Optimisation Service Provider (OSP) Project:

From Web-based Applications to Web-Services

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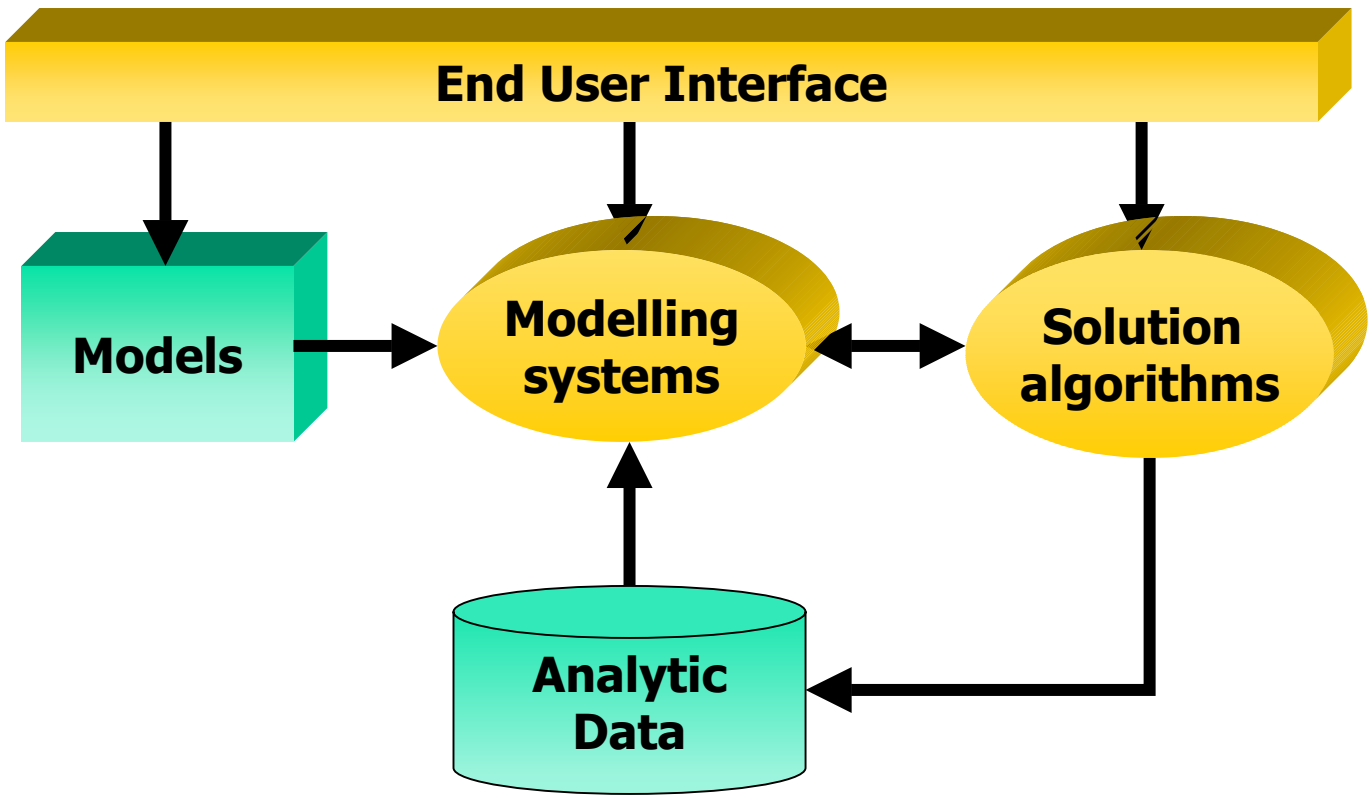
Outline

- Optimisation tools: evolution
- The ASP model
- Optimisation Service Provision (OSP)
- e-Services
- WebOpt
- Conclusions

Optimisation tools interaction

Traditionally, optimisation based applications comprise models, optimisers and analytical data, connected via a model management system.



Evolution: until the 1990s

- Proprietary tools. Optimisation routines and models are hard coded into the system
- Pros:
  - Close match to application requirement
  - Computational Efficiency
  - Customised data mart and reporting facilities
- Cons:
  - Expensive and time consuming to build
  - Poor connectivity to other applications
  - In general, not flexible and hard to adapt when the application changes

Evolution: the 1990s

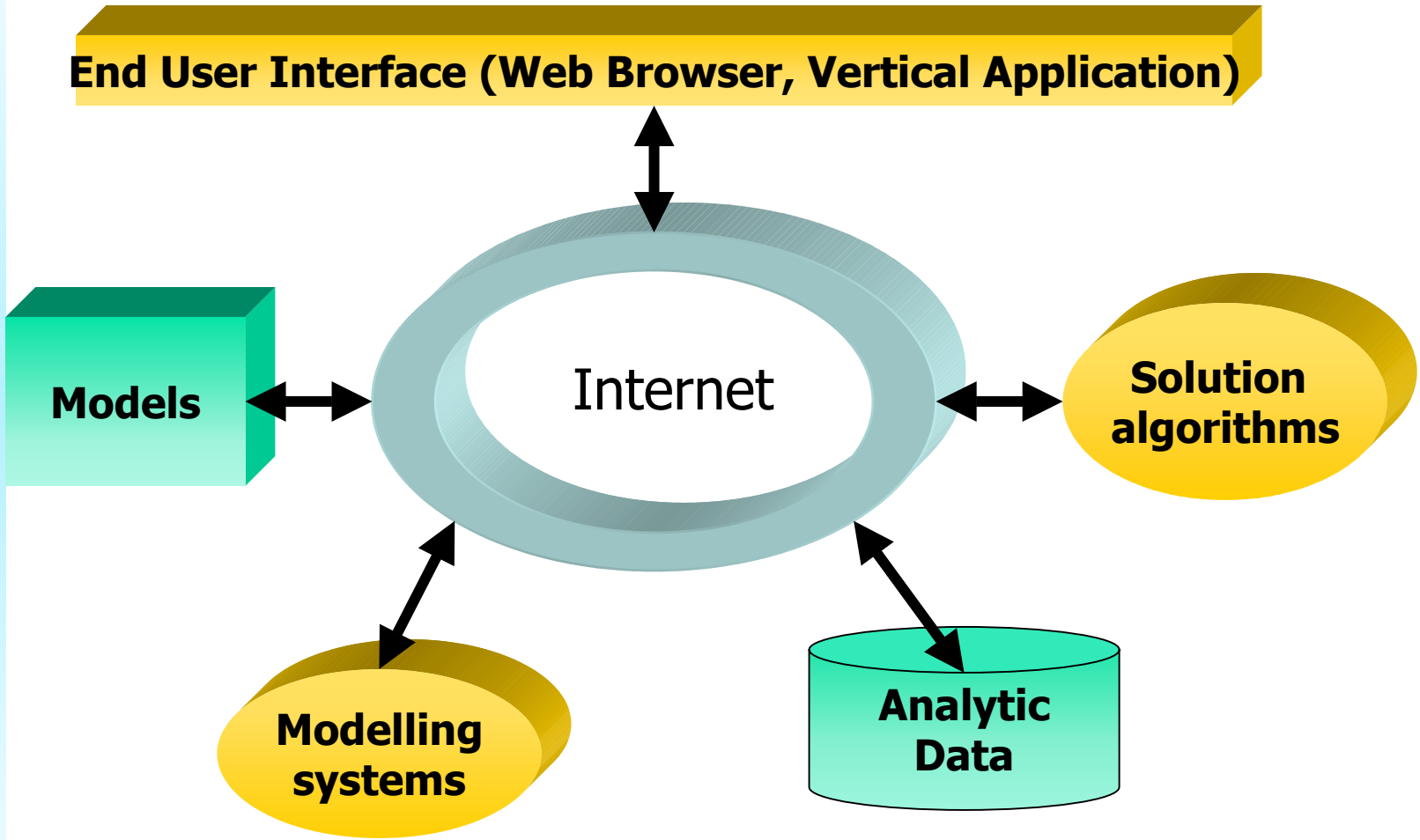
- Off-the shelf tools: Optimisers and Modelling Systems
- Variety of modelling systems possess database and solver connectivity
- Pros:
  - Rapid prototyping can be achieved
  - Industry standard connectivity to other applications such as databases and reporting tools
  - Models can be communicated in file form between different analysts and users

