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The impact of Industry 4.0 to the Digitalisation of Supply Chains

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Trawsnewid Addysg; Trawsnewid Bywydau
Transforming Education; Transforming Lives

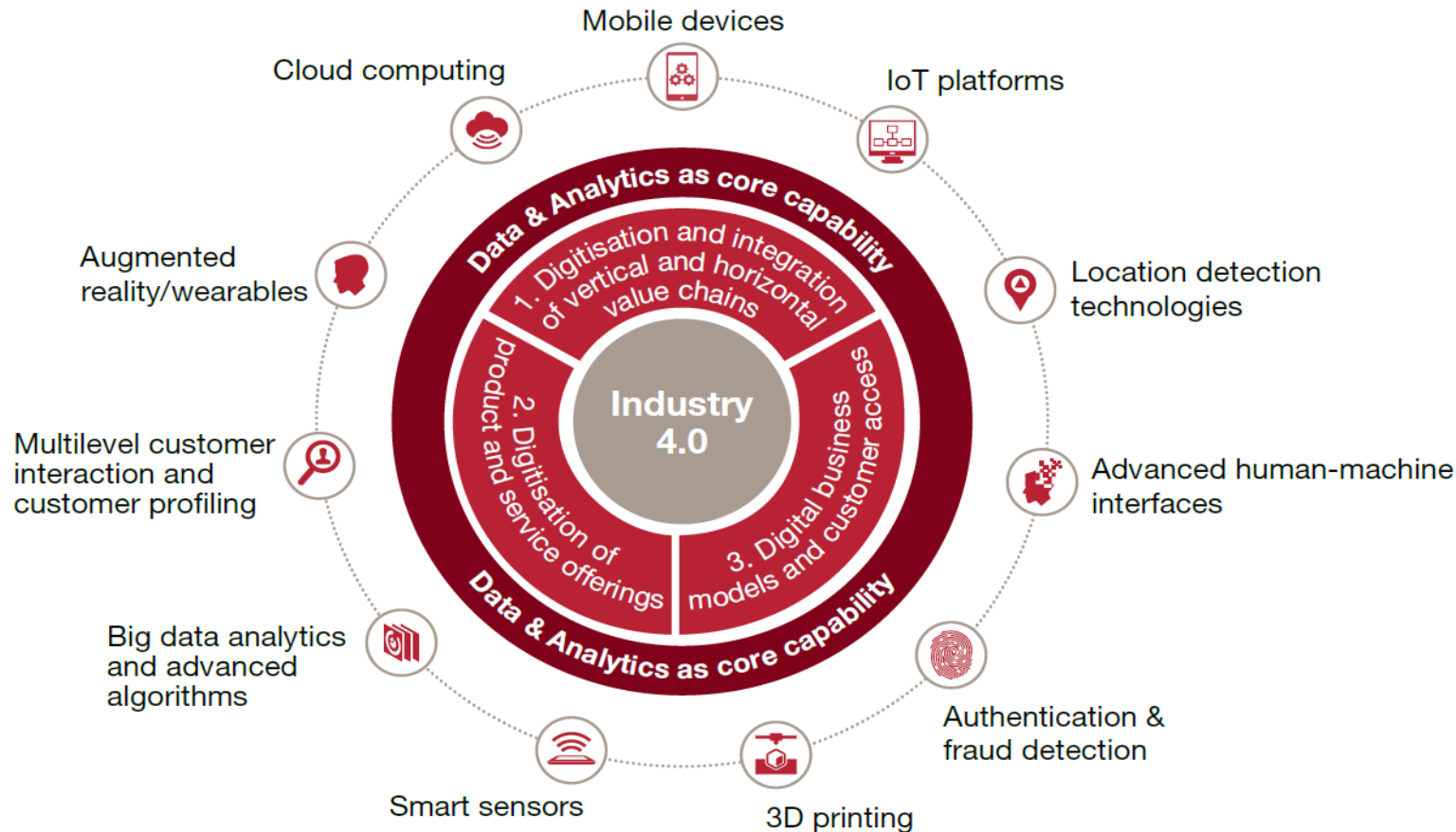


