Tales of Empirically Understanding and Providing Process Support for Migrating to Clouds

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Overview

- Cloud computing and its key facets
- Some scenarios that make migration difficult
- Empiricism as a research approach
- Insights from three tales of cloud migration
- Concluding remarks

Background Brief

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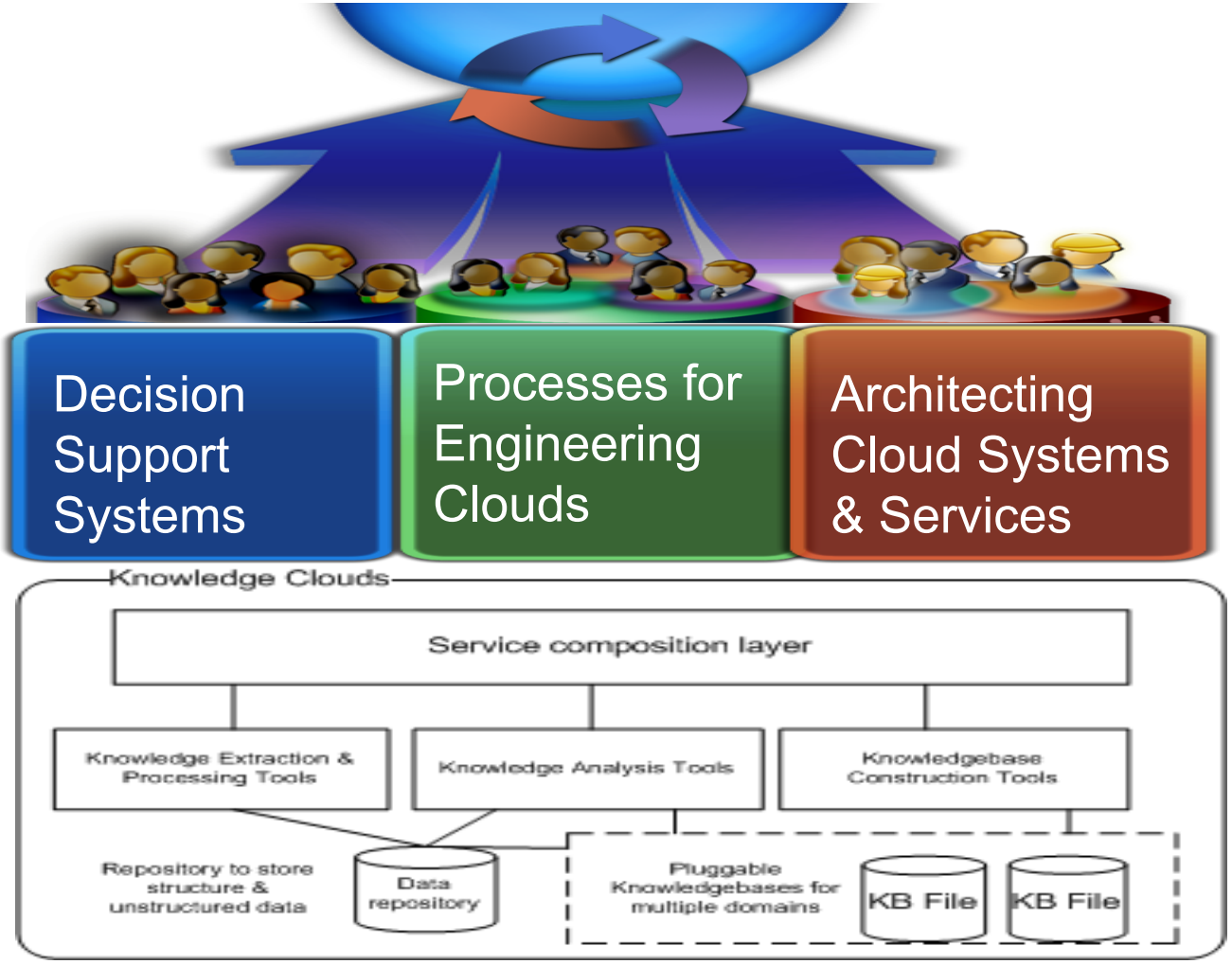
Work History:

Tales of Empirically Understanding and Providing Process Support for Migrating

Software Development Paradig

http://malibabar.wordpress.com

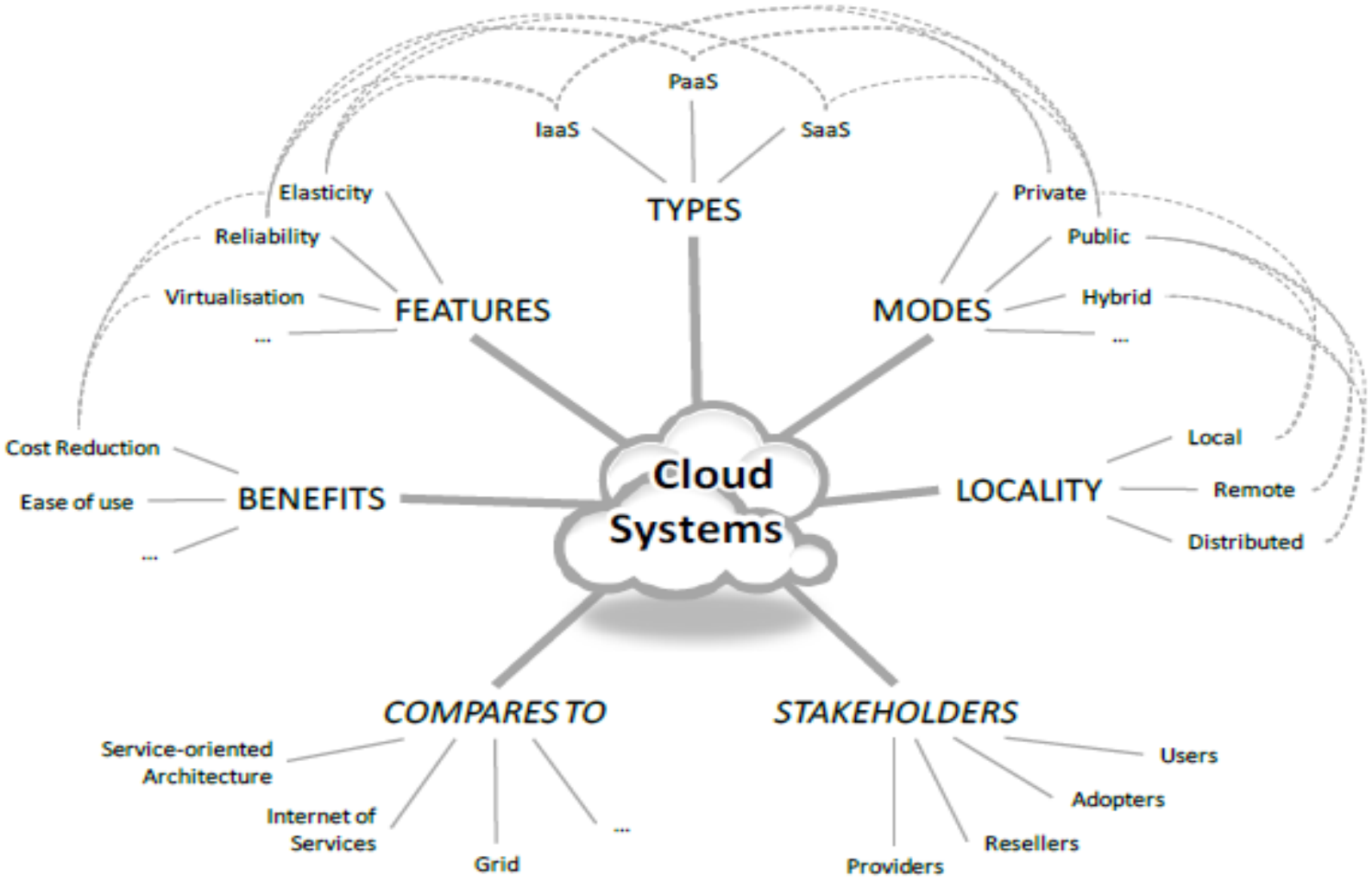
Cloud Computing Research Threads



Defining Cloud Computing!

