

VALUE CO-CREATION IN SMART CITIES



TECHNISCHE
UNIVERSITÄT
WIEN
Vienna | Austria

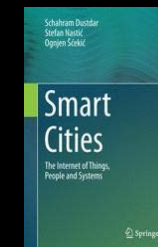


ABOUT ME

- Postdoctoral Research Assistant at Distributed Systems Group (DSG), TU Wien
- Co-founder and CEO of Reinvent
- Earned PhD degree from TU Wien in 2016
 - “Programming, Provisioning and Governing IoT Cloud Systems”
- Published about 30 scientific publications
- Currently helping to build Smart Cities
- Trying to find a balance between research and industry ...



DR. STEFAN NASTIC



Smart Cities: The Internet of Things, People and Systems

~ 10k downloads and copies sold

ABOUT REINVENT

IN A NUTSHELL

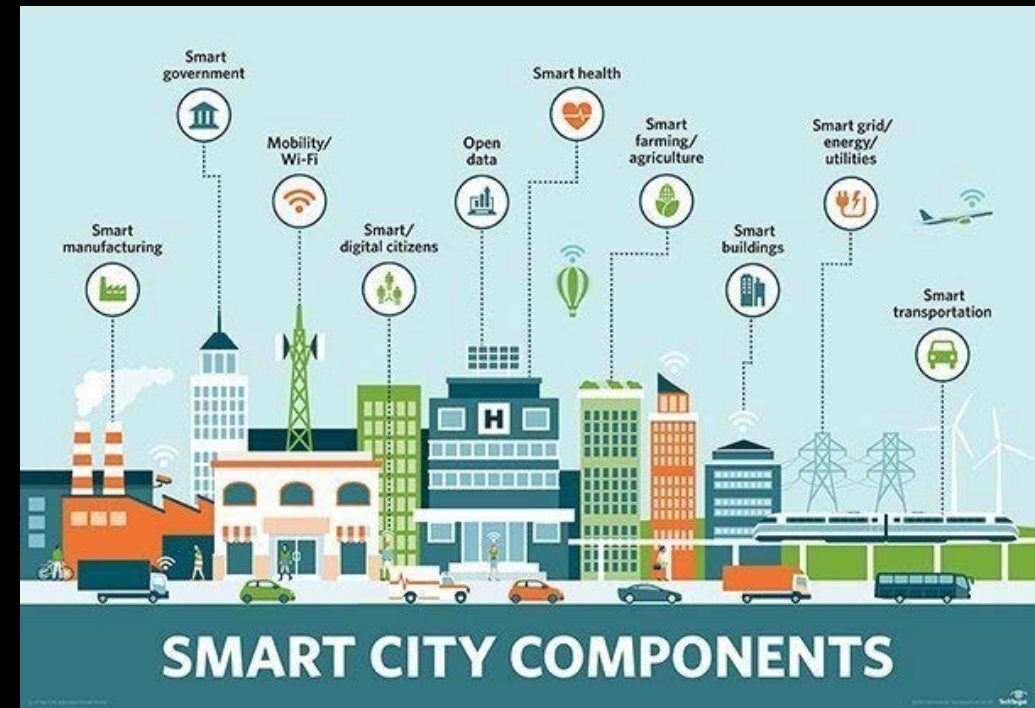
- Vienna University of Technology (TU Wien) spin-off
- Young and dynamic company founded by a group of researchers and software engineers
- Focus on expert IT consulting, development and innovation in GreenTech and Smart Cities

