# Industry 4.0 @ Robert BOSCH

„Internet der Dingen“

„Virtual Prototyping“

„Cyber- physical things“


„Services“

„Finding dependency“

„Data mining“

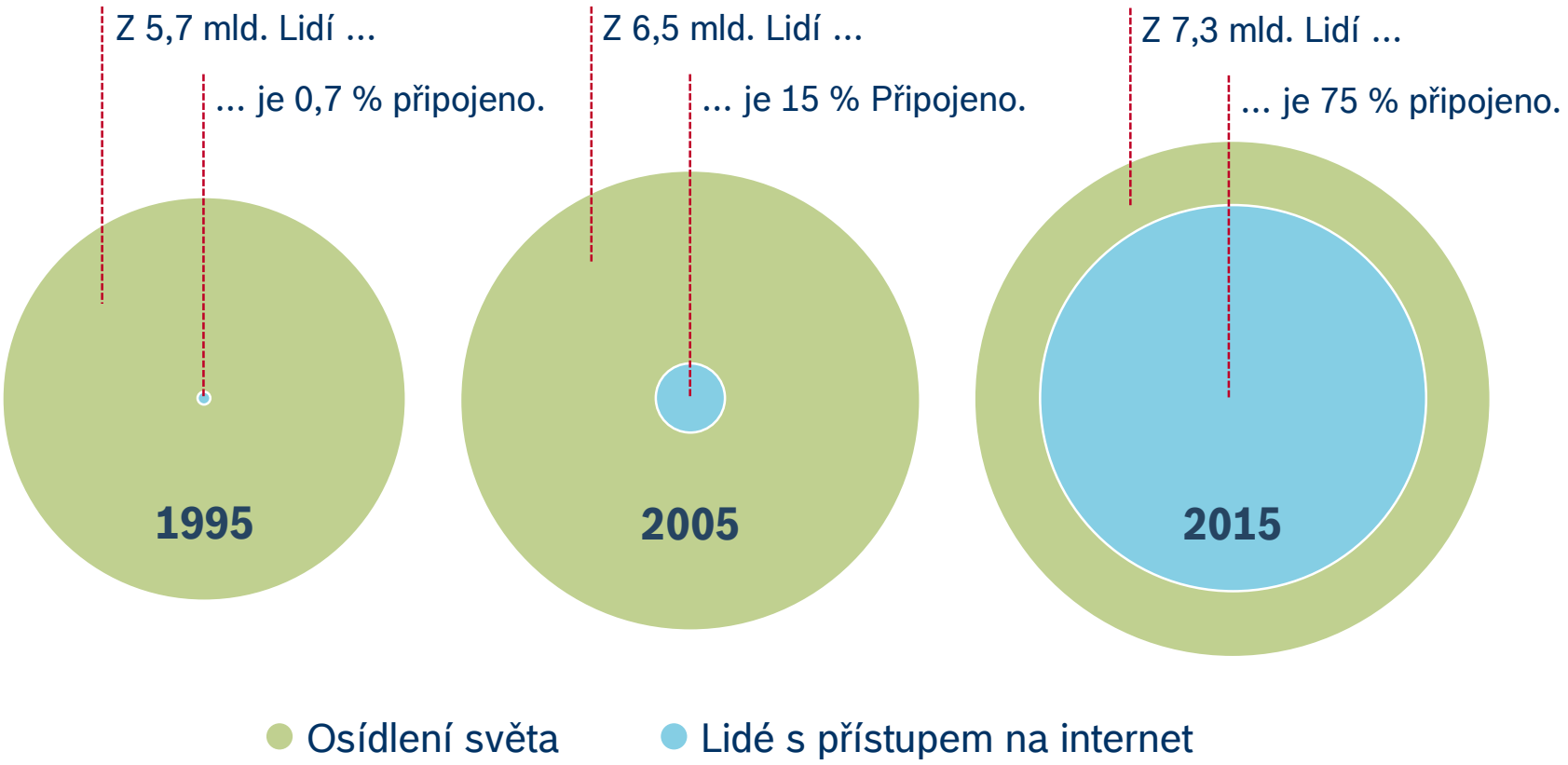
„BIG DATA“

„CLOUDS“

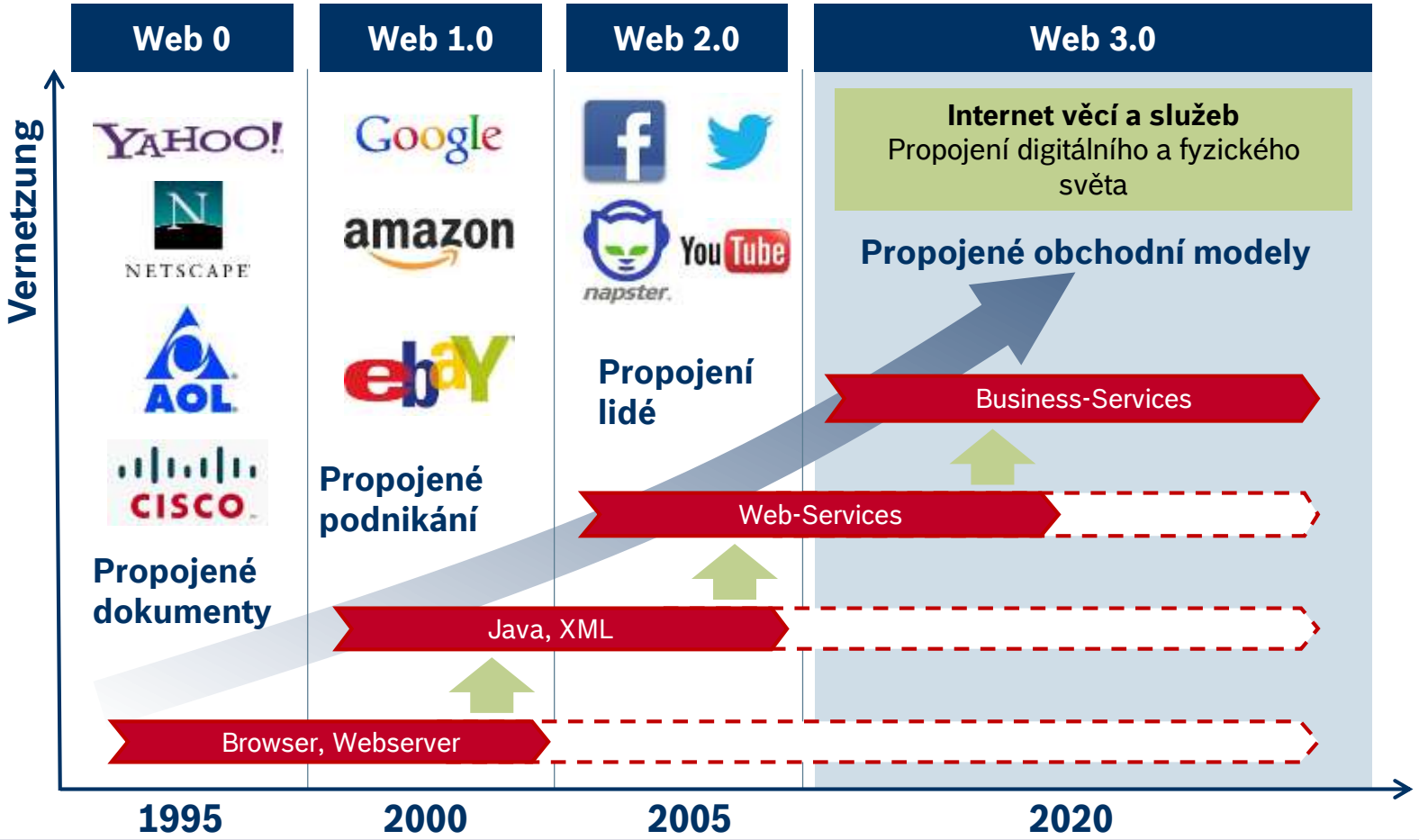
„……..“

# Svět ve změně

# Megatrend: „připojení lidé“



# Internet: „hnací člen“ propojeného