The impact of IoT on construction

Webinar

Munich, July 06, 2021

Rise of IoT is driving data availability and interconnectivity along the whole construction value chain

End-to-end value chain of the construction industry and role of IoT

Construction value chain	Production 1	Distribution 2	Construction 3	Facility management 4
				
IoT use cases	> Control sensors checking for optimizing production efficiency and effectiveness > Smart devices checking material for cracks, moisture etc.	> Transmitters sending information about the goods (installation, usage, etc.) > GPS trackers within transportation machinery	> Interlinking people, machines and tools at the construction site (e.g. BIM) > Construction control sensors (e.g. humidity)	> Sensors, smart meters and smart (connected) devices in building > Tags (e.g. QR codes) providing entire good's history
Effects (examples)	> Diminished downtimes, less production rejects (monitoring while producing) > Enhanced quality density and hence lowered material complaints	> Advanced offering of tailored products/ prices/ delivery dates > Increased routing efficiency and capacity usage	> Improved error identification process > Superior building structures > Increased prevention of accidents and other reasons for downtimes (e.g. fire)	> Simplified identification of recycling/ reuse opportunities and predictive maintenance > Improved efficiency of energy consumption due to automated control of devices
Estimated importance of segment for IoT				

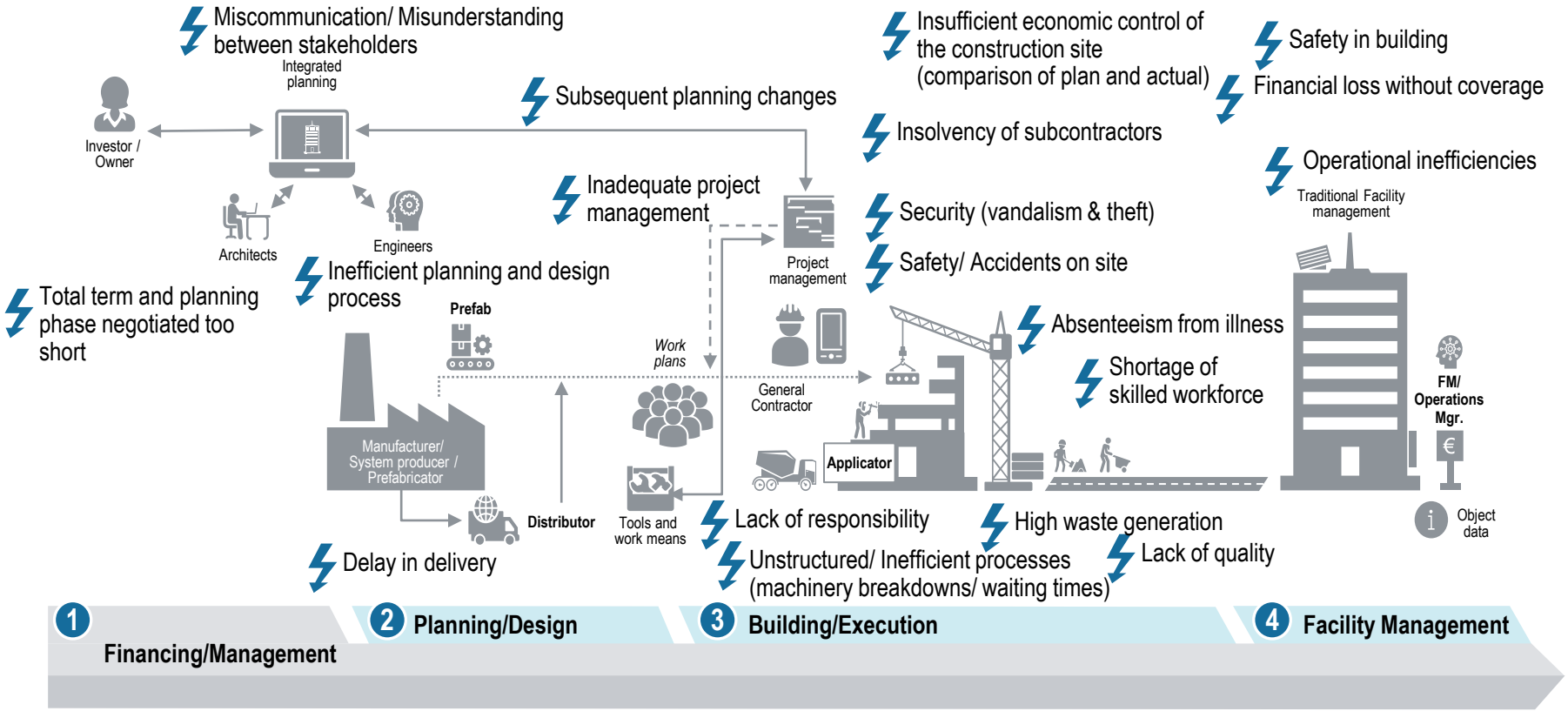
Focus of today's discussion

Source: Roland Berger

Today, the construction value chain is characterized by a multitude of cumbersome pain points that are costly and drive risk – …

