中原大學
工業與系統工程學系
Chung Yuan Christian University
Department of Industrial and Systems Engineering

112-1學期
SK計劃課程
授課教師教學內容

- 課程時間目前安排於：
  3-B、3-CD、5-B、5-78

  *各教師課程內容規畫可能會另調整安排

- 開課課程：個案研究、工業工程方法
  一門課選擇兩位教師

Solver
Knight
Courses

授課時間表

時間	3-B 12:10-13:00	3-C 17:05~17:55	3-D 18:00~18:50	備註	時間	5-B 12:10-13:00	5-7 15:10~16:00	5-8 16:10~17:00	備註
教室安排	待規劃	待規劃	待規劃		教室安排	待規劃	待規劃	待規劃	
9月13日	楊康宏				9月15日	楊康宏	戴淑賢	戴淑賢	
9月20日	楊康宏	黃冠鈞	黃冠鈞		9月22日	楊康宏	趙怡翔(210)	趙怡翔(210)	
9月27日	楊康宏	饒忻	饒忻		9月29日	楊康宏	戴淑賢	戴淑賢	
10月4日	楊康宏	黃冠鈞	黃冠鈞		10月6日	楊康宏	趙怡翔(210)	趙怡翔(210)	
10月11日	楊康宏	饒忻	饒忻		10月13日	楊康宏	戴淑賢	戴淑賢	
10月18日	楊康宏	黃冠鈞	黃冠鈞		10月20日	楊康宏	趙怡翔(210)	趙怡翔(210)	
10月25日	王珮嘉	饒忻	饒忻		10月27日		戴淑賢	戴淑賢	
11月1日	王珮嘉	黃冠鈞	黃冠鈞		11月3日		趙怡翔(210)	趙怡翔(210)	
11月8日				期中考週	11月10日				期中考週
11月15日	王珮嘉	黃冠鈞	黃冠鈞		11月17日		趙怡翔(210)	趙怡翔(210)	
11月22日	王珮嘉	饒忻	饒忻		11月29日		戴淑賢	戴淑賢	
11月29日	王珮嘉	黃冠鈞	黃冠鈞		12月1日		趙怡翔(210)	趙怡翔(210)	
12月6日	王珮嘉	饒忻	饒忻		12月8日		戴淑賢	戴淑賢	
12月13日	王珮嘉				12月15日		王珮嘉	王珮嘉	
12月20日	王珮嘉	饒忻	饒忻		12月22日		王珮嘉	王珮嘉	
12月27日					12月29日				
1月3日				展演週	1/5				展演週
1月10日				期末考週	1月12日				期末考週

Case study: Ergonomics
個案研究: 人因工程

1. Core Ability Direction
   - Problem finding & Problem solving.
   - Develop an effective presentation narrative.

2. Prerequisite: Motion and Time Study, Ergonomics

3. Course Design: 12 hours

No.	Hour	Teaching approach	Content
1	2	Lecture	Industrial ergonomics case studies
2	4	Field study	Case-1: Industry visit & ergonomic assessment
3	3	Group meeting	Case-1: Initiate & intergrate an ergonomic report
4	4	Field study	Case-2: Industry visit & ergonomic assessment
5	3	Group meeting	Case-2: Initiate & intergrate an ergonomic report
6	2	Presentation	Final presentation

•Case Study (Service Quality)

- Overbooking of United Airlines-
- Service Failure that Impairs Corporate Image

Teaching Plan and Class Discussion:

1. Why Overbooking？What the benefit and loss for airline and customers.

2. Service quality perceived by customers.

4. Service failure and recovery.

5. Crisis management.

6. Profit vs. customer satisfy.
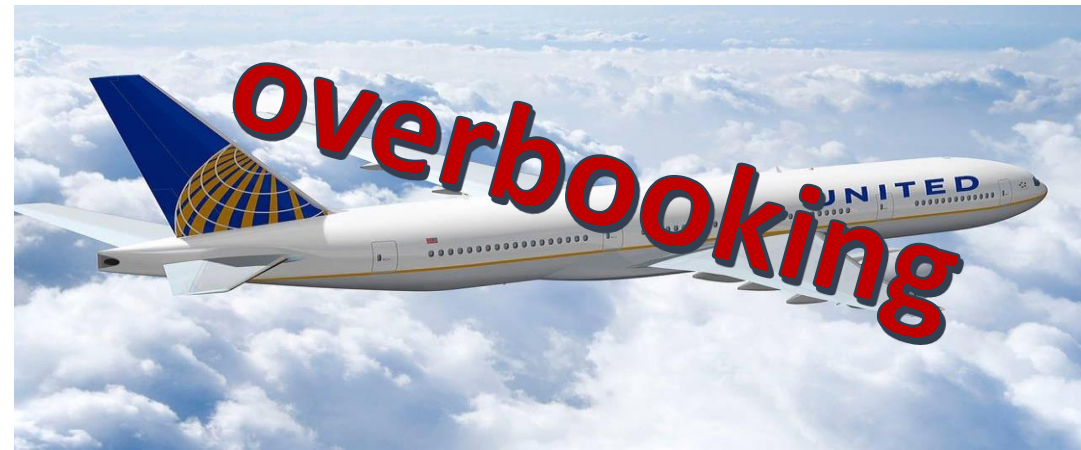
C++ and Excel VBA Fast Training (4 hours)

- Loop

- Data Structure

- Large data processing

- Python self-training and Kaggle for fun!!!

OR – GAMS Little Training

- Basic training (6 hours)
  - sets, parameters, table, equations, solve statements
  - $ control, alias
  - Input and Output: Excel, text file
  - Model Autorun for large size experiments, linking with VBA or C
- Model Building (3 hours)
  - Assignment variants
  - TSP
  - Network flow model
- Case study
  - Student Group Project

GAMS basic training case

- 設計一個交通網路，m間工廠，n間倉庫，應用GAMS模式驗證，所有決策變數都是整數

- 設定m間工廠有產能上限，結果會與沒有設限有何不同

- 設定n間供倉庫有庫存上限，結果和沒有設限有何不同

- 假設不是每一家工廠都可以到每間倉庫

GAMS Advanced Training Case

- 生活在現代基本很幸福，比起100年前的人生活相對來說要好的許多，但可能因為生活過得很幸福，大部分的人多多少少都有幸福肥，說要減肥的人比比皆是，但是在減肥的過程不是一味的不吃東西就行，至少在飲食上還是要注意一定程度營養。表一是體重、工作與每天所需熱量的對照公式。

每天活動量	體重過輕者所需熱量	體重正常者所需熱量	體重過重或肥胖者所需熱量
輕度工作	35大卡×目前體重（公斤）	30大卡×目前體重（公斤）	20~25大卡×目前體重（公斤）
中度工作	40大卡×目前體重（公斤）	35大卡×目前體重（公斤）	30大卡×目前體重（公斤）
重度工作	45大卡×目前體重（公斤）	40大卡×目前體重（公斤）	35大卡×目前體重（公斤）

另外，每人每天攝取蛋白質、脂肪及碳水化合物的公式如下，但有一個限制飽和脂肪必須小於22g，且一般人每天的基本喝水建議量，是將自己的體重乘以30（單位：c.c.）

碳水化合物(公克數) = 65%×每日攝取大卡÷4
脂肪(公克數) =20%×每日攝取大卡÷9
蛋白質(公克數) = 15%×每日攝取大卡÷4

假設情境：
考慮一個人85公斤，每一天都吃一樣不管三餐
考慮一個人55公斤，每一天都三餐吃一樣
考慮一定每一餐一定要吃到甚麼東西
考慮DINK(Double Income No Kid)，一個85公斤，一個55公斤

食物價格營養簡易版(未完成)

for 建模用

台灣食品成分資料庫2020版

Simulation – FlexSim and Witness

- Kendall notations and basic Statistics and Queueing Concepts 1 hour

- FlexSim Little Factory (2 hours)
    - Source, Sink, Queue, Processor
    - Conveyors, Stack, Transporter, AGV
    - Global Table, List
- Witness Little Factory (2 hours)
    - TBD

- FlexSim Healthcare Little model (4 hours)
    - Process Flow
    - People Module

