Course 3: Smart Operations Management (2-2-0)

Course Objective: The objective of this course is to develop competences on design and implementation of continuous and efficient operations while creating a digital copy of the end-to-end process. The Internet of Thing (IoT) system to collect real time data need to be discovered. Real-time data analytics can help to evaluate, and simulate the end-to-end operation to improve and manage all operations efficiently. Emphasis is on cross-enterprise integration of the physical and virtual systems among various functions including operation strategy, process design, capacity planning, facility location and design, forecasting, production scheduling and inventory control.

Learning Outcomes:

The students on the completion of this course would be able to:

CLO1. apply knowledge and methods from the advanced science of industrial engineering to model, evaluate and improve industrial processes and systems in relation with company operating efficiency and customer service.

CLO2. create smart production and co-created product development concepts in planning and controlling company's operations.

CLO3. design real time data analytics and software systems to support planning, scheduling and control of smart production processes and systems.

CLO4. design smart production processes and systems to efficiently respond to changes in operating conditions.

Prerequisite: None

Course Outline:

Module I: Advanced science of industrial engineering to model, evaluate and improve industrial processes and systems and co-created product development concepts

1. Operation management strategy in industry 4.0 context

1.1 Industry 4.0 framework, concept, theories, tools and techniques

1.2 Impact of industry 4.0 on modern operation management in strategic level

2. Smart product and co-created design concept

2.1 Smart product and co-created design concept and tools

3. Smart manufacturing concept

3.1 Introduction of traditional manufacturing concept

3.2 Smart manufacturing definitions

3.3 Architecture model for smart manufacturing

3.4 Characteristics of smart manufacturing and assessment

4. Smart operation concept

4.1 The enterprise-wide and cross-enterprise integration of the physical and virtual world

4.2 The design of smart production planning system and supply chain model

Module II: Smart production in planning and controlling company's operations integrated production planning and shop-flow control system concept

1. Implementation forecasting model under real-time situation:

1.1 Tracking accuracy of forecasting model when data are updated and real-time.

1.2 Adjusting forecasting model to match with the real-time demand.

1.3 Advanced techniques to utilize real-time demand for demand forecasting.

2. Inventory management under real-time situation:

2.1 Utilizing real-time data for inventory management and control.

2.2 Control system and advanced technology in inventory management

3. Advanced integrated production planning

3.1 Intelligent ERP and integration of IoT, massive data analytics. Cognitive and process automation.

3.2 Integrated planning system including aggregated planning, master production schedule (MPS), material requirement planning (MRP), and capacity planning (CRP) by utilizing real-time data.

4. Advanced shop floor control

4.1 Advanced scheduling techniques when real-time data are updated.

4.2 Automated shop floor control system and technology.

Module III: Real time data analytics and software systems to support planning, scheduling and control of smart production processes and systems

1. Real-time monitoring system

1.1 Example

1.2 How to design the system

2. IoT system

2.1 Smart sensor

2.2 Smart device

2.3 Cloud service

2.4 Telemetry service

3. Real-time data analytics

3.1 Logistic regression models

3.2 Time series analysis

3.3 Decision trees

4. Big data for predictive analytics, predictive modeling, and forecasting

4.1 Identify trends in supply chain sales

4.2 Monitor status of manufacturing process

4.3 Forecast when maintenance and repair work should be done in order to prevent problems

Workshop Sessions:

1. Impact of industry 4.0 on modern operation management

2. Product design tools for designing smart product

3. Design smart manufacturing and smart operations for local industry

4. IoT system for automatic data retrieval

Case Study:

1. Integrated production planning and controlling

2. Real-time manufacturing process monitoring system

Laboratory Sessions:

None

Learning Resources:

Textbooks: No designated textbook, but class notes and handouts will be provided.

Reference Books:

1. Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0, Springer International Publishing, 2016

2. Klaus Schwab and Nicholas Davis, Shaping the Future of the Fourth Industrial Revolution, Crown Publishing Group, 2018

3. Guilherme Frederico, Operations and Supply Chain Strategy in the Industry 4.0 Era, Independently Published, 2018

4. Diego Galar Pascual, Pasquale Daponte and Uday Kumar, Handbook of Industry 4.0 and SMART Systems, CRC Press, 2018

5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016

Journals and Magazines:

1. Computers and Industrial Engineering
2. Computers in Industry
3. Engineering Science and Technology
4. International Journal of Distributed Sensor Networks
5. International Journal of Industrial Engineering Computations
6. International Journal of Production Economics
7. International Journal of Production Research
8. Journal of Industrial and Production Engineering
9. Journal of Manufacturing Systems
10. Journal of Productivity Analysis
11. Nature
12. Smart and Sustainable Manufacturing Systems

Teaching and Learning Methods: This is an activity-based course. During lecture sessions, class discussion and case study will be conducted. During workshop sessions, active learning will be used. Students will practice several skills including, but not limited to, decision making, problem-solving, critical thinking, written communication, oral communication, presentation, debate, and teamwork.

Time Distribution and Study Load:

Lectures: 30 hours

Workshop: 30 hours

Self-study: 30 hours

Evaluation Scheme: The final grade will be given according to the following weight evaluation:

Assessment (CLO1): 25%

- Workshop 15%
- Open Exam 10%

Assessment (CLO2): 25%

- Case study 10%
- Class Project 10%
- Oral Presentation 5%

Assessment (CLO3): 25%

- Class Project 15%

- Workshop 10%

Assessment (CLO4): 25%

- Case Study 10%
- Oral Presentation 5%
- Open Exam 10%

Course Developers: Uttapol Smutkupt (uttapol@eng.cmu.ac.th) (CMU), Madalin Catana (mg_catana@yahoo.com) (UPB), Tritos Laosirihongthong (ltritos@engr.tu.ac.th) (TU), ()