TRIZ Forum: Conference Report (23-D)

TRIZ シンポジウム 2010
The Sixth TRIZ Symposium in Japan

Personal Report of The Sixth TRIZ Symposium in Japan, 2010

Held by the Japan TRIZ Society, NPO, on Sept. 9-11, 2010, at Kanagawa Institute of Technology , Atsugi, Kanagawa, Japan

Part D. Case Studies in Industries

Toru Nakagawa (Osaka Gakuin Univ., Japan), Mar. 5, 2011

[Posted on Mar. 21, 2011]

TRIZ Home Page in Japan Jap.

For going to Japanese pages, press Jap. buttons. Japanese translation of this page is not scheduled.

Editor's Note (Toru Nakagawa, Mar. 5, 2011)

This page is Part D of my Personal Report of Japan TRIZ Symposium 2010. Please see the Parent page Engl for the overall description of the Symposium and the general introduction of the Personal Report. I am thankful to the Authors for their permitting me to cite their slides here for introduction. Click here for the PDF file of this page of Personal Report.

The following table shows the list of presentations included in this part.

Code	Author(s)	Affiliation	Title of presentation	Agenda	Review (posted)	Posting of individual paper
E04	**Seung-Hyun Yoo**, Manyop Han, and Ung-Rak Jeong	Ajou University, Korea	From Technical to Business Contradiction: An Example of New Gantry Crane	1st day PM O-2 RB	(Mar. 21, 2011)	
E12	JinHa Jeong, **Jeong-Su Han**, JunHoe Choi	Samsung Electronics Co., Ltd., Korea	Development of a New Weight Sensor for a Washing Machine	2nd day PM Poster-A5	(Mar. 21, 2011)	
J02	**Yoshiharu Isaka**	IDEA Corporation	Development of New Products through Concept Mining and TRIZ – Thinking of New Innovations for Golf Course Lawn Mowers –	2nd day PM O-12 RA	(Mar. 21, 2011)	
J18	**Kouichi Nakamura,** Noritaka Nakayama, Hirotake Makino, Hideki Ohmori, Kazunori Aoki, Etsuo Yamada, Osamu Kumasaka, Minoru Takimoto,	[MPUF (Microsoft Project Users Forum) USIT/TRIZ Study Group]: USIT/TRIZ Study Member Konica Minolta Technology Center, Inc. Tokyo Keiki Kogyo Co., Ltd.,	Application of USIT to Useful Paper Fastener	3rd day AM O-16 RA	(Mar. 21, 2011)	

	Tatsuhiko Atsuta, Yuji Mihara	Kumasaka Professional Engineer Office, Fuji Xerox Information Systems Corp., Creative Technology Institute Co., Ltd				
J19	**Masao Ishihama**	Kanagawa Institute of Technology	Guiding Noise and Vibration Design along General TRIZ Process by Misunderstanding Case List	1st day PM O-4 RB	(Mar. 21, 2011)	
E11	**Hong-Wook Lee**, Qon Gyu Kim, Myung-Rae Cho, Jin Woo Cho, Sang Hee Lee	Hyundai-Kia Motor Company, Korea	Concept Development of a Variable Compression Ratio Engine Using TRIZ	1st day PM O-6 RB	(Mar. 21, 2011)	
E13	**Jung-Bae Kim**, Youngkyoo Hwang, Won-Chul Bang and James D.K. Kim	Samsung Electronics, Korea	Real-Time and Realistic 3D Facial Expression Cloning	2nd day PM Poster-A6	(Mar. 21, 2011)	
E14	**Song-Kyoo Kim**	Samsung Electronics, Korea	Design of Regional Code Adaptation for Mobile Advertisement by Using Theory of Inventive Problem Solving	3rd day PM Poster-B5	(Mar. 21, 2011)	

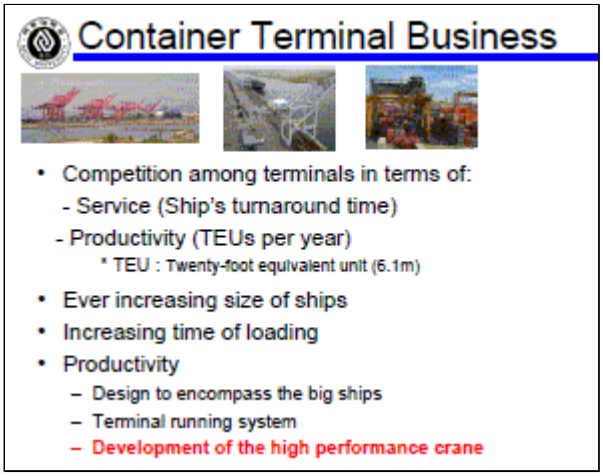
Personal Report (Top) Engl	Part A. Keynotes Engl	Part B. Methods in TRIZ Engl	Part C. Integration with other methods Engl	Part D. Case Studies Engl	Part E. Promotion Engl	Part F. Education and Academia Engl
Part G. Patent studies Engl	Part H. Non-technical Engl		TRIZ Symp. 2010 Official Page (Preparation) Engl	TRIZ Symp. 2010 Official Page (Results) Engl	Japan TRIZ Society Official Site Engl	Japanese page of Personal Report (Top) Jap.