Pain points along the construction value chain

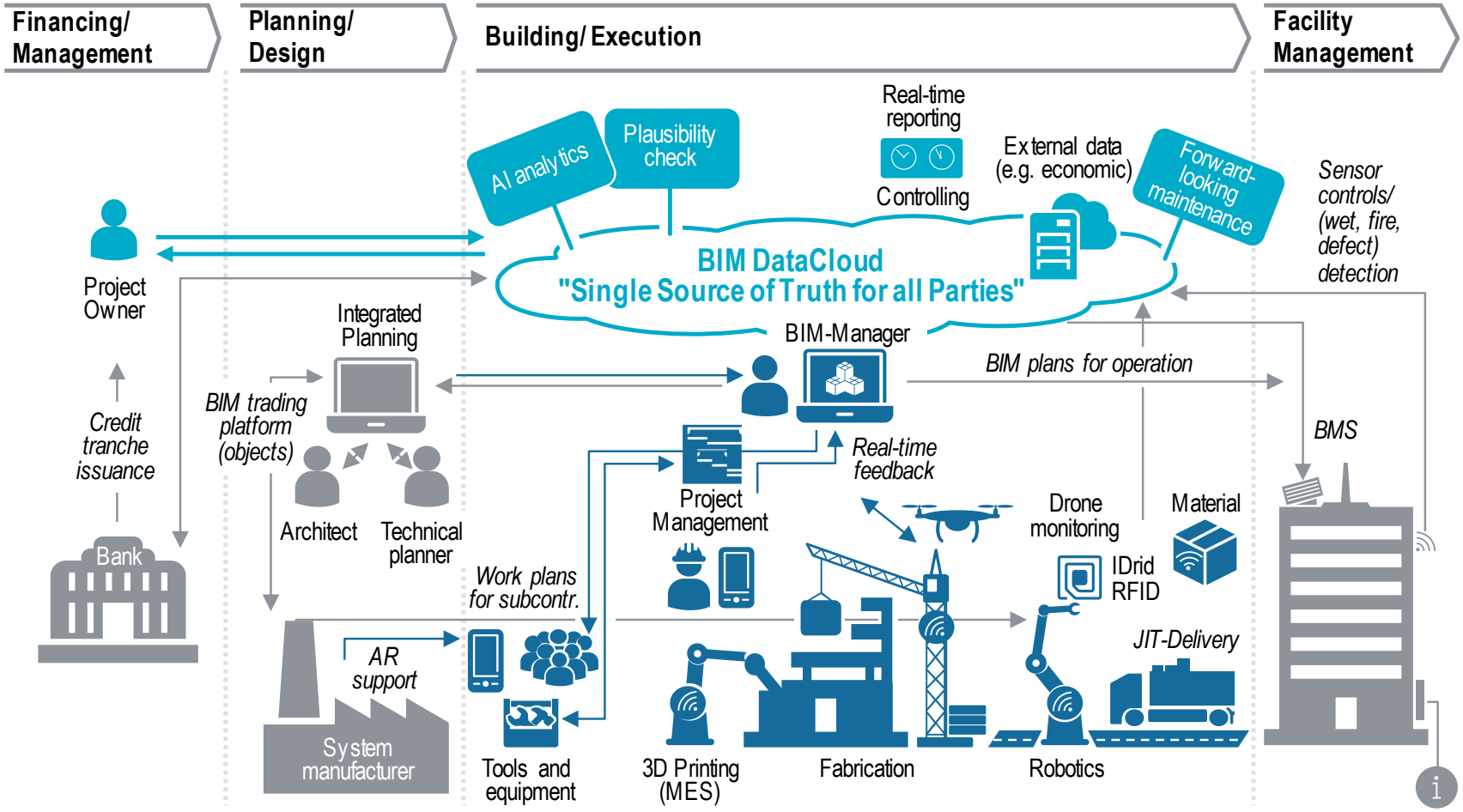
Illustrative



Source: Roland Berger

… – Creating an "intelligent construction site" via use of IoT can help reduce both cost and associated risks