  Cons:
  - Customised DSS still developed using proprietary technology
  - Reliability of the tool associated with the vendor
  - Incompatibility between different tools

Evolution: nowadays

- Optimisation increasingly used as an inference engine
- Modelling systems and solvers are becoming available in **component form**
- Optimisation tools now allow more MP paradigms (QMIP and SP)
- Internet technology has facilitated the creation of distributed applications

Distributed optimisation



Application Service Provision (ASP)

- According to the definition:
  - The provision of applications over an electronic network
- In practice:
  - Delivery of software programs via Web browsers or other internet-based clients
- Underlying idea:
  - Outsourcing of (computation) resources

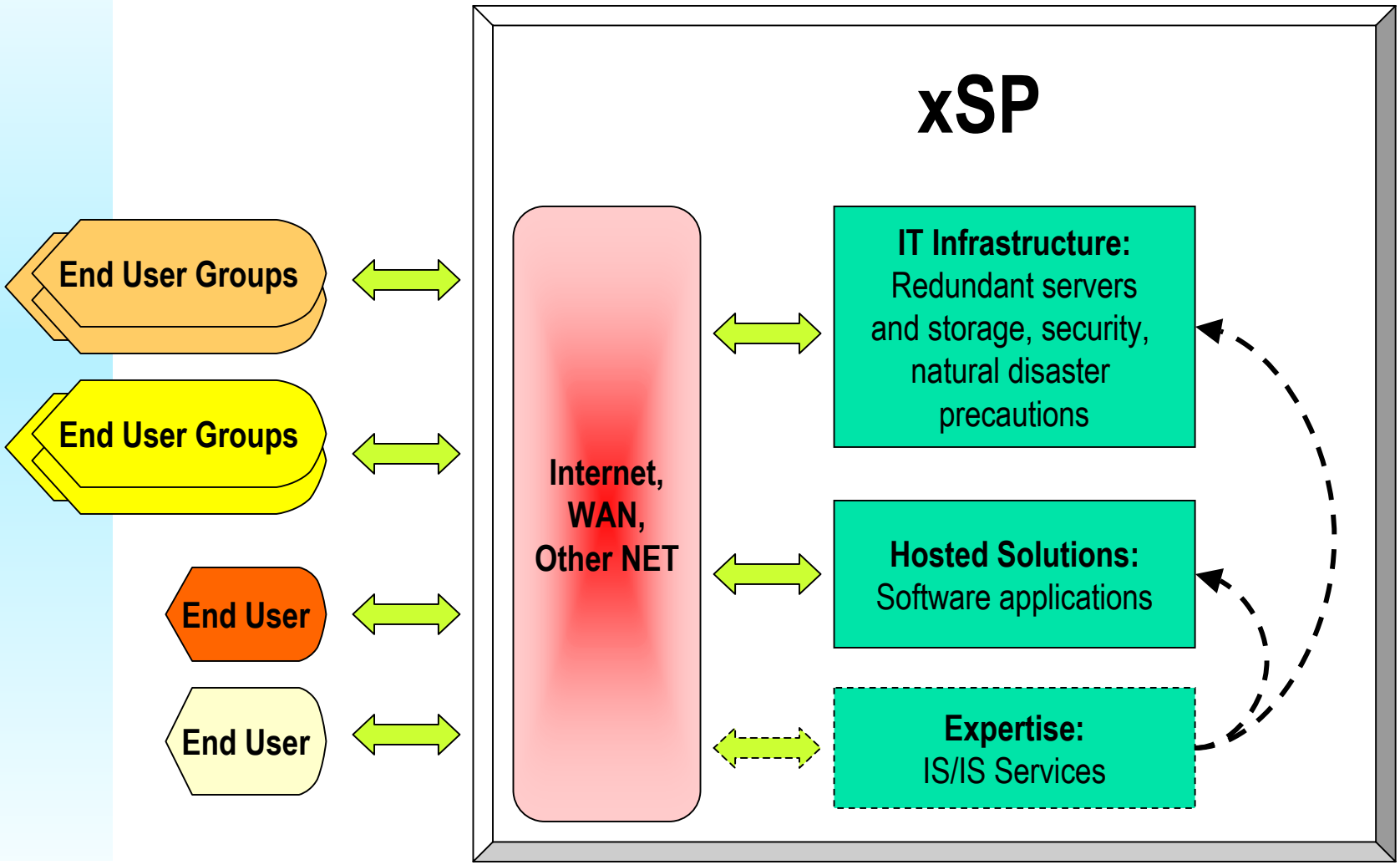
Application Service Provision (ASP)

- Application Service Provision (ASP) promises to reduce the costs of acquiring state-of-the-art IT
- ASP ensures robustness, uptime and upgrade paths
- ASP take up the cost of acquiring, securing, configuring, and maintaining, on behalf of a client, all necessary IT infrastructure, in return of a pay-as-you-go fee

xSP

- The idea of application service provision is extended to include the provision of other IT and IS features:
  - MSP (Managed Service Providers)
  - NSP (Network Service Providers)
  - VSP (Vertical Service Providers)