Part D. Case Studies in Industries

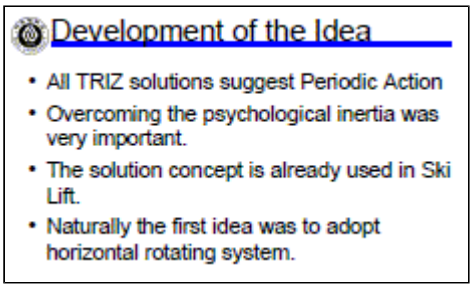
Seung-Hyun Yoo, Manyop Han, and Ung-Rak Jeong (Ajou University, Korea) [E04, O-2] gave an Oral presentation with the title of "**From Technical to Business Contradiction: An Example of New Gantry Crane**". The Authors' Abstract is quoted here:

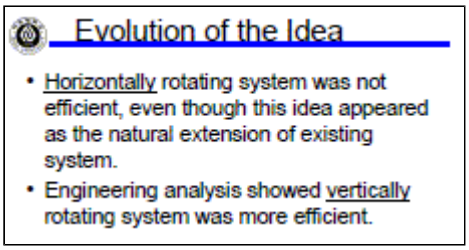
> A new vertically rotating type of gantry crane is developed. The new concept was evolved from the main contents of TRIZ, such as Dynamicity, Spheroidality, Periodic Action in 40 principles. The new idea was implemented in new system and usual design activities were followed. The product is designed in system and element level. Engineering simulation shows the concept was successfully realized and the dynamic simulation reveals the exact clockwork of the system. But the difficult problem appears after this real engineering accomplishment. As the system is so huge, it is not possible to sell so far. The problem emerged not in the technology but in the business. The business problem reveals quite reasonable example of a business contradiction. Struggle with this problem without success is described.

In the slide (right), the Authors show a brief overview of the current business situations of container terminals in ports. Ever increasing size of ships urges more efficiency/productivity in loading/unloading the containers. Thus the Authors worked for the development (or designing) high performance cranes.

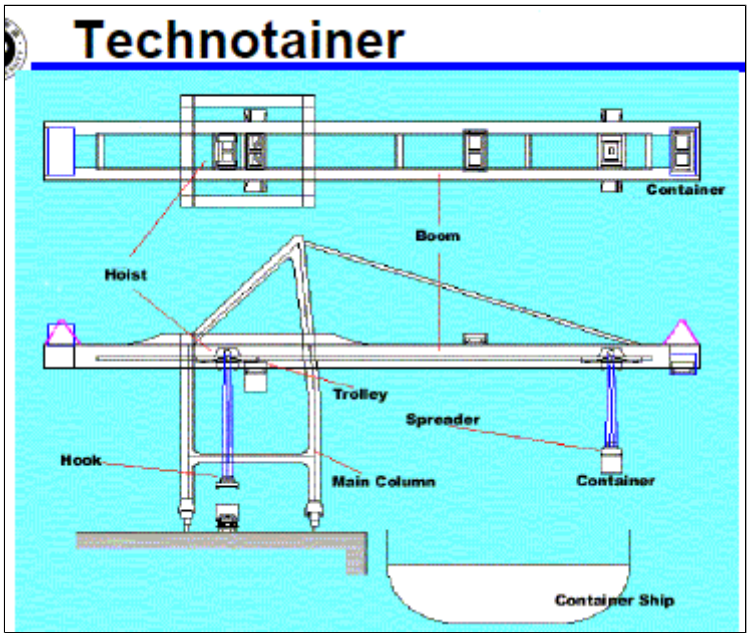


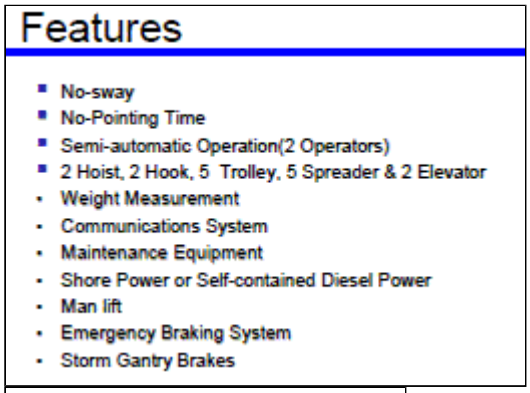
By using TRIZ on this technical problem, the Authors obtained a basic idea of using cyclic motion of the trolley instead of linear back-and-forth motion. As shown in the slide (below-left), their first solution concept was a horizontal rotation system just like the one used in Ski Lift. Then, by overcoming the Psychological Inertia, they developed a new solution concept of vertically rotating system (see slide (below-right)). The new Gantry Crane has two sets of trolley rails (i.e., upper and lower rails for going and returning, respectively), and at the ends of the rails the trolley is moved up and down by using an elevator.

