



TOYO's approach
to
**Digital Transformation of Plant
(DX-PLANT™) in Oil & Gas Industry**
for
the 37th JCCP International Symposium

January 24, 2019
at Hotel Okura, Tokyo

Toyo-Japan: Toyo Engineering Corporation

Consolidated

- Client Value Enhancement -

<http://www.toyo-eng.com/jp/en/>

- Established : May 1, 1961
- Listed : The first section of Tokyo Stock Exchange
- Location/Address
<Head Office> : 2-8-1 Akanehama Narashino-shi, Chiba 275-0024, Japan
[TEL]: +81-47-451-1111
[FAX]: +81-47-454-1800
<Tokyo Head Office> : Shin-Marunouchi Building 11th Floor, 5-1 Marunouchi 1-chome,
Chiyoda-ku, Tokyo 100-6511, Japan
[TEL]: +81-3-6268-6611
[FAX]: +81-3-3214-6011
- Capital Stock : US\$0.17 Billion
- Net Sales (FY2017) : US\$3.16 Billion
- Backlog of Contracts (FY2017) : US\$4.22 Billion
- Number of Employees : 1,712
Global 5,414

(including 199 Domestic Groups)



President and CEO
Haruo NAGAMATSU



Head Office:
Chiba, Japan



Tokyo Head Office:
Tokyo, Japan

Major Business Domains

Engineering, Procurement and Construction for Process and Non-Process Plants



Process Plants

- Oil & Gas E & P
 - FPSO/Offshore Platform
 - Oil & Gas Treatment
 - Gas Processing
 - LNG
 - Gas-to-Liquid
 - Refinery
- Aromatics
 - Petrochemicals
 - Polymers
 - Fertilizers & Chemicals

Non-Process Plants

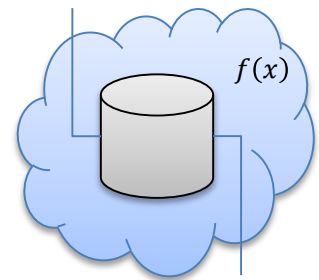
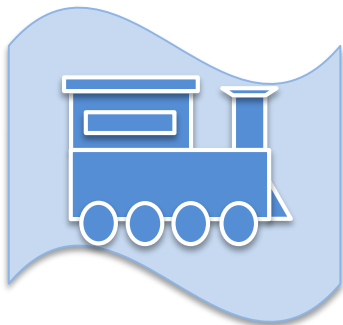
- Power
- Transportation System
- Infrastructure
- Pipeline
- Water
- Industrial Systems
- Information Technology
- Environment

Agenda

- 1. TOYO's DX-PLANT™**
- 2. Current Status
of TOYO's DX-PLANT™**
- 3. Further Development
of TOYO's DX-PLANT™**
- 4. Summary**

The Industrial Digital Revolution

The 4th Industrial Revolution includes the Internet of things (IoT), Artificial Intelligence (AI) and Cloud Computing and it is coming to the plant industry business.



Technology for O&M Support (Since '90s)

Target is improvement of

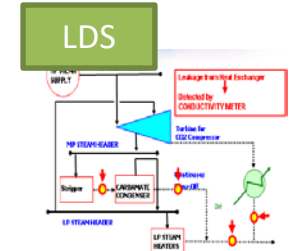
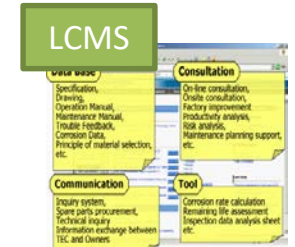
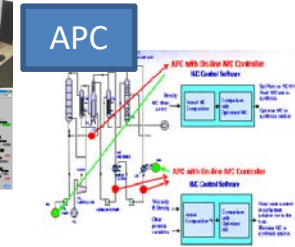
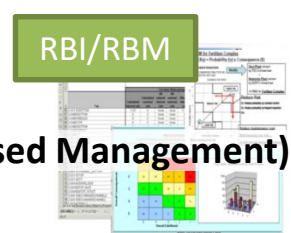
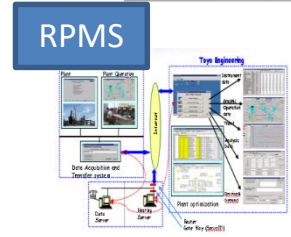
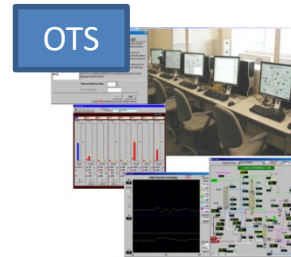
- ✓ On-stream factor
- ✓ Reliability
- ✓ Raw material & utility consumption

