to (or have the staff) to keep an up-to-date capability for the general purpose software, hardware and infrastructure underpinning the simulations, e.g.:

  *We're designing a new widget now, to reach the market in a year's time. This will have a lifetime of about 5 years, and we will consider a design upgrade about 2 years after it hits the markets. We therefore need a concentrated activity now in the initial design phase, some trouble shooting later, and then a new burst of activity 12 months after product launch to give an upgrade to the product.*
- Could require flexible workflows to capture the essentials of the design processes.
- Benefits of new capability significantly outweigh the costs
- High Performance Computing is required for fast turnaround.
- The End User Company may wish that a large number of users within its own Virtual Organisation be able to access the technology in a controlled fashion.
- There are many potential tradeoffs / negotiations to be considered as part of the process:
  - CPU speed, throughput, # parallel processes, memory, cost, robustness, availability of software, licenses, security, recovery from faults etc.
- The Final Design Review could take the form of a collaborative activity, with several groups reviewing the design calculations and conclusions, checking earlier runs, commissioning new runs to complete the design space, or with

increased fidelity (e.g., mode mesh cells). The data could therefore be distributed around the grid, rather than residing on one single repository.

This scenario therefore is concerned with the formation and management of the resources of a Virtual Organisation (VO) formed for the purpose of performing virtual engineering design (in this context, VO denotes a group of business entities). The goal of the virtual engineering VO is to enable teams of engineers to participate from remote locations and collaborate in a distributed design process using simulation and visualisation software tools, based on top of automatic and autonomous contract models and "water-tight" security. Such a VO requires computational, network, storage and visualisation resources and virtual meeting rooms that may be owned and operated by different organisations. These different organisations can be different departments in a geographically distributed enterprise (e.g., ICT services, engineering teams, administration for booking and facilities management), or they can be different organisations (engineering companies, compute cycle providers, software companies, companies concerned with business logistics). Resources need to be reserved and managed throughout the VO lifecycle (though transparent to the end user) while adhering to the business policies of the organisations controlling these resources.

The overall goal of the VO is to carry out the complex simulation of the engineering design process. However, the business objectives of the differing partners of the VO are defined by their own business policies. Each organisation in the VO has their own business objective and their business objectives may conflict. This can be equally true both for intra-enterprise VOs and VOs formed between different organisations. As an example of conflicting objectives, end users – companies – will want to minimize costs while providers would want to maximize profit, which is usually tied to maximising throughput on the resource. Engineers will also want to run their jobs during the peak periods and minimize waiting times while providers prefer to run simulations during their off-peak periods and to evenly spread the load. As the individual organisations have their own goals while participating in a VO, organisational processes need to be harmonised using agents and multi-agents such that organisational goals are met. BREIN is needed in this scenario to provide the automation of the complex negotiations and the management of dynamic processes robustly and in a secure fashion. This allows the interests of the different partners to be met to a sufficient degree to ensure their willing participation in such a dynamic VO, so that such participation helps towards the fulfilment of their own business plans as well as that of the common VO.

## 2.4 Airport Management Scenario

The second scenario takes the concepts for managing Grid services and extends them to managing airport services. One particular group of services – airport logistics and ground-handling services – has been identified that has several degrees of complexity in process execution, adaptation, and re-planning.

### 2.4.1. Vision Statement

The vision is to advance current means of logistic airport operations, which are designed to handle point-to-point flights, to allow for virtual hub flights. A virtual hub flight is one that is being implemented by coupling two independent passenger flights (eg passengers, ground logistics, baggage, booking platforms) offered by two different airlines (see **Figure 1**). An airport that is able to operate these flights

efficiently could extend its current business model and offer these additional flight opportunities as a new product to customers such as airlines.

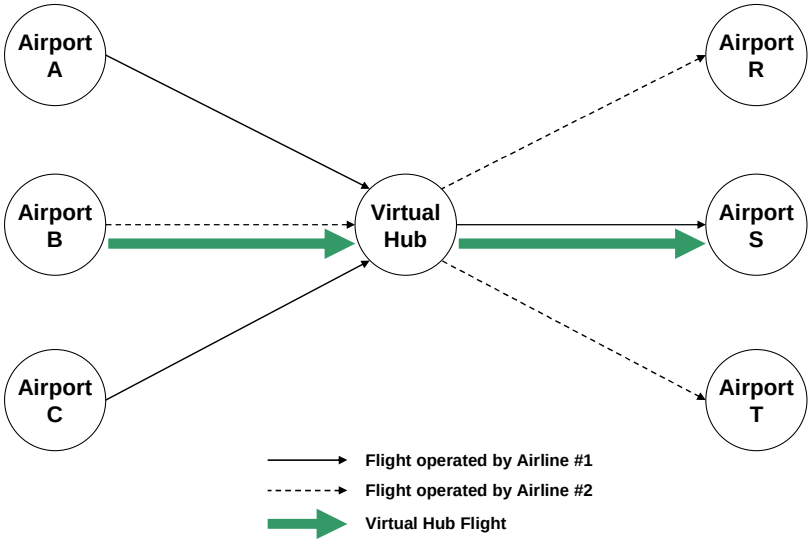


**Figure 1. Virtual Hub Airport**

The visionary scenario goes beyond "true" hub airport operations, which (1) can be found only at actual hub airports, (2) are being confined to flights of the respective airline or airline network, and (3) thus require a high degree of intra-airline coordination.

