IE3100R Systems Design Project. Department of Industrial & Systems Engineering. AY2015/2016
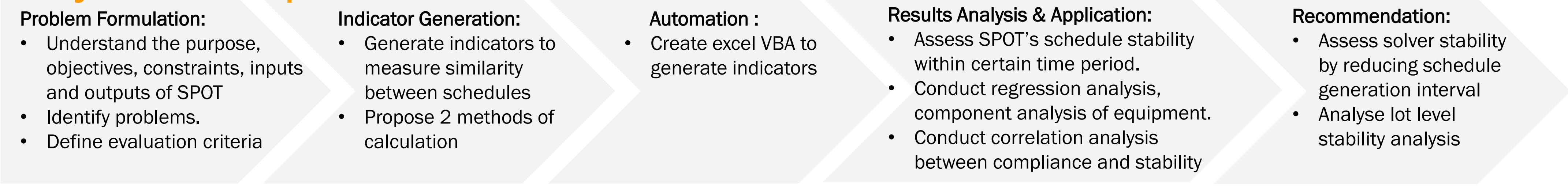
A collaboration between NUS and Infineon
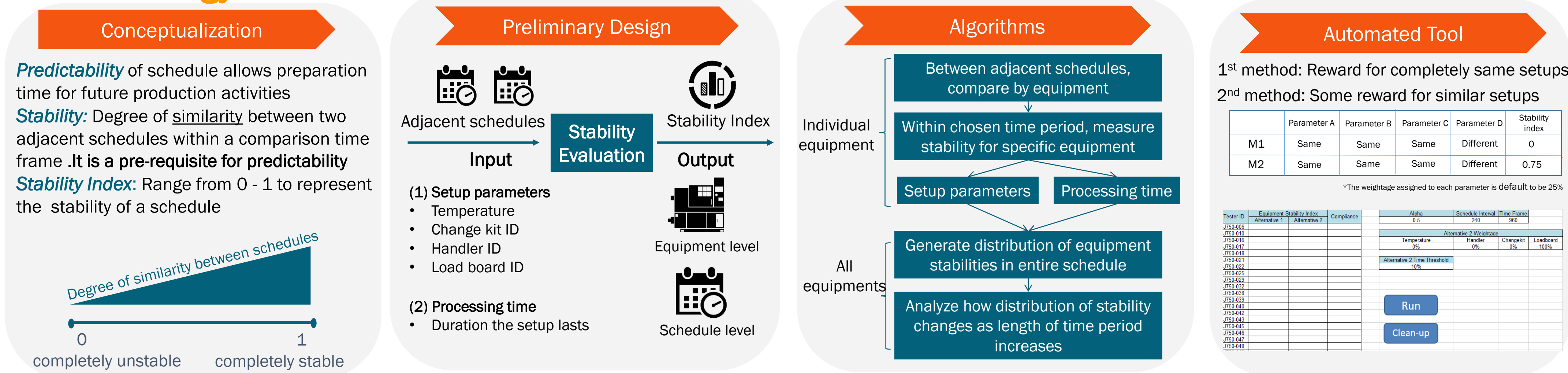
AUTOMATED TOOL TO EVALUATE SPOT SOLVER

Introduction

Infineon technologies AG focuses its sales efforts on semiconductors customized to meet its customers' demand. With complex product combinations, each product is required to undergo different combination of tests. In order to improve the overall efficiency of production, an automated Scheduling and Planning Tool (SPOT) is recently implemented to replace manual scheduling in order to optimise the testing process and make production predictable. This project aims to evaluate the performance of SPOT.

