Apply AI to Make Production Planning & Control Intelligent

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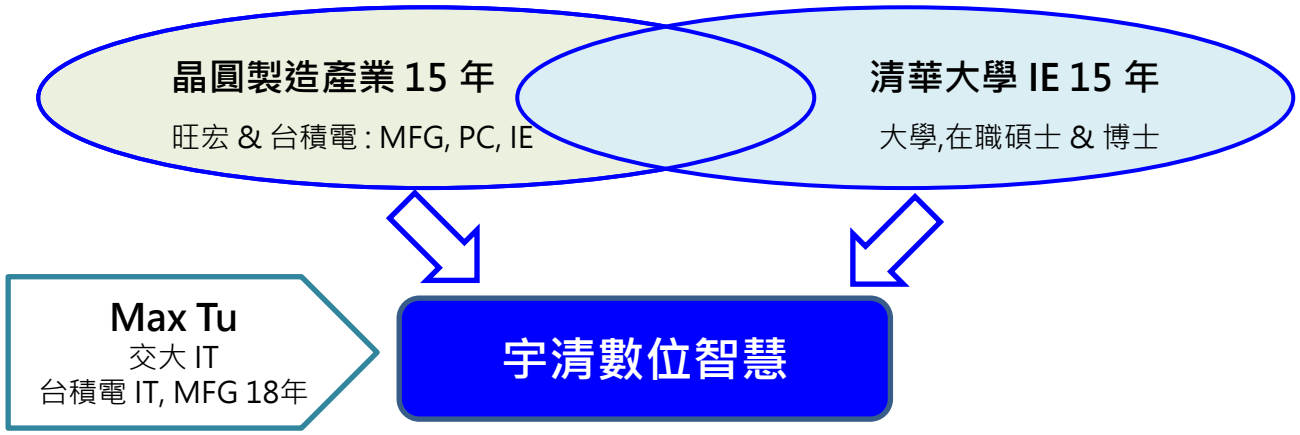


Academic Recognitions

Solid researches on data mining to solve cycle time problems

Article

Manufacturing Intelligence to Exploit the Value of Production and Tool Data to Reduce Cycle Time

February 2011 · IEEE Transactions on Automation Science and Engineering 8(1):103 - 111
DOI: 10.1109/TASE.2010.2040999
Source · IEEE Xplore

Authors:

Chung-Jen Kuo · Chen-Fu Chien · Jan-Daw Chen


IEEE
IEEE ROBOTICS AND AUTOMATION SOCIETY
IEEE Transactions on Automation Science and Engineering
Best Paper Award
is hereby presented to
Chen-Fu Chien
For the paper co-authored with Chung-Jen Kuo and Jan-Daw Chen entitled "Manufacturing Intelligence to Exploit the Value of Production and Tool Data to Reduce Cycle Time," as published in the IEEE Transactions on Automation Science and Engineering; vol. 8, no. 1, January 2011, pp. 103-111
David Orin
Society President
Bruno Siciliano
RAS Awards Chair
August 2012

Article · Publisher preview available

Tool allocation to smooth work-in-process for cycle time reduction and an empirical study

Springer

July 2020 · Annals of Operations Research 290(20)
DOI: 10.1007/s10479-018-3034-5

Authors:

Chen-Fu Chien · Chung-Jen Kuo · Chih-Min Yu

Article

Exploit the Value of Production Data to Discover Opportunities for Saving Power Consumption of Production Tools

September 2017 · IEEE Transactions on Semiconductor Manufacturing PP(99):1-1
DOI: 10.1109/TSM.2017.2750712

Authors:

Chih-Min Yu · Chen-Fu Chien · Chung-Jen Kuo

Article

Optimal Resources Allocation for a Hybrid Material Handling System in a 300mm Wafer Fab

January 2006
DOI: 10.1109/WODES.2006.1678413

Authors:

Chih-Ming Liu · Chung-Jen Kuo · Pei-Lun Chang

Article

Standard WIP Determination and WIP Balance Control with Time Constraints in Semiconductor Wafer Fabrication

Authors:

Chung-Jen Kuo · Chih-Ming Liu · Chih-Yang Chi

YouThought

AI : the Ongoing Trend for Competitiveness

台積電智慧製造進程

1987
追求製造卓越
公司成立，以技術領導、製造卓越、顧客信賴為三大信條

1990
電腦化時代
善用資訊化，成為全球晶片設計公司的虛擬晶圓廠

2000
自動化時代
打造自動化，實現調度自動化、運送自動化、設備自動化的全自動化製造環境

Industry 3.0

2011
智慧化時代
開始智慧化歷程，導入整合式IT平台及大數據分析與應用

2016
AI化時代
啟動深化機器學習計劃

2018
工業4.0時代
計劃每年培育300位深度學習工程師

Industry 4.0

研究整理：熊毅晰

2019, 天下雜誌

YouThought

Need AI to Break Through Planning & Control

Automation systems (Industry 3.0)

Before 2011, 運用 IT & robot 取代人不想做的工作

Sorter Auto	MCS	Sampling	EQP Auto	RCM	SPC
Stocker	Inter-Bay	FOUP Mgt.	R/C Auto	RMS	i-EDA
MES	Intra-Bay	Reticle Mgt.	C/W Mgt.	Alarm	FDC
Dispatching	ERP	ECS	C/W Auto	PMS	APC

Intelligent systems (Industry 4.0)

After 2011, 運用 AI 取代人做不來的工作

Production planning & control still need breakthrough

Cycle time	Delivery	Productivity & Delivery		
Efficiency Diagnosis	**Production Planning**	**Production Optimization**	**Process parameter optimization**	1 Chart FDC
Auto Priority	AMHS Efficiency	Dynamic Sampling	Tool Matching	Auto Spec
WIP Balance	Fast Recovering	Golden Path	Chamber Matching	Virtual Metrology

YouThought

One-plan for Production Planning & Control

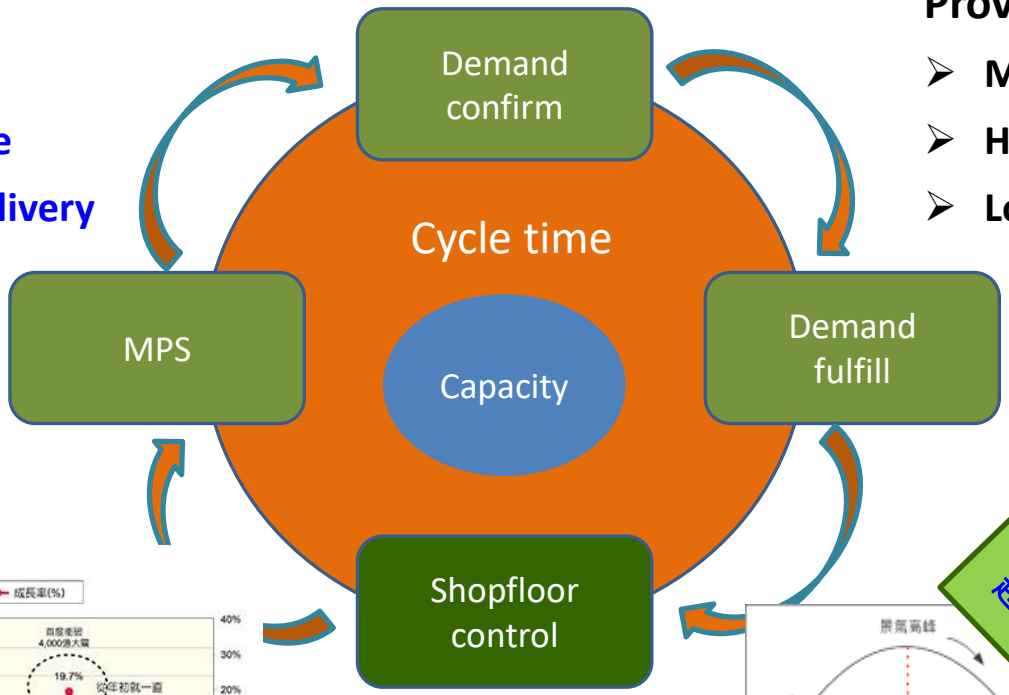
The essential competitiveness, especially in low seasons

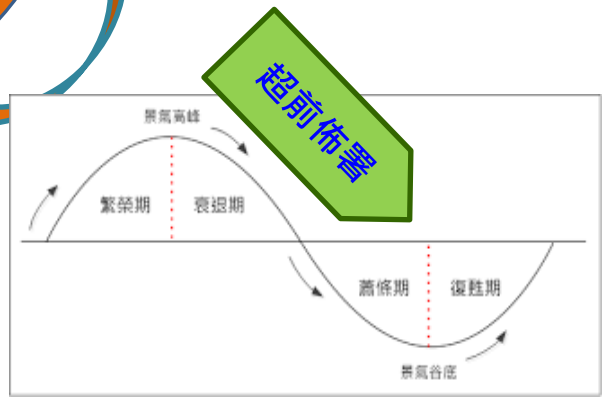
Customer's wish

- Good quality
- Short cycle time
- Trustworthy delivery

Provider's wish

- More orders
- Higher price
- Lower cost





YouThought

Short Cycle Time is Essential for Competitiveness

台積電首度公開智慧製造、張忠謀、魏哲家最關心的神祕數字

天天下雜誌, 2017

五月底的2017年台灣技術論壇，台積電首度揭露部分先進製造的秘密。首先，共同執行長魏哲家在主題演講時透露，台積已將當年熱門的大數據、機器學習技術，應用在製程管理，「都是為了降低我們的cycle time（生產週期）。」

客戶

產品生命週期愈來愈短, 無法容忍晶片廠 cycle time 過長

生產週期已是產業勝負關鍵。一位台積客戶主管表示，格羅方德的生產週期約比台積慢上30%，這不但代表同樣一個廠，台積可多創造三成營收，客戶產品上市的時間，也可快上將近一個月。而一個月，在變化快速的智慧手機業，往往就定生死。

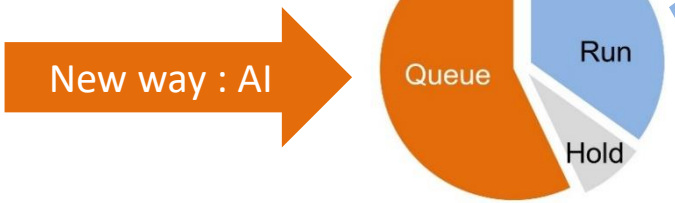
工廠

光罩層數愈來愈多, cycle time 愈來愈長

魏哲家說，早年在180奈米的時代（約15年前），一顆IC內部只有25層，但是生產一層得花上兩天。當前最先進的10奈米手機晶片，內部已高達80層，如果一層還是兩天，便代表一個產品要160天、將近半年才做得出來。「沒有人肯等你的，」魏哲家說。