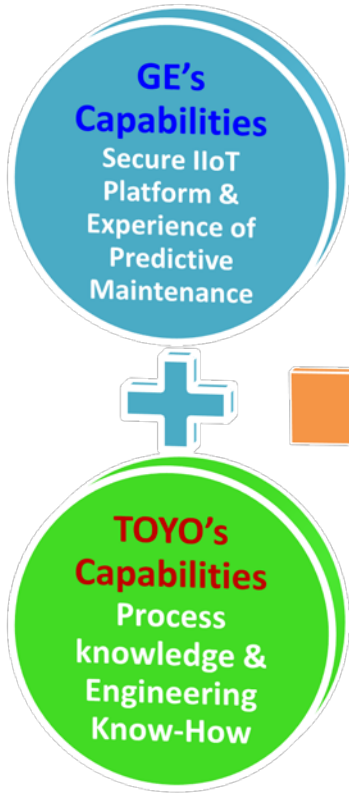
Operation Support

- OTS (Operation Training Simulator)
- APC (Advanced Process Control)
- RPMS (Remote Plant Monitoring System)

Maintenance Support

- LCMS (Life Cycle Management System)
- RBI/RBM (Risk Based Inspection / Risk Based Management)
- LDS (Leak Detection System)





Toyo/GE



DX-PLANT™

(Digital Transformation Plant)

- **DX-PLANT / Fertilizer**
- **DX-PLANT / Ethylene**
- **DX-PLANT / Methanol**
- **DX-PLANT / Aromatics**

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GE and TOYO sign MOU on Digital Collaboration

Dec. 22, 2016

General Electric Company (GE) and Toyo Engineering Corporation (TOYO, President and CEO Kiyoshi Nakao) signed a Memorandum of Understanding for a joint project to explore digital solutions for the fertilizer and petrochemicals industry.

Under the MOU, GE and TOYO will jointly work to evaluate, define and confirm the technical and economic feasibility of the deploying of GE Predix, a unique cloud-based platform built exclusively for industry, and Asset Performance Management (APM) software, to implement specific solutions for pre-FEED, FEED, EPC, commissioning, operation and maintenance phases of Fertilizer and Petrochemicals facilities.

GE has a strong track record in providing asset reliability solutions across the Oil & Gas segments around the world, through advanced sensors, combination of data driven and physics based analytics, and troubleshooting expertise. TOYO brings its complementary expertise on processes and plant operations as EPC contractor of Fertilizer and Petrochemicals plants and as Licensor of Urea synthesis and granulation technologies.

