

Socially enhanced Services Computing

Schahram Dustdar

Distributed Systems Group

TU Wien

Joint work with:

Florian Skopik, Daniel Schall, Martin Treiber, Harald Psaier,
Lukasz Juszczak, Hong-Linh Truong



Evolution of Large-Scale & Collective Problem solving



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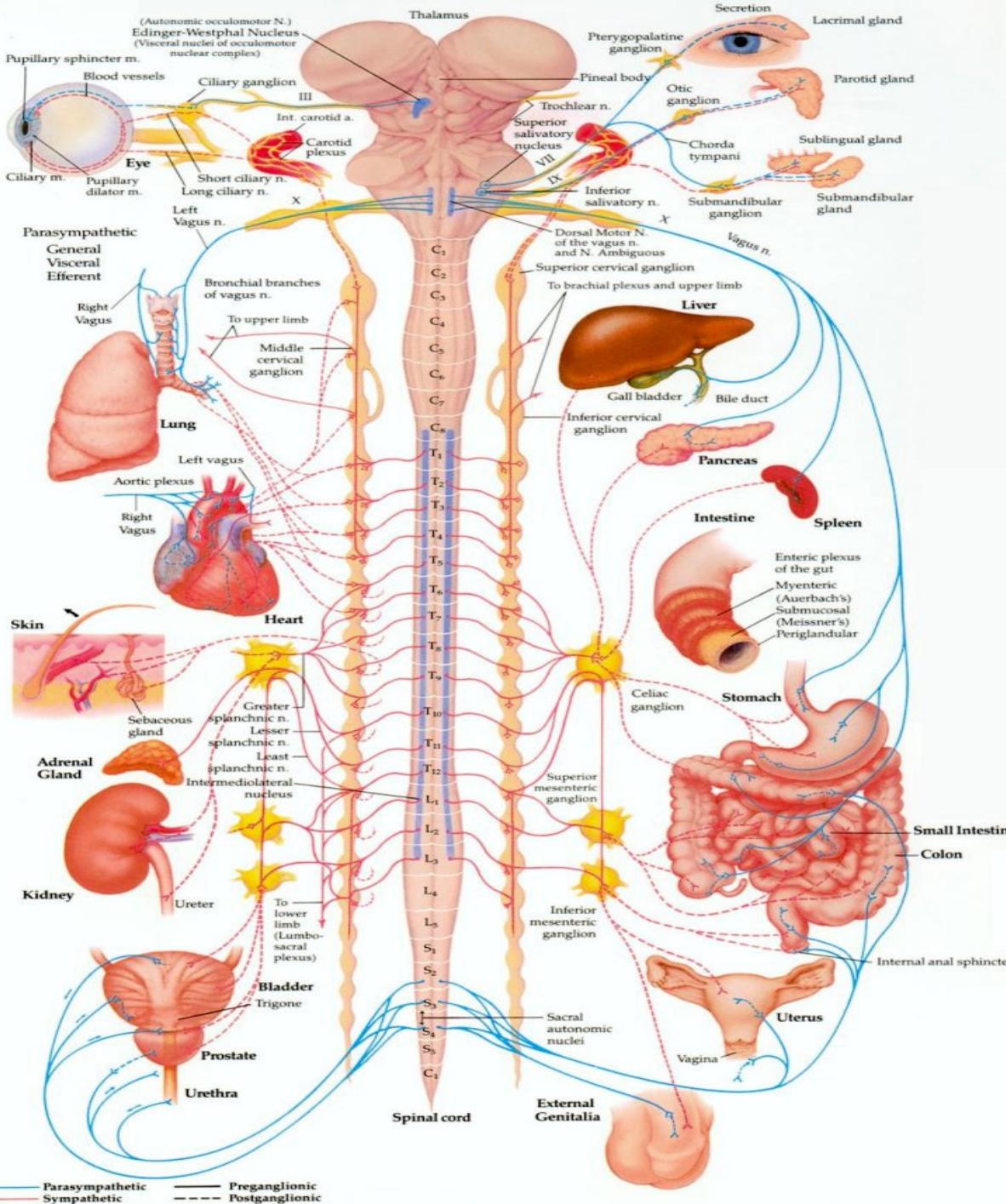