他說，現在台積電10奈米的生產週期目前約1.1到1.2天。「我有一個夢想，以後要做到一層一天，不能再長，」魏哲家強調。

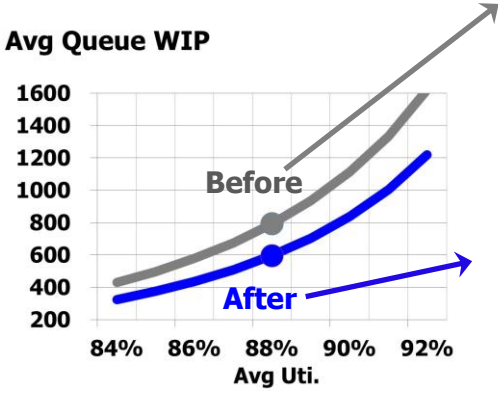
Cycle time profile

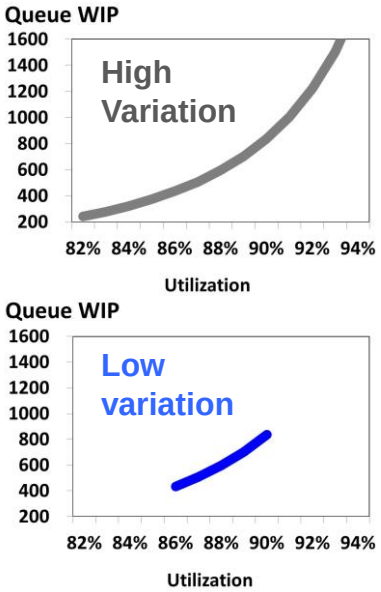


YouThought

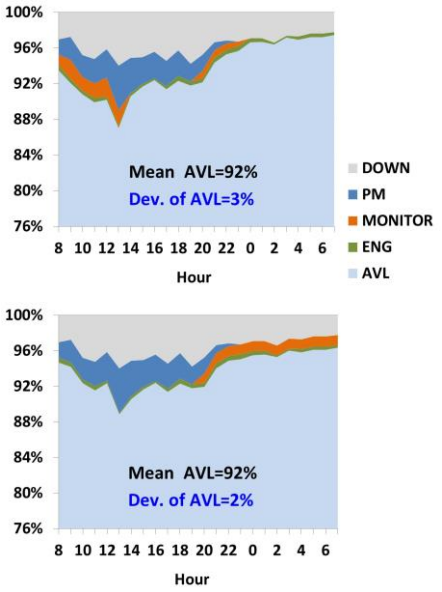
Variations Lead to Longer Cycle Time

How queuing time occurs at non-bottleneck?





zero cost to reduce 33% deviation



Doubled KPI, doubled opportunity

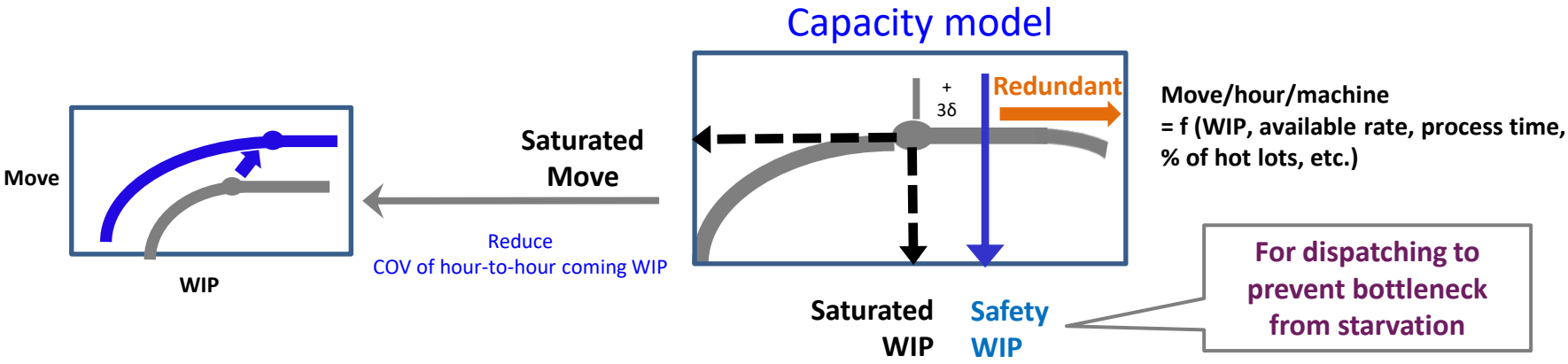
Type	Traditional 15 KPIs	Extra 15 KPIs
Machine	(↑) Mean uptime (↓) Mean process time (↑) Mean # of machines, etc.	(↓) Variation of uptime (↓) Variation of process time (↓) Variation of day-to-day loading, etc.
Material	(↓) Mean arrival rate (↑) Mean lot size (↓) Mean # of recipes for machine group, etc.	(↓) Impact of dispatching on variation of arrival rate (↓) Variation of lot size (↑) Same recipe rate, etc.
Man	(↑) Mean # of operators	(↓) Variation of operator loading, etc.

Black: Engineering, most mean

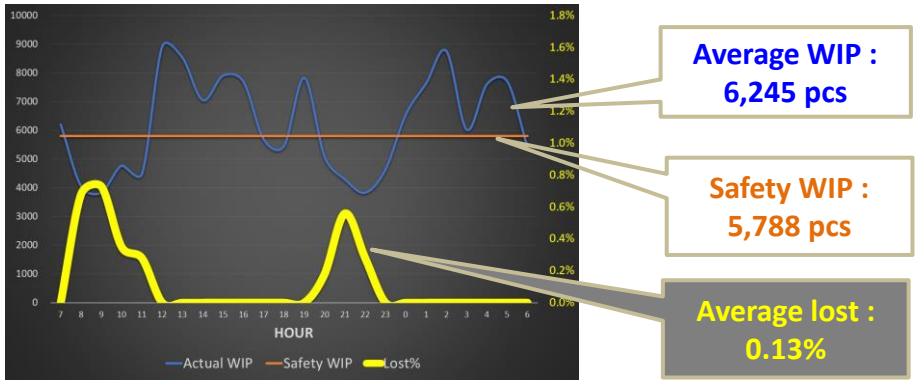
Blue: Managerial, most variation

YouThought

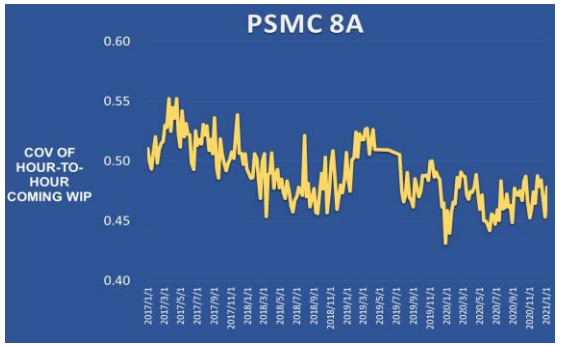
To Prevent Bottleneck from Loss



Case of bottleneck move loss due to insufficient WIP



Improved KPI by PSMC 8A



WIP fluctuation lead to bottleneck productivity loss

- **Upstream dispatching rule should take safety WIP into account**

Assess Your Cycle Time Capability

Optimal WIP level = cycle time capability and can be reduced

PSMC 8A, Q4, 2017

Rank	Machine Group	Safety WIP	Actual WIP	Redundant WIP	Redundant %
1	Wet station xxx	5,327	8,350	3,023	36.20%
2	Photo xxx	974	3,218	2,244	69.70%
3	CMP xxx	496	1,043	547	52.40%
4	Photo xxx	1,886	2,144	258	12.00%
5	Wet station xxx	495	719	224	31.20%
6	Furnace xxx	153	368	215	58.40%

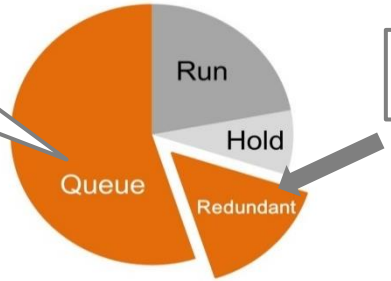
As-is cycle time capability

Actual Factory WIP	61,721	Optimal Factory WIP	55,210	Redundant Factory WIP	6,511	Redundant WIP %	11%

Little's law

$$\text{Cycle time} = \frac{\text{Fab WIP}}{\text{Fab output}}$$

Lean WIP by better KPI



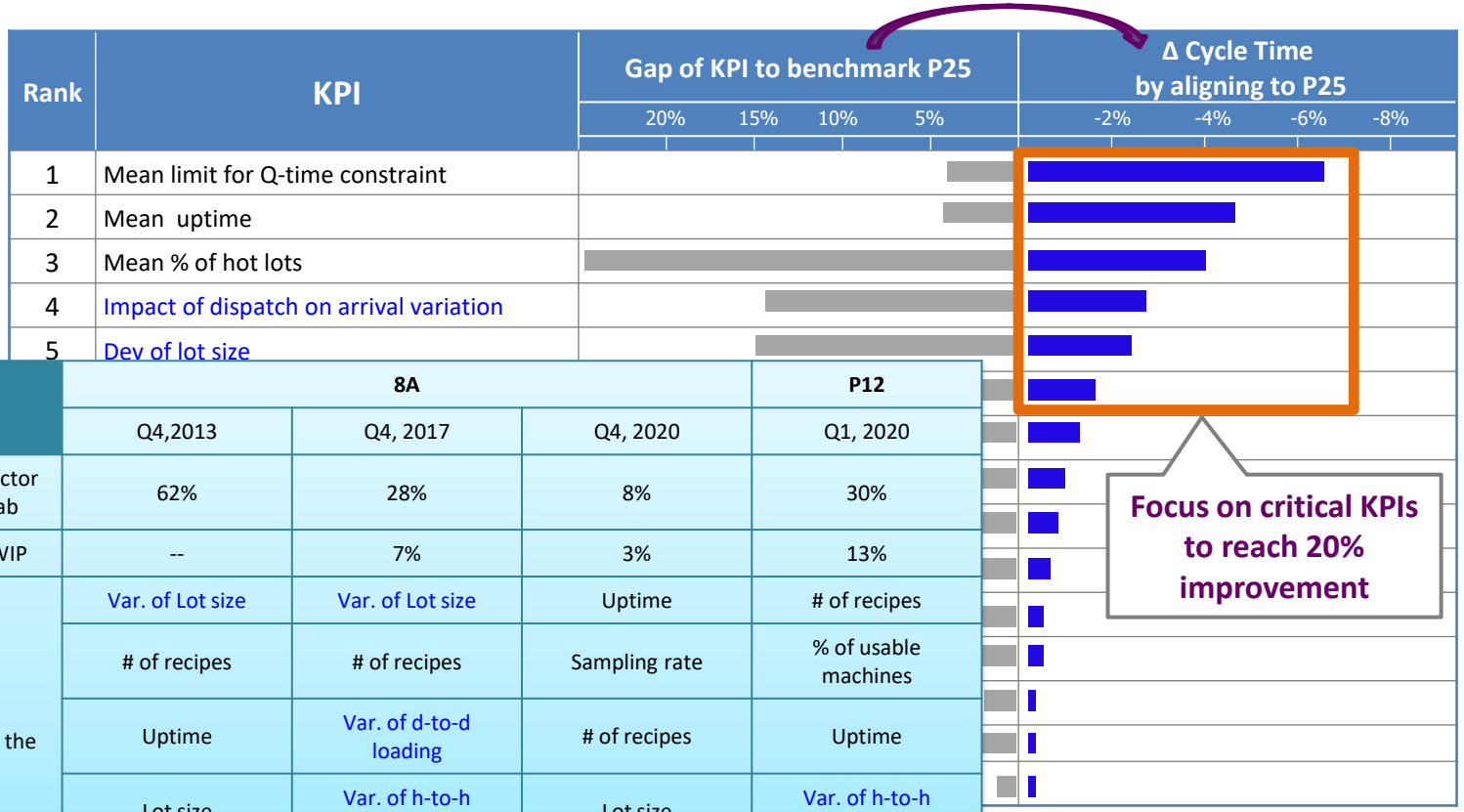
Unrealized cycle time capability

YouThought

Identify Key KPIs for Cycle Time Improvement

20-80 rule, never waste resources on trivial actions

× Sensitivity by Neural network models



Fab	8A			P12
	Q4,2013	Q4, 2017	Q4, 2020	Q1, 2020
Gap of CT x-factor to leading fab	62%	28%	8%	30%
Redundant WIP	--	7%	3%	13%
Top 5 KPIs for filling the gap	Var. of Lot size	Var. of Lot size	Uptime	# of recipes
	# of recipes	# of recipes	Sampling rate	% of usable machines
	Uptime	Var. of d-to-d loading	# of recipes	Uptime
	Lot size	Var. of h-to-h coming WIP	Lot size	Var. of h-to-h coming WIP
	Var. pf operator	Lot size	Var. of takt time	Var. of Lot size