DX-PLANT™: Targeted Outcome

Concept of Solution Category

“E” Engineering Information
Sharing and Recording

“O” Operation Assistance
Service

“M” Maintenance Assistance
Service

“B” Business Management
Assistance Service

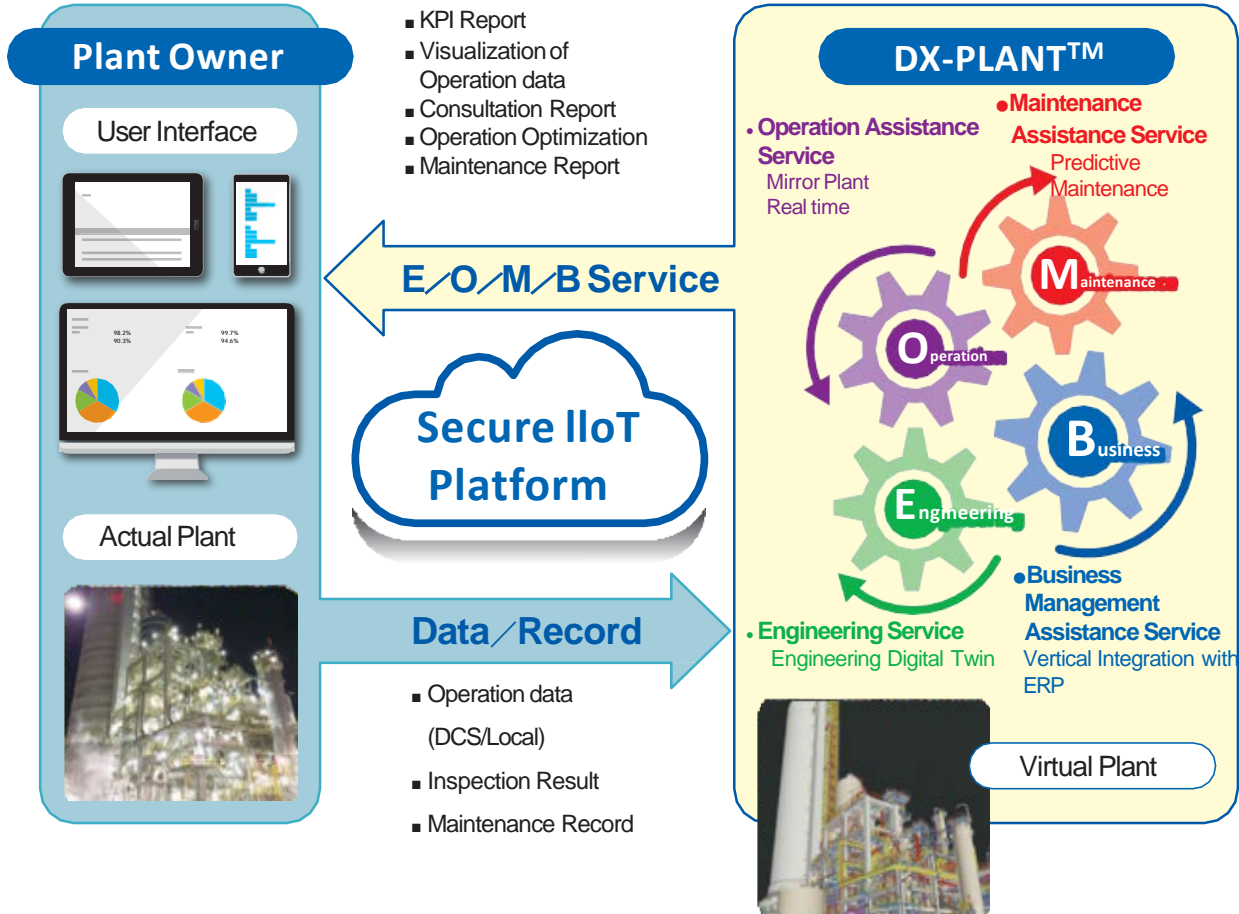
Targeted Outcome



1. Increase of On-Stream Factor
2. Increase of Production Rate
3. Reduction of Unplanned Shutdown
4. Increase of Maintenance Shutdown Interval
5. Reduction of Maintenance Shutdown Period
6. Increase of Energy Efficiency



DX-PLANT™: Digital Solution Scheme



Phasing Approach for Digital Plant

Phase-1 “Plant Insight”

