Part 1

Basic principle of TPS
TPS - Toyota Way

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Former Toyota Corp.
Worked for Toyota for 34 years and had experience in the car production preparation engineering together with IT engineering.


Involved in IMS and E-Commerce project organized by METI.

After retirement from Toyota, had been a visiting professor of Nagoya/Kyusyu Institute of Technology and have been working for some NPOs, such as ESD21 and APSOM and so forth.

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**Agenda**

1. Introduction
2. Why should you learn TPS
3. What is TPS/Lean system
4. Toyota Way (TPS)
5. Fundamental of TPS
6. Concluding

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**Speaker’s Profile**

- Worked for Toyota for 34 years and had experience in the car production preparation engineering together with IT engineering.
- Involved in IMS and E-Commerce project organized by METI.
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## Structural change to the global economy

Almost all issues brought by ICT evolution and digitalization

### Key Issues

- Open
- Speed
- Global
- Collaboration
- Core-competence

1. Globalization of economy
2. Environment and energy issues
3. Change of the industrial structure
4. New ICT impact to the manufacturing industries

<table>
<thead>
<tr>
<th>ICT Sector</th>
<th>Auto Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vertical Structure (~1990)</strong></td>
<td>1. Mega-competition</td>
</tr>
<tr>
<td><strong>Horizontal Structure</strong></td>
<td>2. HV/EV/PHV/FCV</td>
</tr>
<tr>
<td><strong>New era (GAFA)</strong></td>
<td>3. CASE in the new ICT era</td>
</tr>
<tr>
<td>IBM</td>
<td></td>
</tr>
<tr>
<td>CPU: Intel etc.</td>
<td></td>
</tr>
<tr>
<td>OS: Win, Mac,</td>
<td>Google Apple Facebook Amazon Samsung......</td>
</tr>
<tr>
<td>Apps: SAP, etc.</td>
<td></td>
</tr>
<tr>
<td>N/W: Cisco etc.</td>
<td></td>
</tr>
<tr>
<td>Peripheral: Canon, etc.</td>
<td></td>
</tr>
<tr>
<td>PC: Dell etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>All Products</strong></td>
<td>C: Connected</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td>A: Autonomous (Vehicle)</td>
</tr>
<tr>
<td><strong>OS</strong></td>
<td>S: Shearing (Economy)</td>
</tr>
<tr>
<td><strong>Apps</strong></td>
<td>E: Electric (Vehicle)</td>
</tr>
<tr>
<td><strong>N/W</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Peripheral</strong></td>
<td></td>
</tr>
<tr>
<td><strong>PC</strong></td>
<td></td>
</tr>
</tbody>
</table>
Initiatives of enhancement of manufacturing in the new ICT era

- **GAFA**
  - Google, Apple
  - Facebook, Amazon

- **BATH**
  - Baidu, Alibaba
  - Tencent, Huawei

**Industry 4.0**

**Society 5.0**

**AMP, IIC**
- IIC is a consortium organized by GE in 2014
- Since 2012

**Industrie 4.0**
- Activities of standardization
- Since 2011

**中国製造2025**
- Made in China 2025
- Since 2015

**RRI/IoT-A (2015), Society 5.0 (2016)**
- Since 2015

**Industrie 4.0**
- 4th IR (Steam) ⇒ 2nd IR (Motor) ⇒ 3rd IR (Computer) ⇒ 4th IR (??)

**Society 5.0**
- S1 (Hunting) ⇒ S2 (Agrarian) ⇒ S3 (Industrial) ⇒ S4 (Information) ⇒ S5 (??)
Introduction

Toyota’s production history and overviews

- No. of vehicle produced: 8,985,186
- No. of vehicle sold: 8,976,795
- No. of employees: 370,870
- Net revenues: 30,225.6 billion yen
- Operating Income: 2,467.5 billion yen
- Net Income: 1,882.8 billion yen
  (FY2019 Consolidated)

Source: Toyota Sustainability Data Book July 2020

- Japan: 48%
- North America: 20%
- Europe: 8%
- Asia: 19%
- Other: 5%

http://www.toyota-global.com
General-purpose technologies (GPTs) are technologies that can affect an entire economy (usually at a national or global level).

### Toyota System (TPS) and ICT are critical for sustainable manufacturing

#### Why should you learn TPS

**Toyota System (TPS) and ICT are critical for sustainable manufacturing**

General-purpose technologies (GPTs) are technologies that can affect an entire economy (usually at a national or global level).

#### GPTs in the 20th Century

- Automobile
- Airplane
- Mass Production (Ford System)
- Computer
- Lean Production (Toyota System)
- Internet
- Biotechnology

