Intel Corporation's Expert TRIZ Field Guide
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Abstract

After completing the course work required for MATRIZ Level Three Certification the author began organizing and studying the class notes by creating an internal document summarizing the overall TRIZ problem solving methodology and process. The resulting 80 page Intel TRIZ Expert Field Guide is intended to improve standardization and efficiency in the execution of TRIZ based innovation and compliments Intel's manufacturing improvement efforts. This paper describes the TRIZ Expert Field Guide's content, methodology and utilization within Intel.

INTRODUCTION

Intel has been utilizing TRIZ for manufacturing process innovation since 2003 and has increased the number of our TRIZ trained engineers by 10 times over the past few years. The organization realizes the advantage of harnessing TRIZ as one tool to pursue the applied science of innovation and expand our industry leadership beyond product innovation and into manufacturing improvement. As engineers and managers warm up to the relevance and benefit of TRIZ activities within the organization, the push for increased engagement of TRIZ practitioners necessitates the development of standardization and reference tools to assist with the effective and consistent execution of the discipline. The TRIZ Expert Field Guide is one such standardization and reference tool.

BODY

Though the execution of individual TRIZ tools and concepts is manageable by a tyro practitioner, possessing the skills to effectively utilize the entire TRIZ tool chest is more problematic. While many TRIZ concepts and methods build on themselves and progressively enforce predecessor concepts as more advanced models are realized, the array of TRIZ concepts, tools, and methods makes discipline mastery challenging at best. Even as manifold documents detail most, if not all, of the information required to master the discipline; locating, studying and comprehending those documents is somewhat challenging due to the sheer quantity of material required for proper study and review. Further, understanding the relationships between the various TRIZ tools and concepts is instrumental in

Doc. Sec.	Subject	Doc. Sec.	Subject
1	TRIZ Definitions and Characterizations	15	*proprietary material*
2	Elementary TRIZ Roadmap	16	*proprietary material*
3	Problem Model Types	17	*proprietary material*
4	Contradiction Modeling	18	*proprietary material*
5	Su-Field Modeling	19	*proprietary material*
6	Functional Modeling	20-30	Trends of Engineering System Evolution
7	*proprietary material*	31	*proprietary material*
8	Solution Model Types and Their Inter-relationship	32	Forecasting
9	Standard Inventive Solutions	33	*proprietary material*
10	Altshuller's Matrix Overview	34	*proprietary material*
11	*proprietary material*	35	*proprietary material*
12	*proprietary material*	36	*proprietary material*
13	*proprietary material*	37	Appendix - AIST, 39 Parameters, 40 Principals
14	ARIZ (Algorithm for Inventive Problem Solving)	38	Glossary

Expert TRIZ Field Guide Table of Content – Table 1

mastering the discipline, yet garnering that understanding is not straight-forward. Moreover, regardless of the extent of training received in any field of study, a lack of time spent reviewing or exercising the concepts, methodologies, and algorithms will result in a loss of at least some of the knowledge and skills initially gained. The extensive variety of TRIZ tools and methods challenges the practitioner in staying versant across the entire TRIZ spectrum as some concepts may be rarely exercised, regardless of the extent of the general execution of TRIZ by the practitioner. For these reasons the value of a concise reference document becomes evident as an individual progressively tackles the material in each subsequently more complex MATRIZ Levels One, Two and Three.
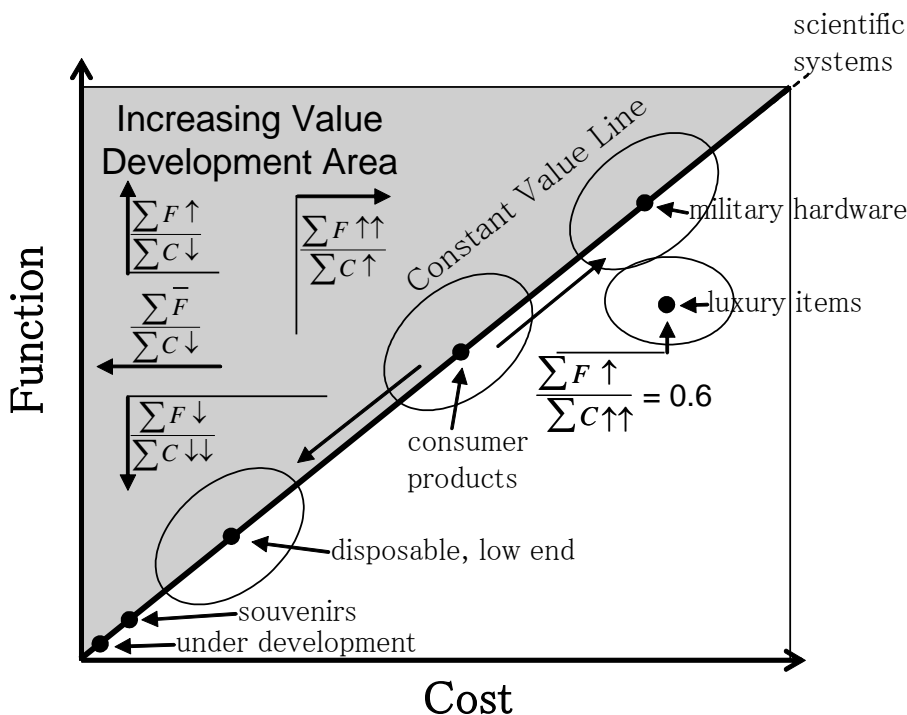
The information within Intel's TRIZ Expert Field Guide is based primarily upon Level Three TRIZ training materials and incorporates supplementary research by the author. Additionally, the guide includes the author's personal observations and realization of concept interrelationships made during the training and the TRIZ

Expert Field Guide compilation. While the document is fundamentally organized in the same progression as the Level Three training, many ideas are presented in more than one document section where establishing further relationships between concepts enhances the student's learning. The Intel's TRIZ Expert Field Guide Table of Content is listed in Table 1 above.