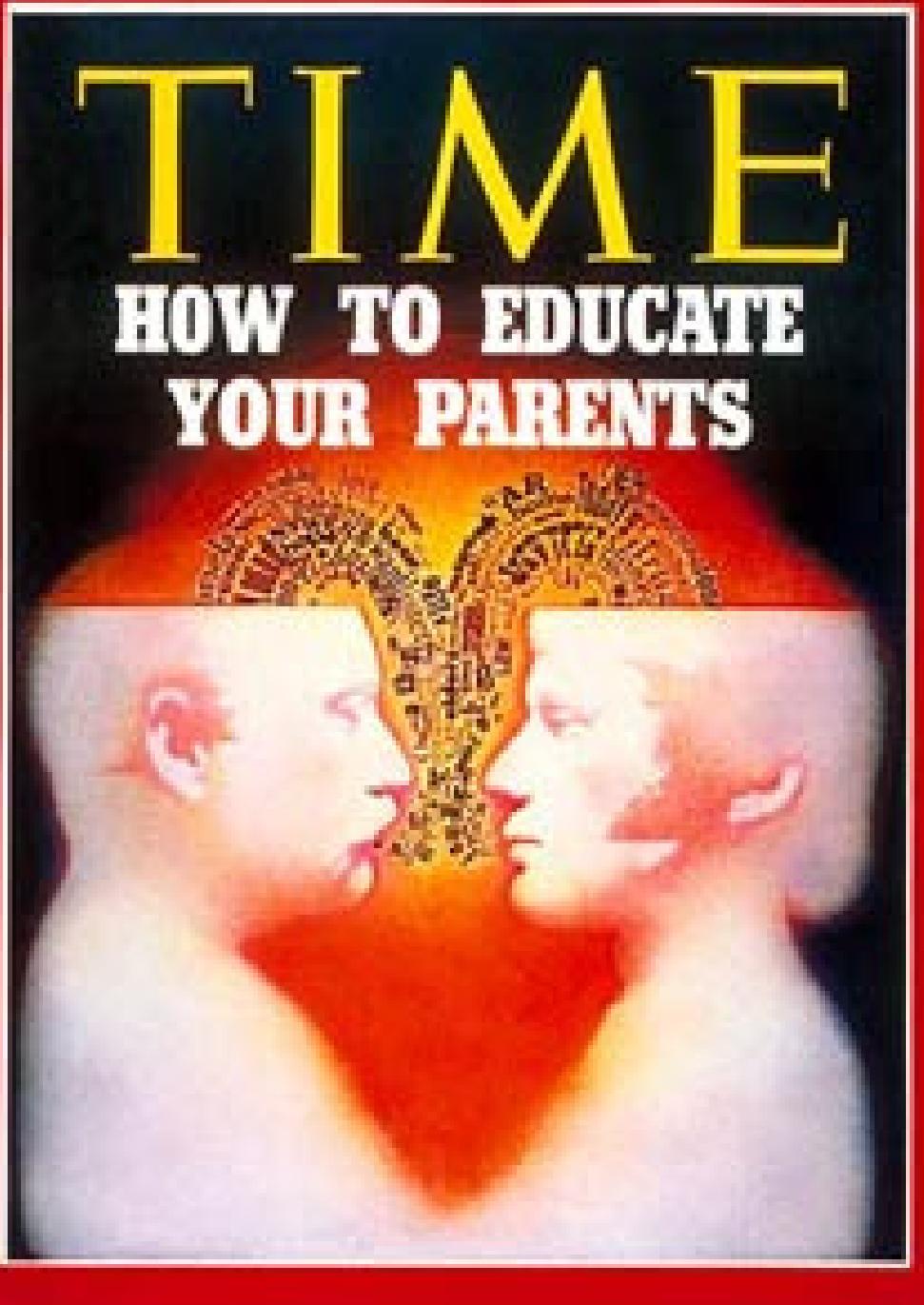


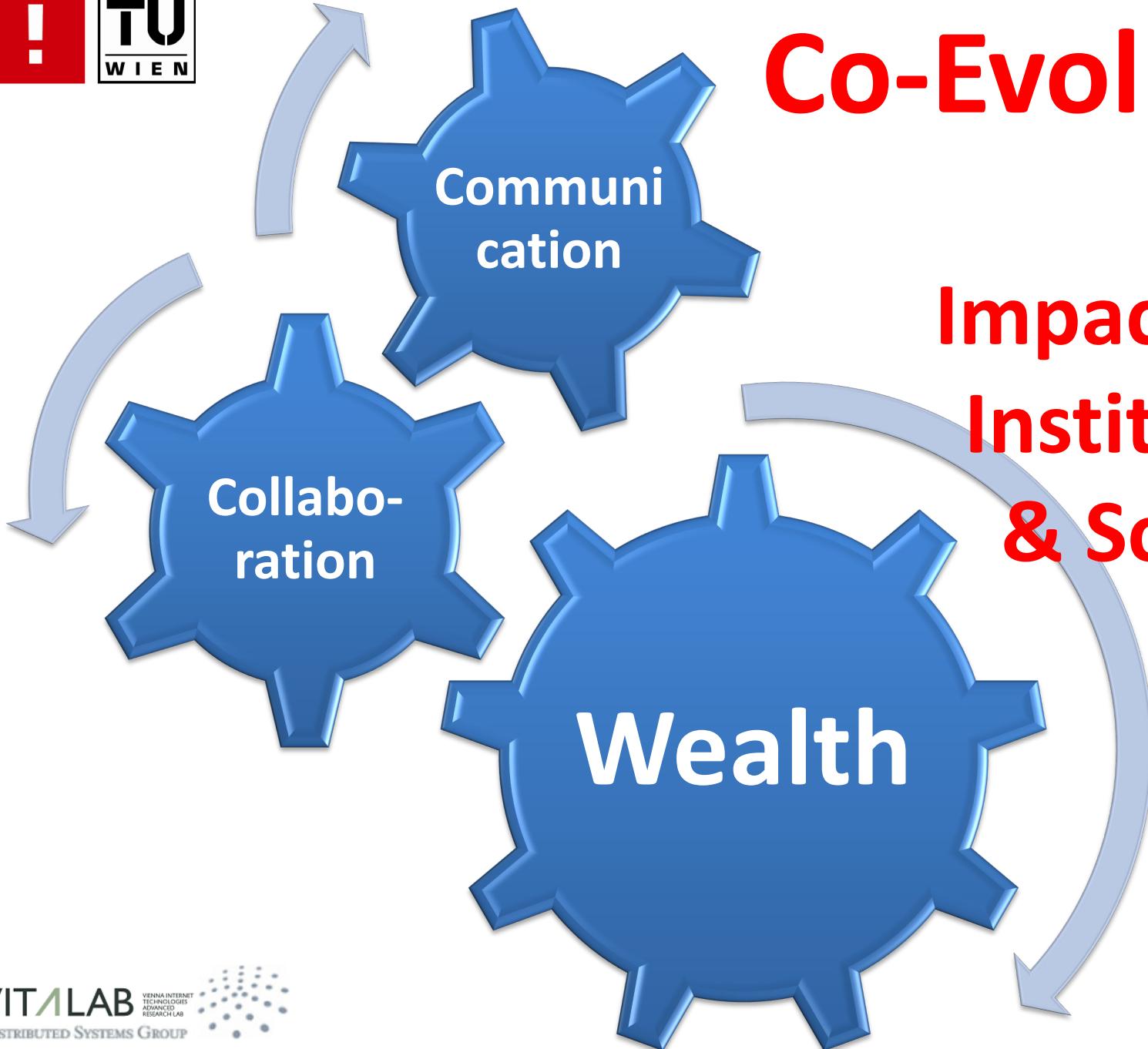
Autonomic Nervous System











Co-Evolution

Impact on all
Institutions
& Society

Crowdsourcing & Social Computation



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Ideas so far



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- 22,749 Coffee & Espresso Drinks
- 1,087 Frappuccino® Beverages
- 7,020 Tea & Other Drinks
- 10,242 Food
- 4,869 Merchandise & Music
- 6,773 Starbucks Card
- 7,061 Other Product Ideas

EXPERIENCE IDEAS

- 5,596 Ordering, Payment, & Pick-Up

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Most Recent Ideas

- 44 Min(s) Ago Colorful Tumblers
- 2 Hour(s) Ago Expand Owatonna store.
- 4 Hour(s) Ago Re starbuck Lids Plastic Toxicity



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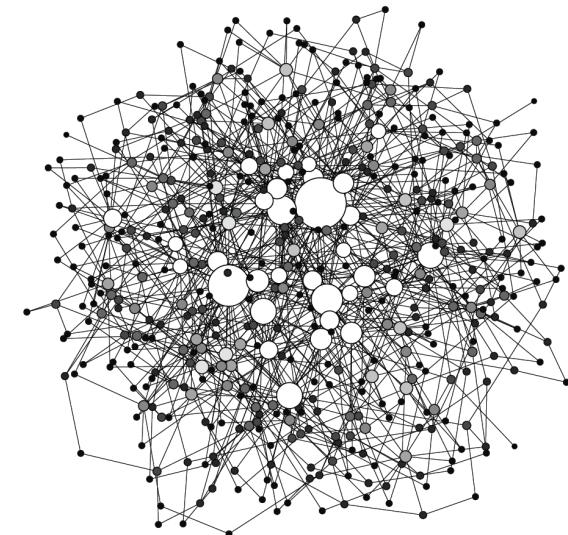
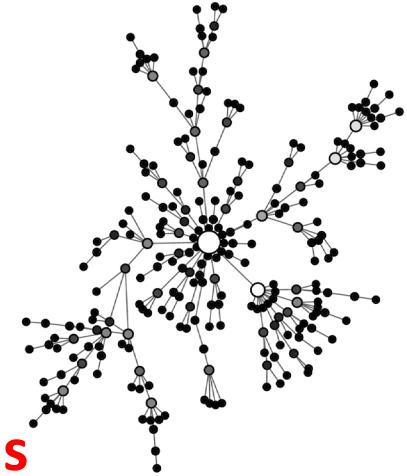