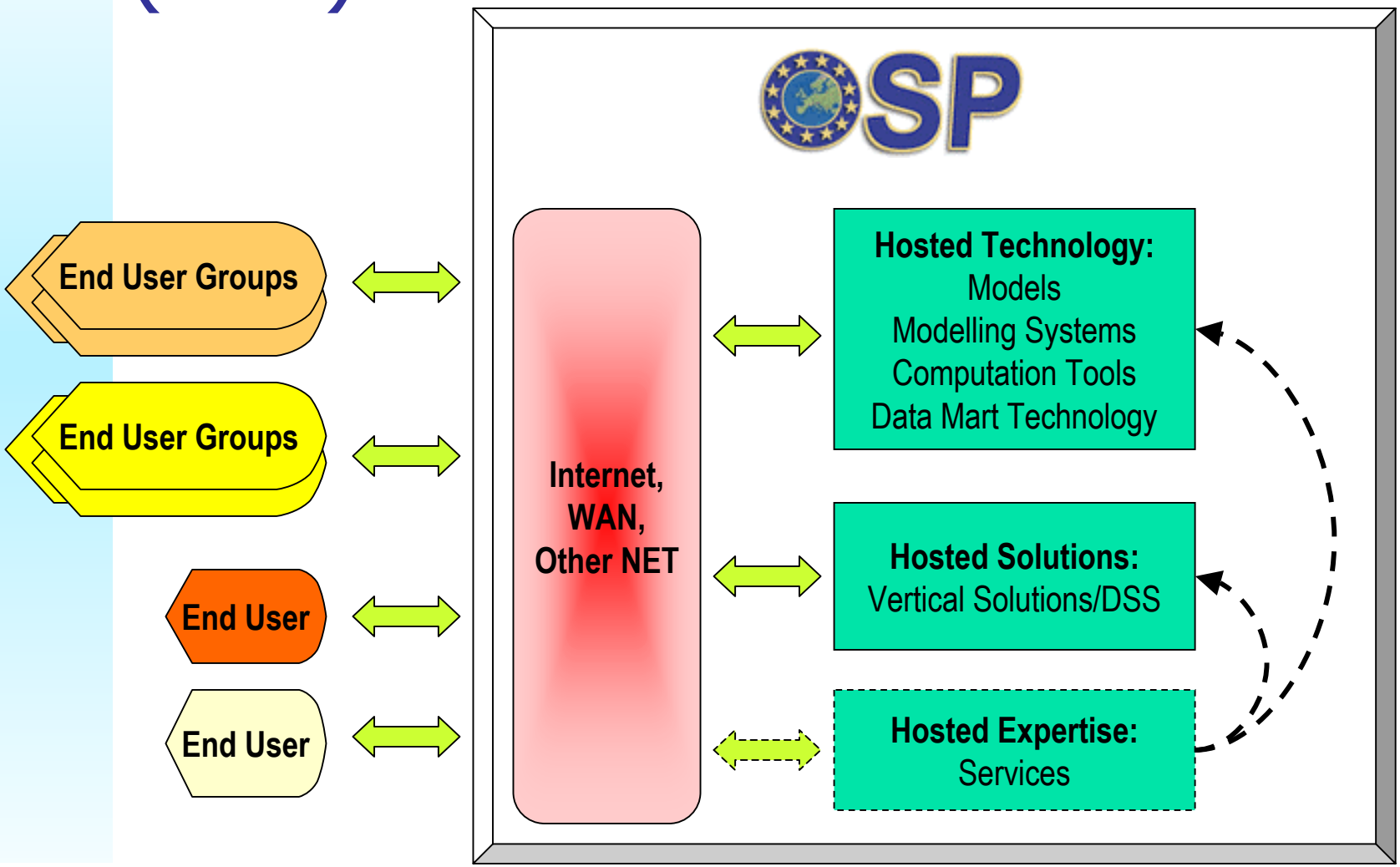
Typical xSP Solution



OSP: Overview

- Optimisation Service Provider
- EU craft project IST-1999-56410
- Adopts the xSP model specifically for the delivery of:
  - Optimisation tools
  - Vertical applications (Optimisation based DSS)
  - Expertise (Training material)

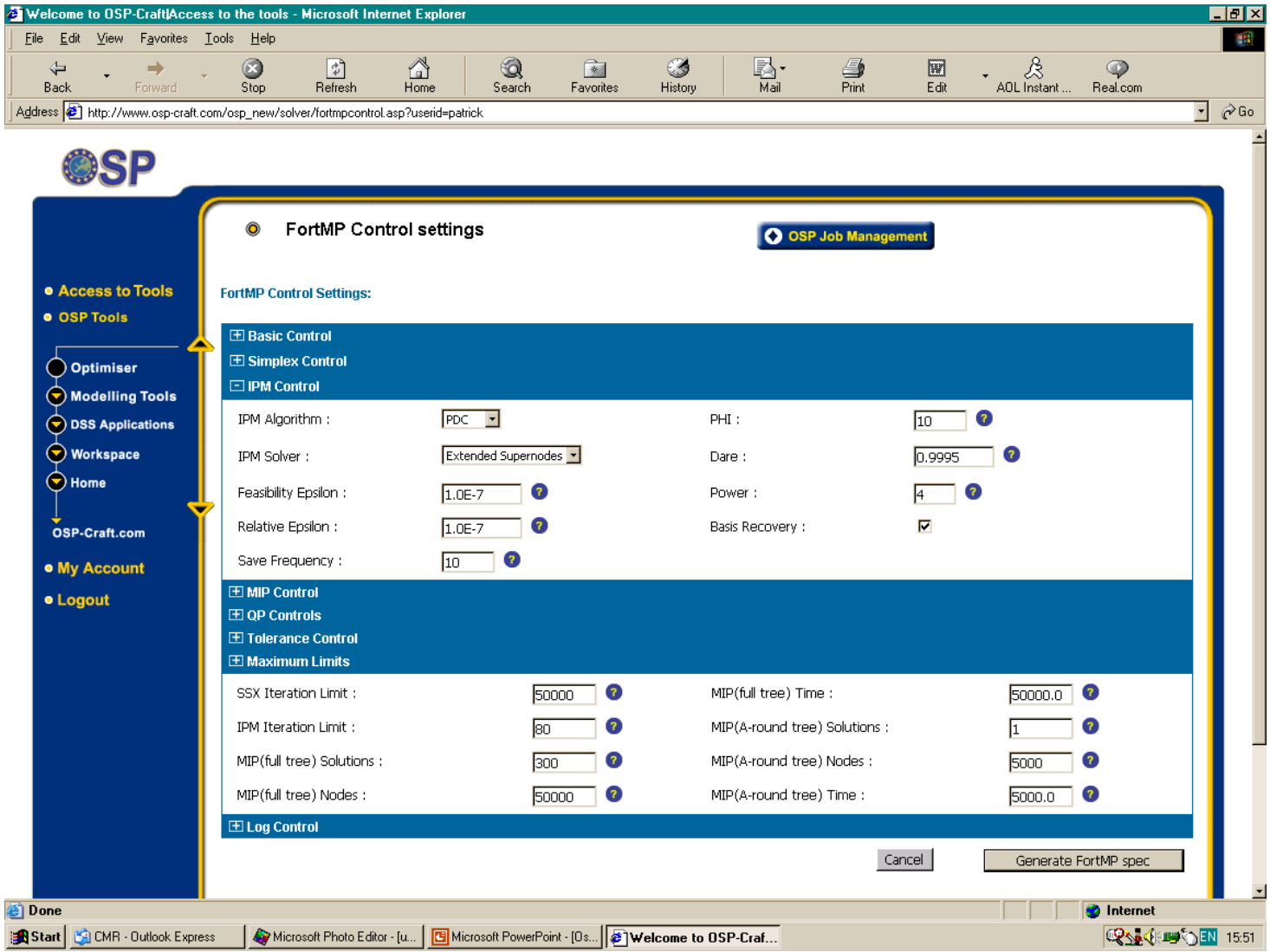
Optimisation Service Provision (OSP)