světa

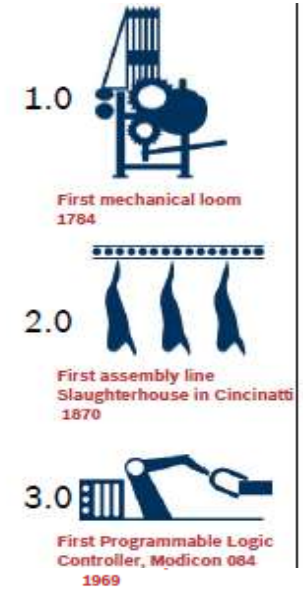


# Definice Industry 4.0:

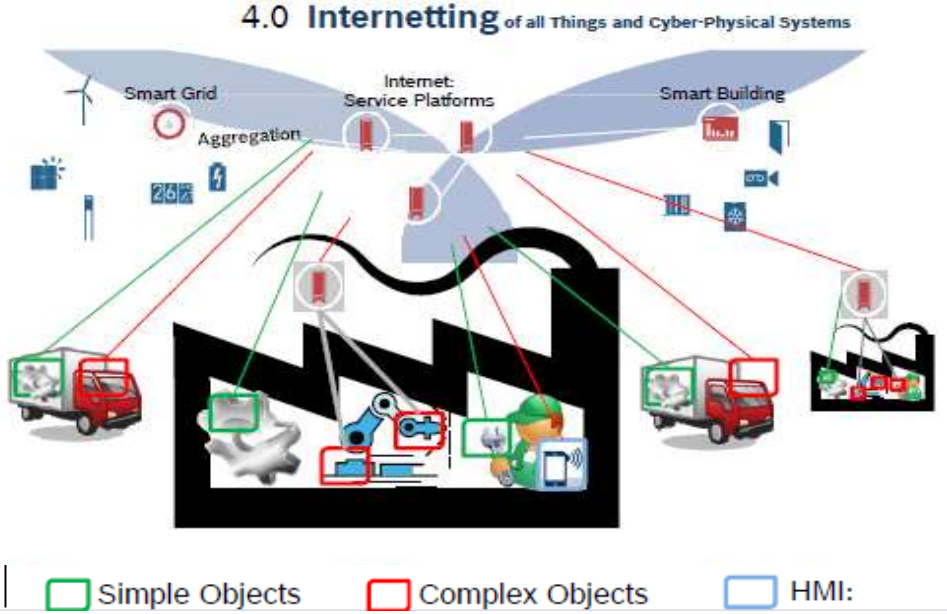
„MECHANIZACE“

„ELEKTRIFIKACE“

„DIGITALIZACE“




**Industry 4.0 = „PROPOJENÍ / INTERNETTING“**




**Proč:**

***„Kyber-Fyzické“ výrobní systémy**: IT-Integrace na úrovni plánování a řízení **přinese transparentnost ve vzájemných vztazích u multi - adaptivních procesů“***

*„Propojené automobily, továrny, smartphony, stroje atd. **umožní zcela nový typ služeb,** které zcela změní všednost dní a **umožní velký obchodní potenciál“***

# Jak sami již pracujeme ve světě internetu?

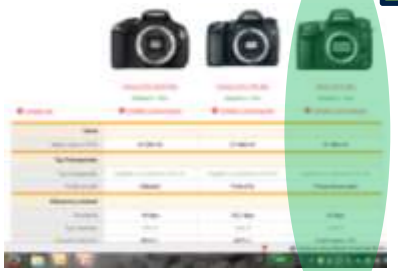
**Internet:**
-Zdroj informací
-Virtuální zdroje

