39th International Conference on Conceptual Modeling

Ontology-based Modeling and Analysis of Trustworthiness Requirements: Preliminary Results

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AGENDA

1. Context and Motivation
2. Trust and Trust-warranting signals
3. Trustworthiness Requirements
4. Ontology-based Approach for the Modeling of Trustworthiness Requirements
5. The Ontology of Trustworthiness Requirements
6. Conclusions and Future Work

MOTIVATION

TRUST

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MOTIVATION

ARTIFICIAL INTELLIGENCE

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MOTIVATION

TRUST

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Reference Ontology of Trust

Trust is a complex mental state of a Trustor

Trustor's Intention

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Trustor's Beliefs about the Trustee and its behavior

The Trustee has the **Capability** to perform the desired action or exhibit the expected behavior

The Trustee's **Vulnerabilities** will not prevent it from performing the desired action or exhibiting the expected behavior

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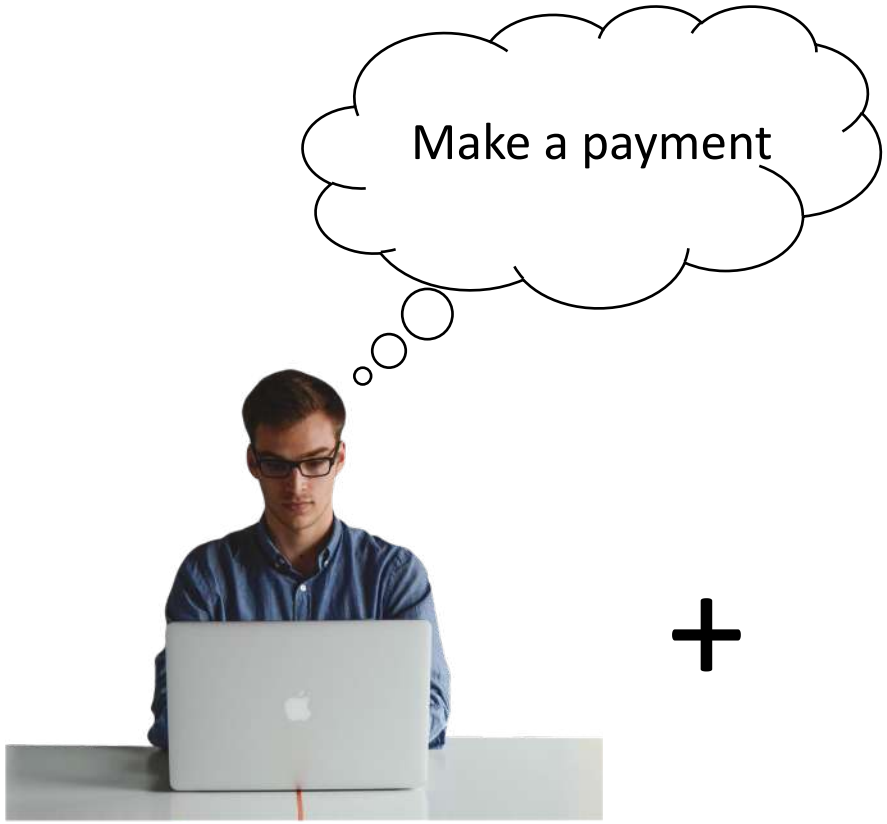
EXAMPLE