- Case study
    - Student Group Project

Simple Jobshop System

- General Process flow
  - Source – Generate Token
  - Create Object – Generate item (product)
  - Sink – Destroy Token
- 3D Model
  - Queue × 6 – temporally place items
  - Processor × 5 – proceed items
- Tool Box
  - Item List
  - Global Table
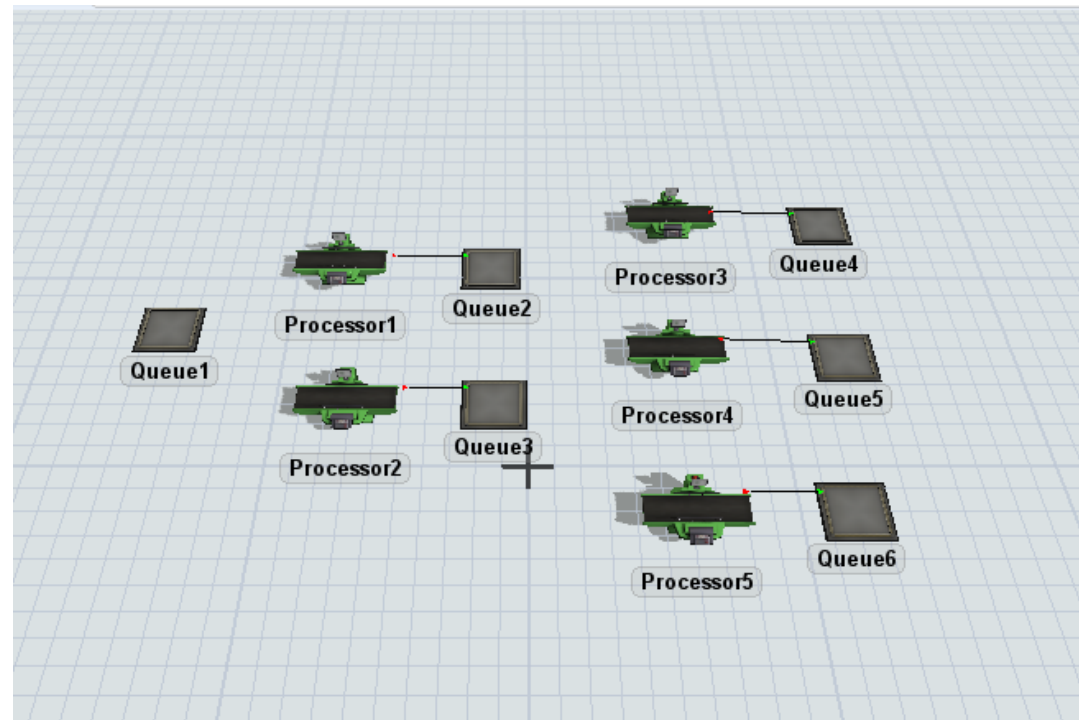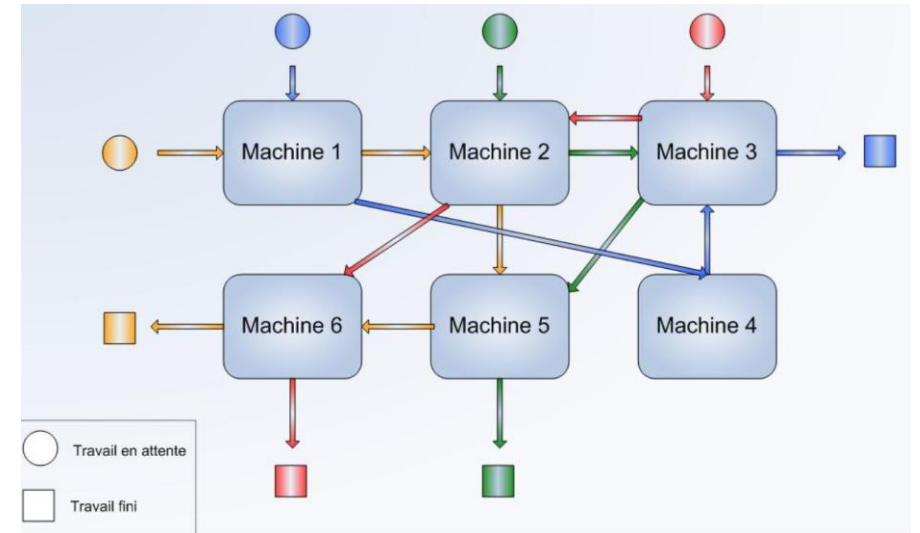
	M1	M2
P1	1	3
P2	1	4
P3	1	5
P4	2	3
P5	2	4
P6	2	5

ProcessFlow | ItemList1 Entries

Source
Create Object
Sink

Assigned Advanced case

Background

Chairs for Tots builds children's chairs that are sold through major outlets and over the internet. The production facility is just keeping up with their order rate but is also trying to keep operating costs down. Work in process at the end of the week is continued the next week. Ideally, operators help clean the area at the end of the week; however, if there are orders still to be completed, the cleaning operation becomes difficult. The plant doesn't want to add overtime but management feels they have to do something to increase the weekly output and still have time to clean and service the equipment.