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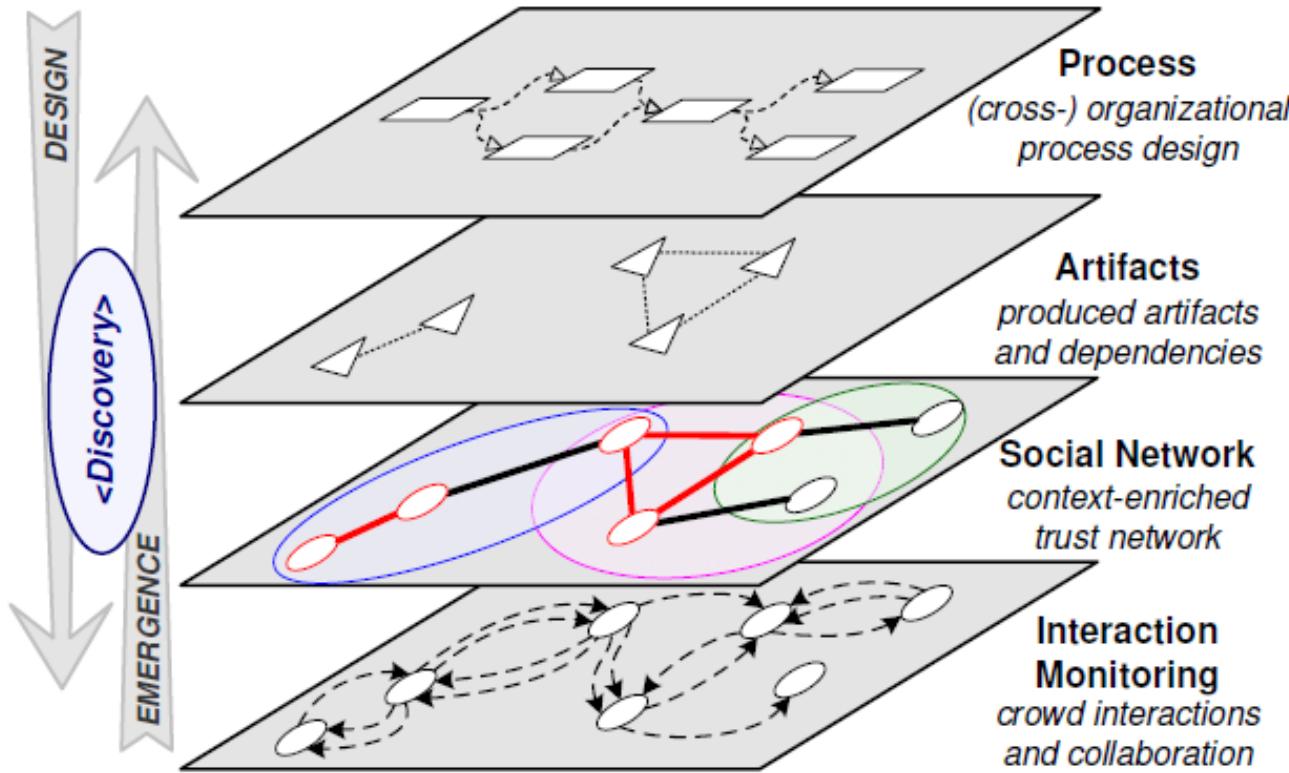




- **Open** and dynamic Internet-based environment
 - Humans **and** software resources (e.g., Web services)
 - **Joining/leaving** the environment **dynamically**
 - Humans perform **activities**
- Massive **collaboration** in **Crowds, Services & Clouds**
 - Large sets of **humans** and software **resources**
 - Dynamic **compositions**
 - Distributed communication and coordination
- Understanding the **dynamics**
 - Future interactions
 - Resource selection
 - Compositions & Adaptation of actors
 - Disclosure of information

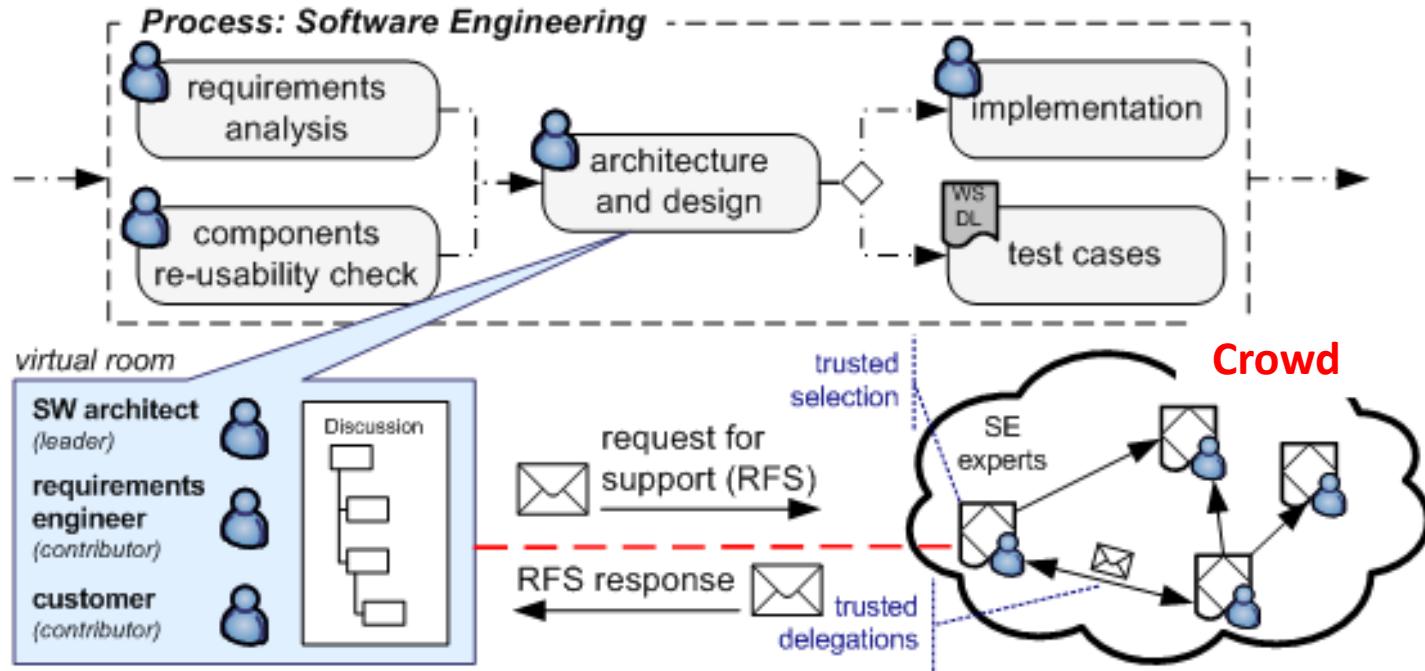


Framework



Skopik, F., Schall, D., Psaier, H., Treiber, M., Dustdar, S. (2011). Interaction Modeling in Crowd Computing Environments. *Information Technology i & t Journal*, Vol 53, 2011