Intention of the Trustor

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Capability Belief

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Vulnerability Belief

Images by Gerd Altmann from Pixabay

Trust presupposes Risk

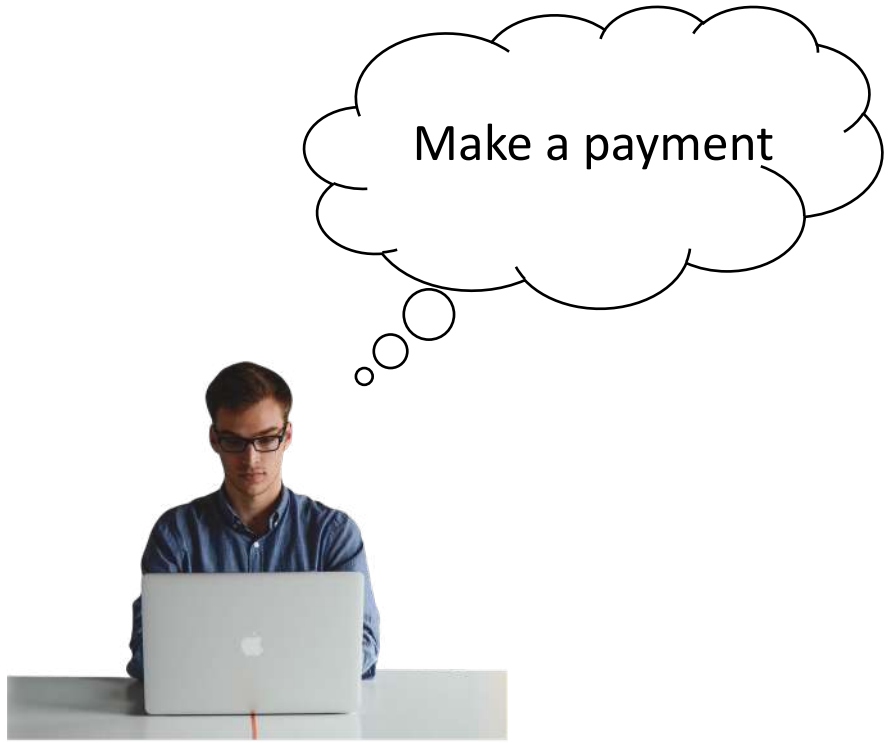
The Trustee may not perform the expected action

- The trustee is no more **capable** of performing the action
- A **vulnerability** of the trustee prevents it from performing the action

The Trustee performs the action but it does not have the desired result

- **Capability**-related
- **Vulnerability**-related

EXAMPLE



Intention of the Trustor

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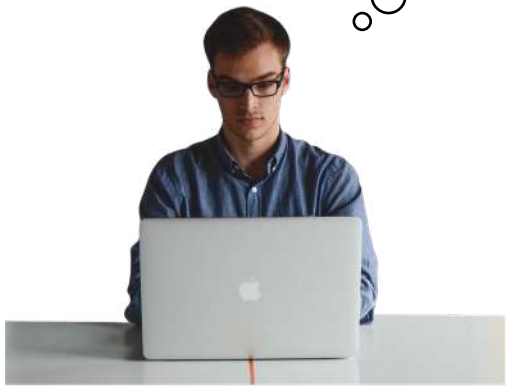
EXAMPLE