Problem statement

- What will be the impact Of higher order rates on the oprations

The base order rate for chairs is approximately one every 25 minutes (distributed exponentially) but is expected to increase to one every 20 or even 15 minutes during a peak period. The plant starts operations at 8 a.m. Monday morning and runs 24 hours a day. It stops taking orders at noon on Friday so that the work in progress can be completed, the area cleaned, and the workers sent home at 4 p.m.

There are 4 major production steps:

1. For each order, a set of raw materials is conveyed to the cutting machine loading queue. An operator moves the wood from the queue to the cutting machine, which operates automatically.

2. Once cut, the cutting operator places the set of parts on a conveyor. The parts move to another queue where they wait to be assembled and painted. The assembly operator takes the parts and then assembles and paints each chair.

3. The painted chairs are conveyed to an oven to dry and set the glaze. The oven can hold up to five orders. Therefore, five orders are usually accumulated and placed in the oven at one time; however, any order shouldn't wait more than 150 minutes to be placed in the oven.

4. When dry, the orders are transported by conveyor to the packing area where they are inspected and prepared for shipment.

Operating times (in minutes; the varying times reflect the size distribution of the orders) can be found in Table 7.4.

Operation	Attribute – Minutes	Distribution
Order arrival rate	Mean = 30	Exponential
Cutting	Min 10; Max 20	Uniform
Assembly	Min 10; Max 20	Uniform
Heat Treatment	60	Constant
Inspection	Mean 20; Std 5	Normal

Table 7.4: Operating times.

Downtime occurs in a number of ways. The cutter and assembly operation both have frequent and infrequent downtimes. The frequent downtimes can be repaired by the operator. The operator will always stop the present job to repair the machine. The infrequent downtimes (changing a cutter blade and repairing the paint sprayer) have to be handled by the plant mechanic, who responds to breakdowns as they occur. The plant mechanic also has to fix problems in the other plant areas.

Operation	Time between failures (minutes)	Distribution	Time to repair (minutes)	Distribution	Repair Person
Cutter	Min. 20; Max. 80	Uniform	Min. 1; Max. 4	Uniform	Cutter Operator
Assembly	Min. 35; Max. 55	Uniform	Min. 1.2; Max. 3.0	Uniform	Assembly Operator
Oven	Mean 420; Std. Dev. 20	Normal	Mean 5; Std. Dev. 2	Normal	Mechanic
Cutter blade change	760	Constant	Min. 10; Max. 15	Uniform	Mechanic
Paint sprayer	Min. 400; Max. 560	Uniform	5	Constant	Mechanic
Other plant areas	Mean 100	Exponential	Min. 20; Std. Dev. 5	Normal	Mechanic

Table 7.5: Historical records for downtimes (minutes).

Material travel times

- Order entry to cutter: 3 minutes
- Cutter to assembly: 3 minutes
- Assembly to oven: 3 minutes
- Oven to packing: 5 minutes

Capacities

- Conveyor to cutter: 10
- Queue before cutter: 10

- Conveyor to assembly: 10
- Queue before assembly: 5
- Conveyor to oven: 10
- Conveyor to packing: 10