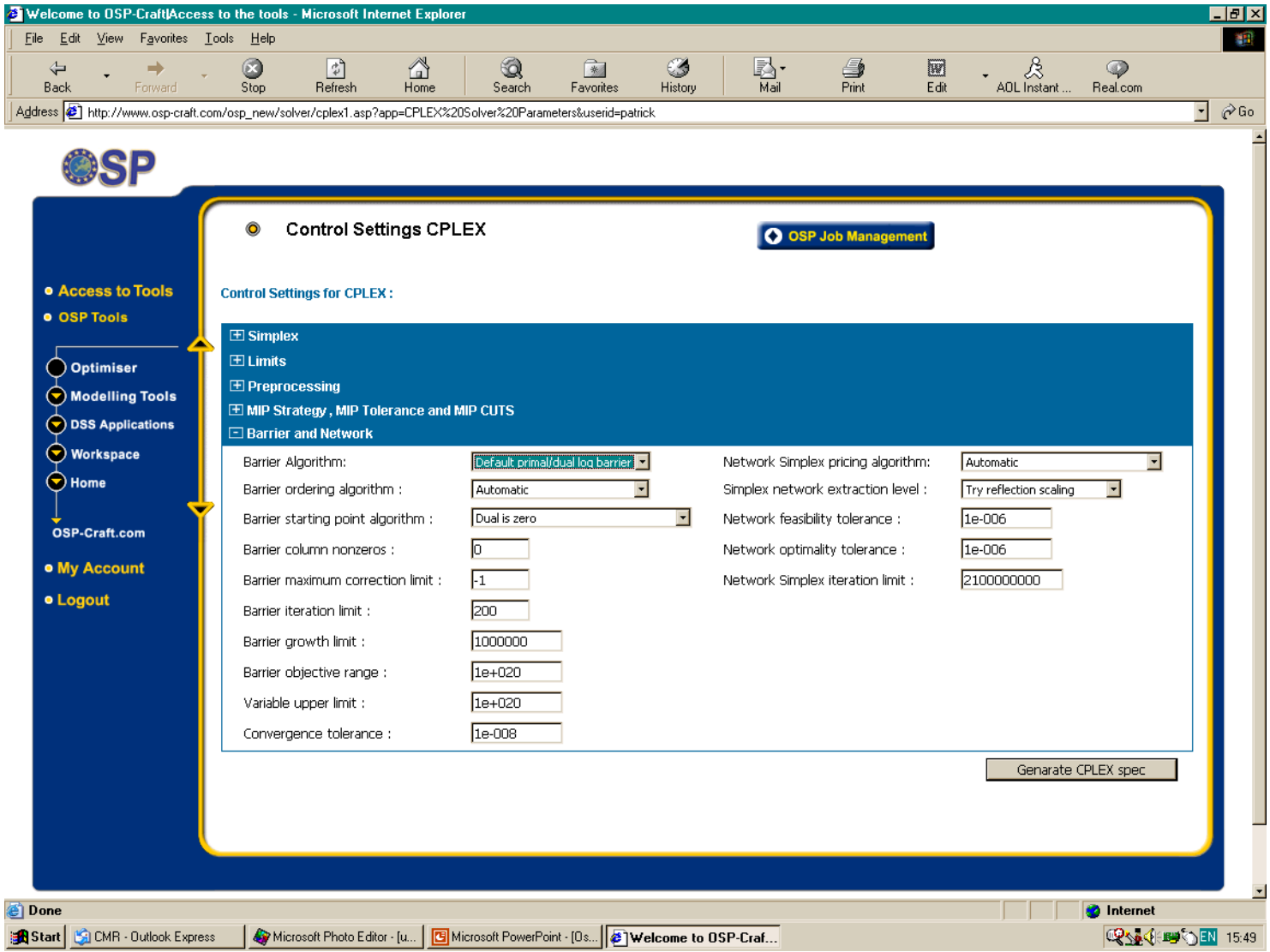
OSP components

- Solvers
  - CPLEX
  - OSL
  - FortMP
  - FortSP (SPInE's stochastic programming solver)
- Modelling systems
  - MPL
  - AMPL
- Vertical applications
  - Portfolio
  - Supply chain

