



# MODAClouds

An FP7 Integrated Project

# MODAClouds – the consortium

- FP7 – Integrated Project (n. 318484)
- Duration: Oct. 1<sup>st</sup>, 2012 – Sept 30<sup>th</sup>, 2015



# MODAClouds – Backgrounds

## Issues identified in the early ages of Cloud Computing (SSAI report, 2010):

- Federation & interoperability
  - Raise important issues relevant, especially for “Data Management” and “Virtualisation”, “Cost Reduction” and “Improved Time to Market”

## SSAI report, 2012:

- “CLOUD providers nowadays offer their infrastructures typically as “isolated” platforms, where a user cannot easily switch between providers without significant additional costs.”

# MODAClouds -- backgrounds

## SSAI 2012 report:

- CLOUD providers offer their infrastructures typically as “isolated” platforms
- Users cannot easily switch between providers without significant additional costs.
- Important impact exist on the resource scope, usability, or the potential for users to combine heterogeneous capabilities according to their need.
- “CLOUDs **need to be open** on as many levels as sustainable possible to achieve economies of scale in terms of users, devices and applications without being commoditized.”

# MODAClouds -- backgrounds

## SSAI 2012 report (continued):

- European ICT industry is NOT characterised by some large suppliers (as in the case of US players)
  - They are mainly innovative SMEs with particular skills especially in provision of software services.
- **A major opportunity** for Europe involves finding a **SaaS interoperable solution** across multiple CLOUD platforms, and
- **migrating legacy applications** without losing the benefits of the CLOUD, i.e. exploiting the main characteristics of the CLOUD, such as elasticity etc

# MODAClouds -- objective



MAIN  
objective...  
to provide

- Methods + DSS + open-source IDE & runtime environment

Supporting

- High-level design
- Early prototyping
- Semi-automatic code-generation
- Automation deployment/redeployment
- Monitoring & self adaptation
- Of application on Multi-Clouds with guaranteed QoS

# MODAClouds -- innovations



A comprehensive set of  
targeted innovations

- Model-Driven Development for Clouds and Multi-Clouds
- Multi-Cloud Economics.
- Quality-Driven Cloud Development.
- Run-Time Quality Monitoring and Assurance.
- Rapid Software Evolution.

# MODAClouds -- innovations



## 1. Model-Driven Development for Clouds and Multi-Clouds

- High-level design of Future Internet service-based applications;
- Semi-automatically translation into code targeting multi-CLOUD platforms
- Automatic deployment on multiple CLOUD providers, with support for public/hybrid CLOUDS
- Support for the migration of legacy applications to the Cloud.



# MODAClouds -- innovations



## 2. Multi-cloud economics

- Develop DSSs (decision support systems) & risk analysis methods,
- Provide proper guidelines;
- Identify new business models
  - suitable for Cloud providers to address the needs of application providers, and
  - improve their trust in Clouds.

# MODAClouds -- innovations



## 3. Quality-Driven Cloud Development

- Support for early analysis and reasoning on non-functional requirements and quality aspects of the final applications;
- Optimise the matching between the target Cloud environments and application characteristics.

# MODAClouds -- Innovations



## 3. Quality-Driven Cloud Development

- Support for early analysis and reasoning on non-functional requirements and quality aspects of the final applications;
- Optimise the matching between the target Cloud environments and application characteristics.



## 4. Run-Time Quality Monitoring and Assurance

- Explicitly address data and application replication on multiple providers
- in order to guarantee high availability and business continuity.