Motivating Scenario



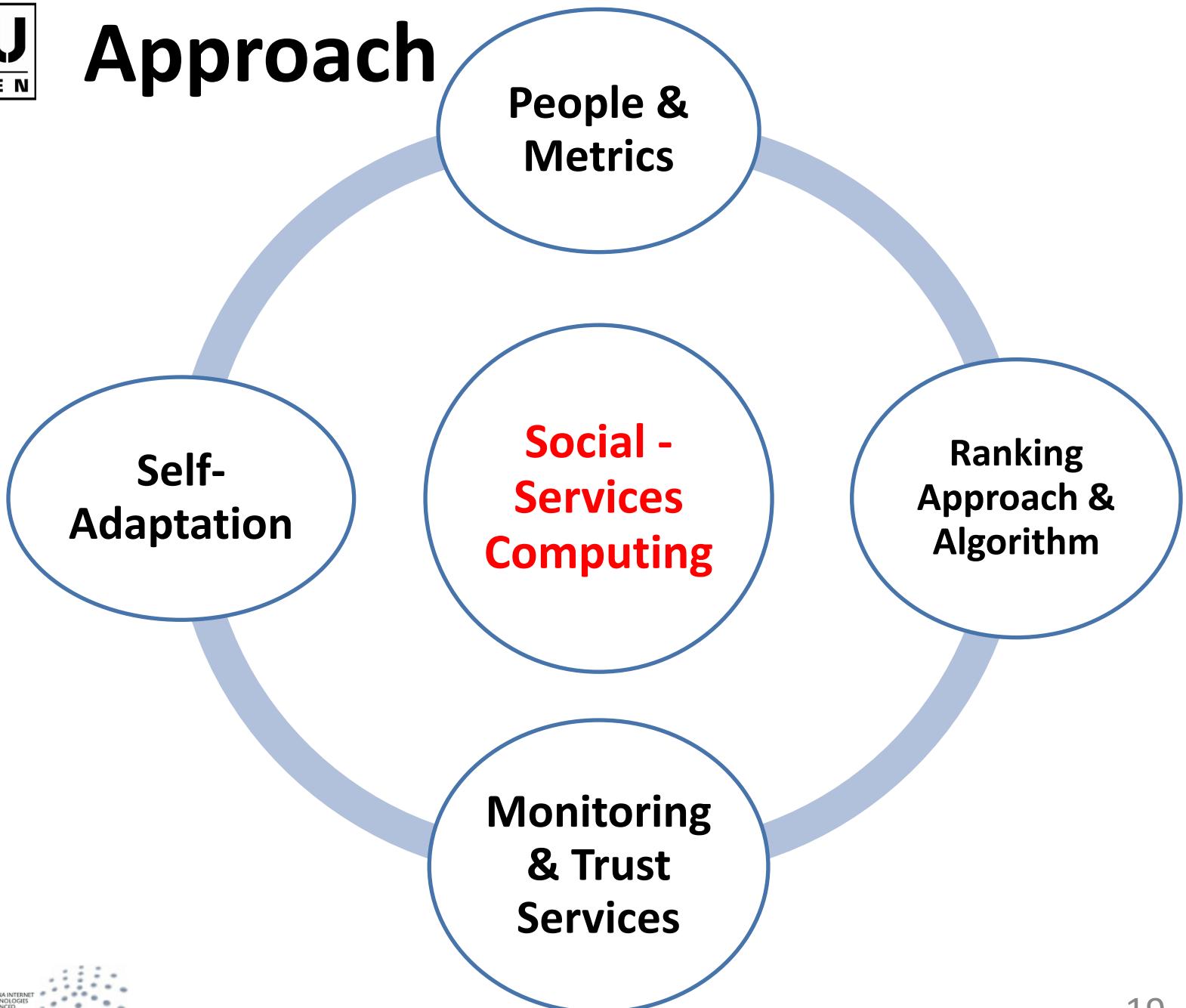
Q1: How do actor **discovery** and **selection** mechanisms work?

Q2: How can actors be flexibly involved (**ranked**)?

Q3: How can interactions and service compositions become **adaptive**?

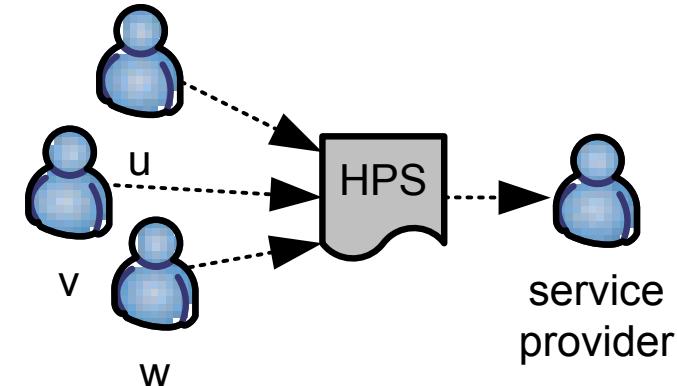
Skopik, F., Schall, D., Dustdar, S. *Trusted Interaction Patterns in Large-scale Enterprise Service Networks*. 18th International Conference on Parallel, Distributed, and Network-Based Computing. Pisa, 2010. IEEE.

Approach



Human-Provided Services (HPS)