Intention of the Trustor

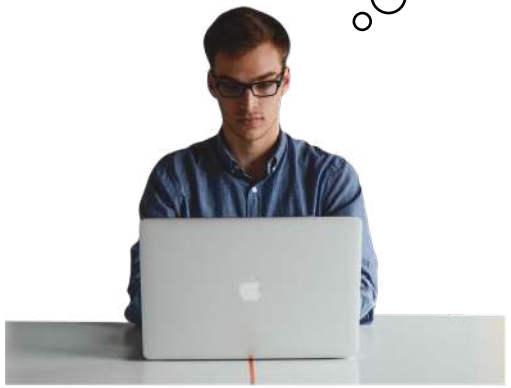
Capability

Threatening Situation

Network malfunction prevents the banking system to access the Internet

Images by Gerd Altmann from Pixabay

EXAMPLE



Intention of the Trustor

Capability

Threatening Situation

Network malfunction prevents the banking system to access the Internet

Threatening Event

As a result, the system cannot deliver its capability of making payments

Images by Gerd Altmann from Pixabay

EXAMPLE

Intention of the Trustor

Capability

Threatening Situation

Network malfunction prevents the banking system to access the Internet

Threatening Event

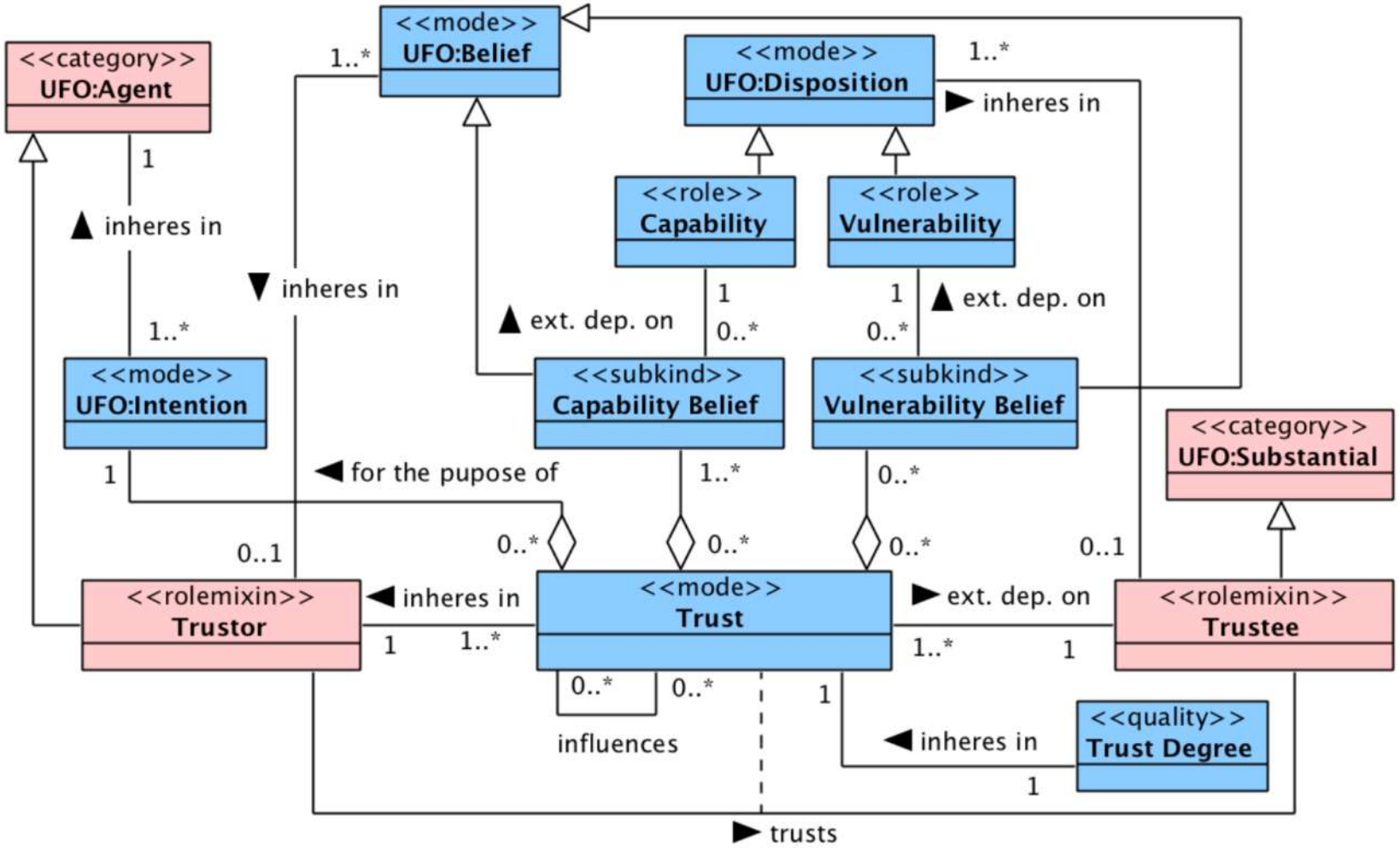
As a result, the system cannot deliver its capability of making payments