Digitalization of Plants for

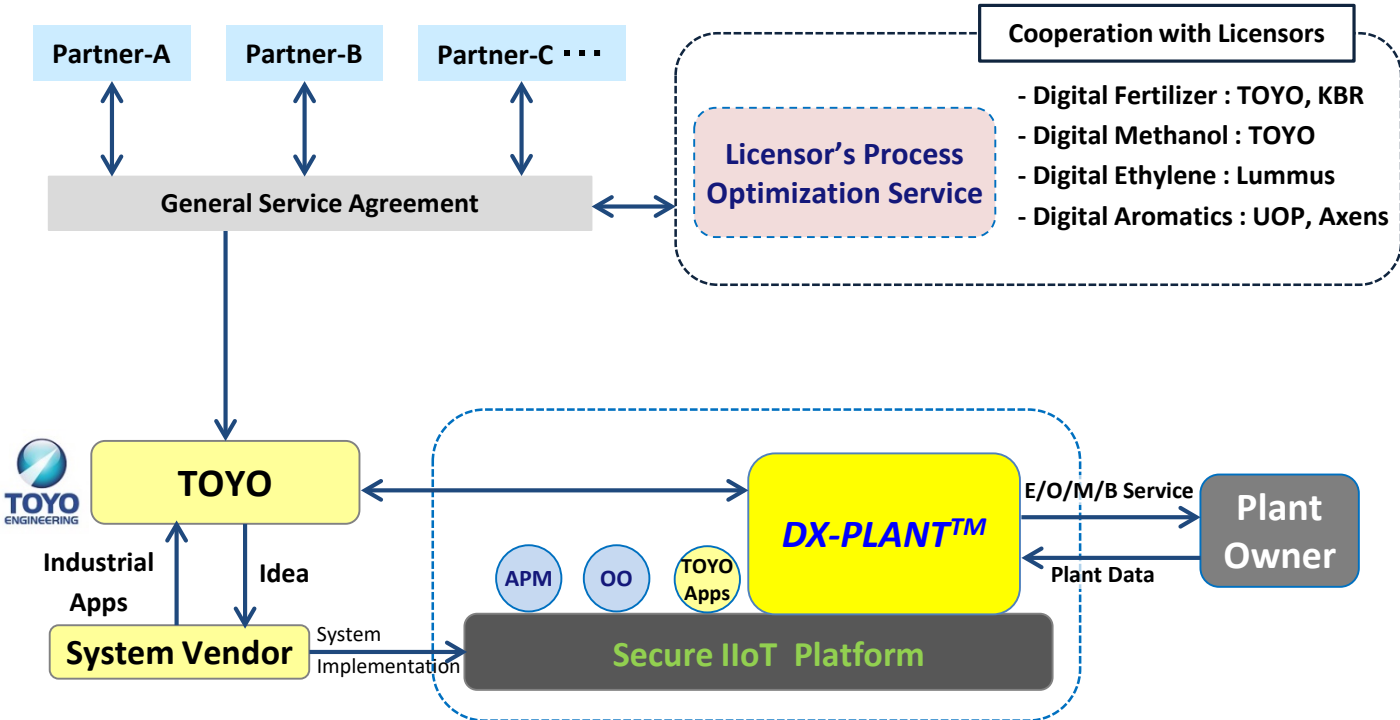
- *Transferring Data → Through internet
- *Storing Data → Cloud and reliable security
- *Visualizing Data → Access to Web through various devices
- *Monitoring and Advice by Expert

Phase-2/3 “Realization of Digital Twin”

Digital Transformation of Plants for

- *Analysis of Big Data → AI: Deep learning
- *Optimizing Operation → OPM: Operation Performance Management
- *Predictive Maintenance → APM: Asset Performance Management
- *HR Management → Field Service Management
- *Integration with ERP

