

# Human motivation an the security of Internet of Things

*Adam Szekeres*

COINS Winter School

Finse

*08.05.2019*

# Human threats in Information Security:

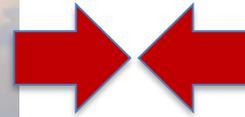
- Sharing keycard with a colleague
- Opening doors to strangers
- Using work password at several sites
- Spying on wife/husband using company privileges
- Responding to phishing mails (e.g. CEO fraud)
- Storing passwords in plain text in a database
- Leaking organizational secrets
- ...



# Fundamental tradeoff: security vs opportunity [RiskManagement]

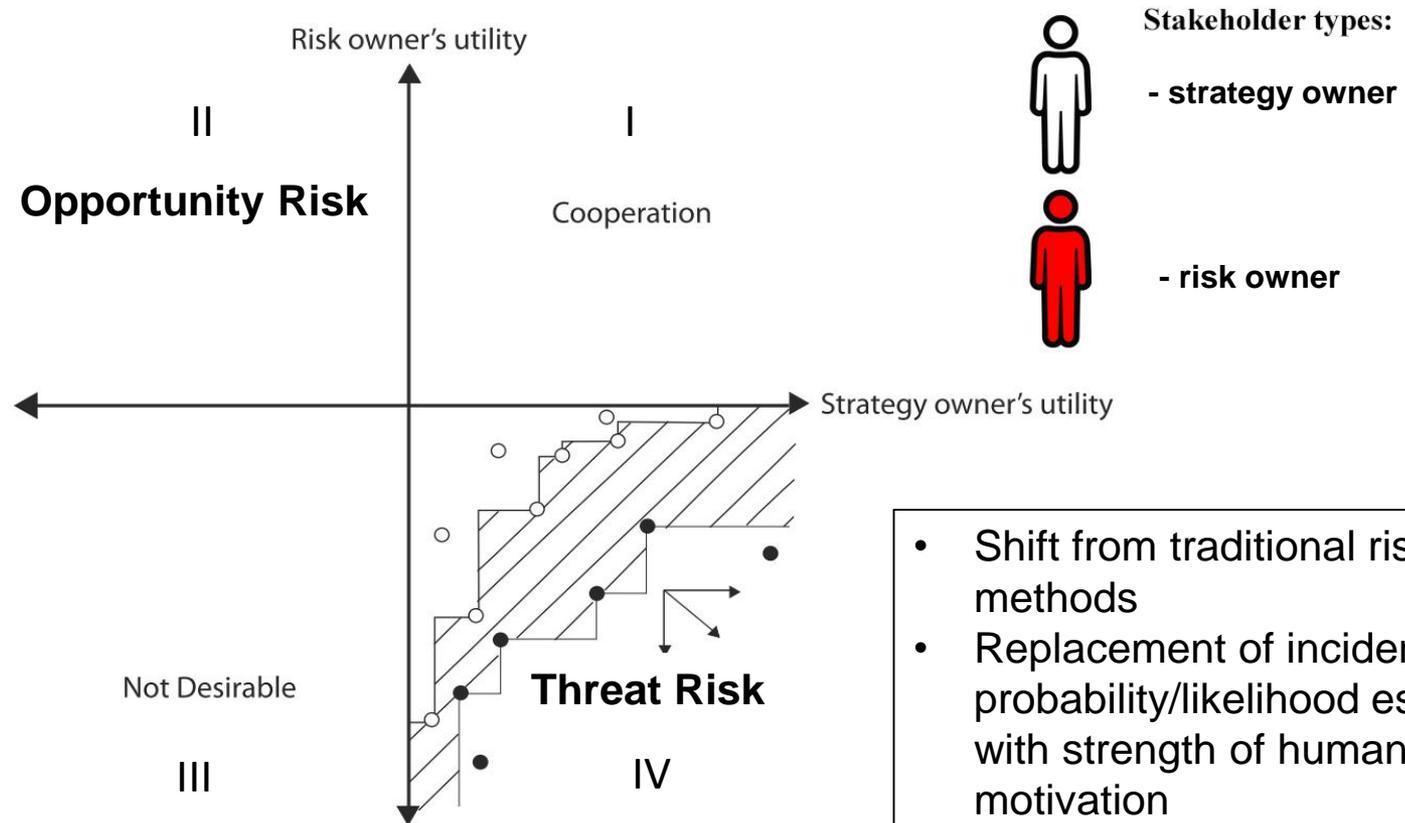


“Perfect security may be achievable only for networkless servers located in rooms without doors in stone buildings without people on high ground with no earth faults in areas with very little rain.”