# MODAClouds -- Outputs

- IDE + MODACloudML (agnostic and QoS ready) modelling language

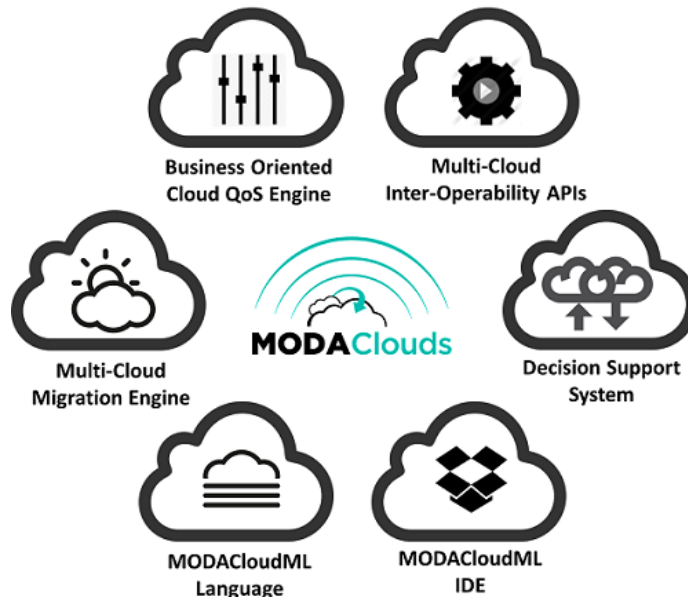
Cloud Development Tools

- maximizes automation with QoS Engine, Monitoring, Portability of underlying infrastructure providers (IaaS/PaaS)

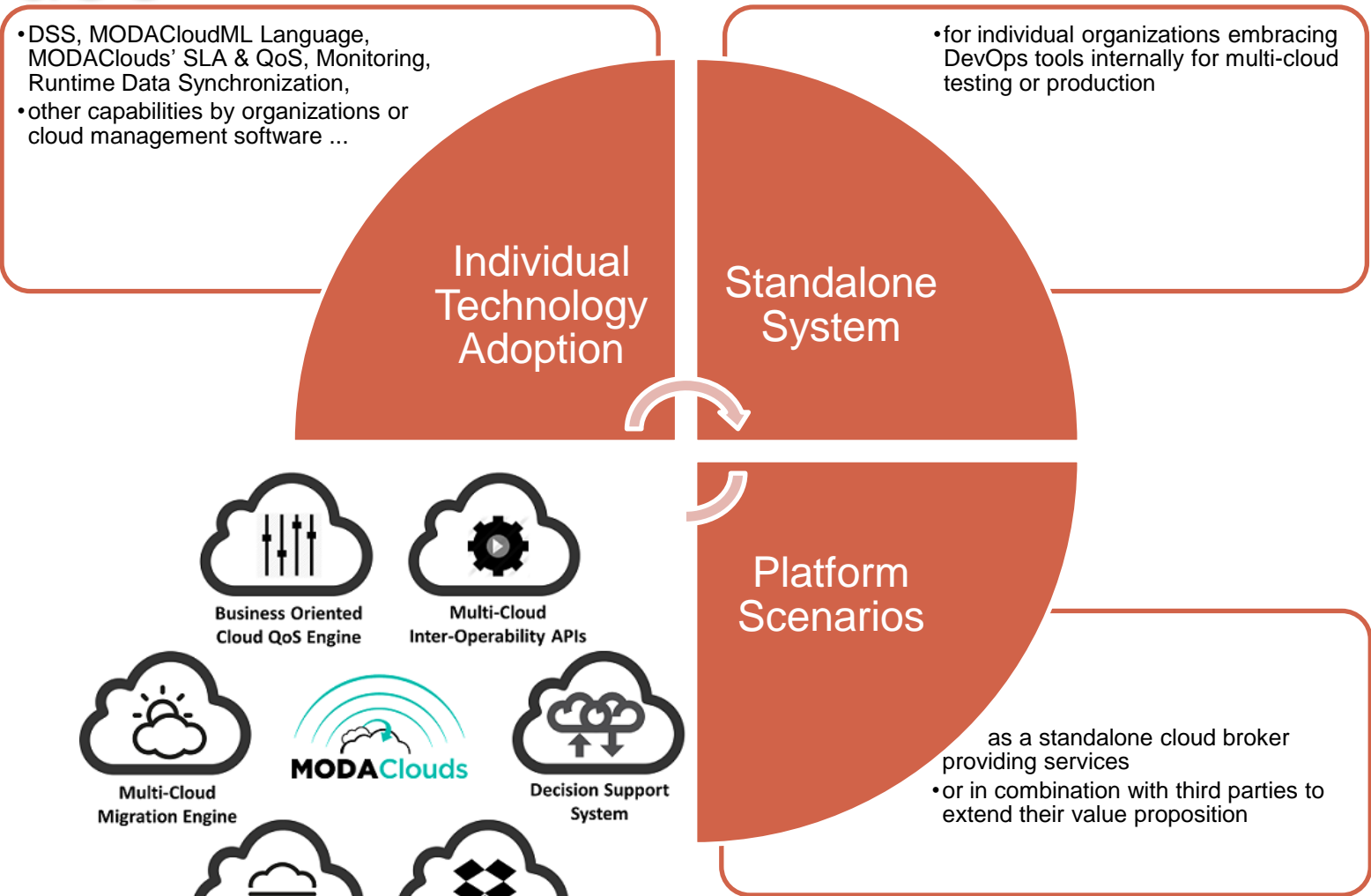
Flexible Multi-Cloud Apps Management, Monitoring & Operation Environment

