ŠKODA

ŠKODA Industry 4.0 and IT approach

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The INDUSTRY4.0 idea is not new…

…new there are technological possibilities and complexity.

Industry 4.0 – nine elements transforming industrial production

1. big data analytics
2. cyber security
3. sensitive robotics
4. internet of things
5. system integration
6. cloud computing
7. additive manufacturing
8. augmented reality
9. simulation

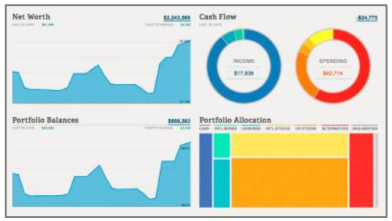
Big data

Big data in production – concept

1. Analysis of machine data: binary, non-structured, semi-structured and structured data from production lines and equipment
2. Performance and qualitative data correlations in real-time
3. Production technologies health and condition prediction by actual and historic data combination

The very sense of big data collection, analysis and visualization is to shift the performance, quality, reliability and automation to brand new level

Collection → Analysis → Visualization



Collection: Data from the production technologies are literally following „**into the lake**" (a data lake), irrespective of their source or type

Analysis: You can **choose** the interesting events within the data lake. **Combine** and **model** these events as you need.

Visualization: Use dashboards, reports, exports or alerts **to visualize** the correlated outputs like trends, predictive maps or warnings.

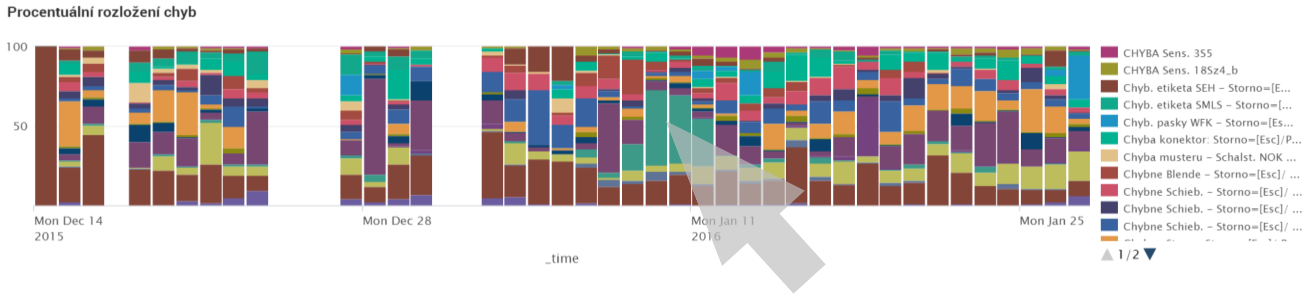
Big data – focus

Almost anyone can analyse data today, the uniqueness of Big data technologies dwells in ***immediate results in one place***"

Pattern Analysis

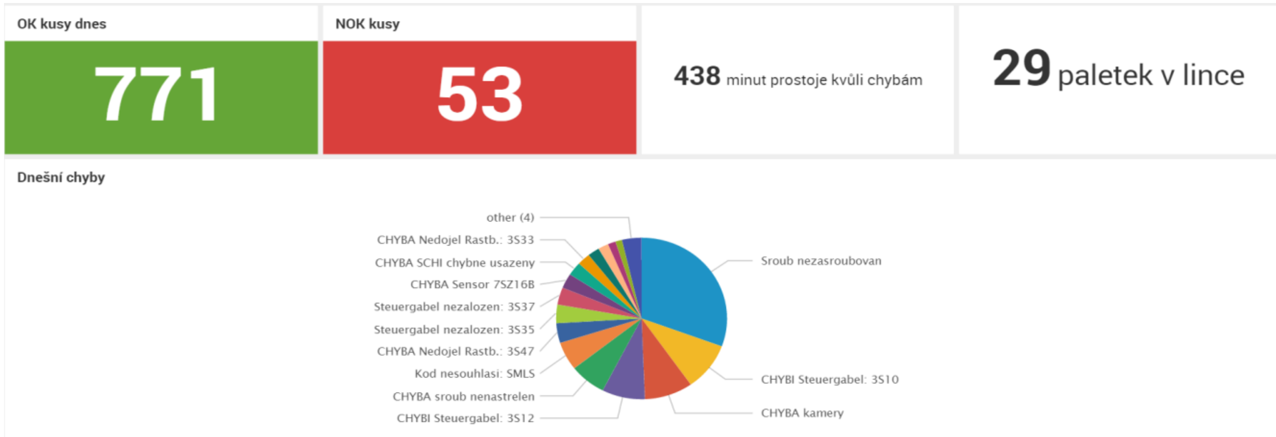
Repetitive similar or same data **patterns** indicate the area you should focus on (e.g. due to root cause analysis).