Loss Event

The Trustor is not able to make the payment

Images by Gerd Altmann from Pixabay

Reference Ontology of Trust



Amaral, G., Sales, T.P., Guizzardi, G., Porello, D.: Towards a Reference Ontology of Trust. In: Proc. of CoopIS. pp. 3–21. Springer (2019)

Trust-warranting Signals

Ensure trustworthy behavior

Data certificates

Information on how privacy and security measures are implemented

Data provenance information

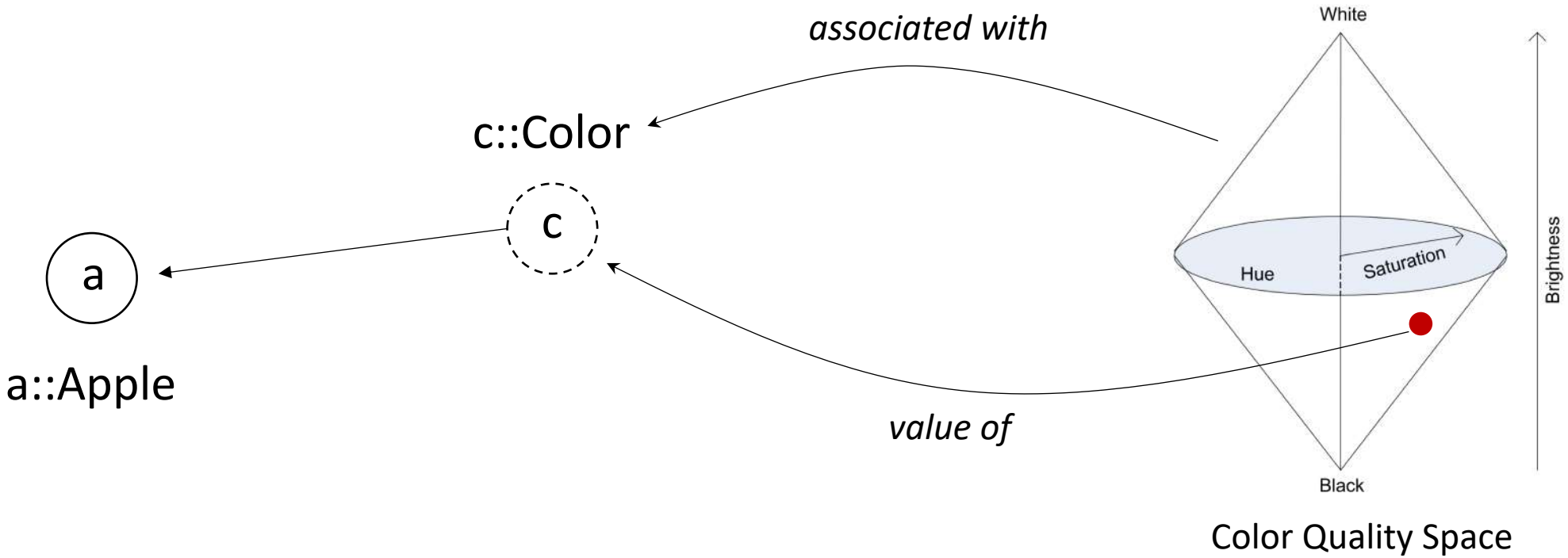
Icons by Muhammad Riza, Vectors Market, H Alberto Gongora (Noun Project)

Trustworthiness Requirements

Trustworthiness requirements are personal requirements, where the desired states-of-affairs are stakeholder mental states that include an attitude of trust towards the system-to-be.