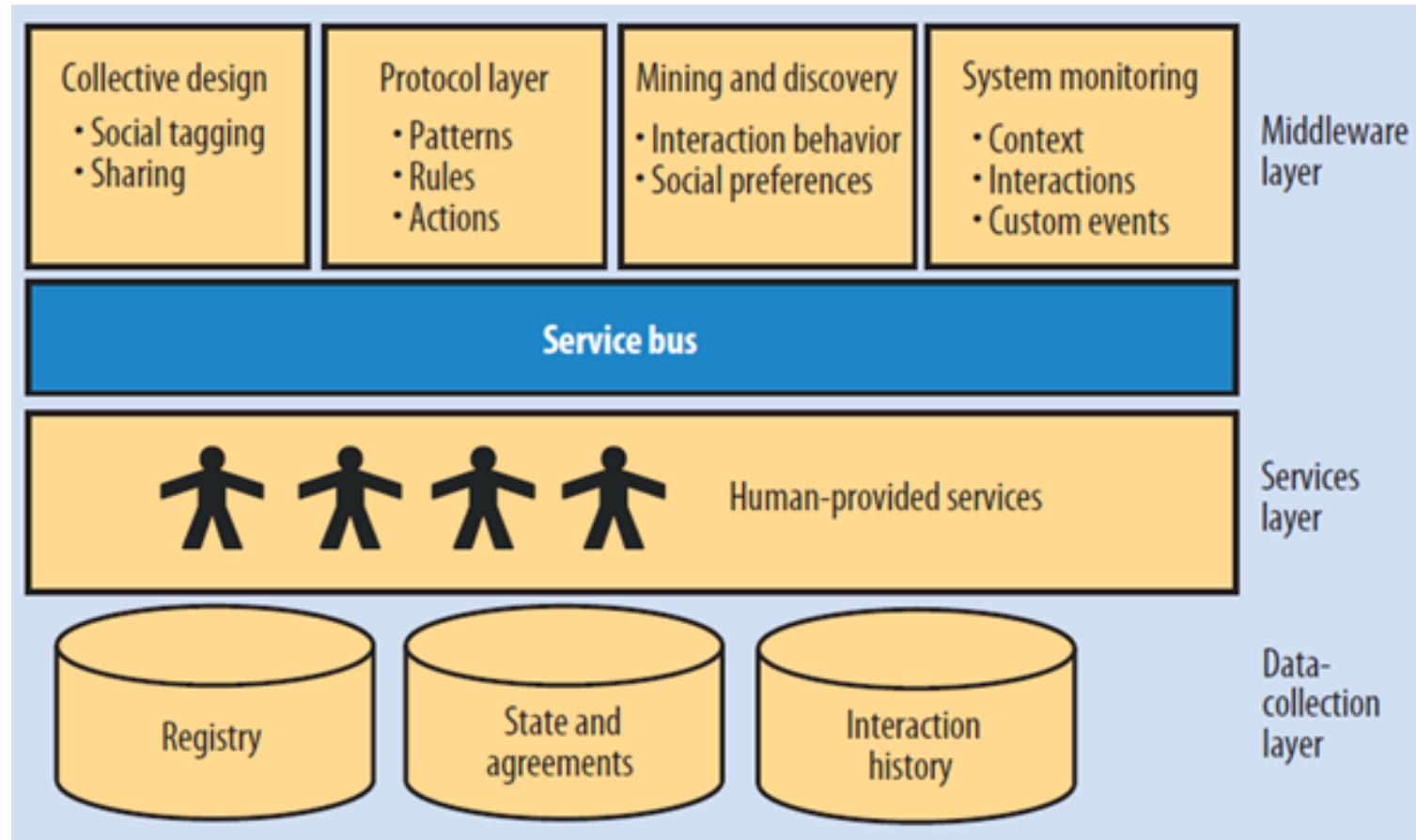
- User contributions modeled as services
 - Users define their own services
 - Reflect willingness to contribute
- Technical realization
 - Service description with WSDL (capabilities)
 - Communication via SOAP messages
- Example: Document Review Service
 - Input: document, deadline, constraints
 - Output: review comments



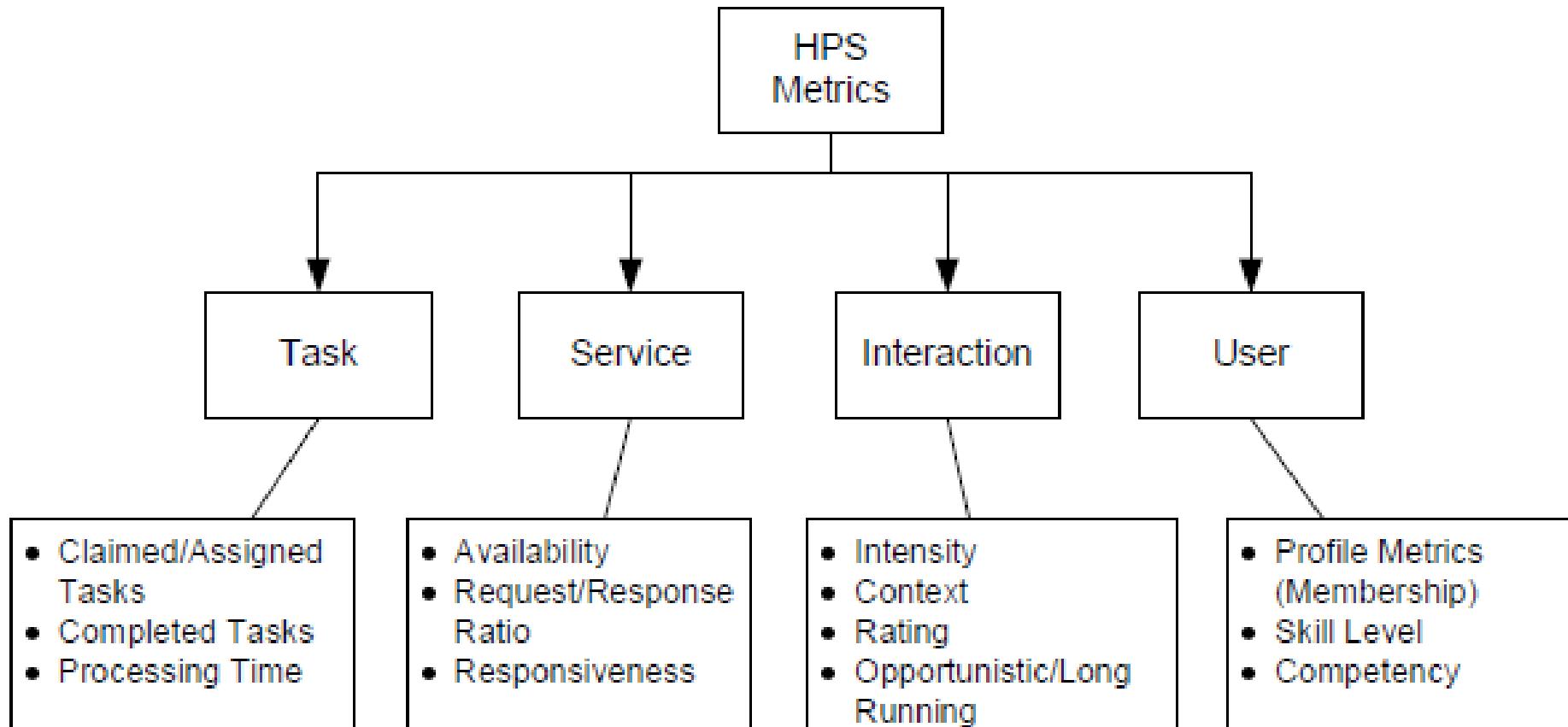
Schall, D., Dustdar, S., Blake, B.M. A Programming Paradigm for Integrating Human-Provided and Software-Based Web Services
IEEE Computer, July 2010

Schall, D., Truong, H.-L., Dustdar, S. *The Human-Provided Services Framework*. IEEE 2008 Conference on Enterprise Computing, E-Commerce and E-Services (EEE), Crystal City, Washington, D.C., USA, 2008. IEEE.