YouThought

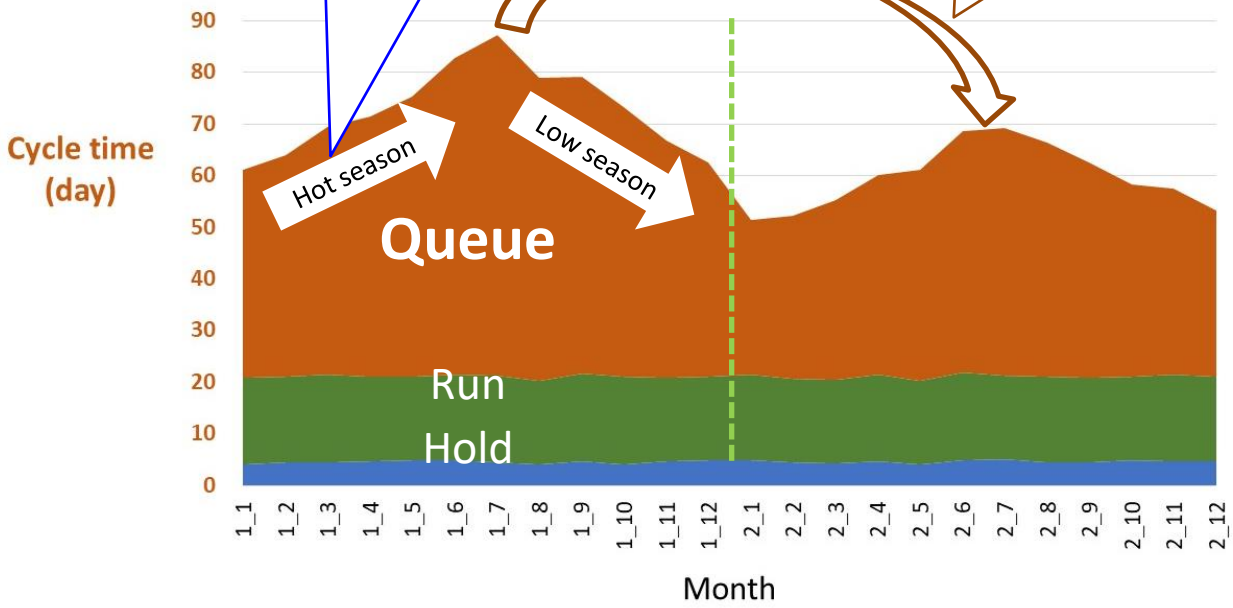
Queue Time: Key for Production Planning & Control

估得準

- To forecast queue time according to
  - ✓ Change of cycle time capability
  - ✓ Volume of wafer start, product mix etc.

跑得快

- Less redundant WIP
- Better KPI performance



YouThought

Simulation-based Planning Approach

Huge effort & long response time, but accuracy is poor

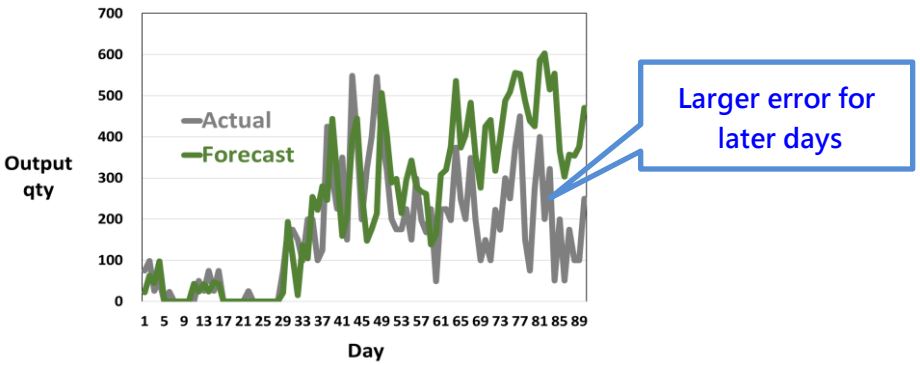
Tedious maintenance effort

Category	Inputs
Equipment	Uptime
	Setup time
	..
	Efficiency
Product	Process flow
	Run time
	Cycle time
	..
	Yield

Hard to assess impact by product mix

Fixed value based on history

Poor forecast accuracy : <60%



Larger error for later days

Inspiration from Google map

Before: use simulation

After: apply neural networks

科技 科學

圖神經網絡讓預估到達準確率提升50%，谷歌地圖實現新突破

2020/09/04 來源：機器之心Pro

機器之心報導

編輯：魔王、杜偉、小舟

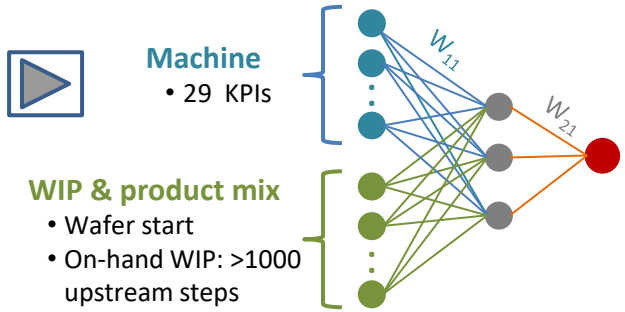
公交車、計程車等交通工具的到達時間是影響公眾出行的一大因素。所以，預估到達時間（ETA）準確率成為非常實際的研究課題。近日，DeepMind 與谷歌地圖展開合作，利用圖神經網絡等 ML 技術，極大了提升了柏林、東京、雪梨等大城市的實時 ETA 準確率。

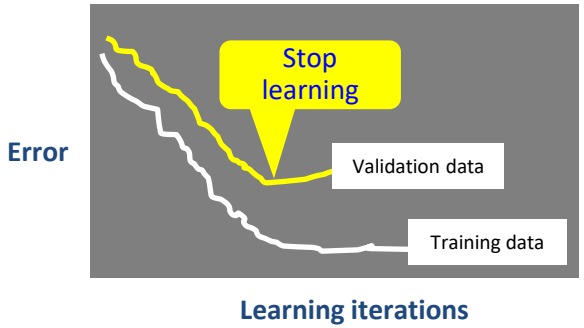
To apply neural networks for forecasting order delivery date

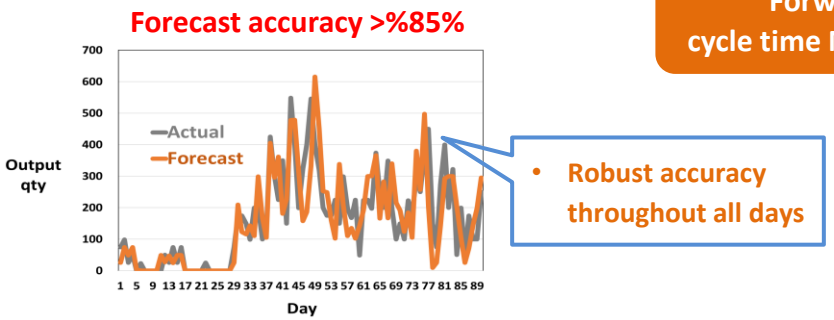
YouThought

Neural-networks-based Planning Approach

- **Less effort**: Make use of historical data in MES to build models
- **More accurate**: Neural networks model impact of numerous factors on cycle time







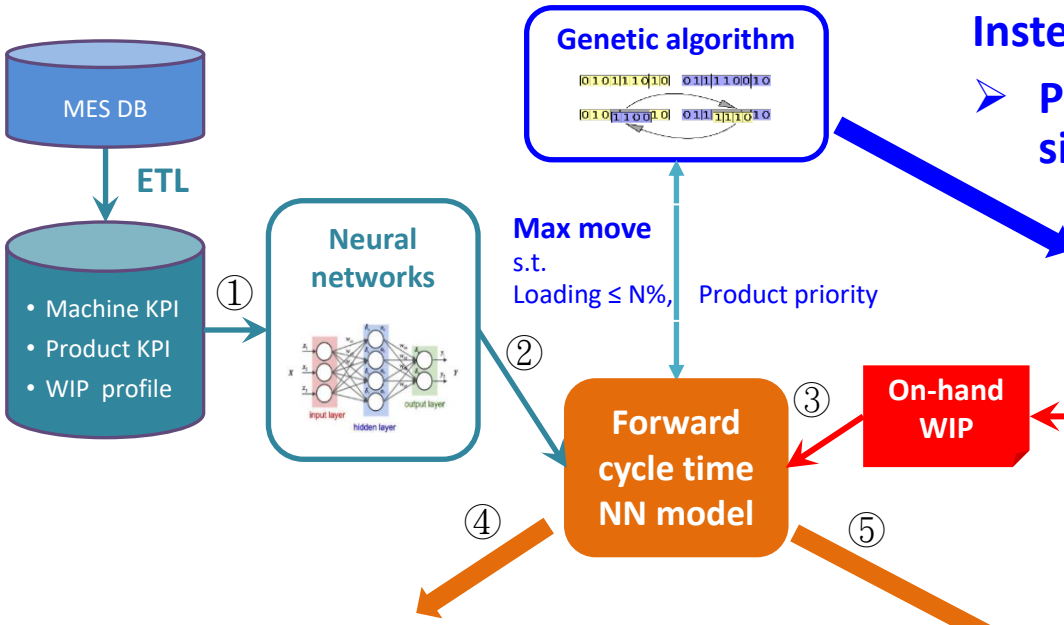
Release date	4/1	4/2	4/3	4/4	4/5	4/6	4/7
Release Qty	127	194	163	240	292	321	289
Cycle time (day)	46	46	47	47	48	50	51
Delivery date	5/17	5/18	5/20	5/21	5/23	5/26	5/28

- **Faster**: What-if to predict cycle time based on weights in the trained models

YouThought

Demand Confirmation

Confirm capable delivery date based on KPI & on-hand WIP profile



Instead of historical performance

- **Predict cycle time based on current situation and future loading**

Wafer start

Prod. ID	Total	4/1	4/2	4/3	4/4	4/5	4/6	4/7
P1	1623	127	194	163	240	292	321	289
P2	2333	303	337	371	389	347	379	307
…								
Pn	3176	447	457	423	443	463	445	498

Replan ⑥

Delivery date (Prod P1)

Release date	4/1	4/2	4/3	4/4	4/5	4/6	4/7
Release Qty	127	194	163	240	292	321	289
Fab cycle time (day)	46	46	47	47	48	50	51
Delivery date	5/17	5/18	5/20	5/21	5/23	5/26	5/28

Machine loading forecast

Machine	4/1	4/2	4/3	4/4	4/5	4/6	4/7
M1	68%	72%	46%	70%	46%	80%	87%
M2	86%	88%	87%	91%	92%	91%	93%
…							
Mn	96%	98%	100%	105%	110%	110%	105%

YouThought

Demand Fulfillment

Define the standard WIP to fulfill the committed due date

Forecast machine loading to take actions in advance

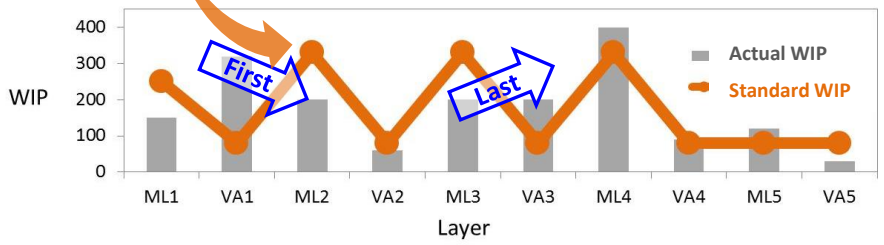
Target WIP & move for each product

Forward cycle time ④

Step	Machine	Standard WIP level on 4/1	Target Move 4/1	4/2	4/3	4/4
1	M14	174	433	263	219	257
2	M21	109	428	263	219	257
3	M21	108	422	262	218	256
..	..	...				
437	M3	67	234	316	348	446
438	M1	57	[illegible]	[illegible]	[illegible]	435
439	M2	98	225	232	359	345
	Committed delivery qty		225	225	350	340

Backward cycle time ①

② WIP deviation to target



③

⑤ Machine loading

Machine	4/1	4/2	4/3	4/4	4/5	4/6	4/7
M1	68%	72%	46%	70%	46%	80%	87%
M2	86%	88%	87%	91%	92%	91%	93%
...							
M20	98%	99%%	105%	108%	111%	108%	105%
...							
Mn	92%	94%	96%	93%	94%	95%	92%