DX-PLANT™: Overview

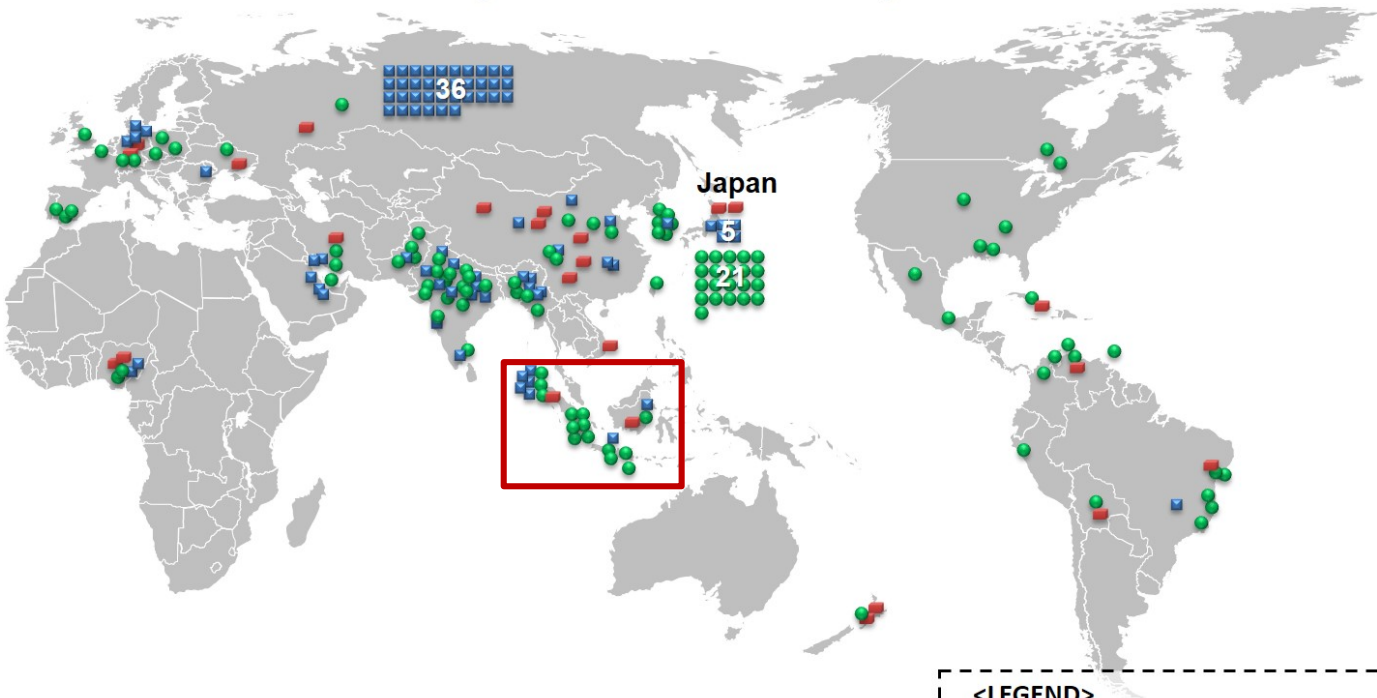





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TOYO's Experience of Fertilizer Projects

85 Ammonia Projects and 108 Urea Projects Worldwide



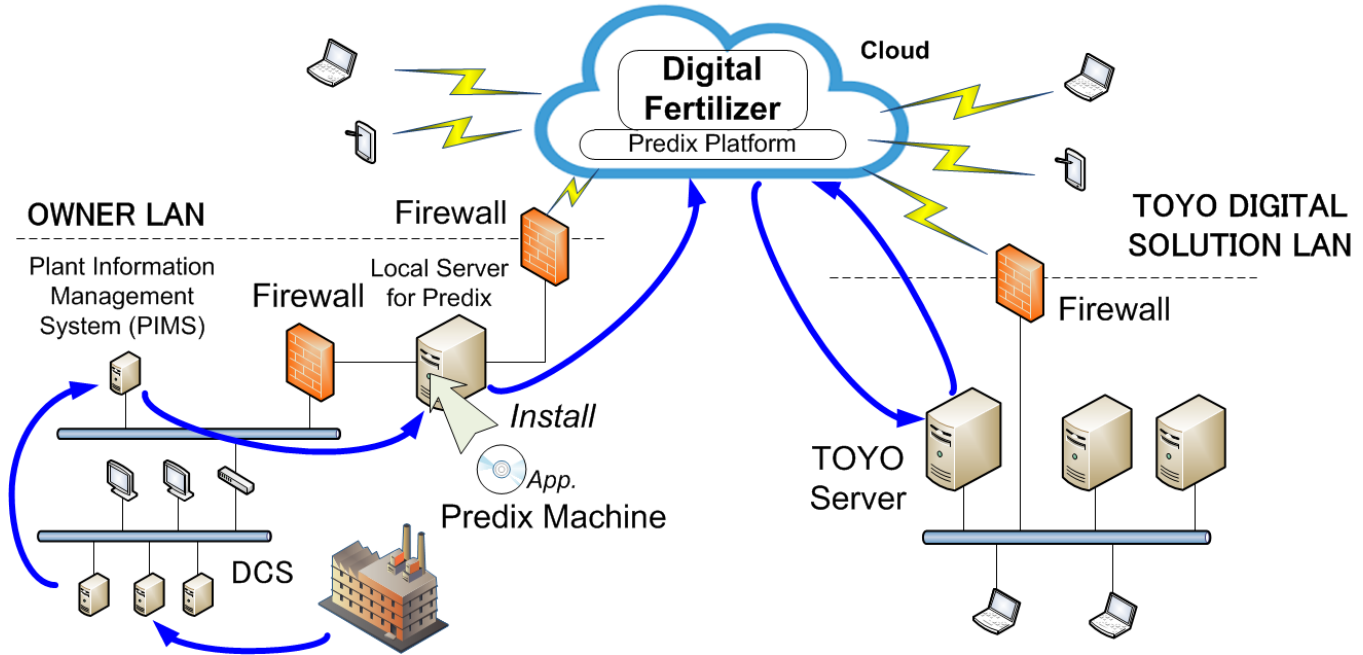
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 Ammonia Plant	85 Projects
 Urea Plant	108 Projects
 Granulation	24 Projects