Focus on repetitive failures in time (non-quality, cycle time heavy load etc.)



All-souce Coverage

Diverse, high volume, cross-company **data analyses** (input control systems, application servers, database servers, sensors, business logs etc.) **enable the immediate insights** arrangement in regard to current needs (real-time state of testers, amount of non-quality, maintenance pre-diction, trends in sales etc.)



High Scalability

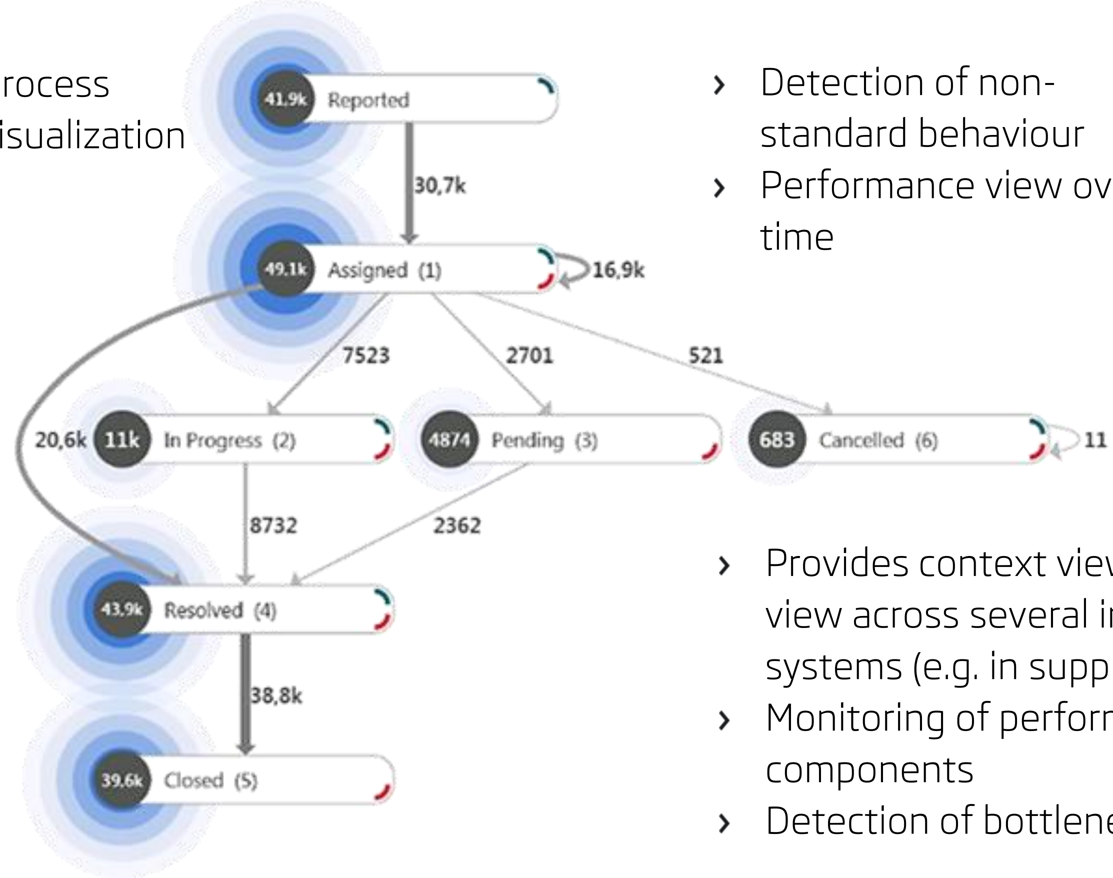
Seamless deployment for similar types of tasks (e.g. replications between production lines) in **limitless scale** (literally from one line to entire plant – i.e. Vrchlabí)