Usually caused by excursion and need to take actions

- Postpone PM
- Cross-fab backup
- Re-commit due date

Lead to more lots in 1st quadrant

Priority quadrant for machine

Next layer \ Current layer	WIP ≧Optimal	WIP <Optimal
WIP <Optimal	First 15 lots	2nd 20 lots
WIP ≧Optimal	3rd 20 lots	Last 15 lots

YouThought

As-is Model & To-be Prospect

Commit cycle time for demand

Link to on-hand WIP & future wafer start

Item	As-is	To-be
Involved department	PC, Fab	
Method	Historical performance	Neural networks
Frequency	Quarterly	Daily
Cover on-hand WIP?	No	Yes
Resolution of results	Days per layer/ tech	Cycle time (days) /product

Delivery fulfillment

Foresee potential delays from global view

Item	As-is	To-be
Involved department	PC, Fab	
Target WIP profile?	No	Yes
Method	Critical ratio* for lots ? (Continuous value)	Priority quadrant for machines (Categorial value)
Conflict with other goals	High	Low
Global view from machine loading	No	Yes

Too sensitive for dispatching to keep same recipe

Allow dispatching to look after other goals

* Critical ratio=Remaining due days/Remaining cycle time

YouThought

Master Production Schedule

To build a scientific platform for all departments to reach persuasive results in short time

Monthly demand

Prod. ID	M1	M2	M3	M4	M5	M6
P1	3200	3370	3650	4320	4070	4310
P2	3700	2210	1550	500	0	0
P3	0	0	500	1500	2500	3200
…	…	…	…	..	…	…
Pn	2400	3170	2100	3340	2900	3950

Genetic algorithm

➢ Apply AI (NN& GA) to realize MPS automation & optimization

Max profit (or move)

s.t.

Qty>min qty /each product

Machine loading ≤ N%

Simulated wafer start for each date → On-hand WIP → ① → Forward cycle time NN model

③ → Cycle time

② → Output

④ → Machine loading

Product mix

- Product KPI
- Machine KPI

Replan or optimization ⑤

Cycle time

Prod. ID	M1	M2	M3	M4	M5	M6
P1	39	44	47	43	45	43
P2	43	49	51	48		
…	…	…	…	..	…	…
Pn	46	51	52	54	52	51

Output

Prod. ID	M1	M2	M3	M4	M5	M6
P1	2981	3022	3289	3443	3952	4122
P2	4043	3249	2785	1988		
…	…	…	…	..	…	…
Pn	2246	2051	2052	2625	3252	2781

Machine loading

Machine	M1	M2	M3	M4	M5	M6
M1	94%	95%	95%	95%	96%	96%
M2	98%	99%	103%	110%	108%	105%
…						
Mn	84%	84%	84%	85%	86%	86%

YouThought

GA to Search out Optimal Product Mix

Better than human and faster than linear programming

Prod. ID	M1	M2	M3	M4	M5	M6
P1	3200	3370 -100	3650	4320	4070	4310
P2	3700	2210 +100	1550	500	0	0
P3	0	0	500	1500	2500	3200
...	...	...	...	...	...	...
Pn	2400	3170	2100	3340 +200	2900	3950

Crossover

Mutation

Reproduction

Crossover
Mutation
Reproduction

- Initiate 10 feasible solutions
- Generate 60 feasible solutions
- Select 10 solutions with better target value
- Determine the optimal solution as the target is saturated

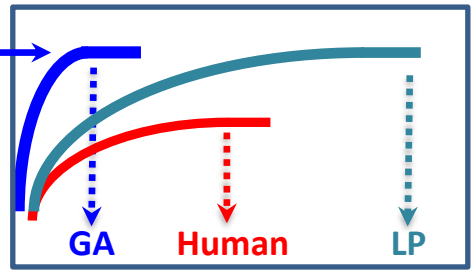
How to find the optimal one from N^6 combinations?

Max factory move

s.t.

Qty Pi > Minimal qty i

Machine loading<=100%



YouThought

As-is Model & To-be Prospect

MPS
(Master Production Schedule)

Weekly review

20X speed, 1/20 effort

Item	As-is	To-be
Involved department	BU, IE, PC	
Frequency	Monthly	
Method	Static simulation	Neural network (NN) & Genetic algorithm (GA)
Require time for each cycle	1 day	20 minutes
Require time for 5 cycles	5 days	2 hours
Consume man-day	14 man-days	0.7 man-day
Plan scope	6 ~ 12 months	
Input	Wafer start qty /product /month	
Result	Machine loading, Wafer out qty/month	
Cover on-hand WIP?	No	Yes
Cycle time	Input by user	Output by system
Continuity among months?	No	Yes
Optimization capability?	No	Yes

As-is: 7 man-days
➢ To-be: 0.4 main-day

As-is: 3 months
➢ To-be: 6~12 months

As-is: Key machines only
➢ To-be: All machines

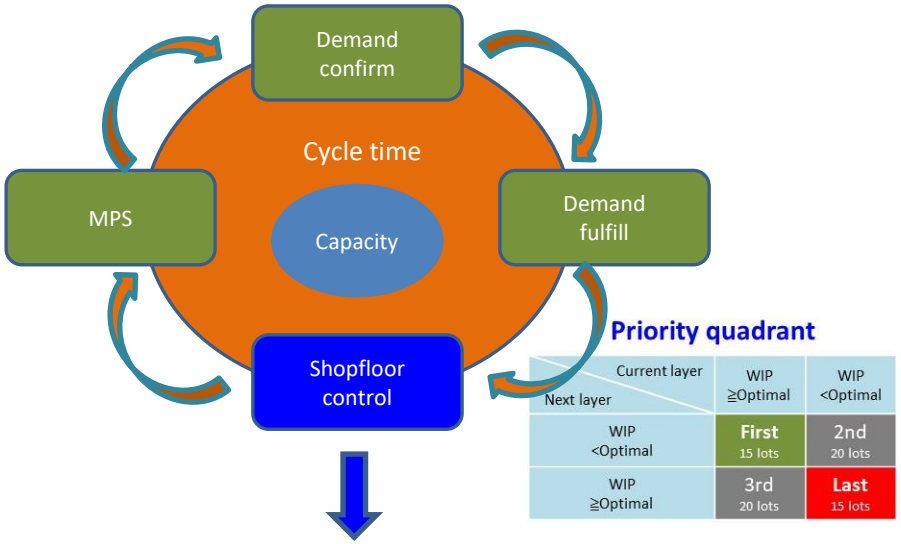
Each month is independent to on-hand WIP and adjacent months

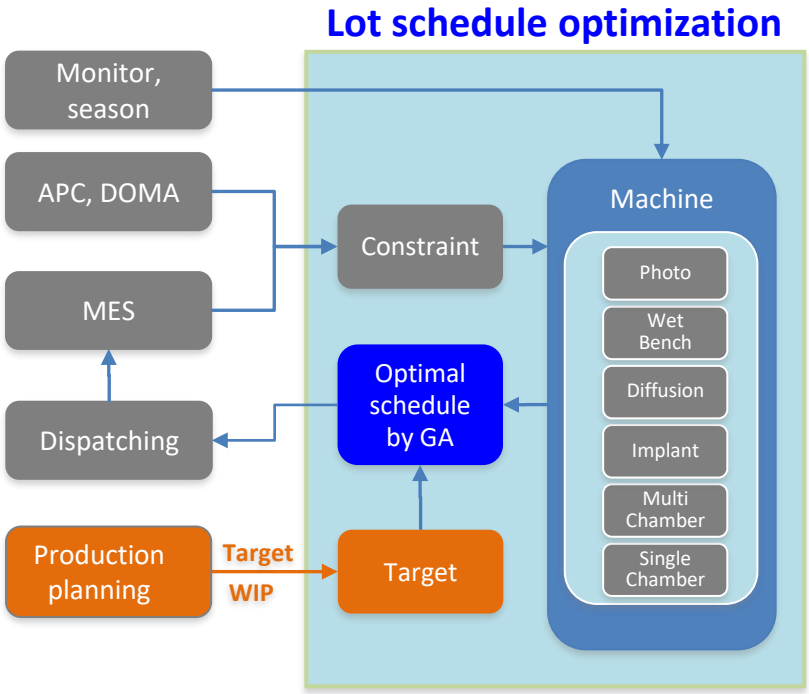
Persuasive results

YouThought

Optimal Shopfloor Control for Trade-off Targets

Shopfloor control is too complicated for human to handle





Bottleneck: Max move x大 + Min dev to target WIP x小

Non-BN: Min cycle time x小 + Min dev to target WIP x大

Subject to:
Scheduled down, Process constraints, Q-time limit, etc.

Beyond capability of rule-based dispatching , e.g., AMAT RTD

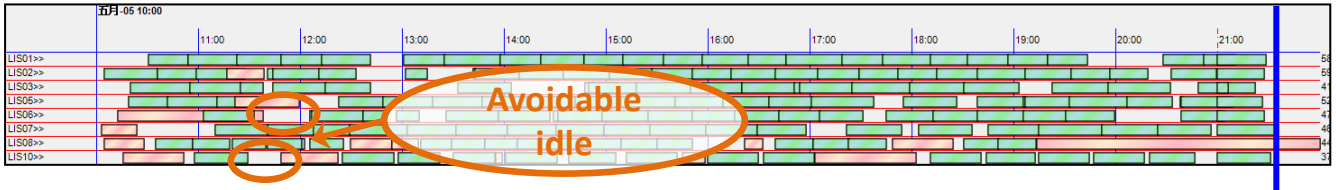
➢ **Need optimization solution to fulfill multiple targets**

YouThought

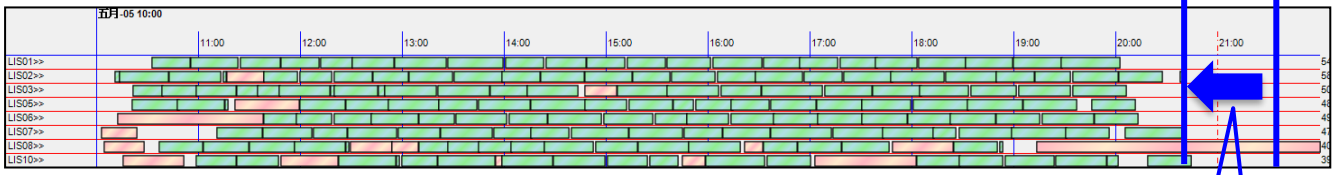
A Case for Production Schedule Optimization

Gain more productivity while secure on-time delivery

Rule-based



Optimized

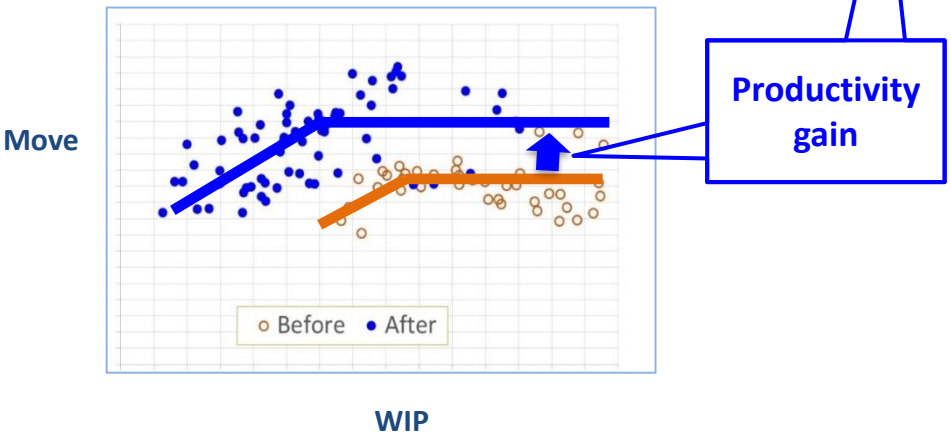


Max move x A

\+ **Min dev to target WIP** x B

Subject to:

Scheduled down
Process constraints
Q-time limit
Super hot lot
....