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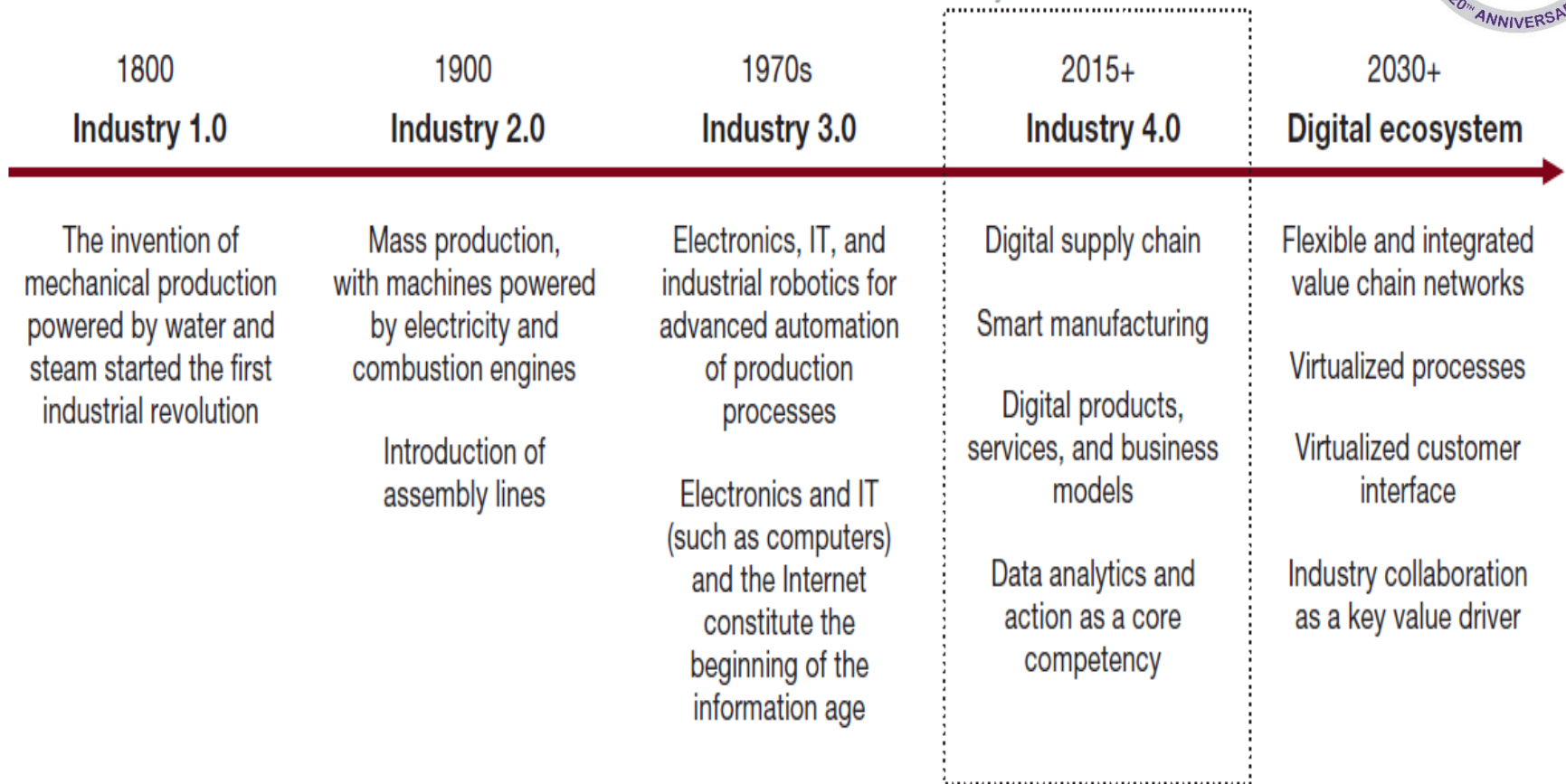
Industry 4.0 Technology Framework



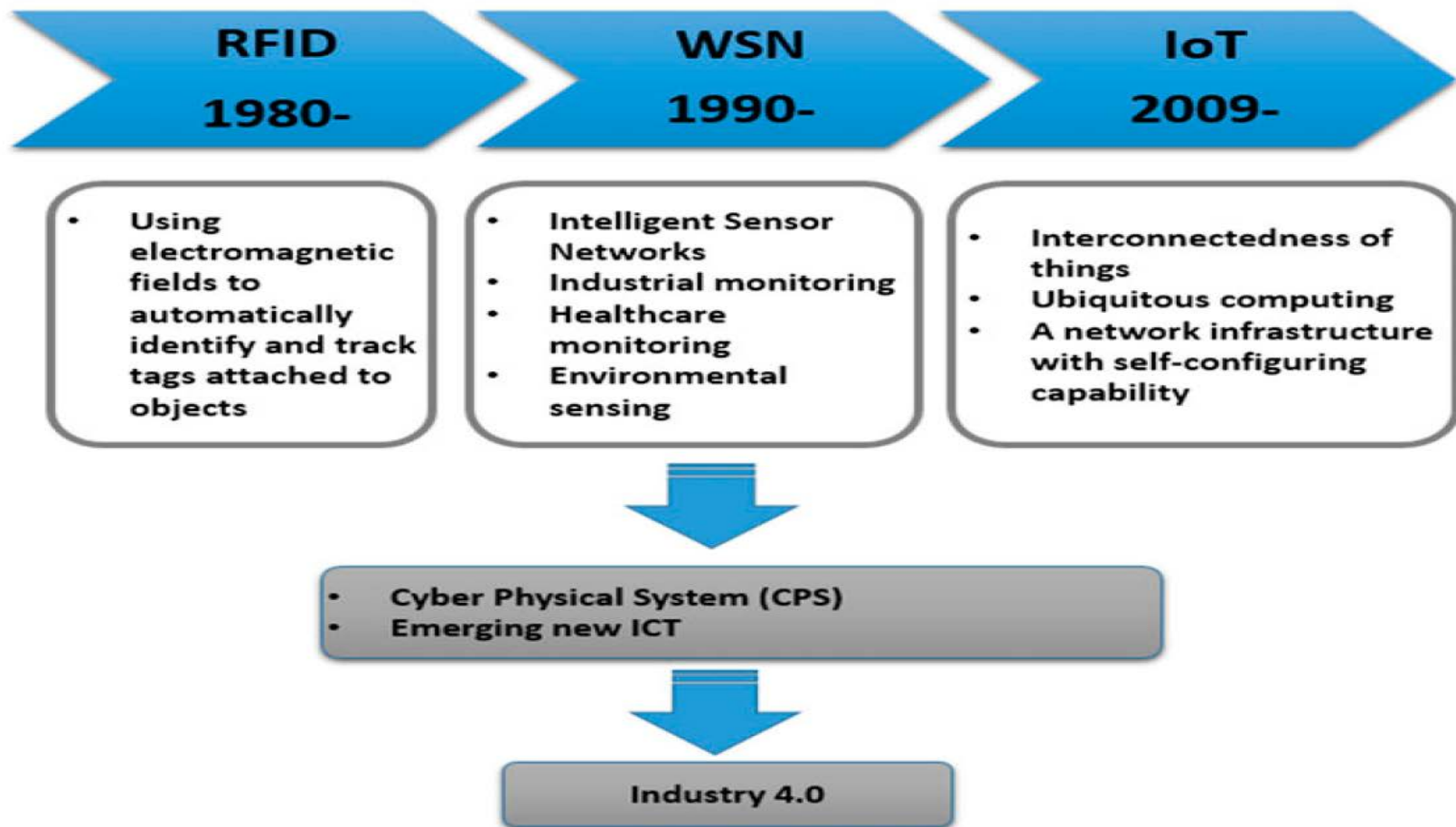
Roadmap



Today



Source: Schrauf, S. and Bertram, P. Industry 4.0 How digitization makes the supply chain more efficient, agile, and customer-focused, PWC Strategy and Analysis Report , N.D.