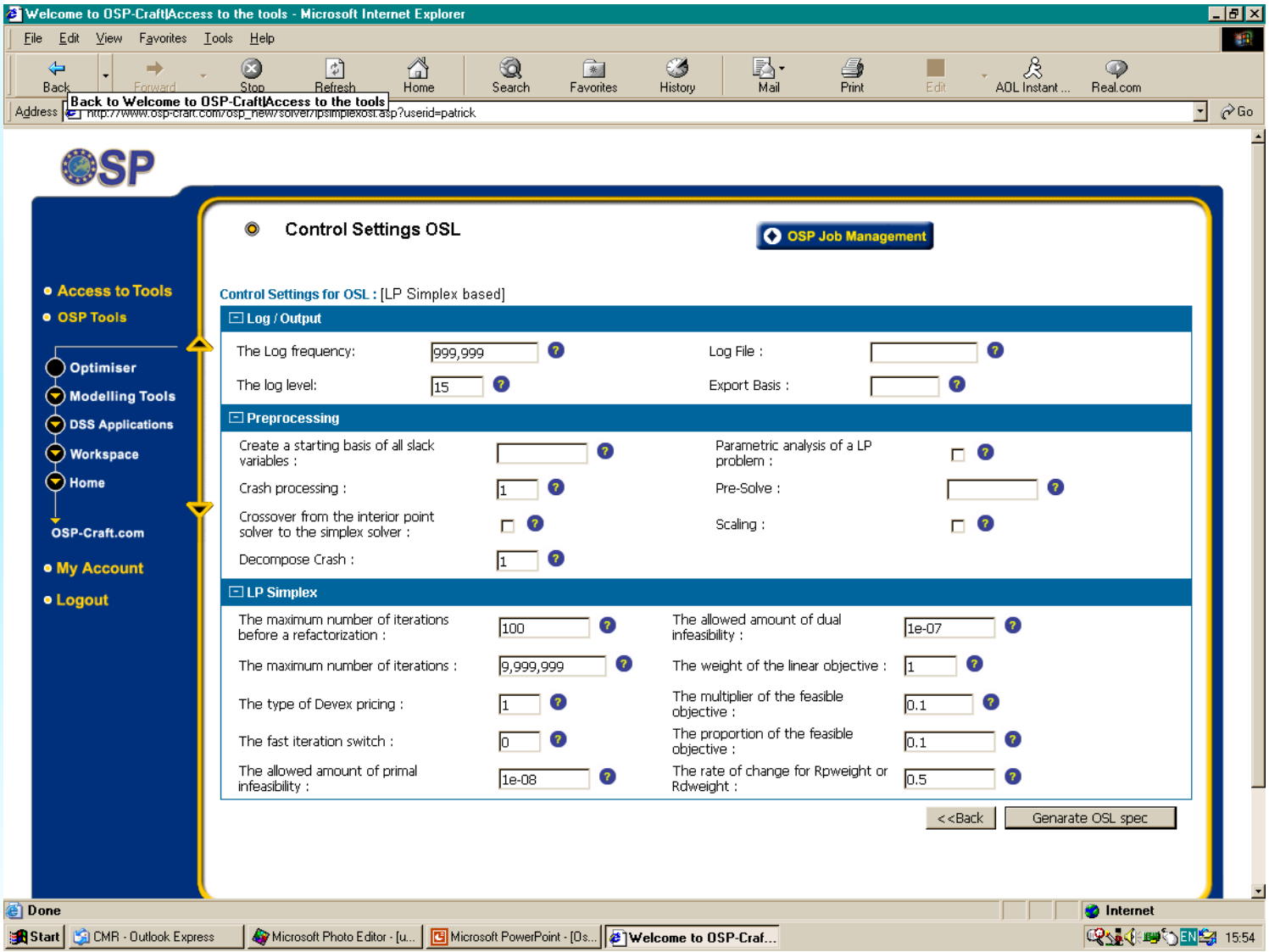
Solver Engines: FortMP



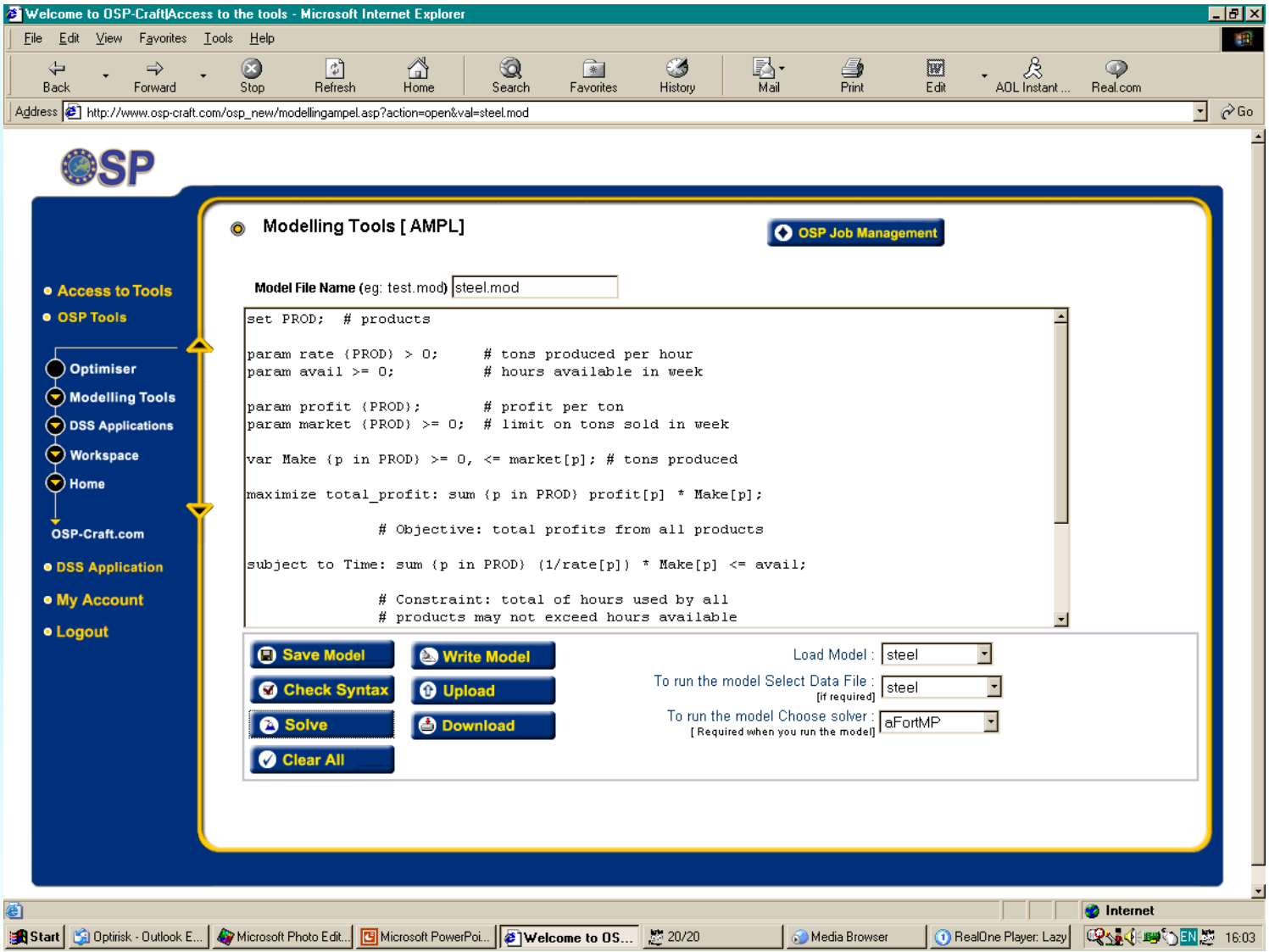
Solver Engines: CPLEX



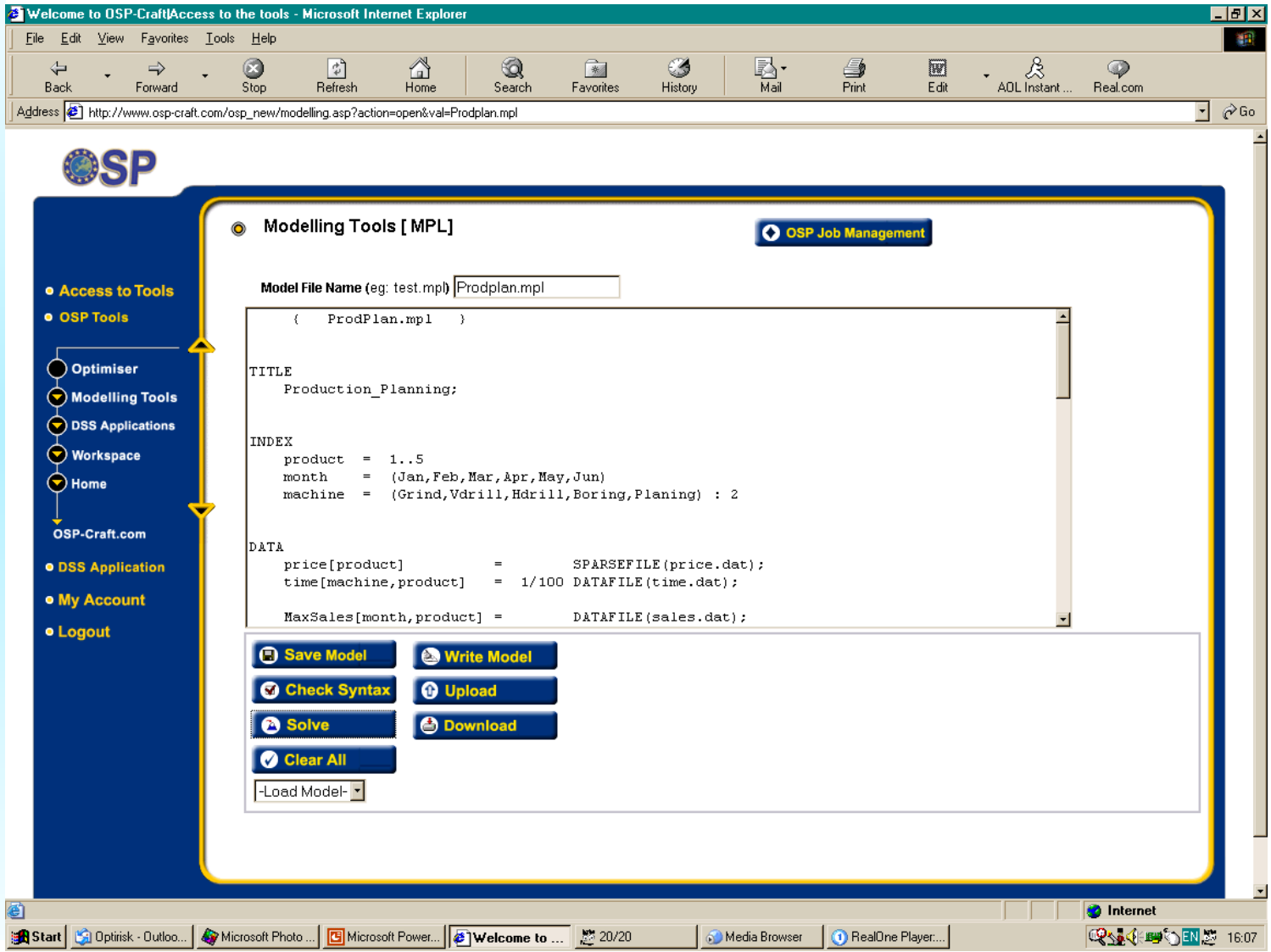