YouThought

Success Factors for Intelligent Planning & Control

Implementation for intelligent planning & control

Industry	Type	Efficiency diagnosis for cycle time	MPS	Demand confirmation	Demand fulfillment	Shopfloor control
TFT-LCD Array Fab	Full-auto	√		√	√	√
8” wafer Fab	Semi-auto	√		√	√	√
12” wafer Fab	Full-auto	√	√	√	√	√

Key factors for success

- **Top managers’ awareness for adopting AI to bring in breakthrough**
- **Define adequate KPIs for success of the project**
- **Integration with existing systems**
- **Top managers’ support for implementation**
- **Seamless cooperation for related departments to pursue same goals**

Incorporate AI into BPR to Boost Business Growth

➢ **Catch up with the trend of AI to make planning & control automatic and intelligent**

- Monitor KPI
- **Cooperation among departments**

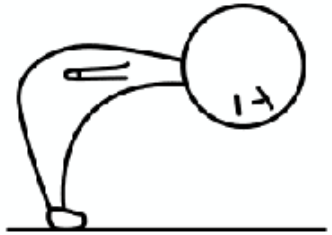
- As-is business flow, KPI, efforts, etc.

POC for AI approach

- **Leverage external experts to ensure success**
- Integration with existing systems, e.g. ERP, RTD

- To-be KPI
- To-be business flow
- Data & integration

YouThought



謝謝各位的聆聽

Q & A

郭仲仁 博士

宇清數位智慧

The Complete KPIs for each Machine Group

Type	Traditional 15 KPI		Extra 15 KPI	
	KPI	Description	KPI	Description
Machine	↑Mean available rate(v)	• (Run time+ Idle time)/Total time	↓Normalized STDEV of available rate(Dvn)	• Deviation of available rate among hours ,normalized by available rate. To assess if non-available statuses are balanced
	↓Mean process time(pt)	• End process time－Start process time for a lot or a batch	↓COV of process times(Cpt)	• Deviation/Mean of process time among lots
	↑Mean number of machines(m)	• Number of machines for the machine group	↓Normalized COV of machine group loading(Cmgln)	• Deviation/Mean of machine loading (arrival/AVL hours) among days, normalized by arrival rate. To measure if PM/ENG schedule is adequate
	↑Mean percentage of usable machines(u) ↓Mean sampling rate(s)	• Released machines/# of machines • Actually measured lots / Moved lots	↓Normalized COV of machine ID loading(Cmiln)	• Deviation/Mean of machine loading among machine IDs, normalized by arrival rate. To assess if scheduling is proper to balance loading among machines
			↓Backup percentage for other factory (bf) ↑Backup percentage by other factory (bb)	• the impact of WIP unbalance • Move backup for other/Total move • Move backup by other/Total move
	↓Mean AMHS cycle time (ol)	• Load time-request time	↓COV of AMHS cycle time (Col)	• Deviation/Mean of AMHS cycle time among lots
Man	↑Mean number of operators(p)	• # of operators allocated to the machine group (weighted by move of individual operators)	↓COV of number of operators(Cp) ↓Normalized COV of operator loading(Cpln)	• Deviation/Mean of #of operators among hours • Deviation/Mean of operator loading (arrival/#of operators) among days, normalized by arrival rate

Black: Engineering, most mean Blue: Managerial, most variation

↑: The higher, the better ; ↓: The lower, the better

YouThought

The Complete KPIs for each Machine Group (cont.)

Type	Traditional 15 KPI		Extra 15 KPI	
	KPI	Description	KPI	Description
Material	↓Mean arrival rate(a)	• Arrived WIP quantity per hour (pcs, = EOH+Move-BOH)	↓Normalized Intrinsic COV of arrival rate(Cain)	• Deviation/Mean of arrival rate among hours if dispatching rule is even by upstream machines, normalized by arrival rate
			↓Normalized Impact percentage of dispatching on Ca(idCan)	• =(Intrinsic COV of arrival rate－Actual COV of arrival rate)/Actual COV of arrival rate, normalized by arrival rate.
	↑Mean lot size(ls)	• Mean lot size of moved lots	↓Normalized STDEV of lot size(Dlsn)	• Deviation of lot size among lots, normalized by lot size
	↓Mean percentage of ENG lots(eng)	• Move of engineering lots/Move of all lots	↓Mean ratio for Q-time constraint(rw)	• Lots subject to q-time SPEC<24 hours/Total moved lots
	↓Mean percentage of RD lots(rd)	• Move of RD lots/Move of all lots	↑Mean limit for Q-time constraint(tw)	• Mean SPEC hours for lots subject to Q-time SPEC <24 hours
	↓Mean percentage of hot lots(h)	• Move of hot lots/Move of all lots	↑Mean same recipe rate(sr)	• Lot move with same recipe/Total lot move
	↓Mean percentage of super hot lots(sh)	• Move of super hot lots/Move of all lots		
	↓Mean percentage of hold WIP(hw)	• WIP of hold lots/WIP of all lots		
	↓Normalized Mean number of recipes(rn)	• # of recipes processed by the machine group (weighted by move of individual recipes), normalized by arrival rate		

Black: Engineering, most mean Blue: Managerial, most variation

↑: The higher, the better ; ↓: The lower, the better

Proposed POC Schedule

Scope of POC

- Duration for historical data : 500 days
- Duration for model training: 410 days
- Duration for model testing: 90 days to cover on-hand WIP
  - To assess the capability for forecast output date of on-hand WIP
  - Accuracy for a product on day i

    =100%: if forecast output qty=0 & actual output qty =0

    =Max(1- ABS(forecast output qty -actual output qty)/actual output qty ,0)
  - Accuracy for a product =average accuracy of day 1~day 90
  - Correlation for a product=Corr (Forecast output qty of day 1~90, Actual output qty of day 1~90)
  - Average accuracy & correlation for all products: Weighted average by output qty of each product

POC schedule

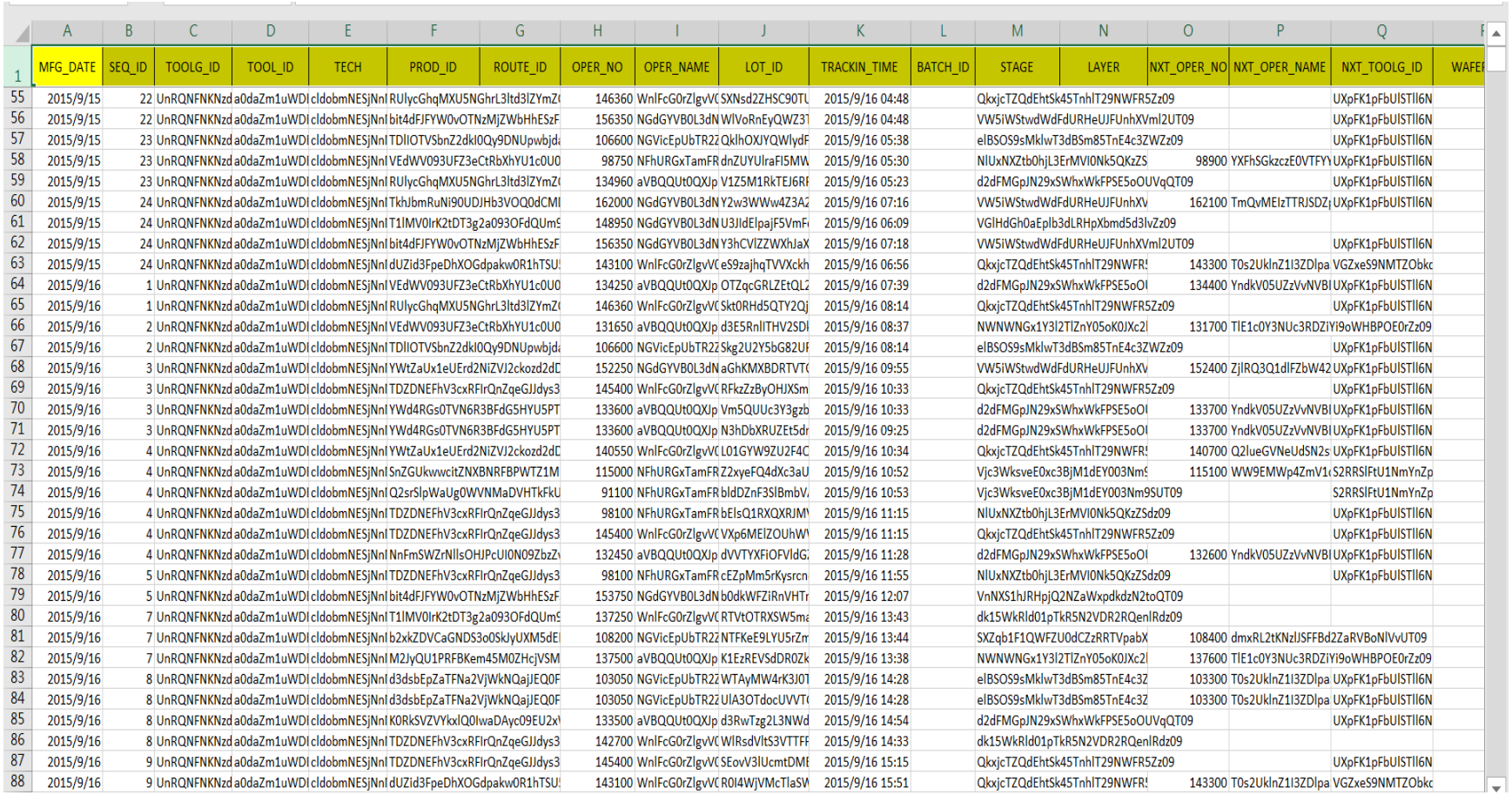
Task	Sponsor	Week
Explain format for required historical data	YT	W1
Complete 3-day historical data	psmc	W5
Check 3-day historical data	YT, psmc	W6
Complete 500-day historical data	psmc	W7
Build KPI	YT	W8
Build NN models	YT	W9
Present POC results	YT	W10
Decide Go/ No-go	psmc	W12

Equipment Status Change History

	A	B	C	D	E	F	G	H	I	J	K	N
1	MFG_DATE	SEQ_ID	TOOLG_ID	TOOL_ID	CHAMBER_ID	RUN	PM	MON	DOWN	LOST	ENG	
14242	2015/9/21	23	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
14243	2015/9/21	23	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14244	2015/9/21	23	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14245	2015/9/21	23	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
14246	2015/9/21	23	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	F	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14247	2015/9/21	24	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		51.0%	0.0%	0.0%	0.0%	49.0%	0.0%	
14248	2015/9/21	24	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14249	2015/9/21	24	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14250	2015/9/21	24	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	50.0%	0.0%	0.0%	0.0%	50.0%	0.0%	
14251	2015/9/21	24	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	F	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14252	2015/9/22	1	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
14253	2015/9/22	1	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14254	2015/9/22	1	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14255	2015/9/22	1	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
14256	2015/9/22	1	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	F	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14257	2015/9/22	2	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		70.0%	0.0%	0.0%	0.0%	30.0%	0.0%	
14258	2015/9/22	2	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14259	2015/9/22	2	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14260	2015/9/22	2	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	69.0%	0.0%	0.0%	0.0%	31.0%	0.0%	
14261	2015/9/22	2	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	F	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
14262	2015/9/22	3	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		35.0%	0.0%	0.0%	24.0%	41.0%	0.0%	
14263	2015/9/22	3	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	61.0%	0.0%	39.0%	0.0%	0.0%	
14264	2015/9/22	3	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	24.0%	76.0%	0.0%	
14265	2015/9/22	3	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	27.0%	61.0%	0.0%	12.0%	0.0%	0.0%	
14266	2015/9/22	3	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	F	0.0%	0.0%	0.0%	24.0%	76.0%	0.0%	
14267	2015/9/22	4	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09		0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14268	2015/9/22	4	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	A	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	
14269	2015/9/22	4	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	C	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
14270	2015/9/22	4	bDB2aVM2dnFtY0ZuVE9SRENUTThoZz09	bG81SVRGRHlVUGFCZ0VVYXI2aUJ0UT09	D	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	