"*Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*" (A definition by the US National institute of standards and technology (***NIST***))

Key Facets of Cloud Computing



Reproduced from Figure 1 of The Future of Cloud Computing: Opportunities for European Cloud Computing beyond 2010.

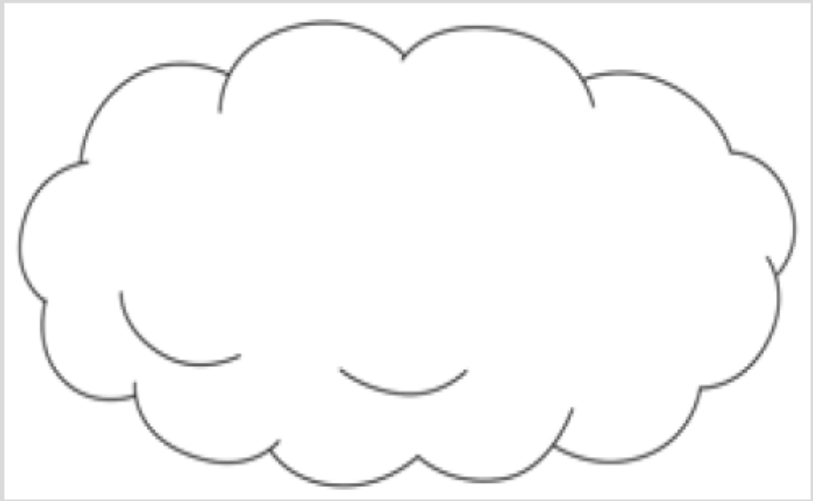
Actors and Reference Architectures

Cloud Consumer
Person or organization that maintains a business relationship with, and uses service from *Cloud Providers*.

Cloud Auditor
A party that can conduct independent assessment of cloud services, information system operations, performance and security of the cloud implementation.

Cloud Provider

Person, organization or entity responsible for making a service available to *Cloud Consumers*.

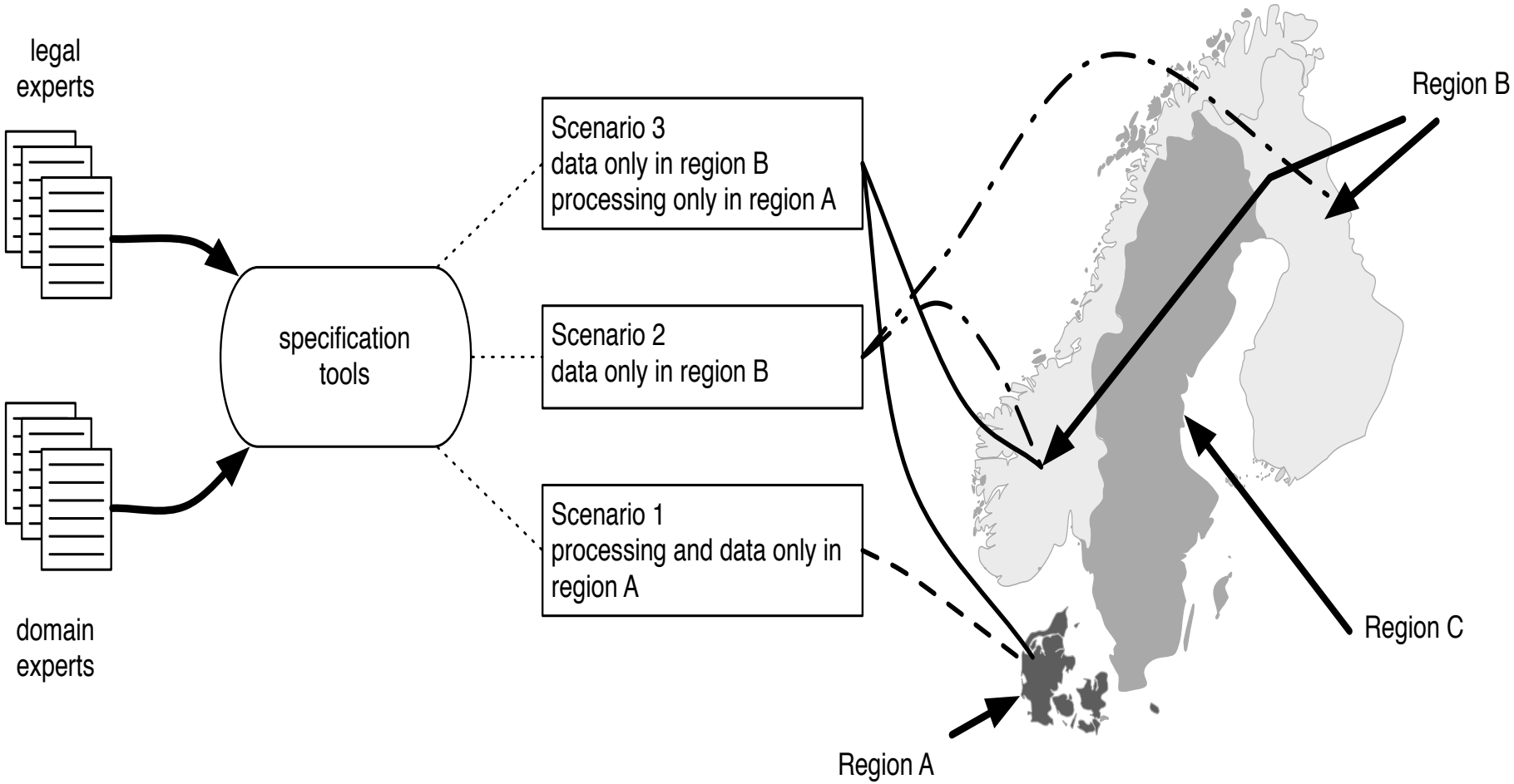


Cloud Broker
An entity that manages the use, performance and delivery of cloud services, and negotiates relationships between *Cloud Providers* and *Cloud Consumers*.

Cloud Carrier
The intermediary that provides connectivity and transport of cloud services from *Cloud Providers* to *Cloud Consumers*.

