Cloudstep: A Step-by-Step Decision Process to Support Legacy Application Migration to the Cloud

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Talk Outline

• Motivation
• Cloudstep
• An Illustrative example
• Conclusion and future work
Motivation

• Cloud computing is growing in popularity due to its flexibility, high scalability and attractive pay-as-you-go business model

• Many companies are having difficulties in adopting cloud-based solutions, particularly when faced with the challenges of migrating an existing legacy application to the cloud

• Lack of a systematic process to guide project managers and application developers in making informed cloud selection and migration decisions
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Cloudstep

• An iterative decision process to help on the identification and analysis of relevant cloud migration factors

• Profile-based characterization of:
  – Organization
  – Application
  – Cloud provider(s)

• Those profiles are then cross-analyzed to help reveal (and possibly resolve) critical cloud migration constraints
Cloudstep
PROCESS OVERVIEW

1. Define Organization Profile
2. Evaluate Organizational Constraints
3. Define Application Profile
4. Define Cloud Provider Profile
5. Address Application Constraints
6. Evaluate Technical/Financial Constraints
7. Change Cloud Provider
8. [no constraints]
9. Define Migration Strategy
10. Perform Migration
The organization profile captures information regarding legal or administrative characteristics of the organization that are relevant to the migration decision.

- Ex.: national or state laws preventing the organization from storing data outside its geographic location or affecting the governance of its software assets.
Goal: to anticipate the detection of critical cloud adoption constraints within the organization, before carrying out any further analysis of the target application or the candidate cloud providers.

If there are such constraints, the process is terminated and cloud migration is considered non recommended for the organization. Otherwise, the process moves on to the next decisions steps.
The application profile captures relevant characteristics of the application pertaining its implementation, execution and usage and that may influence the migration decision

- **Usage characteristics** (ex.: the expected number of concurrent users and their access patterns)

- **Technical characteristics** (ex.: programming language, external libraries, execution platform, O.S.)
The cloud provider profile captures information about a particular cloud provider, so as to allow the verification of whether it satisfies the needs of both the organization and its target legacy application.

- Ex.: the provider’s availability zones and its supported cloud models (IaaS, PaaS, SaaS), OS types and development tools.
Cloudstep

EVALUATE TECHNICAL AND FINANCIAL CONSTRAINTS

• Goal: to assess the conformance between the organization profile, the application profile and the profile of the candidate cloud provider

• Seven types of constraints are considered:
  – Financial constraints, organizational constraints, security constraints, communication constraints, performance constraints, availability constraints, and suitability constraints
  – Chosen based on an informal literature review and our on experience in deploying real-word applications in the cloud
• Goal: to address any identified constraint that is specific to the target application

• Possible approaches:
  – Change the application itself (e.g., source code, implementation dependencies, data formats)
  – Change the migration scope (e.g., migrate only a subset of the application’s components or migrate the whole application along with additional components and systems)

• The process may be terminated due to pending constraints
• Goal: to address any identified provider constraint by selecting an alternative cloud provider
  – Several approaches and tools to cloud provider selection (ex.: CloudCmp, Cloudorado.com, CloudHarmony)

• Again, the process may be terminated due to pending constraints
Goal: to define an appropriate strategy for migrating the target application to the cloud

Key factors:
- Migration cost
- Operational and management costs (after deployment)

Usually start with a pilot project
- Helps to investigate the behavior (functional and non-functional) of the application under different cloud deployment scenarios
Here the application is actually deployed in the cloud, according to the migration strategy previously defined.

This activity also includes the execution of all the tests (functional, stress, etc.) necessary to guarantee that the application will behave as expected.