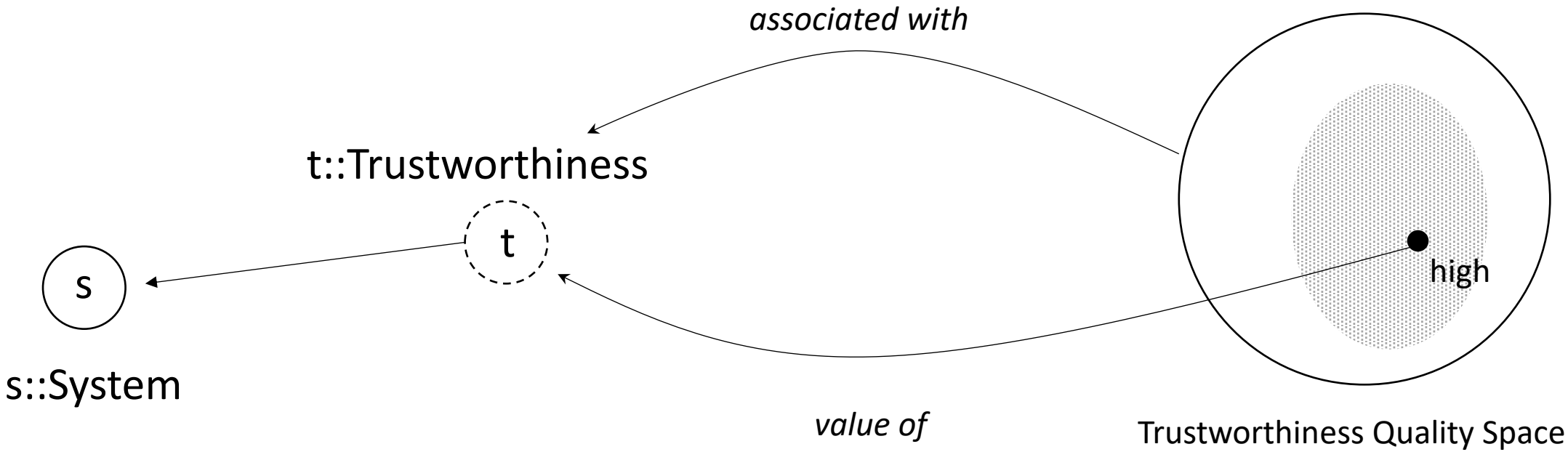
Trustworthiness requirements are quality requirements. This means that they constrain the level of presence of a quality in its subject.

"Being red" is a property that constrains the color quality of an Apple to be in the red region of a color quality space