YouThought

Lot History



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
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55	2015/9/15	22	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	RUlycGhqMXU5NGhrL3ltd3lZYmZ(		146360	WnlFcG0rZlgvV(	SXNsd2ZHSC90TU	2015/9/16 04:48		QkxjcTZQdEhtSk45TnhlT29NWFR5Zz09				UXpFK1pFbUlSTll6N	
56	2015/9/15	22	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	bit4dFJFYW0vOTNzMjZWbHhESzF		156350	NGdGYVB0L3dN	WlVoRnEyQWZ3T	2015/9/16 04:48		VW5iWStwdWdFdURHeUJFUnhXVml2UT09				UXpFK1pFbUlSTll6N	
57	2015/9/15	23	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDlIOTVSbnZ2dkl0Qy9DNUpwbjda		106600	NGVicEpUbTR2Z	QklhOXJYQWlydF	2015/9/16 05:38		elBSOS9sMklwT3dBSm85TnE4c3ZWZz09				UXpFK1pFbUlSTll6N	
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59	2015/9/15	23	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	RUlycGhqMXU5NGhrL3ltd3lZYmZ(		134960	aVBQQUt0QXJp	V1Z5M1RkTEJ6RF	2015/9/16 05:23		d2dFMGpJN29xSWhxWkFPSE5oOUVqQT09				UXpFK1pFbUlSTll6N	
60	2015/9/15	24	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TkhJbmRuNi90UDJHb3VOQ0dCMI		162000	NGdGYVB0L3dN	Y2w3WWw4Z3A2	2015/9/16 07:16		VW5iWStwdWdFdURHeUJFUnhXV	162100	TmQvMEIzTTRJSDZ		UXpFK1pFbUlSTll6N	
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62	2015/9/15	24	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	bit4dFJFYW0vOTNzMjZWbHhESzF		156350	NGdGYVB0L3dN	Y3hCVlZZWXhJaX	2015/9/16 07:18		VW5iWStwdWdFdURHeUJFUnhXVml2UT09				UXpFK1pFbUlSTll6N	
63	2015/9/15	24	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	dUZid3FpeDhXOGdpakw0R1hTSU		143100	WnlFcG0rZlgvV(	eS9zajhqTVVXckh	2015/9/16 06:56		QkxjcTZQdEhtSk45TnhlT29NWFR5	143300	T0s2UklnZ1I3ZDlpa		VGZxeS9NMTZObkc	
64	2015/9/16	1	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	VEdWV093UFZ3eCtRbXhYU1c0U0		134250	aVBQQUt0QXJp	OTZqcGRLZEtQLZ	2015/9/16 07:39		d2dFMGpJN29xSWhxWkFPSE5oOI	134400	YndkV05UZzVvNVBI		UXpFK1pFbUlSTll6N	
65	2015/9/16	1	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	RUlycGhqMXU5NGhrL3ltd3lZYmZ(		146360	WnlFcG0rZlgvV(	Skt0RHd5QTY2Qj	2015/9/16 08:14		QkxjcTZQdEhtSk45TnhlT29NWFR5Zz09				UXpFK1pFbUlSTll6N	
66	2015/9/16	2	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	VEdWV093UFZ3eCtRbXhYU1c0U0		131650	aVBQQUt0QXJp	d3E5RnlITHV2SDI	2015/9/16 08:37		NWNWNGx1Y3l2TlZnY05oK0JXc2I	131700	TlE1c0Y3NUc3RDZiYi		9oWHBPOE0rZz09	
67	2015/9/16	2	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDlIOTVSbnZ2dkl0Qy9DNUpwbjda		106600	NGVicEpUbTR2Z	Skg2U2Y5bG82UF	2015/9/16 08:14		elBSOS9sMklwT3dBSm85TnE4c3ZWZz09				UXpFK1pFbUlSTll6N	
68	2015/9/16	3	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	YWtZaUx1eUErd2NiZVJ2ckozd2dD		152250	NGdGYVB0L3dN	aGhKMXBDRTVT(	2015/9/16 09:55		VW5iWStwdWdFdURHeUJFUnhXV	152400	ZjlRQ3Q1dlFZbW42		UXpFK1pFbUlSTll6N	
69	2015/9/16	3	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		145400	WnlFcG0rZlgvV(	RFkzZzByOHJXSm	2015/9/16 10:33		QkxjcTZQdEhtSk45TnhlT29NWFR5Zz09				UXpFK1pFbUlSTll6N	
70	2015/9/16	3	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	YWd4RGs0TVN6R3BFdG5HYU5PT		133600	aVBQQUt0QXJp	Vm5QUUc3Y3gzb	2015/9/16 10:33		d2dFMGpJN29xSWhxWkFPSE5oOI	133700	YndkV05UZzVvNVBI		UXpFK1pFbUlSTll6N	
71	2015/9/16	3	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	YWd4RGs0TVN6R3BFdG5HYU5PT		133600	aVBQQUt0QXJp	N3hDbXRUZEt5dr	2015/9/16 09:25		d2dFMGpJN29xSWhxWkFPSE5oOI	133700	YndkV05UZzVvNVBI		UXpFK1pFbUlSTll6N	
72	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	YWtZaUx1eUErd2NiZVJ2ckozd2dD		140550	WnlFcG0rZlgvV(	L01GYW9ZU2F4C	2015/9/16 10:34		QkxjcTZQdEhtSk45TnhlT29NWFR5	140700	Q2lueGVNeUdSN2s		UXpFK1pFbUlSTll6N	
73	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	SnZGUkwwcitZNXBNRFBPWTZ1M		115000	NFhURGxTamFR	Z2xyeFQ4dXc3aU	2015/9/16 10:52		Vjc3WksveE0xc3BjM1dEY003Nm9	115100	WW9EMWp4ZmV1(		S2RRSlFtU1NmYnZp	
74	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	Q2srSlpWaUg0WVNMaDVHTkFkU		91100	NFhURGxTamFR	bldDZnF3SlBmbV	2015/9/16 10:53		Vjc3WksveE0xc3BjM1dEY003Nm9SUT09				S2RRSlFtU1NmYnZp	
75	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		98100	NFhURGxTamFR	bElsQ1RXQXRJM	2015/9/16 11:15		NlUxNXZtb0hjL3ErMVI0Nk5QKzZSdz09				UXpFK1pFbUlSTll6N	
76	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		145400	WnlFcG0rZlgvV(	VXp6MElZOUhW	2015/9/16 11:15		QkxjcTZQdEhtSk45TnhlT29NWFR5Zz09				UXpFK1pFbUlSTll6N	
77	2015/9/16	4	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	NnFmSWZrNllsOHJPcUI0N09ZbzV		132450	aVBQQUt0QXJp	dVVTYXFlOFVldG	2015/9/16 11:28		d2dFMGpJN29xSWhxWkFPSE5oOI	132600	YndkV05UZzVvNVBI		UXpFK1pFbUlSTll6N	
78	2015/9/16	5	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		98100	NFhURGxTamFR	cEZpMm5rKysrcn	2015/9/16 11:55		NlUxNXZtb0hjL3ErMVI0Nk5QKzZSdz09				UXpFK1pFbUlSTll6N	
79	2015/9/16	5	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	bit4dFJFYW0vOTNzMjZWbHhESzF		153750	NGdGYVB0L3dN	b0dkWFZiRnVHTr	2015/9/16 12:07		VnNXS1hJRHpjQ2NZaWxpdkdzN2toQT09					
80	2015/9/16	7	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	T1lMV0IrK2tDT3g2a093OFdQUm9		137250	WnlFcG0rZlgvV(	RTVtOTRXSW5ma	2015/9/16 13:43		dk15WkRld01pTkR5N2VDR2RQenlRdz09					
81	2015/9/16	7	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	b2xkZDVCaGNDS3o0SkJyUXM5dE		108200	NGVicEpUbTR2Z	NTFKeE9LYU5rZm	2015/9/16 13:44		SXZqb1F1QWFZU0dCZzRRTVpabX	108400	dmxRL2tKNzlJSFFBd2ZaRVBoNlVvUT09			
82	2015/9/16	7	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	M2JyQU1PRFBKem45M0ZHcjVSM		137500	aVBQQUt0QXJp	K1EzREVSdDR0Zk	2015/9/16 13:38		NWNWNGx1Y3l2TlZnY05oK0JXc2I	137600	TlE1c0Y3NUc3RDZiYi		9oWHBPOE0rZz09	
83	2015/9/16	8	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	d3dsbEpZaTFNa2VjWkNQajJEQ0F		103050	NGVicEpUbTR2Z	WTAyMW4rK3J0T	2015/9/16 14:28		elBSOS9sMklwT3dBSm85TnE4c3Z	103300	T0s2UklnZ1I3ZDlpa		UXpFK1pFbUlSTll6N	
84	2015/9/16	8	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	d3dsbEpZaTFNa2VjWkNQajJEQ0F		103050	NGVicEpUbTR2Z	UlA3OTdocUVVT(	2015/9/16 14:28		elBSOS9sMklwT3dBSm85TnE4c3Z	103300	T0s2UklnZ1I3ZDlpa		UXpFK1pFbUlSTll6N	
85	2015/9/16	8	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	K0RkSVZVYkxlQ0IwaDAyc09EU2x		133500	aVBQQUt0QXJp	d3RwTzg2L3NWd	2015/9/16 14:54		d2dFMGpJN29xSWhxWkFPSE5oOUVqQT09				UXpFK1pFbUlSTll6N	
86	2015/9/16	8	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		142700	WnlFcG0rZlgvV(	WlRsdVltS3VTTFF	2015/9/16 14:33		dk15WkRld01pTkR5N2VDR2RQenlRdz09					
87	2015/9/16	9	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	TDZDNEFhV3cxRFlrQnZqeGJJdys3		145400	WnlFcG0rZlgvV(	SEovV3lUcmtDME	2015/9/16 15:15		QkxjcTZQdEhtSk45TnhlT29NWFR5Zz09				UXpFK1pFbUlSTll6N	
88	2015/9/16	9	UnRQNFNKNzd	a0daZm1uWDI	cldobmNESjNnI	dUZid3FpeDhXOGdpakw0R1hTSU		143100	WnlFcG0rZlgvV(	R0I4WjVMcTlaSW	2015/9/16 15:51		QkxjcTZQdEhtSk45TnhlT29NWFR5	143300	T0s2UklnZ1I3ZDlpa		VGZxeS9NMTZObkc	