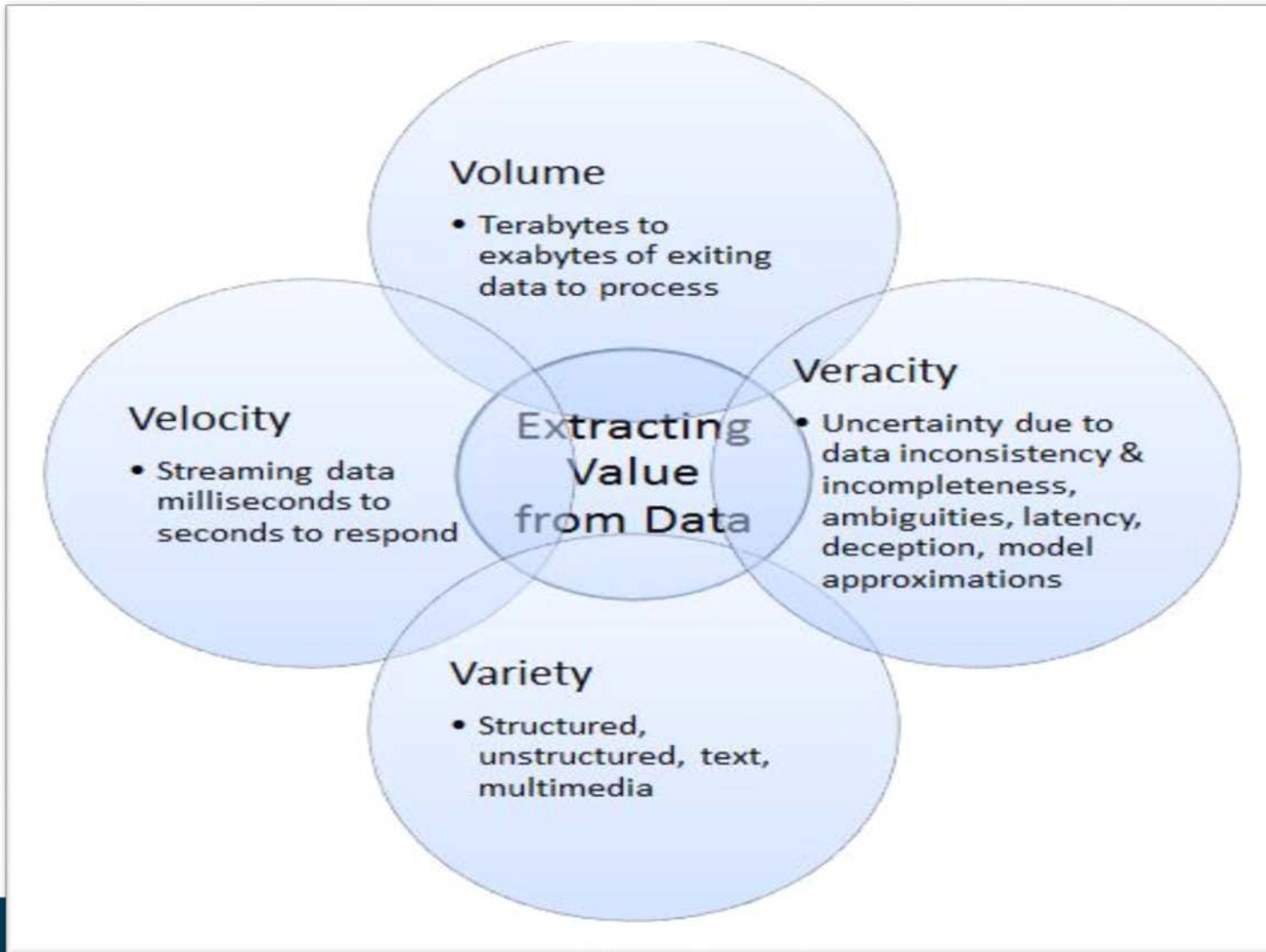
Source: Li Da Xu, Eric L. Xu & Ling Li (2018) Industry 4.0: state of the art and future trends, International Journal of Production Research, 56:8, 2941-2962

Examples

Maersk Line: Using the Internet of Things,
Data Analytics

Siemens: Digital Transformation

Big Data: 5V's Model



Supply Chain Big Data Sources



Data Type	Volume	Velocity	Variety
Sales	<i>Detail records on price, quantity, items, time of day, date, customer</i>	<i>From monthly & weekly to daily & hourly</i>	<i>Direct sales, Distributor sales, Internet sales, international sales, competitor sales</i>
Consumer	<i>Detail records of items browsed & bought, frequency, value, timing</i>	<i>From click through to card usage</i>	<i>Shopper identification, emotion detection, "Likes", "Tweets", product reviews</i>
Inventory	<i>Perpetual inventory by style, color, size</i>	<i>From monthly updates to hourly and real time updates</i>	<i>Warehouse, store, Internet store, vendor inventories</i>
Location / Time	<i>Sensor data to detect location, better inventory control</i>	<i>Frequent updates within store/stock, and items in transit</i>	<i>Not only where, but what is close, who moved it, path, future path, mobile device evidence</i>