In addition to the Level Three TRIZ material, the text encompasses many Level One and Two TRIZ concepts where deemed valuable in supporting the student's progression of subject knowledge and understanding. Furthermore, original examples and concept relationship presentations are included where it was felt that additional concept associations would enhance the material flow and document effectiveness. The document also contains numerous teaching examples, charts, and diagrams as well as an extensive glossary. For example, section one (TRIZ Definitions and Characterizations) contains a chart relating problem models, tools and solution models (shown in Table 2 below).

Discipline	Model of Problem	Tool	Model of Solution	Specificity
Math	10 X 20	Multiplication Chart	200	-
Chemistry	HCl + NaOH	Chemistry	$NaCl + H_2O$	-
TRIZ	Engineering Contradiction	Altshuller's Matrix	Inventive Principles	Low
TRIZ	Su-Field	76 Standard Solutions	Specific Standard Inventive Solution	Medium
TRIZ	Physical Contradiction	Separation, Satisfaction, Bypass Algorithms	Inventive Principles	Low
TRIZ	Physical Contradiction	Library of Effects	Specific Effect	High
TRIZ	Functional Model	Library of Effects	Specific Effect	High

Problem, Tool and Solution Relationships – Table 2

Relationship between Function and Cost as Pertaining to Increasing Value of Engineering Systems - Graph 1

Intel's TRIZ Expert Field Guide was created to:

1.) Share concepts and their relationships realized by the author during training or simply not represented in the original training material documentation. One graph in section 21 (Trend of Increasing Value) of the TRIZ Expert Field Guide illustrating this objective is the Function vs. Cost graph (shown in Graph 1 above).

2.) Present the TRIZ practitioner with a quick orientation to less frequently exercised concepts by providing a condensed reference to the TRIZ training materials. Case in point is a concise summary of Algorithm for Inventive Problem Solving (ARIZ) (shown in Table 3 below) as presented in the TRIZ Expert Field Guide's section 14.

3.) Provide a review guide by which general TRIZ trainees can refresh their knowledge base or discover new concepts not previously covered within their individual level of study. A table contained within the Solution Model Types and Their Interrelationships sections of the TRIZ Expert Field Guide exemplifies this concept (shown in Table 4 below).

Additional benefits can also be enjoyed by an organization creating their own customized TRIZ user's guide. First, organization, company or industry-specific jargon can be used in the guide to further bolster the practitioner's understanding of how TRIZ relates to his or her particular environment. Second, relationships to other key programs, efforts or directions can be established supporting the integration of TRIZ into the organization and it's other activities. One such example of this benefit would be to establish a relationship between TRIZ and Structured Problem Solving and how those disciplines can be used in concert. And finally, if an organization would like to focus its unique application of TRIZ into a specific methodology or process, the user's guide can be employed as a tool in establishing that standardization or direction. For instance, focusing the instruction of the Inventive Principles towards general business process improvement teams exemplifies this customization benefit.

Intel's TRIZ Expert Field Guide has been well received by problem solvers and management alike as exemplified by its broad based utilization across a variety of end users. For example the material has been deployed within Intel in four distinct ways. First, the guide is being utilized as a problem solving reference manual by current Level 3 practitioners. Second, the guide is provided to Level 2 and Level 3 students for use as supplemental training material in conjunction with the associated TRIZ training courses. Third, the guide is used as adjunct information for students of more generic non-TRIZ problem solving training such as the Structured Problem Solving methodology. And finally, the material is also made available as a general intranet download for individuals researching various problem solving methodologies.

Algorithm for Inventive Problem Solving (ARIZ) Summary	
Pre-Work	Functional model of engineering system & component analysis
Part 1	Convert the engineering system into a well defined model of the problem (2 inverse engineering contradictions subsequently represented as 2 su-field models)
Part 2	Inventory of resources (space, time and substance-field resources)
Part 3	Identification of the ideal final result and the associated limiting physical contradiction(s)
Part 4	Resolve the physical contradiction (Small Smart People – helps decrease psychological inertia)
Part 5	Apply the knowledge base, effects, standards and principles
Part 6	If no solution found, redefine the mini-problem (change problem statement if the problem has not been resolved)

Summary of ARIZ – Table 3

Solution Specificity	Level of Problem Abstraction		
	Low (i.e., want to inc. temperature)	Medium	High (i.e., area vs. weight)
very specific	Specific Effect		
no specific effect but specific recommendation		Specific Standard Inventive Solution	
non-specific			Inventive Principles

Relationship between Problem Abstraction, TRIZ Tool and Solution Specificity – Table 4

SUMMARY

In summary, the field of TRIZ is vast and requires dedication and time in staying in tune with the manifold tools available to the practitioner. Developing an organization-specific user's guide is valuable in reducing the sheer quantity of material that must be examined for the student to understand any particular subject. Further, presenting additional concept relationships between TRIZ tools and methodologies within a user's guide can help speed the student's journey towards proficiency. The Intel TRIZ Expert Field Guide is a standardization tool that the corporation is using to help effectively drive the utilization of the TRIZ discipline within the organization

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