„The right tool allows you ***positively delimit the influence*** *of production, technology, quality and maintenance department on overall production performance*"

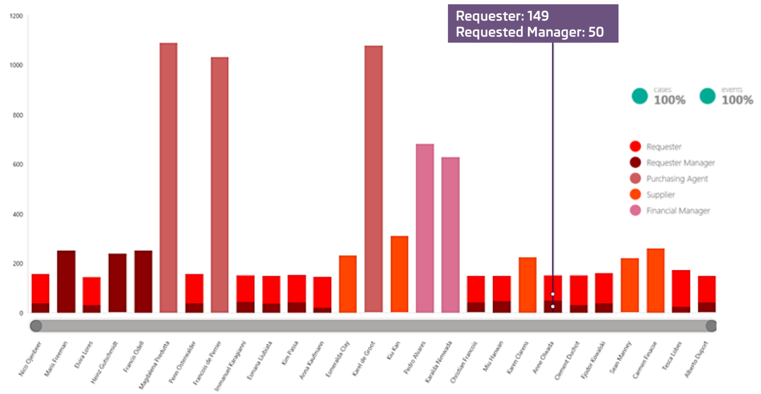
Big data and automated process discovery

Automated process discovery is a big data solution, used for analysis of regular logs available in nearly all information systems. It doesn´t only visualise the process, it also shows the process variations, enables to measure key performance indicators and analyse process performance in detail

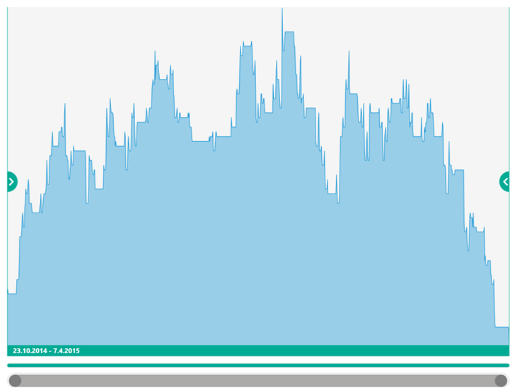
- Process visualization



- Detection of non-standard behaviour
- Performance view over time



- Provides context view - can combine view across several information systems (e.g. in supply chain)
- Monitoring of performance of key components
- Detection of bottlenecks



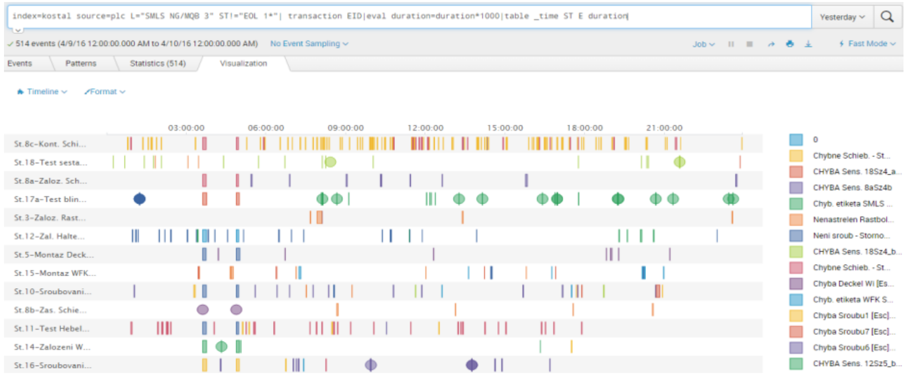
Big data – example of measures

Perf. improvement
Data Analysis

Applicable via error messages collection from operators stations, PLC and robotized work places operations analysis etc. Consecutive discrepancies localization, classification and correlation enables to find out the frequency of particular failure.

Failures type or frequency analysis helps to discover the root cause of lowered line performance.

