DATA ANALYTICS IN SUPPLY CHAIN MANAGEMENT

05 October 2020

Hendro Wicaksono
h.wicaksono@jacobs-university.de

CONTENTS

I

About Us

II

Industry 4.0 Technologies, Ecosystems, and Business Implications

III

Big data and Data Analytics

IV

Supply Chain Management

V

Applications of Data Analytics in Supply Chain Management

VI

Applications of Data Analytics in Real-life Companies

VI

Future Implications

PART II

**INDUSTRY 4.0 TECHNOLOGIES, ECOSYSTEMS, AND BUSINESS
IMPLICATIONS**

WHAT IS INDUSTRY 4.0?

(Ovtcharova & Wicaksono 2017)

INDUSTRY 4.0 TECHNOLOGIES

Advanced and
Multimodal
Interaction

AR, VR, MR

Advanced
Robotics

3D Printing

Intelligence

Big Data
Analytics and
Machine Learning

Reasoning and
Searching

Infrastructure and
Interconnection

IoT

Blockchain

Cloud
Computing

(Wicaksono 2018)

THE PILLARS OF INDUSTRY 4.0 ECOSYSTEM SOLUTION

4 PILLARS OF INDUSTRY 4.0 SOLUTION IN AGRICULTURE

Smart Process/ Operation

Connected farmers,
suppliers, market

Smart Product

Self informing crop

Smart Resource/ Infrastructure

Automatic watering,
smart transport,
smart warehouse

INDUSTRY 4.0 IN DIFFERENT SECTORS

Industry
4.0

IMPLICATIONS ON BUSINESS MODEL: DATA DRIVEN SERVICE

Airplane engine +
real time monitoring,
predictive maintenance,
optimization service

Farming machines +
Farm monitoring, social media
<https://myjohndeere.deere.com>

Sport shirt +
Health monitoring, early
warning system

Product - Service Business Model: Physical product (local) + digital service (global)

PART III

BIG DATA AND DATA ANALYTICS

WHAT IS BIG DATA?

Large and **complex** collection of data sets which becomes difficult to process using typical database system tools or traditional data processing applications

The V's

Volume

Variety

Velocity

Veracity

VARIETY

Different types of data are being generated from **various sources**

Data is being generated at an **alarming rate**

Uncertainty and inconsistencies in the data

Col1	Col2	Col3	Col4
5.7	9.5	?	0.85
34000	1.2	1.02	0.21
4.5	7.8	?	0.33
3.3	5.0	4.1	700000

BIG DATA VS. TRADITIONAL DATA

Description	Traditional Data	Big Data
Volume	In GBs	TBs and PBs
Data Generation Time	Per hour , Per day	More rapid
Data Structure	Structured	Semi-Structured or Unstructured
Data Source	Centralized	Fully distributed
Data Integration	Easy	Difficult
Data Store	RDBMS	HDFS or near real-time
Data Access	Interactive	Batch or near real-time

WHAT IS DATA ANALYTICS?

PART IV

SUPPLY CHAIN MANAGEMENT

BASIC EXAMPLE OF SUPPLY CHAIN

Source: SAP

NETWORKED EXAMPLE OF SUPPLY CHAIN: LAPTOP SUPPLY CHAIN

Image: Andreas Wieland

WHAT IS SUPPLY CHAIN MANAGEMENT?

Definition

Supply chain management is the management of the **flow of goods and services** involving **multiple organizations**, through **upstream** and **downstream** linkages, in the different processes and services that **produce value**, from the **points of origin** to the hands of the **ultimate consumers**.

adapted from [Christopher, Peck: Building the resilient supply chain, International Journal of Logistics Management, Vol. 15, No. 2]

Note:

- Supply: driven by demand
- Chain: a network of organizations instead of a linear chain

UPSTREAM VS. DOWNSTREAM SUPPLY CHAIN

Copy Right
www.TridentSCM.com

DISCUSSION

SUPPLY CHAIN MANAGEMENT OF MINERAL WATER

SUPPLY CHAIN MANAGEMENT IN SERVICE INDUSTRY

PART V

APPLICATIONS OF DATA ANALYTICS IN SUPPLY CHAIN MANAGEMENT

APPLICATIONS OF DATA ANALYTICS IN SUPPLY CHAIN

1. Strategic sourcing ✓
2. Supply chain network design
3. Product design and development
4. Demand forecasting and planning ✓
5. Procurement ✓
6. Production ✓
7. Inventory management
8. (Downstream) logistics and distribution ✓
9. Supply chain agility and sustainability

STRATEGIC SOURCING AND PROCUREMENT

Strategic Sourcing

Strategic sourcing is a process to **critically analyze and evaluate the purchasing activities** of a company and to use this information to make business decision for acquisitions. It includes processes e.g. analysis current spending, supplier selection, total cost analysis, sourcing strategy, negotiation, contracting, continuous improvement.

In service industry, it is called **strategic partnership**

Procurement

Procurement is the process of **finding and agreeing to terms**, to **acquire goods, services, or works** from an external source, often via a tendering or competitive bidding process.