**Internet:**
- nástroje pro vyhledávání dat

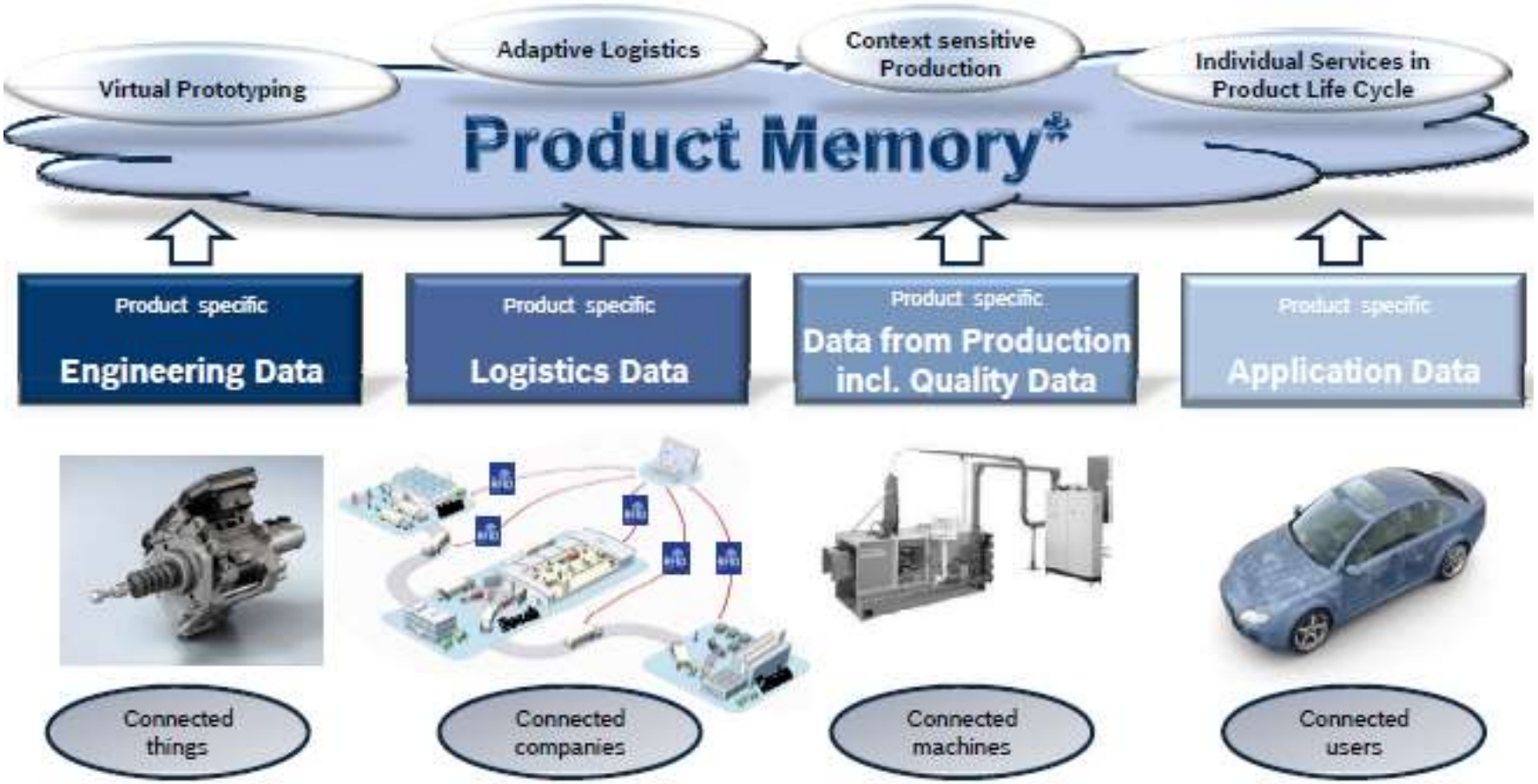
**Internet:**
-Nástroje pro hledání závislostí
-Visualizace rozdílů

**Internet:**
-Rozhodnutí na základě virtuální relaity
-Přímé akce ve virtuálním světě

„BUY IT“

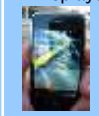


# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.



# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

| | | | |
|---|---|---|---|
| **4. INTERNETING**<br>- Direct actions via services<br>- Self learning systems | **„Internetting“**<br>Self-optimalisation systems<br>Direct actions via SERVICES | | |
| **3. VIRTUAL „world control“**<br>- work with data witout reality<br>-Virtual control of objects | **VISUALISATION + DECISIONS**<br>- DATA MINING<br>- DATA COLECTION<br>-STRUCTURED + UNSTR. data evaluation | | **FINDING OF DEPENDENCE**<br>- Mathematical Models<br>- Prediction<br>- Optimalisation |
| **2. ACCESSIBILITY**<br>-Virtual charakteristik<br>-Virtual inteligence | **IDENTIFICATION:**<br>-RFID<br>-DMC<br>-BAR CODE, ……<br>- DATABASIS INT + EXT | **IDENTIFICATION:**<br>-Stations, Lines, processes ID, IP adresses<br>- over Wi-Fi, GRPS, wires, optical,…<br>-DATABASIS INT + EXT | **VIRTUAL VISUALISATION**<br>-Display, Browsers,Tablet aplication<br>-SW´s application<br>-……. |
| **1. CONNECTIVITY**<br>-Which informations we have<br>-How are informations connected wi´th subject<br>-Which information we can shere with Virtual world | **PARAMETERS** as:<br>-Dimensions<br>-Mech. and el. Properties<br>-Functions, life time | **PARAMETERS** as<br>enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,… | |
| | **Simply objects**<br>- part, components, tools  | **Complex objects**<br>-Machines incl. periferies<br>- transporters<br>-roboters   | **HMI – Human Machine interface**<br>- Displays, Browser, spec. Visual SW   |