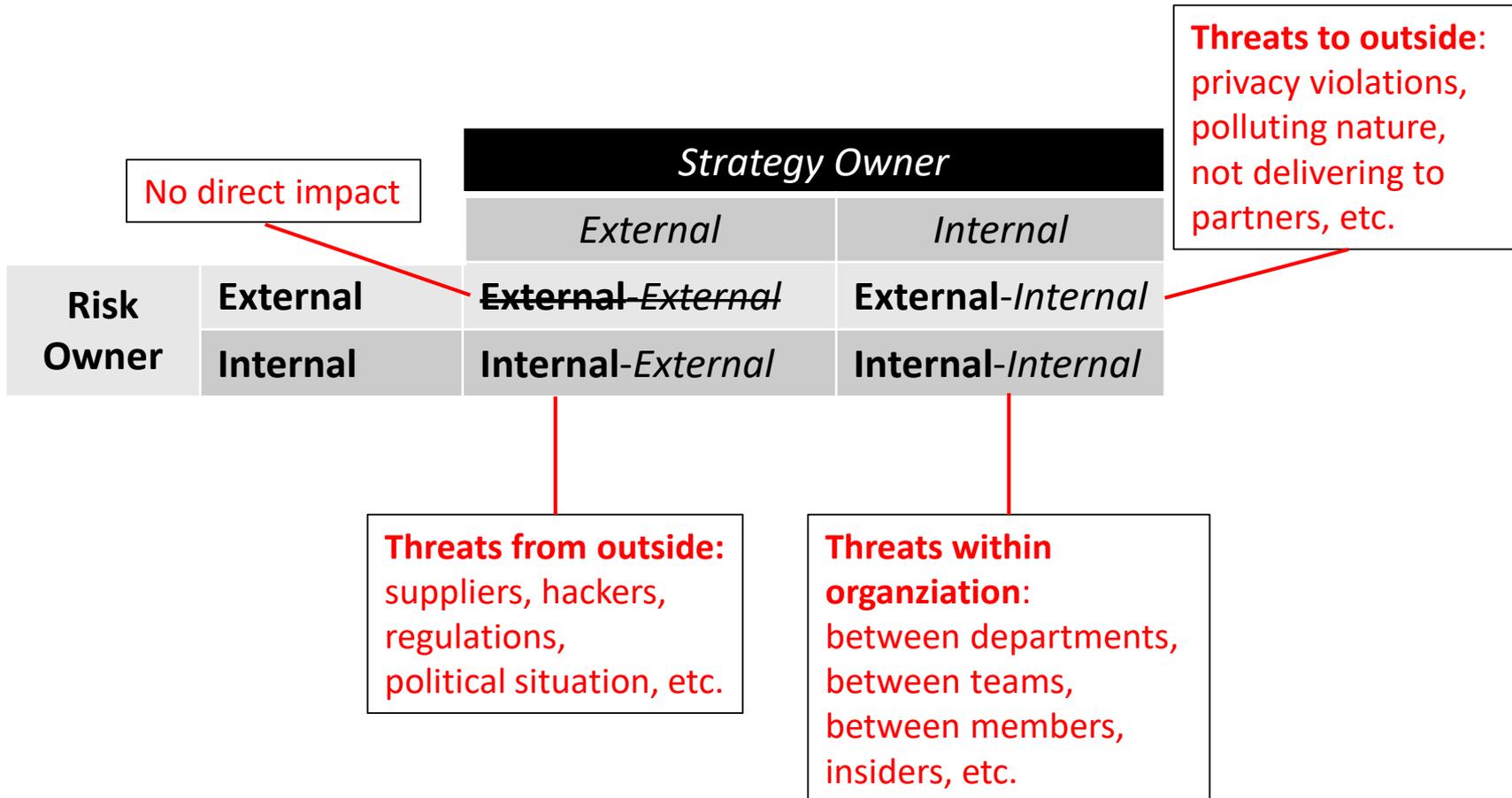
“Only those who risk going too far can possibly find out how far they can go.” T.S. Elliot

# Conflicting Incentives Risk Analysis (CIRA) method [Rajbhandari]



- Shift from traditional risk analysis methods
- Replacement of incident probability/likelihood estimations with strength of human motivation
- Risk is the result of misaligned incentives
- Does not rely on historical data

# CIRA stakeholder constellations



# Example: Internal Risk Owner – Internal Strategy Owner

**Facebook**

## Former Facebook executive: social media is ripping society apart

Chamath Palihapitiya, former vice-president of user growth, expressed regret for his part in building tools that destroy ‘the social fabric of how society works’

**Julia Carrie Wong** in San Francisco

@juliacarriew ✉ Email  
Tue 12 Dec 2017 18.58 GMT




47,889  
 This article is over 1 year old



▲ ‘It is eroding the core foundations of how people behave by and between each other,’ says the former Facebook executive Chamath Palihapitiya. Photograph: Toby Melville/Reuters

A former Facebook executive has said he feels “tremendous guilt” over his work on “tools that are ripping apart the social fabric of how society works”, joining a growing chorus of critics of the social media giant.

Importance of personal involvement and meaning!