YouThought

WIP Summary

	A	B	C	D	E	F	G	H	I	M	N
1	MFG_DATE	SEQ_ID	TOOLG_ID	PROD_ID	OPER_NO	END_ON_HAND	RUN	QUEUE	HOLD		
2	2015/9/15	7	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	212600	7	0	7	0		
3	2015/9/15	7	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	223100	4	0	0	4		
4	2015/9/15	7	a0FOME1tcnZiN	cFBDdVNjV056VW9xQmRnZTZXV	171650	25	0	0	25		
5	2015/9/15	7	a0FOME1tcnZiN	OUFaYnFtMTVKY0NXSWxLRmxCC	180200	4	0	4	0		
6	2015/9/15	7	a0FOME1tcnZiN	aksyNXFpNjJiSnlLZEtvT2RTb1BtZz	155300	24	0	24	0		
7	2015/9/15	7	a0FOME1tcnZiN	RmpQR0NHUWtobkFkMlVYUnEy	41000	3	0	0	3		
8	2015/9/15	7	a0FOME1tcnZiN	c2ZGSjRQdmR6VUhTY1dkZE53NIp	22100	6	0	6	0		
9	2015/9/15	8	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	212600	7	7	0	0		
10	2015/9/15	8	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	223100	4	0	0	4		
11	2015/9/15	8	a0FOME1tcnZiN	cFBDdVNjV056VW9xQmRnZTZXV	171650	25	25	0	0		
12	2015/9/15	8	a0FOME1tcnZiN	OUFaYnFtMTVKY0NXSWxLRmxCC	180200	4	4	0	0		
13	2015/9/15	8	a0FOME1tcnZiN	aksyNXFpNjJiSnlLZEtvT2RTb1BtZz	155300	24	0	24	0		
14	2015/9/15	8	a0FOME1tcnZiN	RmpQR0NHUWtobkFkMlVYUnEy	41000	3	0	0	3		
15	2015/9/15	8	a0FOME1tcnZiN	c2ZGSjRQdmR6VUhTY1dkZE53NIp	22100	6	0	6	0		
16	2015/9/15	9	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	223100	4	0	0	4		
17	2015/9/15	9	a0FOME1tcnZiN	cFBDdVNjV056VW9xQmRnZTZXV	171650	25	0	0	25		
18	2015/9/15	9	a0FOME1tcnZiN	aksyNXFpNjJiSnlLZEtvT2RTb1BtZz	155300	24	0	0	24		
19	2015/9/15	9	a0FOME1tcnZiN	RmpQR0NHUWtobkFkMlVYUnEy	41000	3	0	0	3		
20	2015/9/15	9	a0FOME1tcnZiN	c2ZGSjRQdmR6VUhTY1dkZE53NIp	22100	6	0	0	6		
21	2015/9/15	10	a0FOME1tcnZiN	bCswWTRwS2RxMGk1NjdRQ0wv	223100	4	0	0	4		
22	2015/9/15	10	a0FOME1tcnZiN	cFBDdVNjV056VW9xQmRnZTZXV	171650	25	0	0	25		
23	2015/9/15	10	a0FOME1tcnZiN	aksyNXFpNjJiSnlLZEtvT2RTb1BtZz	155300	24	0	0	24		

u-Efficiency vs u-Planning

Functions	u-Efficiency	u-Planning
Data	Equipment status history, Lot history, WIP snapshot history	
KPI	Machine	Machine & Product
Methods	BPNN	BPNN, GA

Static model	Cycle time reduction
	• Not focus in the P12 project
	• Identify critical KPI & machines
	• 30% x-factor gap to leading fab
	  • Redundant: 7%, # of recipes: 6%, uptime:3%,etc.
		Long-term static planning
		• Simulate move, cycle time, loading for
		  • Product mix
		  • # of machines

	Productivity improvement • Focus in the P12 project (Q4'19~Q1'20) • Identify critical KPI for long-term key machines defined by user IE • Key KPI for contribution by model & breakdown analysis • TC mean & variation, Loading variation among machines, Process constraints, Arrival variation by dispatching, etc.	
Dynamic model	11-day machines arrival forecast for optimal PM schedule to reduce KPI : day-to-day loading • Forecast accuracy: 11-day: 87% • Forecast correlation: 11-day: 0.06	MPS (12-months) • Move, cycle time, output, loading (long-term) Order confirmation • Delivery date, loading (mid-term) • Forecast accuracy: 11-day: 88%, 90-day:85% • Forecast correlation: 11-day: 0.20, 90-day:0.07 Order fulfillment • Move target, move gap, loading (short-term)

PSMC P12 issued 58 requirements, only 5 item not complete yet

- 3 items: BPNN model 驗證
- 1 item: Planning function (30-day forecast)
- 1 item: Customization

Planning functions can be realized by u-Planning

- ✓ 11-day forecast can be improved for both accuracy & correlation
- ✓ 90-day forecast is even satisfactory

YouThought

Q & A with PC, IE _1/6

Q1. CT distribution (by 產品投入到產出的CT表現)

Ans: Forecast cycle time (day) of each step on each date taking into account oh-hand WIP & planned wafer start

	A	B	C	D	E	F	I	J	K	L	M	N	O	P	Q	R	S
1	PROD_ID	STEP_Sequence	LAYER	STAGE	STEP	GROUP_ID (28-D Maximal move MG)	2019/4/1	2019/4/2	2019/4/3	2019/4/4	2019/4/5	2019/4/6	2019/4/7	2019/4/8	2019/4/9	2019/4/10	2019/4/
2	TB546A7AB000	1	1	1-A	1000	VIRPV	0.0782	0.0001	0.0466	0.0558	0.0287	0.0584	0.0250	0.0284	0.0430	0.0676	0.016
3	TB546A7AB000	2	1	1-A	1100	TBUPK	0.0781	0.0730	0.0935	0.0909	0.0901	0.0893	0.0901	0.0613	0.0565	0.0337	0.025
4	TB546A7AB000	3	1	1-B	1150	TBSCN	0.0641	0.0658	0.0662	0.0694	0.0662	0.0676	0.0714	0.0714	0.0690	0.0730	0.082
5	TB546A7AB000	4	1	1-B	1200	TBMSP	0.1124	0.1149	0.1250	0.1250	0.1235	0.1282	0.1299	0.1176	0.1136	0.1111	0.109
6	TB546A7AB000	5	1	1-B	1230	TBNAN	0.1316	0.1266	0.1149	0.1064	0.1010	0.0952	0.0917	0.0901	0.0952	0.0990	0.097
7	TB546A7AB000	6	1	1-C	1300	TBPHL	0.3448	0.3333	0.3030	0.2778	0.2381	0.1961	0.1667	0.1613	0.1724	0.1724	0.188
8	TB546A7AB000	7	1	1-C	135C	TBMRE	0.0505	0.0543	0.0621	0.0633	0.0694	0.0719	0.0730	0.0671	0.0633	0.0559	0.052
9	TB546A7AB000	8	1	1-E	1350	TBMRE	0.0505	0.0543	0.0621	0.0633	0.0694	0.0719	0.0730	0.0671	0.0633	0.0559	0.052
10	TB546A7AB000	9	1	1-E	WIPBANK	TBCHN	0.1031	0.1031	0.1000	0.0962	0.0971	0.0980	0.1000	0.1031	0.1064	0.1075	0.111
11	TB546A7AB000	10	1	1-E	1355	TBAOH	0.0746	0.0794	0.0758	0.0800	0.0862	0.0885	0.0909	0.0885	0.0870	0.0877	0.088
12	TB546A7AB000	11	1	1-E	1358	TBMRE	0.0505	0.0543	0.0621	0.0633	0.0694	0.0719	0.0730	0.0671	0.0633	0.0559	0.052
13	TB546A7AB000	12	1	1-F	1400	TBWET	0.1389	0.1471	0.1471	0.1538	0.1563	0.1639	0.1613	0.1639	0.1587	0.1538	0.151
14	TB546A7AB000	13	1	1-F	1800	TBSTR	0.1010	0.1163	0.1250	0.1370	0.1389	0.1493	0.1563	0.1538	0.1449	0.1389	0.135
15	TB546A7AB000	14	1	1-F	1840	TBOST	0.0840	0.0775	0.0735	0.0671	0.0730	0.0781	0.0763	0.0758	0.0901	0.1031	0.104
16	TB546A7AB000	15	1	1-F	1890	TBILC	0.0885	0.0833	0.0800	0.0813	0.0962	0.1111	0.1220	0.1220	0.1250	0.1220	0.125
17	TB546A7AB000	16	2	2-A	WIPBANK	TBPRO	0.0004	0.0053	0.0043	0.0023	0.0063	0.0039	0.0084	0.0037	0.0020	0.0077	0.000
18	TB546A7AB000	17	2	2-A	2200	TBCVD_2200	0.3125	0.3226	0.3448	0.3333	0.3226	0.3125	0.3333	0.3030	0.2941	0.2778	0.285
19	TB546A7AB000	18	2	2-A	2250	TBAOH	0.0746	0.0794	0.0758	0.0800	0.0862	0.0885	0.0909	0.0885	0.0870	0.0877	0.088
20	TB546A7AB000	19	2	2-A	2253	TBMRE	0.0505	0.0543	0.0621	0.0633	0.0694	0.0719	0.0730	0.0671	0.0633	0.0559	0.052
21	TB546A7AB000	20	3	3-A	3200	TBMSP	0.1124	0.1149	0.1250	0.1250	0.1235	0.1282	0.1299	0.1176	0.1136	0.1111	0.109

... | Proudct foreward forecast>> | >>1-day Forecast | Prod Step CT(PROD final route) | Move fcst(Fab own lot.N+BB) | Prod Stage CT | Prod Layer CT | Move

Q2. Step to step CT(Lot到站與離站的時間)

Ans: Current solution resolution of is Product ID. However, the same loic can be applied to Lot ID

YouThought

Q & A with PC, IE _2/6

Q3. CLIP(Delivery) forecast(產出的結果)

Ans: Forecast step move based on BOH & forecast cycle time. The move of last step represents delivery quantity for each date

	A	B	C	D	E	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	PROD_ID	STEP_Sequence	LAYER	STAGE	STEP	2019/4/1	2019/4/2	2019/4/3	2019/4/4	2019/4/5	2019/4/6	2019/4/7	2019/4/8	2019/4/9	2019/4/10	2019/4/11	2019/4/12	2019/4/13	2019/4/14	
66	TB546A7AB000	51	4	4-B	4201	2382	2303	2569	849	1423	1923	1799	3429	3931	2730	2477	2319	2374	2229	
67	TB546A7AB000	52	4	4-C	4300	4398	1873	1765	1513	1861	2069	3042	3969	3050	2808	3157	3936	4784	4623	
68	TB546A7AB000	53	4	4-C	435E	245	167	223	46	83	140	138	277	220	279	140	138	83	166	
69	TB546A7AB000	54	4	4-D	4350	3254	2788	3444	958	1679	2077	2286	3895	4116	3707	2707	2367	1809	2560	
70	TB546A7AB000	55	4	4-E	4400	3323	3460	3095	1457	1604	1509	2592	3802	3683	3616	2985	1998	2048	2242	
71	TB546A7AB000	56	4	4-E	4800	2967	3518	3065	2064	1570	1264	2837	3551	3378	4009	3094	2024	1966	2126	
72	TB546A7AB000	57	5	5-A	5200	2982	3440	3160	2314	1678	1082	2983	3236	3339	4332	3135	2028	2147	1719	
73	TB546A7AB000	58	5	5-A	5300	2962	3759	3195	2901	1648	1041	2721	2349	4280	4452	2860	2859	2237	1774	
74	TB546A7AB000	59	5	5-A	5351	164	345	277	163	124	55	136	167	251	331	161	166	138	83	
75	TB546A7AB000	60	5	5-A	5354	164	345	250	190	124	55	136	167	251	304	188	166	138	83	
76	TB546A7AB000	61	5	5-B	5310	358	421	354	246	270	130	277	303	411	449	406	268	271	229	
77	TB546A7AB000	62	5	5-B	5352	245	360	219	329	140	98	221	196	392	434	242	245	189	160	
78	TB546A7AB000	63	5	5-C	5350	2709	3812	3016	3056	1174	1752	2433	2562	4111	4562	2944	2904	2080	1891	
79	TB546A7AB000	64	5	5-C	5355	80	477	292	315	27	54	191	108	129	347	462	108	161	186	
80	TB546A7AB000	65	5	5-C	5358	80	423	346	315	27	54	137	107	157	347	243	327	133	132	
81	TB546A7AB000	66	5	5-C	5400	2351	3289	3438	3215	1318	1721	2377	2016	4251	4093	2943	2762	2153	1922	
82	TB546A7AB000	67	5	5-D	5800	2644	2948	3413	3288	1643	1769	2326	1932	4148	4035	3295	2257	2579	1591	
83	TB546A7AB000	68	5	5-D	5870	184	174	215	136	236	156	147	142	260	295	317	162	160	156	
84	TB546A7AB000	69	5	5-D	5900	2650	2345	3347	3226	2270	1935	2107	2008	3640	3956	3598	2484	2467	1835	
85	TB546A7AB000	70	5	5-D	T200	2104	3054	3400	2365	3352	2151	1761	2371	2961	3859	4195	3019	2404	2266	
86	TB546A7AB000	71	5	5-E	T300	2118	3016	2966	2220	2458	3167	2076	2148	1333	3182	4181	4301	3203	2177	
87	TB546A7AB000	72	5	5-F	T203	248	360	56	28	336	112	609	164	84	112	168	530	356	196	
88	TB546A7AB000	73	5	5-F	T303	351	25	244	0	0	109	574	108	564	82	27	82	921	298	
89	TB546A7AB000	74	5	5-F	T700	2773	3037	3504	2691	2809	3736	2916	2334	1961	3408	4411	4782	4363	3059	
90	TB546A7AB000	75	5	5-F	T900	96282348	2984	2361	4319	2170	1956	2001	1749	1944	2858	3729	2866	2638	2967	
91																				
92																				