Expected results

- Run the simulation for 10 workweeks. Although in practice any incomplete orders would carry over to the next week, consider each week a separate run starting with a clean line.
- Report on production levels as well as how many orders are still in the system at the end of the week. The only operating personnel who need to be considered are the cutter operator, assembly operator, and plant mechanic.
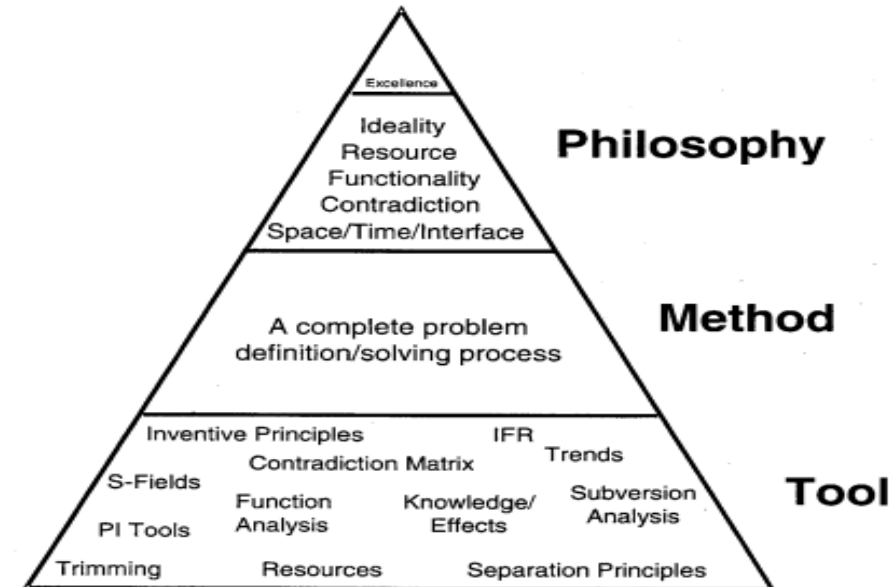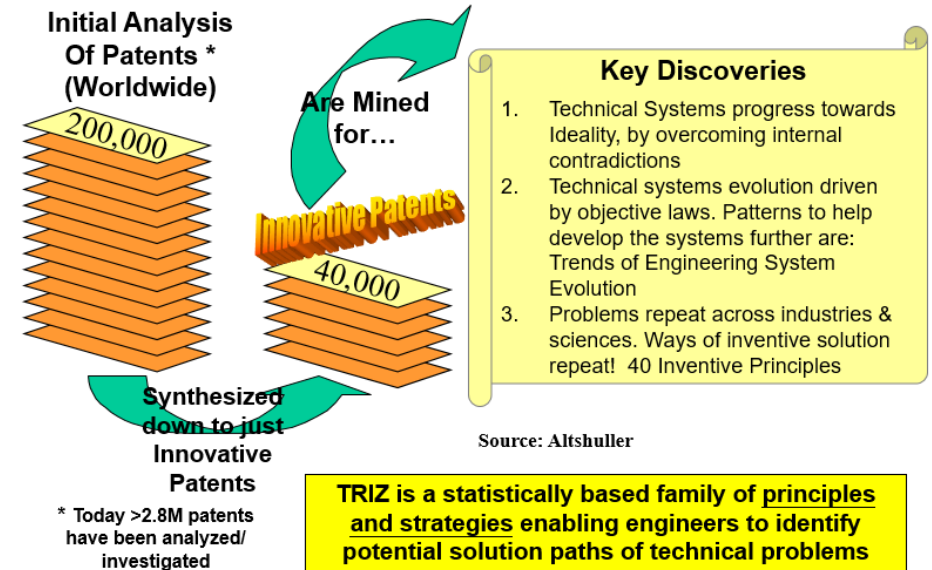
Modeling and analysis issues

- What level of detail is needed? Should all chairs in an order and their parts be tracked?
- What should be the basic time unit?
- How can you start and stop the simulation?
- Although the combiner object can perform batching, is it a good choice here?
    - What other object can handle batching?
    - How can the max waiting time be handled?
- What is the best way to validate that the components are working correctly before adding the complexity of the downtime?
- How can the "rest of the plant" be simulated and given a downtime for the mechanic to fix?
    - Which downtimes will pre-empt other jobs?
    - How is the person to service the downtime selected?
- What performance measures are important?
- What can be done to improve operations so that all jobs are finished by 4 p.m. on Friday?
    - The union wants an additional mechanic added.
    - The cutter operator wants an automatic infeed from the cutter queue.
    - The lean team suggests changing the way orders are entered into the oven-even suggesting converting to a five-lane continuous oven.
- What are the issues with higher order rates and what can be done to improve operations?

Anything else??