Source: European Cloud Partnership Info Day 12/04/2012, inspired by the NIST roadmap

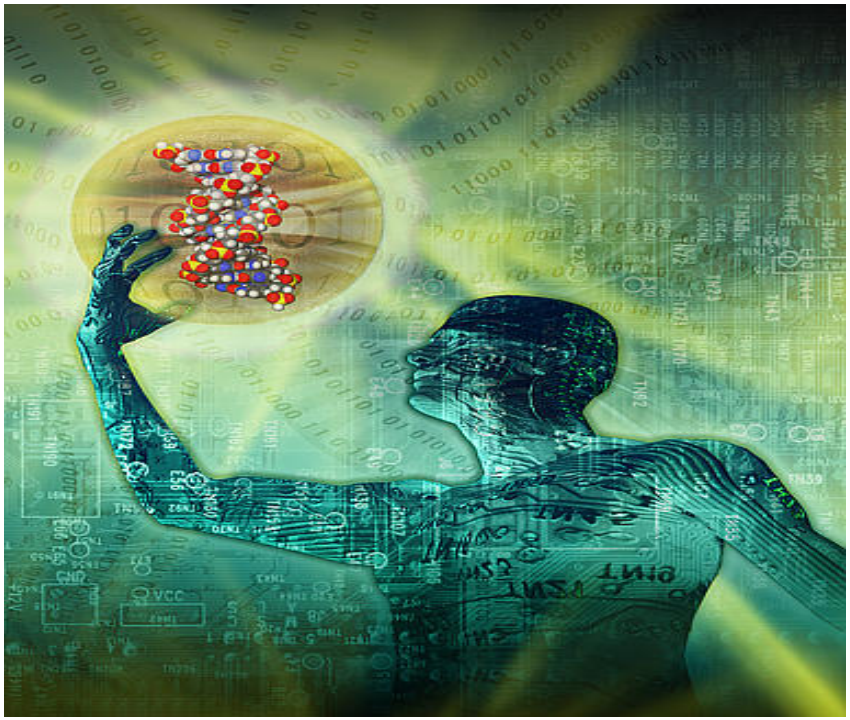
Location Specific Challenges for Migration



Empirism as a Research Approach

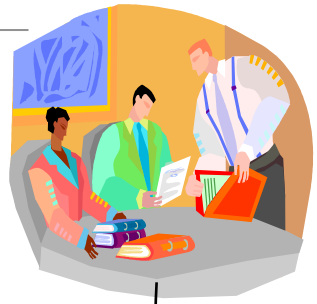
- Empiricism
  - Generally being regarded at the heart of the modern scientific methods, that our theories should be based on our observations of the world rather than on intuition or faith
- Empirical Software Engineering (ESE)
  - Empirical research in SE is the scientific use of quantitative and qualitative data to understand and improve software product and software development process (Vic Basili)
  - Data is central element to address a research issues related to processes or tools
- ESE provides techniques for understanding and developing processes and tools

Being the First Mover in Public Sector!!!



Cloud Migration in Danish Public Sector

- Project purpose
  - Reduce the overhead of running mail system. And focus on delivering core values
- Objectives
  - All mailboxes on O365 and validated
  - Close down of temporary Exchange 2010
  - Use of Microsoft's email center for all emails
- Project scope – email and calendar
  - Migration of all TAP and VIP mailboxes
  - Migration of all student mailboxes
  - Changing our email routing to use Microsoft's email center as primary MX servers



Features & resources

Potential Risks and Mitigation Action 1/2

Risk	Preventive actions
Loss of data during migration	Use of dedicated migration tool. Extra backup before migration and smaller number of user in each migration.
Loss of accessibility to the mailbox during migration.	Use of dedicated migration tool for ensuring accessibility during the migration.
Security breach Security risk lies in data being migrated to the wrong mailboxes, meaning that another user than the owner would gain access to data.	Using a dedicated migration tools for preventing security lapses.
Change in administration paradigm.	Training and workshops around the admin part of O365.
Mail routing - Due to the complex mail routing structure that can be problematic.	Closing down the mails for 2-3 hours – have a backup plan and inform the users.

Potential Risks and Mitigation Action 2/2

Risk	Preventive actions
Delayed migration will create extra expenses in keeping the current Exchange 2010 platform running	Plan for delays and arrange extra internal staff on call.
Lack of internal resources for the project can result in increased project cost due to use of more external resources.	Get commitment from all involved departments of the organizations.
If Consultants may not be able to fulfill the agreed obligations.	Arrange a backup plan with the vendor's support team to complete the project with them directly. There will be a financial impact in this case.

Key Challenges and Strategies

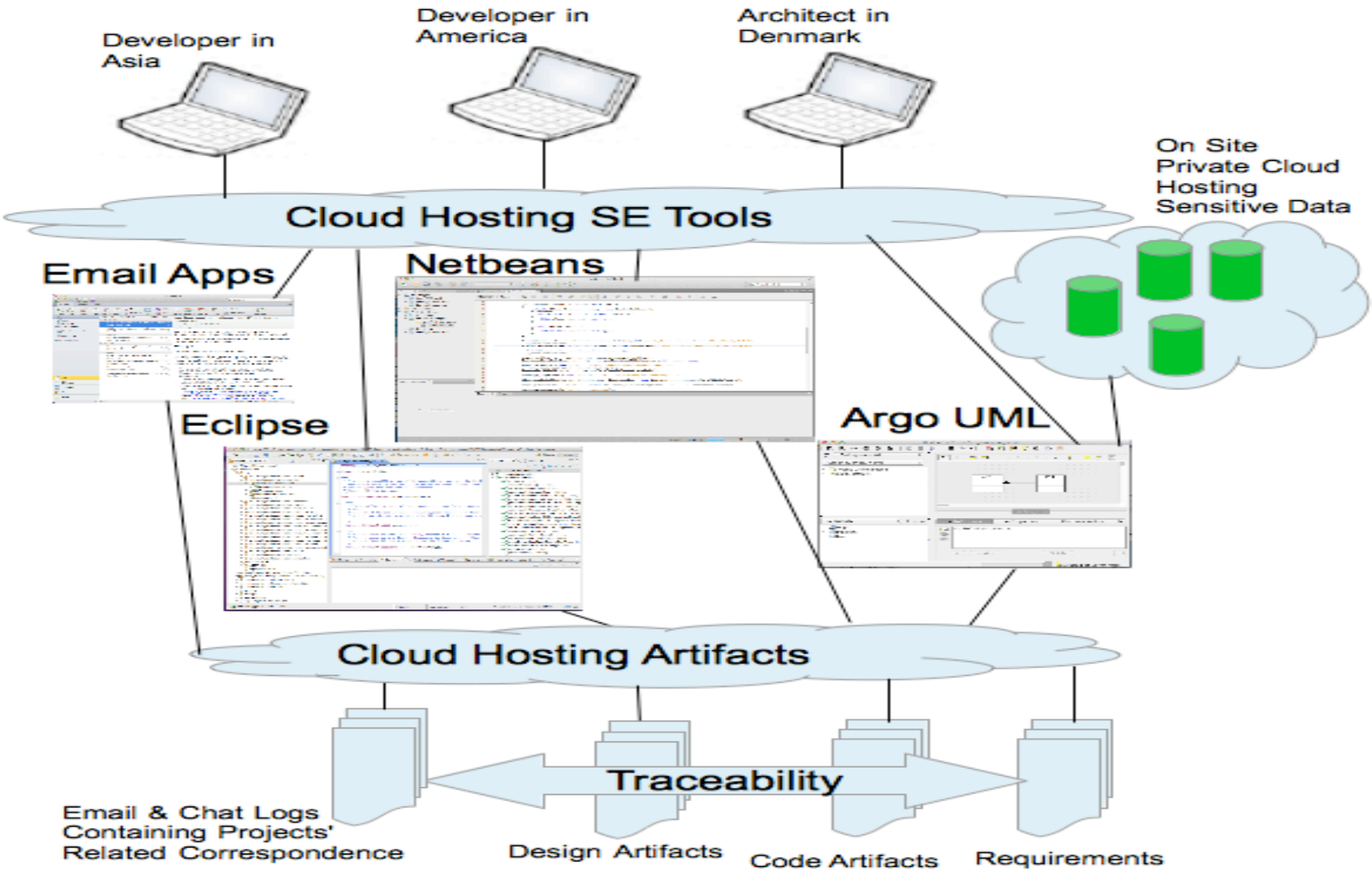
- No specific precedent
  - Get powerful stakeholders behind the move
  - Get the vendors excited for widespread publicity
- Legal impediments
  - Work with regulators – Data Protection Agency
  - Inform vendors about the required customization
  - Have legal and technical tracks within the project
- Fear of unknown
  - Take the internal stakeholders into full confidence
  - IT staff briefings and training
  - Strategy for moving back