OUR MISSION

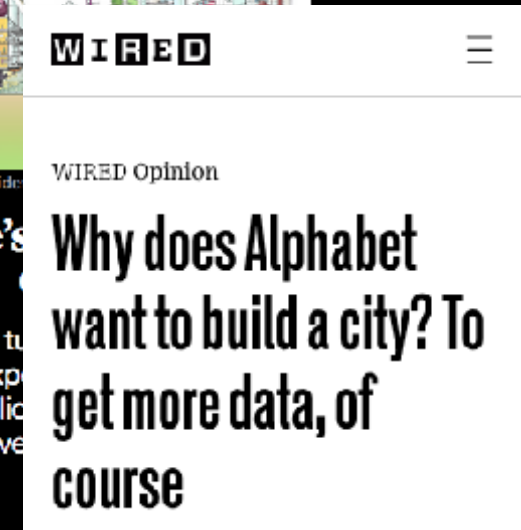
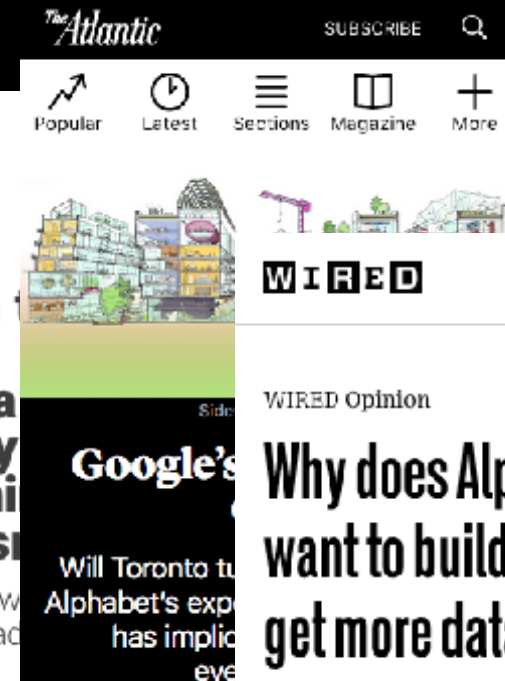
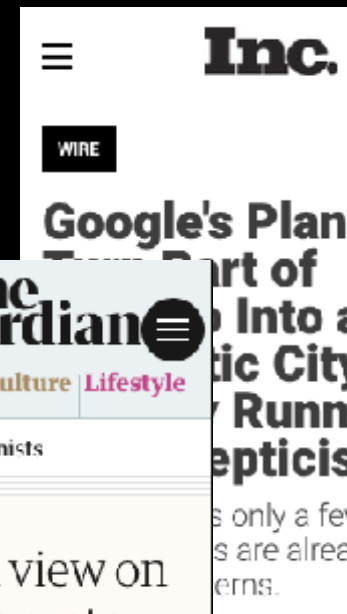
Bring a new perspective and innovative solutions to your problems!

SMART CITIES ON ONE SLIDE

- Really just a **playground** for a bunch of things?
 - Imagine any use case
 - Different business models
- Smart City is a **natural ecosystem** that can empower its inhabitants to create value and proactively shape their environment
- Bring out the **value of unique** in people
- Technology at the core of **Smart Cities infrastructure**:
 - IoT
 - Cloud Computing
 - Blockchain/DLT
 - ...



SMART CITIES & TECHNOLOGY



SMART CITIES & SHARING ECONOMY

THE RINGER

NBA DRAFT GUIDE WORLD CUP MORE

From Berlin
ruin our i

TECH

Airbnb

STREETSBLOG NYC

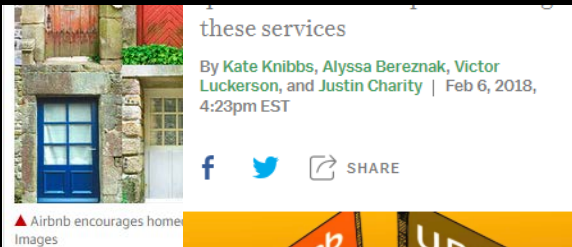
Walking / Bicycling / Transit / L Train Shutdown / Street Cheats / Calendar