Timing of down times on particular production lines



Further positive impacts of data lake analysis

- Localization of robots suitable for sensory upgrade to recognize the correct grip of a part
- Camera-staffed quality check work places identification where the results are seriously affected by ambient light
- Insufficient operator's training discovery causing insufficient tact of line cycle
- Immediate feedback to operators display (type of failure and position of occurence)

Big data - examples of use cases in Skoda production

Further case of data lake analysis benefits across the organization

Overall view of IT/ICS operations and communication of production systems without the back-end's database structures analysis

Overall view on production pull-takt of an organization, from customer orders, through production lines, to stores and deliveries

Quick detection of slowdown causes in production and eventuality of self-repairing (self-driving) or corrective measures (human factor)

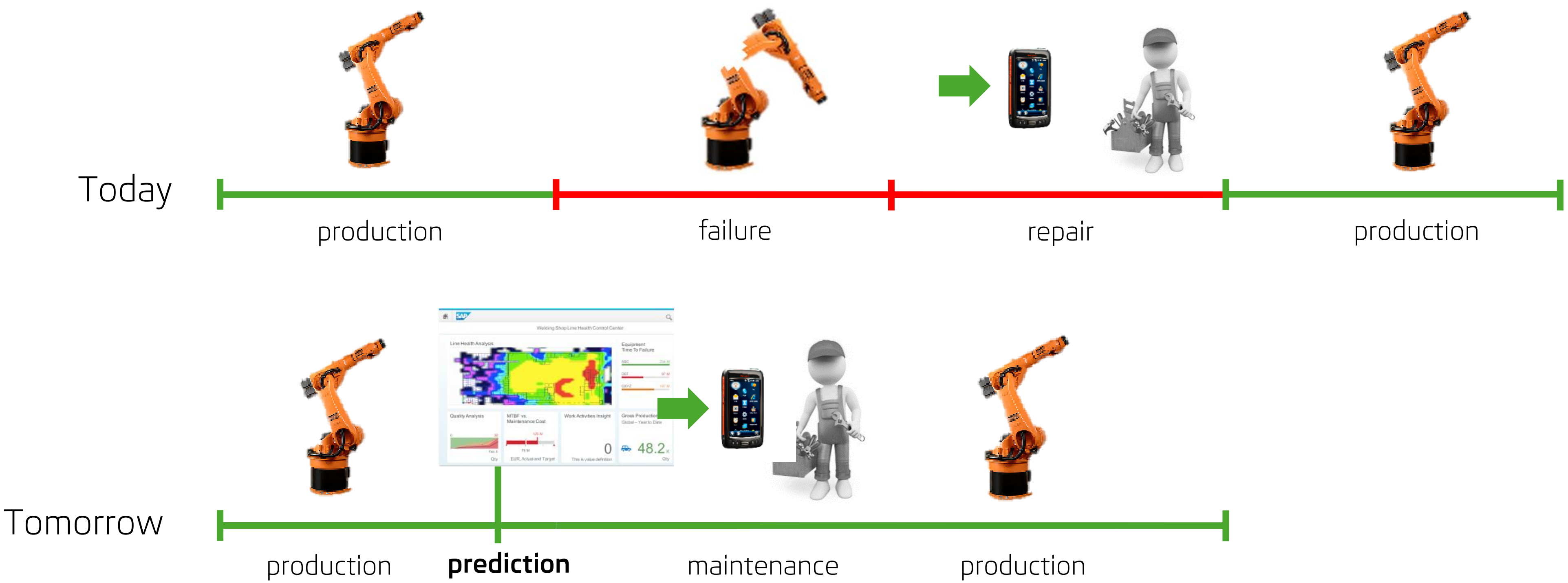
Overall security analysis on all production and non-production equipment (ICS, IT)

EDI communication state check and correlation to state of call-offs, production plan, store take outs and consignments tracking

Immediate quality state of parts, sub-finals and finals in every point of production, ensuring of sufficient output quality and in-time shipping