This new mode of logistic airport operations is not only beneficial to the airport, but also extends the number of flight options by exploiting network externalities. Thus it connects currently separated and autonomous airline networks without the need to redesigning, standardizing, or tightly coupling existing airline operations.

Implementing this vision requires fundamental changes in airport operations, in particular in the way how resources of different stakeholders in the entire process are being allocated and all passenger-related processes are being coordinated. The reason is that in the case of virtual hub flights, it can no longer be assumed that the respective airlines take care of the passenger for the entire flight.

The vision transforms airport business to that of fourth party logistics (4PL): these are service providers that do not own resources (i.e., aircrafts), but offer a service to end-customers and thus coordinate all activities in the logistic chain.

### 2.4.2. Airport Industry Background

The underlying business justifications, constraints and considerations of the visionary scenario are as follows:

- In recent years, competition between airports has increased significantly. The main drivers are deregulation, higher demand for customized transportation services, and the entrance of new market players such as small-sized airports privately owned airport service providers and new budget airlines.
- At the same time, the emergence of "no frill" or "low cost" airlines has changed airport business. Airports have to cope with the situation of decreasing turn-around charges and the danger of losing customers (airlines) to other airports. Many airports charge airlines based on the number of passengers, i.e., the more passengers the airport obtains, the higher the revenue. Therefore, the goal of any airport is to maintain and increase the number of flights and passengers.

- Due to these changes, airports are subject of an on-going transformation from monolithic, hierarchical organizations to networks of multiple companies that either cooperate closely to offer services to its customers or are in competition. For instance, ground handling services are no longer offered only by the airport exclusively but also by airlines or third parties, both located at the airport. In these cases, the airport provides only basic infrastructure such as buildings, access to power supply and telecommunication networks etc.

Providing virtual hub flights is a prospective extension to the current business model of airports. It is also consistent with major changes in airport value chains as well as major strategies such as concentration on core competencies (i.e., coordination), outsourcing, and added-value services.

While hub airports and hub flights greatly contribute to the mobility of passengers, the number of these airports is limited and will not increase in short time. The reason is that the implementation of true hub airports depends on strategic decisions and priorities of major international airlines that base their flight network on a small number of hubs only. Very often, each international carrier has only one or two hub airports (e.g., Lufthansa: Frankfurt and Munich). Thus, the role of all other airports in these carrier-specific networks is that of a source or destination of passengers by aggregating respectively distributing traffic.

In the vision of virtual hub flights, the limitation determined by airlines and their strategies could be overcome, because these flights can be offered to a great extend independently from the plans and priorities of the respective airlines.

### 2.4.3. Benefits

The vision aims at improving the current airport system by enabling a new form of passenger transportation based on a more flexible, loosely coupled coordination rather than the implementation of full-scale hub airports. The concept of virtual hubs yields the following benefits for the respective stakeholders:

<u>Virtual Hub Airport:</u>

- More passengers: The airport attracts passengers that are en-route to their final destination.
- More flights: By attracting more direct flights that plug in to the virtual network.
- Higher resource usage: Due to a higher number of passengers per flight. Better usage of central infrastructures such as runway systems and terminal buildings.

<u>Arrival/Departure Airport:</u>

- More passengers: By extending the number of destinations and sources respectively (that are connected via the virtual hub only).
- More flights: By attracting airlines that connect to the virtual hub.
- More destinations: Destinations that are only accessible via the virtual hub.
- Higher resource usage: Due to a higher number of passengers per flight. Better usage of central infrastructure such as runway systems and terminal buildings.

<u>Airlines:</u>

- More passengers: Passengers prefer airports that offer more and better connections.

- More flights: Allows for additional flights on the same route.
- Higher resource usage: Additional passengers fill-in empty seats (load factor).

- Passengers:
    - More destinations: By adding those that are reachable only via the virtual hub.
    - Lower costs: Expected, due to higher resource usage by airlines and airports (economies of scale).
- Society:
    - Improved transportation system: higher degree of networking; better coverage of secondary airports and respective regions (i.e., rural, remote).

