»Blockchain for Industrial Applications«

Trends, Challenges & Chances

"I guarantee you – Blockchain will play an important role in every company"

Achim Berg
President of Bitkom

"We don´t believe that traceability is the goal. We believe that transparency is the ultimate goal. Blockchain will give us the ability not only to track where food came from, but how it was produced."

Frank Yiannas
Vice President of Food Safety at Walmart

Start: March 2018
End: December 2018

Join the consortium to …

gain an understanding of the **technologies** behind the trend and learn to evaluate relevant **use cases:**

- Get an overview of **application fields outside of crypto-currencies** like healthcare, logistics, automotive, machine and plant engineering, pharmaceuticals, chemistry, etc.
- Identify **specific applications** that are relevant for your company like **fraud prevention, release of specific features** and **elimination of unwanted counterfeits**
- Evaluate the **technological and economical challenges** and **chances** behind the industry trend

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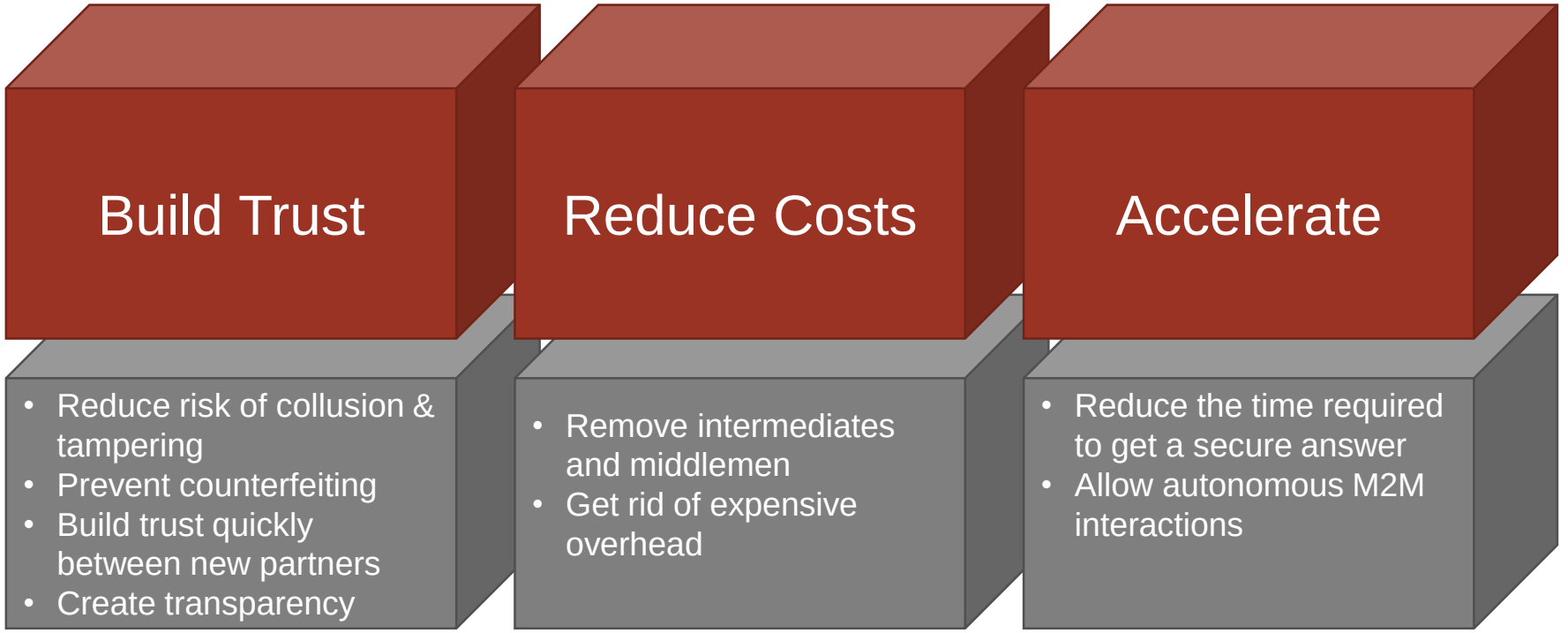
KEX. Knowledge Exchange® | Fraunhofer IPT | Fraunhofer FIT | Fraunhofer IML | DEMOFABRIK AACHEN | TIME Research Area Technology, Innovation, Marketing, Entrepreneurship | RWTH AACHEN UNIVERSITY | fir an der RWTH Aachen

