

Laboratory for Open Systems and Networks
Jožef Stefan Institute, Ljubljana

A Novel Systemic Taxonomy of Trust

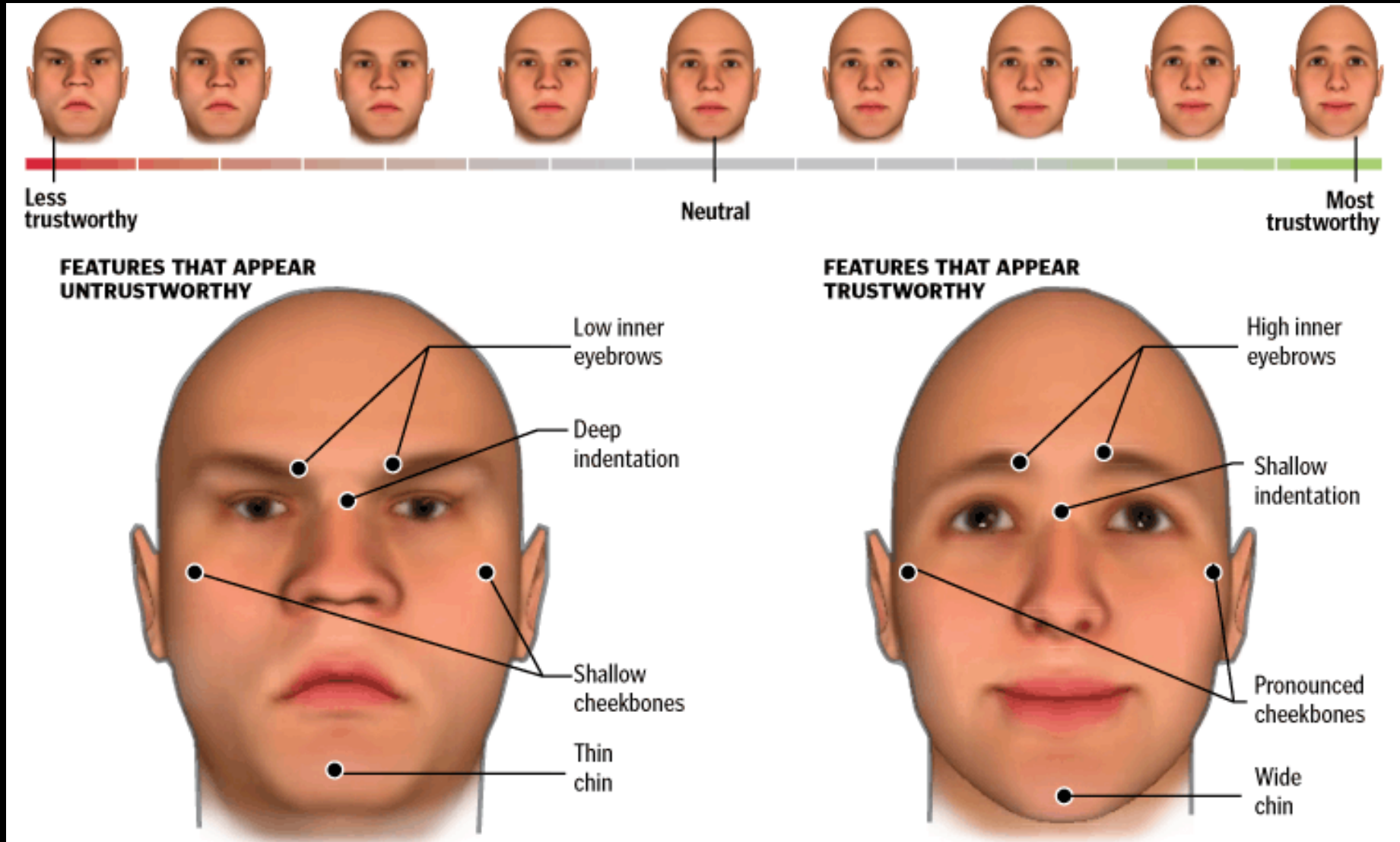
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THE TRUSTED FACE

ON THE INTERNET?



Outline

➤ Part I

- Aspects of Trust and Reputation

➤ Part II

- General Systems Taxonomy: Reputation Systems

➤ Part III

- A Novel Systemic Framework of Interrelations

➤ Part IV

- A Systemic Framework of BarterCast

➤ Part V

- Future Work

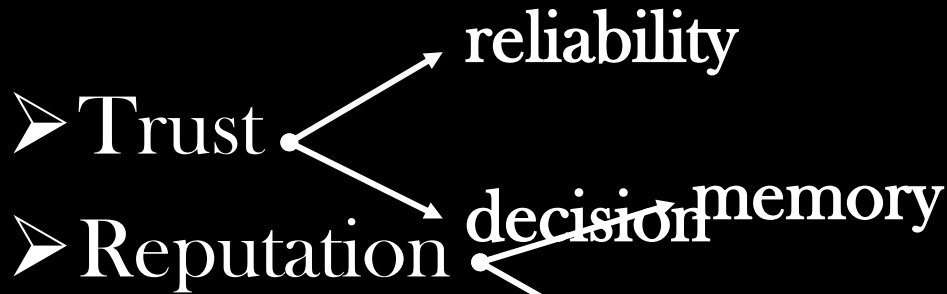
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- Part I
 - **Aspects of Trust and Reputation**
- Part II
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Trust and Reputation

is subjective.

is more objective assessment.



I trust you because of your good reputation.

I trust you despite your bad reputation.

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Why General Systems Theory?

- Technicians strive things to work well
- Social scientist - for things to behave well
- General Systems Theory (GST) - Theory of wholeness

The whole is different than just sum of its parts

Ontology of the State of the Art

Using a semi-automatic ontology editor¹

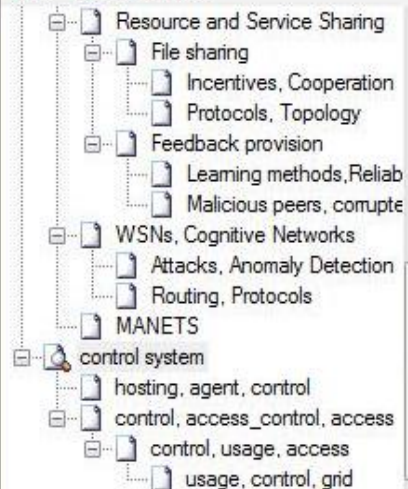
- Two clusters of research:
 - P2P networks and distributed platforms
 - Online Services and Web Applications

¹OntoGen: Semi-automatic Ontology Editor B. Fortuna, M. Grobelnik, D. Mladenic

Only 3 documents that mention "control system" other than Access Control

Concepts

New Move Delete



Concept properties

Details Suggestions Relations

Name: control sy

Keywords: control, hosting, agent, selected, platforms, mode, external, methodology, predicted.

SVM Keywords:

All documents: 3

Unused documents: 0

Avg. similarity:

Ontology details

Ontology visualization **Concept's documents** Concept Visualization

Apply Reset Show: Context document Sort by: Similarity

Document	Similarity
<input checked="" type="checkbox"/> 0592 -- Autonomy and Coordination: Controlling External Infl...	0,674
<input checked="" type="checkbox"/> 0126 -- A methodology for trust control mode prediction : Tr...	0,644
<input checked="" type="checkbox"/> 1142 -- How to Play Sherlock Holmes in the World of Mobil...	0,583
<input type="checkbox"/> 0477 -- An extended JADE-S based framework for developi...	0,280
<input type="checkbox"/> 2166 -- TRUMMAR - A Trust Model for Mobile Agent Syste...	0,264
<input type="checkbox"/> 1794 -- Securing distributed computing against the hostile h...	0,264
<input type="checkbox"/> 0610 -- Boosting-Based Distributed and Adaptive Security-...	0,261
<input type="checkbox"/> 0942 -- Enforcing integrity of agent migration paths by distri...	0,260
<input type="checkbox"/> 0833 -- DiSigncryption: An Integration of Agent-Based Sign...	0,254
<input type="checkbox"/> 1406 -- Nonlinear Model Predictive Control via Feasibility-P...	0,252
<input type="checkbox"/> 1379 -- Multiagent Reputation Management to Achieve Ro...	0,231
<input type="checkbox"/> 1473 -- Overcoming agent delusion : Agent models are inter...	0,230
<input type="checkbox"/> 1919 -- Strategies for exploiting trust models in competitive ...	0,229
<input type="checkbox"/> 2035 -- The impact of naive agents in heterogeneous trust-...	0,228
<input type="checkbox"/> 0576 -- Attitude Driven Team Formation using Multi-Dimensi...	0,227
<input type="checkbox"/> 0507 -- An ontology of social control tools : In multi-agent sy...	0,227
<input type="checkbox"/> 2098 -- Toward establishing trust in adaptive agents : As ad...	0,226
<input type="checkbox"/> 0824 -- Developing strategies for the ART domain : In this p...	0,225
<input type="checkbox"/> 1756 -- Role evolution in Open Multi-Agent Systems as an i...	0,224
<input type="checkbox"/> 1150 -- Hybrid security architecture (HSA) for secure execu...	0,224
<input type="checkbox"/> 0354 -- A Trust/Honesty Model with Adaptive Strategy for ...	0,218

Keywords for selected documents:

control, hosting, agent, selected, platforms, mode, external, methodology, predicted, influence

1142

How to Play Sherlock Holmes in the World of Mobile Agents : In the world of mobile agents, security aspects are extensively being discussed. In this context, denial of service (DoS) attacks are of considerable interest where the focus is on malicious hosts that either delete received agents or prevent them from continuing their route. This paper discusses a detection method for a posteriori identification of such malicious hosts to build a trust policy useful for future agent journeys. Depending on how much the agent owner trusts the hosts, he can either define an appropriate order in which selected hosts should be visited, or he can decide which hosts he does not want to contact again. Additionally, we show how the sequence of hosts to be visited should be determined in order to minimize some costs. Moreover, our proposal ensures that hosts originally intended to be visited cannot be skipped as a result of one malicious host's misbehavior. Our method is achieved by a new protocol that combines the

Document name:

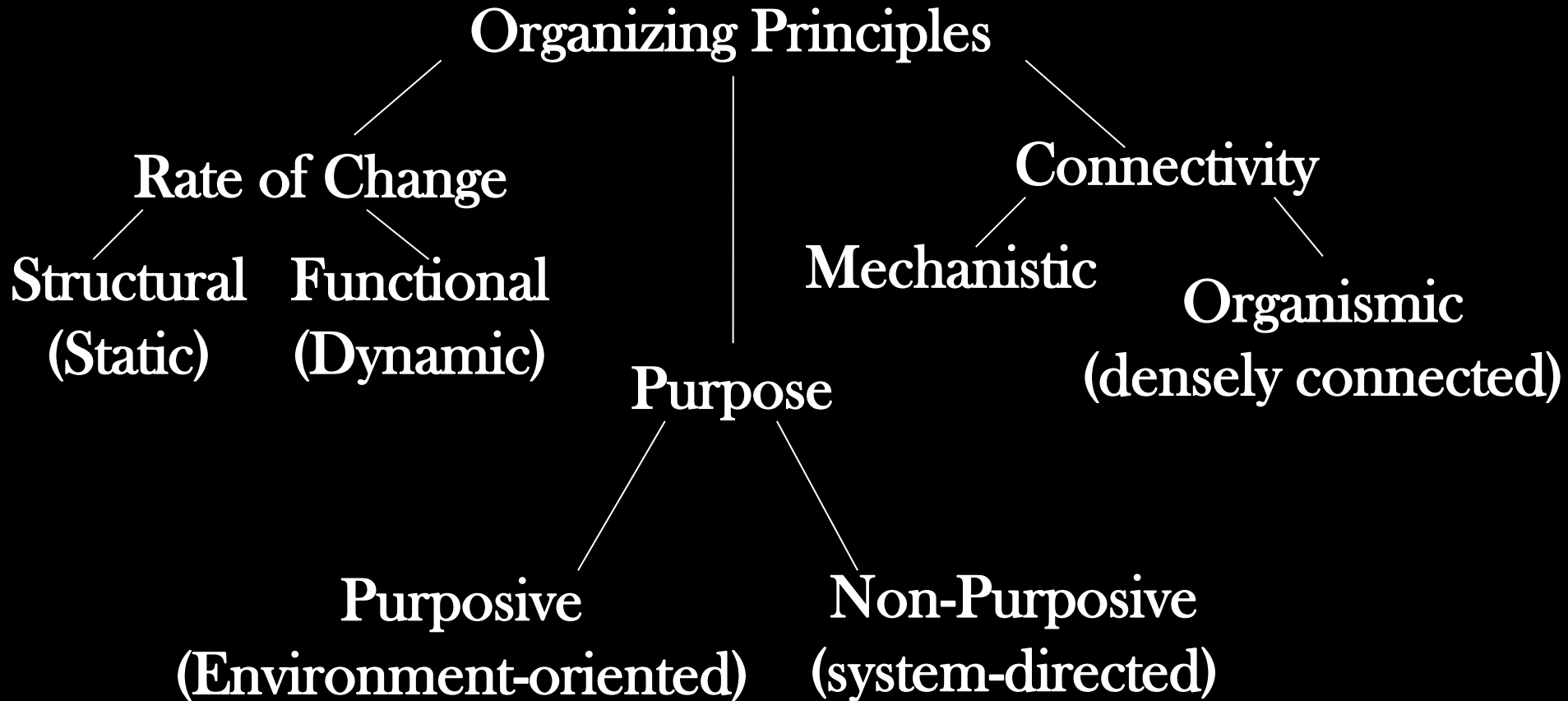
Existing Taxonomies

- Few taxonomies (Josang et al., Huynh et al., O'Hara et al.)
- One (*Marti et al.*) that tackles some systemic aspects by defining the T&R subsystems
- However:
 - It determines no interrelations between the subsystems
 - It points to none of their interdependencies and interactions with the general system;
 - It takes no interactions with the system environment into consideration
 - It does reveal some attacks on the system as outside disturbances, without complete connection to the factors that influence the system design