Non-productive time reduction > expenses reduction

Predictive Maintenance – forecast of the equipment maintenance



Benefits

- Downtime reduction
- Reduction of repair costs
- Increasing in car production

Security

Security in production

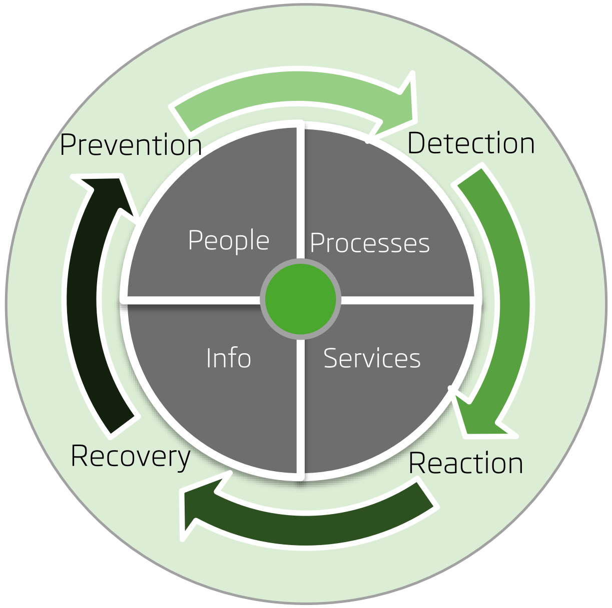
Securing of production technologies is new important topic

Because of limited performance of industrial control systems (ICS) and unique protocols it is not easy to apply access rights and roles easily.

ICS are often connected via "gateways" accessible from anywhere even from internet and residing on common company network together with enhanced IT technique (PC, tablets, Wi-Fi routers, mobile phones).

In addition we have to avoid unauthorized physical access to ICS, not updated firmware, hardware dependency, or missing data redundancy.

Security management



… let's adopt best practices from the IT world

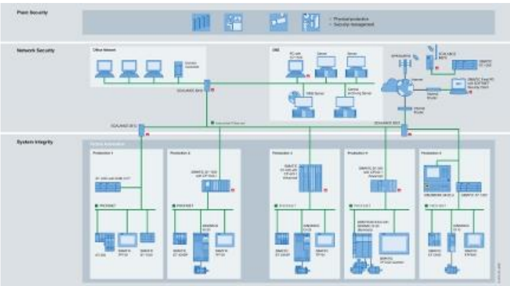
The purpose of the securing production devices is to reduce the threats acting through these devices on continuity, performance and quality of production

Security on Shop floor IT level

Common IT principles work password-protected access to control SW – IIoT Device Management, secure password, possible encryption in IIoT network, authorized personnel, cable connection

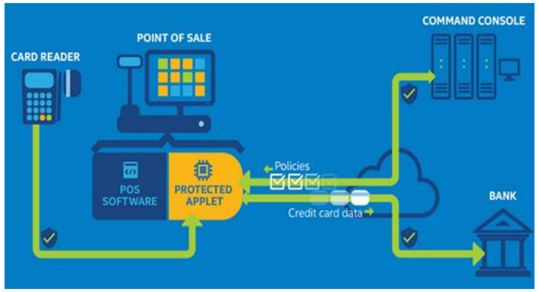
PLC Security

- Common specialized components for PLC application development
- Strategy of development integrity
- Security data visualization



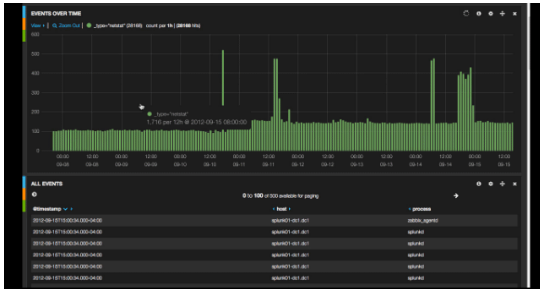
IIoT Security

- SW and HW level based security
- Specific IIoT type needs particular way of security



Robots Security

- Proactive security
- Forensic activity analysis
- Immediate and persistent threats under control
- Robots behaviour evaluation in regard of incident occurrence time



Security is an ongoing process

Industrial control systems – subject of attack

- Attacks to ICS, from energetics to production lines to MIS, are more often
- Attacking to production device has very destruction potential
- Attacker knows IT, has knowledge of production process and ICSs
- 2/3 of attacks is realized by insiders = employees
- The average damage is more than 3Mio EUR*

The main questions

- What are the main vulnerabilities?
- How will the company react in case of an attack?
- What impact have identified threats to the business of the company?
- How will the incidents be resolved to minimize damage and to restoration take place quickly?