Project Outline of PUSRI-IIB Project in INDONESIA

- ✿ *Plant Owner :*
P.T. Pupuk Sriwidjaja, Palembang (PUSRI)
- ✿ *Plant Location :*
Palembang, Indonesia
- ✿ *Plant Capacity :*
Urea: 2,750 MTPD (Prilled Urea)
- ✿ *Process :*
Urea: Toyo ACES 21® and Prilling Tower
- ✿ *Key Milestones :*
2016 Sep. First Production
2017 Sep. Digital Fertilizer Project Start
2017 Dec. Digital Fertilizer Launching



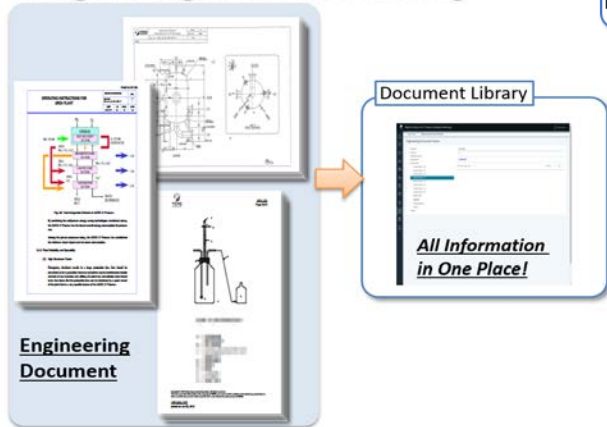
Digital Fertilizer (PUSRI) Configuration



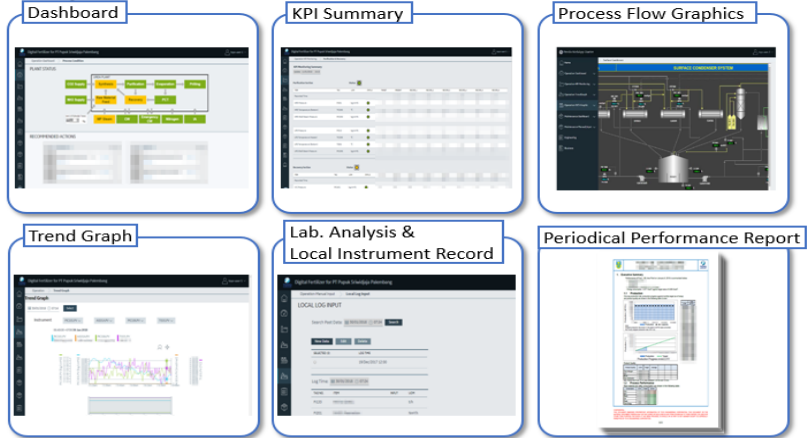
Function and Service of Phase-1



E: Engineering Information Sharing



O: Operation Assistance Service



Dashboard

KPI Summary

Process Flow Graphics

Trend Graph

Lab. Analysis & Local Instrument Record

Periodical Performance Report



M: Maintenance Assistance Service



Corrosion Monitoring

Inspection Record

Downtime Record

Agenda

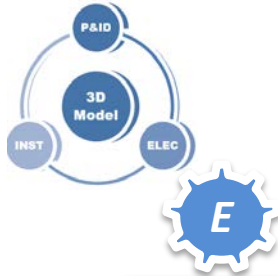
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Further Development (Phase-2/3)