### 2.4.4. Challenges

Implementing the vision requires new means of logistic airport operations and an ICT infrastructure that addresses the specific organizational setting of a virtual hub. In particular, these challenges are:

<u>Non-hierarchical planning:</u>

- A top-down approach for planning and executing the process of a virtual hub flight is not feasible. The reason is that multiple stakeholders/participants are involved in this process and that the airport has not full control over all respective activities. Thus the airport has limited capabilities and power while coordinating the process. The business of virtual hub flights is primarily that of the airport, and not of the involved airlines.
- Conflicting goals: More specifically, the goals of the stakeholders are conflicting. For instance, airlines are interested in the performance of their own point-to-point flights, not in hub flights that incorporate activities of others, especially competitors. These conflicts need to be considered when allocating central resources.
- Balance between normal operations and hub operations: Passengers en route between virtual hub flights represent only a small amount of all passengers; hence the airport has to consider both types of passenger and respective processes. Thus hub operations should not harm other modes of operations. For instance, in the case of missing resources and expected delays a consideration of potential effects on the airport, involved airlines, and third parties is necessary.
- Competition between airport service providers: In general, each service and resource that is part of logistic airport operations can be provided by the airport or another entity (note: restricted by national legislation). Thus the coordinator must incorporate the potential benefits of substituting services and resources by those of third parties; this requirement is most evident for highly fragmented airport systems that rely on networks or pure competition rather than long-term, static structures. In these systems, service provision is the result of negotiations, and is defined in detailed specifications. Current ICT support for negotiating services between providers and users as well as the formal specification of these services is weak; it is very often subject of individual applications on top of ERP systems (e.g., data extraction and calculation using Excel sheets).

Dynamics and volatility:

- Dynamics and volatility are essential characteristics of any airport operation.
- Dynamics describes the fact that all planned activities can be subject of internal (e.g., resource failure) and external disturbances (e.g., delay of arriving flight) that affect, delay or constrain the process. These disturbances can not be foreseen, though their probability can be forecasted and thus integrated in plans. In virtual hub operation, disturbances are even more demanding since they could prevent the implementation of the virtual hub flight at all (because the number of alternatives is lower).
- Volatility describes multiple, heterogeneous patterns of resource utilization that often show short intervals of peaks (i.e., during rush hour) followed by periods of low utilization.
- Both properties require the capability to dedicate resources timely and at the right place while resources also need to be set up and suspended flexible and at no cost, if possible.

Time constraints:

- Hubs in general and virtual hubs in particular require speeding up operations and reducing lead times. At least, it is necessary (1) meeting time constraints such as a given maximum time for baggage transfer and (2) guaranteeing a certain level of service to the final customer (passenger). Otherwise, the transfer passenger would miss the connecting flight or leave without baggage. However, current airport operations and ICT infrastructure have not been designed towards virtual hub operations.
- Meeting time constraints is up to the airport, not to the airlines. Thus coordination by the airport also calls for accessing all relevant process information from various entities, evaluating the current state of all transferring passengers as well as taking ad-hoc measures to secure the transfer, e.g., finding and allocating additional resources to specific process instances.
- These constraints call for automating manual tasks, if possible, and exchanging information in real-time and across organizational boundaries.

Interoperability and connectivity:

- Considering that logistic airport system evolve from formerly monolithic, hierarchical structures to network organizations that consist of some central infrastructure and multiple, even competing service providers, the need for interoperability and connectivity becomes evident.
- Interoperability addresses the capability of ICT systems to work together. Current ICT systems at airports realize interoperability by increasing the coverage of the airport's ERP system as far as possible, thus replacing legacy systems and making interfaces obsolete. In network organizations, however, this approach is no longer feasible, since network participants will not make short-term, risky investments in proprietary, hence airport-customized ERP systems.
- Connectivity addresses the capability of ICT systems to allow for an easy entry to the airport system as well as an easy dissolution of the connection. This capability supports new business models of service providers that participate flexible and temporarily in these networks.

- Both issues call for a machine-readable, unambiguous and inter-organizational representation of the common domain concepts, the actors, their goals and service capabilities. It requires also the adoption of industry-wide standards for inter- and intra-airport data exchange, at least on the conceptual level.

Security:

- In general, airport operations are subject of extensive security requirements (i.e., security checks, hand baggage restrictions, customs, anti-terrorism measures) as well as legislation (i.e., passenger rights) that either can (1) require to exchange a specific information with third parties or (2) prevent exchanging and accessing all passenger-related information within the process.
- Thus, for managing a virtual hub flight, the hub has to design the information exchange with the airlines that operate the arriving and departing flight (i.e., automated check-in), service providers involved in the ground handling process, customs (i.e., automated declaration), and the passenger itself. This imposes the consideration of technical, legislative, and process-related requirements.

# 3. Validation Scenarios

The Visionary Scenarios are descriptions of what the End User Organisations, ANSYS and Stuttgart Airport would like to achieve as a result of the BREIN project in order to meet their internal business objectives. They are intended to provide a Vision to the project. '*This is really what we would like to see in an ideal world without constraints'*, and to drive the project in the direction of trying to achieve the vision. However, it is recognised that these are visions, and as such are not intended to be completely fulfilled by the end of the project's lifetime.