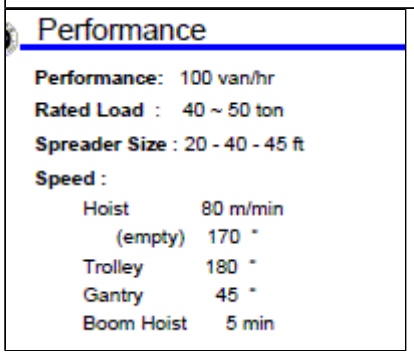




The Authors developed their engineering model, as shown in the slide (center). As summarized in the Features (slide (right-top)), 5 trolleys are working in a cyclic manner. No-sway is resulted from the vertical setting of every load.

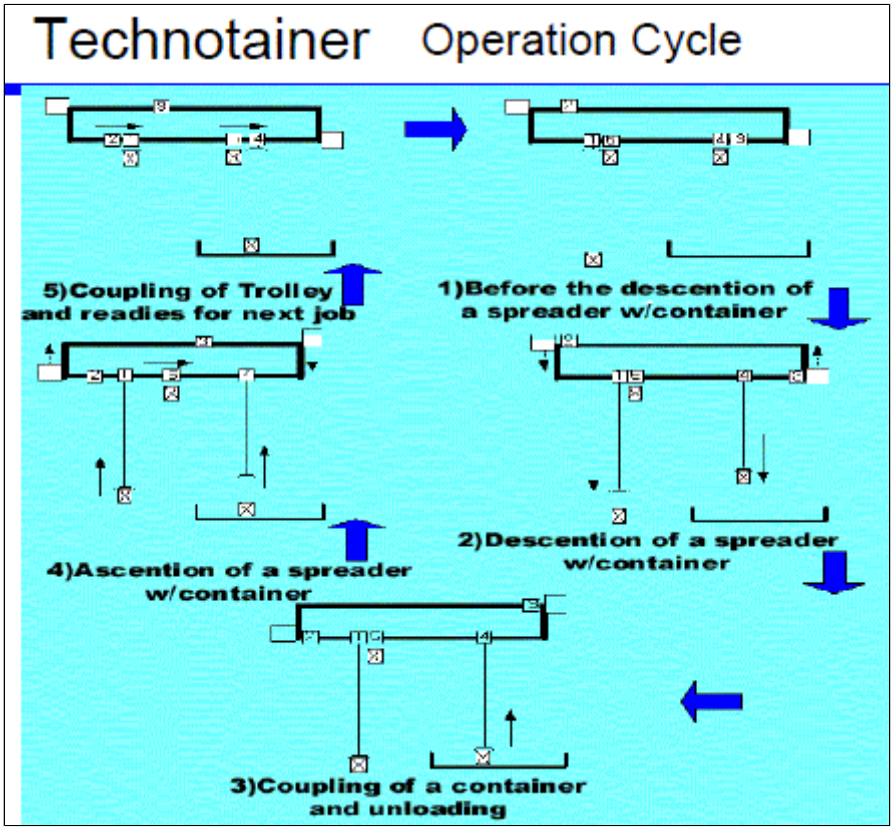


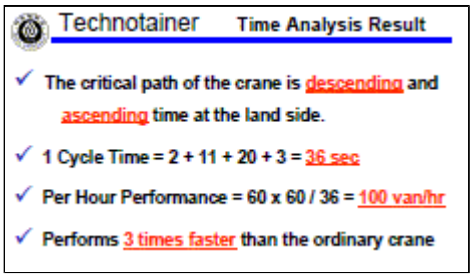




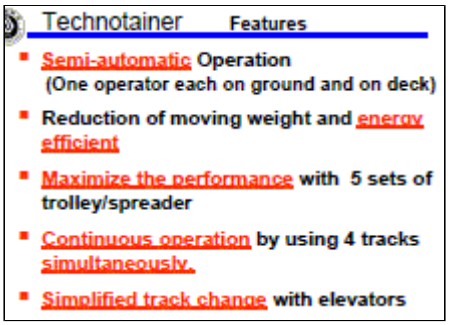
The design of Operation Cycle of the system is most interesting. The slide (right) is the schematic of the Operation Cycle, for the case of lifting the containers at the land (left-side) and loading them onto the ship (right-

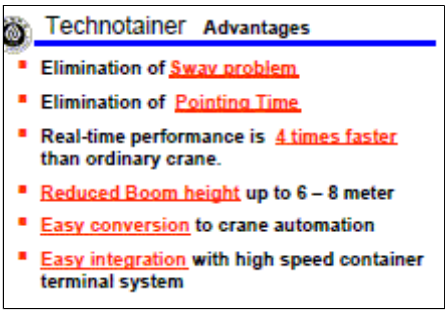
side). At the stage 1), the land-side Hoist for Trolley 1 is going to descend the Spreader (without container); a container is coupled at the stage 3) and is lifted up at the Stage 4). Then in the next cycle, the same Trolley (now named Trolley 5) is waiting for a while and moved to the ship-side Hoist. In the 3rd cycle, the container of the Trolley (No. 4) is lowered and unloaded on the ship. In the 4th cycle the Trolley (No. 3) is moved to the upper rail, and in the 5th cycle the Trolley (No. 2) is transferred to the position next to the land-side Hoist. The time analysis is summarized in the slide (below).