#### GPTs in the 19th Century

- Printing
- Steam Engines
- Railway
- Electricity

#### Table: General-purpose Technologies

<table>
<thead>
<tr>
<th>GPT</th>
<th>Spillover Effects</th>
<th>Date</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestication of plants</td>
<td>Neolithic Agricultural Revolution</td>
<td>9000-8000 BC</td>
<td>Process</td>
</tr>
<tr>
<td>Domestication of animals</td>
<td>Neolithic Agricultural Revolution, Working animals</td>
<td>8500-7500 BC</td>
<td>Process</td>
</tr>
<tr>
<td>Smelting of ore</td>
<td>Early metal tools</td>
<td>8000-7000 BC</td>
<td>Process</td>
</tr>
<tr>
<td>Wheel</td>
<td>Mechanization, Potter’s wheel</td>
<td>4000-3000 BC</td>
<td>Product</td>
</tr>
<tr>
<td>Writing</td>
<td>Trade, Record keeping</td>
<td>3400-3200 BC</td>
<td>Process</td>
</tr>
<tr>
<td>Bronze</td>
<td>Tools &amp; Weapons</td>
<td>2600 BC</td>
<td>Product</td>
</tr>
<tr>
<td>Iron</td>
<td>Tools &amp; Weapons</td>
<td>1200 BC</td>
<td>Product</td>
</tr>
<tr>
<td>Water wheel</td>
<td>Inanimate power, Mechanical systems</td>
<td>Early Middle Ages</td>
<td>Product</td>
</tr>
<tr>
<td>Three-Hulled Sailing Ship</td>
<td>Discovery of the New World, Maritime trade, Colonialism</td>
<td>15th Century</td>
<td>Product</td>
</tr>
<tr>
<td>Printing</td>
<td>Knowledge economy, Science education, Financial credit</td>
<td>16th Century</td>
<td>Process</td>
</tr>
<tr>
<td>Factory system</td>
<td>Industrial Revolution, Interchangeable parts</td>
<td>Late 19th Century</td>
<td>Organisation</td>
</tr>
<tr>
<td>Steam Engine</td>
<td>Industrial Revolution, Machine tools</td>
<td>Late 19th Century</td>
<td>Product</td>
</tr>
<tr>
<td>Railways</td>
<td>Suburbs, Commuting, Flexible location of factories</td>
<td>Mid 19th Century</td>
<td>Product</td>
</tr>
<tr>
<td>Iron Steamship</td>
<td>Global agricultural trade, International tourism, Dreadnought Battleship</td>
<td>Mid 19th Century</td>
<td>Product</td>
</tr>
<tr>
<td>Internal Combustion Engine</td>
<td>Automobile, Airplane, Oil industry, Mobile warfare</td>
<td>Late 19th Century</td>
<td>Product</td>
</tr>
<tr>
<td>Electricity</td>
<td>Centralized power generation, factory electrification, telegraphic communication</td>
<td>Late 19th Century</td>
<td>Product</td>
</tr>
</tbody>
</table>

#### GPTs in the 21st Century

- Business Virtualization
- Nanotechnology
- Artificial Intelligence

#### Notes

- **After AD to 19th Century**
  - Printing, Steam Engines, Railway, Electricity, and so forth

- **GPTs in the 20th Century**
  - Automobile
  - Airplane
  - Mass Production (Ford System)
  - Computer
  - Lean Production (Toyota System)
  - Internet
  - Biotechnology

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https://en.wikipedia.org/wiki/General-purpose_technology
Why should you learn TPS

Basic fundamentals of Monozukuri

**TPS** (Toyota Production System)
- Just-In-Time
- *Jidoka* (Autonomation)
- Production technology
- Processing technology
- TQM / TPM - IT system

**Quality First**
- *Gnechi-genbutu (Go and see)*
- QC (Quality control)
- Making things is making people
- Respect for people
- Teamwork

Continuous Improvement with Technology and Skill

**Monozukuri**

**Hitozukuri**

- Human development
- Manufacturing

Aim for an ideal Factory

- Zero number of accidents
- Zero number of delays
- Zero number of defects
- Zero number of conveyances
- Reduce stock near zero
- Zero number of disasters
- Perform your 100% abilities
- Perform 100% facility capacity

Resources of an enterprise

- People
- Money
- Material
- Information
- Wisdom

*The Ideal Factory Manager* published by NIT
Why are Toyota System (TPS) and IT?

- Business outcome is brought by activities with people and machine systems (IT)
- IT has evolved one million times in 50 years.
- IT is a powerful tool for business activities

Business Activity

Input:
- People
- Material
- Money
- Information

Value added by Information processing/creating, (Design/Production/procurement and etc.) and Production

Output:
- Products, Service
- Customer Value

Productivity and Competitiveness

Productivity = Output / Input = Value added / Lead-time = Sales / Cost

Increase productivity:
- Increase sales
- Reduce cost
- Shorten lead-time
Why should you learn TPS

**Business consists of people and machines (IT)**

Business Activities are information processing with people and machine systems (IT)

<table>
<thead>
<tr>
<th>People Systems</th>
<th>Machine/IT Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>People (Brain)</td>
<td>Computer (software)</td>
</tr>
<tr>
<td>Organization</td>
<td>IT Architecture</td>
</tr>
<tr>
<td>Management</td>
<td>Control</td>
</tr>
<tr>
<td>Communication</td>
<td>Connection</td>
</tr>
</tbody>
</table>

**Analogy**

Office work = People + Machine
Production work = People + Machine

**TPS**

(CAD/ERP, RPA, e-Mail, Printer)
(Robot/Automation, FA/IT)
Why should you learn TPS

"Man-machine (IT) system" in manufacturing

Vehicle production Line (process) of Assembly plant

Toyota’s Kanban (Index card)

Engine production order indicator in 1980

Fujitsu PC production factory Monozukuri Grand Award in 2015
Part 1

-Pause-