Successful industrial attack samples

- 2008: stuxnet, digital weapon aiming to centrifuge control systems of Iran's nuclear enrichment program (stuxnet – malicious computer warm focused on SCADA systems and PLCs reprogramming)
- 2014: attackers gained access to steel plant IT networks and resulted to serious damage of iron foundry stove**

Company must be ready for future incidents. Big data tools in cyber-security allow:

- perform ongoing analysis perimeter
- analysis after the attack reveals the real impact
- big data tools after the attack facilitate application and monitoring of corrective actions

*) Based on result CERT Program, Carnegie Mellon University research, 2014 **) Based on report Bundesamt für Sicherheit in der Informationstechnik, SRN

Sensitive robotics

Sensitive robotics – The very first implementation in Czech Republic

Robots are in competence of production area, but IT can support them in fields of:

› Consolidation of development platforms (now it is JAVA)

› Application of methodology of shared development and reuse of components

› Common and secure solution of communication of data from and to robot

Vrchlabí Škoda Auto plant producing DQ200 transmission known as DSG (7 gears, double clutch, automatic)

- Robot KUKA iiwa (intelligent industrial work assistant)
- Piston inserting into Mechatronic

Internet of things

IoT vs IIoT

IoT (internet of things)

„Greenfield" projects

- Building infrastructure, speed ...

Openness, interoperability, compatibility

- Ensuring data security (building barriers)

Plug & Play

- It is obvious

Open connectivity is the priority

- Off the real-time, flowing latency ~ seconds

Public environment

- Smaller demands for resistivity against interference and fidelity
- Wireless technologies

Centralization

- Vertical hierarchical architecture, tree and star topologies

Integration and data are the objectives

IIoT (industrial internet of things)

„Brownfield" projects

- Coupling the existing systems

Closeness, variety, incompatibility

- Creating of standards (breaking converters and barriers)

Plug & Produce

- It is only the vision now

The real-time is the priority

- milli- to microsecs., determinism, jitter, closeness

Industrial environment

- High demands to resistivity against interference and fidelity
- New technologies ?

Decentralization

- Horizontal Peer to Peer architecture, linear topology

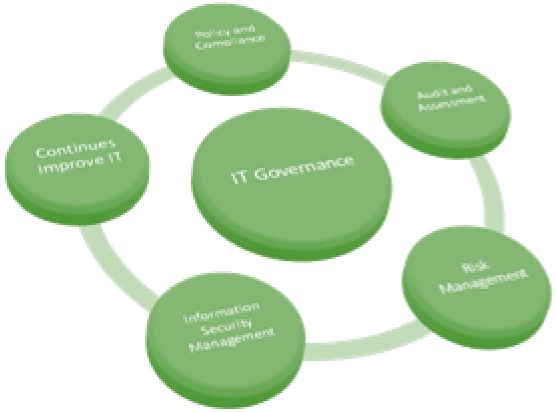
Communication and physical controlling are the objectives

System integration

Architecture, Governance

- Preparation of clear rules and technology support for integration
- Clear, enforceable and revisable rules even for security
- Open, extendable architecture enabling the autonomy of control systems
- Concept of the „integration layer“ – i.e. separating the sources and consumers - no spaghetti
- Conceptual solution of system integration, IT plays the role of system integrator amongst automation implementation experts

Architecture



Governance

Augmented reality

Augmented reality – Pick-by-Vision pilot in Logistics

In 2015/2016 was done a PoC (Prove of Concept) for Pick by Vision process. The idea was, to navigate a worker in a warehouse to position of material in a rack by projection of the way and the position in glasses.

Some kind of glasses were tested in the PoC.

Pick by Vision

Lessons learnt

- PoC is crucial for innovation process
- It is important to find balance between needs of business and technology feasibility in respect to security
- Nowadays is very necessary work together to succeed
  - Business (Planning, Production, Logistics)
  - IT (Architect, Infrastructure, Application)

Simulation

Simulation

Today…

Production companies use in the design and engineering phases 3D simulations of products, materials, combine traditional clay models with modern 3D modelling techniques

Production processes are also simulated, including boundary scenarios, to eliminate potential risks already in the design phase of the production process