# Internal RO – Internal SO



Risk owner

Name: Mark Zuckerberg  
Role: CEO

Key UFs



- |   |   |
|---|---|
| <p><b>Organizational (e.g. KPIs):</b></p> <ul style="list-style-type: none"> <li>- generate profit</li> <li>- rule the world</li> <li>- increase active user base</li> <li>- comply with regulations?</li> <li>...</li> </ul> | <p><b>Personal (e.g. values):</b></p> <ul style="list-style-type: none"> <li>- Achievement (high)</li> <li>- Power (high)</li> <li>- Universalism (high)</li> <li>- Security (low)</li> </ul> |
|---|---|



Strategy owner

Name: Chamath Palihapitiya  
Role: former vice-president of user growth

Key UFs



- |  |  |
|--|--|
| <p><b>Organizational (e.g. KPIs):</b></p> <ul style="list-style-type: none"> <li>- increase active user base</li> <li>- number of new users signing up</li> <li>- develop engaging services</li> </ul> | <p><b>Personal (e.g. values):</b></p> <ul style="list-style-type: none"> <li>- Universalism (high)</li> <li>- Tradition (high)</li> <li>- Power (low)</li> </ul> |
|--|--|

# Desirability of a strategy is a function of profile and contribution of action on the affected values



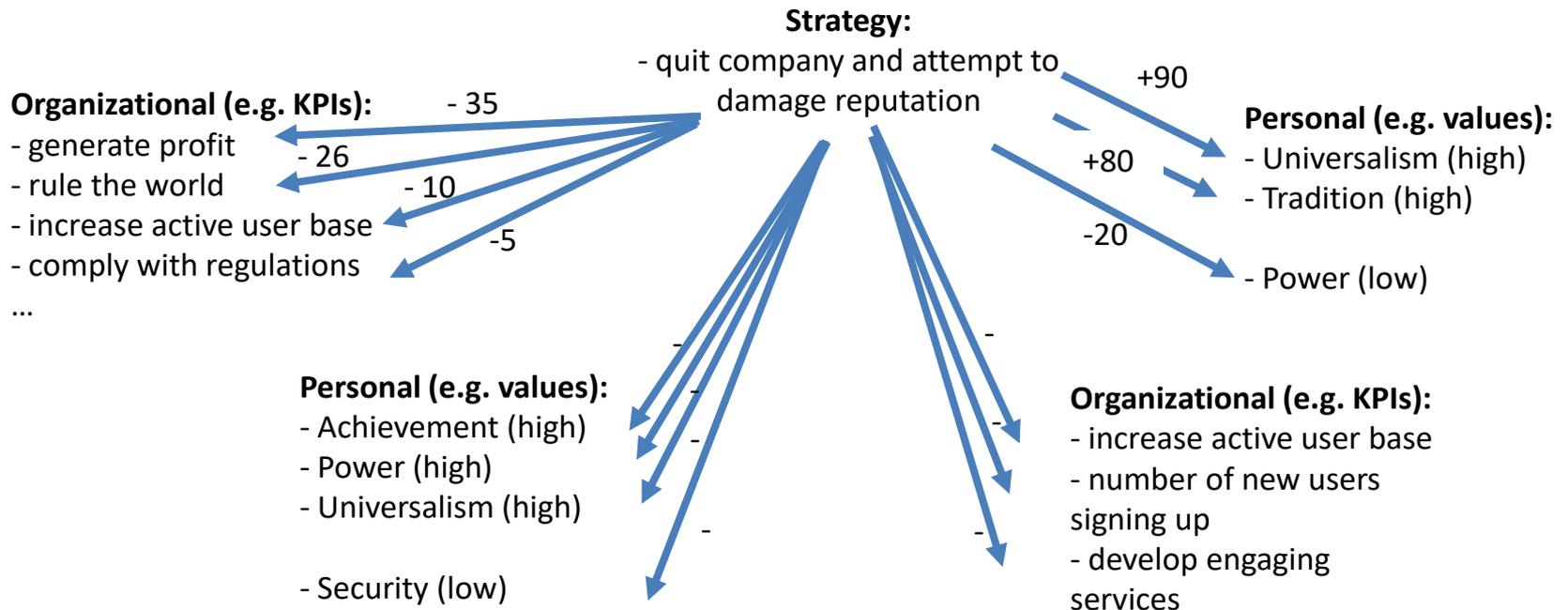
Risk owner

Name: Mark Zuckerberg  
Role: CEO



Strategy owner

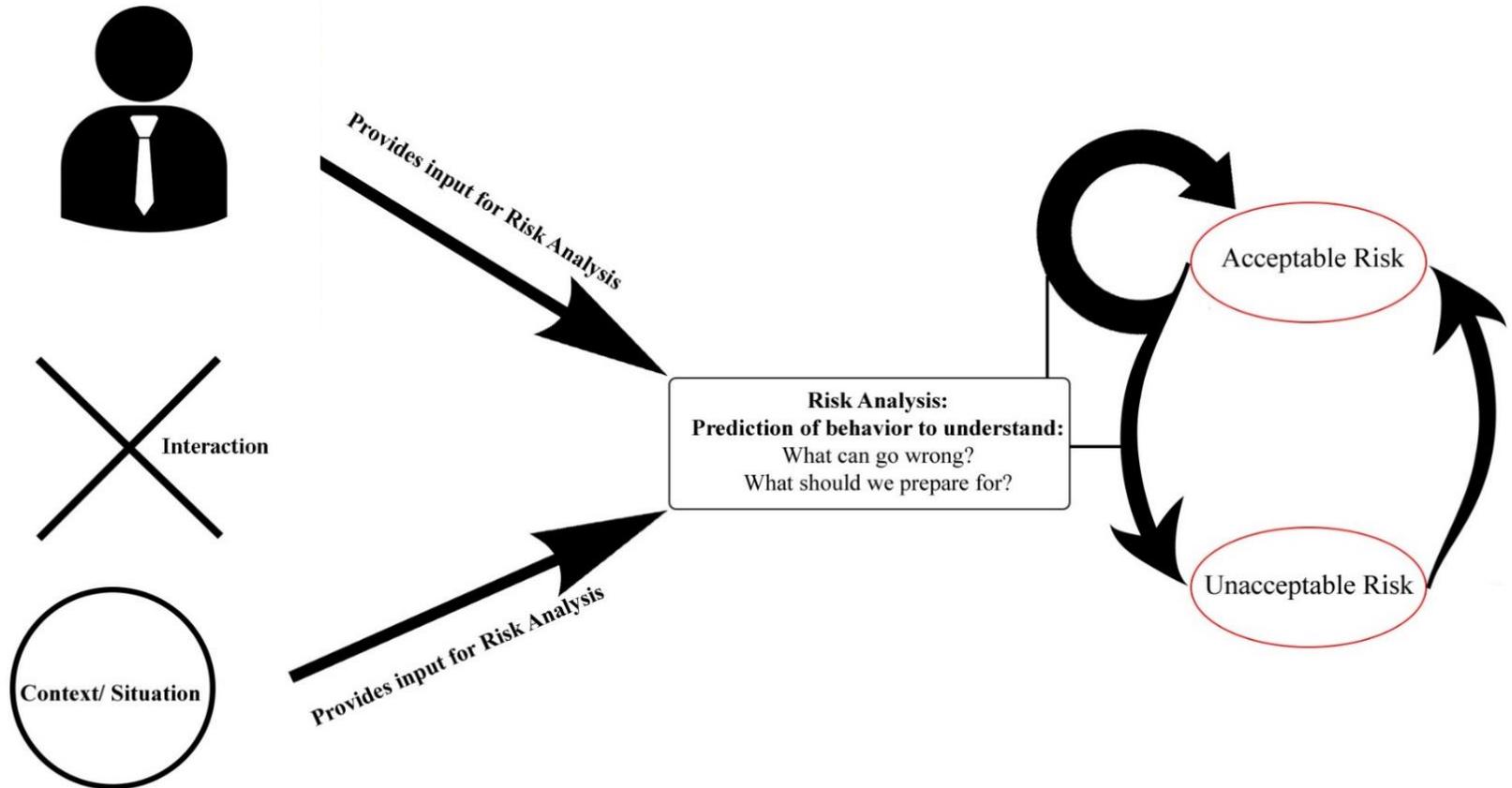
Name: Chamath Palihapitiya  
Role: former vice-president of user growth



# Problem statement

Is it possible to improve the **CIRA** method by using theories from psychology which enable the **prediction of future behavior** of key stakeholders, **without** relying on **reactive data collection methods**?

# Person-situation interaction



# Major assumption: no direct access to stakeholders

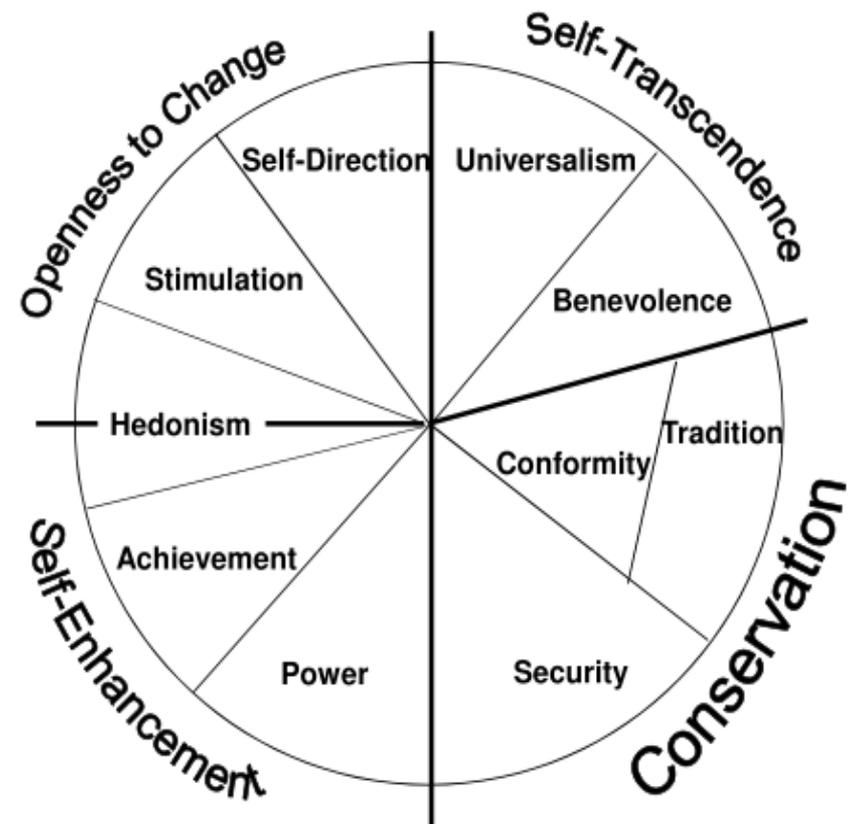
- Subject reactivity refers to (conscious/unconscious) modification of behavior due to the fact of being observed
- E.g. motivated self-misrepresentation, social desirability, non-cooperation, intrusive nature of Risk Analysis