Key Outcomes

- Setting the path for Danish public sector
  - Ministerial support and appreciation
  - From 18 months to 2 months migration time
  - O365 contract tailored for Danish legal system
- Stable platform for critical services
  - No more regular outrages of email and calendar
  - Security and privacy better managed
  - Staff allocated to more value added services
- Cost reduction and reinvestment
  - No big licensing fee for educational institutes; saved money is going towards improving services

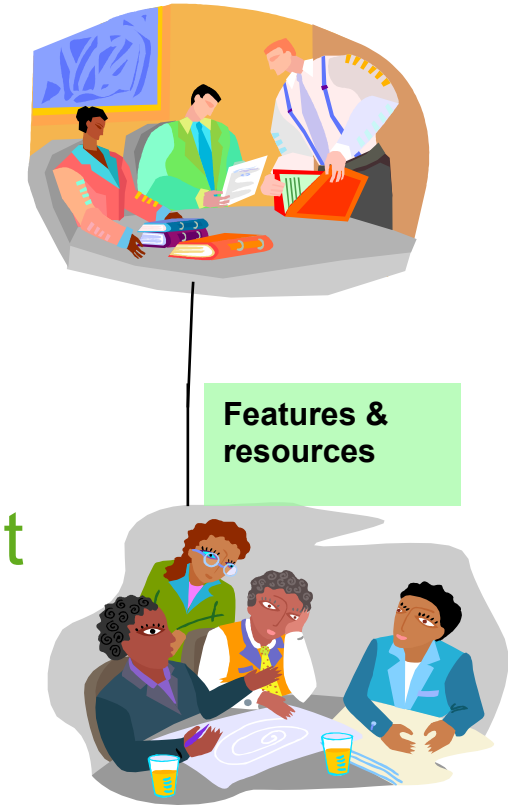
Cloud Migration of Software Engineering Tools

Tools as a Service (TaaS)



Experimental Cloud Migration of Tools

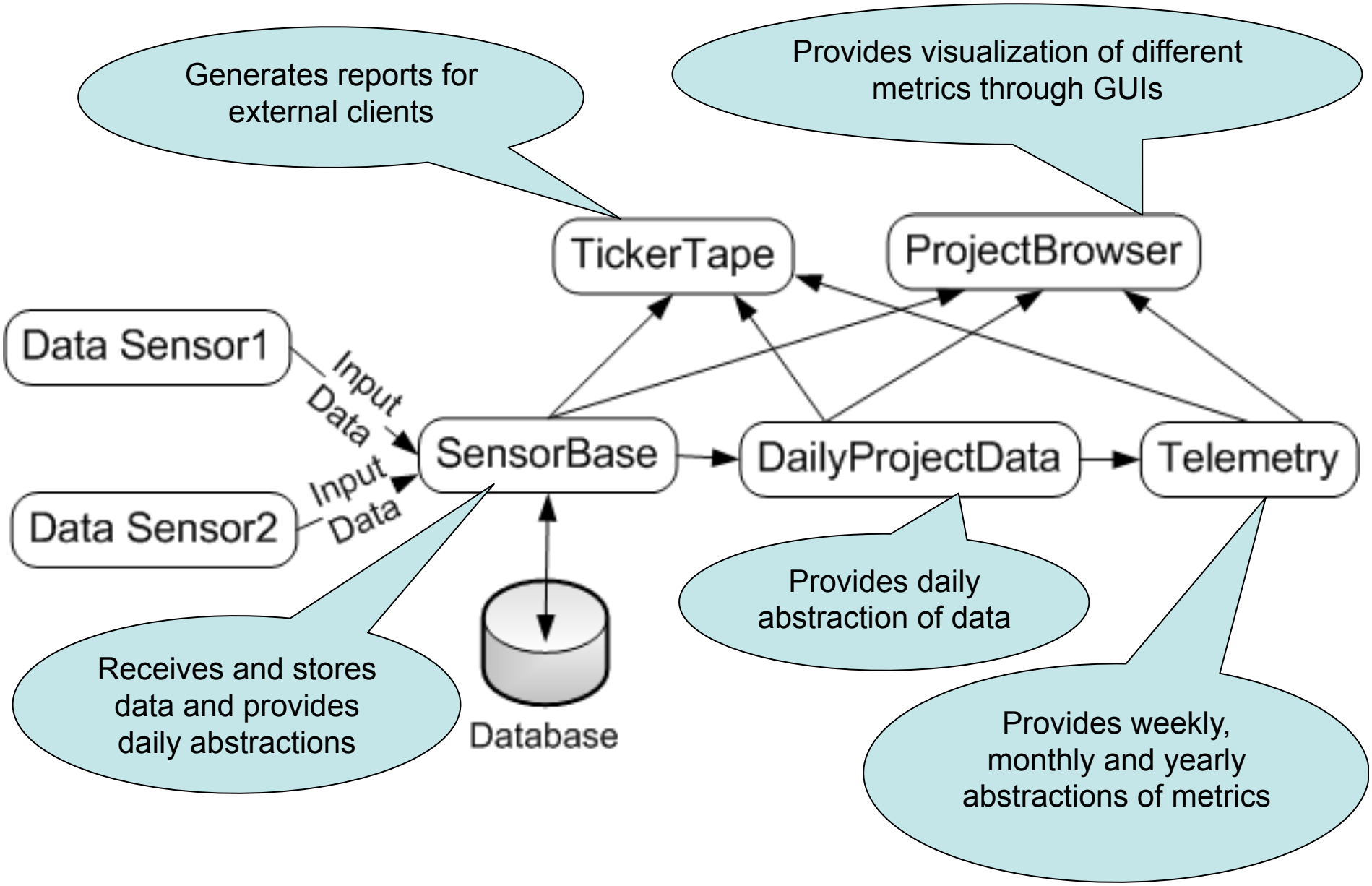
- Migrating software metrics collection and analysis tool – called Hakystat
- Supporting a large number of organizations for process and product metrics for monitoring and improvement
- GSE organizations require elastic computing and storage resources
- SaaS on IaaS (Amazon) or SaaS on PaaS (Goolge)



What is Hackystat?