It's Settled: Uber Is Making NYC Gridlock Worse

THE NEW REPUBLIC

MAGAZINE SUBSCRIBE

*Smart Cities are just a playground
for big guys...*



\$500 m
will soc
collect
compa



Graphic: Bruce Schaller

— BRIAN CHESKY, CEO OF AIRB
#DELETEUBER-TYPE CRISIS FO

Airbnb Will Probab
You Evicted and Pr
Out of the City

A banner reading "I
balcony in Barcelon
PAU BARREN/GETTY IMAGES

Running Sharing
for Everybody

The marketing lie behind
companies like Airbnb and Lyft

By NOAM SCHEIBER



DISTRIBUTED
SYSTEMS GROUP

REINVENT
we set perspective in motion

BIG CORPORATIONS COUNTRY ABOVE COUNTRIES

Local communities are systematically disrupted by corporations

The right of decision is being taken away from those who are affected the most

The value of individuals is exploited for the benefit of big corporations





SCIENTIFIC DISCOURSE

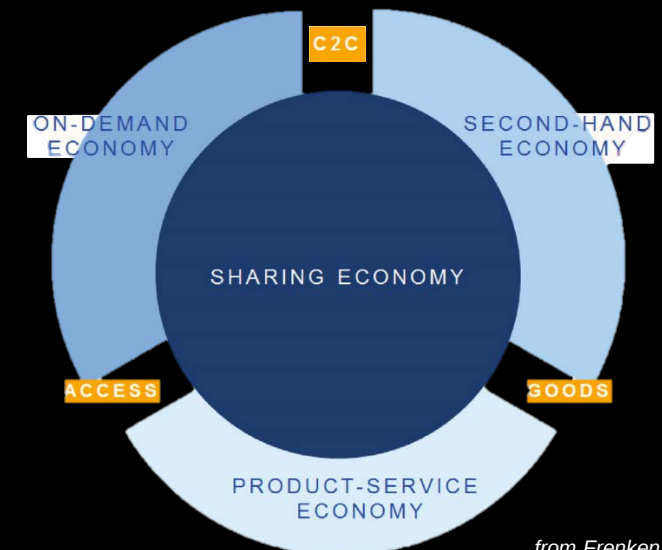
The (failed) promise of sharing economy

SHARING ECONOMY IN THEORY

- A revival of the basic economic concepts of **sharing**, **borrowing** and **exchange**
- Supported by advances in ICT:
 - increasing **numeric scalability** (number of possible interaction partners)
 - increasing **geographic scalability** (remote economic interactions)
 - acting as **trust** mediator
- Made it socially acceptable to enter business **interactions with unknown people** paving the way for a new revolution in global economy.

SHARING ECONOMY IN THEORY

- Definition:
Consumers granting each other **temporary** access to **under-utilized** physical assets (“idle capacity”), possibly for money. *[Frenken and Schor, 2017]*
- Blurring the limit between consumers and producers
⇒ **prosumers both create value**
- Near **zero marginal cost**
- The different facets of Sharing Economy



from Frenken et al., 2015

SHARING ECONOMY IN THEORY

- Why does it often fails in practice?
 - Centralization of trust for otherwise decentralized interactions
- How do we fix it?
 - Decentralization of trust (i.e., **trustless economic interactions**)
 - Direct interactions and **co-creation** among prosumers
 - **Ad-hoc value** determination

HOW DO WE FIX SMART CITIES

“CITIES HAVE THE CAPABILITY OF PROVIDING SOMETHING FOR EVERYBODY, ONLY BECAUSE, AND ONLY WHEN, THEY ARE CREATED BY EVERYBODY.”

Jane Jacobs

Author, urbanist and activist

THE POWER TO EMPOWER

Reinvent is building a Smart City platform that will enable a paradigm shift from value exploitation to community value co-creation

Replacing centralized authority with implicit, decentralized trust mechanisms based on Blockchain