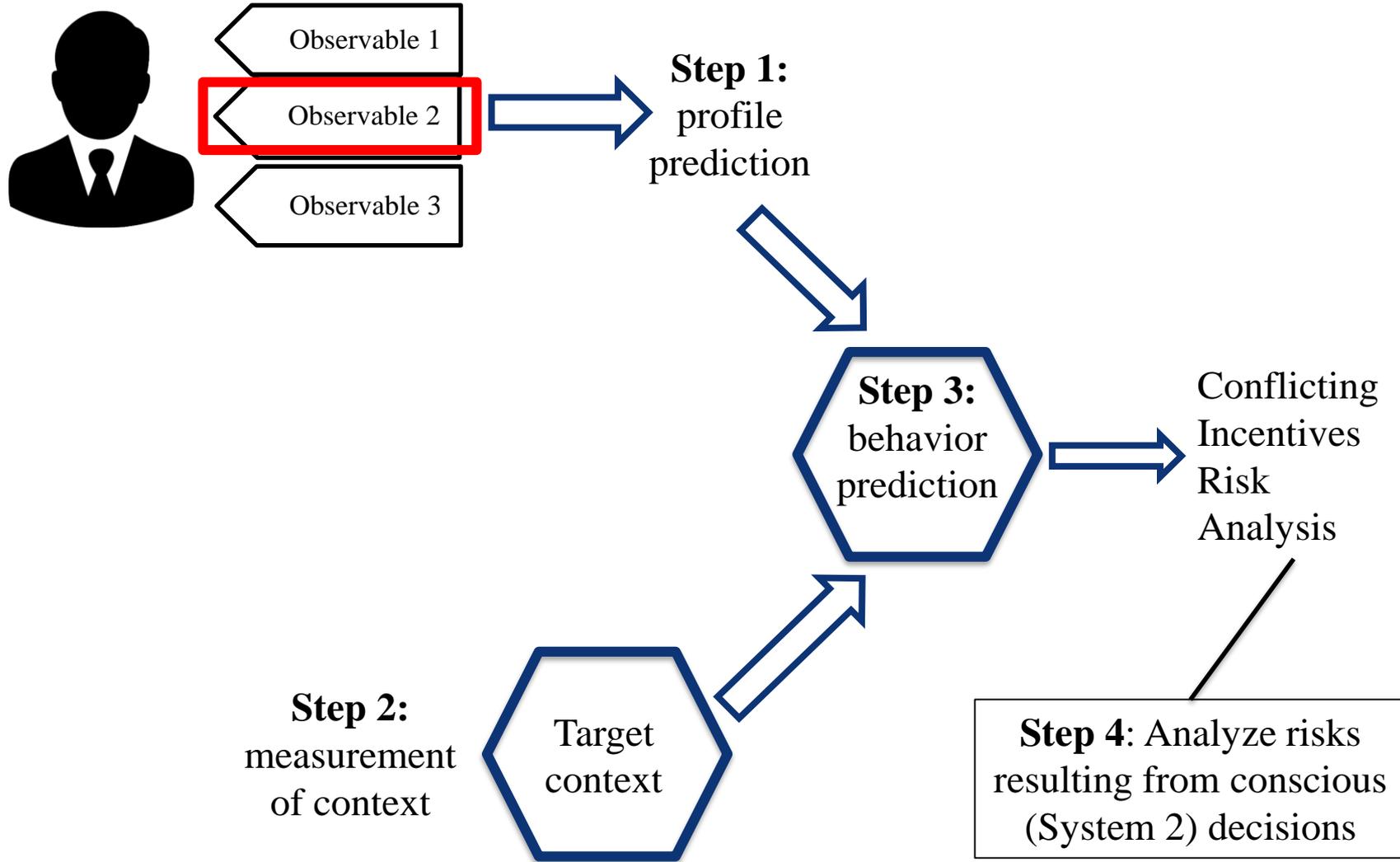
# Motivational profile – Basic Human Values [Schwartz]

## Values:

- Are relatively stable individual characteristics.
- Represent desirable end-goals and prescribe ways of acting.
- Transcend specific actions and situations.
- Are universally recognized.
- Are ordered by importance.
- The relative importance of values guides actions.
- That are closer to each other are more compatible, opposing values are in conflict.



