TRIZ Application in Semiconductor Manufacturing & Case Studies

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Introduction

TRIZ is a structured methodology for modeling problems, tools for the models and finally models of solutions. TRIZ is a recognized international science of creativity, based on the laws of physics and innovative patents distilled to numerous problem solving tools. It is a toolbox with 12 tools which provides methods to create breakthrough ideas. Three TRIZ tools, Contradiction, 40 Inventive Principles, and Process Analysis are described.

Methodology & Case Studies

Contradiction is defined as an improvement in one characteristic of a system which results in the degradation of another characteristic. Utilizing standard Parameters and Contradiction matrices, Inventive Principles are suggested to resolve contradictions.

CASE 1

One particular project is the docking of two equipments together, as in Fig. 1 through the means of a guide pin, Fig. 2. The short length of the guide pin gives rise to a *Engineering Contradiction*, i.e. "short guide pin allow equipment #1 and #2 to dock without gaps, but alignment is difficult and time consuming due to allowable small gap". The next level of detail in *Physical Contradiction*, reads: "Guide pin needs to be long during alignment, but short when both equipment are finally docked together". Based on the Contradiction Matrix and 40 Inventive Principles, an elegant solution would be to use Principle #7 i.e. *Nested doll* in the form of a retractable guide pin. The retractable guide pin would be long enough for alignment and will retract to the required length when both equipment are finally docked, thus resolving the contradiction, as shown in Fig. 3.

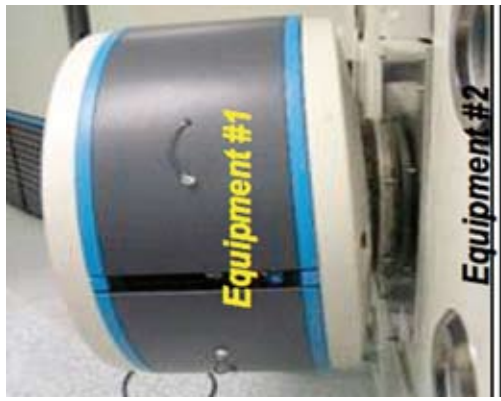

Figure 1: Docking

Figure 2 : Guide pin

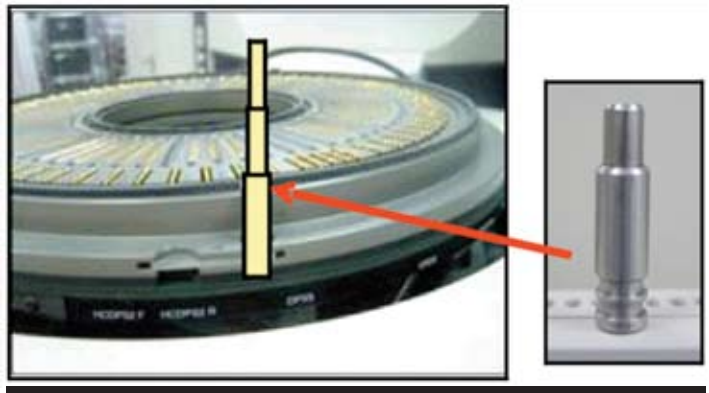
Figure 3 : Retractable guide pin

CASE 2

Another TRIZ tool, *Process Analysis*, is used to reduce Preventive Maintenance (PM) process steps and time. It is used to analyze and reduce PM, operating procedures and process interaction throughput times. Thus, the PM time can be converted to productive time to generate revenue. By understanding the process details and targeting long operating steps, solutions are derived to reduce PM time. Burn-In is a process of subjecting a device to elevated temperatures and voltages to accelerate early life failures in an effort to assure that outgoing Quality & Reliability targets are met.

Process Analysis is performed to determine potential areas for improvement. The methodological development of the Process Analysis, Table 1, revealed a potential Ergonomic and Productivity issue where 200 screws have to be removed prior to PM and put back after PM. Using one of the 40 Inventive Principles, Merging, Principle #5, the solution is to combine the parts and thus reduce the number of screws.

Equipment Preparation
Maintenance crew holds Allen key
Allen key contacts nut
Allen key turns 720 degrees anti clockwise
Allen key loosens 200 screws
Maintenance crew slides down retainer guide
Maintenance moves retainer guide to storage cage
Storage cage placed in Maintenance bay
Maintenance crew removes board

Removing 200 screws takes a long time and is an ergo issue. Improve fixture design to reduce the number of screws. Use the Principle of Merging.

Figure 4 : Process Analysis of Burn-In Equipment

CASE 3

Another example, where Process Analysis can be used is, the Test handler, Fig. 5. Test handler is an equipment which picks a unit from a tray and inserts it into a test board. The test board serves as an intermediary between the unit and the tester. It is found that *Non-Value-Added steps*, i.e. corrective actions are taken to wipe off excess grease applied to the lead screw. Focusing on *Zone of Conflict*, it is the lead screw groove, Fig. 6, that requires greasing, and not the entire lead screw.

Zone of Conflict is defined as where the Useful Operational Zone (UFOZ) and the Harmful Operational Zone (HFOZ) intersects with one another. UFOZ is where helpful or useful actions are taking place, i.e. the lead screw groove. HFOZ is where negative or harmful actions are taking place, i.e. the entire lead screw as over time, the grease hardens on the lead screw and particles and dirt stick to the grease.

Figure 5 : Test Handler

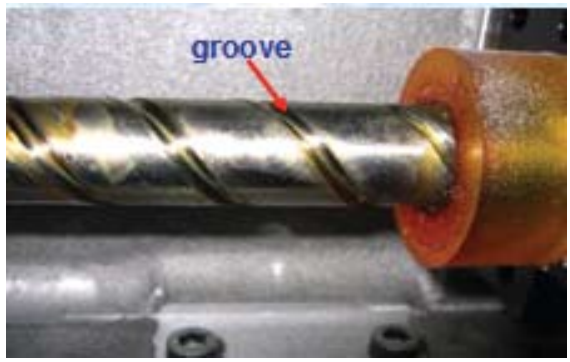

Figure 6 : Zone of Conflict on Lead Screw Groove

Thus, a method was devised to dispense the correct amount of grease in the right area, i.e. the lead screw groove. A significant reduction of 50% greasing time was achieved.

Summary

As a result of the effort, about RM 42M savings has been generated based primarily on sustaining manufacturing. This has been extremely encouraging as there is always a perception that one cannot innovate while in sustaining mode. As the TRIZ awareness increases beyond manufacturing, we have initiated training and workshop sessions for other non-manufacturing organizations.

Intel is a very close partner of Universiti Malaysia Perlis especially with the Intel Elite Programme, where undergraduates are sponsored by Intel for their studies.