Motivation

Initial Situation	**Distributed Ledger Technologies (Blockchain, Tangle, Smart Contracts…)** are told to be revolutionary - the “new internet” - which could **solve** current **issues related to digitalization and globalization**. Starting in the financial sector the hype spills over in multiple other industries, leading to many open questions: ▪ What are the **opportunities** behind this technology and what are new fields of application? ▪ What are the potential **implications** for my markets, sector, business unit and team? ▪ What are the **challenges** of relevant and developing technologies?
Procedure	▪ Starting point is an **overview** and **SWOT** analysis to create a **general understanding** of the technologies and their potential impact on selected application fields ▪ **Best practice applications**, **high potential applications based on partner needs** and **research applications** will be structured and offered for further evaluation ▪ Based on your vote, a **deep dive on technological and economic aspects** will be executed for selected applications
Major Outcome for Participants	➔ Understanding the concepts of blockchain technologies and the implications for your business ➔ A detailed overview of current and future blockchain and tangle applications, underlying enabling technologies, software tools and enabling partners ➔ Technological and economical evaluation of potential implementation of selected cases ➔ Access to a large cross-industrial & interdisciplinary partner network

Potential of Blockchain / Tangle Usage



Source: IBM Watson ioT

Potential Focus Areas

Smart Production

Production
Data Handling

Supply Chain
& Logistics

…

Smart Products

Product
Transparency

Product Data
Handling

…

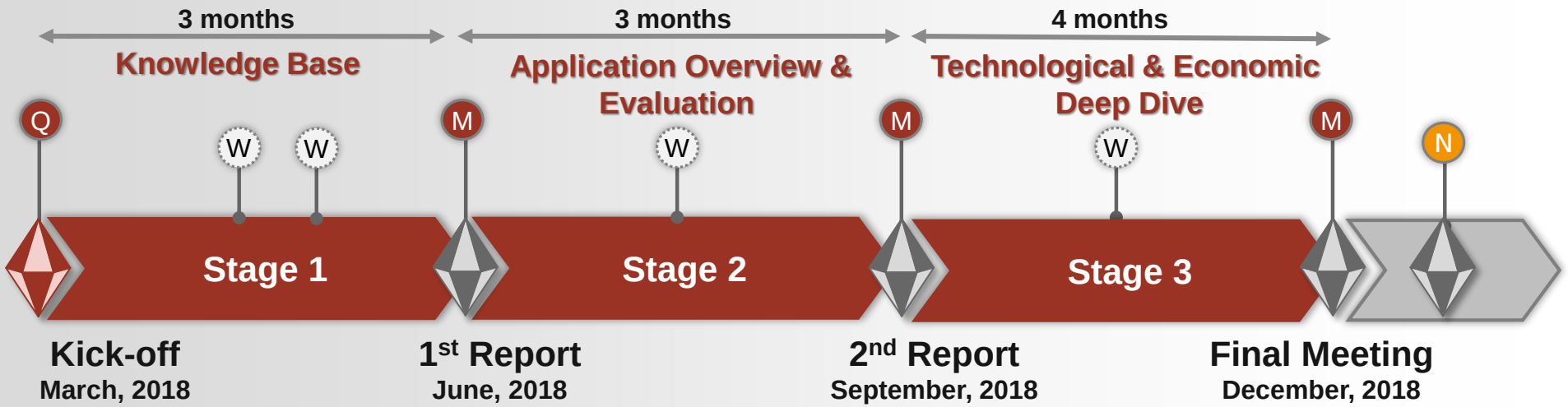
Smart Processes

Smart
Services

Collaboration
Platforms

…

Project Structure & Timeline



Stage 1 Content:

- Development of a **structured and detailed knowledge base**
- Internal and external **expert input** regarding different underlying technologies like **blockchains** and **tangle**
- **Segmentation** of different application fields and target markets

➔ *Information for **a common understanding and profound basis***

Stage 2 Content:

- Assessment of most relevant **use cases, best practices and research activities** within the derived segments
- **Technical** and **economic** evaluation in terms of short fact sheets
- Assessment of **potential collaboration partners &** solution providers

➔ *Information basis for selection of **relevant detail cases***

Stage 3 Content:

- **In depth technological or economic analysis** of defined use cases according to the partners needs
  - Technological **implementation**, to develop a **roadmap** and define stage gates
  - Assessment of potential **added value, costs for implementation or business model generation**

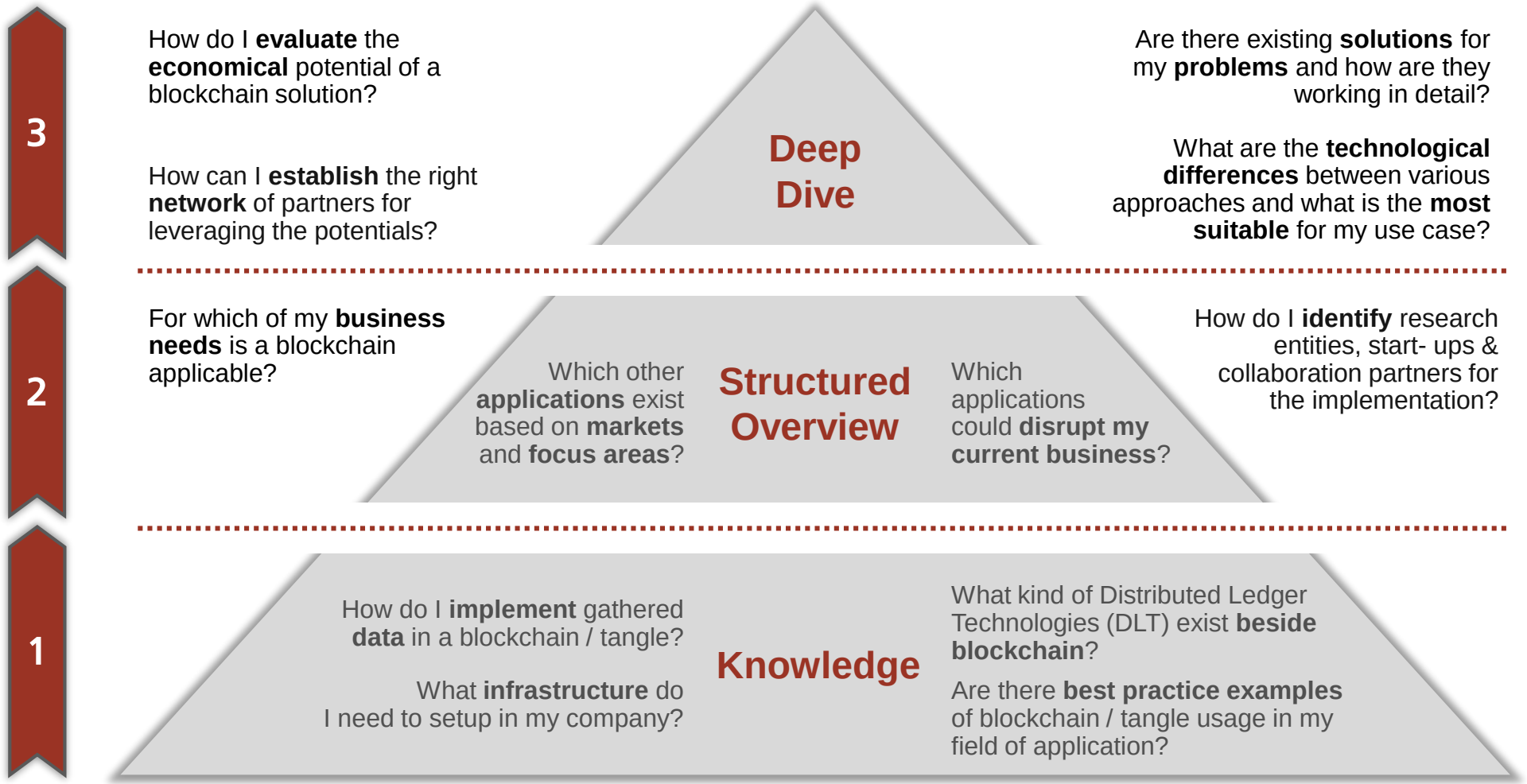
➔ *Information basis for subsequent partner-specific **roadmaps/decisions** concerning the initiation of specific **monitoring, demonstration or implementation projects***