Project Roadmap

Problem Formulation:
- Understand the purpose, objectives, constraints, inputs and outputs of SPOT
- Identify problems.
- Define evaluation criteria

Indicator Generation:
- Generate indicators to measure similarity between schedules
- Propose 2 methods of calculation

Automation :
- Create excel VBA to generate indicators

Results Analysis & Application:
- Assess SPOT's schedule stability within certain time period.
- Conduct regression analysis, component analysis of equipment.
- Conduct correlation analysis between compliance and stability

Recommendation:
- Assess solver stability by reducing schedule generation interval
- Analyse lot level stability analysis

Methodology

Conceptualization

Predictability of schedule allows preparation time for future production activities
Stability: Degree of similarity between two adjacent schedules within a comparison time frame .It is a pre-requisite for predictability
Stability Index: Range from 0 - 1 to represent the stability of a schedule

Degree of similarity between schedules

0 — completely unstable
1 — completely stable

Preliminary Design

Adjacent schedules → **Input** → Stability Evaluation → **Output** → Stability Index

(1) Setup parameters
- Temperature
- Change kit ID
- Handler ID
- Load board ID

(2) Processing time
- Duration the setup lasts

Equipment level

Schedule level

Algorithms

Individual equipment
- Between adjacent schedules, compare by equipment
- Within chosen time period, measure stability for specific equipment
- Setup parameters | Processing time

All equipments
- Generate distribution of equipment stabilities in entire schedule
- Analyze how distribution of stability changes as length of time period increases

Automated Tool

1st method: Reward for completely same setups
2nd method: Some reward for similar setups

	Parameter A	Parameter B	Parameter C	Parameter D	Stability index
M1	Same	Same	Same	Different	0
M2	Same	Same	Same	Different	0.75

*The weightage assigned to each parameter is default to be 25%

Analysis

Equipment Level Stability Index Analysis

Equipment stability - Method2

- Pareto analysis based on 40 sets of result
- Bottom 20% of the unstable testers are identified.
- Further investigations could be done to analyze the reasons for instability for these testers. Whether they are due to operational constraints or solver issues.

Stability Trend over time

Change of stability over time

- Schedule stability decreased exponentially over time.
- E.g. stability index = 60% with schedule interval of 4hr. It means using schedule 1 for 4 hours would ensure that the production is 60% optimized

Impacts of 4 setups on schedule stability

Method 1
- Unable to differentiate the impacts of individual components on stability index

Method 2
- Initially all 4 parameters show high stability
- Handler contributes more to instability after some time

Relationship between Compliance & Stability

Compliance VS Stability (Y1)
Compliance VS Stability (Y2)

Stability Method1 – Y1
Y1 = -0.005 + 0.817 Y3
(R^2 = 96%)

Stability Method2 – Y2
Y2 = 0.105 + 0.722 Y3
(R^2 = 79%)

Y1: Stability from Method 1
Y2: Stability form Method 2
Y3: Compliance

- Compliance and stability of schedule are strongly correlated.
- Problems with compliance correlates with about 80% of drop in stability.

SHORT TERM Stability index target setting

Percentile plot of stability
0.54   0.58   0.71

- Use empirical data to estimate distribution of stability index
- Set upper 20 percentile as the target
- Revise target after major solver change

LONG TERM Stability index target setting

Compliance target = 85%

Stability Target Setting Method1 – Y1
Y1 = 0.005 + 0.817 Y3
Target = 0.005 + 0.817 * 85% = 0.70

Stability Target Setting Method2 – Y2
Y2 = 0.105 + 0.722 Y3
Target = 0.105 + 0.722 * 85% = 0.72

- Since 80% of instability are correlated with compliance, we can use the compliance target set by Infineon to set target for stability index
- Revise the relationship between compliance and stability after major compliance/solver changes.
- Revise target.

Recommendation

- Compliance is closely related to schedule stability. Compliance issue, as the most significant factor, explains around 80% of schedule instability. Besides non-compliance, SPOT solver might explain up to 20% of the instability observed. With current compliance status and spill over effect on subsequent schedules, estimation on solver stability would be inaccurate.

Action item 1:
- In the near future, use stability index to assess and improve on solver stability when compliance increases significantly (with shorter schedule run interval)
- Identify solver's limitation and make improvement.
- With each improvement in SPOT solver algorithm, compare its stability with previous versions to assess the impact of solver improvement
- Track the performance of SPOT over time with stability index

Action item 2:
- After the solver is stabilized, use stability index to assess the schedule instability due to operational problems.
- Based on the recommended benchmark, assess whether operations required further improvement.

Action Item 3:
- After lot dispatching is implemented, use lot level schedule stability index to assess the solver's performance

Application
Infineon is able to identify the right schedule-run interval, given a x% level of schedule stability.

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