To Trust or not to Trust?
A Survey of Models Describing Trust into Cloud Services from a UX Perspective

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Trust in Cloud Computing – Outline and Agenda

- Why is trust important for IT and Cloud Computing?
- What influences trust in Cloud Computing?
- How can trust, use and acceptance be modelled?

- Introduction: Buzzword Cloud Computing
- What is Cloud Computing
- Trust (in Cloud Computing Services)
- Empirical insights and models to analyze Cloud Trust
- Towards a Unified Model of Cloud Trust
Cloud Computing – Definition

A buzzword
• new style of computing (5th utility)
• cost savings (pay-as-you-go)
• high availability
• easy scalability

What is it?
• dynamically scalable virtualized resources provided as a service via internet
• significant trend: cloud computing to reshape IT processes and marketplace
• a variety of devices have access to programs, storage, and application-development platforms from any place
Cloud Computing – One Cloud to Rule Them All?

INTRODUCTION

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TRUST AND ACCEPTANCE MODELS

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Cloud Computing – Definition and Research Framework

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Cloud Computing

Service Level
- SaaS
- PaaS
- IaaS

Entities
- Provider
- User
- Developer / Organization / End User (Private / Job)

Deployment Models
- Public
- Hybrid
- Private

Physical Resources
- Network
- Storage
- Processing Power (CPU)

Scalability

Virtualization

Interfaces
The user is not involved in data storage, processing, collection, disclosure anymore (Cavoukian, 2008)
Lack of control over data leads to risk and uncertainty → Trust is needed to bridge vulnerability (Firdhous et al., 2011)
Trust in Cloud Computing – What is Trust?

Introduction

What is Cloud Computing

Trust in Cloud Computing

Trust and Acceptance Models

Towards a Unified Model

- Based on an risky and uncertain interaction of trustor (who trusts) and trustee (who is trusted)
- Trust = the trustors willingness to be vulnerable by the trustee (Mayer et al., 1995)
- Trust decreases complexity of social interaction and enables risk taking (Luhmann, 1968)
Trust in Cloud Computing – What is Trust in the Cloud?

- **Vulnerability** by processing / storing data inside the cloud
- **Trustor**: End user
  **Trustee**: The „Cloud“ (Provider(s), Interface, Data Center → entities)
- **Not to trust means not to use** (not to store)

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Empirical Insights from the User‘s Perspective

Assumptions, Models and a Unified View on Trust in Cloud Computing
Cloud Trust and Usage – Empirical Approach

INTRODUCTION

• **Research question**: What influences the user’s (dis)trust in cloud and cloud (dis)usage?

• **Research goal**: Building an empirical model that explains the (dis)use and (non-)acceptance of cloud services

• **Research objects**: Cloud storage and backup services (Dropbox vs. ownCloud)

• **Research methods**: Literature review (empirical results and models), large-scale survey
Cloud Trust and Usage – Empirical Approach

- Literature review – Theoretical assumptions
  - Trust is important
    - facilitates Cloud acceptance and usage (Habib et al., 2012)
    - but mostly technical examination of trust-related issues in Cloud Computing (e.g. Wenjuan et al., 2012)
  - focus on building control systems (privacy / security) to mitigate risk in cloud computing
    - control over storing, processing, billing of data (Khan & Malluhi, 2013)
    - Transparency of service: Quality of Service, Service Level Agreements, Audits, reputation-based trust etc. (Huang & Nicol, 2013)
  - need for user-centred, empirical models of trust and acceptance
Cloud Trust and Usage – Empirical Approach

INTRODUCTION

- Literature review – Models explaining trust and cloud usage
  - TAM (Technology Acceptance Model)
    - UX Factors (Usefulness, Ease of Use) (Davis & Venkatesh, 2008)
    - Trust as antecedent of usage (e-commerce websites=, perceived risk as antecedent of disuse (Pavlou, 2003)
  - Enablers and Inhibitors (Herzberg)
    - Collaboration Support and Omnipresence increase Google Apps usage (Park & Ryoo, 2013)
  - Migration Models (Migration theory)
    - Security Concerns increase disuse of Google Apps (Bhattarjachee & Park, 2013)
Models Describing Trust in Cloud Computing / Cloud Acceptance