Outside the process scope (for the moment, at least)
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• Small (<30 employees) software company in the Northeast of Brazil offering IT solutions for several markets (wholesalers, hospitals, medical clinics, restaurants)

• Company’s local IT infrastructure solely devoted to support its internal operations (commercialized IT systems deployed in the infrastructure acquired by their respective contracting clients)
  – Company may offer an additional service to manage the client’s IT infrastructure
Naja RIS
CLOUD ADOPTION MOTIVATION

• To speed up the deployment of its software services and reduce upfront client costs
  – Clients will no longer need to acquire and manage high-end hardware resources

• To reduce or eliminate software problems related to the underlying physical infrastructure installed on each client

• To improve its commercial and marketing operations
  – Cloud-based services are much easier to setup and demonstrate for new prospective clients

• To facilitate and expedite closing of new contracts, by taking advantage of the less restrict SaaS business model
The following (non-critical) constraints were identified within the organization:

- Low confidence of client companies in keeping their data outside their premises
- Lack of a more formal contract with the cloud provider, which may facilitate evasion of current customers
- Lack of confidence in the cloud model
- Need for stronger confidentiality agreements over customer data in order to comply with established legal issues
Naja RIS APPLICATION PROFILE

• Naja RIS is a Radiology Information System used by about 60 imaging clinics in Brazil

• Usage characteristics:
  – 66 hours of intense use per week (7am-7pm, Monday to Friday, and 7am-1pm on Saturdays by most customers)
  – In the remaining hours, the system is only used sporadically
  – Need to keep the system running on a 24x7 basis
  – Due to the medical data kept by the system, security is an essential non-functional concern
Layered architecture:

- **Application layer** – client application developed in Delphi and Java
- **Business layer** – application server written in Delphi
- **Persistence layer** – Microsoft SQL Server database
- All components run in a Windows environment only
Naja RIS
APPLICATION PROFILE

- System’s current monthly costs (per customer):

<table>
<thead>
<tr>
<th>Item</th>
<th>Monthly cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software license</td>
<td>US$ 300.00</td>
</tr>
<tr>
<td>Acquisition of two servers (4 year depreciation)</td>
<td>US$ 107.50</td>
</tr>
<tr>
<td>Local infrastructure</td>
<td>US$ 175.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>US$ 582.50</strong></td>
</tr>
</tbody>
</table>
Naja RIS
CLOUD PROVIDER PROFILE

• Two public cloud providers considered: Amazon EC2 and Rackspace
  – IaaS cloud models
  – Multiple virtual machines types pre-configured with different OS (Windows and Linux variants), memory size and processing power
  – On demand and reserved on demand pricing options
  – Several availability zones in different continents (Amazon EC2 has one in São Paulo, Brazil!)

• No critical technical constraint identified for neither of the two providers
Naja RIS
MIGRATION STRATEGY

- Scenario 1: single-tenant deployment (pilot project)
- Scenario 2: multi-tenant deployment
• Amazon EC2 virtual machines (instances) types selected for each application component:

<table>
<thead>
<tr>
<th>Component</th>
<th>Instance type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal server</td>
<td>c1.medium (business hours)</td>
</tr>
<tr>
<td></td>
<td>t1.micro (non business hours)</td>
</tr>
<tr>
<td>Application server</td>
<td>m1.small (business hours)</td>
</tr>
<tr>
<td></td>
<td>t1.micro (non business hours)</td>
</tr>
<tr>
<td>Database server</td>
<td>c1.medium with MSQL Server (full time)</td>
</tr>
</tbody>
</table>

• Rackspace instances types (called *flavors*) selected with similar capacity
Naja RIS
MIGRATION STRATEGY

- System’s estimated monthly cost per customer:
  - On premise X cloud
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Conclusion

• Cloudstep contributions:
  – Offers practical guidelines to help application developers and project managers in facing the challenges of adopting a cloud-based solution
  – Reduces the subjectivity of the decision process when migrating a legacy application to the cloud
  – Increases the likelihood that the organization will find a solution that best fits its needs and constraints

• Naja RIS developers provided us with positive feedback on the use of the process, although the actual migration is yet to be done
Future Work

• Improving the process as we gain more experience with its use in different cloud migration scenarios

• Migration to multi-cloud environments

• Tool support
  – Web-based prototype currently under development
Thanks!