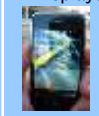




BOSCH

# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

| | | | |
|---|---|---|---|
| **4. INTERNETING**<br>- Direct actions via services<br>- Self learning systems | **„Internetting“**<br>Self-optimalisation systems<br>Direct actions via SERVICES | | |
| **3. VIRTUAL „world control“**<br>- work with data witout reality<br>-Virtual control of objects | **VISUALISATION + DECISIONS**<br>- DATA MINING<br>- DATA COLECTION<br>-STRUCTURED + UNSTR. data evaluation | | **FINDING OF DEPENDENCE**<br>- Mathematical Models<br>- Prediction<br>- Optimalisation |
| **2. ACCESSIBILITY**<br>-Virtual charakteristik<br>-Virtual inteligence | **IDENTIFICATION:**<br>-RFID<br>-DMC<br>-BAR CODE, ……<br>- DATABASIS INT + EXT | **IDENTIFICATION:**<br>-Stations, Lines, processes ID, IP adresses<br>- over Wi-Fi, GRPS, wires, optical,…<br>-DATABASIS INT + EXT | **VIRTUAL VISUALISATION**<br>-Display, Browsers,Tablet aplication<br>-SW´s application<br>-……. |
| **1. CONNECTIVITY**<br>-Which informations we have<br>-How are informations connected wi´th subject<br>-Which information we can shere with Virtual world | **PARAMETERS** as:<br>-Dimensions<br>-Mech. and el. Properties<br>-Functions, life time | **PARAMETERS** as<br>enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,… | |
| | Simply objects<br>- part, components, tools  | Complex objects<br>-Machines incl. periferies<br>- transporters<br>-roboters   | HMI – **Human Machine interface**<br>- Displays, Browser, spec. Visual SW   |

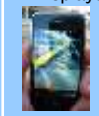




BOSCH

# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

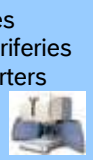
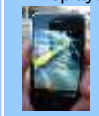
IMPLEMENTATION LEVEL

| | | | |
|---|---|---|---|
| 4. INTERNETING<br>- Direct actions via services<br>- Self learning systems | „Internetting“<br>Self-optimalisation systems<br>Direct actions via SERVICES | | |
| 3. VIRTUAL „world control“<br>- work with data witout reality<br>-Virtual control of objects | VISUALISATION + DECISIONS<br>- DATA MINING<br>- DATA COLECTION<br>-STRUCTURED + UNSTR. data evaluation | | FINDING OF DEPENDENCE<br>- Mathematical Models<br>- Prediction<br>- Optimalisation |
| **2. ACCESSIBILITY**<br>-Virtual charakteristik<br>-Virtual inteligence | **IDENTIFICATION:**<br>-RFID<br>-DMC<br>-BAR CODE, ……<br>- DATABASIS INT + EXT | **IDENTIFICATION:**<br>-Stations, Lines, processes ID, IP adresses<br>- over Wi-Fi, GRPS, wires, optical,…<br>-DATABASIS INT + EXT | **VIRTUAL VISUALISATION**<br>-Display, Browsers,Tablet aplication<br>-SW´s application<br>-…… |
| **1. CONNECTIVITY**<br>-Which informations we have<br>-How are informations connected wi´th subject<br>-Which information we can shere with Virtual world | **PARAMETERS** as:<br>-Dimensions<br>-Mech. and el. Properties<br>-Functions, life time | **PARAMETERS** as enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,… | |
| | Simply objects<br>- part, components, tools  | Complex objects<br>-Machines incl. periferies<br>- transporters<br>-roboters   | HMI – **Human Machine interface**<br>- Displays, Browser, spec. Visual SW   |