Value
Contract

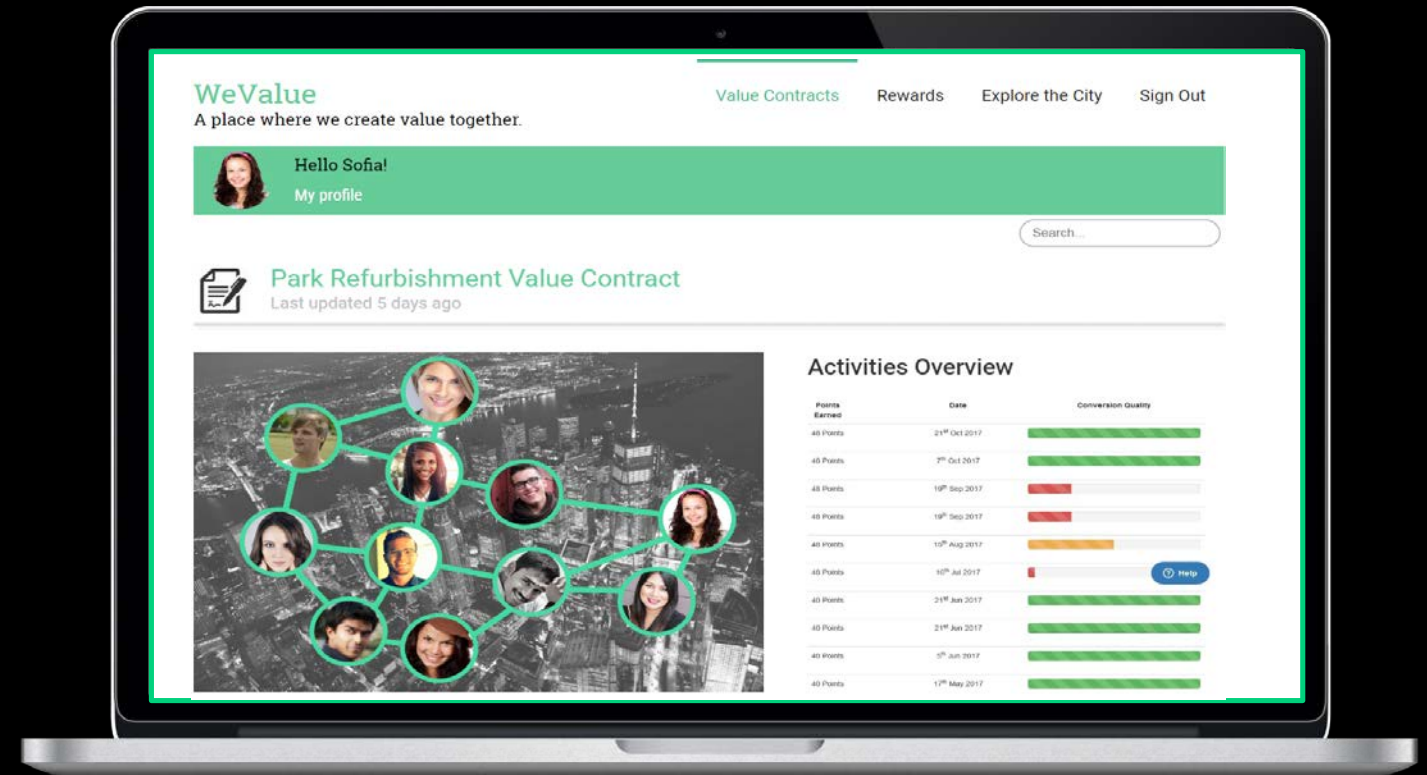
Valu

WEVALUE AT A GLANCE

A PLACE TO CREATE VALUE TOGETHER

WeValue platform offers
ValueContracts, which act as agents
on behalf of users in transforming
actions to rewards

WeValue enables direct and
unconstrained **co-creation** of and
trading in value



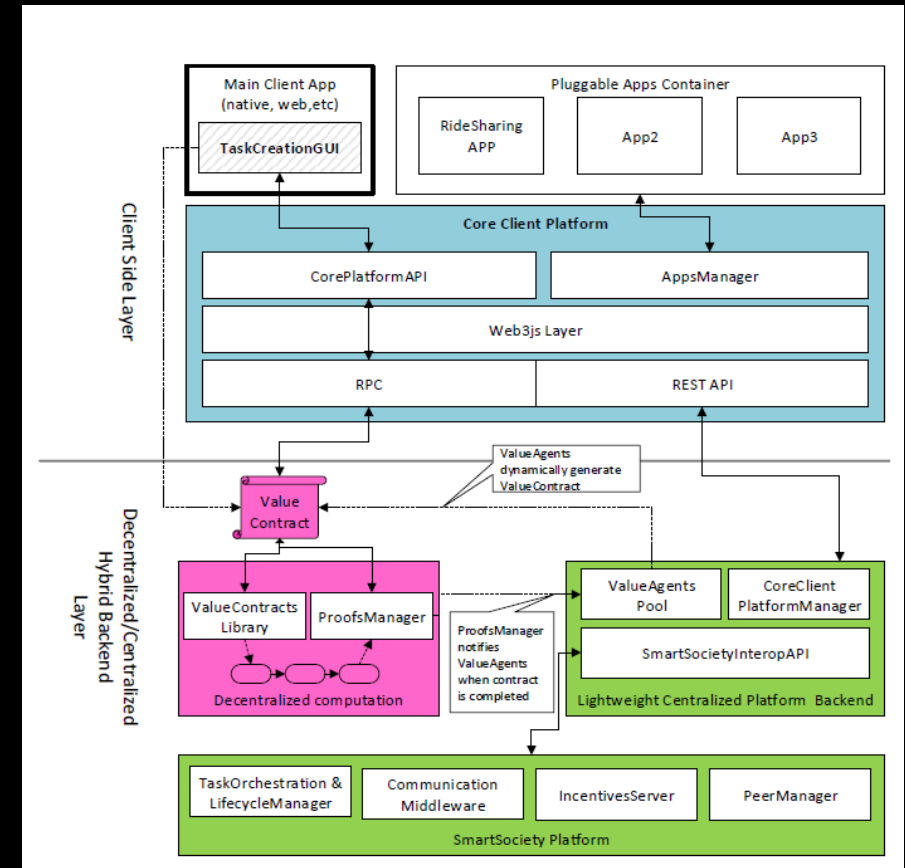
EXAMPLES

- Neighborhood-level co-creation activities:
 - Attract private funding
 - Diverting ad-placement funds into local, socially responsible brand awareness projects
 - Foster local economy
 - Increase local prosumption
 - Save resources
 - Competitions in energy savings
 - Optimize public/shared infrastructure
 - Local park redecoration
 - Redistributing “free floating” city bikes