Q **Questionnaire**

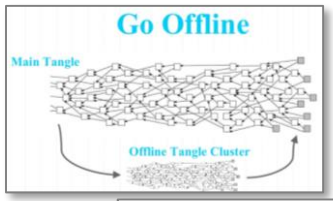
M **Consortium meeting**

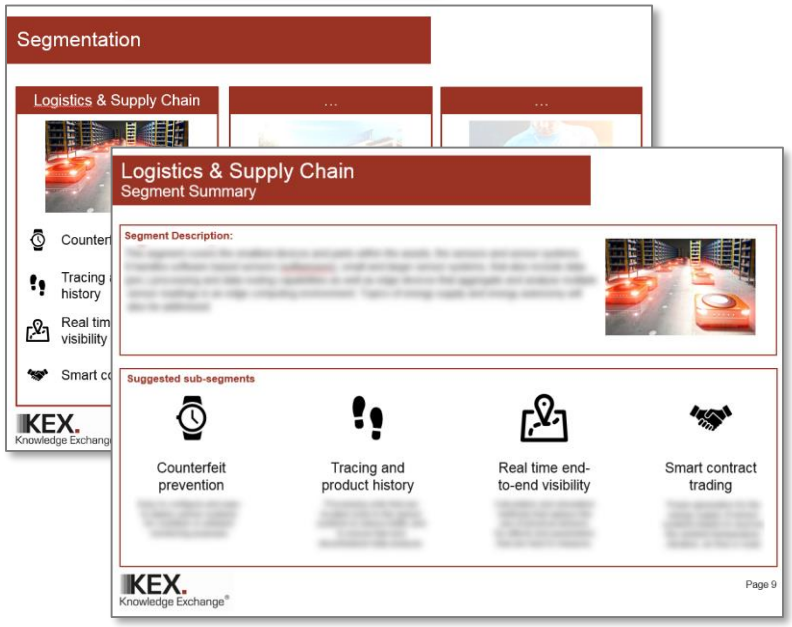
W **Optional workshops with partners/experts**

Project Framework



Exemplary Proceeding & Results
Stage 1: Segmentation & Knowledge Base





Knowledge Base

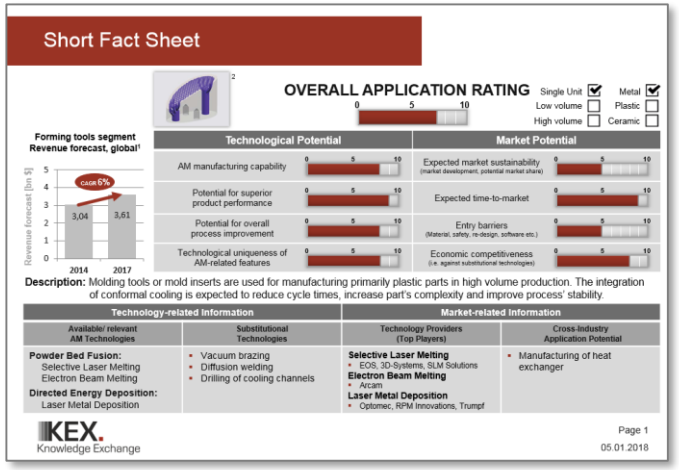
- Build up **background knowledge** regarding **blockchain-based** or **blockless** systems like directed acyclic graph/ tangle and **hybrid systems**
- Understand the differences and advantages of different distributed **consensus methods** like proof of work, burn, capacity, stake, activity, etc.
- Generate a common **understanding** & **discuss relevant issues** with the consortium partners