Source: Waller and Fawcett (2013a) *Journal of Business Logistics*

(Big) Data Mining Applications for Inventory Management and Warehousing

Demand forecasting

Linking real-time sensors to machine learning and mining algorithms and systems

Bar-coded checkout & Wal-Mart
RFID chips

Enabling real-time response

Warehouse design & location

System design for optimality

A classical operations research problem

Using network analysis to improve the design and location planning

Supplier evaluation & selection

Probably the most commonly researched supply chain function

Can consider more factors, more up-to-date data

Selection of transportation nodes and routes

Real-time truck/rail assignment

Source: Waller and Fawcett (2013a) *Journal of Business Logistics*

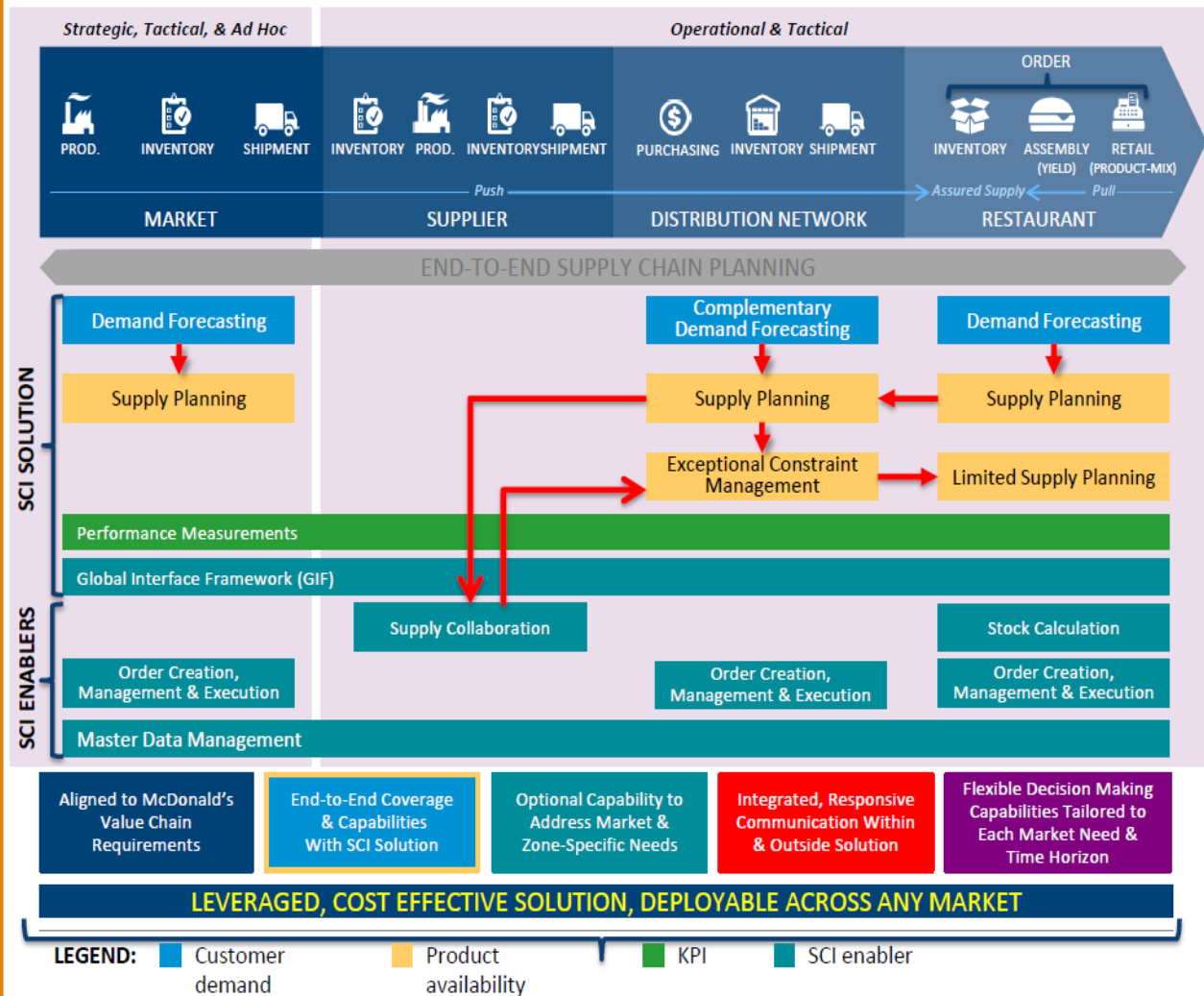
For Example: Forecasting and Big Data

Demand Modeling and Machine Learning based forecasting requires Big Data.

The result impacts the full supply chain, the way people interact and how processes are connected.

Each link of the chain is impacted and the implication of a change can be huge.