# Scope of present work



## Research Questions [ValuePrediction]

**RQ 1:** To what extent can demographic features be utilized to construct stakeholder motivational profiles?

**RQ 2:** How well do different predictive models perform in terms of inferring stakeholder motivational profiles?

# Methods [ESS2018]

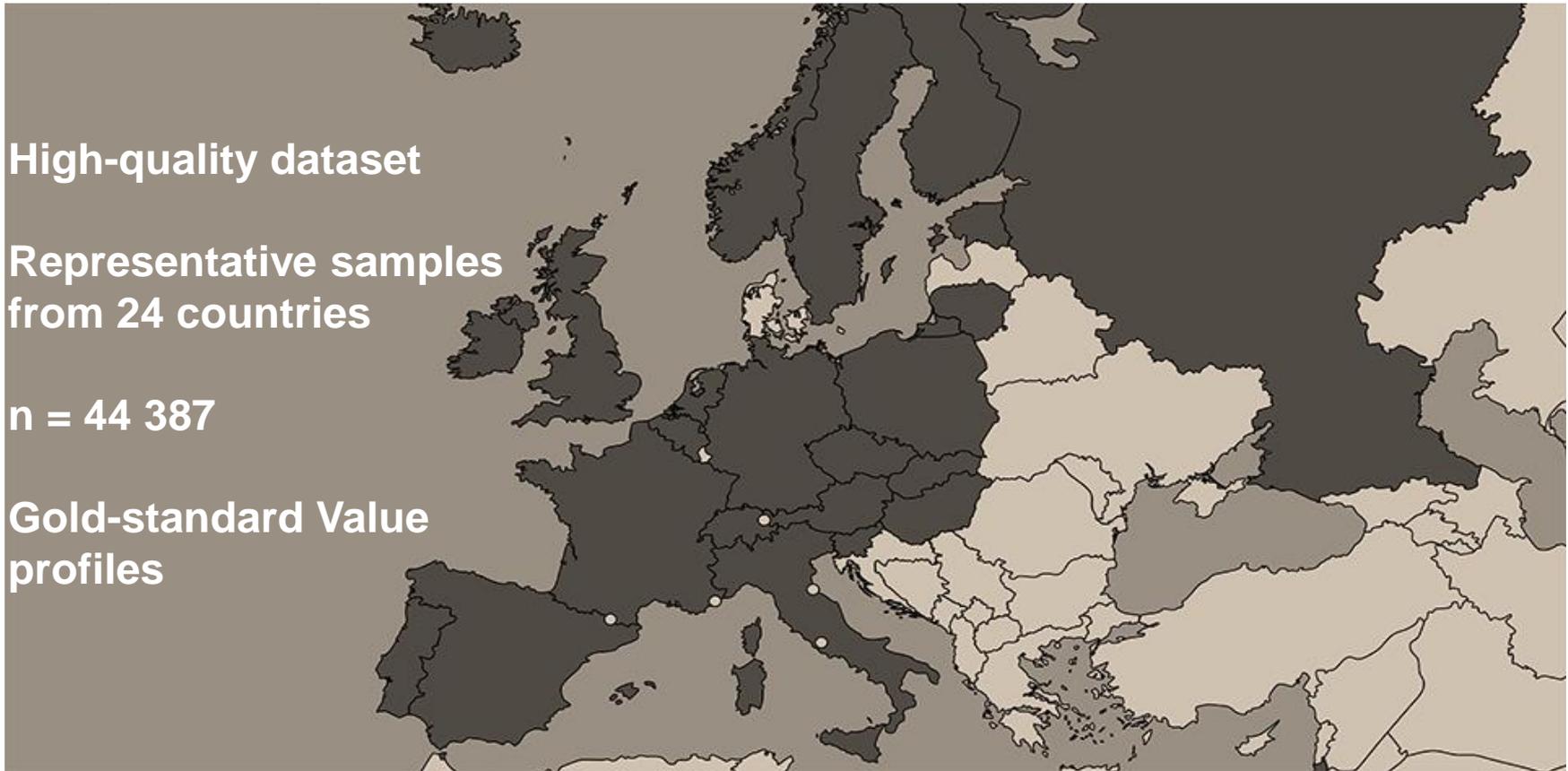


High-quality dataset

Representative samples  
from 24 countries

n = 44 387

Gold-standard Value  
profiles



# Methods

$N_{\text{variables}} = 536$ 
→
 selection of observables

	Categorical variable (Yes/No)	Number of categories
1. Country	Y	23
2. Gender	Y	2
3. Age	N	-
4. Domicile	Y	5
5. Belonging to religion	Y	2
6. Belonging to a minority ethnic group	Y	2
7. Number of people living in the same household	N	-
8. Living with partner	Y	2
9. Ever had a divorce	Y	2
10. Highest level of education	N	-
11. Employment relation	Y	3
12. Supervising others at work	Y	2
13. Type of industry working in (NACE rev.2)	Y	21
14. Type of organization working for	Y	6

# Methods

48.5% male, 51.5% female

Mean age: 50.41 years (SD = 17.55)

The database was randomized and divided into three sets:

- Training set: 60%
- Development set: 20%
- Testing set: 20%

*Multiple Linear Regression (LR) approach:*

- SPSS 25's automatic linear modeling module, supervised merging of the categories, outlier detection, and several feature-selection methods.