Solver Engines: OSL



Modelling systems: AMPL

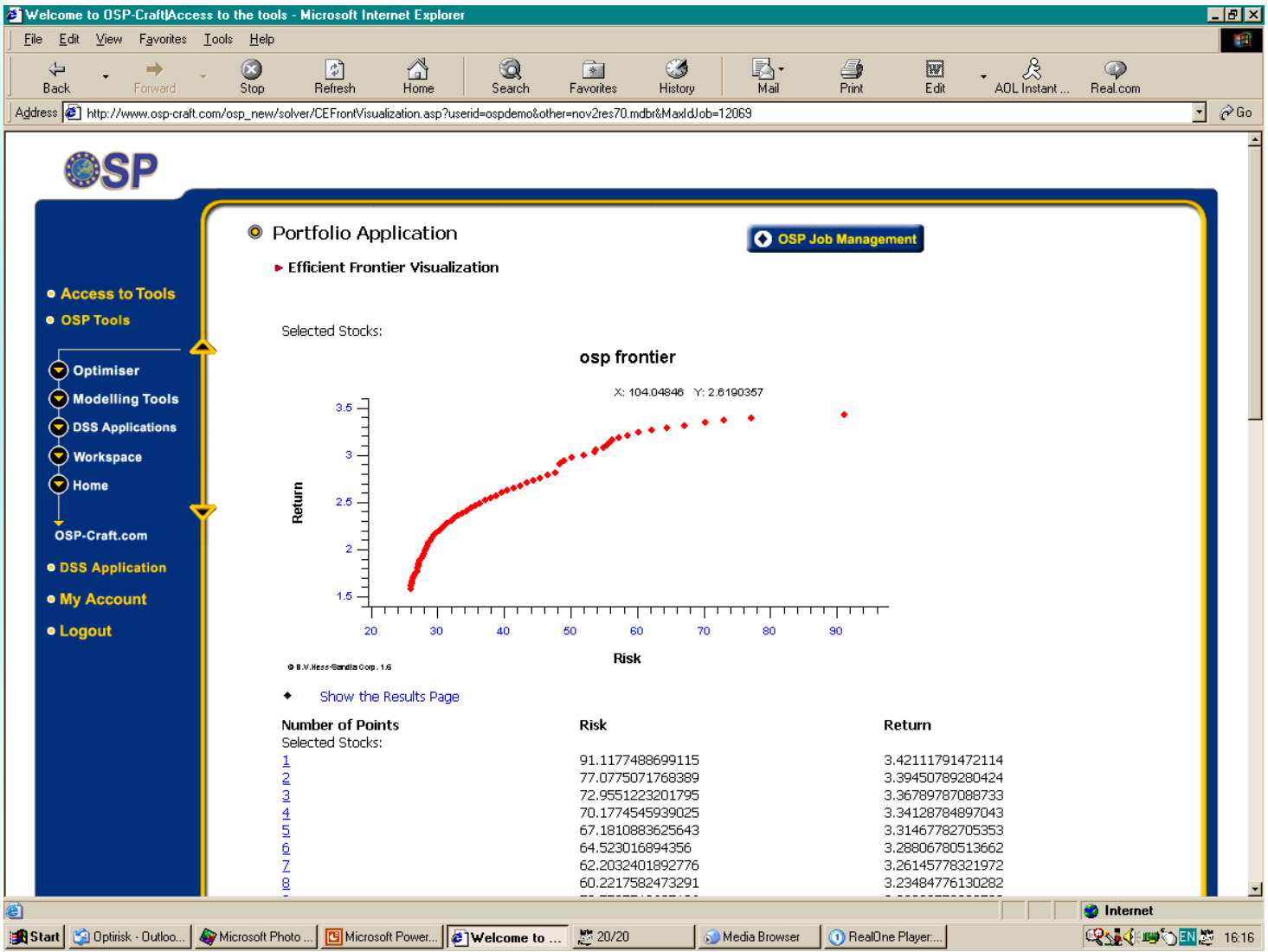


Modelling systems: MPL



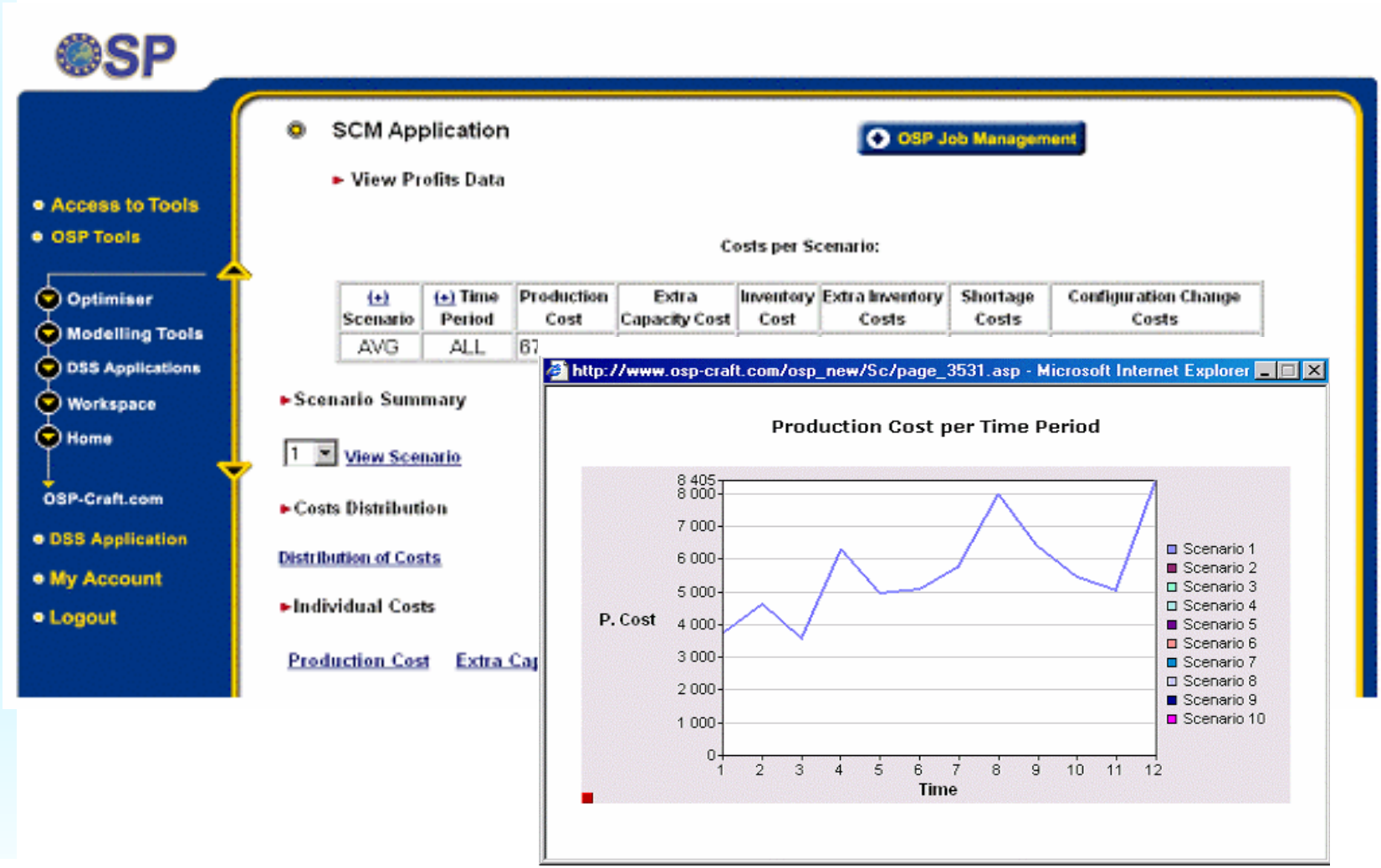
Vertical applications: Portfolio