HPS – Framework & Middleware



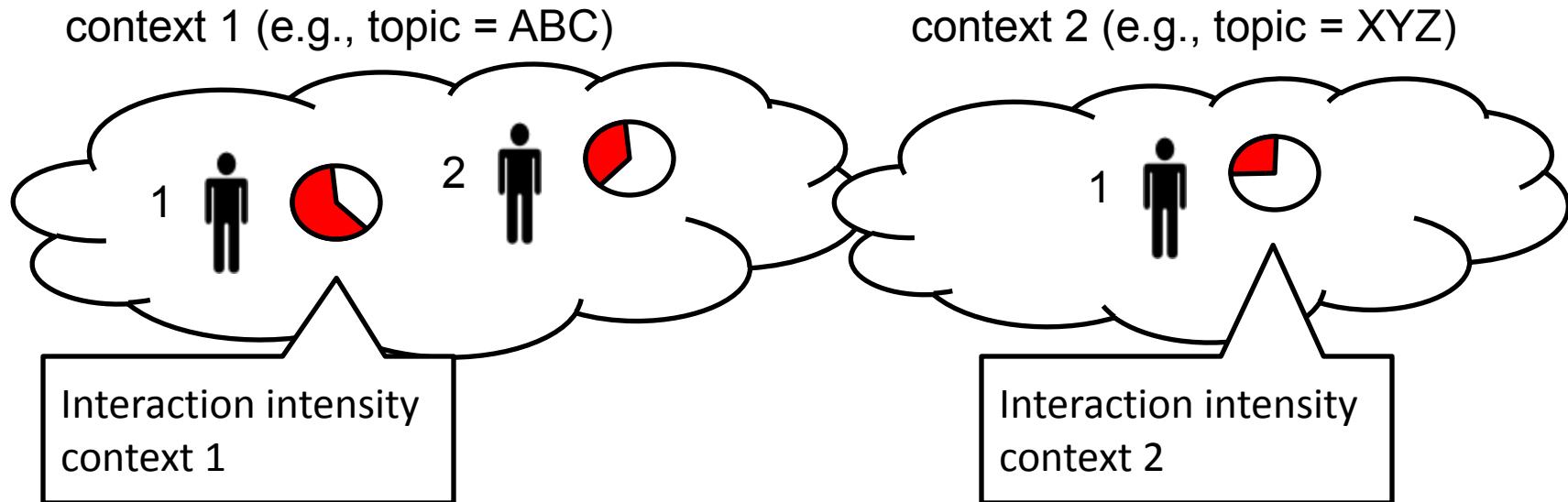
Overview Metrics



Metrics: ranking and selection of services

Ranking Algorithm: Interaction context

- Users interact in different contexts with different intensities

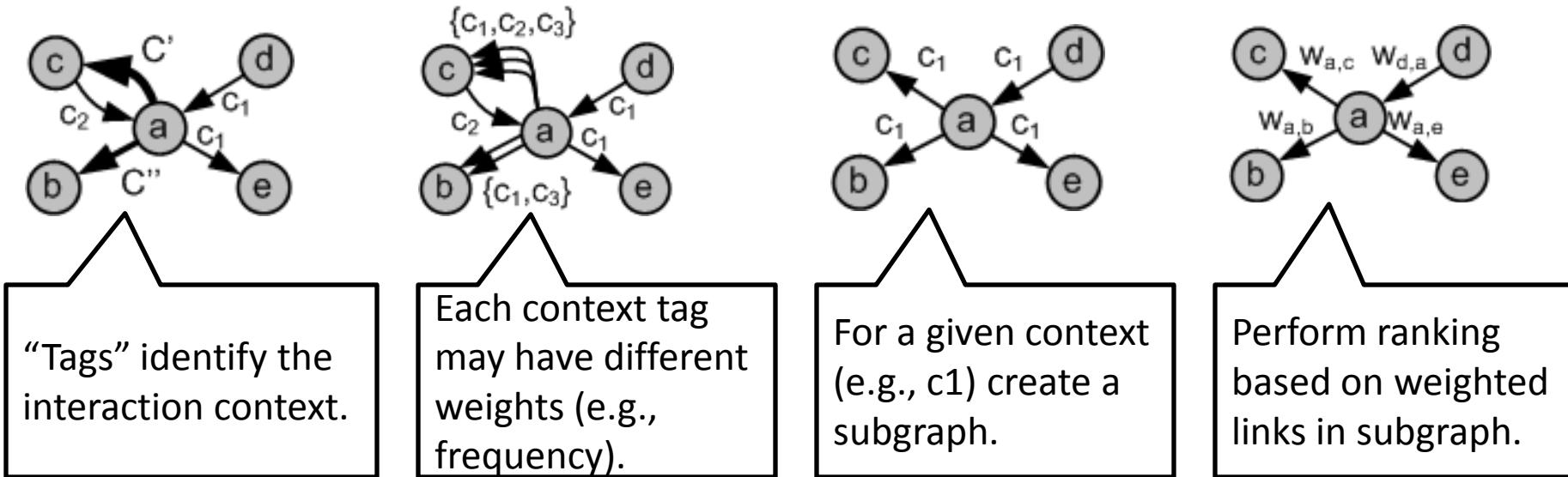


- Personalize ranking (i.e., expertise) for different contexts

Schall D., Dustdar S. (2010) Dynamic Context-Sensitive PageRank for Expertise Mining, [2nd International Conference on Social Informatics \(SocInfo'10\)](#), 27-29 October, 2010, Austria. Springer.

Ranking Algorithm: Context-aware DSARank (Dynamic Skill Activity)