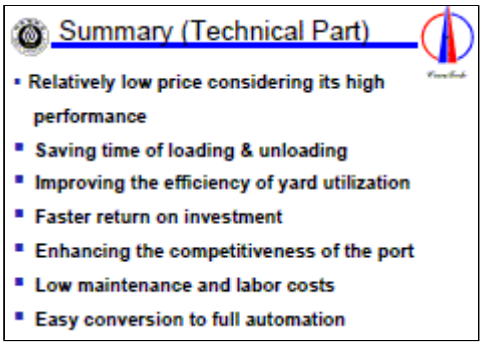




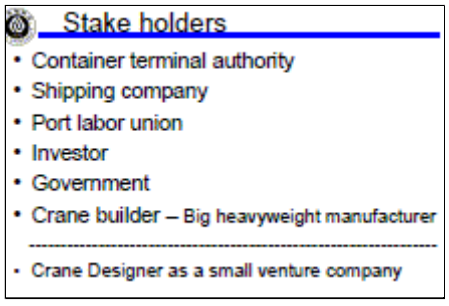
The Authors further carried out static and dynamic simulation analyses of the system and developed well a new Gantry Crane. The features and advantages of the system are shown in the slides (below-left and below-center). Real-time performance is 4 times faster than ordinary crane. The Authors summarize the results very positively in the "technical" viewpoints, as shown in the slide (below-right).

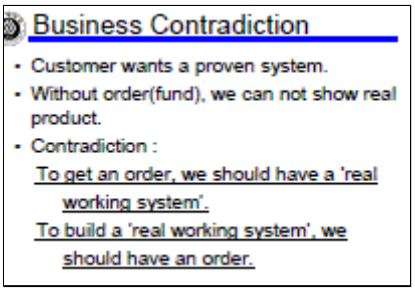


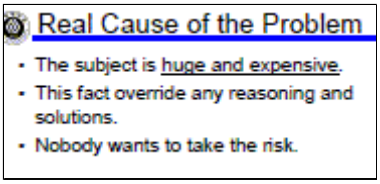




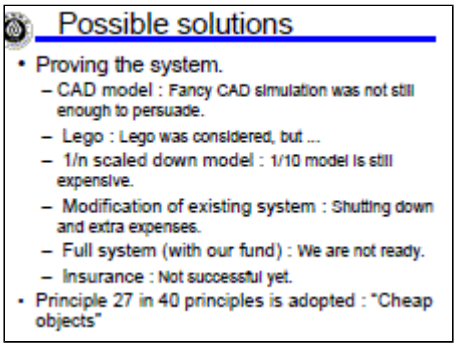
The problem for the Authors is now the business problem, they say (See the four slides (below)). They have started a small venture company for the business of the new Gantry Crane. But they face with the Business Contradiction: Customers want a proven, real working system but without order (or fund) the venture company cannot make a real product. Since the new system is huge and expensive, nobody wants to take the risk of building the first model.

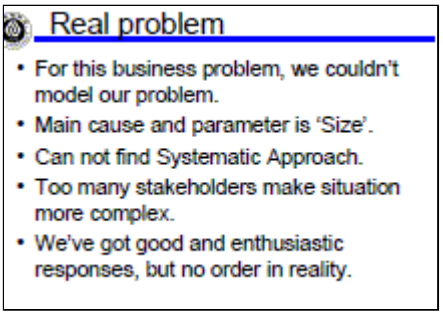




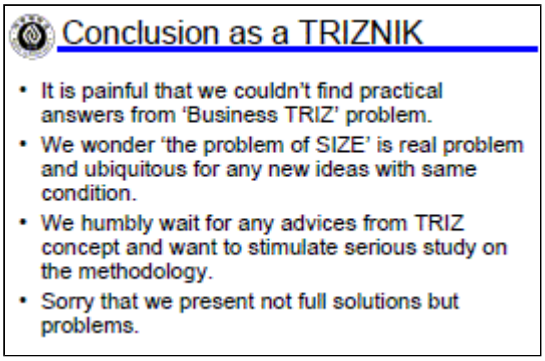


The following 3 slides (below) discusses on possible solutions, real problems, and strategic suggestions. These are of course typical problems for technology-oriented venture companies, but are particularly serious in the present case because of the huge technical system.