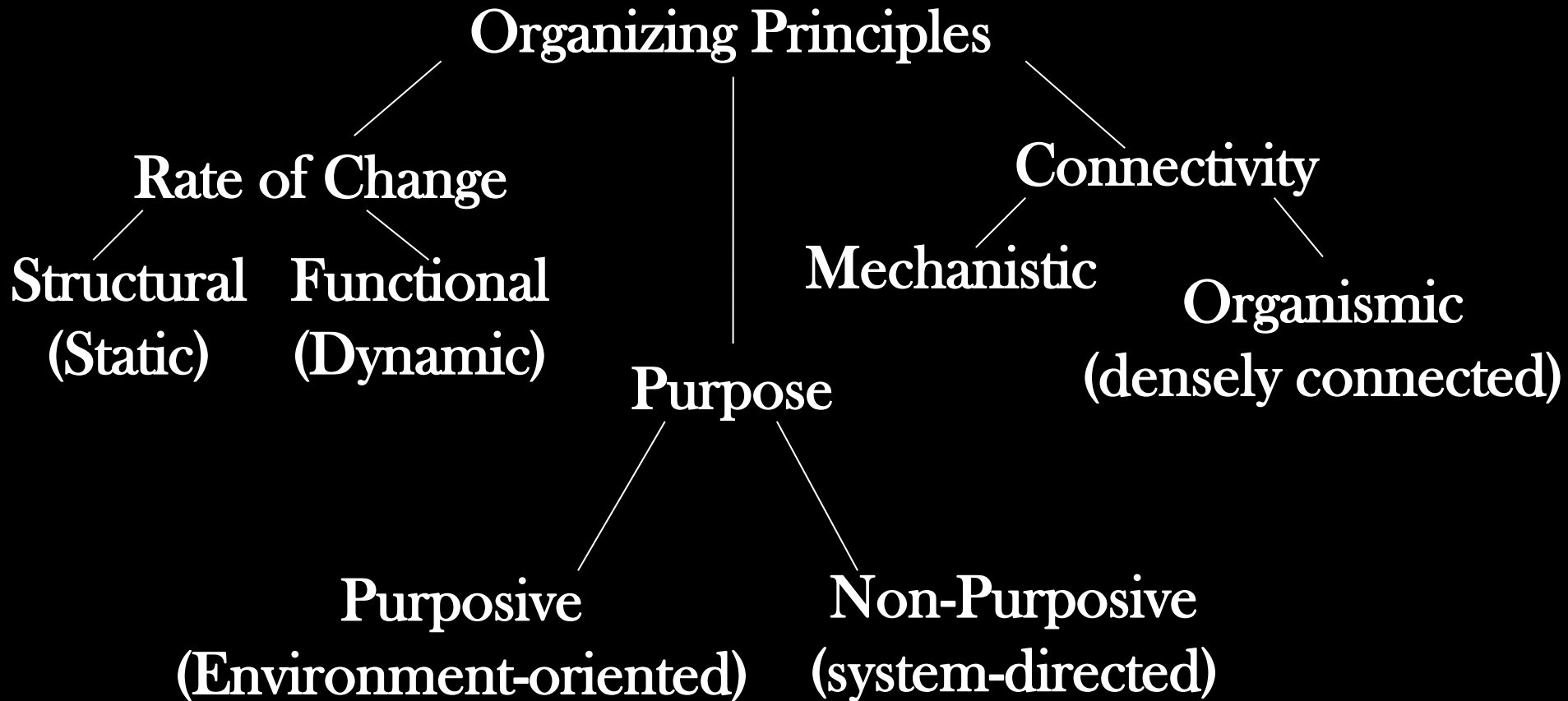
Systemic Aspects of Reputation

- Reputation Mechanism as an Aspect System
 - Including the same entities and using the existing interconnections between them
- Reputation Mechanism as a Subsystem
 - Part of the hierarchy of the general system
- Reputation Mechanism's Subsystems
 - System on it's own as well
 - *Determining the system's boundaries*

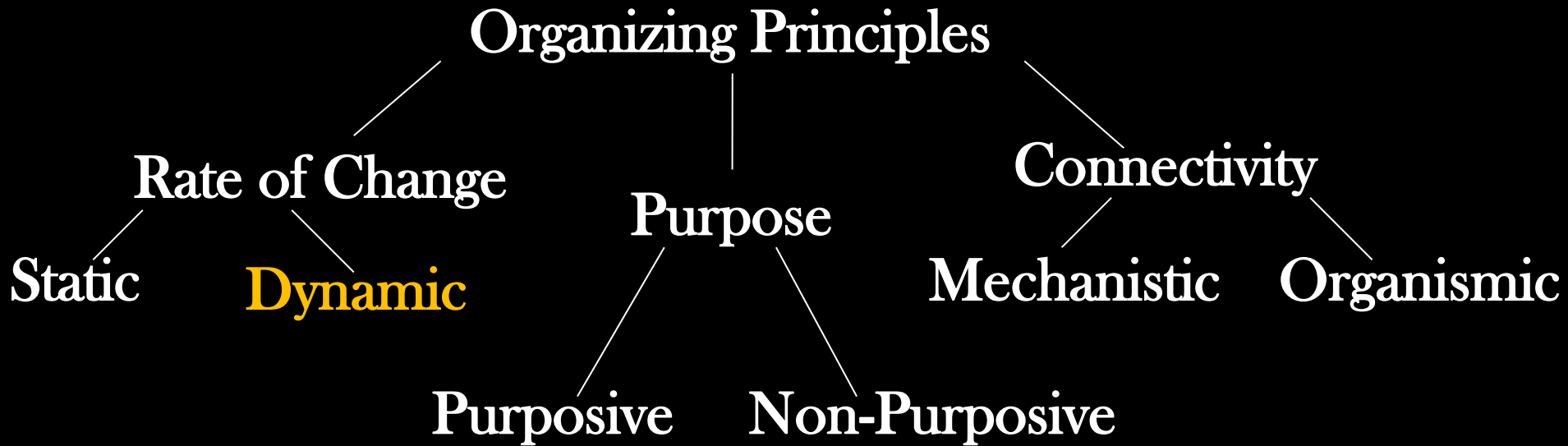
General Systems Taxonomy



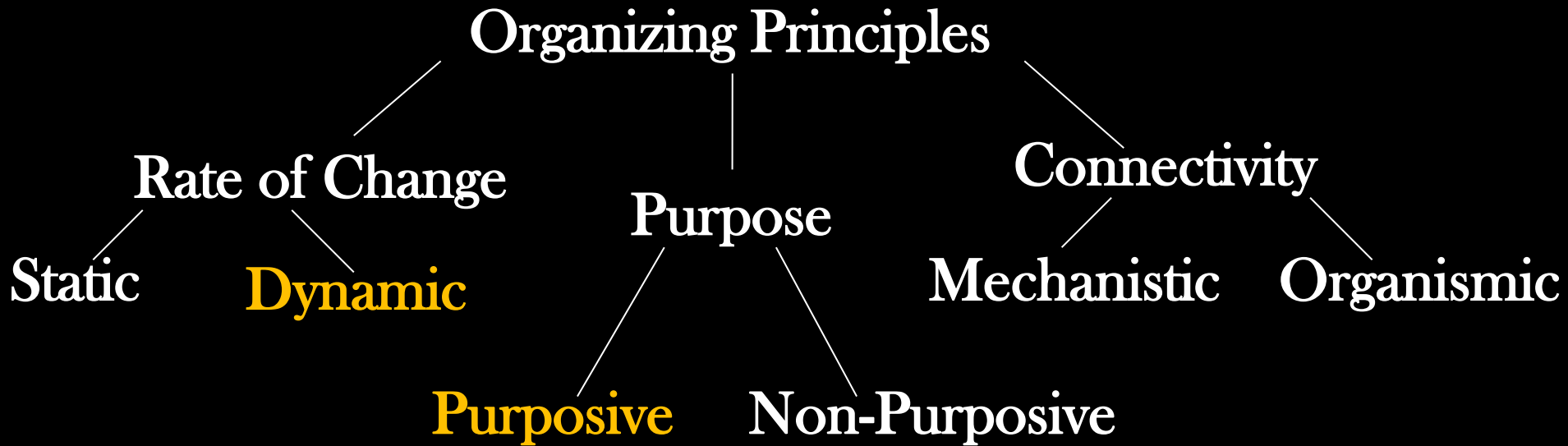
Reputation Systems



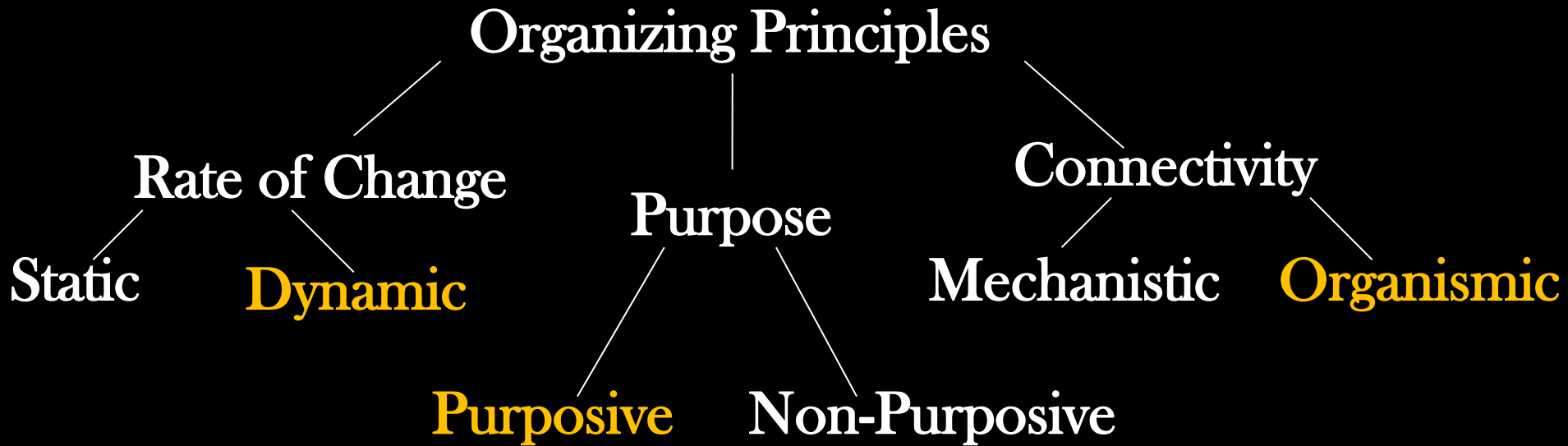
Reputation Systems



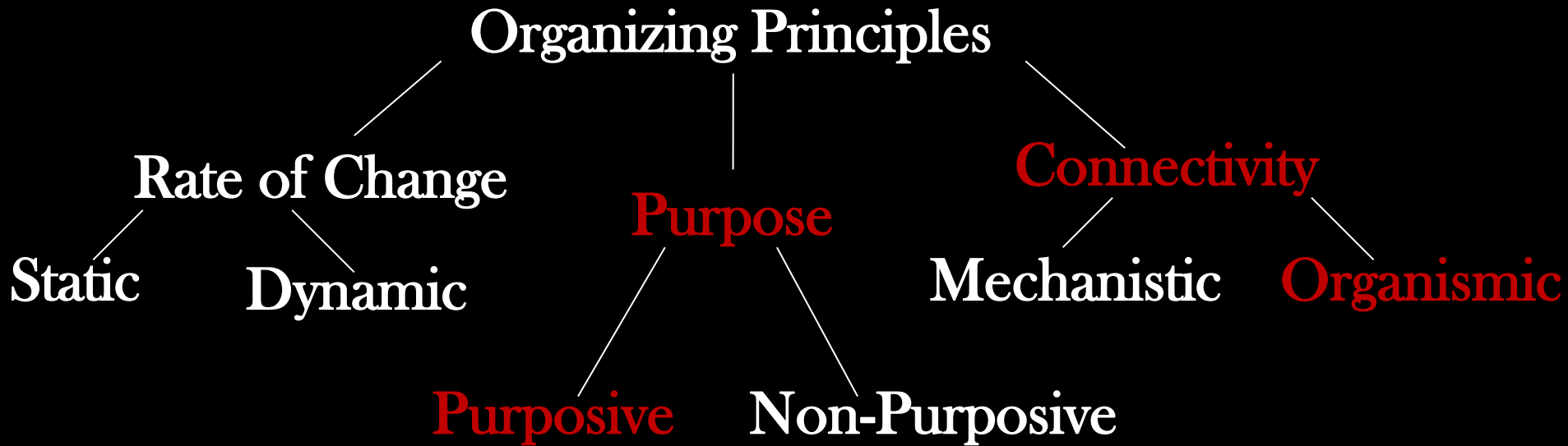
Reputation Systems



Reputation Systems



Contribution of our approach

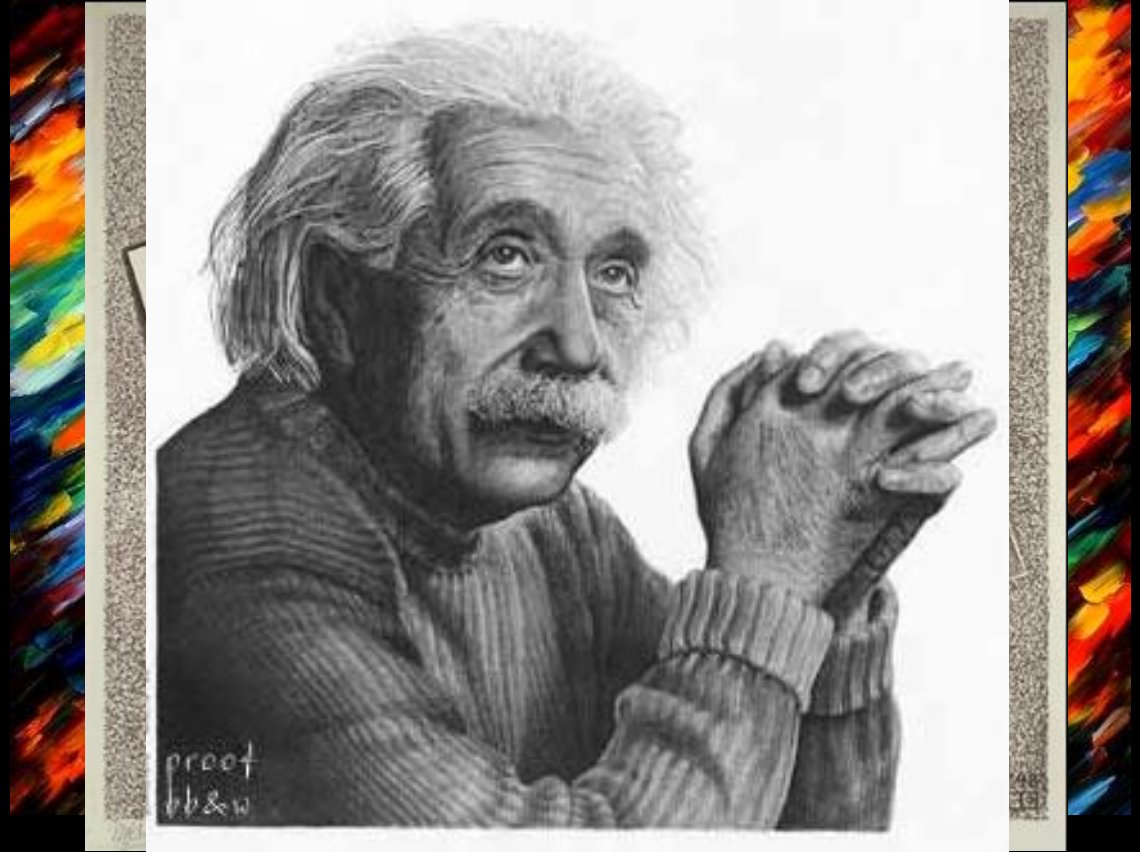
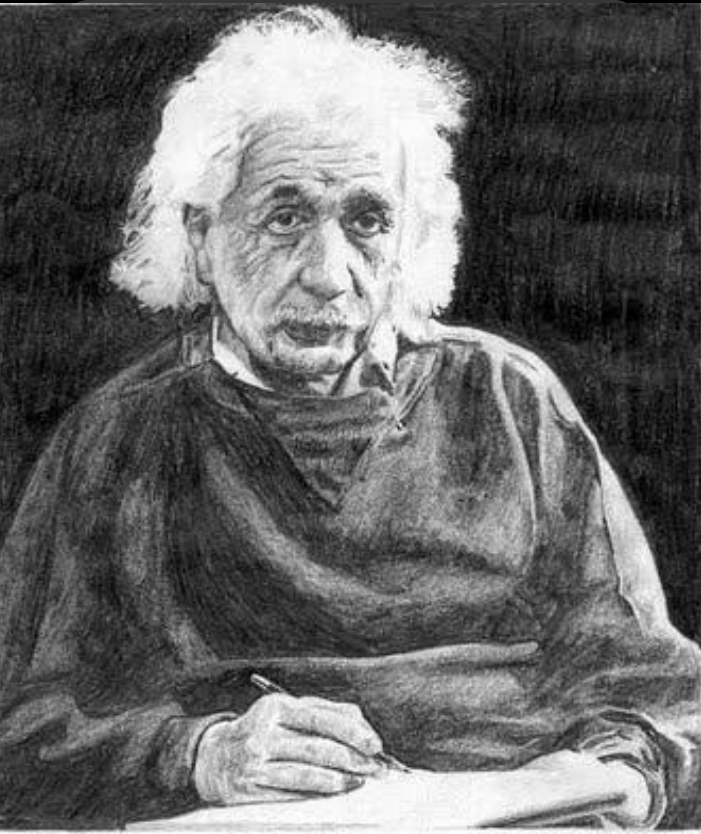


Main reasons:

- ❖ Non-intuitive
- ❖ Nonlinear
- ❖ Unpredictable
- ❖ Emergent

The greatest gap between the novel taxonomy and the existing ones

Intuition behind purpose and connectivity



The art of drawing conclusions.