- A framework for collecting and analyzing process and product data
- Provides IDE's Plugins called sensors that send information to a service called SensorBase
- Several services to compute metrics by using the data from SensorBase
- Metrics are viewed by using a ProjectBrowser, which uses services like SensorBase, Telemetry, DailyProjectData, and TickerTape

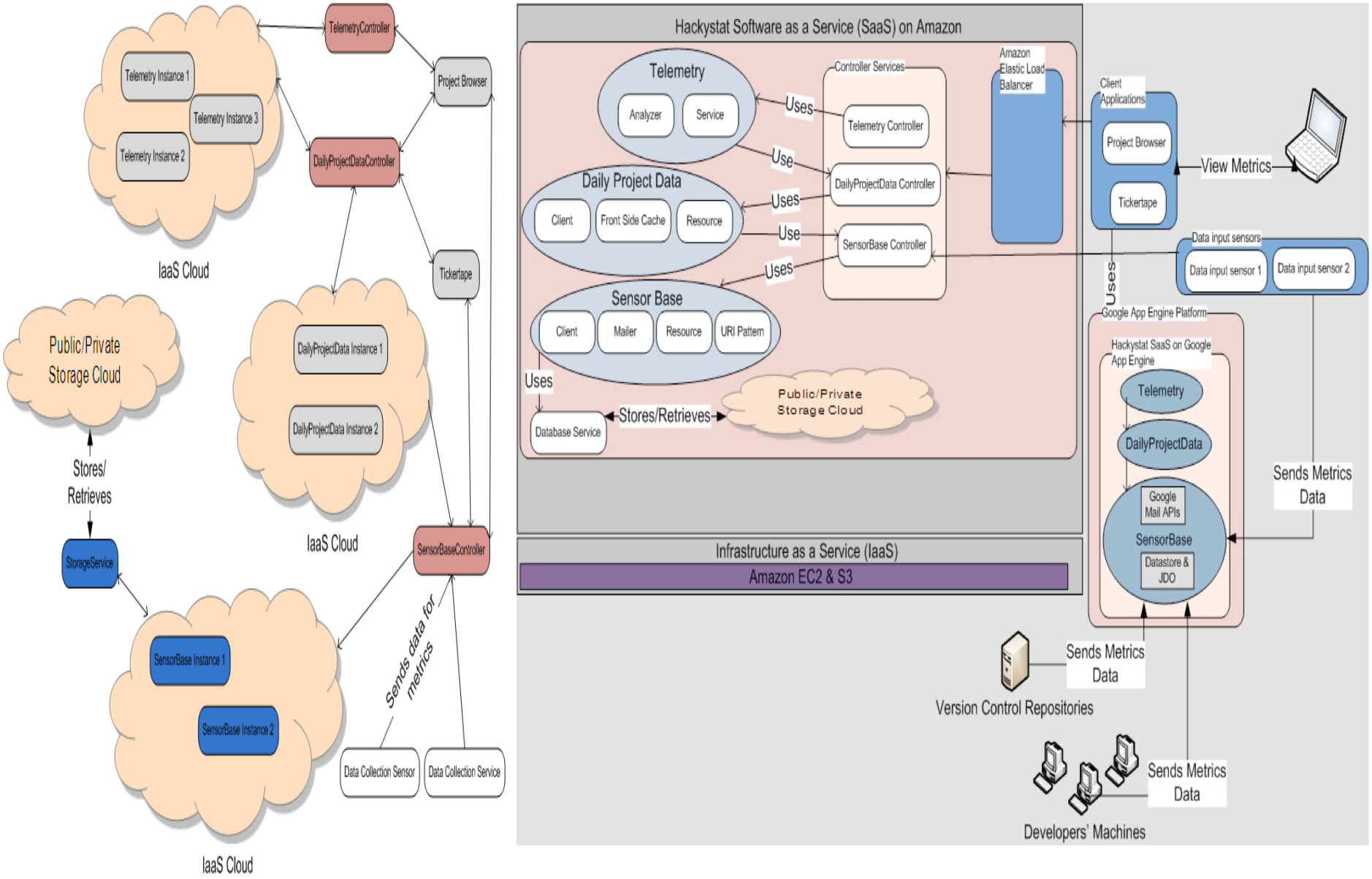
Architecture of Hackystat



Quality Attributes & Architectural Decisions

Quality Attributes	Architectural Decisions	
	Amazon EC2 & S3	***Google App Engine***
Scalability	Replication of system services to meet performance requirments.	No action required. Scalability is handled by platform.
	Separation of database layer into a new service that utilizes platform specific persistency features.	Refactoring of persistency components to make it compatible with Google Datastore persistence.
Portability	A wrapper layer is added to ensure platform independence. A separate database layer to provide seamless transfer of database layer.	Portability to other platforms is not possible.
Compatibility	System features are exposed through origonal REST API. A wrapper layer is added to provide abstraction to services cluster and their deployment configuration.	System features are exposed through origonal REST API.
Reliability & Autonomous Scalability	Façade/Waper layer to provide abstraction. Amazon's Elastic Load Balancer ensures autonomous scalability.	Ensured by platform.
Efficient & effective deployments	Amazon Elastic Load Balancer ensures auto scaling as well as efficient and cost effective deployment configuration.	Deployment of application components on cloud is managed by platform.

Architectural Views of Hackystat in Cloud



Key Challenges 1/2

- Heavy reliance on cloud infrastructure
  - SaaS on PaaS or IaaS are tightly coupled with the APIs provided by a service provider
  - Huge efforts required for porting applications
- Vendor dependent technology enhancements
  - Make it difficult to evolve a complex system using public clouds based on changing business needs
- Lack of tooling support
  - Existing tools only cover API specific details and do not help understand underlying virtual environment

Key Challenges 2/2

- Evaluation of quality attributes
  - Supporting implementation level investigation of static quality attributes e.g., complexity
  - Modeling & testing unknown users and infrastructures for scalability, accountability…..
  - Modeling & reasoning fine-grained control over privacy and security – design and implementation of multi-tenancy

- Testing
  - Change in the infrastructure of PaaS/SaaS platforms necessitate continuous testing

Differences in TaaS and SaaS

- TaaS contains executable artifacts – needs different security mechanisms
- TaaS needs to be integrated with other tools and middleware components
- TaaS artefacts can consume unpredictable resources
- TaaS needs different kinds of SLAs – continuous monitoring and adaptation

