

Third ACM International Workshop on Service Integration Pervasive Environment

Sorrento - 07/06/2008

> POLITECNICO DI MILANO

Dipartimento di Elettronica e Informazione

> Towards understanding the role of adverse selection and moral hazard in automated negotiation of service level agreements

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Introduction Contract theory Adverse selection Moral hazard Electronic contracting SLA-oriented framework Penalties Temporal approach to SLA management Conclusion

# Introduction

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### Introduction

In outsourcing of IT services, Service Level Agreements (SLAs) are formal documents that define the relationships between the provider and the customer.

SLAs report warranties and specifications that can be both:

functional

non-functional

SLAs are strategic for the enterprise They are the building blocks to evaluate KPIs and CSFs Example: outsourcing of ERP implementation

Two main approaches:

•Microeconomics is interested in studying SLAs theoretically and its results are hardly applicable in complex real systems

•Engineering defines relevant aspects of SLAs (QoS, pre- and postconditions) without taking into account real world problems

We think research is lacking a narrower integration between these two fields of inquiry

#### Introduction

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#### **Contract theory**

Branch of economics studying how actors interact to stipulate an agreement under some conditions:

- Agents' rationality, i.e. they tend to maximize their own utility function using information coming from the external environment and agent's past experience
- Information asymmetry, i.e. one of the contracting agents has more or better information than the other about the good or the service

Several research streams within contract theory: incentive theory, incomplete contract theory, transaction cost theory and agency theory.

# **Agency theory**

Agency theory studies a very common setting in which two agents bargain for a good or service

- **Principal:** he is the customer, who requires the good or the service
- Agent: he is the provider, offering the good or the service

It is a common and general schema to which almost all transactions can be reduced

Examples: employer and employee, insurance company and its customers, a firm and its suppliers

Problems arising in the relationship between agent and principal are due to:

- divergent interests
- the principal is not able to verify properly (or it is too expensive) if the agent behaves correctly

### Adverse selection and moral hazard

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These lead to two kinds of opportunistic behavior:

- Hidden information (adverse selection): agents may not reveal the truth about their state
- Hidden action (moral hazard): agents may not deliver properly on their task

# Adverse selection (1/3)

Adverse selection refers to the problem of the principal of properly representing the actual characteristics of the agent

#### Third-party verification:

Involving a trusted third party that collects data, formalizing them and standardizing the results

#### Signaling:

aims at reducing the asymmetry in information between the principal and the agent by allowing the agent to offer a way to determine his or her capabilities, such as a certification

#### Limitations:

Not always certifications reveal the agents' state truthfully The cost to obtain a certification must be very high for low-quality agents

# Adverse selection (2/3)

Adverse selection refers to the problem of the principal of properly representing the actual characteristics of the agent

#### Screening:

is a means by which a principal is capable to evaluate the quality of the service offered by agents, splitting the contract in two parts, where the duration of the first one is much longer than the second one. The output of the first part is evaluated by an external third-party so that the relationship with the agent continues if the performance of the agent has satisfied the principal

#### Limitations:

#### it can become very expensive

this technique is effective only if an agent's performance in the second contract phase can be evaluated at a very low cost and the evaluation parameters are not significantly dependable on exogenous factors

# Adverse selection (3/3)

Adverse selection refers to the problem of the principal of properly representing the actual characteristics of the agent

#### Self-selection:

Is the adoption of a strategy that makes the agent self-classify, revealing the true information, e.g. low salary in the first phase of the contract, tipically lower than market level and enacting an encrease of the remuneration in the second phase

# Moral hazard (1/2)

**Moral hazard** is a problem arising during the contract enactment, when the agent has the possibility not to behave properly, due to an imperfect monitoring by the principal

#### Monitoring:

Is the activity of monitoring the agent's work. It can be performed on a single unit of work or only on the output. A way to better perform monitoring is introducing limitations or compliance agreements, like standardized procedures.

#### Limitations:

It can be very expensive It is not possible to perform perfect monitoring

# Moral hazard (2/2)

**Moral hazard** is a problem arising during the contract enactment, when the agent has the possibility not to behave properly, due to an imperfect monitoring by the principal

#### Feedback and reputation systems:

Is the activity of measuring agents' performance through the evaluation of previous contracts and transactions. They can be used against both adverse selection (creating a "shadow on the future") and moral hazard (because of the pressure of the final evaluation)

#### Limitations:

It is not effective in small markets

#### Incentives:

Aligns the personal goals of agents and principal, introducing payments correlated to the agent's performance

It is not effective if the measured output is subject to exogenous events

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# **Stack of process activities**

#### How process activities are mapped within a virtual enterprise



Current frameworks do not explicitly provide any link between service negotiation and contract theory issues

### **SLA-oriented framework**



# **Penalties policy management**

It is necessary to bargain also on penalties because this is likely to reduce opportunistic behavior, and also because penalties represent a warranty for the principal in case of economic loss due to scarce quality of service.

Example:

S1's SLA: 99% availability of the online service, 1€ penalty for each not answered request under some specific conditions;

S2's SLA: 95% availability of the online service, 2€ penalty for each not answered request under the same conditions as specified in S1's SLA.

S1's SLA more profitable than S2's SLA?

under ideal conditions YES

But it could be more convenient to stipulate a contract with S2, because S1 could behave under moral hazard regime and reject some way the vast majority of penalty requests.

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#### **Temporal SLA management**

It should be possible to specify not only the start and the end point of a contract, but also, to express more complex temporal constraints for contract execution

Example: Service S costs 3 €/h from 8 a.m. to 6 p.m. and 1 €/h from 6 p.m. to 8 a.m.

This would allow the implementation of more robust policies to avoid adverse selection and moral hazard

Availability of WS-Agreement language extension, but no current utilization

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### Conclusion

- We have introduced the problem of merging research on contracts from the **microeconomic** and **engineering** perspectives.
- We proposed a **framework** for analyzing contracts at different layers and for defining mechanisms that are likely to reduce the risk related to **adverse selection** and **moral hazard** for the SLA principal.
  - Among such mechanisms, we plan to focus on: the automated establishment of **penalties** the definition of a **temporal approach** to SLA definition and management.

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