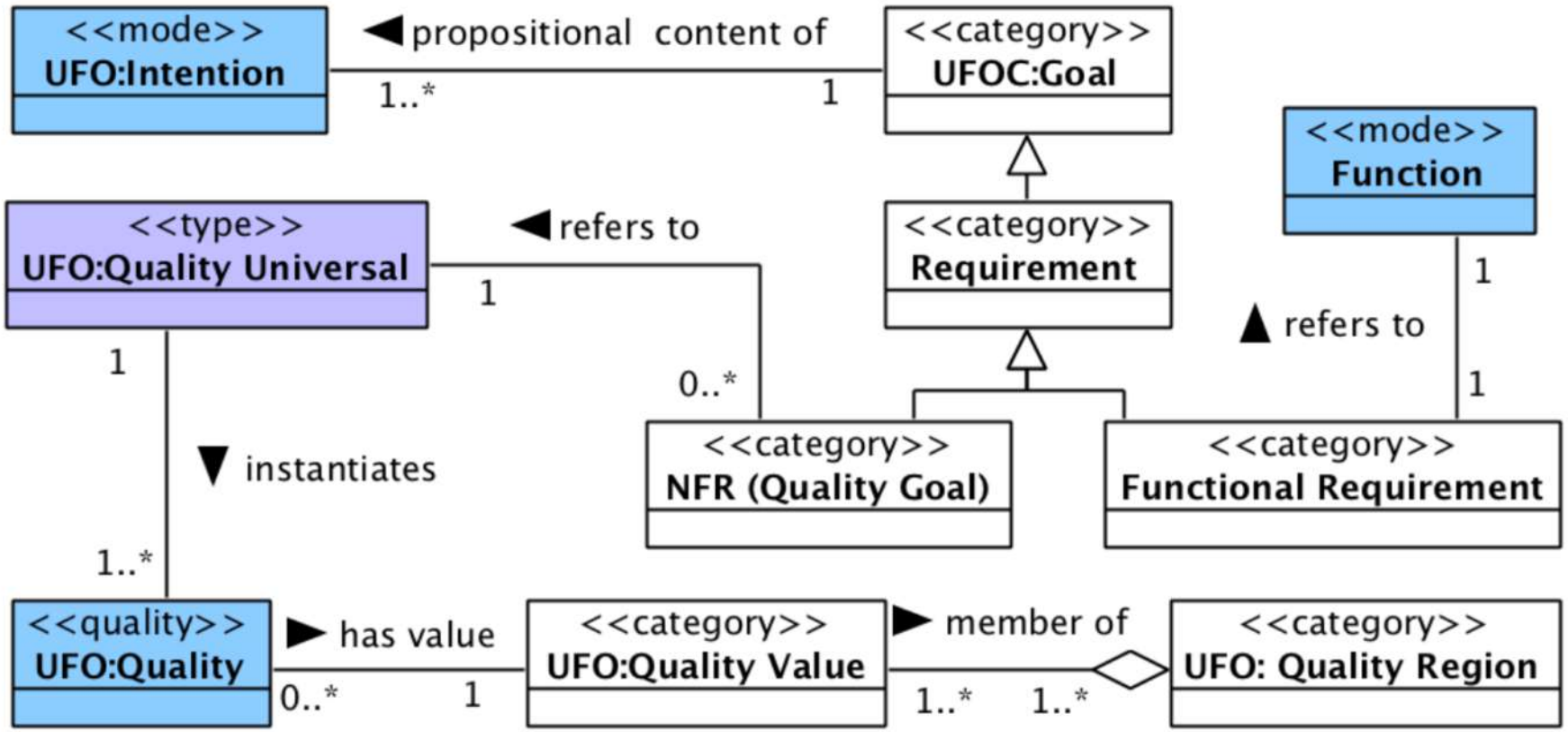


Color Quality Space

"Being trustworthy" is a constraint for agents or services to fall in the trustworthiness region of a space that also includes an untrustworthiness region.



THE ONTOLOGY OF NON-FUNCTIONAL REQUIREMENTS



Guizzardi, R. et al.: An ontological interpretation of non-functional requirements. In: Proc. of FOIS. vol. 14, pp. 344–357 (2014)

Ontology-based Approach for the Modeling and Analysis of Trustworthiness Requirements