Elements of intelligent construction site – disruptions in the construction industry



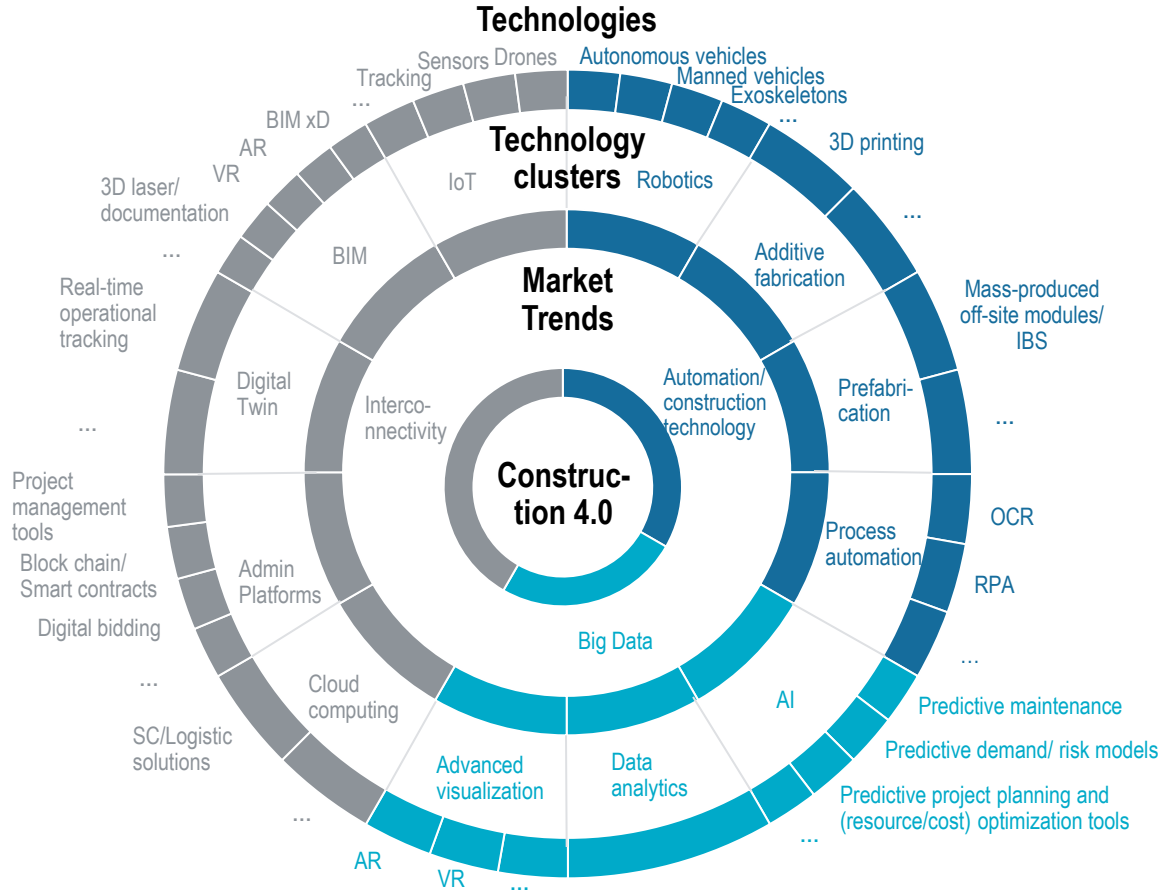
Elements of smart building 1) Radio-frequency identification