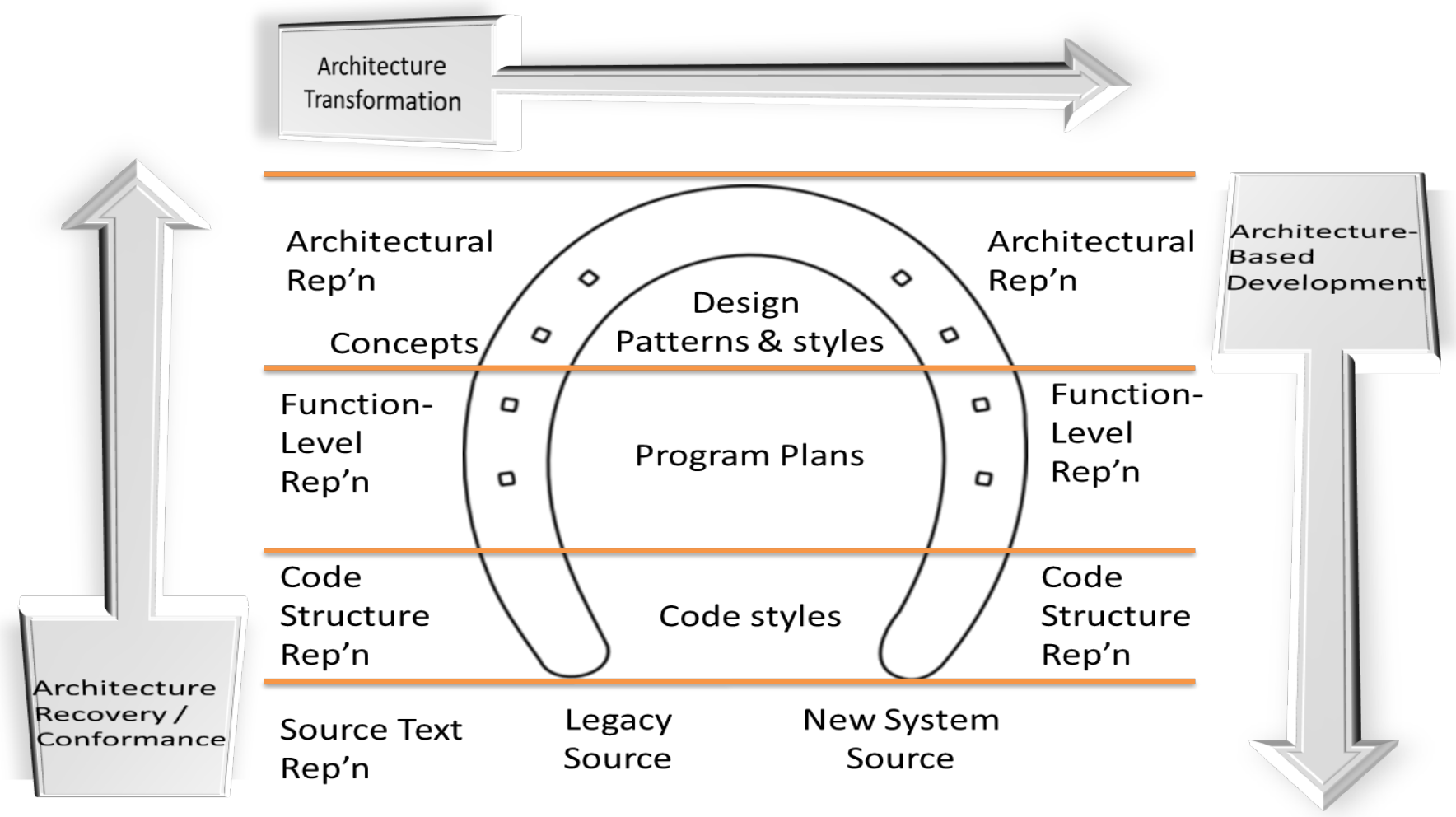
Educating Engineers in Cloud Migration

Cloud Migration Education

- Context
  - Cloud computing project cluster - imparting knowledge, understanding, and skills of cloud computing in general and migration in particular
- Set up
  - Teams of 7-8 students working on migration projects – open source projects – 6 projects
- Project phases and process support
  - Pilot project – migration of one given system – no process support provided
  - Main project – independent selection of an open source – support through a generic process framework, general guidelines, and GitHub

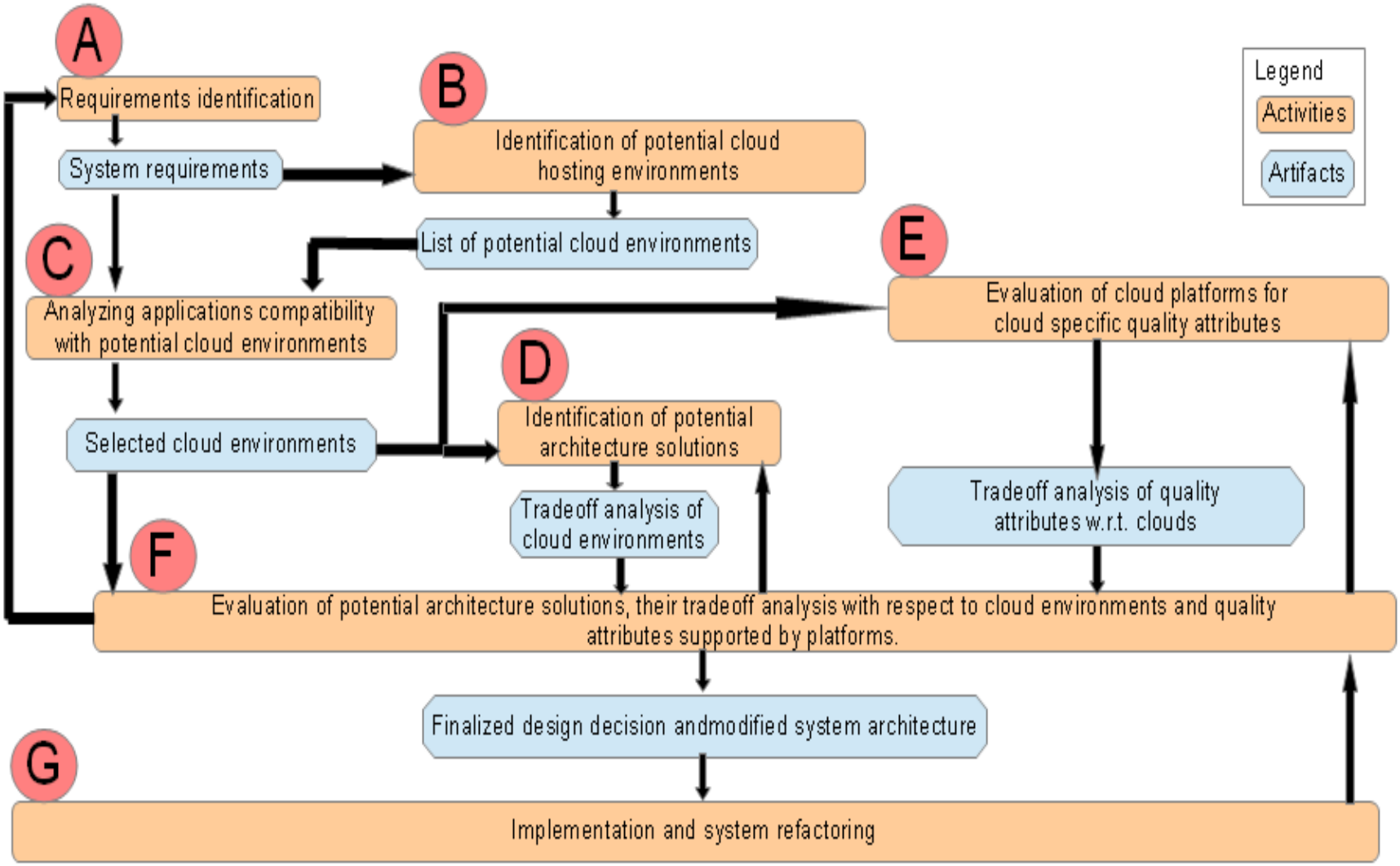
Process and Tools Support: Research Agenda & Progress