RBCB Fundament für INDUSTRY 4.0

# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

| | | | |
|---|---|---|---|
| **4. INTERNETING**<br>- Direct actions via services<br>- Self learning systems | **„Internetting“**<br>Self-optimalisation systems<br>Direct actions via SERVICES | | |
| **3. VIRTUAL „world control“**<br>- work with data witout reality<br>-Virtual control of objects | **VISUALISATION + DECISIONS**<br>- DATA MINING<br>- DATA COLECTION<br>-STRUCTURED + UNSTR. data evaluation<br>  | **FINDING OF DEPENDENCE**<br>- Mathematical Models<br>- Prediction<br>- Optimalisation<br>  | |
| **2. ACCESSIBILITY**<br>-Virtual charakteristik<br>-Virtual inteligence | **IDENTIFICATION:**<br>-RFID<br>-DMC<br>-BAR CODE, ……<br>- DATABASIS INT + EXT | **IDENTIFICATION:**<br>-Stations, Lines, processes ID, IP adresses<br>- over Wi-Fi, GRPS, wires, optical,…<br>-DATABASIS INT + EXT | **VIRTUAL VISUALISATION**<br>-Display, Browsers,Tablet aplication<br>-SW´s application<br>-…… |
| **1. CONNECTIVITY**<br>-Which informations we have<br>-How are informations connected wi´th subject<br>-Which information we can shere with Virtual world | **PARAMETERS** as:<br>-Dimensions<br>-Mech. and el. Properties<br>-Functions, life time | **PARAMETERS** as<br>enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,… | |
| | **Simply objects**<br>- part, components, tools<br>  | **Complex objects**<br>-Machines incl. periferies<br>- transporters<br>-roboters<br>  <br>  | **HMI – Human Machine interface**<br>- Displays, Browser, spec. Visual SW<br>  <br>  |

Services: DMS,.... / MES Opcon / RFID

RBCB Fundament für INDUSTRY 4.0

# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

**4. INTERNETING**
- **Direct actions via services**
- **Self learning systems**

## „Internetting - I4.0“
Self-optimalisation systems
Direct actions via SERVICES

**3. VIRTUAL „world control“**
- work with data witout reality
-Virtual control of objects

**VISUALISATION + DECISIONS**
- DATA MINING
- DATA COLECTION
-STRUCTURED + UNSTR. data evaluation


**FINDING OF DEPENDENCE**
- Mathematical Models
- Prediction
- Optimalisation

**2. ACCESSIBILITY**
-Virtual charakteristik
-Virtual inteligence

**IDENTIFICATION:**
-RFID
-DMC
-BAR CODE, ……
- DATABASIS INT + EXT

**IDENTIFICATION:**
-Stations, Lines, processes ID, IP adresses
- over Wi-Fi, GRPS, wires, optical,…
-DATABASIS INT + EXT

**VIRTUAL VISUALISATION**
-Display, Browsers,Tablet aplication
-SW´s application
-……..

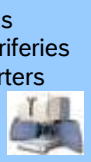
**1. CONNECTIVITY**
-Which informations we have
-How are informations connected wi´th subject
-Which information we can shere with Virtual world

**PARAMETERS** as:
-Dimensions
-Mech. and el. Properties
-Functions, life time

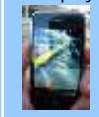
**PARAMETERS** as
enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,…

### Simply objects
- part, components, tools

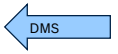
### Complex objects
-Machines
incl. periferies
- transporters
-roboters

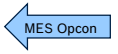


### HMI – **Human Machine interface**
- Displays, Browser, spec. Visual SW









Services

RBCB Fundament für INDUSTRY 4.0

# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

## 4. INTERNETING
- **Direct actions via services**
- **Self learning systems**

## „Internetting - I4.0“
Self-optimalisation systems
Direct actions via SERVICES

## 3. VIRTUAL „world control“
- work with data witout reality
-Virtual control of objects

**VISUALISATION + DECISIONS**
- DATA MINING
- DATA COLECTION
-STRUCTURED + UNSTR. data evaluation


**FINDING OF DEPENDENCE**
- Mathematical Models
- Prediction
- Optimalisation

Services
- .....
- .....
- DMS
- MES Opcon
- RFID

## 2. ACCESSIBILITY
-Virtual charakteristik
-Virtual inteligence

**IDENTIFICATION:**
-RFID
-DMC
-BAR CODE, ……
- DATABASIS INT + EXT

**IDENTIFICATION:**
-Stations, Lines, processes ID, IP adresses
- over Wi-Fi, GRPS, wires, optical,…
-DATABASIS INT + EXT

**VIRTUAL VISUALISATION**
-Display, Browsers,Tablet aplication
-SW´s application
-……..

## 1. CONNECTIVITY
-Which informations we have
-How are informations connected wi´th subject
-Which information we can shere with Virtual world