Note also that these scenarios are scenarios driven by requirements from two End Users, who do not represent all the potential uses of the BREIN results. They are therefore not comprehensive in scope.

The Validation Scenarios are cases whose purpose is to validate [4] the results of the project, and to use objective evidence to confirm that these products meet user needs. They have been devised to test whether specific aspects of the project work meet selected user requirements (described in the visionary scenarios), and to measure the progress towards those goals. They can be considered individual steps to be taken towards the „visionary scenario". However, they are not intended to actually reach this goal

The Validation Scenarios are cases that have been devised to validate [4] the results of the project, and to use objective evidence to confirm that these products meet user needs. They have been devised to test whether specific aspects of the project work meet selected user requirements (described in the visionary scenarios), and to measure the progress towards those goals. Each validation scenario can be considered an individual step to be taken towards the respective visionary scenario. They are, however, not intended to actually reach this goal to the full extent.

## 3.1 Format of the Validation Scenarios

The validation scenarios are presented in a standardised tabular format, with the following general categories:

- Outline description of the Test Case
- Importance of the Test
- Resources required
- Aspects of the project tested
- Acceptance Criteria.

## 3.2 Virtual Engineering Design

### 3.2.1. Basic DOE Operation

| Validation Scenario Definition Sheet | |
|---|---|
| #1 | Title: Basic DOE Operation |
| Description | |
| • Define fixed number of runs. (32 say) and input files<br>• Each Run takes 0.5 hours single processor, 5 mins 8 processors<br>• Requirement, 32 results in 12 hours<br>• Discover resources, (hardware, software installed, licences available)<br>• Negotiate agreement, minimum cost<br>• Run cases, get summary results returned<br>• Send bill to customer | |
| Ranking(1-5)<br>(5 Essential, 1 Nice to Have) | Comments |
| 5 | Basis for rest of the scenarios |
| Resources Required | |
| Hardware | Several Virtual Service Providers with existing umbrella agreements for use |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| Dependencies | |
| None | |
| BREIN Aspects | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | See #1a |
| Dynamic Workflow | |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| Acceptance Criteria | |
| 32 results in 24 hours | |

| Validation Scenario Definition Sheet | |
|---|---|
| #1.1 | Title: Ease of Use for Engineer |
| Description | |
| • This scenario should test that the engineer can use the services available to them with little intervention from the business aspects. All the business aspects should be dealt with by separate actors. | |
| Ranking(1-5)<br>(5 Essential, 1 Nice to Have) | Comments |
| 4 | |
| Resources Required | |
| Hardware | Several Virtual Service Providers with existing umbrella agreements for use |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| Dependencies | |
| None | |
| BREIN Aspects | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | Yes |
| Dynamic Workflow | Yes |
| Semantics and Interoperation | Yes |
| Exploitation potential | Yes |
| Other, please specify | |
| Acceptance Criteria | |
| Engineer can use the services without having to bother with making business agreements and paying bills. These should be handled by other actors (for example the account manager at the engineer's company). | |

| Validation Scenario Definition Sheet | |
|---|---|
| #1.2 | Title: Make Abstract Workflow Concrete |
| Description | |
| • User gets an abstract workflow and attempts to enact it.<br>• The enactor discovers resources, (hardware, software installed, licences available)<br>• Agents negotiate SLAs<br>• Enactor runs jobs at service providers<br>• Results are collated and returned to user.<br>• Bill is sent to user's account manager | |
| Ranking(1-5)<br>(5 Essential, 1 Nice to Have) | Comments |
| 5 | This is a workflow-specific version of scenario #1 |
| Resources Required | |
| Service Providers | These need to be discoverable and their offerings need to be represented in ways that are comparable to the customer. |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| Dependencies | |
| None | |
| BREIN Aspects | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | Yes – tokens for access to the service will be issued to authorised users at enactment time. |
| Dynamic Workflow | Yes |
| Semantics and Interoperation | Yes |
| Exploitation potential | Yes |
| Other, please specify | |
| Acceptance Criteria | |
| The workflow can be executed. | |

| Validation Scenario Definition Sheet | |
|---|---|
| #1.3 | Title: Workflow Adaptation |
| **Description** | |
| • The workflow is running as normal and an event that causes the need for adaptation in the workflow occurs. (This could be something like a service provider is busy or the customer needs more resources than previously agreed).<br>• The workflow must be adapted to take account of these events. | |
| **Ranking(1-5)**<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 4 | This will test the agents adaptation of the workflow |
| Resources Required | |
| Service Providers | These need to be discoverable and their offerings need to be represented in ways that are comparable to the customer. |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| Dependencies | |
| None | |
| BREIN Aspects | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | See #1a |
| Dynamic Workflow | This is what is being tested. |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| Acceptance Criteria | |
| An error condition (event as above) occurs and the workflow is automatically adapted to fix the problem. | |