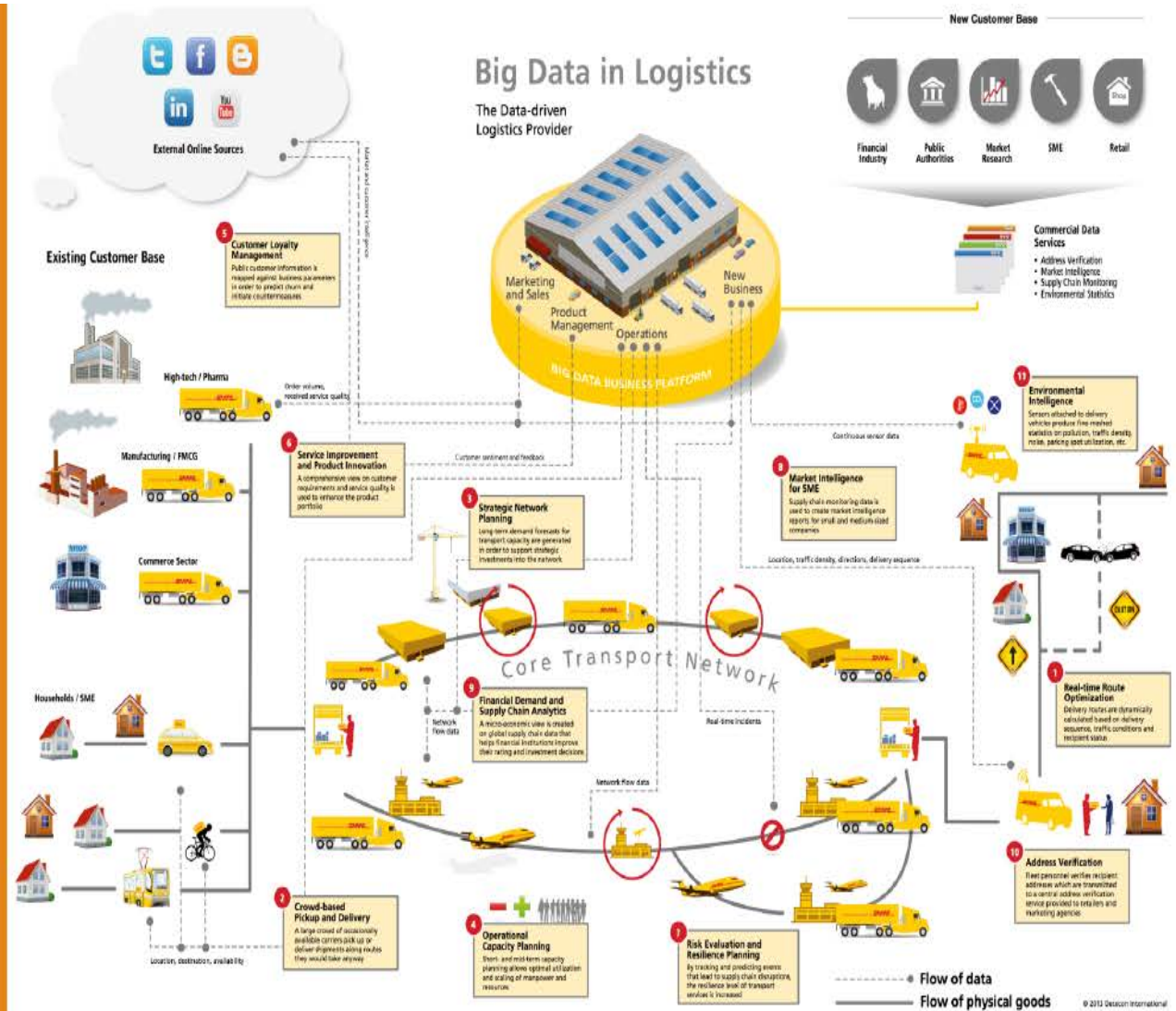
The data will come from all links and reversely influence how the whole supply chain operates and reduces the flexibility within a link.



Copyright :HAVI Logistics, SCI Process Overview, 2014

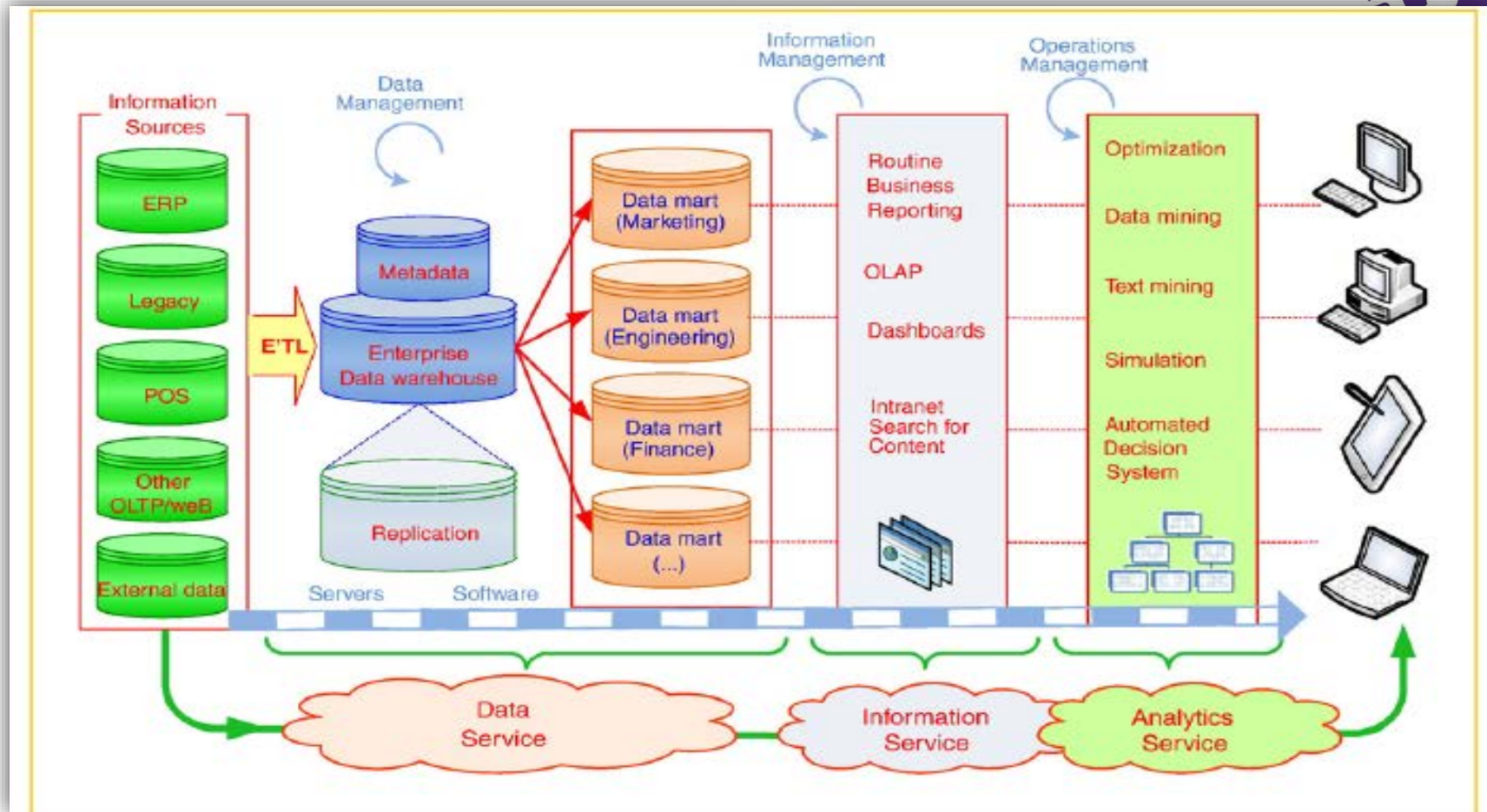
The usage of Big Data leads to an impact across most of the links of the chain.