Approach: Expertise mining in weighted subgraph

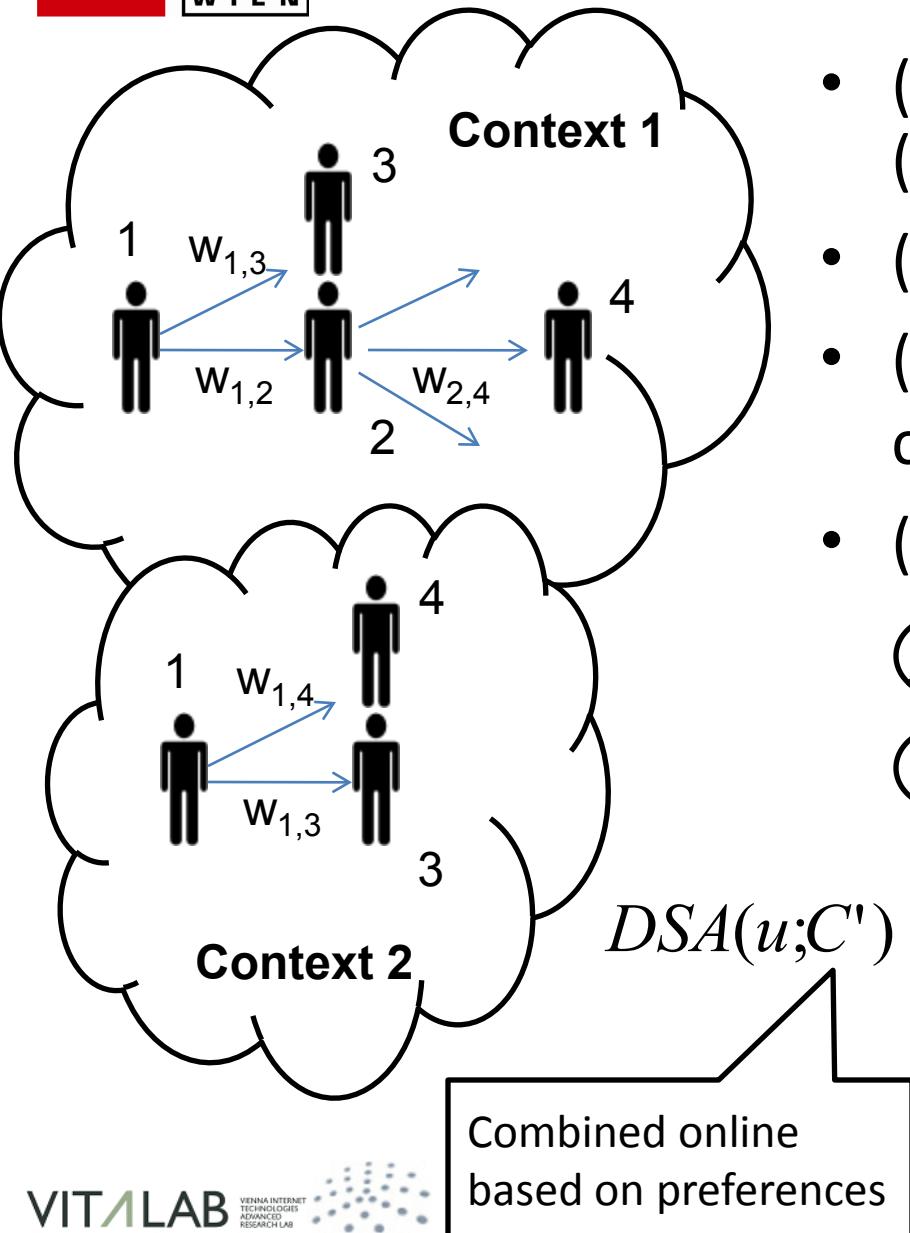


- Linearity Theorem (Haveliwala 02):

$$w_1 PR(p_1) + w_2 PR(p_2) = PR(w_1 p_1 + w_2 p_2)$$

Schall D., Dustdar S. (2010) Dynamic Context-Sensitive PageRank for Expertise Mining, [2nd International Conference on Social Informatics \(SocInfo'10\)](#), 27-29 October, 2010, Austria. Springer.

Context-dependent DSARank



- (1) Identify context of interactions (“tags”)
- (2) Select relevant links and people
- (3) Create weighted subgraph (for context)
- (4) Perform mining



User 1's expertise in context 1



User 1's expertise in context 2

$$DSA(u;C') = \sum_{c \in C'} w_c DSA(w_1 p_1(u) + \dots + w_n p_n(u))$$

Calculated offline

E.g., $p(u) = w_1 \text{ IIL}(u) + w_2 \text{ availability}(u)$

Delegation Factory/Sink

• Factory

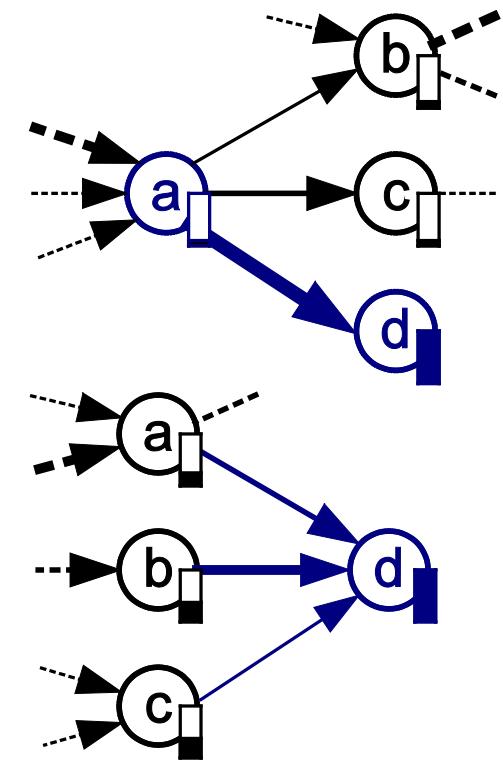
- a accepts and delegates tasks frequently
- a processes few tasks and has a low task-queue

■ Sink

- d accepts too many tasks
- d processes slow (capability vs. overload)

■ Misbehavior impact

- Produces unusual amounts of task delegations
- Tasks miss their deadline
- Leads to performance degradations of the entire network



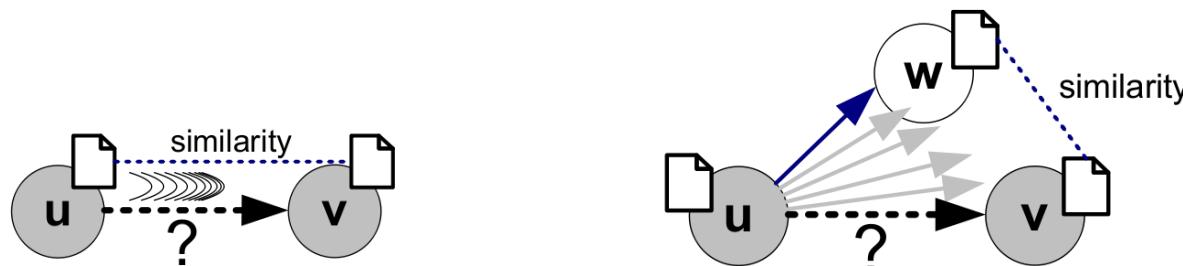
Psaier H., Juszczyk L., Skopik F., Schall D., Dustdar S. Runtime Behavior Monitoring and Self-Adaptation in Service-Oriented Systems, [4th IEEE International Conference on Self-Adaptive and Self-Organizing Systems \(SASO'10\)](#), 27 Sept.-01 Oct. 2010, Budapest, Hungary.

(Mis)behavior monitoring

- Open System with varying participation
- All services use the communication infrastructure
- Interaction logging:
 - Log the exchanged messages and process their content
- Logs provide information on:
 - Task properties: id, tags, etc.
 - Type, skills, and interests of services

Similarity Service

- Cos-similarity to determine the similarity of two services' profile vectors: $sim_{profile}(\mathbf{p}_u, \mathbf{p}_v) = \cos(\mathbf{p}_u, \mathbf{p}_v)$
- **Trust mirroring:** “similar minded” nodes tend to trust each other more than random nodes
- **Trust teleportation:** the past trust relation (u,w) “teleports” to others having similar interests.
 - Note: u and w have different profile, e.g., different roles