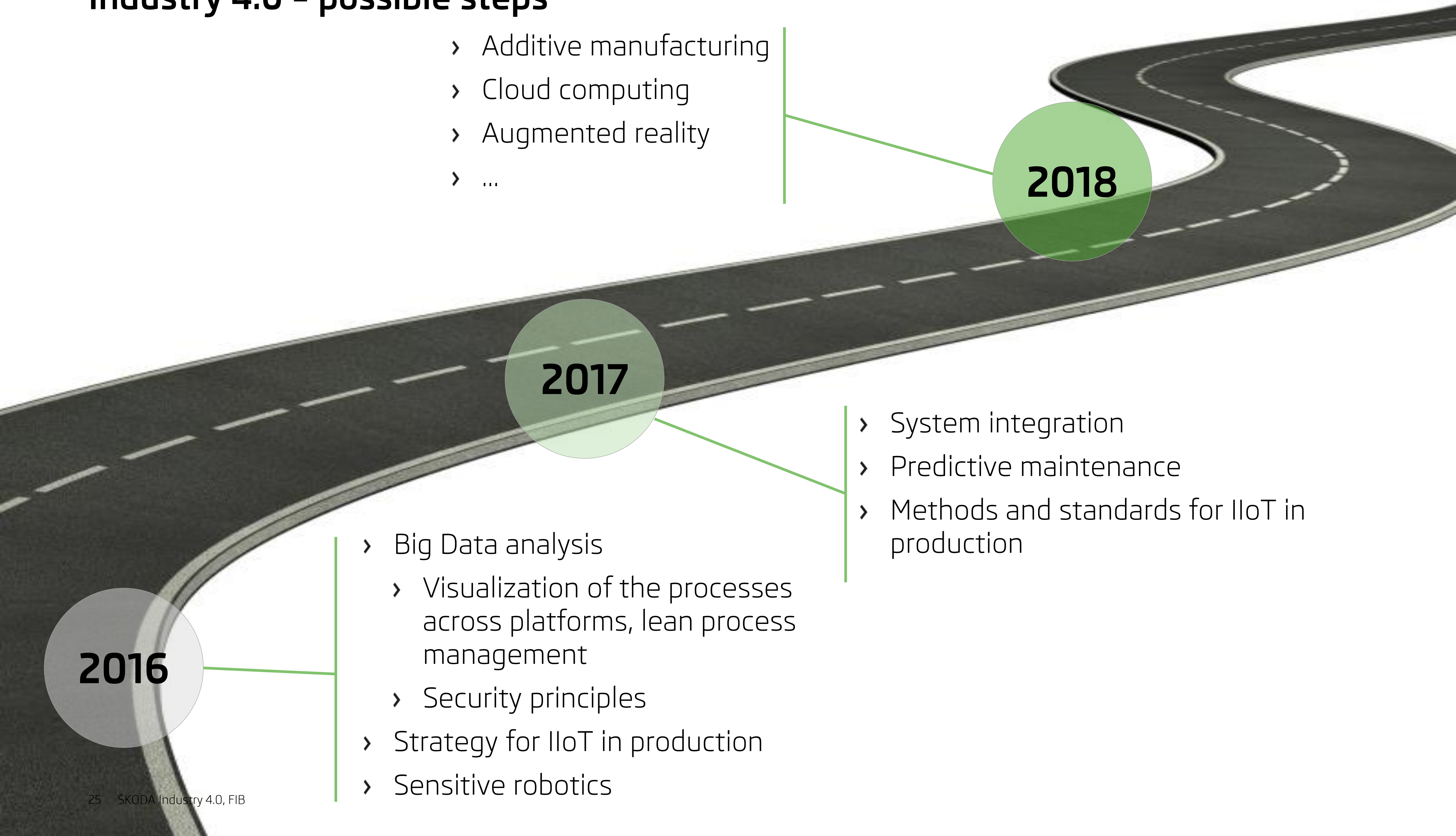
…and the future?

Simulations are going to be used more intensely in production and assembly operations

Simulations will process real-time data to model the main parameters of the actual situation in the real world. The final simplified model covers products on the production line, robots, other machines, material supply systems, warehouse solutions, unfinished products and also human workers

As a result, virtual machines can simulate the production of a car, using data from the real world objects. The machines can be then preconfigured in a virtual world and the real-world setup will happen more quickly with less errors and shorter time necessary for the next production step to start.

Industry 4.0 – possible steps



- Additive manufacturing
- Cloud computing
- Augmented reality
- …

- System integration
- Predictive maintenance
- Methods and standards for IIoT in production

- Big Data analysis
  - Visualization of the processes across platforms, lean process management
  - Security principles
- Strategy for IIoT in production
- Sensitive robotics

Thank you.