Decision Support System

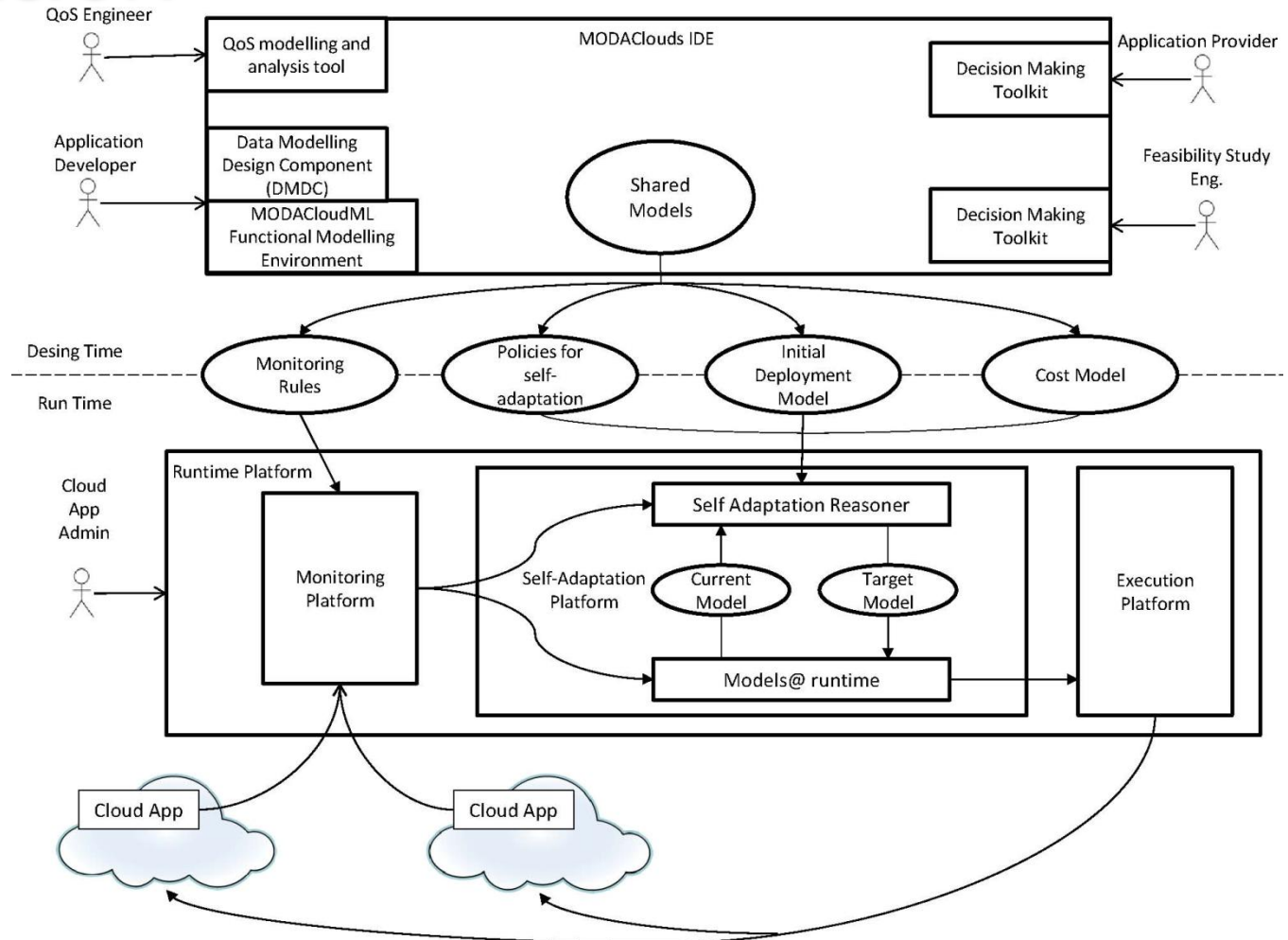
- Is a system on its own that enables selection of provider at development & testing phase;
- adds automation of runtime adaptation



