

IDTF 技術白皮書 (第二版)

Industrial Digital Twins Framework - Technical Whitepaper

版本: 2.0

日期: 2025 年 1 月

作者: IDTF 技術團隊

4. 範本庫系統

4.1 兩層範本庫架構

Layer 2: Factory Design Template Library (工廠設計範本庫)

↓ 使用

Layer 1: Asset Template Library (資產範本庫)

4.2 Asset Template Library

定義: 標準化的工業資產範本庫

範本數量: 15+ 個核心範本

範本類別:

1. 泵 (Pumps):

2. 離心泵 (Centrifugal Pump)

3. 容積泵 (Positive Displacement Pump)

4. 真空泵 (Vacuum Pump)

5. 閘門 (Valves):

6. 控制閘 (Control Valve)

7. 開關閘 (On/Off Valve)

8. 安全閘 (Safety Valve)

9. 容器 (Vessels):

10. 壓力容器 (Pressure Vessel)

11. 儲槽 (Storage Tank)

12. 反應器 (Reactor)

13. 換熱器 (Heat Exchangers):

14. 管殼式換熱器 (Shell & Tube)

15. 板式換熱器 (Plate Heat Exchanger)

16. 空冷器 (Air Cooler)

17. 分析儀表 (Instruments):

18. 流量計 (Flow Meter)

19. 壓力變送器 (Pressure Transmitter)

20. 溫度變送器 (Temperature Transmitter)

21. 液位計 (Level Transmitter)

範本結構:

```

template:
  id: "centrifugal_pump_v1"
  name: "Centrifugal Pump Template"
  version: "1.0"
  category: "pumps"

parameters:
  - name: "flow_rate"
    type: "number"
    unit: "m3/h"
    required: true

  - name: "head"
    type: "number"
    unit: "m"
    required: true

plc_tags_template:
  - name: "{asset_id}_RUN"
    data_type: "BOOL"
    description: "Running status"

  - name: "{asset_id}_FLOW"
    data_type: "REAL"
    unit: "m3/h"
    description: "Flow rate"

scada_tags_template:
  - name: "{asset_name}_Status"
    alarm_enabled: true
    logging_enabled: true

alarms:
  - name: "Low Flow"
    condition: "{asset_id}_FLOW < {flow_rate} * 0.5"
    priority: "HIGH"

model_3d_template:
  usd_base_path: "/templates/pumps/centrifugal/"

```

4.3 Factory Design Template Library

定義: 行業區分的完整工廠設計範本庫

範本數量: 132 個範本 (11 個行業)

行業分類:

行業	工廠類型	規模變體	範本數
半導體	Fab 12吋, Fab 8吋, 後段封測	小/中/大	9
能源	LNG, 太陽能, 風力, 儲能	小/中/大	12
LED	封裝 (SMD/Mini/Micro), 晶片	小/中/大	12
數據中心	AI, 超大規模, 邊緣	小/中/大	9
化工	煉油, 石化, 精細化工	小/中/大	9
製藥	原料藥, 製劑, 生物製劑	小/中/大	9
食品飲料	啤酒, 乳品, 飲料	小/中/大	9
汽車	電池, 組裝, 塗裝	小/中/大	9
鋼鐵金屬	鋼鐵, 鋁冶煉, 金屬加工	小/中/大	9
紙漿造紙	紙漿, 造紙, 包裝	小/中/大	9
Smart City	交通, 能源, 建築, 水務等	小/中/大	36
總計			132

範本結構: ``yaml factory_template: id: "led_packaging_medium_v1" name: "LED Packaging Factory (Medium)" version: "1.0" industry: "led" scale: "medium"

overview: capacity: "50M units/month" equipment_count: 800 monitoring_points: 15000 floor_area: "10,000 m²"

systems: - id: "die_bonding" name: "Die Bonding System" equipment_count: 200
assets: - type: "die_bonder" template: "led/die_bonder" count: 200

```
- id: "wire_bonding"  
  name: "Wire Bonding System"  
  equipment_count: 150  
  assets:  
    - type: "wire_bonder"  
      template: "led/wire_bonder"  
      count: 150  
  
- id: "packaging"  
  name: "Packaging System"  
  equipment_count: 100  
  assets:  
    - type: "molding_machine"  
      template: "led/molding_machine"  
      count: 100
```

layout: zones: - name: "Clean Room" area: "8,000 m²" class: "ISO 7"

```
- name: "Equipment Area"  
  area: "1,500 m2"  
  
- name: "Warehouse"  
  area: "500 m2"
```

integration: erp: "SAP" mes: "Siemens Opcenter" scada: "Wonderware InTouch" plc: "Siemens S7-1500"

kpis: oee_target: 0.75