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Reputation Mechanism - Subsystems

- Information gathering
- Scoring and Ranking
- Results (Taking action)

System-design Influencers

➤ *Factors of Impact (Marti et al.)*

- System architecture

- Users

- Threats (adversaries)

System-design Influencers

System
architecture
Threats

The number of users
System resilience and
availability impact
evolution depends on
usable system
operation and all
systemity

Entities



Active Entities' Behavior



CONTEXT

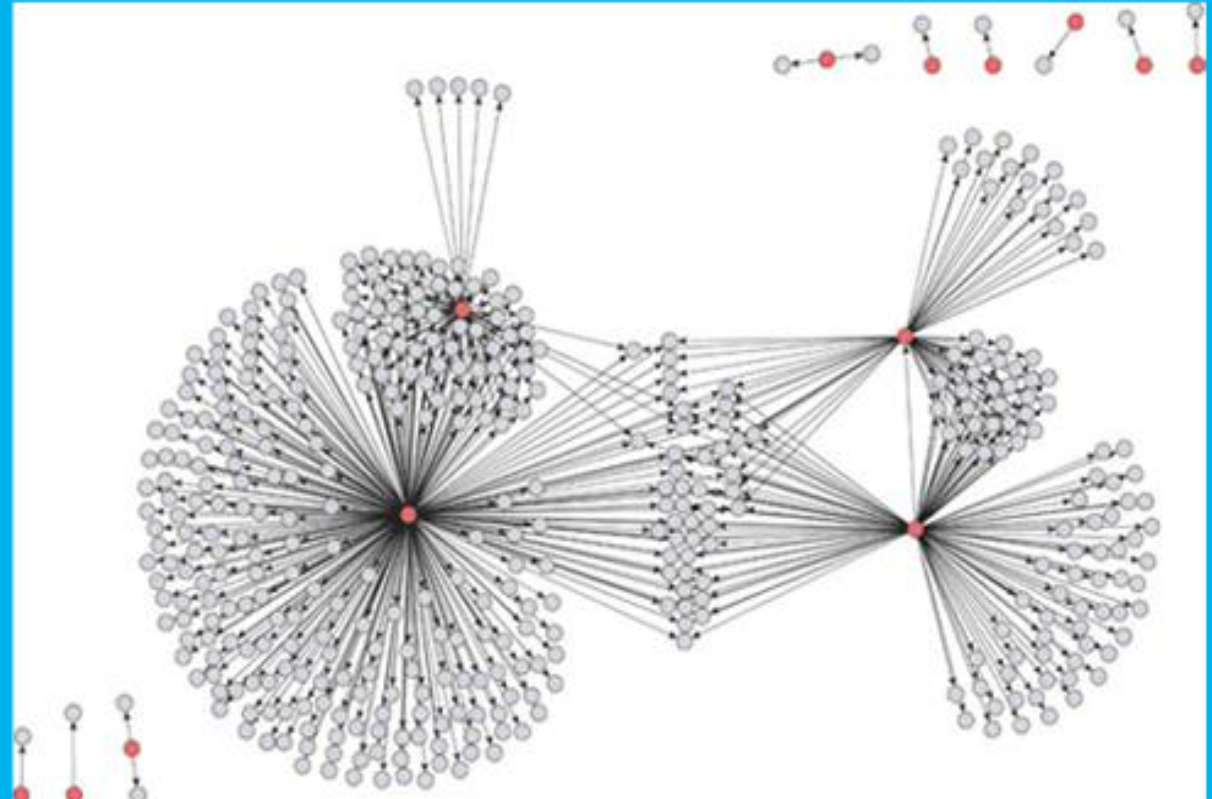


Trust me, i got you!

TIME AND DYNAMICITY



"It takes years to build trust,
and a few seconds
to destroy it"



PRIVACY



PRIVACY - Implicit Knowledge

BOB WILL DEMONSTRATE OUR NEW BIOMETRIC SECURITY SYSTEM.



www.dillbert.com scottclams@aol.com

THE SYSTEM CHECKS FOR PULSE, HEAT AND FINGERPRINTS TO IDENTIFY EACH EMPLOYEE.



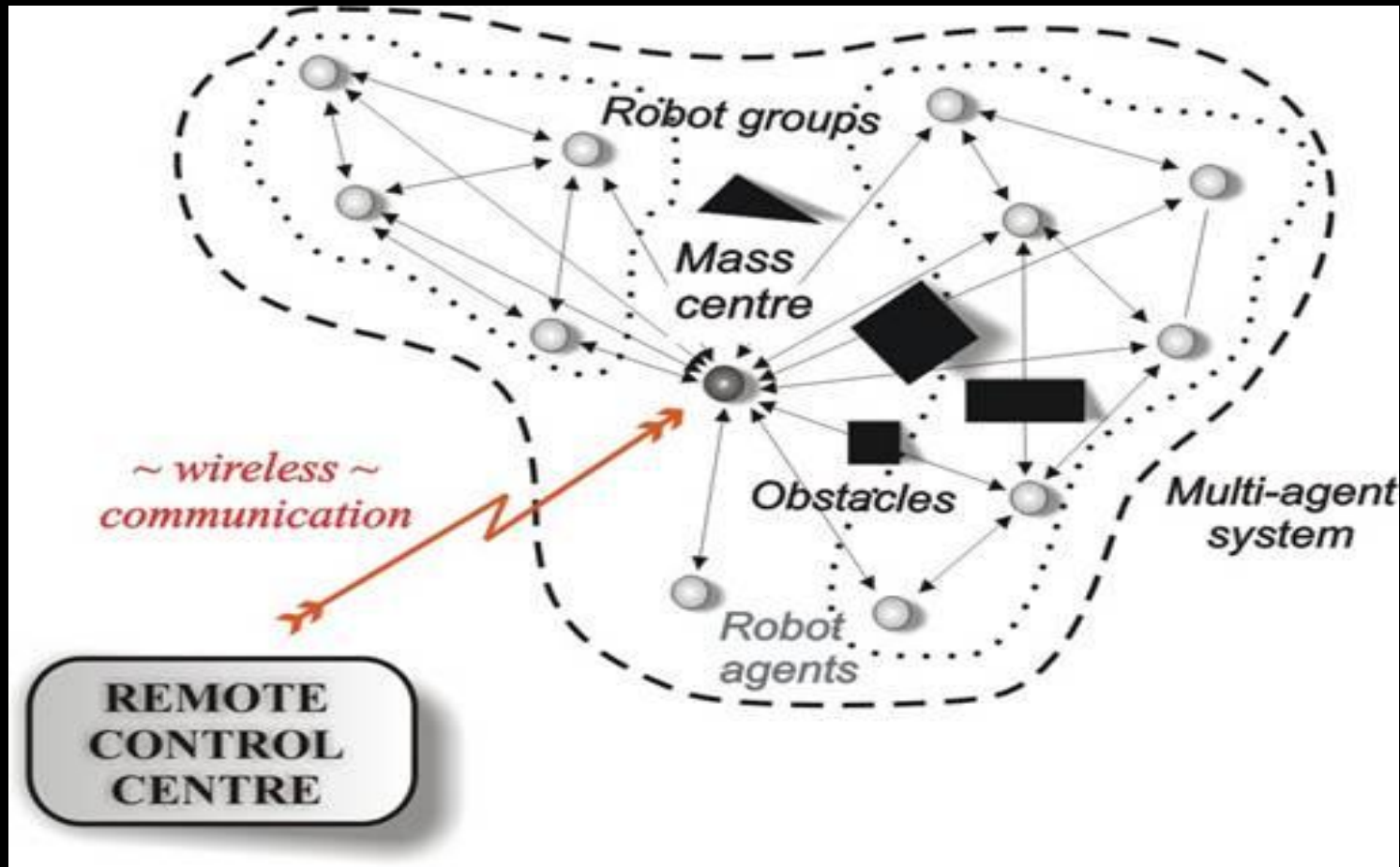
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IT SAYS I DON'T HAVE ANY OF THOSE THINGS.

ARE YOU THE ONE THEY CALL WALLY?

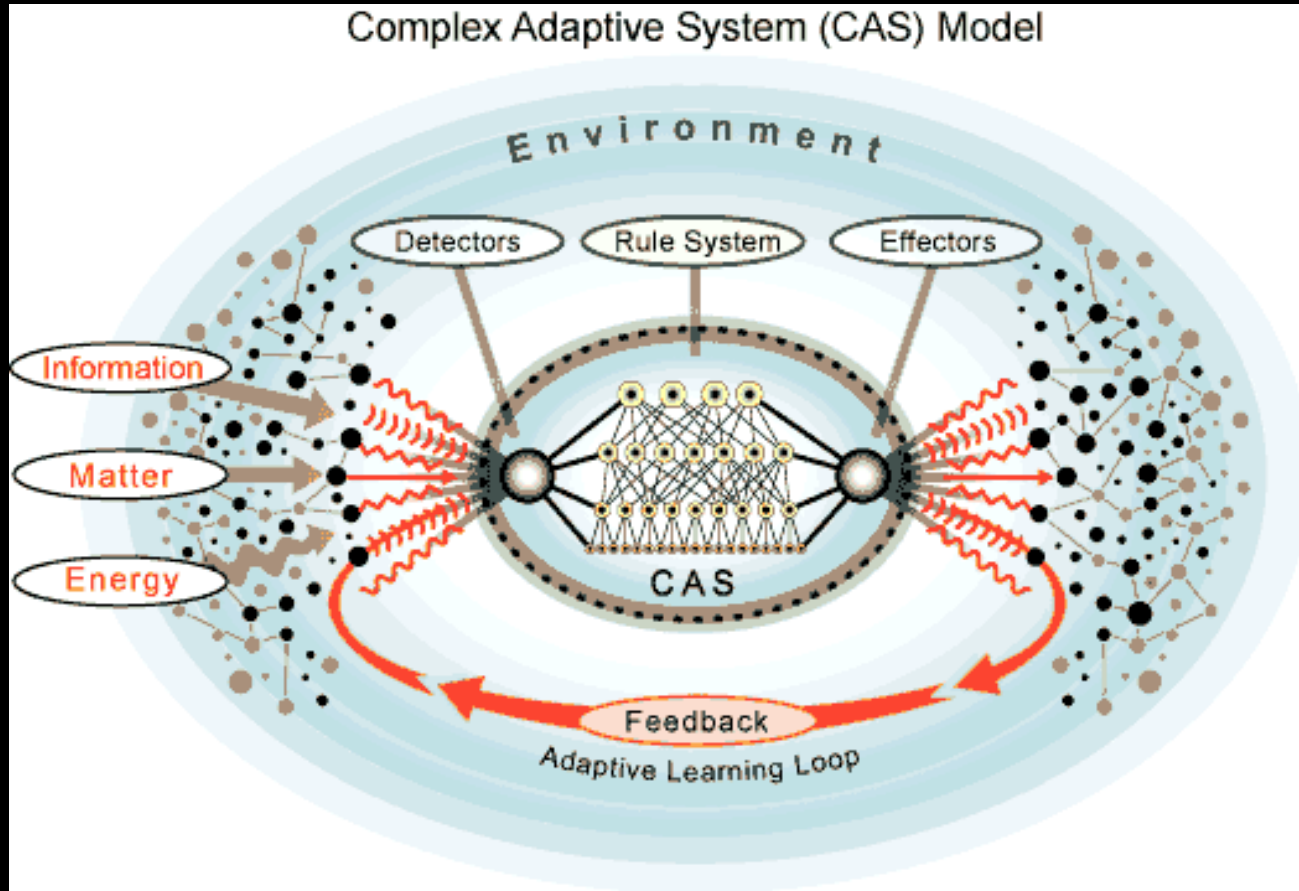


Resilience and Evolutionism



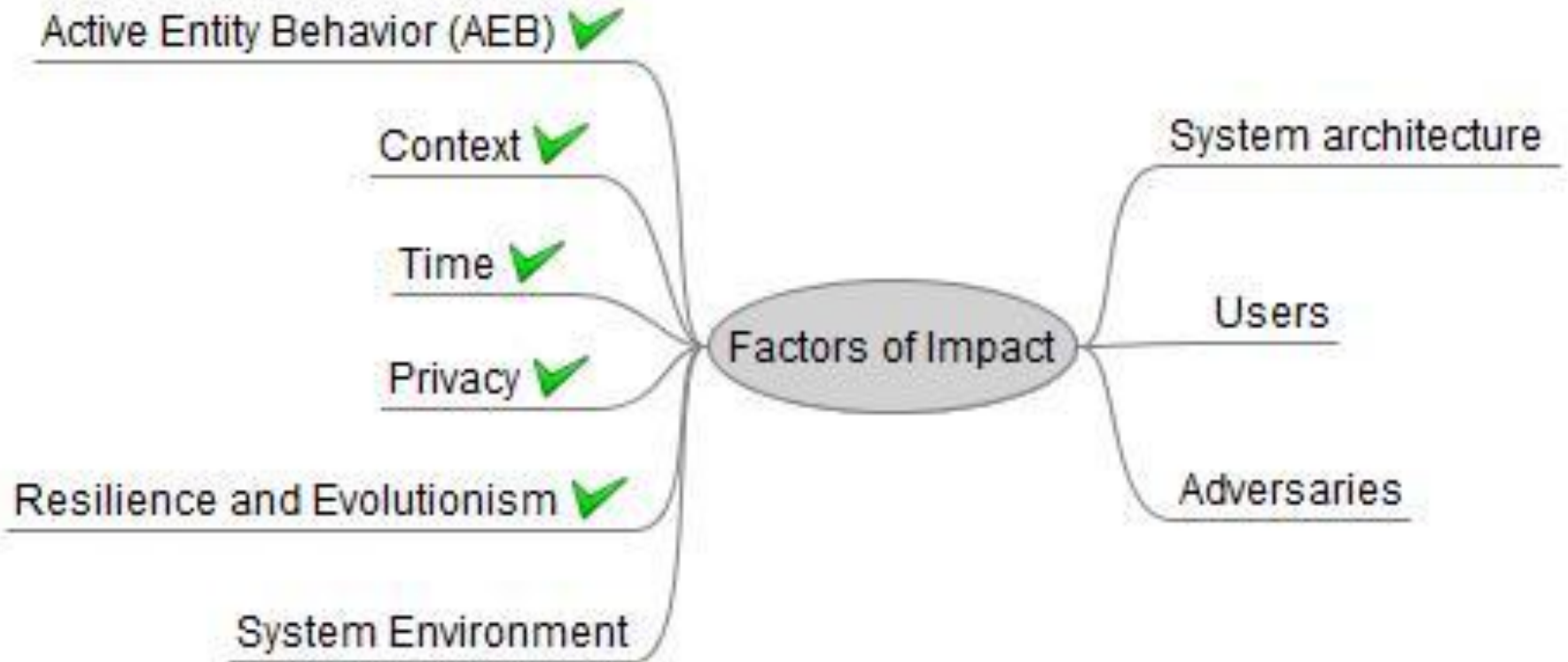
- Control is imposed from outside
- Intelligence is considered to be in the parts