Source: Roland Berger, IDG Research Services

To ensure a comprehensive understanding, we propose to start by analyzing market trends and then dive deeper into technologies

Most relevant IoT-related technology clusters in construction

Selection



Construction 4.0

> Three key market trends drive Construction 4.0
  - Interconnectivity
  - Automation/ construction technology
  - Big data
> Technology clusters and technologies partly overlap (e.g., AI necessary for many automation technologies, AR solutions or BIM)
> For each market trend, technology clusters and specific technologies can be identified – Next step is then identification of specific use cases

Notes: BIM = Building Information Modeling, IoT = Internet of Things, AI = Artificial Intelligence, AR = Augmented Reality, VR = Virtual Reality, SC = Supply Chain, RPA = Robotic Process Automation, OCR = Optical Character Recognition, IBS = Industrialized Building Systems

Source: Roland Berger

A glossary of terms ensured a common understanding as a prere-quisite to properly assess technologies

IoT-related technology clusters in construction – Definitions

Trend	Technology cluster	Definition
Inter-connectivity	**Internet of Things (IoT)**	 Interconnection of devices, people and software to collect, exchange and analyze/track data utilizing embedded sensors within the construction site/building
	Building Information Modeling (BIM)	 Software-based method to conduct and optimize construction planning/design, execution and facility management including different technologies such as virtual or augmented reality
	Digital twin	 Virtual model or replica of assets, processes, systems, and other entities in construction mainly used as means to optimize operation and maintenance
	Administration platforms	 Digital platforms that connect different construction stakeholders for administrative tasks, e.g., project management tools or digital bidding platforms
	Cloud computing	 Delivery of computing services (e.g., storage, databases, networking, servers, software and analytics) via a 'cloud' to allow building stakeholders access to faster and more flexible resources
Automation/ construction technology	**Robotics**	 Use of robots that automate and accelerate construction and production processes, which operate autonomously or manned (also via remote control)
	Additive fabrication	 Production of digitally designed components from various materials such as plastics or metals with the aid of high temperatures, or concrete, using a 3D printer
	Pre-fabrication	 Method of assembling construction components in the production plant and transporting these assembled components to the construction site for final incorporation in the building
	Process automation	 Technologies to automate processes, e.g., robotic process automation (RPA) and software applications that focus on standardized/stable processes and follow a rule-based decision logic to execute activities
Big data	**Data analytics**	 Big Data Analytics to analyze large amounts of data from different sources; the information obtained or patterns recognized can be used, for example, to guide business decisions
	Artificial intelligence (AI)	 Method of advanced data analytics that is able to learn and self-develop similarly to natural intelligence, e.g., to predict maintenance needs
	Advanced virtualization	 Use of advanced virtualization technologies like virtual reality or augmented reality, e.g., AR-based glasses to support workforce during construction

Source: Roland Berger

On the construction site, IoT provides transparency and helps to optimize planning, minimize risk and improve efficiency