**PARAMETERS** as:
-Dimensions
-Mech. and el. Properties
-Functions, life time

**PARAMETERS** as
enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,…

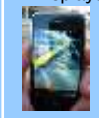
RBCB Fundament für INDUSTRY 4.0

*Reifegrad in RBCB*
*(flächendeckend)*

## Simply objects
- part, components, tools

## Complex objects
-Machines
incl. periferies
- transporters
-roboters

## HMI – **Human Machine interface**
- Displays, Browser, spec. Visual SW



# Inovační think-tank TA ČR - Robert Bosch spol .s r.o.

IMPLEMENTATION LEVEL

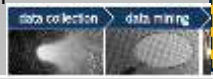
**Project: „*Data mining for reduction scrap and testing time by FM5.x*“**

## 4. INTERNETING
- **Direct actions via services**
- **Self learning systems**

## „Internetting - I4.0“
Self-optimalisation systems
Direct actions via SERVICES

## 3. VIRTUAL „world control“
- work with data witout reality
-Virtual control of objects

**VISUALISATION + DECISIONS**
- DATA MINING
- DATA COLECTION
-STRUCTURED + UNSTR. data evaluation




**Pilot 2**

**FINDING OF DEPENDENCE**
- Mathematical Models
- Prediction
- Optimalisation

Services
- .....
- .....
- DMS
- MES Opcon
- RFID

## 2. ACCESSIBILITY
-Virtual charakteristik
-Virtual inteligence

**IDENTIFICATION:**
-RFID
-DMC
-BAR CODE, ……
- DATABASIS INT + EXT

**IDENTIFICATION:**
-Stations, Lines, processes ID, IP adresses
- over Wi-Fi, GRPS, wires, optical,...
-DATABASIS INT + EXT

**VIRTUAL VISUALISATION**
-Display, Browsers,Tablet aplication
-SW´s application
-……..

3rd **Pilot 1**

RBCB Fundament für INDUSTRY 4.0

## 1. CONNECTIVITY
-Which informations we have
-How are informations connected wi´th subject
-Which information we can shere with Virtual world

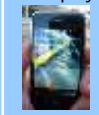
**PARAMETERS** as:
-Dimensions
-Mech. and el. Properties
-Functions, life time

**PARAMETERS** as
enviroment, status of sensors, power consuption, part list, producer, life time, history of failures / reparatures,...

## Simply objects
- part, components, tools

## Complex objects
-Machines
incl. periferies
- transporters
-roboters

## HMI – **Human Machine interface**
- Displays, Browser, spec. Visual SW



**Project:**
***“Tablet applikcation for process monitoring”***

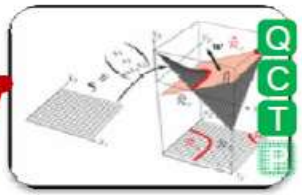
*Reifegrad in RBCB*
*(flächendeckend)*

**Pilot 1, 2** *Pilotprojekte in RBCB*

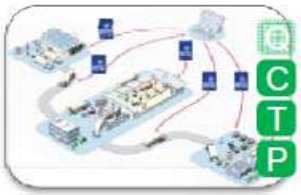
# Robert BOSCH Pilotní aplikace/ oblasti

- Adaptivní výrobní systémy
- „Data mining, Big Data“
- Produktová a provozní data
- Propojené výrobní systémy
- Inteligentní, prediktivní údržba
- Adaptivní logistika
- Informační toky

Best practice sharing




Data Mining




RFID


Smart Automation


APAS


Operator Support System


Smart Maintenance

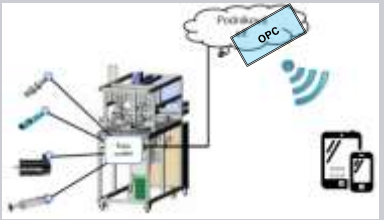
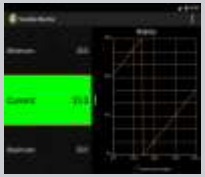
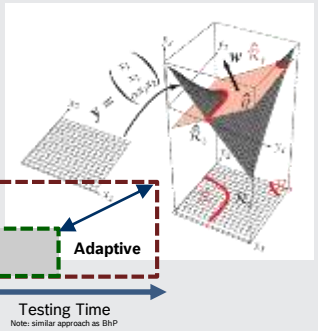
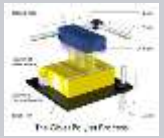