Resilience and Evolutionism

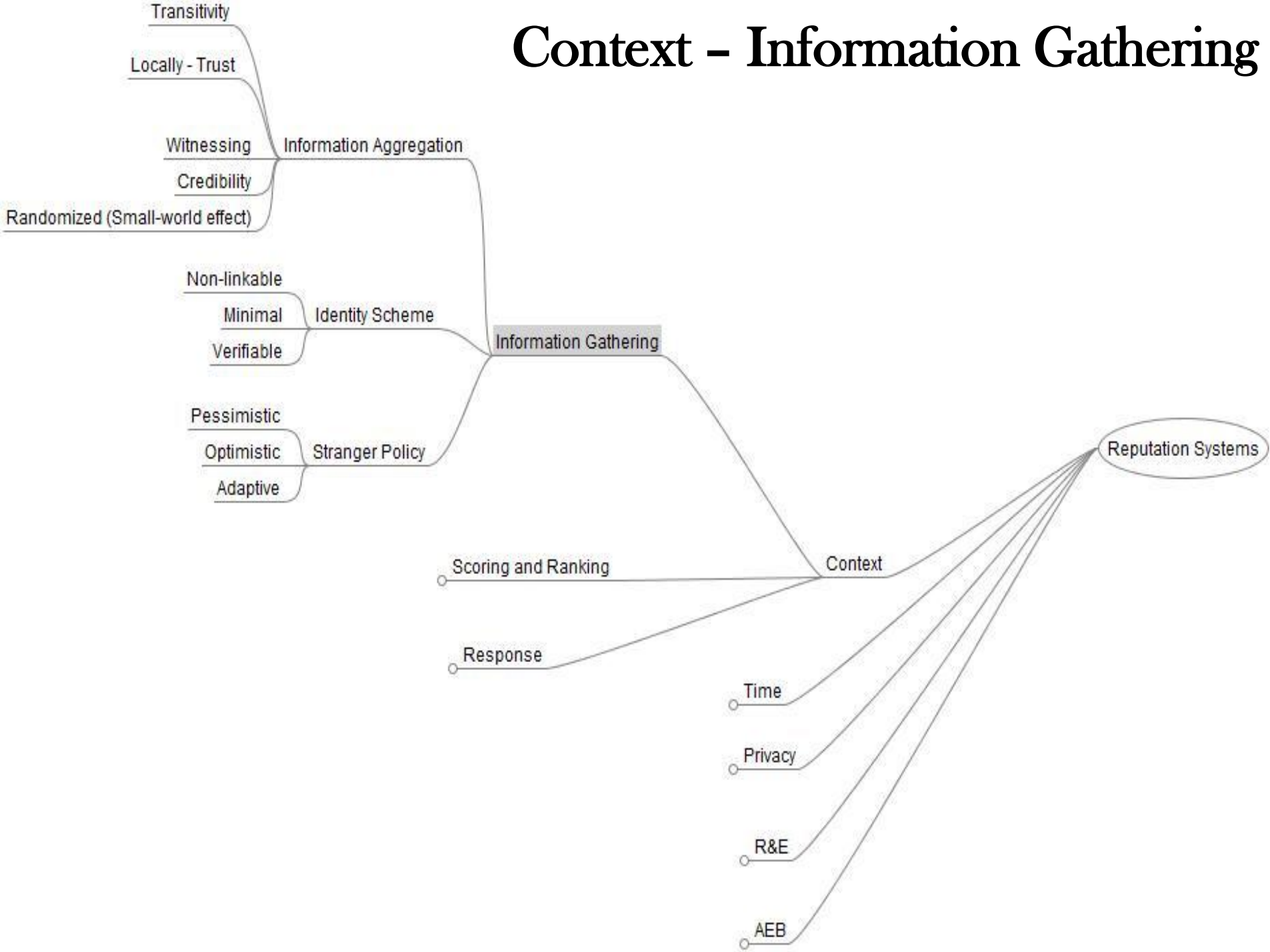


- Control is distributed across system entities
- Intelligence is in the connections between entities