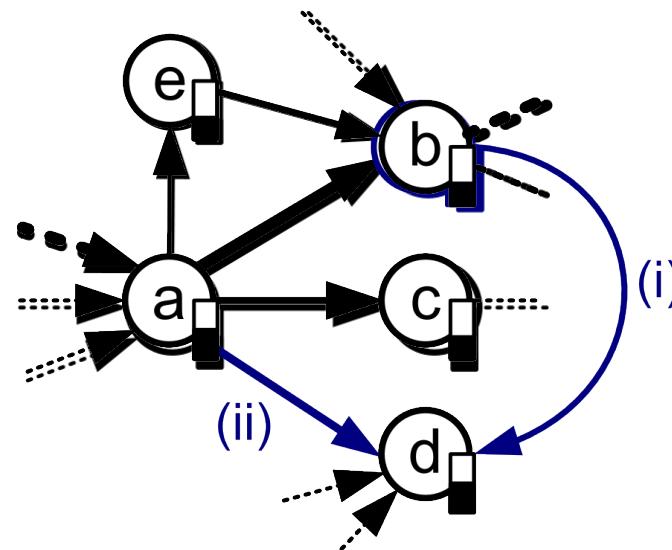


Skopik F., Schall D., Dustdar S. (2010). [Modeling and Mining of Dynamic Trust in Complex Service-oriented Systems](#). Information Systems 35 (2010), 735–757

Misbehavior adaptation

initial state

- > b queue overload detected
- > find alternative/similar service
- > (i) 1st support **b mirroring of trust**
- > (ii) 2nd avoid **b teleportation of trust**

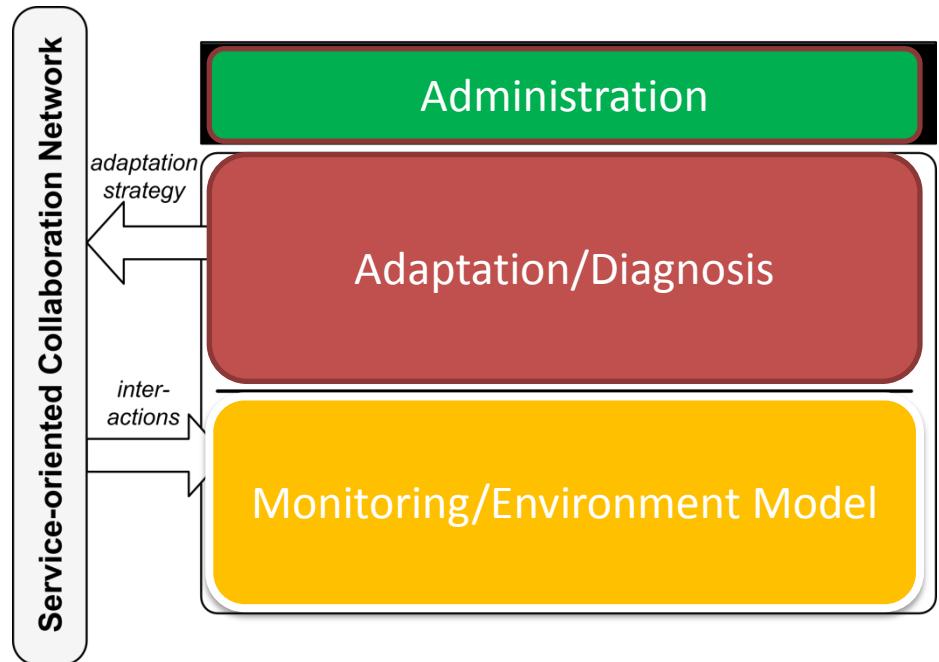


Self-adaptation concepts

- feedback loop design for misbehavior healing
- MAPE loop of autonomic computing:
 - **monitor** interactions and queue threshold
 - **analyze** behavior and compare to misbehavior models
 - update **behavior registry** (part of **knowledge**)
 - **plan** adaptive actions
 - **execute** channel regulations and redirections

VieCure framework

- Interaction logging updates monitoring db and behavior registry.
- Policy Store and Similarity Service determine the adaptations
- Admin tools allow to fine-tune the framework



Some Software

HPS – Human-Provided Services

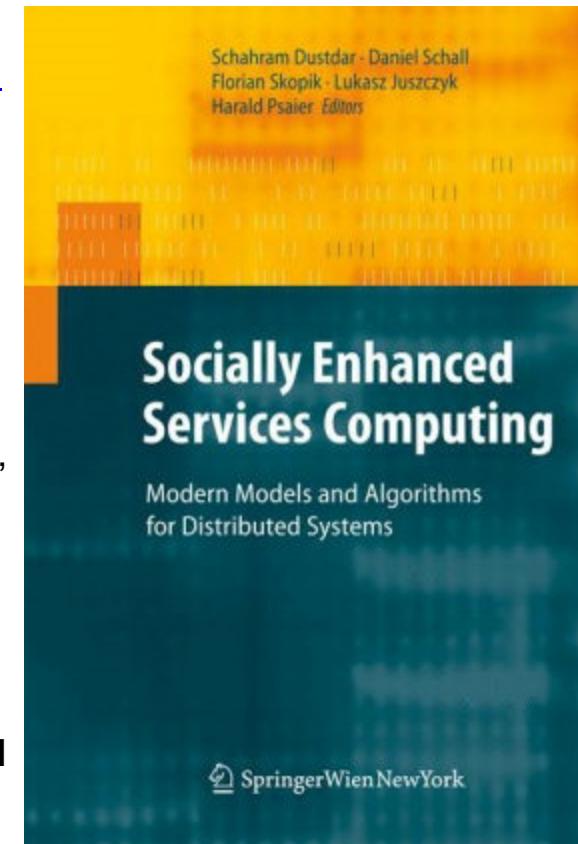
http://www.infosys.tuwien.ac.at/prototyp/HPS/HPS_index.html

VieTE – Trust Emergence Framework

http://www.infosys.tuwien.ac.at/prototyp/VieTE/VieTE_index.html

Some papers...

1. **Trust-based Discovery and Interactions in Mixed Service-Oriented Systems**
Schall D., Skopik F., Dustdar S. [IEEE Transactions on Services Computing \(TSC\)](#), Volume 3, Issue 3, pp. 193-205
2. **Modeling and Mining of Dynamic Trust in Complex Service-oriented Systems**
Skopik F., Schall D., Dustdar S. [Information Systems Journal \(IS\)](#), Volume 35, Issue 7, November 2010, pp. 735-757. Elsevier.
3. **Programming Human and Software-Based Web Services**
Schall D., Dustdar S., Blake M.B. [IEEE Computer](#), vol. 43, no. 7, pp. 82-85, July 2010.
4. **Unifying Human and Software Services in Web-Scale Collaborations**
Schall D., Truong H.-L., Dustdar S.
[IEEE Internet Computing](#), vol. 12, no. 3, pp. 62-68, May/Jun, 2008.
5. **Runtime Behavior Monitoring and Self-Adaptation in Service-Oriented Systems**
Psaier H., Juszczyk L., Skopik F., Schall D., Dustdar S. [4th IEEE International Conference on Self-Adaptive and Self-Organizing Systems \(SASO'10\)](#), 27 Sept.-01 Oct. 2010, Budapest, Hungary.



Conclusions

Socially enhanced Services Computing requires novel “programming model” (**concepts, primitives**) for composing collaborative HPS and SBS :

1. Delegation principle & Interaction Models
2. Social Trust & Patterns
3. Monitoring & Adaptation principles
4. Incentive & Reward structures and mechanisms
5. Dynamic Role Models

Thanks for your attention

Schahram Dustdar

Distributed Systems Group

TU Wien

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