*Machine Learning (ML) approach:*

- H2O.ai API, open-source ML platform, Distributed Random Forest (DRF) algorithm, handling of categorical variables.

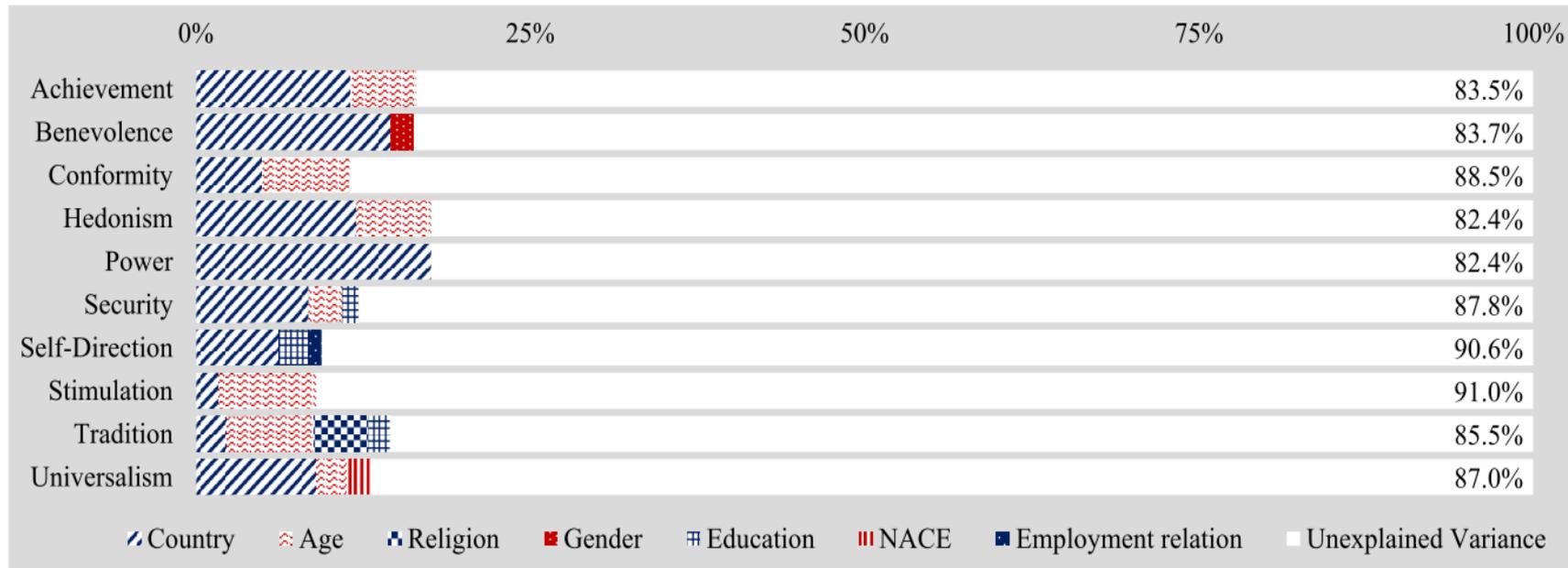
Performance metrics:

- $R^2$  (coefficient of determination) and  $RMSE$  (root-mean square error)

# Results 1 - LR approach

	Max possible $R^2$	Final $R^2$
Achievement	0.23	0.16 (2)
Benevolence	0.22	0.16 (2)
Conformity	0.17	0.11 (2)
Hedonism	0.22	0.18 (2)
Power	0.24	0.18 (1)
Security	0.20	0.12 (3)
Self-Direction	0.16	0.09 (3)
Stimulation	0.16	0.09 (2)
Tradition	0.24	0.14 (4)
Universalism	0.18	0.13 (3)