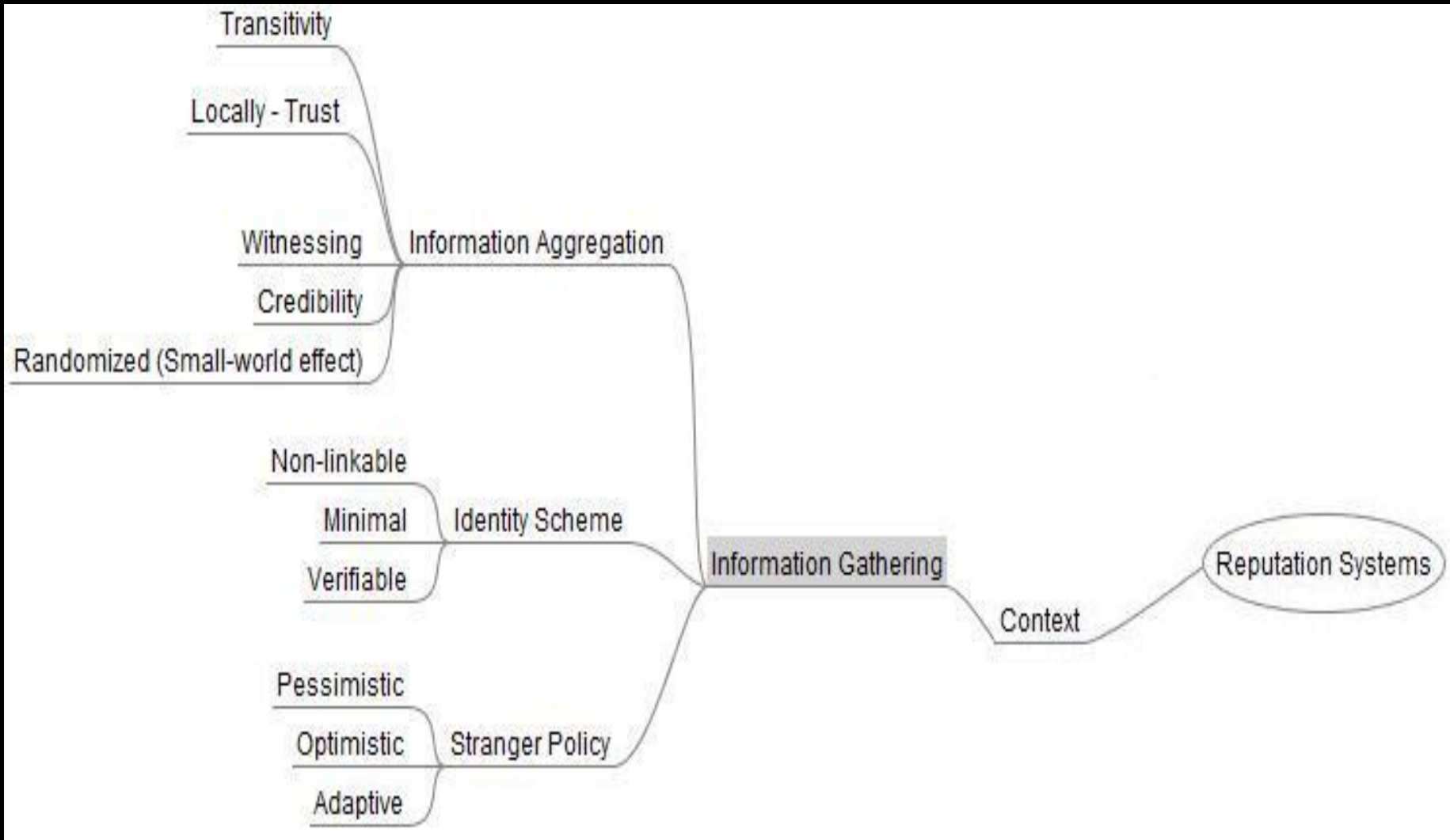
Redefining the design influencers



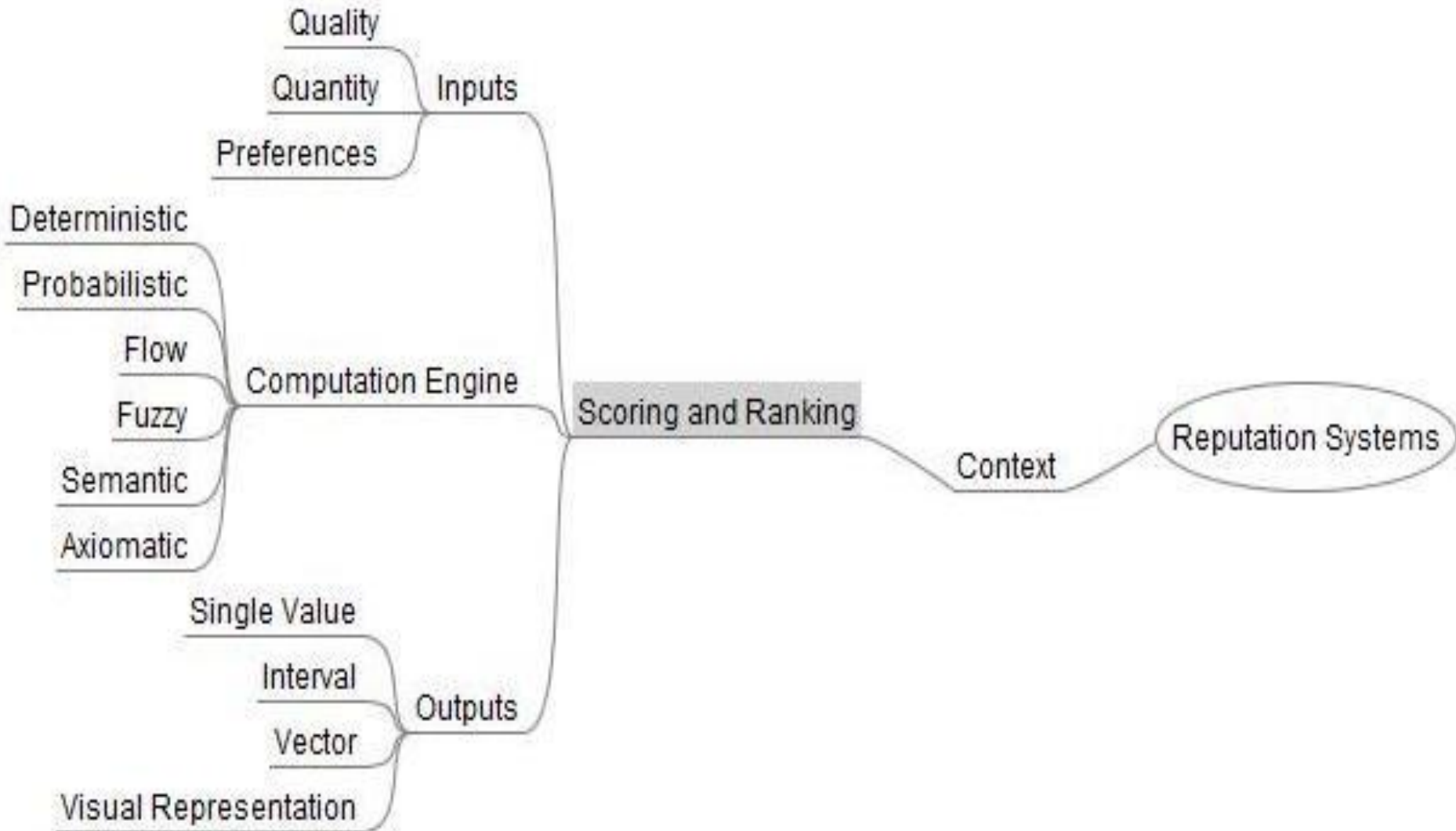
Context - Information Gathering



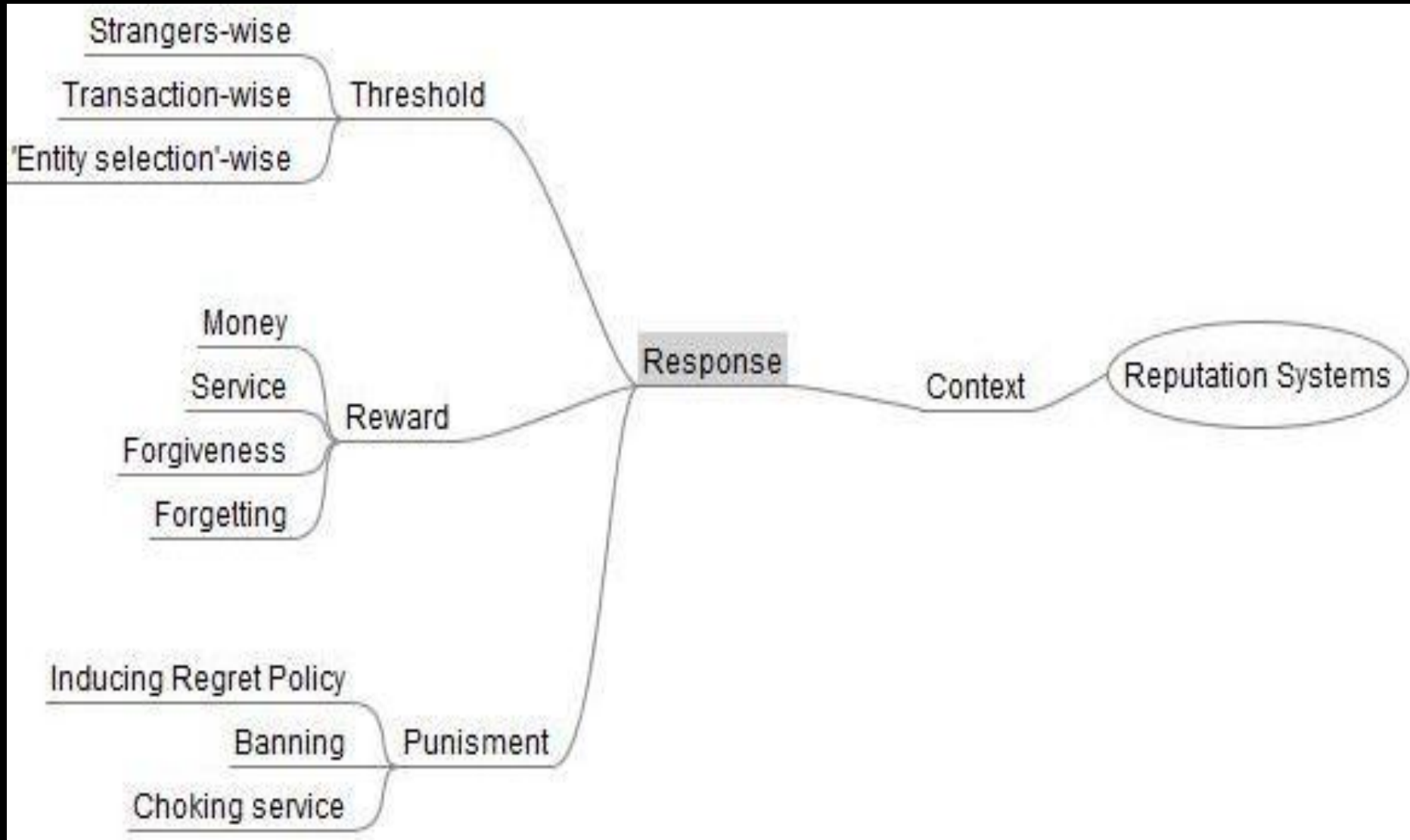
Context - Information Gathering



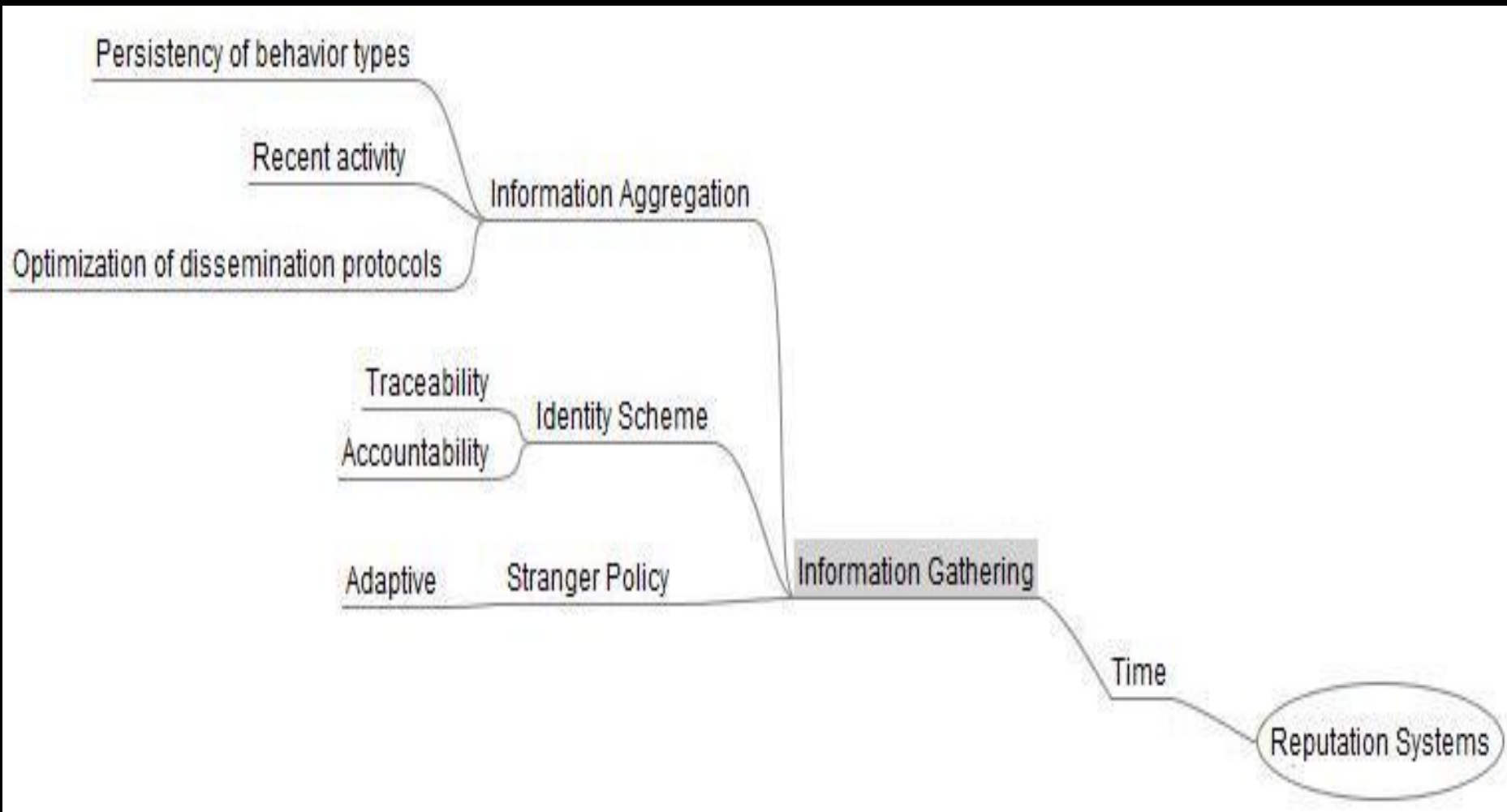
Context – Scoring and Ranking



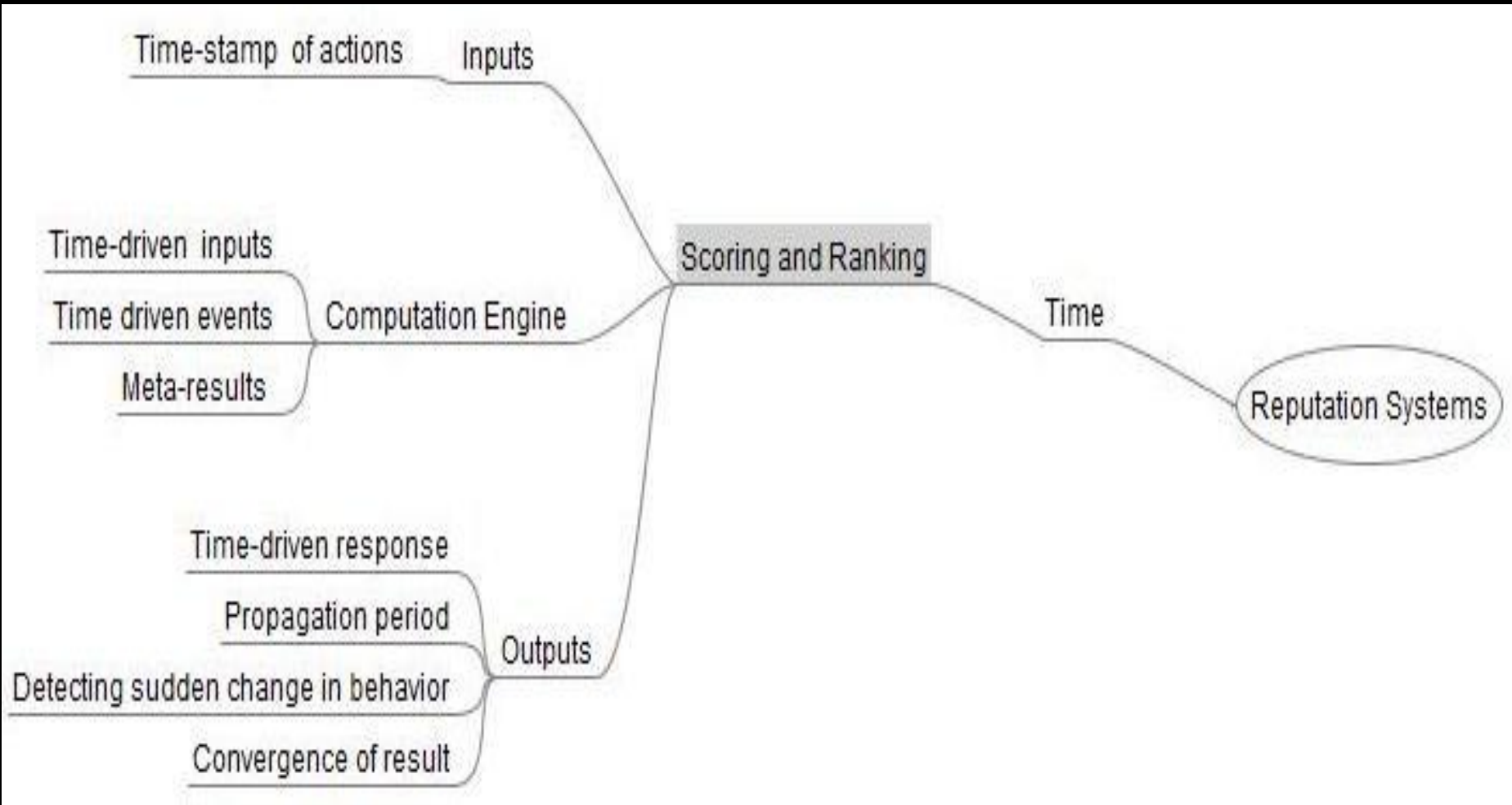
Context - Response



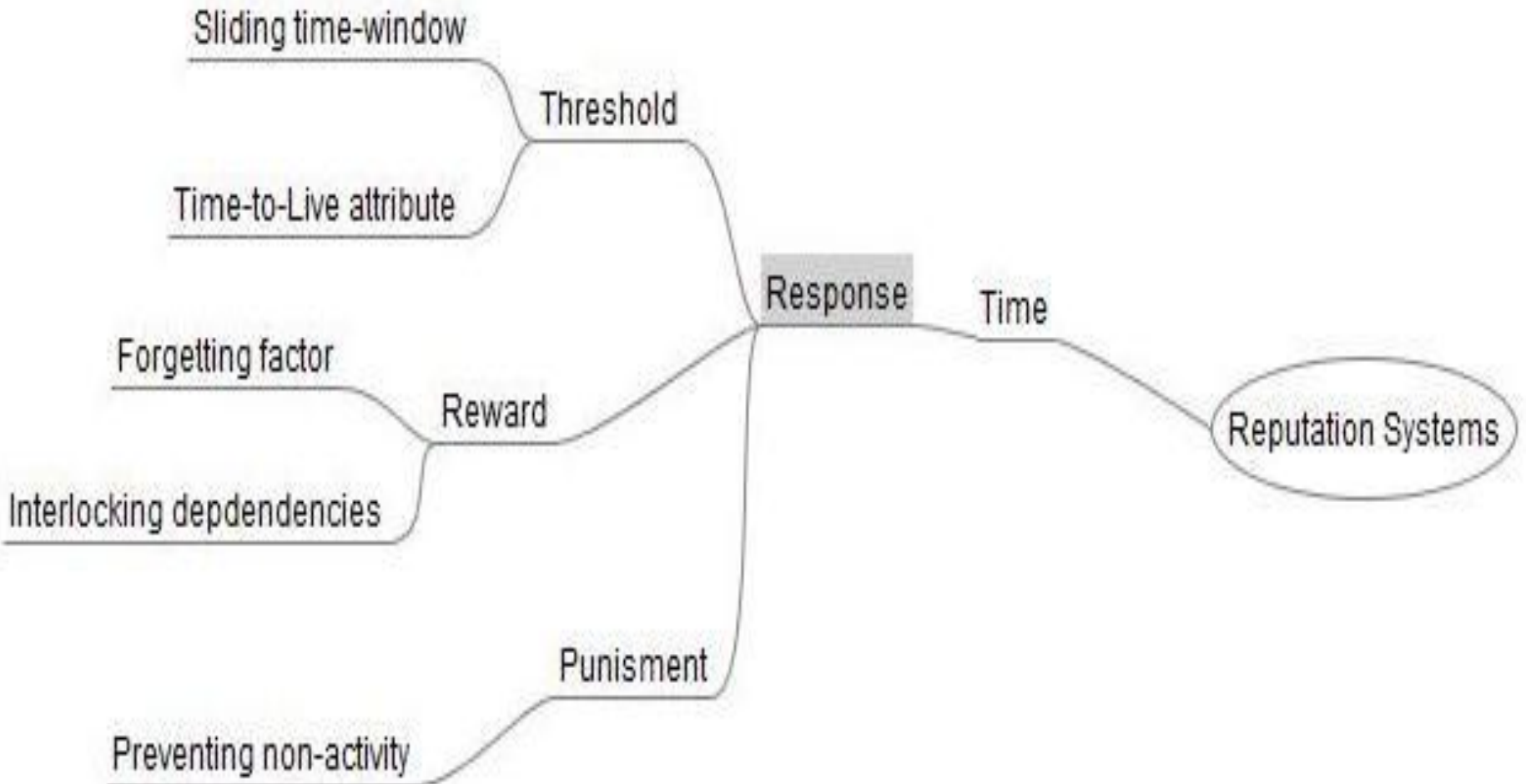