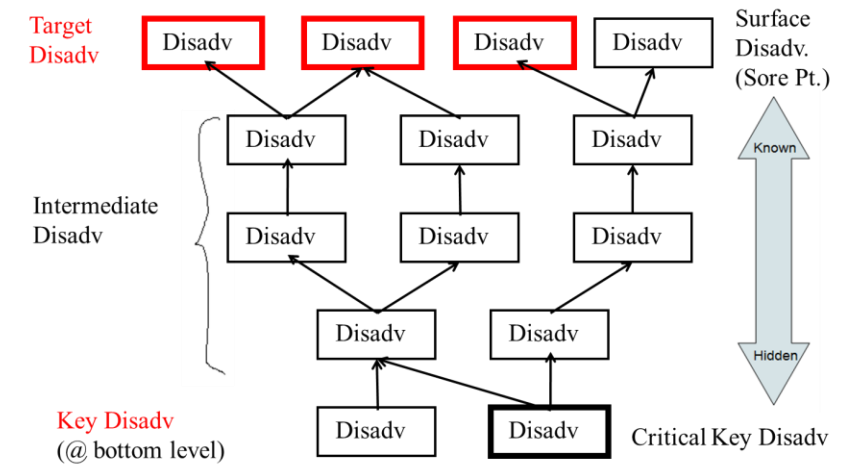# Innovative Design – by Hsin Rau

Week 1: What Is TRIZ?

- Key Discoveries
- Hierarchical View
- Seven Pillars
- Success Stories
- Global Innovation Index
- Applications & Organizations

Week 2: TRIZ and Systematic Innovation Tools (1)

- Six Thinking Hats with Practice
- Psychological Inertia
- STC Operator

Week 3: TRIZ and Systematic Innovation Tools (2)

- Ideality
- Ideal Final Result
- 9 Windows Method with Practice
- S-curve

Initial Analysis Of Patents * (Worldwide)

200,000

Are Mined for...

Innovative Patents

40,000

Synthesized down to just Innovative Patents

* Today >2.8M patents have been analyzed/ investigated

Key Discoveries
1. Technical Systems progress towards Ideality, by overcoming internal contradictions
2. Technical systems evolution driven by objective laws. Patterns to help develop the systems further are: Trends of Engineering System Evolution
3. Problems repeat across industries & sciences. Ways of inventive solution repeat! 40 Inventive Principles

Source: Altshuller

TRIZ is a statistically based family of principles and strategies enabling engineers to identify potential solution paths of technical problems

Excellence

Ideality
Resource
Functionality
Contradiction
Space/Time/Interface

Philosophy

A complete problem definition/solving process

Method

Inventive Principles   IFR   Trends

S-Fields   Contradiction Matrix

PI Tools   Function Analysis   Knowledge/Effects   Subversion Analysis

Trimming   Resources   Separation Principles

Tool

Innovative Design – by Hsin Rau

- Week 4: TRIZ Solution Procedure (1)
  - Problem Definition
  - Function Analysis
  - Cause Effect Chain and Contradiction Analysis

- Week 5: TRIZ Solution Procedure (2)
  - 40 Inventive Principles
  - Contradiction Matrix
  - Design Evaluation

- Week 6: Final Project
  - Project Proposal
 - Project Presentation

Manufacturing/AI：CPS introduction

- Phase 1: Virtual system development
  - Platform：Automation Studio
  1. Introduction of technologies applied to manufacturing systems
  2. Process control introduction
     a) Actuators
     b) Electric control system (JIC and IEC standards)
     c) PLC and Ladder diagrams
     d) Sequential Function Charts (SFC)
     e) 3D virtual system development (Case study and existing equipment)

*Note: Please refer to the figures
(1) CPS development Plan and
(2) CPS development details*