| Validation Scenario Definition Sheet | |
|---|---|
| #1.4 | Title: Negotiate SLAs |
| **Description** | |
| • Automatic negotiation of SLAs is the focus of this test. The extent of the automation is to be determined, as it is unlikely customers will want completely automated negotiation and agreement of the SLAs as there needs to be someone that can take responsibility for the agreement. | |
| **Ranking** (1-5)<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 5 | |
| **Resources Required** | |
| Service Providers | |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| **Dependencies** | |
| None | |
| **BREIN Aspects** | |
| SLA and negotiation | This is what is being tested |
| Agents, | This is what is being tested |
| Security | |
| Dynamic Workflow | |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| **Acceptance Criteria** | |
| There is a large proportion of automated negotiation for SLAs. | It may be the case that the negotiation is automatic and a series of options is presented to a user, who then picks one (or more) and then does the final step of making the agreement. |

### 3.2.2. Security

| Validation Scenario Definition Sheet | |
|---|---|
| #1a | Title: Security |
| Description | |
| • Check users of the system (people and organization) are permitted to access the resources<br>• Allow engineering groups in the VO access to engineering results which will be stored on the system on which the job was run, ie distributed data<br>• Allow finance people (service provider) access to finance records on system usage<br>• Allow finance people (software provider) access to license usage<br>• Allow legal people (software provider) access to information on licenses, users, Export controls.<br>• Enable security and access controls to be audited ? (How ?) | |
| **Ranking** (1-5)<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 5 | Essential Basic Security |
| **Resources Required** | |
| Hardware | Several Virtual Service Providers with existing umbrella agreements for use |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| User Verification System | Eg Use synthetic system to mimic action of Tradepoint web site<br>(web system, send user name, Nationality, Company name, get OK, or not) |
| **Dependencies** | |
| # 1 | |
| **BREIN Aspects** | |
| SLA and negotiation | |
| Agents, | |
| Security | Yes |
| Dynamic Workflow | |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| **Acceptance Criteria** | |
| Demonstrate and test access controls | Show non-authorised people cannot access the data |

| Validation Scenario Definition Sheet | |
|---|---|
| #1a.1 | Title: Correct Issuance of Access Tokens |
| **Description** | |
| • A User wants to run an experiment within the context of an existing SLA.<br>• The system must issue security tokens for that user and only at the request of an authorised party (for example an account manager or signatory of the SLA).<br>• The access tokens may be access tokens for a user, or they may be access tokens for software licenses. We should have scenarios that test both of these (separately or in one workflow). | |
| **Ranking** (1-5)<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 5 | |
| **Resources Required** | |
| Service Providers | These need to already have SLAs with the customer. |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| **Dependencies** | |
| 1a | |
| **BREIN Aspects** | |
| SLA and negotiation | SLAs need to be pre-existing |
| Agents, | |
| Security | This is what is being tested |
| Dynamic Workflow | |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| **Acceptance Criteria** | |
| Authorised users (and only these) will be able to request tokens for access to services for identified users and those users will be able to access the correct service. | |

| ValidationScenario Definition Sheet | |
|---|---|
| #1a.2 | Title: Collaboration |
| **Description** | |
| • This is where a user that owns a job running on a service provider can grant access to a part of that job (or the data coming out of it) to another user in a *managed and constrained* way (e.g. the delegated user can only see exactly the data they are permitted an no other data, and they only have read access). | |
| **Ranking** (1-5)<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 4 | |
| **Resources Required** | |
| Service Providers | These need to already have SLAs with the customer. |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| **Dependencies** | |
| 1a | |
| **BREIN Aspects** | |
| SLA and negotiation | SLAs need to be pre-existing |
| Agents, | |
| Security | This is what is being tested |
| Dynamic Workflow | |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| **Acceptance Criteria** | |
| The job owner can grant access to another user, and that user can access the information to which they have been granted access, and no other. | |

### 3.2.3. Service Failure

| Validation Scenario Definition Sheet | |
|---|---|
| #2 | Title: Service Failure |
| Description | |
| System dies or becomes unavailable.<br>• Identify problem<br>  – failure of machine, network dies, runs out of financial credit, licenses being used<br>  – software fails, (divergence)<br>  – Killed by a master process / user for some reason<br>• clean up<br>• identify and renegotiate resources,<br>• reschedule jobs (or mark it a failure) | |
| Ranking (1-5)<br>(5 Essential, 1 Nice to Have) | Comments |
| 4 | Basis for rest of the scenarios |
| Resources Required | |
| Hardware | Several Virtual Service Providers with existing umbrella agreements for use |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| Dependencies | |
| # 1 | |
| BREIN Aspects | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | |
| Dynamic Workflow | Yes |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| Acceptance Criteria | |
| 32 results in 24 hours | Need a data base of possible failure modes, eg<br>• error #6 returned.<br>• No response from system in 5 minutes<br>• (Could have a learning system, ??)<br>Test: Randomly pick a resource, and kill it |