Time - Information Gathering



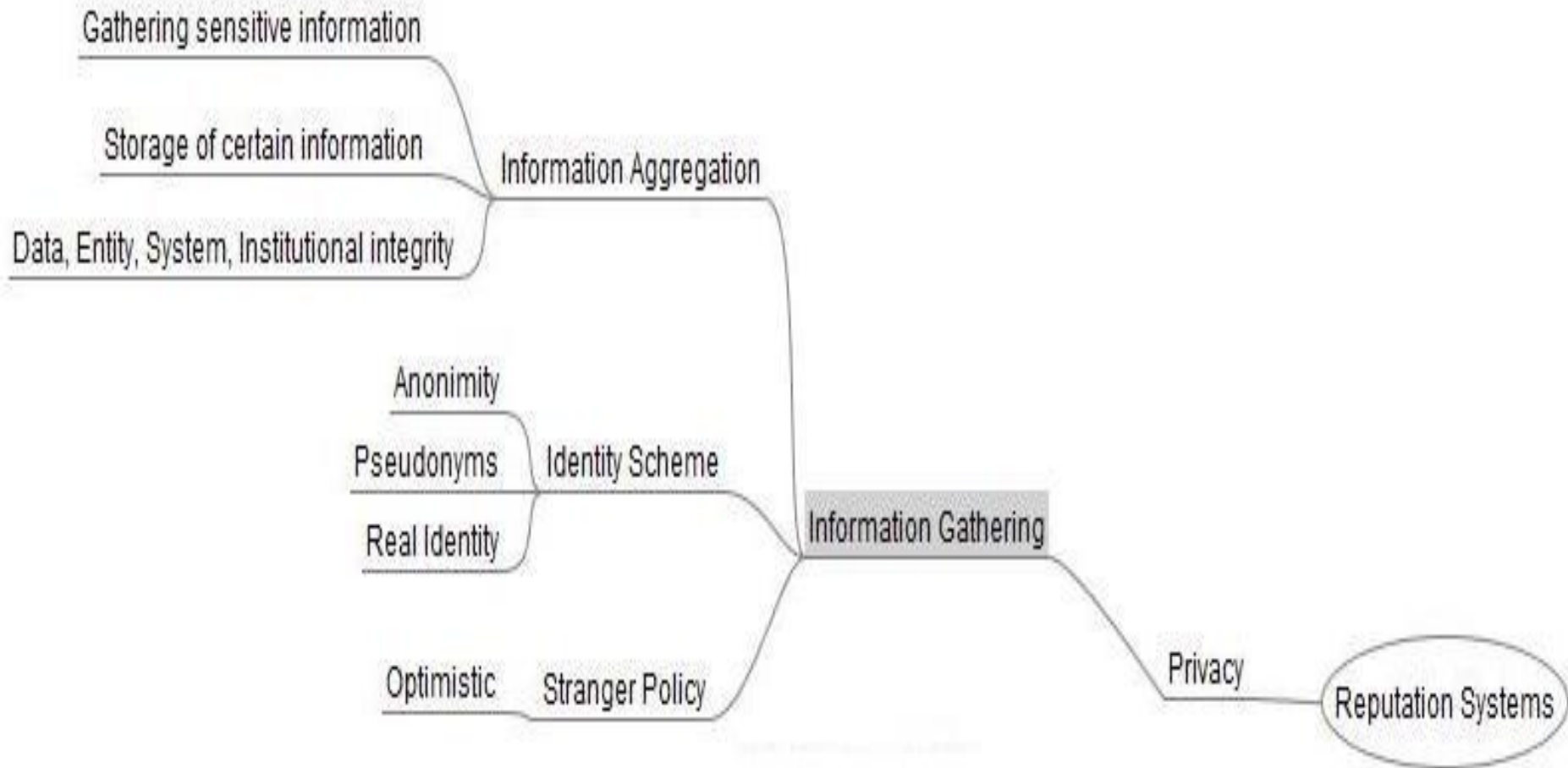
Time - Scoring and Ranking



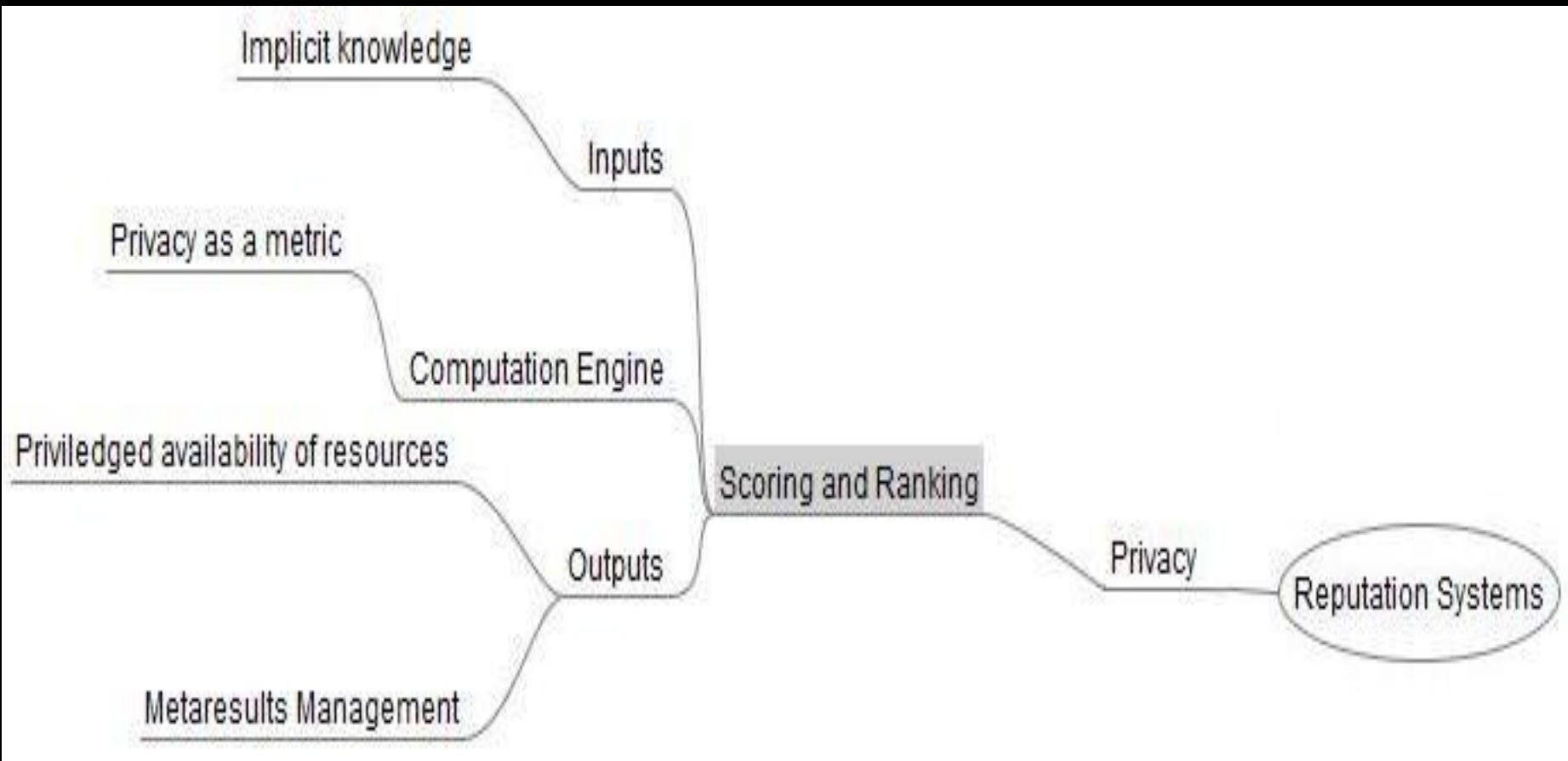
Time - Response



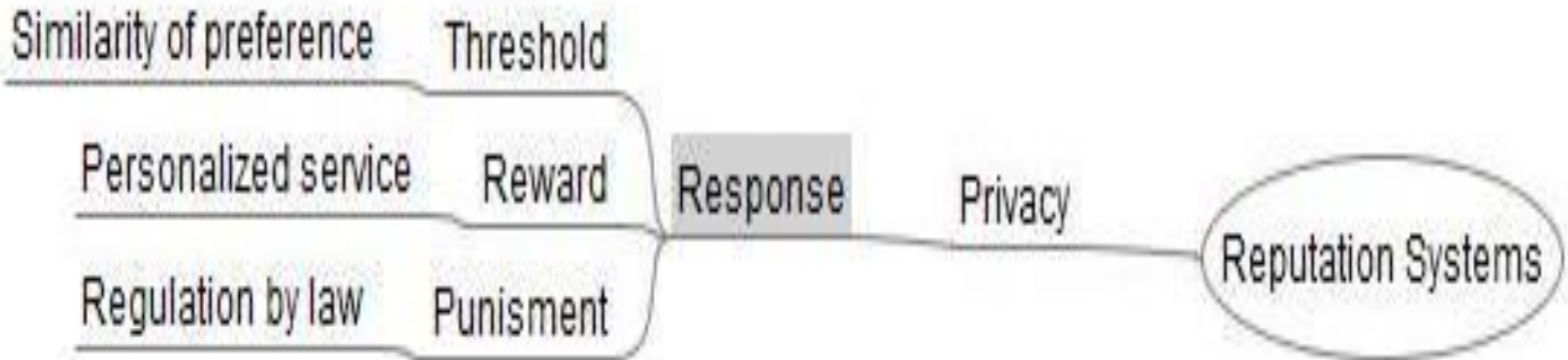
Privacy – Information Gathering



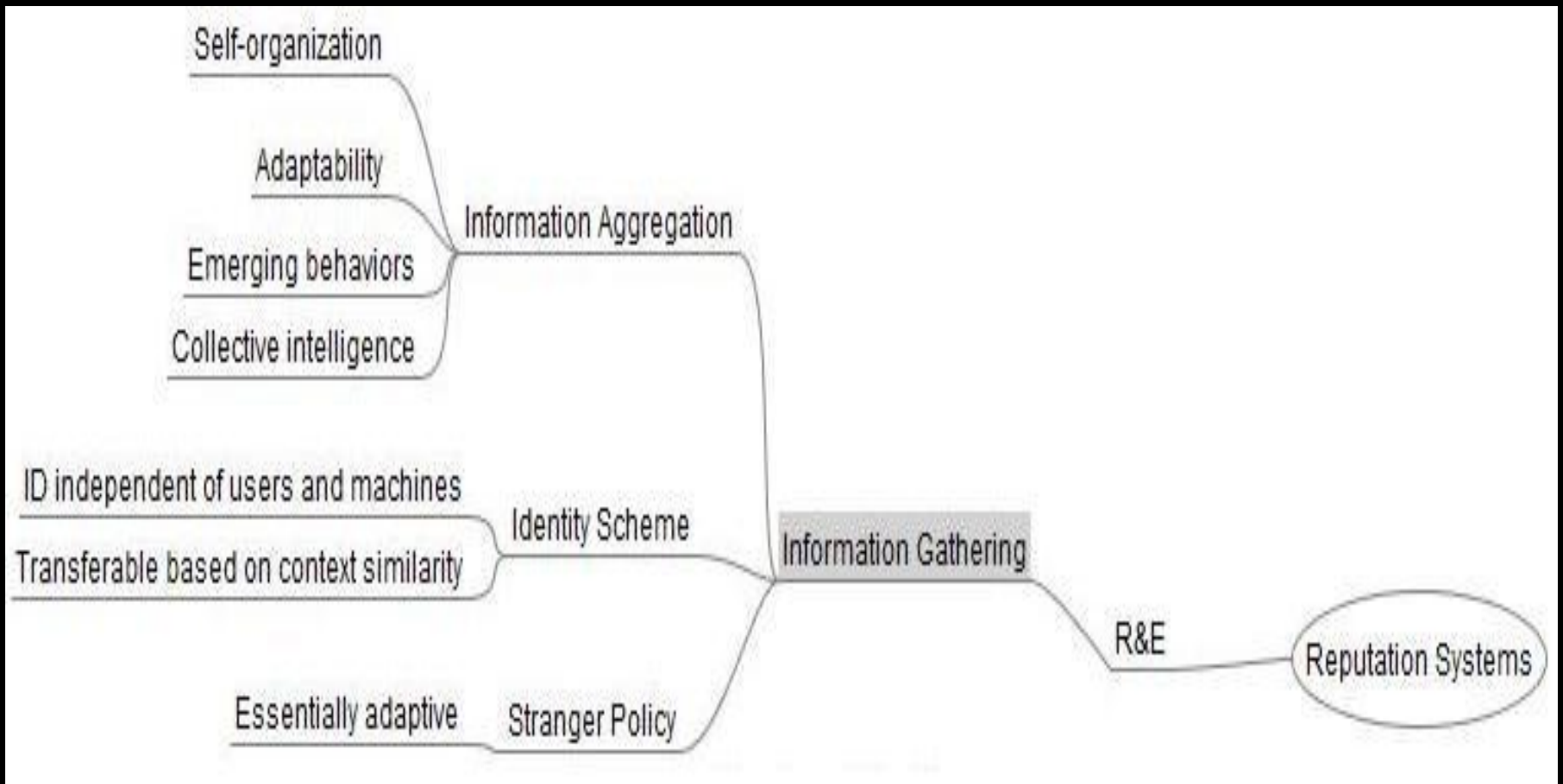
Privacy – Scoring and Ranking



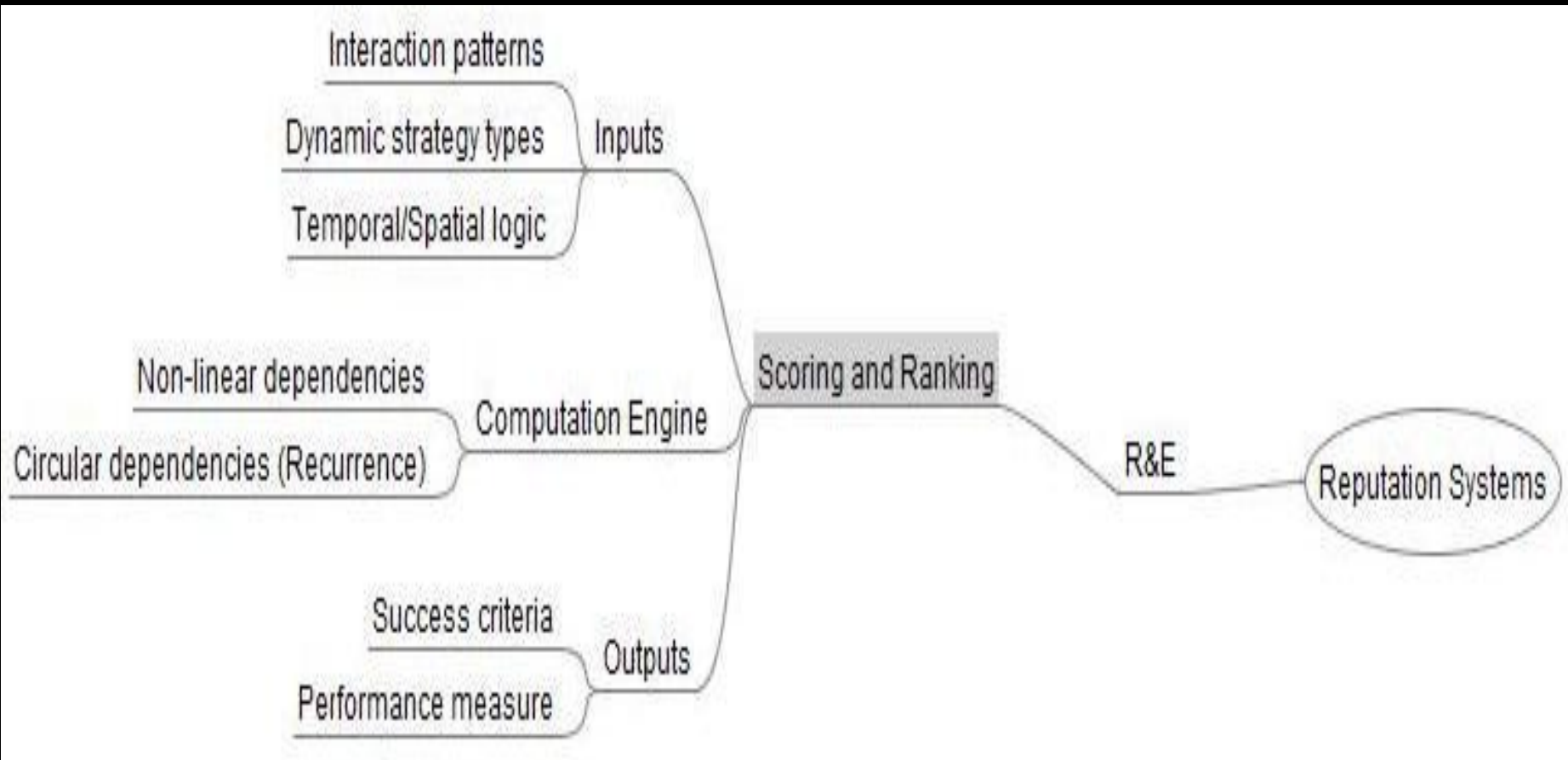
Privacy – Response



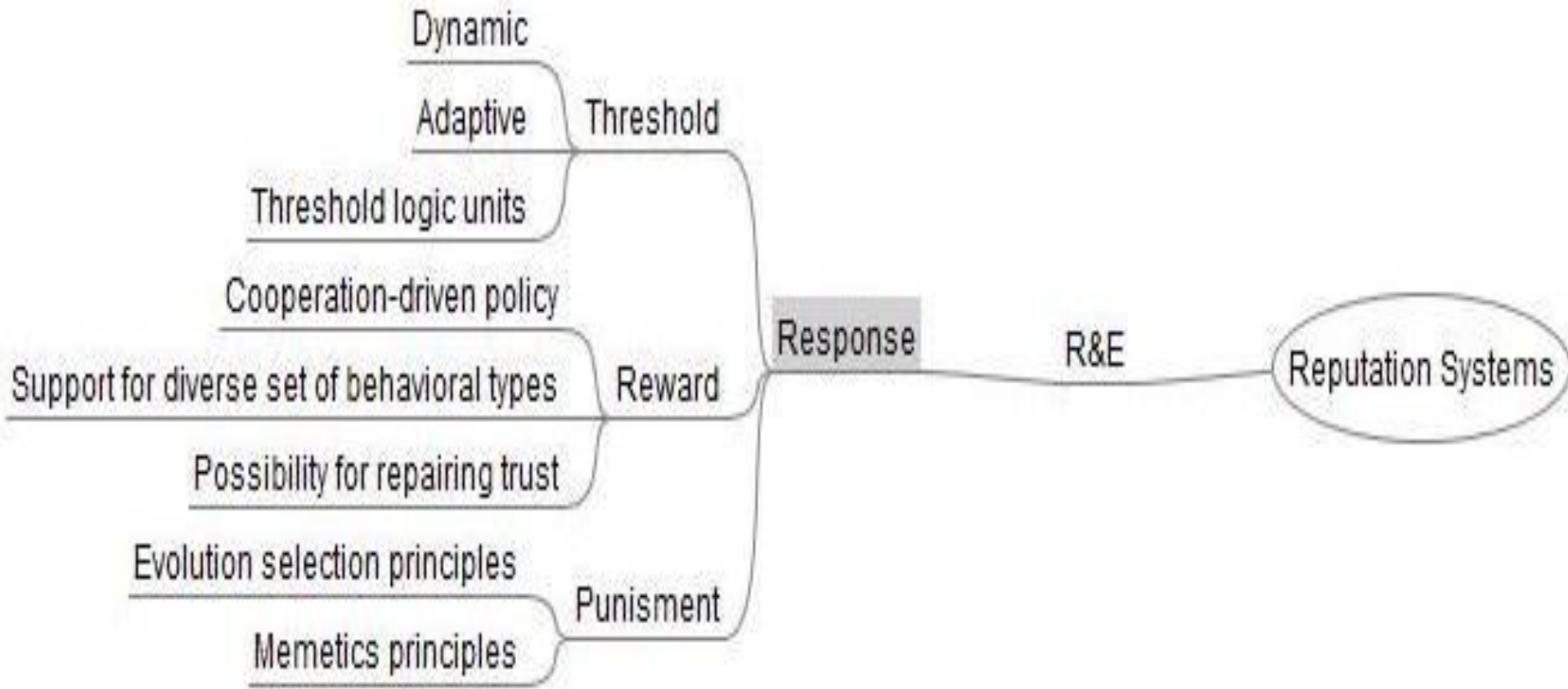