The Authors shows the slide (right) as the conclusion.



After this presentation, there were various discussions and suggestions on the business problem. Since business problems depend much on specific situations, such suggestions may not be applicable to the present case.

[*** This is a nice case study of a technical problem. The development of the solution concept and brushing it up with simulations into a practical solution are a nice work for a university laboratory and its venture company. Since the solution seems excellent, we wish the Authors find some opportunities to make it in reality.]

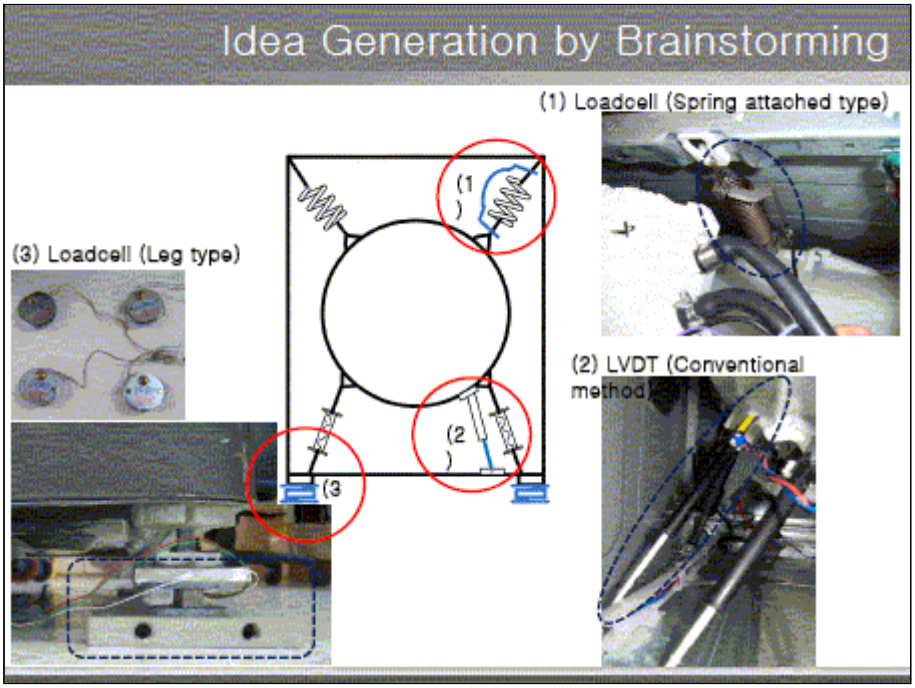
JinHa JEONG, Jeong-Su HAN, and JunHoe CHOI (Samsung Electronics, Korea) [E12, P-A5] gave a Poster presentation with the title of "**Development of a New Weight Sensor for a Washing Machine by Using TRIZ Problem Formulation**". The Authors' Abstract is quoted here first:

> Recently, energy regulation pushes development of eco-saving products. Washing machine, one of energy consuming product, can reduce water usage and heating energy of water by controlling water supply based on the weight of laundry. There are two conventional weight sensing methods in washing machine. One is sensing the force of inertia of a rotating motor and the other method adopts a weight sensor, called LVDT sensor. The former renders inaccurate weight and the latter is expensive. To develop an accurate and inexpensive weight sensor, we have adopted TRIZ tools such as a problem formulation, RCA and function analysis to identify a problem, and FOS (Function-Oriented Search) algorithm to generate suitable solutions. As a result, we have obtained even weight sensing performance and 80% cost effective than a conventional weight sensor. Furthermore the developed sensor has increased manufacturability and easy installation due to its simple structure.

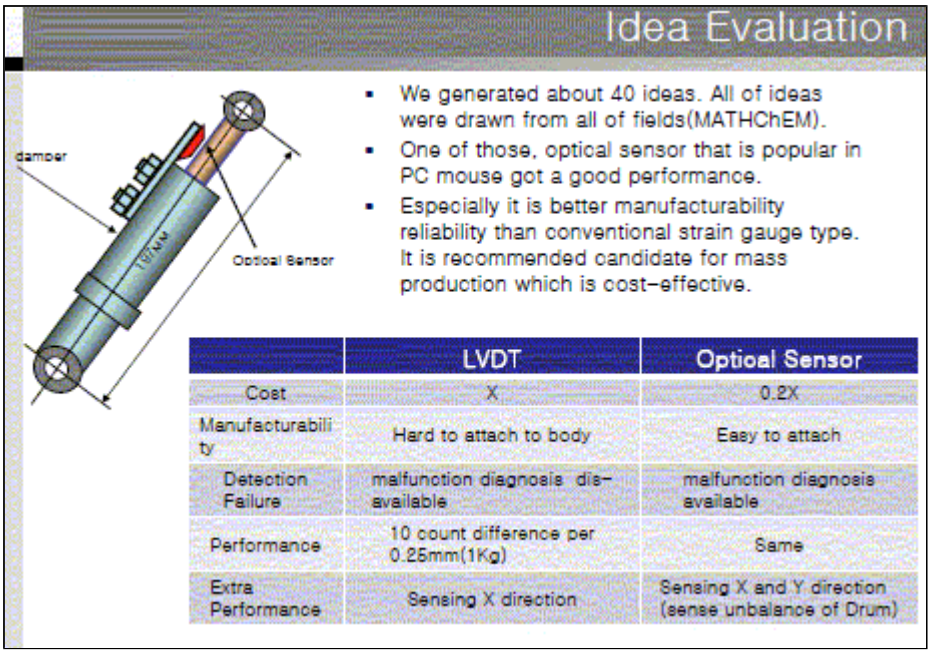
The slide (right) schematically shows the structure of the drum (rotating vertically) and its supports of the present system. The Authors initially generated ideas by using brainstorming. They have obtained 10 ideas, which are related to the improvement of the three parts