CPS Development Plan
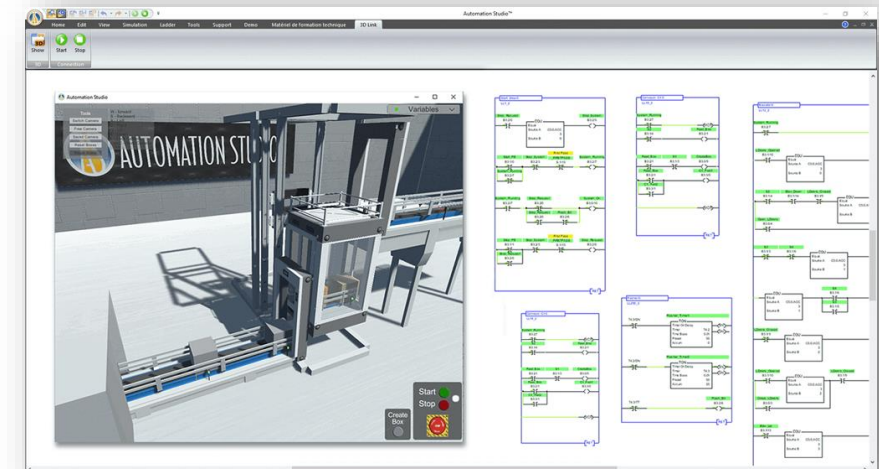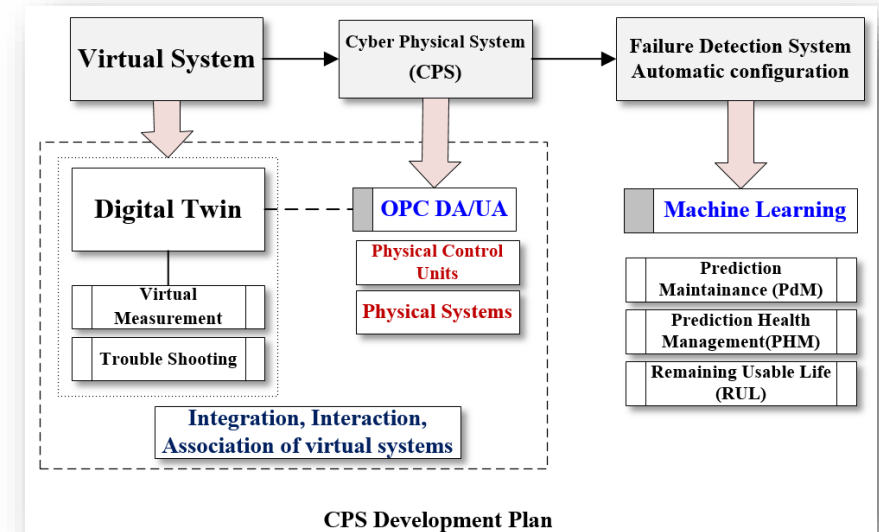
Manufacturing/AI：CPS introduction

- Phase 2: CPS development
  - Platform：Automation Studio
  1. Introduction of physical control units
     a) Mitsubishi
     b) Omron

  2. Introduction of communication strategies
     a) OPC severs
     b) OPC DA/UA
     c) Communications

Note: Please refer to the figures
(1) CPS development Plan and
(2) CPS development details
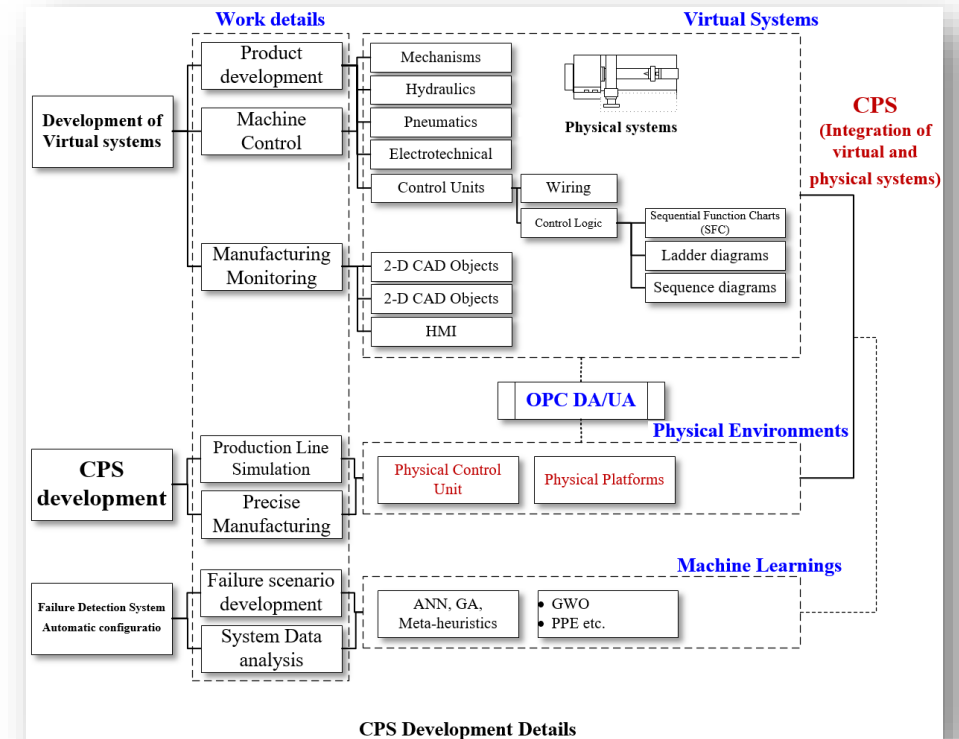
CPS Development Details