R&E- Information Gathering



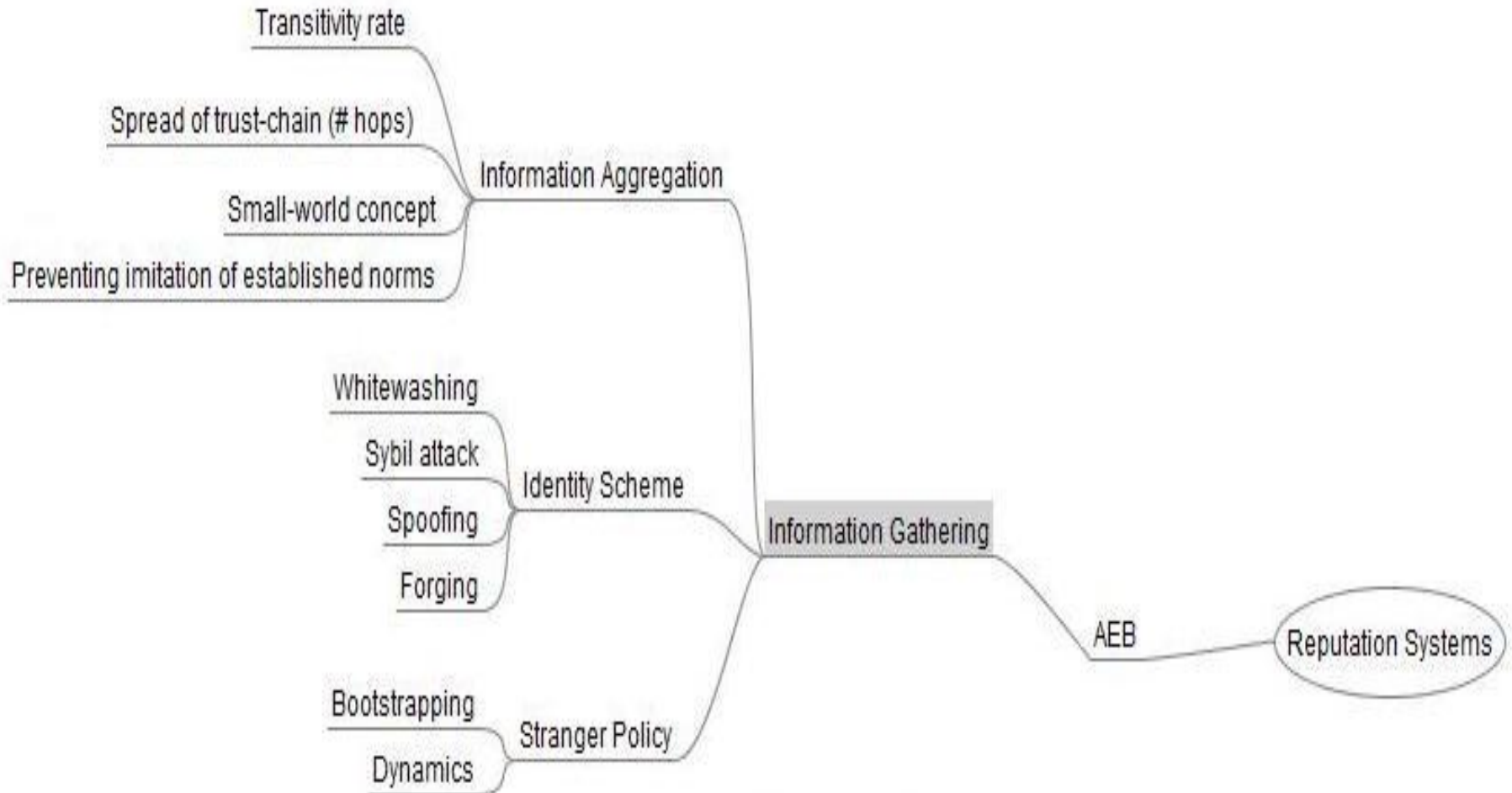
R&E- Scoring and Ranking



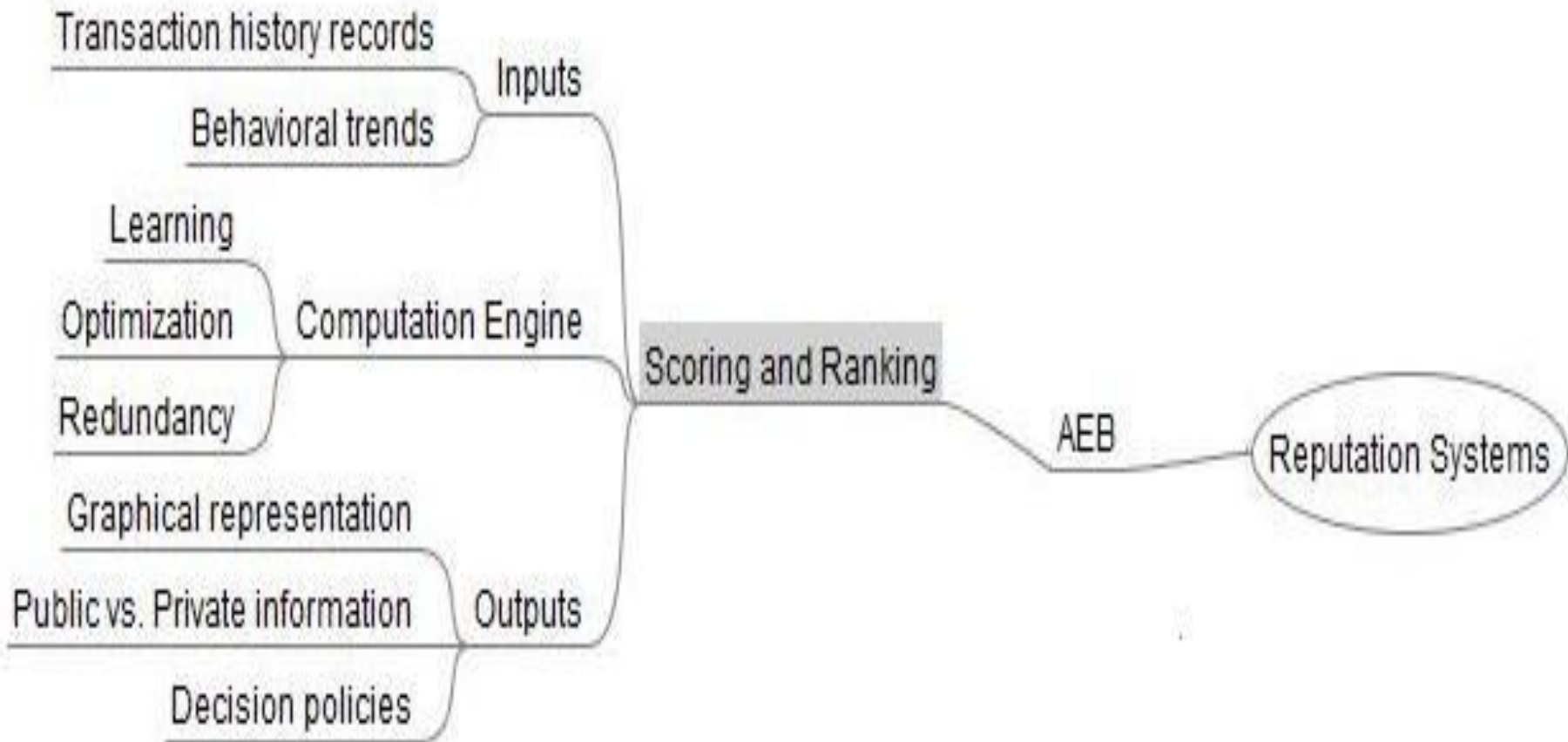
R&E- Response



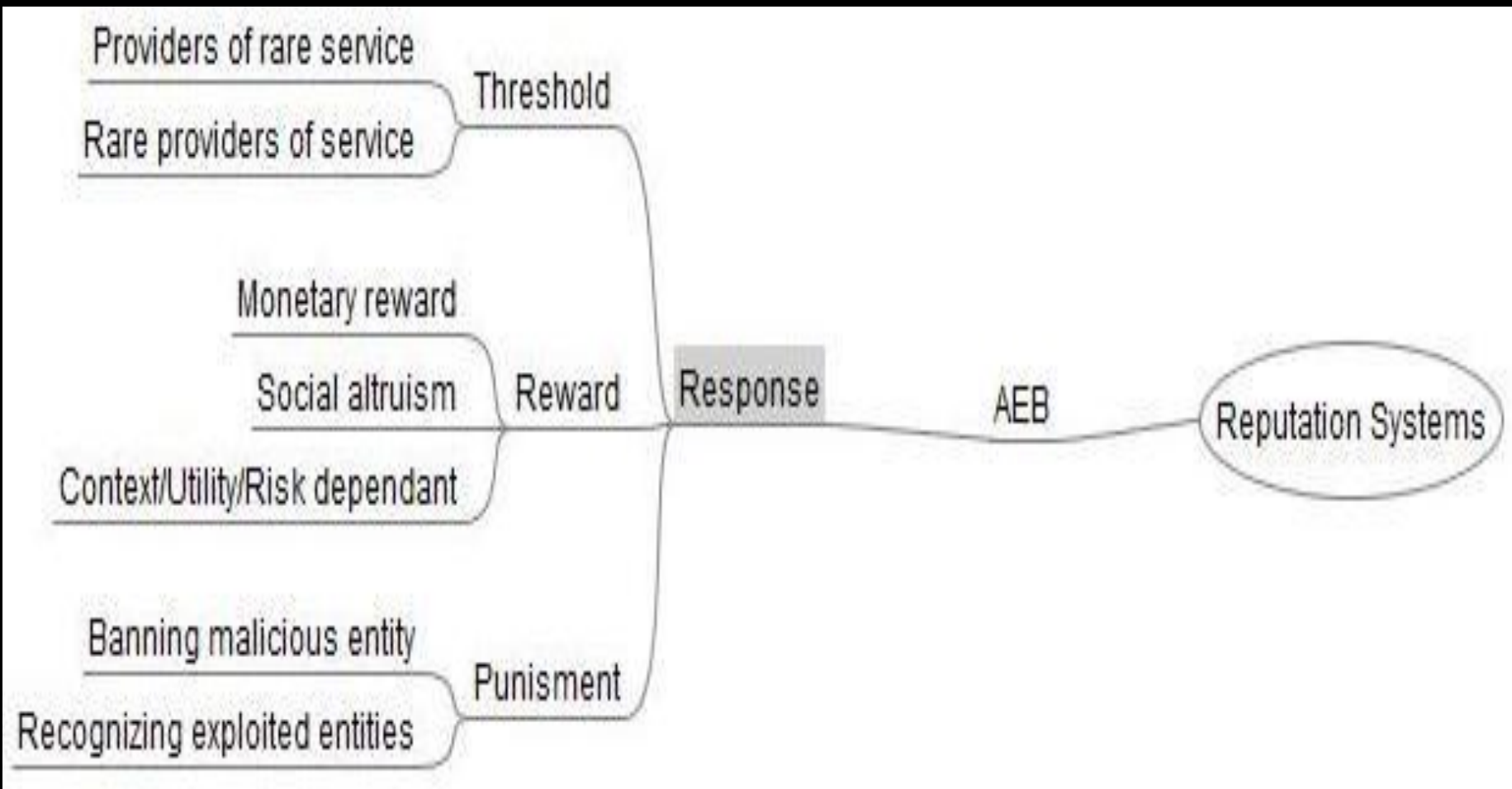
AEB- Information Gathering



AEB- Scoring and Ranking



AEB- Response



Outline

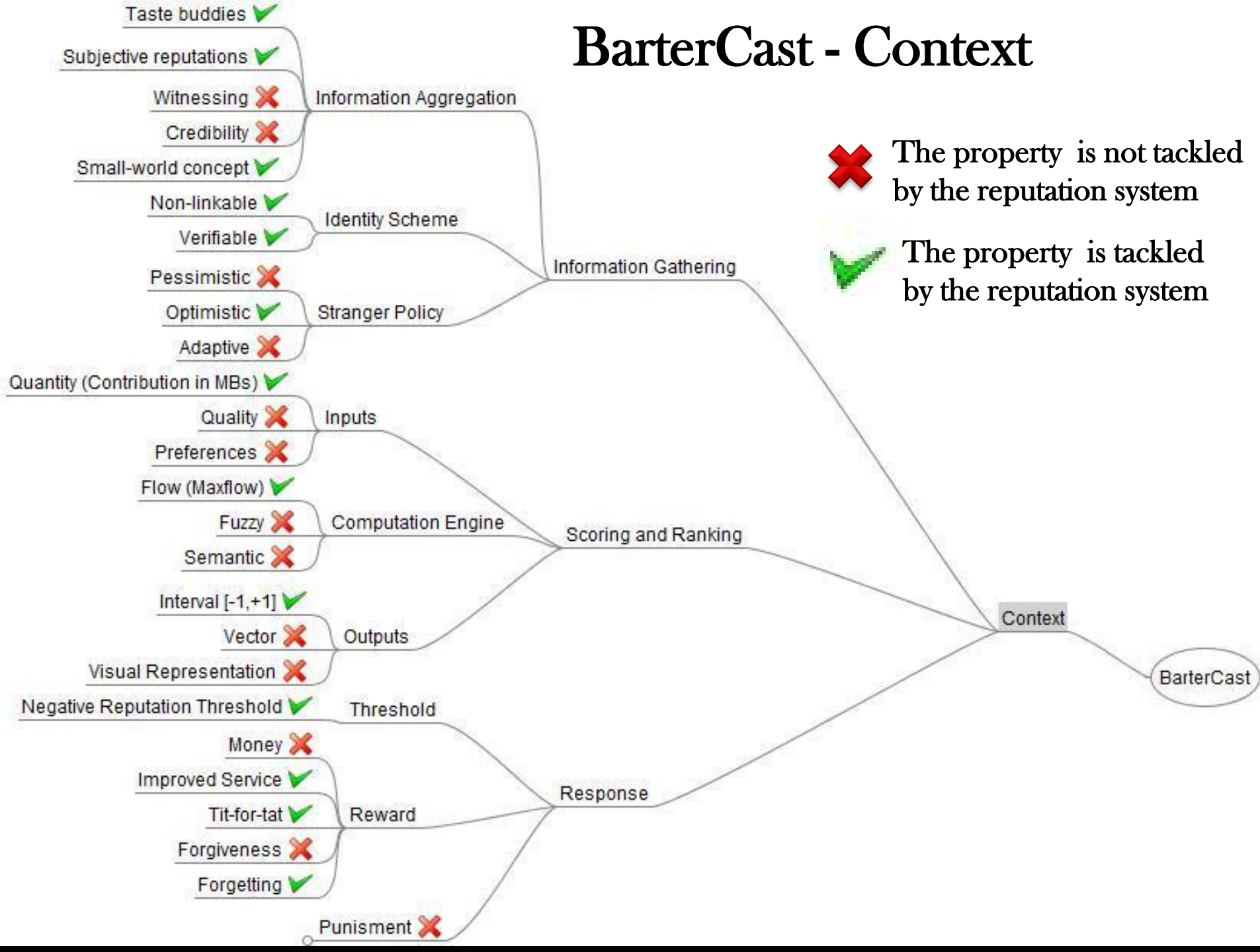
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BarterCast