### 3.2.4. Portfolio Management

| Validation Scenario Definition Sheet | |
|---|---|
| #3 | Title: Portfolio Management |
| Description | |
| • 2 users, different requirements re resources have negotiated resources and have commenced runs using the available resources from a service provider.<br>• Then 2 key customers with pre-agreed SLA's committing to fast response come along, and need resources NOW. | |
| **Ranking** (1-5)<br>(5 Essential, 1 Nice to Have) | **Comments** |
| 3 | Really a perturbation on the Failure scenario |
| **Resources Required** | |
| Hardware | Several Virtual Service Providers with existing umbrella agreements for use |
| OS | Standard ANSYS supported platforms |
| Winzip | |
| ANSYS Software | Use synthetic software |
| FlexLM licenses available | Use synthetic license management |
| **Dependencies** | |
| # 1 | |
| **BREIN Aspects** | |
| SLA and negotiation | Yes |
| Agents, | Yes |
| Security | |
| Dynamic Workflow | Yes |
| Semantics and Interoperation | |
| Exploitation potential | Yes |
| Other, please specify | |
| **Acceptance Criteria** | |
| 32 results in 24 hours for original customers + meeting key customer's demands. | |

## 3.3 Airport Management

The set of validation scenarios comprises three groups:

- Scenarios describing the complexity of processes:
  - #1: Normal Flights
  - #2: Real Hub Flights
  - #3: Virtual Hub Flights
- Scenarios describing the degree of disturbances:
  - #4: Service Failure
  - #5: Service Shortage
- Scenarios describing the VO Lifecycle. In the airport scenario, a VO is formed in order to handle a flight or a group of similar flights:
  - #6: VO Formation
  - #7: VO Re-formation
- Scenarios describing the role of passengers:
  - #8: Booking Platform
  - #9: Virtual Hub Flight Information & Communication

Each group represents a specific aspect of the overall airport management scenario, thus there are mutual relations and dependencies between two or more validation scenarios. In particular, a realistic and more complex situation can be easily represented by combining them.

Each validation scenario is defined in a uniform manner (see next page).

### 3.3.1. Airport Operation for Normal Flights

| No. | #1 |
|---|---|
| Title | Airport Operation for Normal Flights |
| Definition | In this scenario, selected logistic activities related to a normal flight are controlled and executed by the system. Based on a pre-defined process, the interactions between the airport and its internal and external service providers are simulated and recorded. |
| Description | • The built-time of this scenario includes manual definition of the logistic process based on known services and requirements coming from the flight (e.g., aircraft, contract with the airline).<br>• The process starts with accessing information on the incoming aircraft (e.g., flight number, departure and arrival time, aircraft type, number of passengers, total weight etc.) and ends with the same aircraft leaving the airport (or being parked there overnight).<br>• The logistic process consists of services that must be performed independently, in parallel, or serial only. **Services may** require set-up times; others can not start directly after the preceding one has finished.<br>• **All services** performed and the state of resources need to be monitored and logged permanently (due to security, legal, and revision requirements). |
| Quantity Structure | • 1 flight only (no performance issues)<br>• 4 different types of services: transportation of passengers (1-to-many); transportation of the aircraft (1-to-1); provision of static equipment; fuelling.<br>• 3 different types of resources (i.e., physical, electronic/virtual, human) |
| BREIN Aspects | |
| SLA and Negotiation | Tests that service contracts can be represented (definition only). |
| Multi-agent | Tests that agents interact with each other (i.e., requesting and delivering services) |
| Semantics and Interoperation | Tests that logistic services and resources can be represented semantically based on a service ontology and a domain-specific logistics ontology. |
| Dynamic Workflow | None |
| Security | None |
| Dependancies | This is a prerequisite for all subsequent tests. |

### 3.3.2. Airport Operation for Real Hub Flights

| No. | #2 |
|---|---|
| Title | Airport Operation for Real Hub Flights |
| Definition | A real hub flight requires that logistic activities of at least two subsequent, inter-related flights are controlled and executed by the system in order to guarantee that arriving passengers get their connecting flight. Based on two pre-defined processes, the interactions between the airport, its service providers, and the responsible airline are simulated and recorded. |
| Description | • The built-time includes manually defining two or more logistic processes based on known services and requirements coming from the single flights (e.g., aircraft, contract with the airline) as well as the inter-relation between the flights which is also described in a contract with the airline (i.e., minimum time span, service level, penalty fees etc.).<br>• The scenario starts with accessing information on the earlier (incoming) aircraft and ends with the latter aircraft leaving the airport.<br>• The logistic processes are similar to those of normal flights. Both processes share some data (e.g., passenger data) and exchange data on their current state: e.g., arrival time; progress of ground handling, expected completion time; delay (requires that connecting flight waits). |
| Quantity Structure | • 3 flights: 2 incoming flights with passengers sharing the same connecting flight (no performance issues)<br>• 5 different types of services: see validation scenario #1, plus: transportation of flight attends from incoming to connecting flight. |
| BREIN Aspects | |
| SLA and Negotiation | (added) Tests that more complex service contracts can be represented. |
| Multi-agent | (added) Tests that agents involved in two or more logistic processes interact with each other. |
| Semantics and Interoperation | (added) Tests the validity of the logistics ontology. |
| Dynamic Workflow | None |
| Security | None |