Segmentation

- **Structured overview** of branches where the different technologies could be beneficial
- Possible **fields of application and general concepts** like smart contracts, “long data”, trace (food) contamination, verification of software updates, etc.

➔ *Consortium votes for the most relevant segments based on partners’ needs and interests. Applications dedicated to these selected segments will be assessed in Stage 2.*

Exemplary Proceeding & Results
Stage 2: Application Short Fact Sheets


Short Fact Sheet

OVERALL APPLICATION RATING

Single Unit / Low volume / High volume — Metal / Plastic / Ceramic

Forming tools segment
Revenue forecast, global¹

Revenue forecast [bn $]

CAGR 6%

3,04 (2014) 3,61 (2017)

Technological Potential	Market Potential
AM manufacturing capability	Expected market sustainability (market development, potential market share)
Potential for superior product performance	Expected time-to-market
Potential for overall process improvement	Entry barriers (Material, safety, re-design, software etc.)
Technological uniqueness of AM-related features	Economic competitiveness (i.e. against substitutional technologies)

Description: Molding tools or mold inserts are used for manufacturing primarily plastic parts in high volume production. The integration of conformal cooling is expected to reduce cycle times, increase part's complexity and improve process' stability.

Technology-related Information		Market-related Information	
Available/ relevant AM Technologies	Substitutional Technologies	Technology Providers (Top Players)	Cross-Industry Application Potential
Powder Bed Fusion: Selective Laser Melting, Electron Beam Melting **Directed Energy Deposition:** Laser Metal Deposition	Vacuum brazing Diffusion welding Drilling of cooling channels	**Selective Laser Melting:** EOS, 3D-Systems, SLM Solutions **Electron Beam Melting:** Arcam **Laser Metal Deposition:** Optomec, RPM Innovations, Trumpf	Manufacturing of heat exchanger

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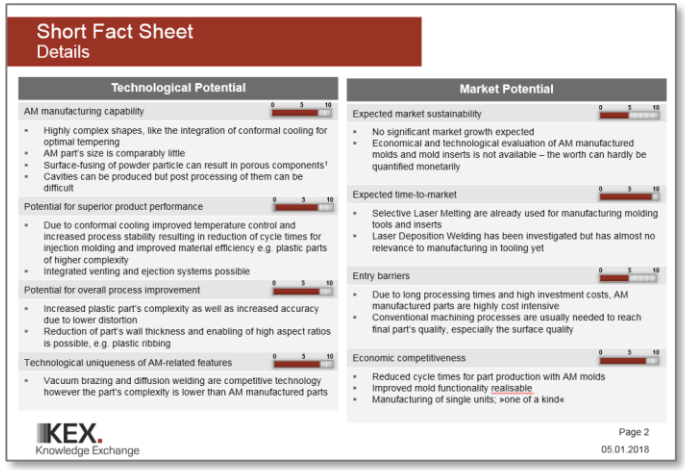
Short Fact Sheet
Details

Technological Potential

AM manufacturing capability
- Highly complex shapes, like the integration of conformal cooling for optimal tempering
- AM part's size is comparably little
- Surface-fusing of powder particle can result in porous components¹
- Cavities can be produced but post processing of them can be difficult

Potential for superior product performance
- Due to conformal cooling improved temperature control and increased process stability resulting in reduction of cycle times for injection molding and improved material efficiency e.g. plastic parts of higher complexity
- Integrated venting and ejection systems possible

Potential for overall process improvement
- Increased plastic part's complexity as well as increased accuracy due to lower distortion
- Reduction of part's wall thickness and enabling of high aspect ratios is possible, e.g. plastic ribbing