(Discrete Efficient Frontier Visualisation)



Vertical applications: SCM

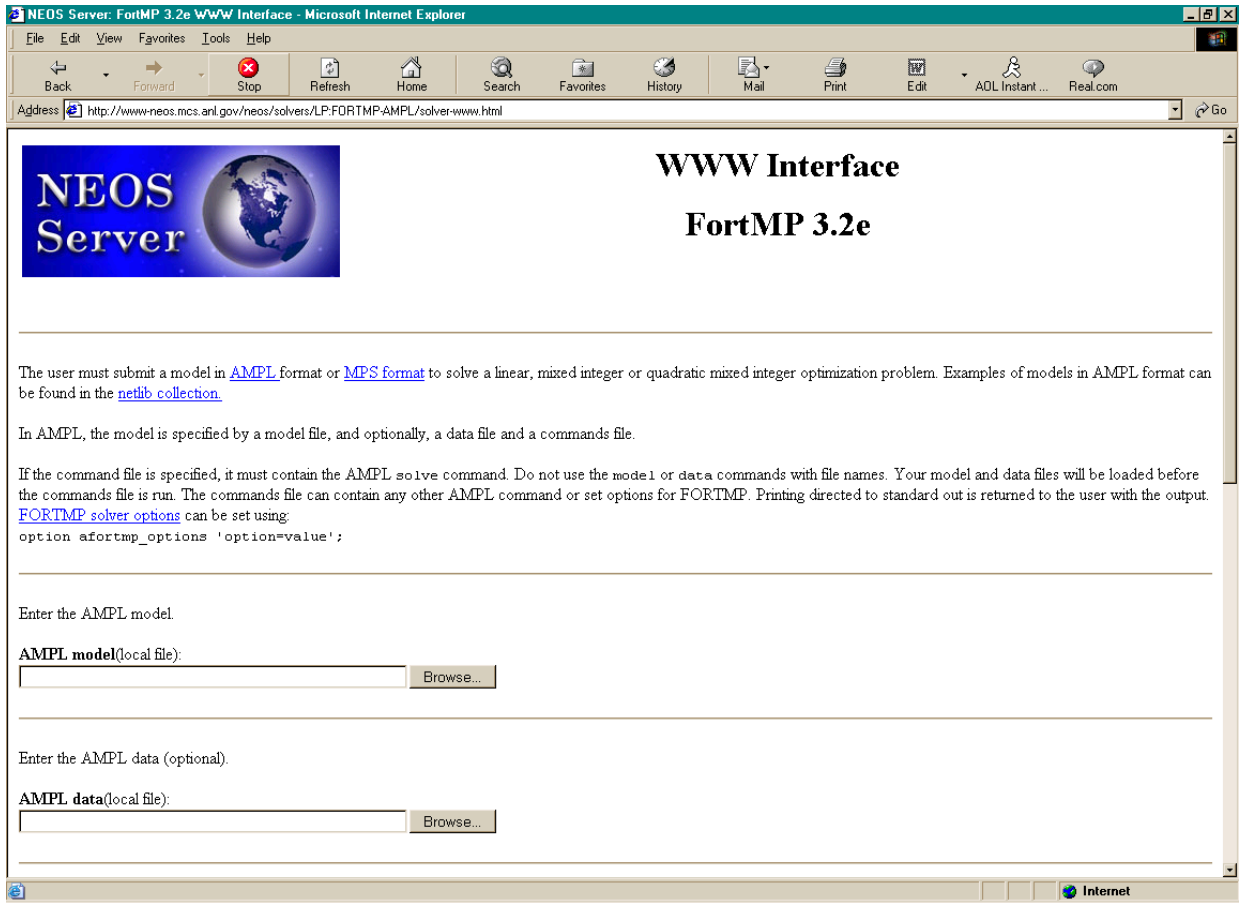
(Discrete Efficient Frontier Visualisation)