... | MG_RECIPE Arrival fcst | Move fcst(Actual move,N+BF) | MG Move fcst | MG_RECIPE Move fcst | Stage Move fcst | Layer Move fcst | WIP forecast>

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YouThought

Q & A with PC, IE _3/6

Q4. Daily Capacity consumption detail(機台產能消耗的狀況)

Ans: Forecast machine move based on BOH & forecast cycle time. Forecast machine loading = Forecast move/ Forecast capacity for each date

B2 =IF('MG Saturated move'!B2="","",'MG Arrival fcst(Fab_own_lot)'!B2/('MG Saturated move'!B2*'MG_#of machines'!$I2*24))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Machine_group	2019/4/1	2019/4/2	2019/4/3	2019/4/4	2019/4/5	2019/4/6	2019/4/7	2019/4/8	2019/4/9	2019/4/10	2019/4/11	2019/4/12	2019/4/13	2019/4/14	
2	FBBPH	82.98%	51.58%	34.74%	23.08%	41.71%	66.00%	42.07%	117.35%	12.34%	61.89%	68.89%	49.76%	60.78%	51.95%	
3	FBGPH	77.32%	54.31%	23.40%	25.80%	57.77%	53.64%	58.83%	117.37%	9.44%	57.96%	65.24%	48.73%	58.77%	75.78%	
4	FBRPH	71.24%	47.71%	34.33%	44.04%	47.31%	69.78%	102.28%	83.74%	9.97%	67.30%	70.67%	66.02%	63.46%	52.23%	
5	TBAOH	31.38%	15.79%	23.53%	26.41%	37.45%	31.04%	34.83%	33.30%	3.58%	32.53%	33.05%	26.82%	34.98%	30.03%	
6	TBATS	50.25%	52.70%	66.79%	59.36%	41.22%	35.09%	38.88%	36.04%	8.27%	76.00%	69.15%	54.51%	49.19%	33.18%	
7	TBCDO	4.83%	4.62%	7.87%	4.77%	2.69%	3.80%	3.53%	3.76%	1.01%	7.81%	7.49%	4.27%	4.27%	3.82%	
8	TBCHN															
9	TBCVD_2200	9.17%	58.65%	50.19%	75.45%	70.32%	89.46%	74.72%	66.60%	8.42%	64.18%	63.25%	85.85%	33.94%	27.48%	
10	TBCVD_4200	56.27%	36.91%	37.00%	34.58%	40.04%	62.43%	78.34%	58.64%	6.96%	63.28%	87.32%	88.87%	89.47%	74.72%	
11	TBCVD_4201	70.57%	78.00%	78.76%	18.42%	35.21%	83.48%	37.10%	122.09%	14.95%	77.41%	82.75%	54.32%	73.18%	59.80%	
12	TBDRY	40.76%	26.82%	51.45%	35.44%	61.27%	53.20%	53.23%	64.44%	7.35%	53.69%	56.81%	48.83%	58.66%	36.33%	
13	TBFLC															
14	TBFLR	43.80%	61.35%	62.54%	41.87%	66.42%	41.86%	44.91%	43.37%	6.69%	70.32%	81.27%	59.31%	50.47%	44.91%	
15	TBILC	39.67%	34.16%	34.04%	44.94%	50.82%	73.03%	63.02%	51.05%	6.80%	48.87%	56.55%	56.47%	35.81%	42.94%	
16	TBITO	50.98%	58.89%	49.09%	35.52%	26.71%	21.40%	43.00%	58.92%	6.87%	69.53%	47.50%	34.99%	34.74%	35.47%	
17	TBMAC	8.27%	9.04%	7.39%	4.98%	4.56%	3.08%	5.93%	6.26%	1.06%	9.18%	8.44%	5.34%	6.27%	3.69%	
18	TBMRE															
19	TBMSP	21.84%	36.03%	52.25%	55.13%	68.88%	71.47%	65.38%	63.41%	5.94%	45.41%	56.20%	62.49%	23.61%	44.68%	

... | >>3-hour fcst | Move fcst_4200_3-hour | >>Others | MG Saturated move | MG_#of machines | MG Loading fcst | >> other rule | Example_Train & What-if _I ..

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YouThought

Q & A with PC, IE _4/6

Q5. WIP pattern(WIP 未來的分布狀態)

Ans: Forecast WIP based on forecast cycle time & forecast move

G2 ='Move fcst(Fab_own_lot,N+BB)'!M15*'Prod_Step CT(PROD final route)'!I2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
1	PROD_ID	STEP_Sequence	LAYER	STAGE	STEP	GROUP_ID	2019/4/1	2019/4/2	2019/4/3	2019/4/4	2019/4/5	2019/4/6	2019/4/7	2019/4/8	2019/4/9	2019/4/10	2019/4/11	201
2	TB546A7AB000	1	1	1-A	1000	VIRPV	130	0	98	237	116	136	88	87	222	326	81	
3	TB546A7AB000	2	1	1-A	1100	TBUPK	130	82	249	288	333	288	404	230	150	76	72	
4	TB546A7AB000	3	1	1-B	1150	TBSCN	106	140	232	166	226	246	220	240	164	184	303	
5	TB546A7AB000	4	1	1-B	1200	TBMSP	22	23	46	42	59	57	51	43	35	34	46	
6	TB546A7AB000	5	1	1-B	1230	TBNAN	170	334	347	343	385	332	308	303	210	282	346	
7	TB546A7AB000	6	1	1-C	1300	TBPHL	19	46	59	61	46	49	33	32	29	24	42	
8	TB546A7AB000	7	1	1-C	135C	TBMRE	110	104	192	194	283	247	264	189	170	162	181	
9	TB546A7AB000	8	1	1-E	1350	TBMRE	8	6	12	19	17	24	16	17	15	11	15	
10	TB546A7AB000	9	1	1-E	WIPBANK	TBCHN	223	173	239	368	384	356	327	315	281	324	374	
11	TB546A7AB000	10	1	1-E	1355	TBAOH	417	399	456	553	496	509	656	648	636	796	630	
12	TB546A7AB000	11	1	1-E	1358	TBMRE	6	9	21	17	19	4	14	2	7	8	4	
13	TB546A7AB000	12	1	1-F	1400	TBWET	16	24	45	38	47	9	26	5	18	22	13	
14	TB546A7AB000	13	1	1-F	1800	TBSTR	173	197	305	457	524	510	560	440	410	431	361	
15	TB546A7AB000	14	1	1-F	1840	TBOST	54	207	181	222	269	277	273	203	280	299	287	
16	TB546A7AB000	15	1	1-F	1890	TBILC	69	231	177	280	310	445	400	354	384	340	372	
17	TB546A7AB000	16	2	2-A	WIPBANK	TBPRO	0	14	9	8	19	16	28	11	6	22	1	
18	TB546A7AB000	17	2	2-A	2200	TBCVD_2200	131	214	211	382	312	374	286	197	282	328	307	
19	TB546A7AB000	18	2	2-A	2250	TBAOH	36	120	145	221	209	264	253	242	197	202	187	
20	TB546A7AB000	19	2	2-A	2253	TBMRE	3	12	9	23	23	26	22	18	19	15	15	
21	TB546A7AB000	20	3	3-A	3200	TBMSP	6	22	21	42	41	46	43	31	34	28	31	
22	TB546A7AB000	21	3	3-A	3230	TBNAN	101	205	270	376	344	349	345	313	266	268	264	
23	TB546A7AB000	22	3	3-A	3300	TBPHL	19	37	58	63	51	47	37	40	33	23	35	

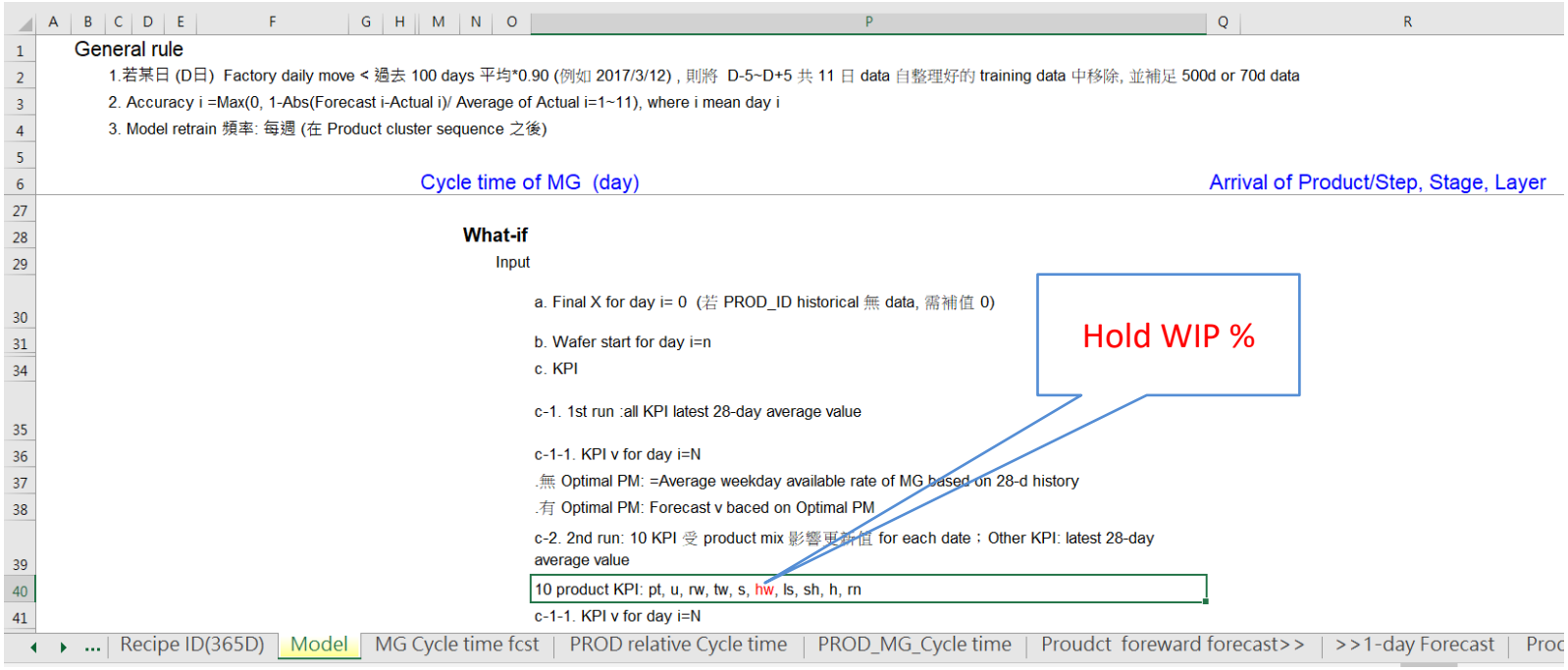
... | Layer Move fcst | WIP forecast>> | MG_WIP fcst | Step WIP fcst | Stage WIP fcst | Layer WIP fcst | >>3-hour fcst | Move fcst_4200_3-hour | >>Others | MG ...

YouThought

Q & A with PC, IE _5/6

Q6. model 如何考量 Future Hold & Future Release

Ans: User input Hold WIP % of machine & product for each date, then what-if by NN model to reflash forecast for cycle time, move, output, and WIP.



YouThought

Q & A with PC, IE _6/6

Q7.請提供一個實例說明 Input Data & Output Data & 依結果所產生的Action

Ans: Refer to

Page 14 “Demand confirmation”

Page 15 “Demand fulfillment”

Page 17 “Master production schedule”