# MODAClouds -- Context of use



# MODAClouds – software stack



# MODAClouds – Design-time components

## MODAClouds IDE

- Including the functional modelling tool
  - **MODACloudsML** metamodel
- The Qos-modeling & analysis tool

## QoS-modeling & analysis

- **LINE**: tool for the performance analysis of cloud applications.
  - <https://code.google.com/p/line/>
- **Space4Cloud**: specification, assessment and optimisation of QoS characteristic of cloud applications.
  - <https://github.com/deib-polimi/modaclouds-space4cloud>

## ModaCloudML

- functional, operational and data modelling environments & modules for the analysis of non-functional characteristics of a multi-cloud system
  - <https://github.com/SINTEF-9012/cloudml>

# MODAClouds – Run-time components

## Monitoring platform

- Offer a wide range of capabilities:
- MONITORING
- ANALYSIS
- RULES PROCESSING
- INPUTS/OUTPUTS

## The Execution platform

- Handles the IaaS and PaaS deployments and execution, offering to the user an unified experience...
- Offers three specific sub-systems:
  - PLATFORM
  - INFRASTRUCTURE
  - COORDINATION

## Execution platform (mOSAIC)

- Include updates of
  - The open-source **mOSAIC** -- a self-deployable open-source platform that runs on a multitude of public or private IaaS;
  - Offers the basis for the MODAClouds run-time environment, especially for managing the support services.

## Execution platform (Cloud4SOA)

- **Cloud4SOA** is providing an open semantic interoperable framework for PaaS developers and providers
- The **Cloud4SOA** system supports Cloud-based application developers with multi-platform matchmaking, management, monitoring and migration by semantically interconnecting heterogeneous PaaS offerings across different providers that share the same technology.



Case study	MODAClouds challenges
Software development company/ <i>Project management server</i> (SOFTEAM)	<ul style="list-style-type: none"> <li>• Deploy <b>legacy applications</b></li> <li>• <b>laaS to laaS migration</b></li> <li>• Run-time <b>monitoring</b> effective resource <b>scaling</b></li> </ul>
Software development company/ <i>Business Process Modelling System</i> (BOC)	<ul style="list-style-type: none"> <li>• Migration of <b>legacy application re-deployed as a SaaS</b></li> <li>• <b>DSS, risk, and utility</b> analysis to select the best <b>laaS</b></li> <li>• <b>laaS to laaS migration</b></li> <li>• <b>Parallel execution</b> of long- running activities</li> </ul>
Services for citizens in the health sector/ <i>Palliative care application</i> (ATOS)	<ul style="list-style-type: none"> <li>• Develop <b>new application services</b></li> <li>• <b>Data</b> managed on a <b>private laaS</b></li> <li>• <b>Heterogeneous environments</b>: virtual desktops, application logic; hybrid Clouds (private laaS, multiple public PaaS)</li> <li>• Validate activities for <b>filling the gap between runtime and design time</b></li> </ul>
IoT in crisis management/ <i>Smart City Urban Safety Planner</i>	<ul style="list-style-type: none"> <li>• Develop a <b>new application</b></li> <li>• <b>High performance, scalability, and availability requirements</b></li> <li>• <b>Data design and run-time management</b></li> <li>• <b>PaaS to PaaS migration</b></li> </ul>