NEOS

- Provides access to several classes of solvers
  - Linear Programming
  - Mixed Integer Programming
  - Mixed Integer Nonlinearly Constrained Optimisation
  - Nonlinearly Constrained Optimisation
  - Stochastic Programming
  - Complementarity Problems
  - Others
- Can be used as remote solver using the kestrel client for AMPL
- Website: http://www-neos.mcs.anl.gov/neos

NEOS


NEOS Server: FortMP 3.2e WWW Interface - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit AOL Instant ... Real.com
Address http://www-neos.mcs.anl.gov/neos/solvers/LP:FORTMP-AMPL/solver-www.html
Go
NEOS Server
WWW Interface
FortMP 3.2e
The user must submit a model in AMPL format or MPS format to solve a linear, mixed integer or quadratic mixed integer optimization problem. Examples of models in AMPL format can be found in the netlib collection.
In AMPL, the model is specified by a model file, and optionally, a data file and a commands file.
If the command file is specified, it must contain the AMPL solve command. Do not use the model or data commands with file names. Your model and data files will be loaded before the commands file is run. The commands file can contain any other AMPL command or set options for FORTMP. Printing directed to standard out is returned to the user with the output. FORTMP solver options can be set using:
option afortmp_options 'option=value';
Enter the AMPL model.
AMPL model(local file):
Browse...
Enter the AMPL data (optional).
AMPL data(local file):
Browse...
Internet

Other distributed systems for optimisation

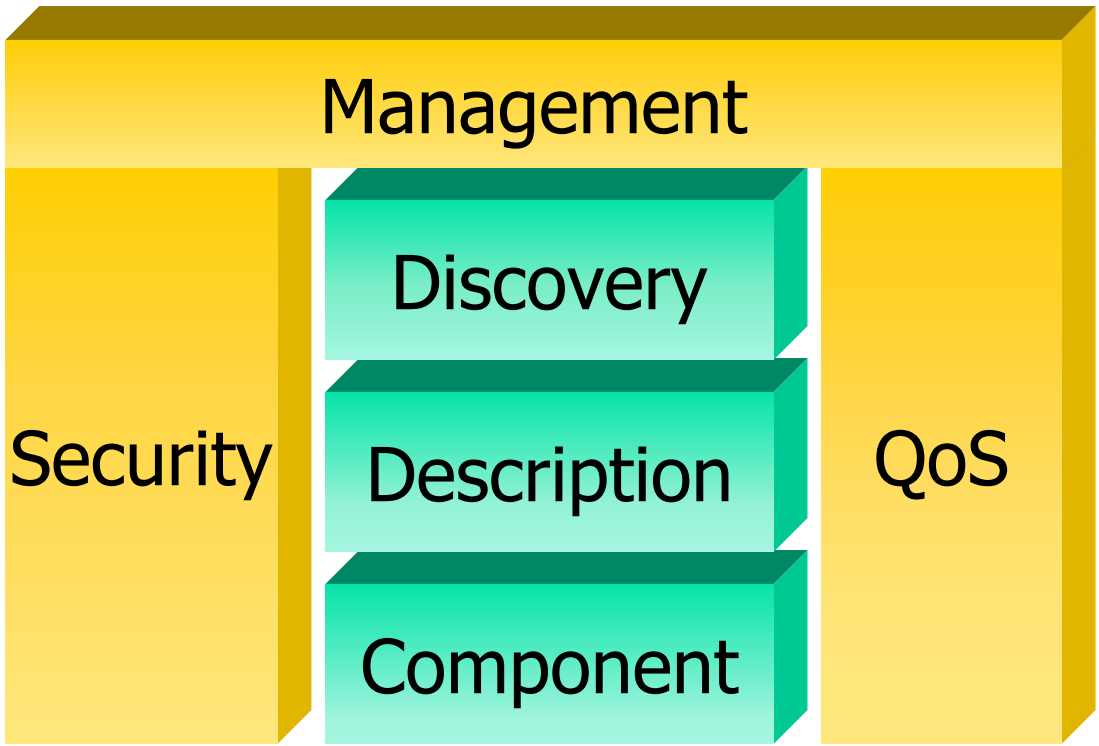
- AURORA / Financial GRID (Vienna Univ.)
- Open Optimization Framework (Imperial College)
- WebOpt (CARISMA et al.)

e-Services

- According to the definition:
  - The provision of **services** over an electronic network
- In practice:
  - Extends ASP by enriching the underlying application with support infrastructure
  - Merge several xSP's into one
- Underlying ideas:
  - Components and customer focus

e-Services

- Technology based on the concept of web-service



e-Services and optimisation

e-Services and optimisation

- The main ideas:
  - Provide each individual optimisation tool as an independent service
  - Enable remote interaction between the optimisation components
  - Take advantage of the e-Service paradigm for support and security

Web service

- Software system running on a server and providing a service by exposing a set of functions and methods.
- Concepts:
  - UDDI provides a worldwide registry for advertisment, discovery and integration of web services
  - WSDL describes the public interface of the service
  - SOAP is used to invoke methods provided by the web services
  - XML is used as the underlying representation format for the above and for the data sent to and from the web service

WebOpt

- EU-sponsored ASIA IT&C project
- Promotes knowledge transfer and collaboration between Europe and Asia
- Extends OSP by implementing optimisation web-services
- The aim is to develop complete optimisation e-Services

OptiRisk SYSTEMS

WebOpt: solver web services

- Requirements:
  - Common calling interface
  - Common representation standard for
    - Input models
    - Optimum solutions
    - Messages

CARISMA

OptiRisk SYSTEMS

COIN based solver web service

- Based on the OSI Solver Interface
- Provides a set of methods to:
  - Upload and manipulate models
  - Set algorithmic parameters
  - Solve a model (using SSX, IPM, B&B…)
  - Extract the solution
- Methods are invoked using SOAP messages
- Uses (which?)ML to represent the MP model format and the results

Conclusions

- ASP is a viable model for optimisation (See OSP)
- Optimisation components are becoming all the more important in DSS
- Deployment of optimisation in BPM requires DSS with extended features
- E-Services are a natural direction for the provision of optimisation tools

Thank You

http://www.optirisk-systems.com

http://carisma.brunel.ac.uk

http://www.osp-craft.com

http://www.webopt.org