### 3.3.3. Airport Operation for Virtual Hub Flights

| No. | #3 |
|---|---|
| Title | Airport Operation for Virtual Hub Flights |
| Definition | A virtual hub flight requires that logistic activities of at least two subsequent, inter-related, though independent flights are controlled and executed by the system in order to guarantee that arriving passengers get their connecting flight. The major difference is that the 'virtual hub aspect' of the process is mainly managed by the airport: the involved airlines do not cater for the process, they even do not know about the fact that passengers board one airline in order to continue their flight by another airline. Again, there are pre-defined processes and the interactions between the airport, its service providers, and the responsible airline are simulated and recorded. |
| Description | • The built-time includes manual definition of two or more logistic processes based on known services and requirements coming from (1) the single flights (e.g., aircraft, contract with the airline) and (2) the inter-relation between the flights which is mainly described in a contract between the airport and passengers en-route to virtual hub flights.<br>• The scenario starts with accessing information on the earlier (incoming) aircraft and ends with the latter aircraft leaving the airport.<br>• The logistic processes are similar to those of real hub flights, though there is a thighter inter-relation. |
| Quantity Structure | • 3 flights: 2 incoming flights (airline A and B) with passengers sharing the same connecting flight (airline C).<br>• 6 different types of services: see validation scenario #2, plus: transportation of individual passengers from incoming to connecting flight, and transportation of respective baggage. |
| BREIN Aspects | |
| SLA and Negotiation | (added) Tests that service contracts with passengers can be represented and maintained in order to decide of rescheduling / shifting passengers. |
| Multi-agent | (added) Tests that agents involved in two or more logistic processes interact with each other; these agents may represent different organisations, thus they may have different and maybe conflicting goals. |
| Semantics and Interoperation | (added) Tests the validity of the logistics ontology. |
| Dynamic Workflow | None |
| Security | None |

### 3.3.4. Service Failure

| No. | #4 |
|---|---|
| Title | Service Failure |
| Definition | A service, being part of a current logistic process, fails and becomes unavailable (e.g., due to failure of machine, missing staff, or broken communication). The system replaces the service by a new one. |
| Description | The service failure needs to be recognized by the system. The system needs to find service providers that can deliver the same or a similar service in due time. The new service will be integrated in the current process. Finally, the service usage must be considered in the billing of services. |
| Quantity Structure | • 1 logistic process for a flight.<br>• 1 service failure; the scenario distinguishes different types of services (one for each service type such as aircraft-related service, passenger-related service, airport-related service). |
| BREIN Aspects | |
| SLA and Negotiation | Tests that the airport can look for replacement services and negotiate with potential service providers. Tests that service providers can be found by the airport and that service providers can offer their capabilities. Tests that a solution must be found in due time, even if it is a sub-optimal solution. |
| Multi-agent | Tests that agents negotiate the new service with respect to their business goals. Airport and service providers (and their respective resources) are represented by agents.<br>Tests that agents observe current services, recognize service failures, assess the failure type, and reason about solutions to the problem in due time. |
| Semantics and Interoperation | Tests the validity of the service properties in the ontologies. |
| Dynamic Workflow | Yes (scenario is about dynamic workflow) |
| Security | Tests that only approved service providers are considered. |

### 3.3.5. Service Shortage

| No. | #5 |
|---|---|
| Title | Service Shortage / Resource Bottleneck |
| Definition | A service becomes overloaded, thus the capacity of the respective resources is not sufficient to fulfil all service requests in due time. The system adjusts relevant planned processes that require this service under consideration of business goals and trade-offs. |
| Description | The service shortage needs to be recognized by the system. The system needs to identify the processes that are in danger of being hampered. The system reasons about how to distribute the limit capacity of the resource to the most valuable processes (from the airport's viewpoint). It negotiates new processes (thus modifies the current plan) with the respective stakeholders. |
| Quantity Structure | • 10 logistic processes within in the same interval of time (let say, 1 hour)<br>• 1 service shortage: the overall capacity is sufficient to fulfill only xx % (need to be defined) of the processes; the scenario distinguishes different types of services, thus there will be several runs (one for each service type). |
| BREIN Aspects | |
| SLA and Negotiation | Tests that service providers (here: airport or third party) can negotiate with multiple customers simultaneously. Tests that service providers can assess the inter-relation between multiple SLAs concerning the same service. |
| Multi-agent | Tests that agents negotiate under consideration of trade-offs (e.g., which processes are most valuable, which should be served to what degree?). |
| Semantics and Interoperation | Tests that inter-relations between multiple SLA can be represented or derived. |
| Dynamic Workflow | Yes (scenario is about dynamic workflow) |
| Security | None |