Technological uniqueness of AM-related features
- Vacuum brazing and diffusion welding are competitive technology however the part's complexity is lower than AM manufactured parts

Market Potential

Expected market sustainability
- No significant market growth expected
- Economical and technological evaluation of AM manufactured molds and mold inserts is not available – the worth can hardly be quantified monetarily

Expected time-to-market
- Selective Laser Melting are already used for manufacturing molding tools and inserts
- Laser Deposition Welding has been investigated but has almost no relevance to manufacturing in tooling yet

Entry barriers
- Due to long processing times and high investment costs, AM manufactured parts are highly cost intensive
- Conventional machining processes are usually needed to reach final part's quality, especially the surface quality

Economic competitiveness
- Reduced cycle times for part production with AM molds
- Improved mold functionality realisable
- Manufacturing of single units; »one of a kind«

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*Exemplary extract of short fact sheet

Technology & Market Analysis

- Scouting for **relevant** blockchain **applications**, already **in use or under research** within the selected focused areas
- **Structured overview** of best practices, concepts and solutions that are already in use or under development
- Analysis of the application on a **technical** level:
  - What type of **distributed ledger technology** (e.g. Blockchain)**, consensus mechanism** (e.g. proof of work), etc. is used and why?
- Assessment of the **market** potential:
  - What is the market potential or are there possible synergetic uses?
- Identification of **cooperation partners** like suppliers, key researchers or business partners
- Identification and **discussion of challenges** to cope with, as basis to define a **roadmap**

➔ *Consortium votes for blockchain applications to be further deeply evaluated in Stage 3*

Exemplary Proceeding & Results
Stage 3: Technology or Business Case

1 2 3

*Exemplary extract of technology case

Technology Case

- In depth **technological assessment** of different concepts their advantages & challenges regarding the specific application
- **Implementation or development roadmap** to define stage gates and i**dentify key players** to talk to
- In depth analysis of a possible example use case **from development to roll out**

Business Case

- Evaluation of a possible business case regarding **implementation costs and ROI**
- **Comparison** of different solutions and concepts **regarding their technological and market potential**
- **Overview and suggestion** regarding possible development **strategies** within the defined scenario like wait and buy up or becoming an innovation leader
- Assessment of potential new **Business Models**