Architecture-Based Migration Process

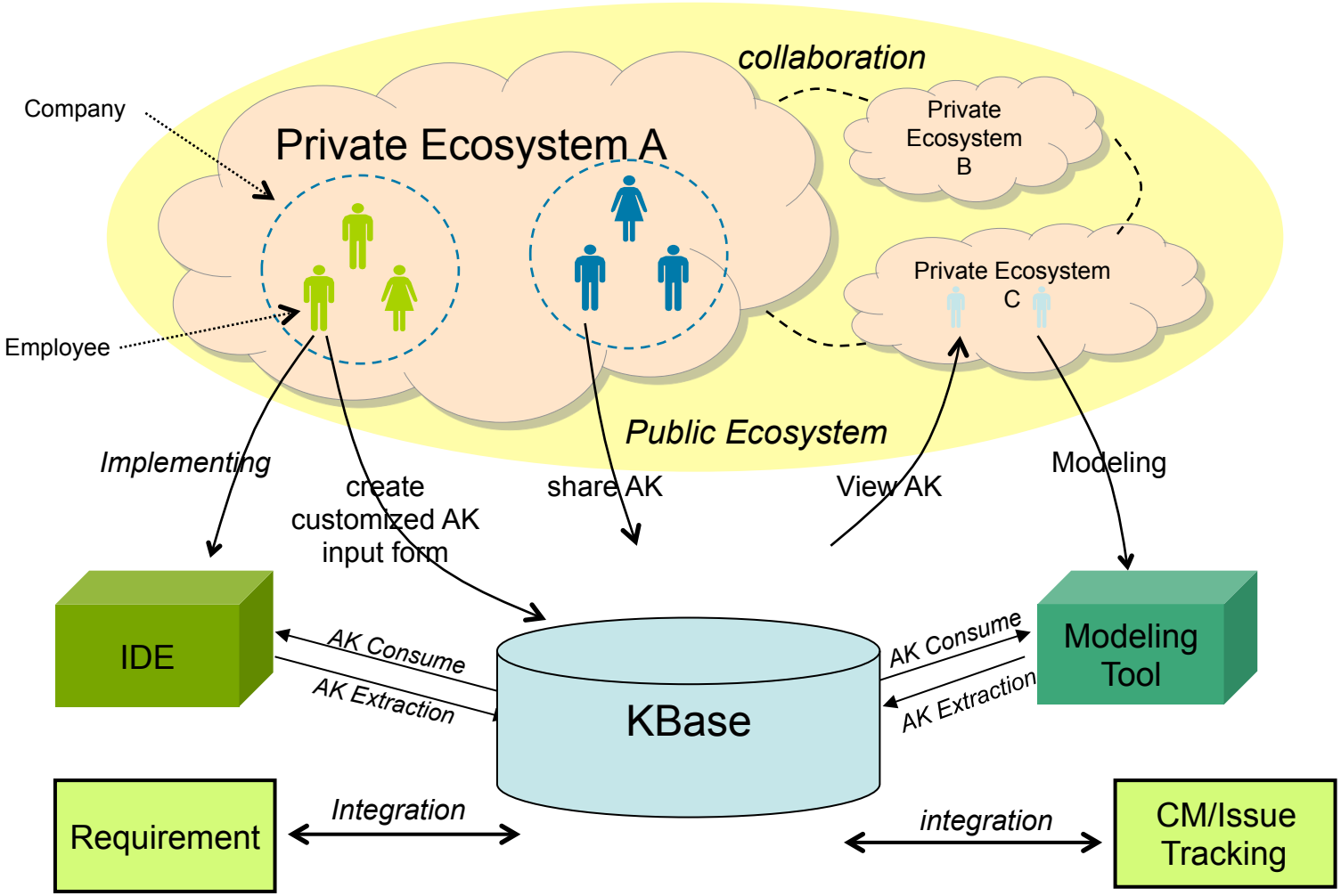


Source: Kazman R., Woods S. G., Carrière S. J.: "Requirements for Integrating Software Architecture and Reengineering Models: CORUM II", in proc. of the Working Conference on Reverse Engineering (WCRE'98), pp. 154, IEEE, 1998