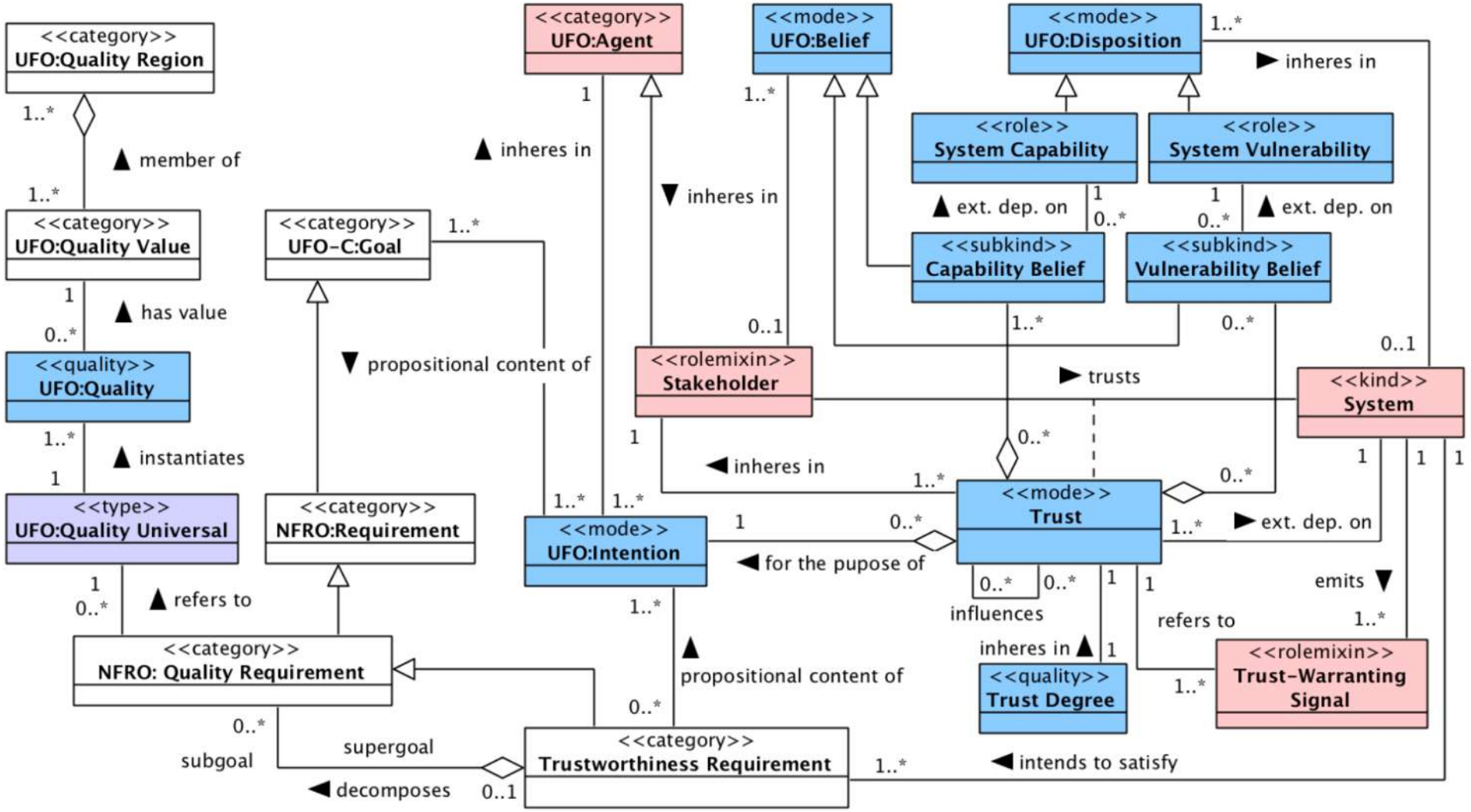
Propose a reference model of a well-founded ontology that characterizes the concept of trustworthiness requirements in the context of software systems

The concept clarification provided by the proposed ontology, promotes practical implications in terms of improving trustworthiness requirements specifications