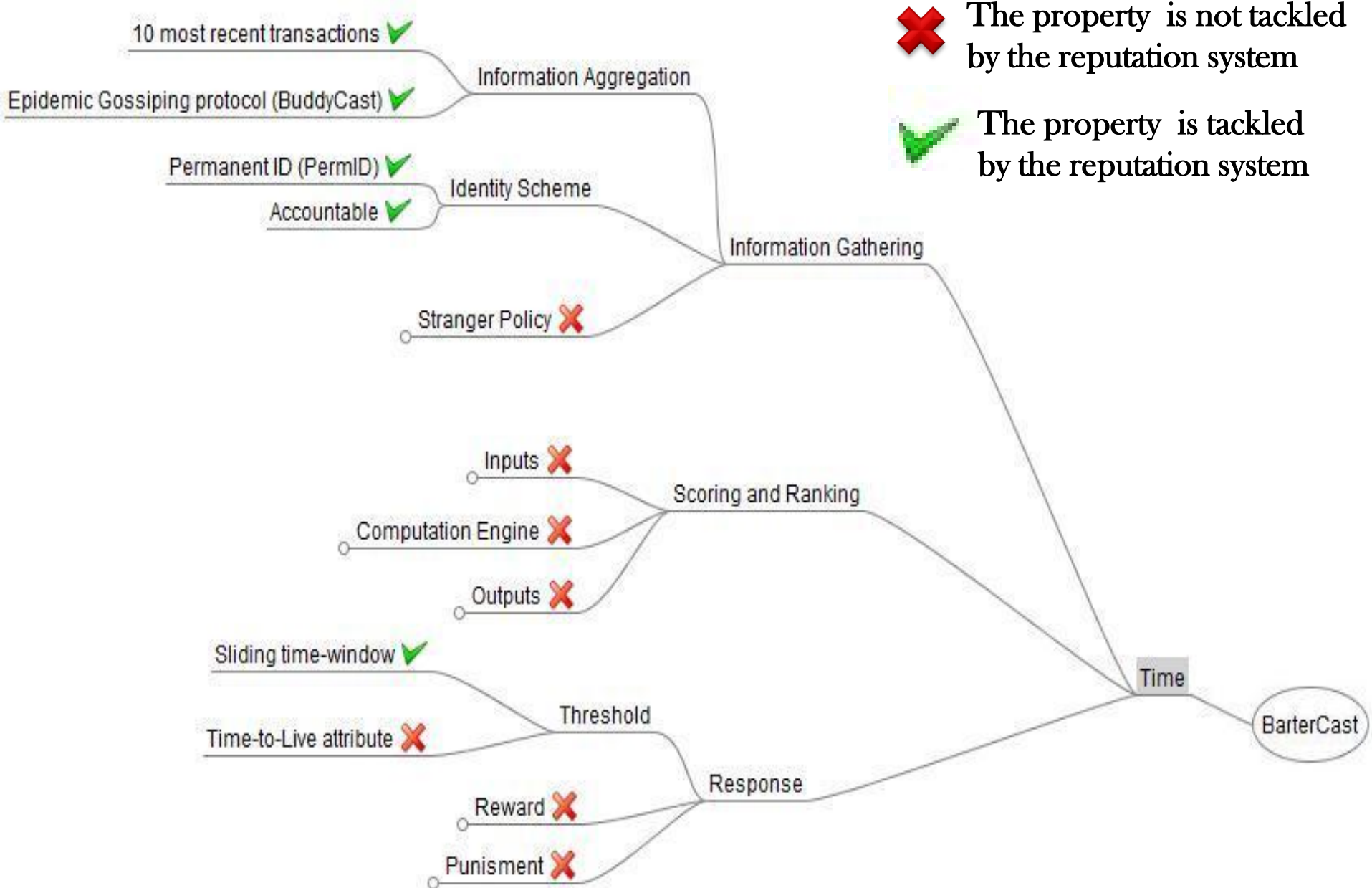
- Fully distributed P2P reputation mechanism
- Deployed in the P2P BitTorrent client Tribler
- General context: File-sharing
- Goal of implementation: combating Free-riding

IMPLEMENTED

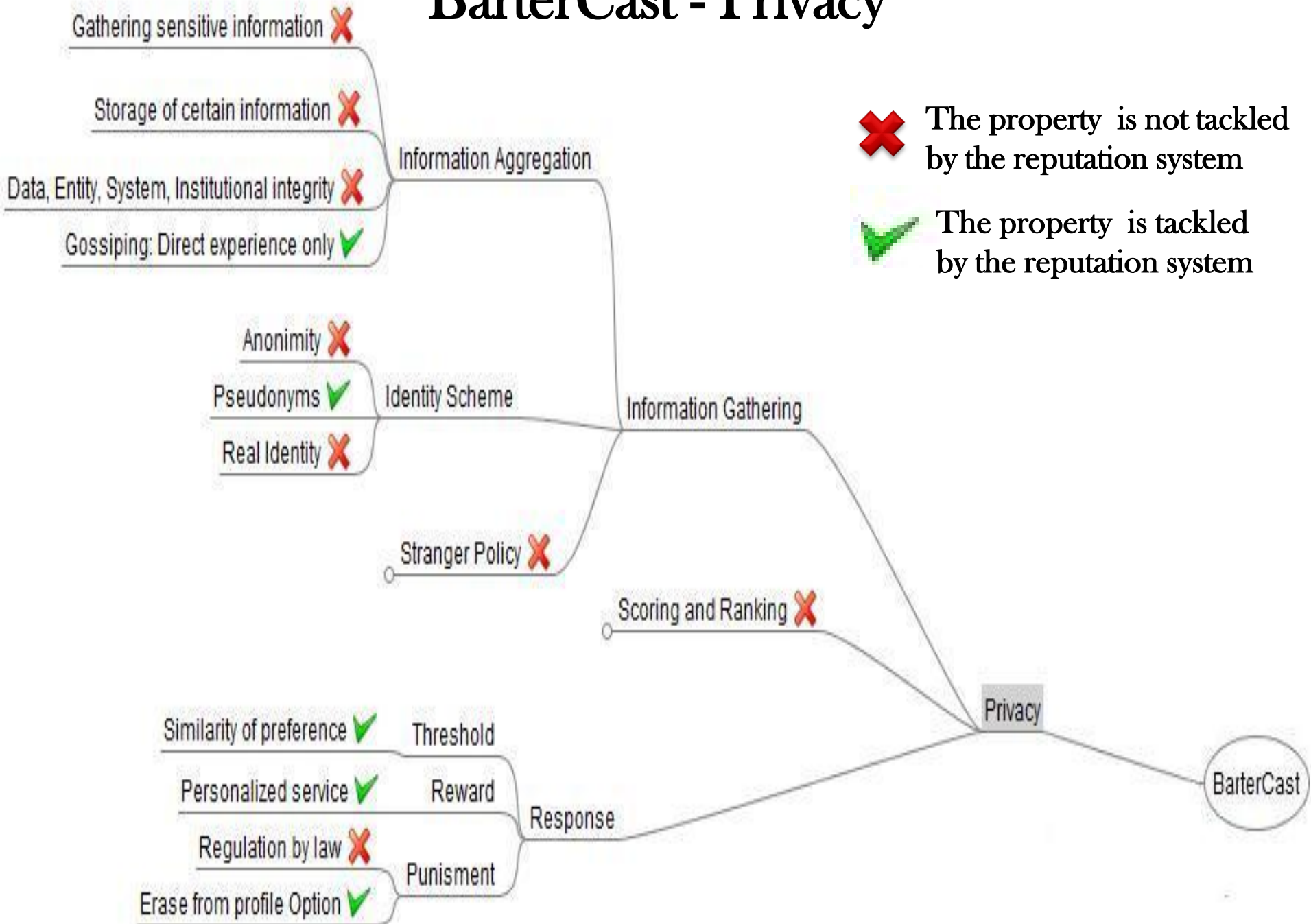
BarterCast - Context



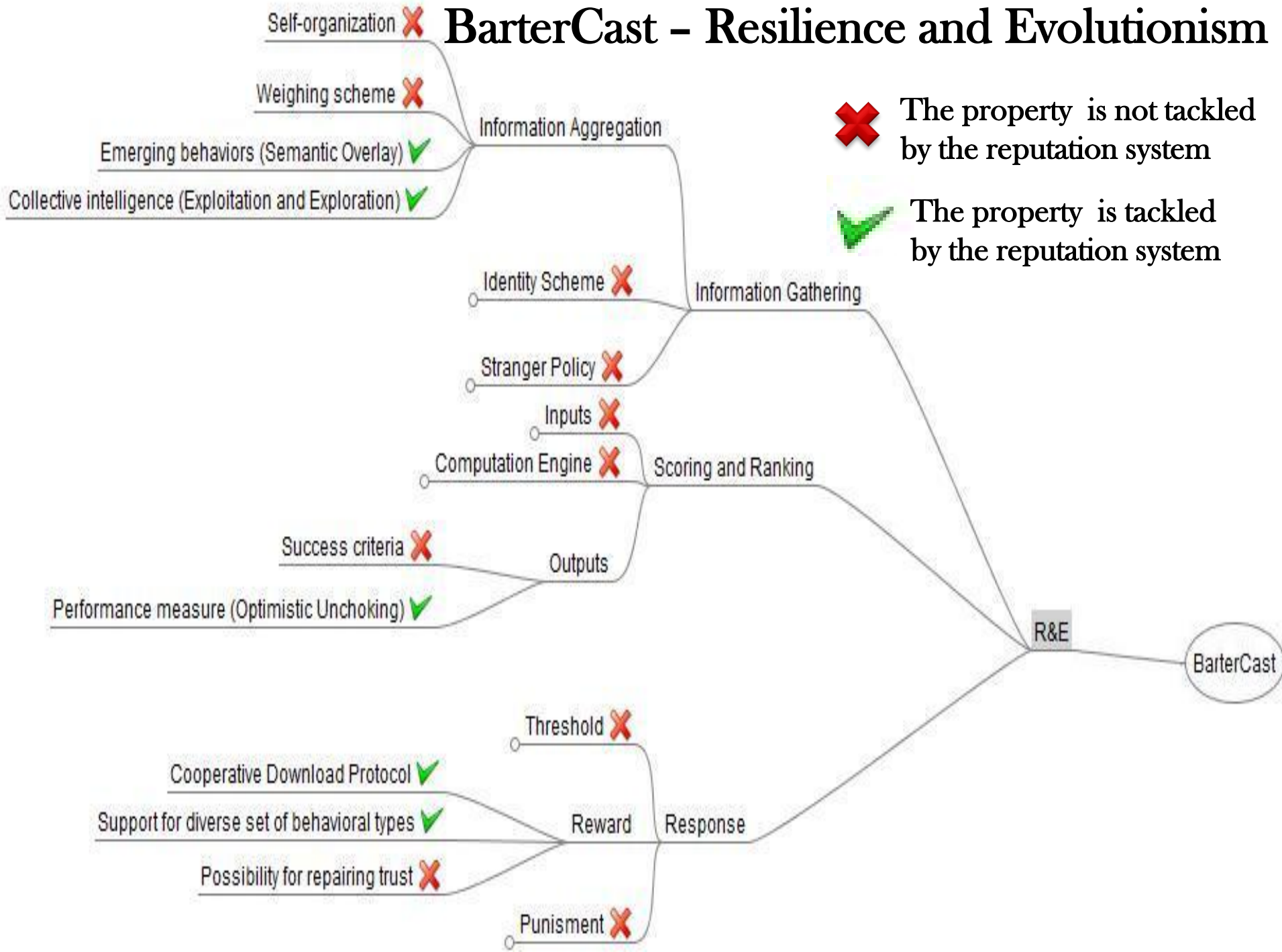
BarterCast - Time



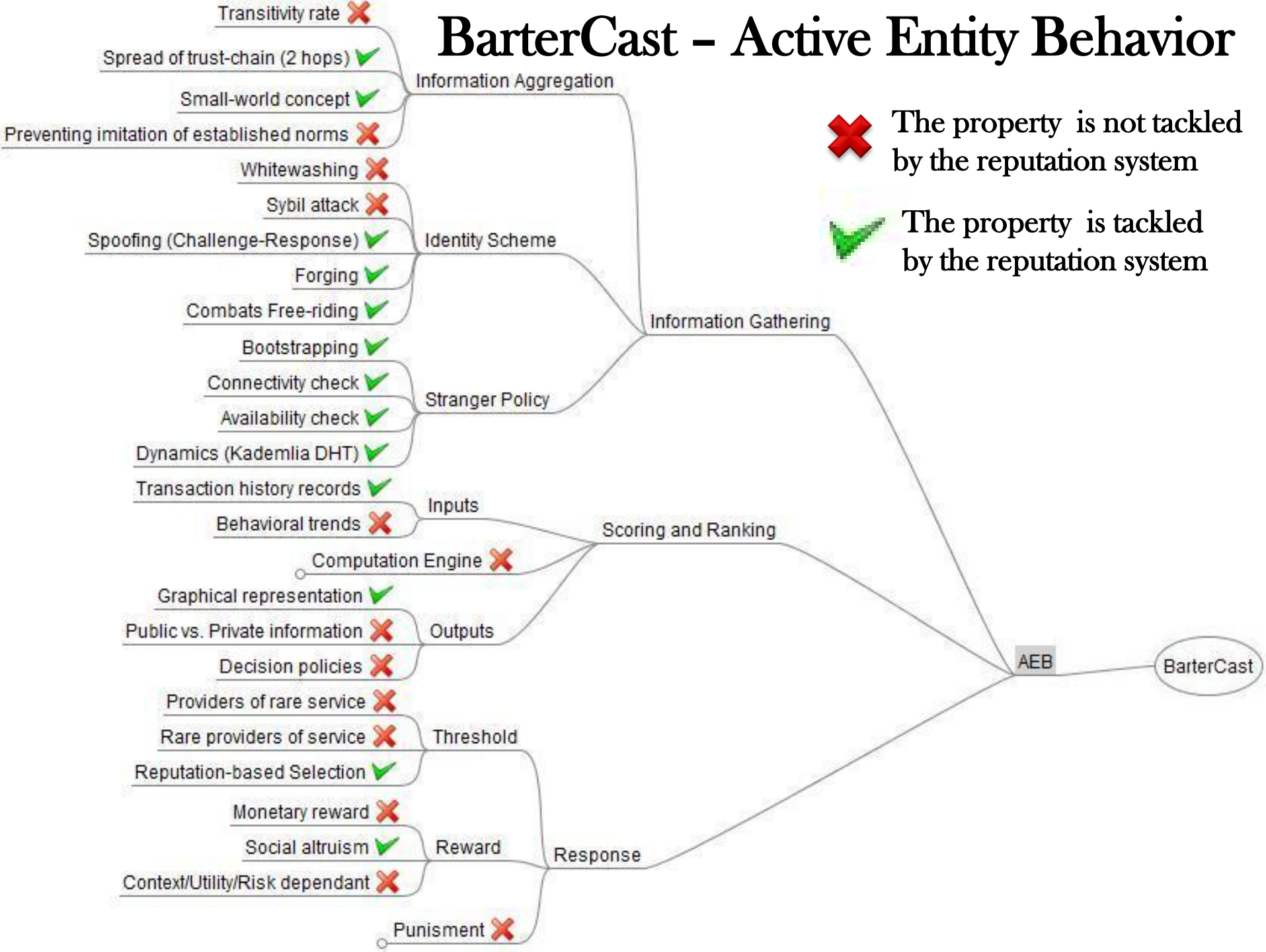
BarterCast - Privacy



BarterCast - Resilience and Evolutionism



BarterCast - Active Entity Behavior



Observations

- The novel framework gives a clear representation of the mapping between its properties, and those of the analyzed reputation system
- An important convenience of the tree-form of the framework is the visual representation of the depth to which the defined properties are considered
- It helps the design process by providing contextualization of the entities' interdependencies
- It presents the idea of the *reputation system as a systemic whole, its treatment as an aspect system, as well as a hierarchical subsystem of the general architecture*

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Future Steps

- The taxonomy as an evaluation framework for a reputation system design
 - Systemic modeling of reputation mechanisms: cybernetics and control theory, complexity theory, neural networks
 - Context-Aware Reputation by Fuzzy-Ontological Approach
- Impression management and Social interactions
 - Cost/Benefit analysis
 - Complexity - Robustness - Optimality analysis
- Experimental work
 - system limits; types of 'players'
 - parallel between social online trust and automated agent trust

Questions?

Thank you !

Reputation Mechanisms

Adverse selection

Moral Hazard

Information asymmetry

Post-contractual
opportunism

Signaling role

Sanctioning role

Examples:

*The
market*

“Lemon”

The Prisoner’s dilemma

Applications

- Online Recommendations (Slashdot, delicious, Epinions, imdb)
- Online commerce (eBay, Amazon)
- Rating (Google PageRank, Gaming Communities)
- Wireless sensor networks, MANETs (routing, negotiation protocols)
- File-sharing communities (BitTorrent, Gnutella)
- Cloud computing (SLA compliance, QoS)
- Digital currencies (BitCoin)