(Laffont & Tirole 1993)

EXAMPLES OF STRATEGIC SOURCING AND PROCUREMENT

Transactions					
Spend	AI suggestion	AI confidence	Material	Vendor	Account
	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
573,94	Packaging > Cardboard > Cardboard boxes	0,59	Box 20x10	DS Smith Packaging Pakkausjaloste Oy	Cost of Production - Packaging Materials
1 411,27	Packaging > Cardboard > Cardboard boxes	0,59	Box 20x10	DS Smith Packaging Pakkausjaloste Oy	Cost of Production - Packaging Materials
1 058,99	Packaging > Cardboard > Cardboard boxes	0,59	Box 20x10	DS Smith Packaging Baltic Holding Oy	Cost of Production - Packaging Materials
607,75	Packaging > Cardboard > Cardboard boxes	0,59	Box 20x10	Oy Hollsten Packaging Ab	Cost of Production - Packaging Materials

Spend Classification

Suppliers risk assessments

Vendor classification

DEMAND FORECASTING AND PLANNING

Definition

Demand planning is the process of **forecasting the demand** (mostly the quantity) for a product or **service** so it can be produced and delivered more efficiently.

EXAMPLE. DEMAND FORECASTING OF A PRODUCT

Forecast the demand for item A

Dataset contains
4 features:

train.csv (3.08 MB)

4 of 4 columns

	date	store	item	sales
1	2013-01-01	1	5	13
2	2013-01-02	1	5	11
3	2013-01-03	1	5	14
4	2013-01-04	1	5	13
5	2013-01-05	1	5	10
6	2013-01-06	1	5	12
7	2013-01-07	1	5	10
8	2013-01-08	1	5	9
9	2013-01-09	1	5	12
10	2013-01-10	1	5	9
11	2013-01-11	1	5	9
12	2013-01-12	1	5	7
13	2013-01-13	1	5	10
14	2013-01-14	1	5	12

Demand

EXAMPLE: ELECTRIC VEHICLE CHARGING DEMAND

Weekday residential

Weekday commercial

Weekend residential

Weekend commercial

Definition

Production is a process of transforming material and immaterial inputs (plans, know-how) to outputs for consumption.

PREDICTION OF PROCESS DURATION

On machine number: 95512

No	Rule
1	IF weight < 150.4 kg AND material='100MnCr' THEN mes_value=0.2*weight+5.12
2	IF weight < 150.4 kg AND material='15CrMg' THEN mes_value=0.45*weight+14.5
3	IF weight < 150.4 kg AND material='10Ni14' THEN mes_value=0.11*weight-12.1
4	IF weight ≥ 150.4 kg AND diameter < 120 cm THEN mes_value=0.2*weight+0.5*diameter+11.1
5	IF weight ≥ 150.4 kg AND diameter ≥ 120 cm THEN mes_value=0.15*weight+0.8*diameter-35.2

Definition

The process to distribute, transport, and deliver goods to customers

EXAMPLE: BIG DATA IN TRANSPORTATION CAPACITY SHARING

(Mehmood & Graham 2015)

PART VI

APPLICATIONS OF DATA ANALYTICS IN REAL-LIFE COMPANIES

DATA ANALYTICS IN AGRICULTURE 4.0

■ What?

- Prediction and simulation which crops and where to plant and how much fertilizer is needed (**Product**)
- Predictive supplier selection (**Process**)
- Machine health monitoring/diagnostics and *predictive* maintenance (**Resource**)

■ Which data?

- Machine activities and probes in the soil
- Weather data
- Financial data
- Supplier data

■ How?

- Sensors on machines
- Data analytics platform, e.g. SAP's HANA
- Interaction portal, eg. <https://myjohndeere.deere.com/>

Source: Oklahoma Farm Report

■ Challenges

- Who owns the data?
- Data privacy
- Reduce employment opportunities

DATA ANALYTICS FOR PREDICTIVE MAINTENANCE AND FAULT DIAGNOSIS

- **Why?**

- To identify maintenance actions days or weeks ahead of time
- To diagnose faults, to correct them and preventing them from occurring again

- **Which data?**

- Engine performance at key flight phases
- Event during flight
- Manufacturing logs

- **How?**

- Sensors on products and productions
- Machine learning

- **Challenges**

- Lack of data analytics skills

Source: Rolls-Royce

PENDLETON & SON BUTCHERS: DATA ANALYTICS FOR SMALL BUSINESS

- **Why?**

- To measure the impact of window displays and promotions
- To decide special offers

- **Which data?**

- Shop visits and window shopping
- Transaction and stock
- Google trends
- Customer surveys
- Weather

- **How?**

- Sensors for cell phone detection
- Cloud business intelligence

- **Challenges?**

- Limited resource and manpower
- Doubt of investment of data

Source: businessadvice.co.uk

PART VII

FUTURE IMPLICATIONS

SIMPLIFIED EXAMPLE IN AGRICULTURE 4.0 ECOSYSTEM

Linked data changes data integration paradigm from data exchange to data linking

WHAT SHOULD BE IMPLEMENTED IN INDONESIA?

1. Wider impacts especially for people living in villages
2. Optimizing the value and efficiency of key natural resources of Indonesia.
3. Focusing on *human skill*, not *human strength*
4. Optimizing the roles of all societal elements through ecosystems (villagers + start-ups+ SME+ government + researchers/academia).
5. Bringing Indonesia to be *leader*, not *follower*.

Empower people from rural areas

Agriculture 4.0

Aquaculture 4.0

Mining 4.0

Energy 4.0

Healthcare 4.0

(Wicaksono 2019)

TAKEAWAYS

- An industry 4.0 ecosystem consists of four pillars: **Smart PPR and data-driven service**, the implementation sectors may vary
- Industry 4.0 **enables global access to a local product** through data-driven services
- Data management (**linked data**) and **data analytics** play central roles in industry 4.0 since data is the enabler of the ecosystem
- Data analytics plays essential roles in almost **all processes in supply chain management** if it accompanied with **innovative business models**
- The focus of industry 4.0 should **optimize the value and efficiency of human and key natural resources** not just technological values and financial profits => empowering all people, especially from rural area