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• TAM (Technology Acceptance Model)
  – Pavlou, 2003 (B2C, E-Commerce)
  – Trust as an antecedent, (in)directly

```
   Actual Transaction
     ↳  .37
       ↙   .46**
          ↙
       Intention to Transact
          ↙ .56
             ↙
      Perceived Risk
            ↙ .42
                 ↙
                .30**
                Trust
                .60**
        Satisfaction with Past Transactions

   Perceived Usefulness
      ↙ .66
         ↙ .41**
            ↙
            Perceived Ease of Use
            .49**
                .41

   Reputation
```
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Models describing Trust in Cloud Computing / Cloud Acceptance

- **Switching models**
  - Park & Ryoo, 2013 (Google Apps)
# Cloud Trust and Usage – Empirical Approach

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  - **Migration Models (Migration theory)**
    - Security Concerns increase disuse of Google Apps (Bhattarjachee & Park, 2013)
• Migration-theoretic approach
  – Bhattacharerjee & Park, 2013 (Google Apps)
Cloud Trust and Usage – Empirical Approach

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  – No specific, unified model integrating both, Cloud Computing and trust, linked to (dis)use
Cloud Trust and Usage – Methodological steps

Online Survey: Cloud Storage Services
- Analyzing the influence of several aspects on trust in cloud computing
  - UX factors (perceived ease of use, from TAM)
  - Privacy, security, reputation, social norm (from Switching Models, TAM, migration models)
Cloud Trust and Usage – Methodological steps

- **Scales** (items to evaluate Cloud Services):
  - Perceived Ease of Use, Perceived Usefulness, UX, Perceived Risk (TAM, Davis & Venkatesh, 1996; Pavlou, 2003)
  - Omnipresence, Collaboration support (Park & Ryoo, 2013)
  - Security and Privacy (Casaló, Flavián, & Guinalíu, 2007)
  - Trust (Corritore et al., 2005)
  - Reputation and social norm (Casaló et al., 2005, Kumar et al., 2005; Park & Ryoo, 2013)
Cloud Trust and Usage – Methodological steps

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  - Analyzing the influence of several aspects on trust in Cloud Computing
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    - Privacy, security, reputation, social norm (from Switching Models, TAM, migration models)
  - Linking the aspects influencing trust and trust to the usage of Cloud Computing
    - Data stored in the Cloud (types, features)
    - Usage behavior
Cloud Trust and Usage – Methodological steps

- **Scales** (Items to analyze usage)
  - *where* do you store data (generally), cloud-/client-based (USB, hard disk), webmail
  - *for which data type* do you prefer cloud-/client based storage (pictures, documents, financial data)
  - *for which data features* do you prefer cloud / client based storage (sensitive, public, occupational, …)
  - which of your **devices** are connected to the Cloud Service (local PC, Laptop, mobile devices, …)
  - **functions** do you use with the Cloud Service (sending data via link, collaboration, backup, …), and how often

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Cloud Trust and Usage – Methodological steps

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  - Modelling these questionnaire data in an empirical based linear Structure Equation Model (SEM), using Partial Linear Squares Methods
Cloud Trust and Usage – Methodological steps

- towards a unified model

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Cloud Service

- Cloud Features
  - X1
  - X2
  - X3
  - X4
  - X5

Aesthetics / Interface
- Perceived Ease of Use
- Perceived Usffulnesses

Use Incentives
- Collaboration Support
- Data Omnipresence

Trust
- Privacy
- Security

Social Influence
- Social Norm
- Reputation

Cloud Usage
- Frequency of Use
- Type of Data
- Amount of Data
- Devices
- Use Cases

Cloud User

- Dropbox vs. ownCloud

Interaction

- user profile

Control Var.
- Generalized Trust
- Personal Innovativeness
Outlook

- Trust is important for Cloud Computing
- Technical and organizational control systems are not enough – socio-technical IT needs human trust
- To trust means to accept means to use
- Empirical models can add insights to Cloud Trust
- Practitioners can use this insights to improve Cloud acceptance on the user’s side
Any Questions?

• Thanks for your attention!
# References

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