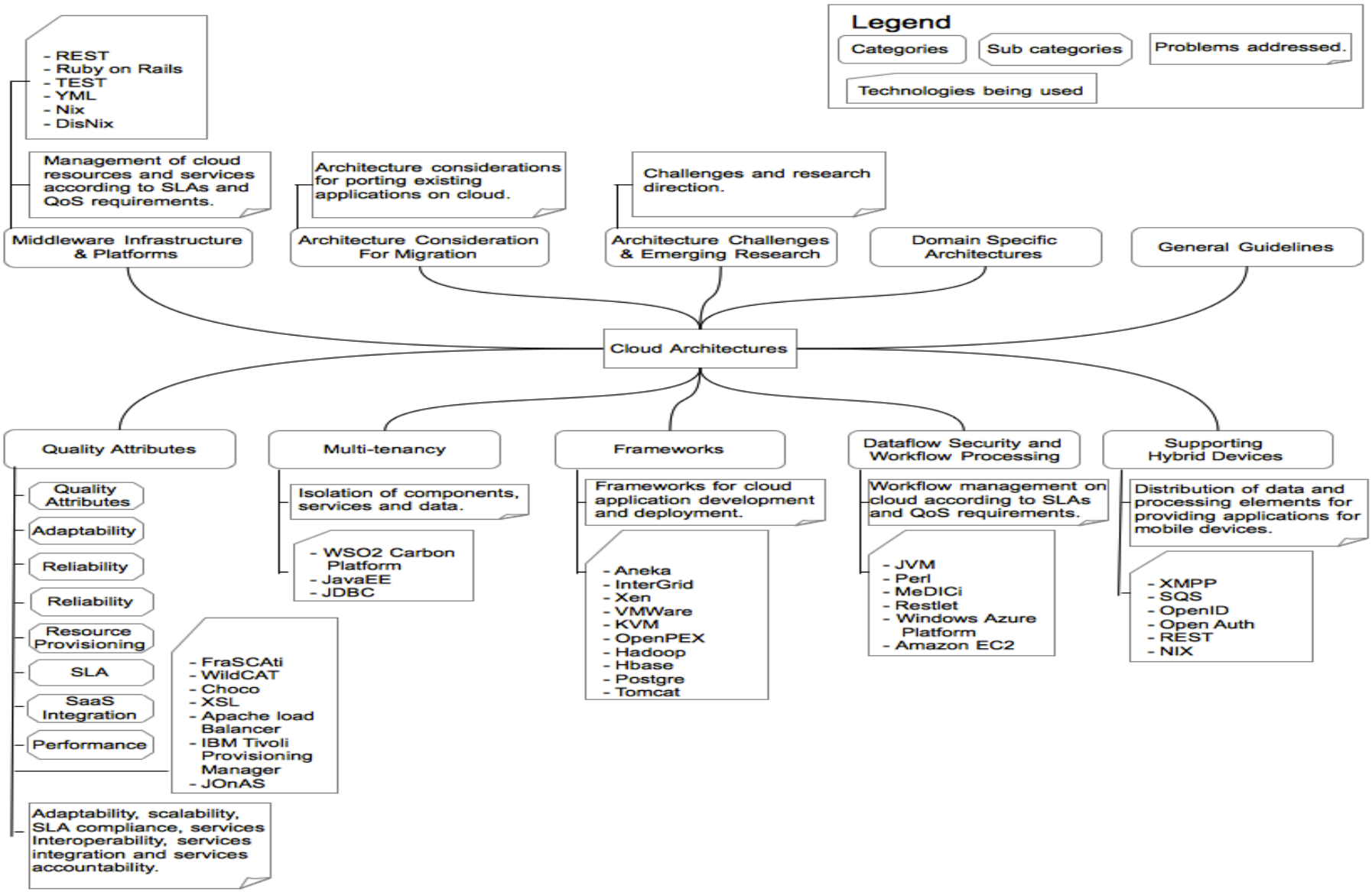
A Generic Cloud Migration Process



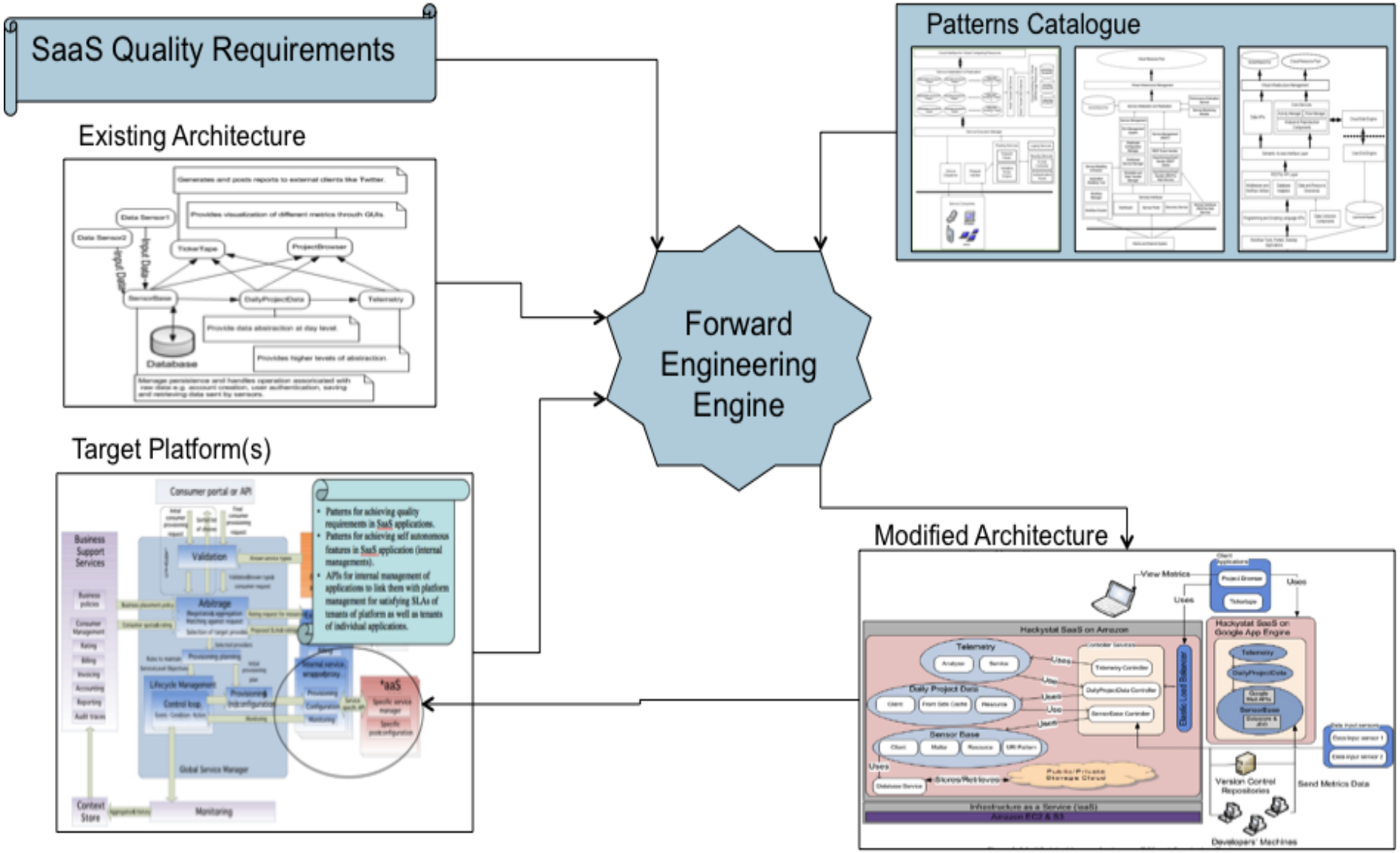
Cloud Migration Knowledge Ecosystems



Architecture Knowledge for Cloud Migration



Tools for Supporting Cloud Migration



Concluding Remarks!!!

- Cloud computing matters, quickly learn how to exploit the benefits and address the challenges
- Technological issues are difficult to address but socio-legal challenges can be daunting
- Migration without suitable processes and tools can be painful – support is needed
- Lack of knowledge and skill – migration education is very important but not attractive

Acknowledgements

- Slides are based on the work that is being carried out in my group in close collaboration with several colleagues, students, and industrial partners.

- Some research challenges and promising solutions have been developed for joint research proposals.

- ITU's migration to O365 project documents and interviews with key stakeholders

- Students teams' reports and interviews for the project cluster course 2013 at ITU

- Maryna's contributions to the study on ITU's migration to O365.

For the Details of the Work

- Chauhan, M. A., Ali Babar, M., Towards Process Support for Migrating Applications to Cloud Computing, Proceedings of the International Conference on Cloud and Service Computing (CSC 2012), Shanghai, China, 2012.

- Chauhan, M.A., Ali Babar, M., Cloud Infrastructure for Providing Tools as a Service: Quality Attributes and Potential Solutions, Proceedings of the Nordic Symposium on Cloud Computing & Internet Technologies (NordiCloud), Helsinki, Finland, 2012.

- Ali Babar, M., Chauhan, M. A., A Tale of Migration to Cloud Computing for Sharing Experiences and Observations, SECLOUD workshop, Collocated with ICSE 2011, Hawaii, USA.

Thank You!

Questions

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