- New processes
- Data tells you more often what to do
- New services are possible
- The way of working (together) changes
- IT becomes the glue of the links
- It's becoming a real chain



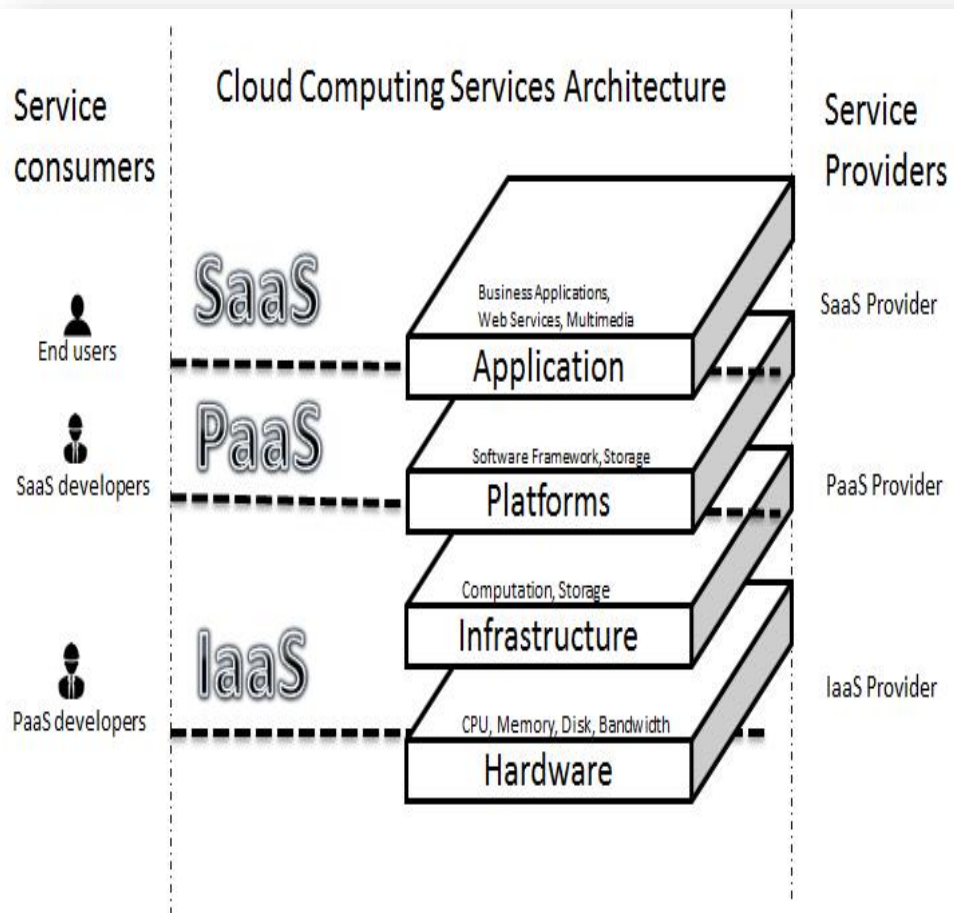
Copyright :BIG DATA IN LOGISTICS, A DHL perspective on how to move beyond the hype, 2013

