IE3100R: Systems Design Project

INFLUENCE OF DEMAND STRUCTURE TO CAPACITY COMMITMENT (PHASE 2)

Industrial & Systems Engineering

Team Members:
Feng Li, Gian Jian Xiang, Liew En Rui, Shu Xin
Supervisors:
A/Prof Chai Kah Hin, Asst Prof Liu Yang
Industrial Supervisor:
Ivan Tay Chee Siang

PROJECT DEFINITION

Production Process

Front-end
(Wafer Fabrication)

Semi-Constrained Loads
Requested production quantity from **FE** to **BE**

Back-end
(Assembly, Testing)

Constrained Loads
Planned delivery from **BE** to **customers**

Customers (Product Deliveries)

Problem Example

1 unit of **PKN1** requires **2 units** of resource A
1 unit of **PKN2** requires **1 unit** of resources A
Total Capacity Available for resource A = **3000 units**

ACG
PKN1 PKN2
- *Aggregated Capacity Group*
- *Package Name*

Original Order Fulfilled

Total ***Demand:*** *2000 units*	Units of Resource A Consumed
1000 PKN1	2000
1000 PKN2	1000

Limited by resources

Total ***Produced:*** *2000 units*	Units of Resource A Consumed
1000 PKN1	2000
1000 PKN2	1000

Demand Structural Changes

New Order NOT Fulfilled

Total ***Demand:*** *2000 units*	Units of Resource A Consumed
1500 PKN1	3000
500 PKN2	500

Limited by resources

Total ***Produced:*** *1750 units*	Units of Resource A Consumed
1250 PKN1	2500
500 PKN2	500 (with priority)

Problem Diagnosis: ① ACGs composed of PKNs with different resource consumptions, ② Demand structures prone to changes.

Project Objective: **To evaluate the sensitivity levels of Capacity Commitment with respect to Demand Structural Changes of all ACGs, and to provide solutions for better capacity planning.**

PHASE 1 SUMMARY

Data Selection

- **32** past production planning files used.
- Extract **200 sets** of data on Demand and Capacity Commitment.

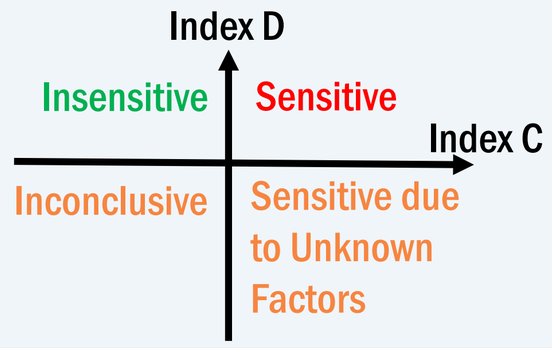
Indices Development

- **Index C:** Capacity commitment variation
- **Index D:** Demand structure variation

Note: Calculations based on Coefficient of Variance

Sensitivity Matrix

① Plot Indices C and D for all ACGs.
② Set x-axis as median of Indices C, y-axis as median of Indices D.



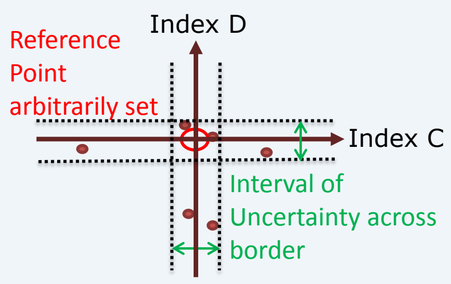
PHASE 2: MODEL VALIDATION

To ensure that methodology developed in phase 1 is reliable and robust.

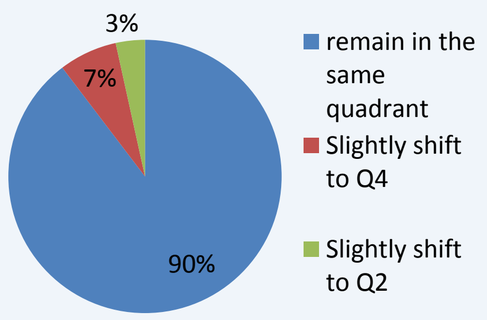
Model Improvement

Continuity of Sensitivity
- Sensitivity is continuous and relative in nature.
- Boundaries of quadrants are arbitrarily set.
- Difficult to categorize points near boundaries.