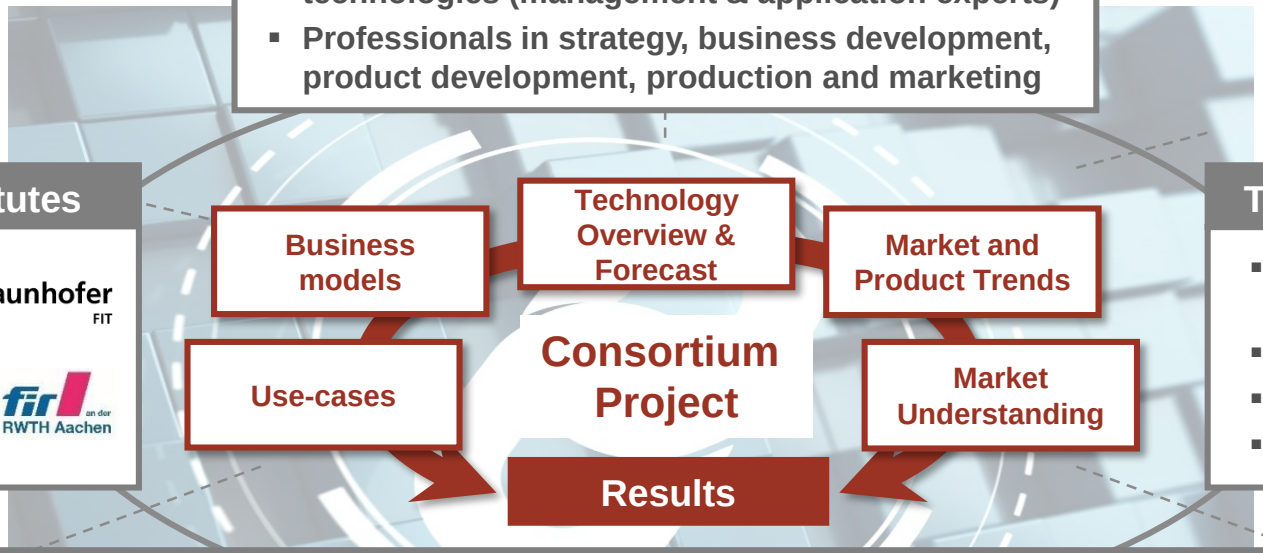
Consortium Structure

Consortial Partners

- Representatives of companies in industries potentially affected by blockchain related technologies (management & application experts)
- Professionals in strategy, business development, product development, production and marketing

Research Institutes

Fraunhofer IPT
Fraunhofer FIT
Research Area Technology, Innovation, Marketing, Entrepreneurship
RWTH AACHEN UNIVERSITY
fir an der RWTH Aachen



Technology Providers

- Software, platform and ICT providers
- Smart Data providers
- System integrators
- Start-Up ecosystems