### 3.3.6. Process Planning / VO Formation

| No. | #6 |
|---|---|
| Title | Process Planning / VO Formation |
| Definition | The processes for a set of flights need to be planned. The system negotiates with potential service providers that form VOs for these flights. |
| Description | The input for this scenario are requirements coming from an airline. The airport has to form a VO for handling this flight that does not fit into the more conventional, every-day flights and processes. |
| Quantity Structure | • 10 flights within in the same interval of time (let say, 1 hour)<br>• 6 different types of services, see validation scenario #2 |
| BREIN Aspects | |
| SLA and Negotiation | Tests that the system can set up a VO and define respective SLAs. |
| Multi-agent | Tests that agents representing the stakeholders in the foreseen VO negotiate the structure and conditions of the VO. Tests the pro-activity property of agents. |
| Semantics and Interoperation | Tests the representation of market-oriented properties of services and their stakeholders (in order to enable market-oriented negotiation). |
| Dynamic Workflow | None |
| Security | Tests that only approved service providers are considered in the VO. |

### 3.3.7. Process Re-Planning / VO Re-Formation

| No. | #7 |
|---|---|
| Title | Process Re-Planning / VO Re-Formation |
| Definition | A process plan for one or more flights can not be fulfilled due to a severe change in the environment. Therefore, the respective plan needs to be modified. This may cause a re-formation of the respective VO. |
| Description | Re-planning may also change the time of respective flights. |
| Quantity Structure | • 10 flights within in the same interval of time (let say, 1 hour)<br>• 6 different types of services, see validation scenario #2 |
| BREIN Aspects | |
| SLA and Negotiation | Tests that the system can change a VO and re-define respective SLAs. |
| Multi-agent | Tests that agents representing the stakeholders in current VOs re-negotiate the structure and conditions of the VO. |
| Semantics and Interoperation | Test the representation of stakeholders and their services. |
| Dynamic Workflow | This may require a dynamic workflow to meet the changed conditions |
| Security | Tests that only approved service providers are considered in the VO. |

### 3.3.8. Booking Platform for Virtual Hub Flights

| No. | #8 |
|---|---|
| Title | Booking Platform for Virtual Hub Flights |
| Definition | The airport operator provides a booking platform for virtual hub flights. Thus it extends its own business by offering flights to the final customer. The platform will be accessed by final customers and exchanges information with airlines. |
| Description | The platform needs to gather information about all incoming and outgoing flights based on the flight schedule, find potential and realistic combinations, calculate a price for those combinations, offer combinations to customers via a front-end, process orders (by collecting data from the customer, forwarding orders to the airlines, serving as the interface to the customer, and handing over passenger and travel information to airport operations for virtual hub flights. |
| Quantity Structure | 10 airlines, each offering 20 flights per day to/from 5 locations |
| BREIN Aspects | |
| SLA and Negotiation | Tests agreements with different service providers |
| Multi-agent | None |
| Semantics and Interoperation | Semantics: Tests the representational validity of the 'flight ontoloty'.<br>Interoperation: Tests that distributed transactions can be performed. |
| Dynamic Workflow | None |
| Security | Tests that passenger information can be exchanged. |

### 3.3.9. Virtual Hub Flight Information & Communication

| No. | #9 |
|---|---|
| Title | Virtual Hub Flight Information & Communication |
| Definition | Passengers are provided with real-time information related to their virtual hub flight. In addition, passengers that about to miss their connecting flight may communicate with the booking platform. |
| Description | • The main question is how to access, aggregate and disseminate this distributed information in a timely manner (i.e., special monitors at the gates, instructing flight and ground assistants).<br>• The passenger needs to be informed pro-actively if he is in danger of missing his connecting flight<br>• If the passenger will miss his connecting flight, he may contact – or will be contacted by the system – in order to check whether the airport provides alternative flights. If so, he may book immediately such a flight. |
| Quantity Structure | 10 airlines, each offering 20 flights per day to/from 5 locations |
| BREIN Aspects | |
| SLA and Negotiation | None |
| Multi-agent | Tests that individual passengers can be represented by agents that take over their role and aim at meeting personal goals. These agents search for alternatives (via the booking platform) and negotiate with the airport and/or airlines (since they have a contract and respective rights). From the airport's point of view, the scenario tests agents that monitor individual passengers, thus there are counterparts to the former agents. |
| Semantics and Interoperation | Tests the representational validity of the 'passenger ontology'. |
| Dynamic Workflow | None |
| Security | Tests that passenger information can be exchanged, yet respecting individual passenger's security requirements.. |

# References

[1] BREIN Description of work, Internal Project Document

[2] BREIN Internal Report IR 3.1.1

[3] http://en.wikipedia.org/wiki/Design_of_experiments

[4] ISO 9000 Definitions Translated into Plain English http://www.praxiom.com/iso-definition.htm