Deep Dive Construction – Concrete use cases of IoT

Illustrative

	1 Financing/ Management	2 Planning/ Design	3 Building/ Execution	4 Facility management
	Investors, owners	*Architects, engineers*	*Contractors, craftsmen*	*Facility managers*
IoT Use Cases	> **Real-time observation** of **status** and **progress** on construction site, facilitating **loan payout process** > (Semi-)automated **valuation**	> Real-time **synchronization** of **as-built & as-designed** model based on Building Inform. Model (BIM) > Large-scale Reference Database	> **Real-time observation** of **status** and **progress** on construction site, incl. required and available **staff**, **material**, and **machines**	> **Predictive** and **preventive maintenance** to reduce operating cost
Effects	> **Transparency** of status of building over **whole lifetime** > **Planning and execution security** (time, quality, costs) and hence risk mitigation > **Less cost** on progress control	> Increased **planning quality** (e.g. less cost overruns) through generative design > Constant, high level of **transparency** > Correct **plans** for **final building**	> **Timely execution** of building > **Optimized use of resources** (e.g. precise material orders, less fuel consume, less machine hours) > **Less incidents and damage** (on both humans and materials)	> **Less shutdowns/downtimes** of building > **Reduced maintenance** costs > **Increased safety** for inhabitants/ workers
Insurance Approach	> More **precise premium** calculation > Performance **guarantees, business continuation** > **Service-based** insurance, e.g. automated **valuation** of assets	> Automated **information sourcing** > Avoidance of **risk drivers**/ optimized **planning** of buildings > **New insurance solutions** (e. g . project cost insurance)	> **Reduced claims cost** due to early warning system (risk prevention and mitigation) > **New insurance solutions** (e. g . credit default, subcontractor default)	> **Reduced claims cost** due to early warning system (risk prevention and mitigation) > More/new **risks insurable** (e. g . insurance of whole IoT system)
Products/ Services	triax, adbits, APROPLAN Part of LetsBuild, KUZZLE	AUTODESK., NEMETSCHEK GROUP, UrbanSim	triax, CORRUX, adbits, KUZZLE, APROPLAN Part of LetsBuild, wakecap, Putzmeister, BOSCH	

Source: Roland Berger

IoT reduces asymmetric information and allows for improved risk assessment and management to support tailored financing solutions

IoT Deep Dive: Value chain segment 1: "Financing/Management"

Level 1: Availability of more and better data

Live monitoring of the construction site

> **High transparency** of the construction site to **owner/ investor by real-time data**, e.g. via sensors and cameras **("Status Quo")**
> Combined with **historical data**, also effective **monitoring at reduced cost,** e.g. by replacing checks of human personnel by automated algorithms (**"Trend analysis"**)
> **Use case insurance:** For **Collateral Protection Insurance, collateral can be monitored** and evaluated at all times, i.e. potential claims are controlled real-time
> **Use case banking**: **less credit risk** due to more frequent and smaller payout of credit tranches along building progress

Level 2: Application of Advanced Analytics

Transform data into information

> Application of **advanced analytic methods** on data pool to gain **deeper insights** into underlying risk
> **Use case insurance I:** More **precise estimate** of all types of already known **risks and related insurance premiums**, e.g.
  – Overall project risk
  – Contractor risk
  – Risk of machine breakdown which results in a more exact **risk premium**
> **Use case insurance II: Identification of new risks structures/** correlations not known so far

IoT applications allow better assessment of financing needs and supports the development of tailored service and risk solutions (e.g. guarantee on project delivery)

Source: Roland Berger

BIM is a key enabler for data-driven use cases and can be further enhanced by the inclusion of external data

IoT Deep Dive: Value chain segment 2 "Planning/Design"

Step 1: Building Information Model

Complete Building Visualization

> A complete building is **duplicated** real-time with a **"digital twin"** as a 3 D model

> **Reduced** number of **planning errors** and **related cost/cost overruns** due to **improved collaboration** between architects, engineers, and contractors

> Easier renovations/adaptations of building during whole lifecycle as **as-built** and **as-designed** models are synchronized real time – "**Less surprises**" for future owners, less project risk

Step 2: BIM Reference Database

Comprehensive Database for BIM

> **Multiple BIM** models and related data/risk factors are **consolidated** in **one database** – Establishment of a new **market standard**

> **Reduced cost and error rate** for insurer due to

– **Automated** and **dynamic querying** of a building's risk factors

– **Less manual information** gathering from several sources by underwriters

Step 3: Database with enriched BIM data, e.g. by UrbanSim

Socio-economic Simulation

> **Enrich** BIM database with **data on surrounding**, e.g. schools, shops transportation system, other buildings

> **Simulate** interaction between a building and its environment to **answer questions** like "What **effect** will a new shop nearby have on a building?"