Multi Product Line


Service Portal


Plant Concept I 4.0

**Q** Kvalita **C** Náklady **T** Čas **P** Nové produkty

# Pilotní projekty Robert Bosch Č. Budějovice

| I4.0 – Fokus / Pilot | Cíl / KPI | Vizualizace |
|---|---|---|
| **1. „Prediktivní údržba“**<br>-„3rd EYE“ - HMI – interface Člověk vs. stroj<br>Oficiální RB-Projekt! | **-Produktivita**<br>- Efektivní řešení problémů<br>- optimalizace nákladů na údržbu<br>**-Kvalita**<br>- kontrolní mechanismy zajištění kvality |   |
| **2. „Data Mining“**<br>- Kolekce dat<br>- Hledání závislostí<br>- Prediktivní modelování<br>Oficiální RB – Projekt! | **-Náklady**<br>- Produkt / Proces – porozumění hranicím<br>- Redukce zkušebních časů<br>- Adaptivní procesy<br>**-OEE – Stabilní procesy**<br>**-Kvalita: 0-KM, „Field“ + Životnost produktů** |    |
| **3. 3D TISK - plasty**<br>(3D-Print) | **- Inovace**<br>**- Redukce nákladů**<br>**- „Time to market“**<br>**- Servisní koncepty** |    |

# Šance a rizika spojená s I4.0 – fokus výroba automotive

## ➔ Šance:

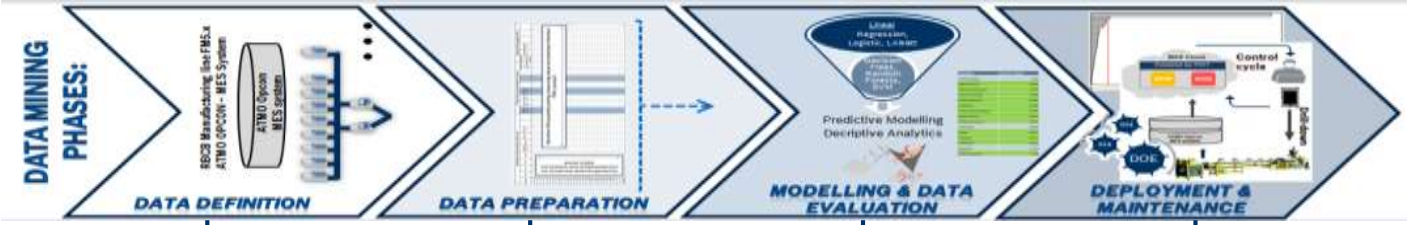
- **Transparentnost** — Q C T
  - ve vzájemných vztazích designu, výrobních procesů a funkce výrobků
- **Flexibilní výrobní koncepty** včetně **adaptivního řízení** — Q C T
- **Self learning** („samoučící se“) **systémy** — Q C T
- **Nové typy služeb a komplexních produktů** pro zákazníky — P

Q **Kvalita** C **Náklady** T **Čas** P **Nové produkty**

## ➔ Rizika:

- **Bezpečnost a ochrana dat - ztráty !!!**
  - Nedostatečná datová architektura, Nedostatečné zabezpečení dat vůči zneužití
- **Vysoké počáteční investiční náklady:**
  - Vybudování „datových fundamentů“, náklady na identifikaci a datovou dostupnost
- **Kompetence zaměstnanců**
  - Vysoké požadavky – viz příklad z „Data Mining“

# Příklad: „Data Mining - Dolování dat“ přehled potřebných kompetencí




| Fáze / Kompetence: -úroveň expert | Definice a kolekce dat | Příprava dat | Matematická analytika a vizualizace | Vyhodnocení , interpretace dat, Opatření/ výrobní, obchodní modely….. |
|---|---|---|---|---|
| **ELEKTRONIKA, MECHATRONIKA**<br>-Machine connections<br>- Programing DDL, PLC skills, XLM stream<br>- Identification, DMC readers | X | | | X |
| **DATABASE, SW Enginee.**<br>-Maintenance DB, SQL, datové architektury<br>-Formats languages example<br>- Data „Joiners“ SW Skills | X | X | | X |
| **MATEMATIKA/ STATISTIKA**<br>-Know How, tools SW und HW<br>-Result interpretation<br>-Self-learning Algorithm | | X | X | X |
| **PRODUDKT, PROCES**<br>- Domain Knowlage<br>- Data aviability | X | X | X | X |