Enterprise Big Data Systems



Source: Demirkan, H. and Delen, D. Decision Support Systems, 2012

Cloud computing model and services architecture

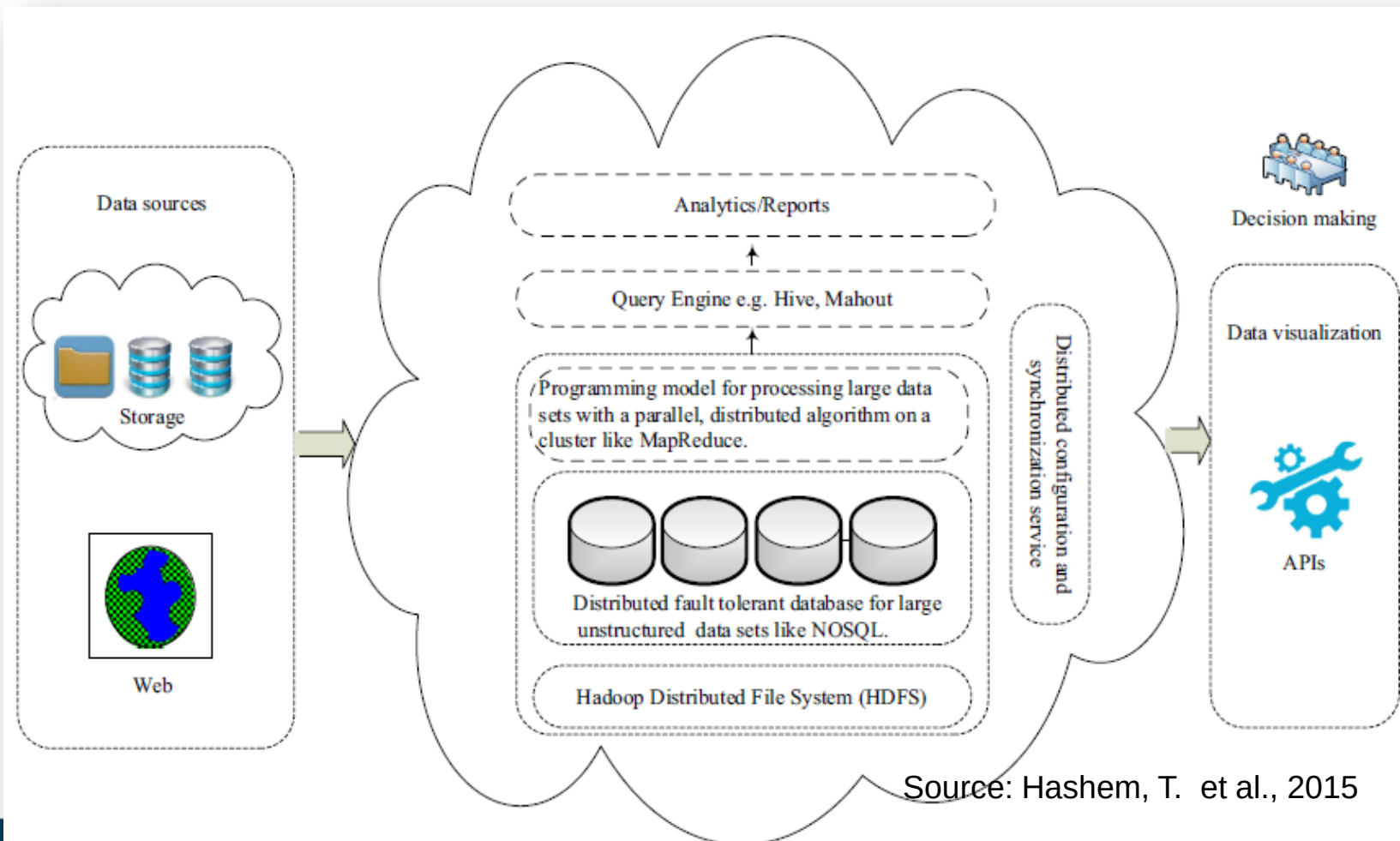


Software as a Service (SaaS) provides applications hosting and online delivery;

Platform as a Service (PaaS) provides the software platform for systems (as opposed to just software)

Infrastructure as a Service (IaaS) provides virtual computing resources, such as storage and computing services that are hosted in the cloud; customers deploy and run only their own applications for obtaining the needed services.

Big Data Analytics in the Cloud



Big Data Cloud Platforms

	Google	Microsoft	Amazon	Cloudera
Big data storage	Google cloud services	Azure	S3	
MapReduce	AppEngine	Hadoop on Azure	Elastic MapReduce (Hadoop)	MapReduce YARN
Big data analytics	BigQuery	Hadoop on Azure	Elastic MapReduce (Hadoop)	Elastic MapReduce (Hadoop)
Relational database	Cloud SQL	SQL Azure	MySQL or Oracle	MySQL, Oracle, PostgreSQL
NoSQL database	AppEngine Datastore	Table storage	DynamoDB	Apache Accumulo
Streaming processing	Search API	Streaminsight	Nothing prepackaged	Apache Spark
Machine learning	Prediction API	Hadoop+ Mahout	Hadoop+ Mahout	Hadoop+ Oryx
Data import	Network	Network	Network	Network
Data sources	A few sample datasets	Windows Azure marketplace	Public Datasets	Public Datasets
Availability	Some services in private beta	Some services in private beta	Public production	Industries

Source: Hashem,T. et al. ,2015

Big Data Driven Logistics Services



Logistics Service Layer

Strategic logistics network planning service

Operational capacity planning service

Real-time rout optimisation service

Risk evaluation & resilience planning service

Crow-based pickup & delivery

Customer loyalty management service

Logistic Service Interoperability & Collaboration Sub layer

Semantic service composer

Semantic matching

Interoperability services

Consumption Channels

Forming 4PL logistics network

Forming supply chain Services

Forming E-retail service

Forming E-Commerce services

Mobil app. widgets

Web authoring

Logistics Standards

Rule of engagement

Regulations

Industrial standards

Registries

Big Data Logistics Buinses Platform (BDLBP)

Server Abstraction Layer

Process interoperability platform

Service interoperability platform

Data interoperability platform

BDLBP Platform Services

Service ranking & selection

User management

Service discovery

BDLBP Service Runtime

Monitoring

Reporting

Deployment

Logistics service repository

Collaborative logistics process repository

Logistic data visualisation and manipulation service

Big Logistics Data and Resources Cloud Layer

Customer data

Operations data

Product data

Process data

Marketing and sale data

Freight transport data

Traffic data

Real time incident data

Social net data

Big Logistics Data and Resources Cloud Layer

Logistics Data and Analysis and Management Sub-layer

Data Service Abstraction

Logistics Metadata Management

Unstructured and Social Data Analysis Sub-layer

Trend Analysis Engine

Processing/Querying Engine

Logistics Metadata Management

RSS

Face
book

Twitter

...