Engineering: Information Management

- 3D Model Platform
- AR/VR Application

~Engineering Digital Twin~

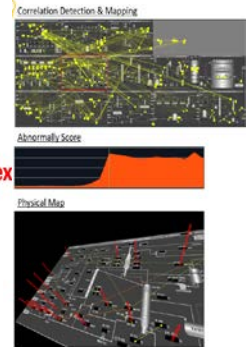


Operation: Prediction/ Optimization



Optimization

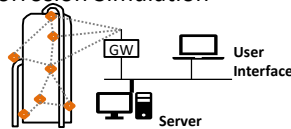
- Condition Monitoring
- Anomaly Detection
- Condition Prediction
- SOFT SENSOR
- Scoring, Benchmark & Index



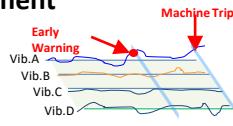
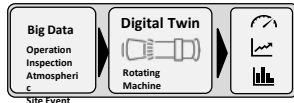
Maintenance: Time Based → Condition Based

Corrosion Monitoring

- Real-time Monitoring
- Corrosion Simulation



Rotating Machine Management



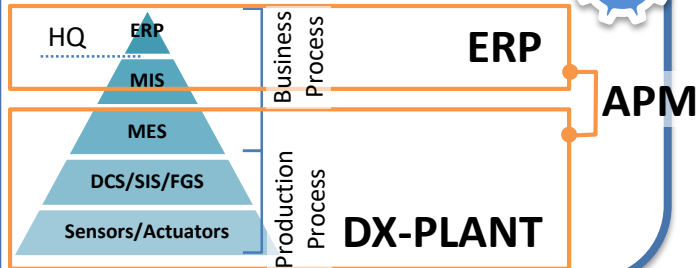
Early Detection



Realization of Digital Twin

Business Management

- Vertical Integration of ERP / APM(OPM)/DX-PLANT
- Digital Solution Center



TOYO as Total Solution Provider

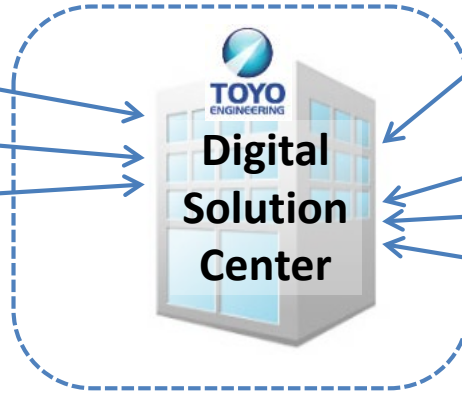
Plant Owners

Plant A

Plant B

Plant C

-
-
-
-
-



Licensor



Manufacturers

Static Equipment

Rotary Machinery

Instrument



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Service

Operation Service

- Remote Monitoring & TAS
- Dispatch SV

Maintenance Service

- Remote Monitoring & TAS
- Dispatch SV
- Spare Parts Management

Business Management

- Integration with ERP
- Production Planning
- Maintenance Planning

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Summary

1. In Nov. 2016, **BHGE and TOYO** signed a MOU for a joint project to explore digital solutions for the fertilizer and petrochemicals industry.
2. **“DX-PLANT”** is a digital ECO-system on cloud-based and/or on-premise platforms using TOYO’s expertise on processes and plant operations as licensor and EPC contractor of Fertilizer and Petrochemicals plants.
3. In Dec. 2017, TOYO has developed and launched **“DX-PLANT/Fertilizer”** for an actual fertilizer plant.
4. TOYO will provide the **total solution** to the owner by Digital Plant through **Digital Solution Center** by harmonizing human resources, assets and plant data for more productivity and less production cost of **all of other plant industries.**

**Toyo
Engineering**



**PLANT
OWNER**

Plant Owner

- Enterprise Resource Management
- Experience and knowhow of O&M



TOYO's Capabilities

- Process knowledge
- Engineering Know-How
- Integration of Partners

TOYO's DX-PLANT™

**Improve
Industrial
Plants
Profitability**

**Digital Transformation
for Oil & Gas Industry**

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