WEVALUE ARCHITECTURE

- Decentralized computing platform:
 - Client app
 - Hybrid backend
- Decentralized 'trustless' computation vs. centralized authority
- Most important features
 - Matching and coordination algorithms
 - ValueContracts
 - Proof of value creation



MAIN CHALLENGES

1. Techniques for **automatic generation of Value Contracts**. Generally, there are inherent technical complexities related to developing Decentralized Applications.
2. Secondly, in order to make the platform suitable for a wider usage, **scalability** issues related to its decentralized (Blockchain-based backend) part need to be addressed.
3. Finally, probably the most important challenge is related to the **proof generation of value creation** in the Value Contracts.





SCIENTIFIC DISCOURSE

Byzantine generals, Maxwell Demons & Impossibilities

CONSENSUS IN DIST. SYS.

- The consensus problem is paradigm of agreement problems
- Distributed Systems Models:
 - Timing Models (Sync vs. Async)
 - IPC Model (Shared memory vs. Message passing)
 - Failure Modes (Crash-stop vs. Byzantine)
- Master (centralized, deterministic leader) consensus algorithms:
 - Paxos
 - Raft



FLP IMPOSSIBILITY

“The consensus problem involves an asynchronous system of processes, some of which may be unreliable. The problem is for the reliable processes to agree on a binary value. In this paper, it is shown that every protocol for this problem has the possibility of nontermination, even with only one faulty process.”

Choose two:

- safety (results are valid and identical at all nodes),
- liveness (nodes that don't fail always produce a result)
- fault tolerance (the system can survive the failure of one node at any point).

Master algorithm is an impossibility!

Impossibility of Distributed Consensus with One Faulty Process

MICHAEL J. FISCHER

Yale University, New Haven, Connecticut

NANCY A. LYNCH

Massachusetts Institute of Technology, Cambridge, Massachusetts

AND

MICHAEL S. PATERSON

University of Warwick, Coventry, England

Abstract. The consensus problem involves an asynchronous system of processes, some of which may be unreliable. The problem is for the reliable processes to agree on a binary value. In this paper, it is shown that every protocol for this problem has the possibility of nontermination, even with only one faulty process. By way of contrast, solutions are known for the synchronous case, the “Byzantine Generals” problem.

Categories and Subject Descriptors: C.2.2 [Computer-Communication Networks]: Network Protocols—protocol architecture; C.2.4 [Computer-Communication Networks]: Distributed Systems—distributed applications; distributed databases; network operating systems; C.4 [Performance of Systems]: Reliability, Availability, and Serviceability; F.1.2 [Computation by Abstract Devices]: Modes of Computation—parallelism; H.2.4 [Database Management]: Systems—distributed systems; transaction processing

General Terms: Algorithms, Reliability, Theory

Additional Key Words and Phrases: Agreement problem, asynchronous system, Byzantine Generals problem, commit problem, consensus problem, distributed computing, fault tolerance, impossibility proof, reliability

1. Introduction

The problem of reaching agreement among remote processes is one of the most fundamental problems in distributed computing and is at the core of many

Editing of this paper was performed by guest editor S. L. Graham. The Editor-in-Chief of JACM did not participate in the processing of the paper.

This work was supported in part by the Office of Naval Research under Contract N00014-82-K-0154, by the Office of Army Research under Contract DAAG29-79-C-0155, and by the National Science Foundation under Grants MCS-7924370 and MCS-8116678.

This work was originally presented at the 2nd ACM Symposium on Principles of Database Systems, March 1983.

Authors' present addresses: M. J. Fischer, Department of Computer Science, Yale University, P.O. Box 2158, Yale Station, New Haven, CT 06520; N. A. Lynch, Laboratory for Computer Science, Massachusetts Institute of Technology, 545 Technology Square, Cambridge, MA 02139; M. S. Paterson, Department of Computer Science, University of Warwick, Coventry CV4 7AL, England.

Permission to copy without fee all or part of this material is granted provided that the copies are not made or distributed for direct commercial advantage, the ACM copyright notice and the title of the publication and its date appear, and notice is given that copying is by permission of the Association for Computing Machinery. To copy otherwise, or to republish, requires a fee and/or specific permission.