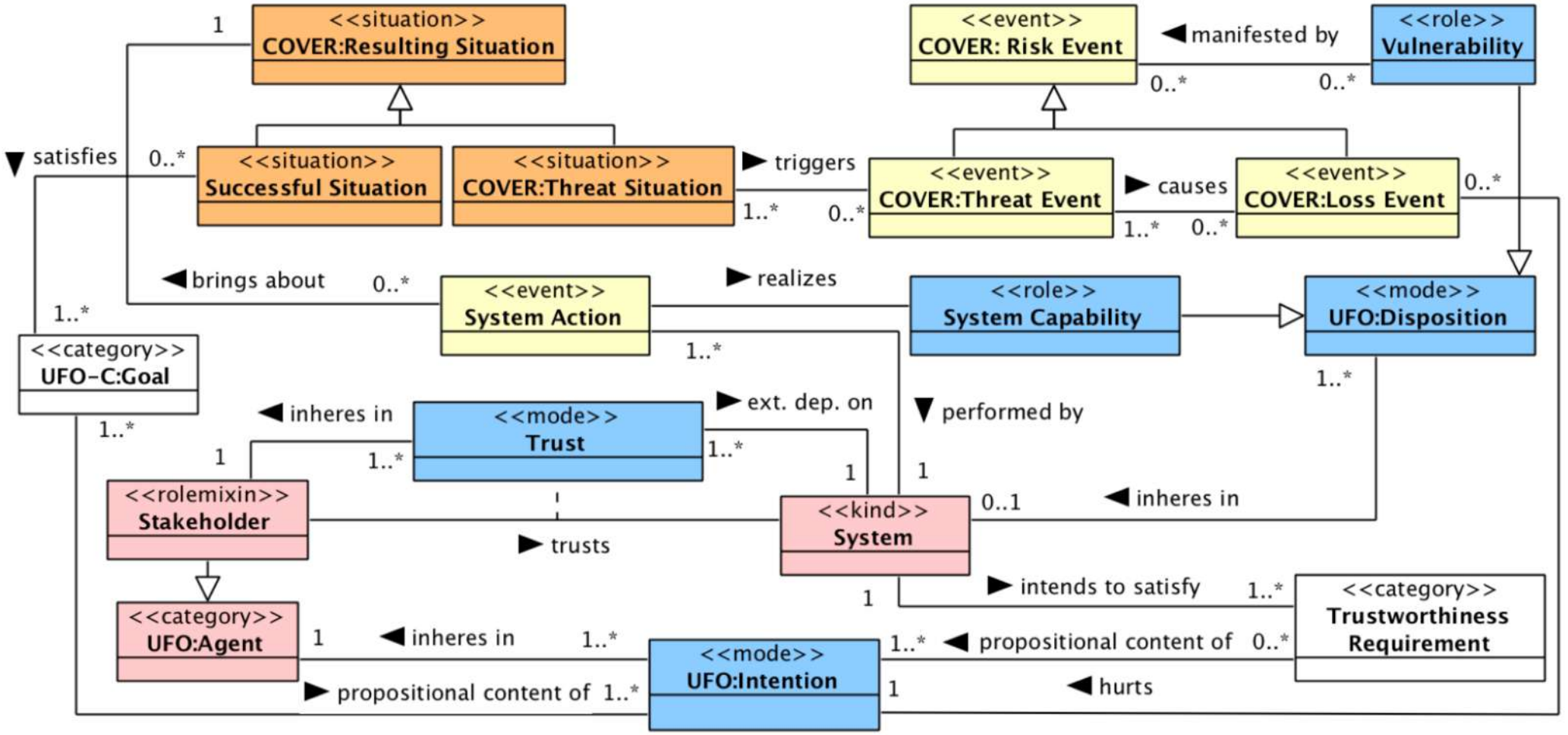
This is accomplished due to better understanding what trustworthy requirements are, and how they relate with other concepts, which should also be specified (e.g. system's capabilities, vulnerabilities, trust-warranting signals etc.)

Icons by mynamepong , Tomas Knopp, Adrien Coquet (Noun Project)

THE ONTOLOGY OF TRUSTWORTHINESS REQUIREMENTS



THE ONTOLOGY OF TRUSTWORTHINESS REQUIREMENTS



CONCLUSIONS

- It is important to understand the elements of stakeholder trustworthiness towards the system to be, as they reveal the qualities and properties the system should have in order to be considered trustworthy and effectively promote well-placed trust.
- This knowledge can be used as input to the definition of trust-warranting signals that ensure trustworthy behavior.
- Finally, the identification of trust components is equally important to the assessment of risks related to the capabilities and vulnerabilities, which are the focus of stakeholders' beliefs.

Future Work

- Further validate our ontology by doing real case studies and having experts evaluate the results.
- Define ontological patterns, based on our ontology, to support the modeling and analysis of trustworthiness requirements, aiming at facilitating the development of trustworthy systems
- Propose a systematic process for identifying trustworthiness requirements, grounded on these patterns and on the ontological account of trustworthiness requirements presented here

Thank You

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