AI Technology for Smart Healthcare:
Biomedical Image Segmentation using CNN (1/2)

End-to-end image segmentation
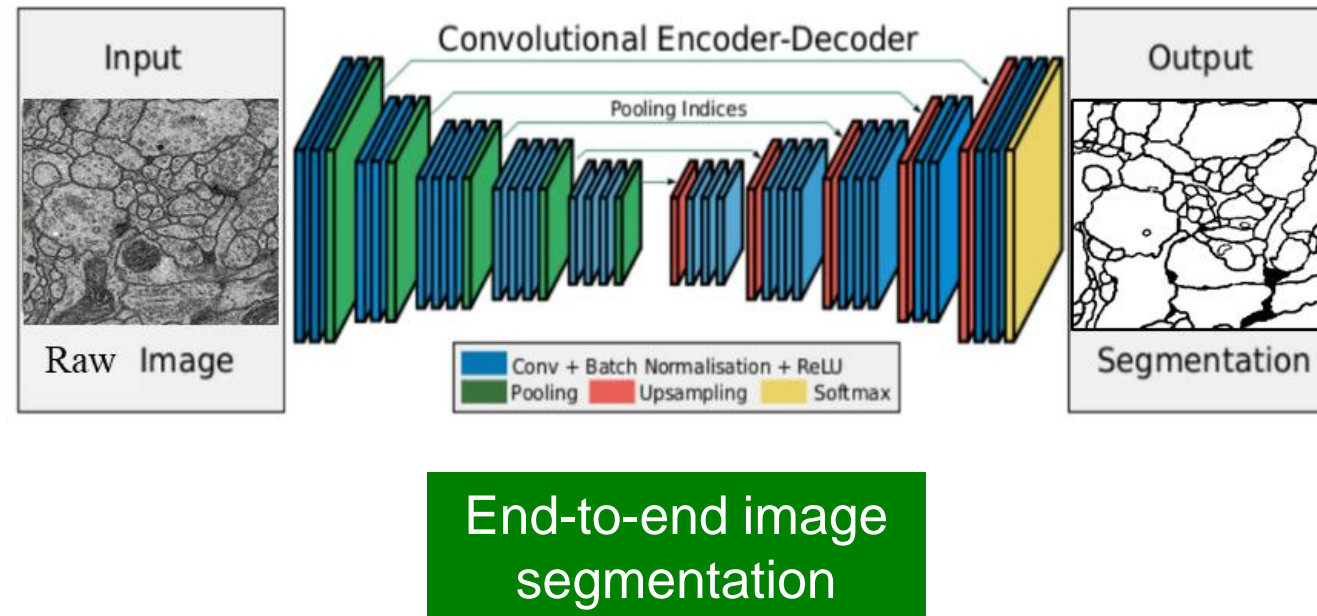
- Course Objectives
  - To learn the SOTA medical image segmentation method : Unet
    - » This method won the 2015 IEEE International Symposium on Biomedical Imaging (ISBI) challenge
      - ✓ Only 30 cell images in the training dataset

AI Technology for Smart Healthcare: Biomedical Image Segmentation using CNN (2/2)

- ## Course Outline
  - What is Image Segmentation ?
  - Fundamentals of Convolutional Neural Network (CNN)
  - The biomedical image segmentation method : Unet
  - The implementation of Unet using Pytorch or Keras
    - » Train a Unet model using the cell image training dataset
    - » Inference the cell image testing dataset using your Unet model
- ## You can apply Unet in other applications
  - Lesion Detection
  - Cell Tracking