shown with red circles. They tried the ideas, especially the one setting a loadcell at the spring. The results were not satisfactory in the precision of weight measurement of the clothes.

Thus the Authors stepped back to face with the problem more seriously by using TRIZ and System Engineering. They reconsidered the purpose of the problem, applied functional analysis, thought of the Effective Zone (i.e. the range of objects influenced by the weight of the clothes), used IFR and Resources, built Su-Field Model, considered possible Fields, etc.



In this manner they have generated about 40 ideas (slide (right)). On the basis of these ideas they have generated a solution as shown in the slide (light). The change in the stroke of the damper due to the weight of the clothes is measured precisely by use of an optical sensor newly attached at the side of the damper bar. They found this solution good in precision, in cost, and further in sensing the unbalance of the Drum.



Yoshiharu Isaka (IDEA Corporation) [J02, O-12] gave an Oral presentation with the title of "Development of New Products through Concept Mining and TRIZ – Thinking of New Innovations for Golf Course Lawn Mowers –". The Author's Abstract is quoted here first:

> At the fifth TRIZ Symposium, we presented an application case of concept mining and TRIZ methods, taking up a small-sized cultivator as an example. The purpose of using these methods was to create new competitive value criteria in marketing to replace the current competitive value criteria that are based on slight function or price differences.
> This time, we took up an industrial product as an extended application example and the purpose was to show that we could obtain new concepts even through a B2B product.
> There have only been a few cases in which concept mining and TRIZ have been applied to B2B products. However, we plan to use a lawn mower (a B2B product) and methodically introduce how we can make the best use of the TRIZ method to solve technical problems, which are technical bottlenecks in creating new competitive value criteria.
> We believe this demonstration will definitely show that concept mining and TRIZ are effective and essential methods for the creation of new products, which suggest future value and materialize it throughout the processes, from making product concept to finding concrete and definite solutions for technological problems.

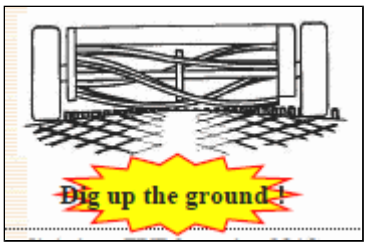
According to the present demonstration, the Concept Mining seems to have the processes of (a) Set a target market (golf course maintenance) and product (walking-type lawn mower for golf course green), (b) understand the tasks of the product and its users (care taker of the green), (c) set a (type of) targeted company (leading golf courses), (d) breakdown the jobs of using the product (golf course management), and (e) consider the scenes of the jobs and personal needs of the users.

Based on such a background work, the Author demonstrates the Concept Mining Chart in the slide (below). The rows of this matrix represent scenes of using the target product. The columns stand for the Personal Needs of the users; the original needs shown at the top are general enough for various cases of Concept Mining analysis while the Personal needs are somewhat specific. After considering the importance of needs in each matrix elements, the targeted scenes (in the right most column) and the targeted needs (in the bottom raw) are chosen as marked with solid circles.