© 1985 ACM 0004-5411/85/0400-0374 \$00.75

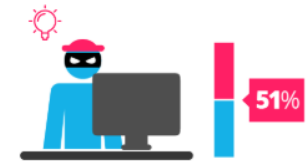
Journal of the Association for Computing Machinery, Vol. 32, No. 2, April 1985, pp. 374–382.

DLT & PROOF-OF-WORK

- High consensus (total order) implies low entropy
- The second law of thermodynamics: The entropy of total systems always tends to increase
- Master algorithm (ICT) = Maxwell's Demon (Physics)
 - None of them are possible!
- Proof of Work “consensus algorithm”
 - Dumping the extra entropy by doing work i.e. “wasting energy”



proof of work is a requirement to define an expensive computer calculation, also called mining



A reward is given to the first miner who solves each blocks problem.

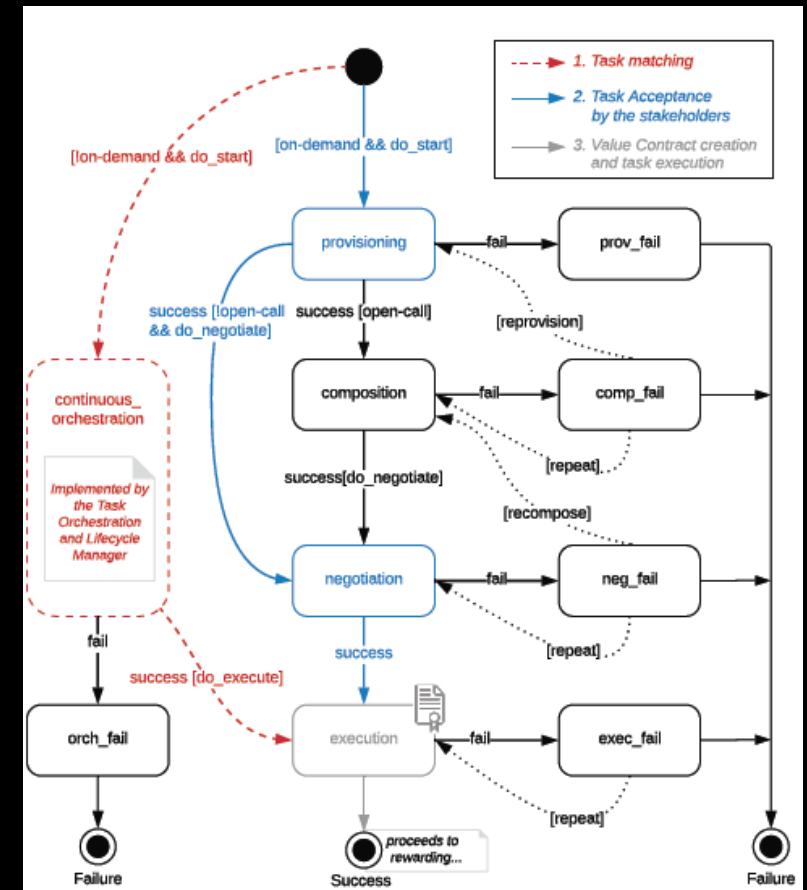


Network miners compete to be the first to find a solution for the mathematical problem

WEVALUE SOLUTIONS

ValueContracts generation and lifecycle management

- Matching phase:
 - A task is submitted to the platform and a corresponding Value Agent is created
 - All tasks in this state are subject to automated negotiation
- Task acceptance phase
- Execution phase:
 - ValueContract is permanently recorded on the Blockchain
 - They live and execute autonomously from this point on



WEVALUE SOLUTIONS

The key ingredients to achieve optimal proof of value creation

1. Off-chain Oracles
2. Sidechain settlements and Lightning networks
3. Alternative consensus mechanisms such as Proof-of-Authority



SUMMARY

- Smart Cities are not just a playground for big players
- Sharing economy has a great potential, but we need to do it right this time
- We need to remove the centralized authority and create a trustless environment
 - Value Contracts
- We need to enable an ecosystem for value co-creation and exchange
 - Contract Lifecycle Management
 - Proof of Value Creation
- DLT is one of the core enablers of Smart City infrastructure
- But still some challenges that need to be solved



Thank you for your attention!

Get in touch with us!

Web: www.reinvent-group.at

Email: snastic@reinvent-group.at

Twitter: [@ReinventGroup](https://twitter.com/ReinventGroup)