# Results 2 – LR approach, predictability of Basic Human Values

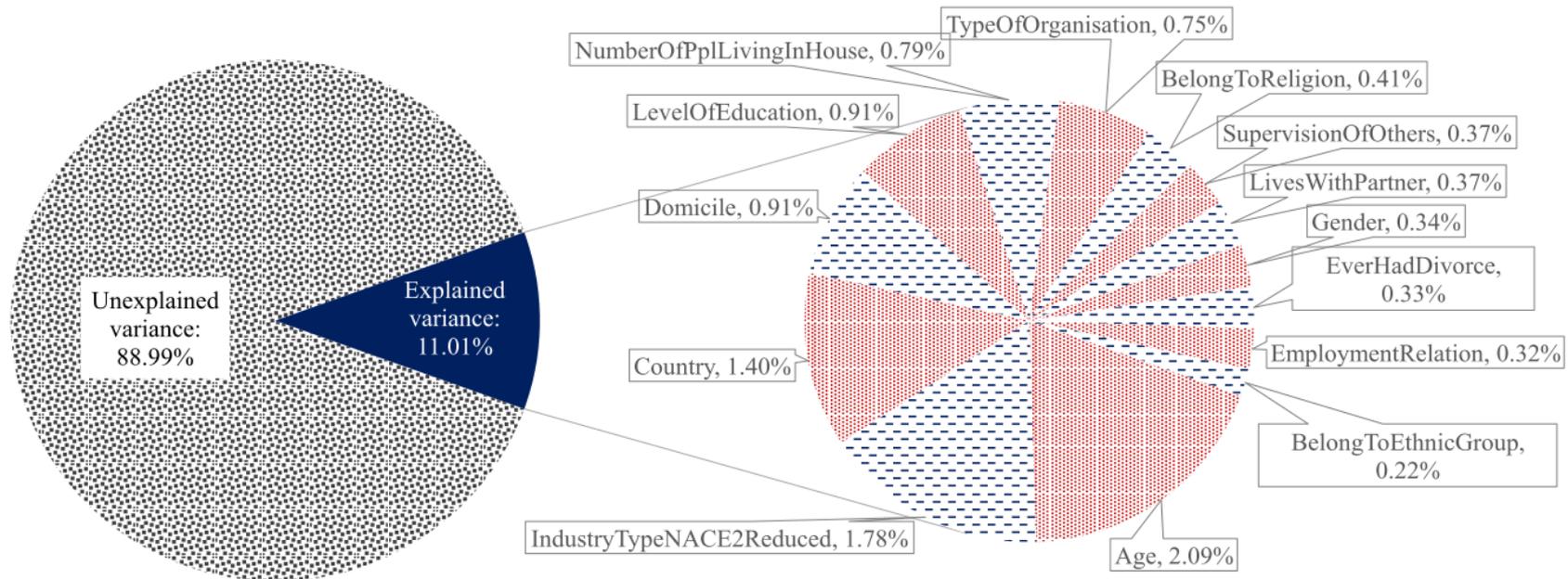


# Results 3 – ML approach

- 5-fold cross validation to obtain the final model of the training set, for all of the 10 models, 50 tree-solutions were selected

Dependent Variable	ML	MG	RG
Achievement	0.1282	0.1376	0.1393
Benevolence	0.0974	0.1046	0.1485
Conformity	0.1267	0.1328	0.1454
Hedonism	0.1056	0.1133	0.1134
Power	0.1195	0.1293	0.1293
Security	0.1134	0.1195	0.1515
Self-Direction	0.1146	0.1180	0.1303
Stimulation	0.1144	0.1182	0.1244
Tradition	0.1031	0.1100	0.1445
Universalism	0.1017	0.1081	0.1086

# Results 4 – ML approach: average contribution of features for predicting the Basic Human Value profile



# Results 5 – performance comparison between approaches

Dependent Variable	ML approach		LR approach	
	$R^2$	RMSE	$R^2$	RMSE
Achievement	0.13	0.128	0.16	0.127
Benevolence	0.14	0.097	0.16	0.095
Conformity	0.09	0.127	0.11	0.126
Hedonism	0.12	0.106	0.18	0.104
Power	0.15	0.120	0.18	0.118
Security	0.08	0.113	0.12	0.113
Self-Direction	0.07	0.115	0.09	0.113
Stimulation	0.08	0.114	0.09	0.114
Tradition	0.12	0.103	0.14	0.102
Universalism	0.11	0.102	0.13	0.101

# Conclusion

- **Demographic features have some limited utility for predicting motivational profiles**, which can be useful in situations where no other piece of information is available or direct access to subjects is impossible.
- **Most useful predictors:** Age, Country, Industry type.
- **ML** approach established that the models' performance is superior to random guessing, as well as educated guessing.
- **LR** approach achieves **slightly better performance**.
- Setting a solid **benchmarking baseline** for other classes of observables.

# References

[[Rajbhandari](#)] - Rajbhandari, L. and Snekkenes, E. (2013). Using the conflicting incentives risk analysis method. In IFIP International Information Security Conference, pages 315–329. Springer.

[[Schwartz](#)] - Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in experimental social psychology*, volume 25, pages 1–65. Elsevier.

[[RiskManagement](#)] – N.A. (2018). Developing an Information Technology Risk Management Program. Retrieved from <https://slideplayer.com/slide/13202369/>.

[[ValuePrediction](#)] - Adam Szekeres, & Pankaj Shivdayal Wasnik, & Einar Arthur Snekkenes. (2019). Using Demographic Features for the Prediction of Basic Human Values Underlying Stakeholder Motivation. Accepted for publication In 21<sup>st</sup> International Conference on Enterprise Information Systems (ICEIS).

[[ESS2018](#)] – N.A. (2018). European social survey round 8 data. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC.

**Thank you for your attention!**