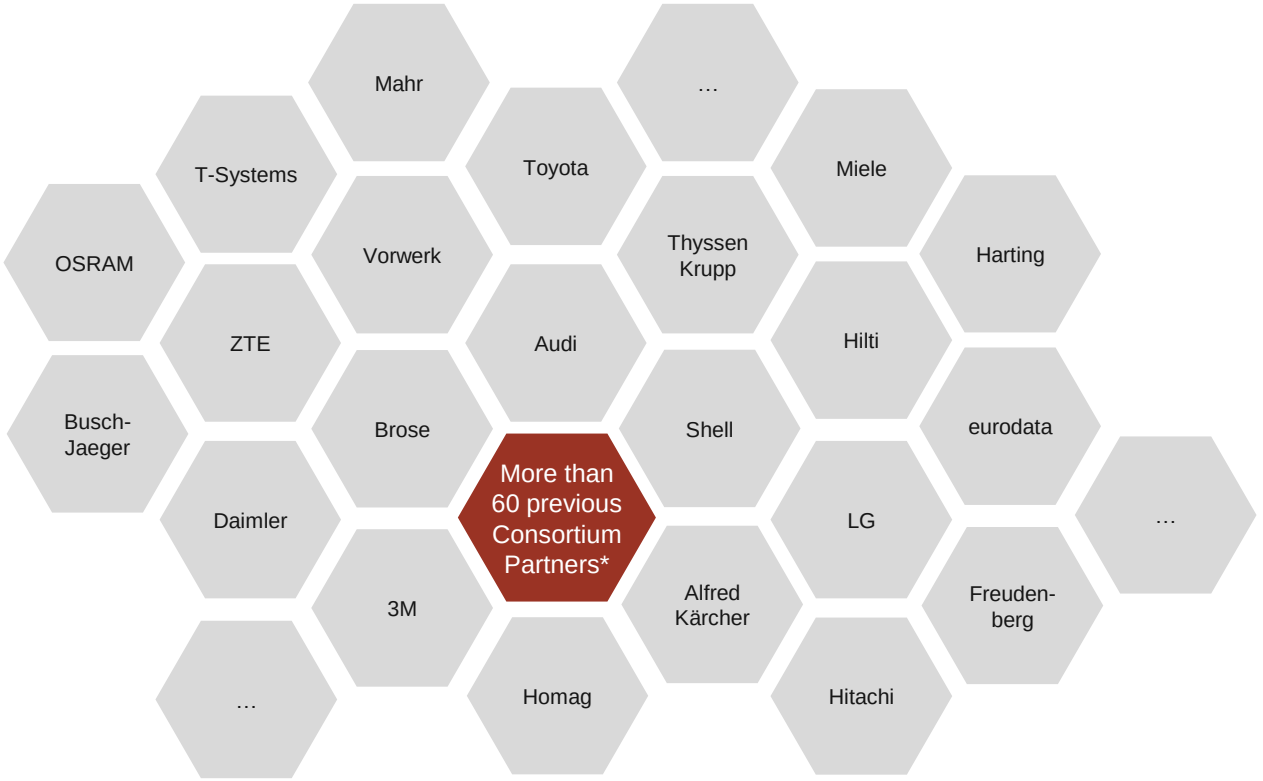
Interdisciplinary Consortium

- Approx. 20 consortium partners
- € 25,000 per partner
- 10 month duration (Mar ‘18 to Dec ‘18)
- Worldwide scope
- Kick-off and two interim meetings
- Final presentation and report

Project References

Consortial Project Framework:

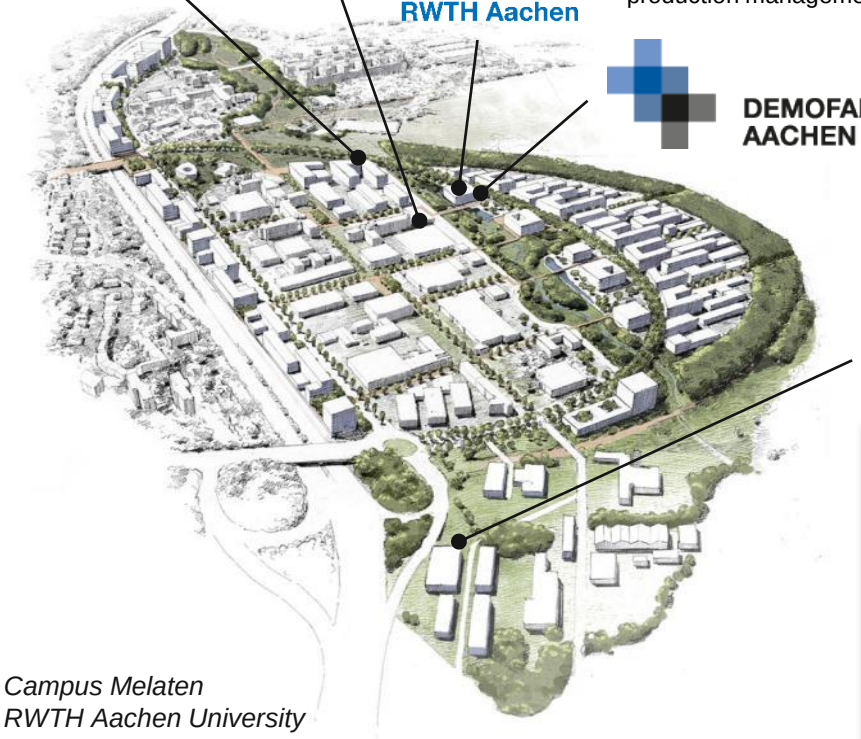
- **Result generation by research partners** (TIME Chair RWTH, FIR, Fraunhofer IPT & FIT)
- **Face-to-face results presentation** and **discussion** with industrial consortial partners
- Moderated **cross-industrial workshops** and **expert key note speeches**
- **Networking** with a **cross-industrial consortium** and **highly relevant research entities**



*amongst others all mentioned companies were partners of a former consortium project hosted by KEX AG and its research partners

Your Contacts
A Powerful Team in Technology Research

Expert Network in Aachen:



Campus Melaten
RWTH Aachen University

Fraunhofer IPT
Knowledge and experience in all fields of production technology for developing and optimizing solutions for modern production facilities

FIR - Institute for Industrial Management at RWTH Aachen
Industry-oriented research in the areas service, information and production management

Demonstration Factory Aachen
Application, exploration and further development of Industrie 4.0 solutions with industrial and research partners

TIME Chair RWTH Aachen
Technology and innovation management, business model innovation

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Additional Experts:

Fraunhofer FIT
For about 30 years now Fraunhofer FIT has been conducting R&D on user-friendly smart solutions that blend seamlessly in business processes

Fraunhofer IML
Founded in 1981 with 260 employees is said to be first address for all questions with respect to holistic logistics