Customer
data

Process
data

Other
data

Sensor
Cloud

Social Net
Data

Opportunities

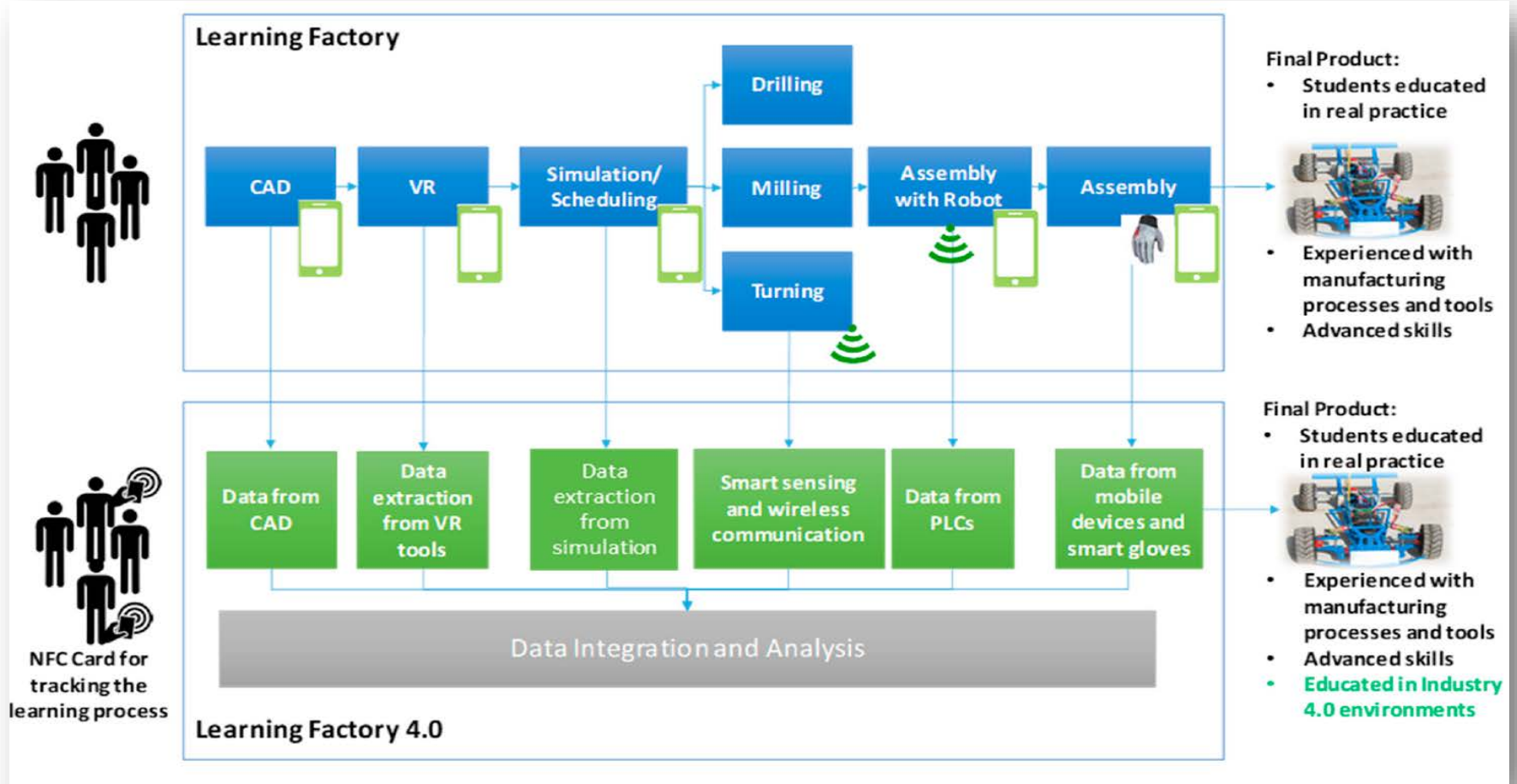
- The main outcome of this research is the definition of an architectural framework and the research and development agenda for the application of Industry 4.0 and deployment of a Big Data Logistics Business Platform (BDLBP) for supply chain network management services including inventory control and warehousing operations.
- Big data systems developed in the cloud are empowering modern logistics services through fostering synergies among 3/4PL in order to establish inclusive, integrated and sustainable logistics supply chain systems and services.

Challenges



- Supply chain networks information integration aims to unify various sources and types of data/information provided by users of different backgrounds (e.g., even non-IT savvy user) defining a consistent integrated information source.
- Service infrastructure aims to provide an infrastructure towards integration and provision of logistics related information processing systems as services.
- A standardised data model aims to develop a unify description language for logistics data and information to enable the integration and delivery of logistics data in a unified manner to support inventory management .
- The interoperability should support different data proprietary, legacy and existing solutions through open standards for logistics information systems.

Education 4.0



Source: Mourtzis, D., Vlachou, E., Dimitrakopoulos, G., and Zogopoulos, V. Cyber-Physical Systems and Education 4.0 – The Teaching Factory 4.0 Concept, *Procedia Manufacturing*, Volume 23, pp. 129-134, 2018, Elsevier Publishers Ltd

Higher Education for Industry 4.0



- Interdisciplinary engineering educational programmes holistically teaching science, engineering, and business.
- Rapid / real-time innovation of the higher education programmes in partnerships with industry requirements
- Developing adaptive learning environment and associated strategies.

Accessibility

Jeschke, S. "Engineering Education for Industry 4.0 : Challenges, Chances, Opportunities," World Engineering Education Forum, 2015. RTWH Aachen University



Thank You !

DISCUSSION & QUESTIONS?