> Insurers can use the simulation insights in background checks to gain a more precise estimates of the **project risk**

Use of IoT in planning/design phase significantly improves availability of coherent and reliable data to serve as a basis for better risk assessment, risk management and new products

Source: Roland Berger, UrbanSim

IoT reduces both claims frequency and severity for different lines of insurance business during the construction phase

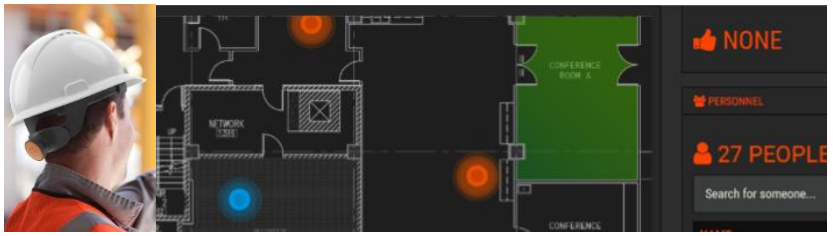
IoT Deep Dive: Value chain segment 3 "Building/ Execution"

Property and Assets

Real-time information on the construction site

> Tagging **material, and equipment** with transmitters to receive real-time information about **location and condition**
> **Use case I: Prevention** of fire, water and weather damage to building due to early detection (e.g. reduce re-construction cost, loss in value)
> **Use case II:** Better **risk estimates** through constant monitoring of construction progress (e.g. for Contingent Business Interrup.)
> **Use case III: Reduction of vandalism and theft** due to
  – **Alerts** when material is removed
  – **Less** material **present** on site

Personnel



Real-time information on workers (e.g. with adbits)

> **Tagging** workers with transmitters, e.g. in their helmet (wakecap), to receive real-time information about their location
> **Labor productivity** increase through better coordination of workers
> **Use case I: Synchronize workers and machines** (e.g. automated stop of machine when worker is approached/in case of emergency)
  – **Faster construction** of building
  – **Less hours** needed in total

Real-time tracking of construction site facilitates risk reduction and subsequently reduced claims frequency and severity in both P&C (e.g. for theft) and workers' compensation

Source: Roland Berger, adbits

IoT-based predictive maintenance becomes a driver for claims reduction as part of facility management

IoT Deep Dive: Value chain segment 4: "Facility management"

Step 1: Updated BIM

Correct data on the building

> **Combining information** of the BIM and IoT sensors in buildings
> The building information model contains up to date **information** about all **parts of a building**
  – As built
  – As replaced

Step 2: Predictive Maintenance

Probability based forecasting of maintenance

> Maintenance needs are **dynamically predicted** instead of being planned in fixed intervals
> **Less damages** on building will occur as required maintenance/exchange will happen before expected damage
> **Remaining damages** are **detected earlier** and severity decreases (e.g. as water break cannot spread as far as today)
> Implication for insurer
  – **Less standard damages** and lower claims
  – Lower total premium volume
> But also: **New risk "Failure of IoT"** to be insured

IoT enables de-risking and better planning in facility management, but brings also new kinds of risk

Source: Roland Berger

Selecting the right strategic segments requires a systematic and holistic view and a clear prioritization of use cases

Key learnings

1 IoT will grow

> Digitization (e.g. IoT) **expected to grow significantly** in the medium term

> Growth driven by **evolving technologies** and industry/ segment specific developments (e.g. BIM)

2 Broad variety of use cases

> **Vast number of possible use cases** for insurers (both in core business and beyond) which cannot be addressed simultaneously

> **Identification** of most relevant **uses cases** based for application should blend use of an **analytical** approach with involving **market experts**

3 Strategic focus required

> **Being clear on purpose** of IoT application (e.g. developing new business models vs. operational efficiency) is **critical for successful use** of IoT

> **Leveraging existing capabilities** further increases probability of success

Source: Roland Berger


Roland
Berger
THINK:ACT