Concept Mining Chart

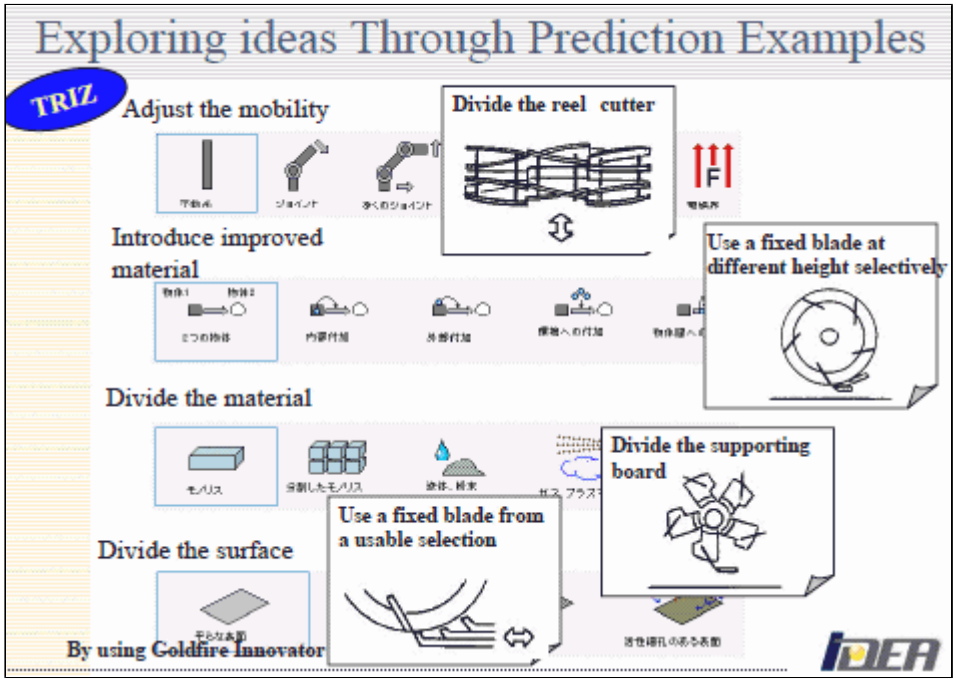
Original needs / Personal Needs / Scenes	Health Want to make working environment better	Rich spirit Want to work in good time	Respect Want to be recognized in the field	To be oneself Want to finish work with just one cut	Affection Want to be praised by golfers	Friendship Want to deepen exchanges in and outside the company	Sensation-joy Want to mow uneven lawn excellently	Personal growth Want to finish work in a short amount of time	 Want to promote soil management	Targeted Scenes	Product Concept Catch-phrase
The green is mowed evenly regardless of many undulations		◎	○	○	○		◎	○		●	Mollusk-like lawnmower which is flexibly adjusted to the green surface
Due to the wide cutting width and efficient operation, working time is short		○	○	○			○	◎		●	
Mowing width is less, even at high mowing speed		○			○			◎			
The lawn after mowing maintains its beautiful green hue		○			◎						
Can cut the time for sharpening by half, thus can work in good time								◎			
Due to shortening mowing time, the extra time is to be spared for soil maintenance		○							◎		
Targeted Needs							●	●			

In this way, it is understood that an innovation in the walking type lawn mower machine requests to make the machine excellent and efficient in mowing uneven, undulating green. The difficulty or the focus of the problem is shown in the illustration (slide right).

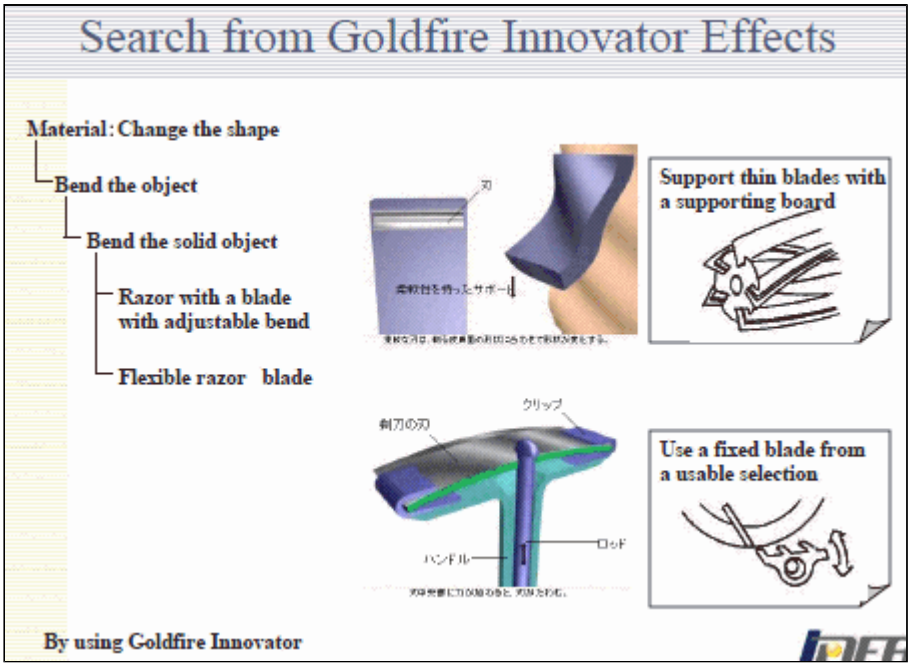


For solving the problem, the Author applies TRIZ. He uses a software tool, Goldfire Innovator of Invention Machine. The slide (right) uses the Trends of Systems Evolution for getting hints for ideas. The trend of 'Adjust the mobility' has suggested to divide the reel cutter across the shaft so as to be adjustable in the height of the cutter position of each section. Three other ideas are shown here for adjusting the

