INTEL's TRIZ EXPERT FIELD GUIDE - DEVELOPMENT, CONTENT AND UTILIZATION

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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.

Key words: Reference, Training, Expert, Level Three, Documentation, TRIZ Concept Relationships.

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.

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 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 TRIZ 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 below.

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

Partial Expert TRIZ Field Guide Table of Content - Table 1

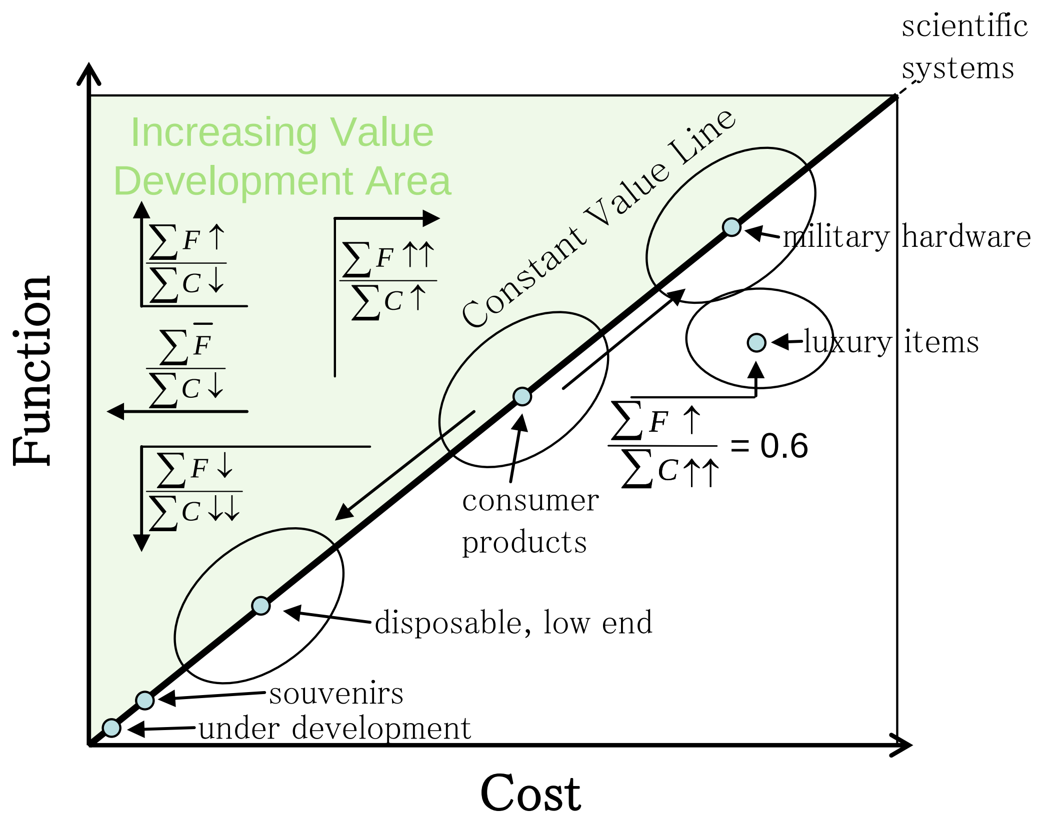
In addition to the Level Three TRIZ material, the text encompasses many Level One and Two TRIZ concepts where deemed valuable in supporting the student's progression of subject knowledge and understanding. Furthermore, original examples and concept relationship presentations are included where it was 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
Math	10 X 20	Multiplication Chart	200
Chemistry	HCl + NaOH	Chemistry	NaCl + H_2O
TRIZ	Engineering Contradiction	Altshuller's Matrix	Inventive Principles
TRIZ	Su-Field	76 Standard Solutions	Specific Standard Inventive Solution
TRIZ	Physical Contradiction	Separation, Satisfaction, Bypass Algorithms	Inventive Principles
TRIZ	Physical Contradiction	Library of Effects	Specific Effect
TRIZ	Functional Model	Library of Effects	Specific Effect

Problem, Tool and Solution Relationships - Table 2

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 below).



Relationship Between Function and Cost As Pertaining to Increasing Value of Engineering Systems - Graph 1

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 ARIZ (shown in Table 3 below) as presented in the TRIZ Expert Field Guide's section 14.

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

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).

	Level of Problem Abstraction		
Solution Specificity	**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

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 its 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.

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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Biography:
David Conley received a BS of Nuclear Engineering from Texas A&M University in 1983. After graduating from the United States Air Force (AF) Officer Training School he joined the AF Weapons Laboratory (AFWL) where he performed plasma physics and space nuclear propulsion research where he contributed to the development of burst x-ray and neutron beam test platforms as well as the radio-isotope power module for the Galileo mission to Venus. While at the AFWL, David took assignments at Los Alamos and Brookhaven National Laboratories and served on the NASA Interagency Nuclear Safety Review Panel. Once separating from the AF as a Captain and receiving a Masters of Finance form the University of New Mexico in 1989 he started his private sector career at Johnson and Johnson where he performed as a Sterilization Engineer until 1994.

Following 5 years in the medical products industry David worked for a time at Philips Semiconductor and then joined Lockwood Greene Engineers and consulted to Intel Corporation in robotics design, installation and qualification. In 1995 he joined Intel where he has held a variety of engineering and management roles including AMHS Senior Engineer, Wet and Dry Etch Install and Qualification Group Leader, US Payroll Operations Manager, Industrial Engineering Manager, Automation Manager, and Technical Programs Manager. In 2006 David received his level 3 certification from the St. Petersburg school of the International TRIZ Association. Since, he has been active in the TRIZ community in technical and business problem solving, TRIZ training and training development, TRIZ program integration and pursuit of his level 4 certification. David has broad international business and engineering experience and currently lives in New Mexico, USA with his wife and his three sons.