Choice of Data
- Large number of data sets greatly increases computation complexity.
- An efficient number of data sets (*100 vs 200 in Phase 1*) was determined to reduce total number of data sets without compromising model accuracy.

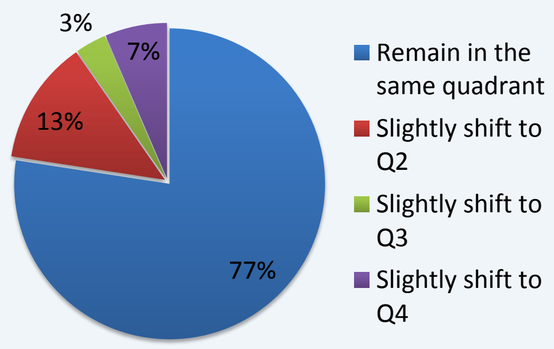


Comparison of Results from 100 and 200 Data Sets



Model Consistency

Comparison of Results from Two Consecutive 100 Data Sets



Result: Considering continuity of sensitivity and errors introduced by imperfect data(which introduce large variations), we conclude that **the model is consistent.**

Model Accuracy

Key Assumptions:
- Utilization is a key determinant of sensitivity
- Resources with utilization rates above 90% deemed critical.

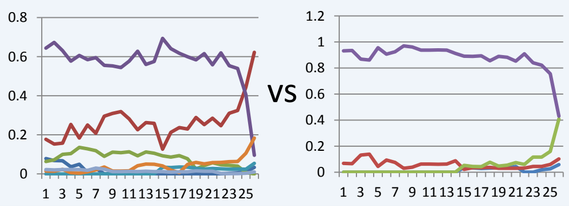
Approach: Validate accuracy by checking criticality of resources used by identified sensitive ACGs as follows:
- Identify all resources used by each sensitive ACG and respective utilization rates
- If the utilization rate is above 90%, the respective ACG is deemed sensitive.

Result: All sensitive ACGs identified by the model use one or more resources with very high utilization rates. **The model is accurate.**

PHASE 2: RECOMMENDATIONS

To address capacity planning issues after identifying the sensitive ACGs.

Plot constrained loads of PKNs over planning horizon for each sensitive ACG.



Existence of following features?
- Non-increasing/ decreasing trend
- Large Fluctuations

YES → **ACG Restructuring**
NO → **Capacity Investment**
Alternatively, → **Capacity Investment**

ACG Restructuring

Change the composition of sensitive ACGs by:
① ACG Splitting – Separate out 'problematic' PKN(s)
② Re-combining ACGs – Cluster compatible PKNs into another existing ACG without creating new ones.

Set of Sensitive ACGs

ACG_1
⋮

List of ACGs, their PKNs and Load Factors

PKNs in ACG_1	% Change in Index C
PKN_1	2.5% Decrease
PKN_2	20.3% Decrease
PKN_3	5.1% Increase
⋮	

Take out PKN_2 for Investigation

Capacity Investment

Invest in critical resources to improve capacity planning
Base Case:
Increase in Resource i (%)
= *Average Gap(%) * Utilization of Resource i by ACG j (%)*
- Utilization of Resource i by ACG j: proportion of a particular resource used by ACG j,
- Average Gap: % unmet demand, i.e. % difference between actual production (Product Deliveries) and demand (Constrained Loads) for ACG j

Worst Case: Use *maximum gap* for computation.

Example:

ACG	Resource	Utilization Rate (%)	Average Gap (%)	Capacity Investment (%)	Current No. of Tools	No. of Tools to invest
ACG 1	Resource 1	80%	10%	8% (= 80% * 10%)	20	1.6 (=20 * 8%)