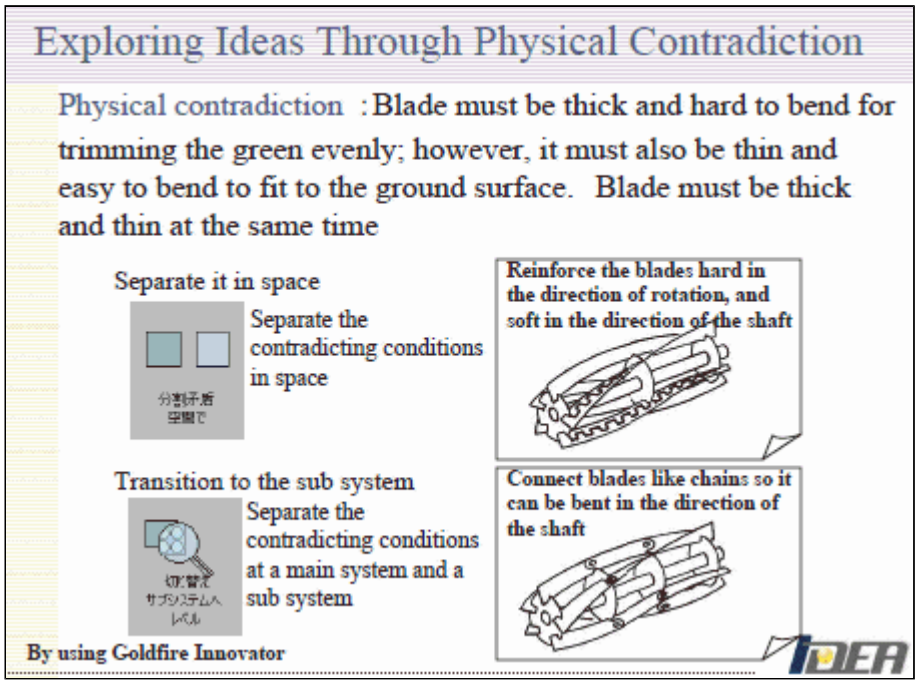
height of the cutting positions.



The Author seek for other hints for solution ideas by using the Effects knowledge base (in Goldfire Innovation) (see slide right). The hierarchical search process used by the Author is illustrated at the left part of the slide. Looking at the examples of bending the razor blade, the Author is thinking to apply the ideas in the blade of he reel cutter.

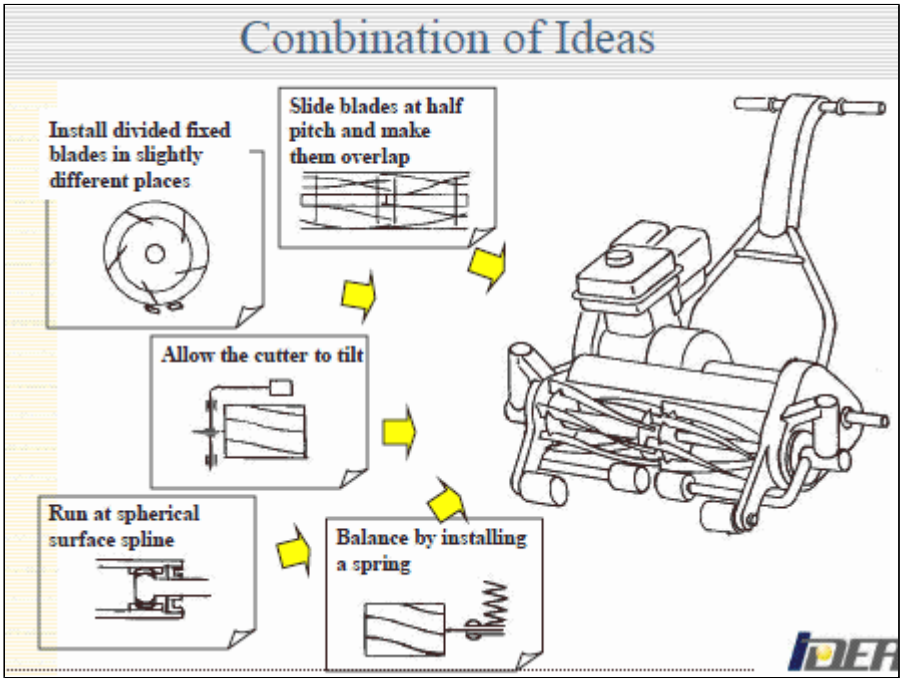


He also uses the example knowledge bases for solving Physical Contradictions. Here he has shown two ideas to make the reel cutter blade soft, or adjustable, in the direction of the shaft, i.e. the distance from the shaft.



Obtaining such elements of ideas and combining them, the Author tries to build up a conceptual solution, as illustrated in the slide (right).

[*** (Nakagawa's comment) I am not sure about the feasibility and effectiveness of this conceptual solution. However, the main contribution of this paper is the method of "Concept Mining", which has been introduced at the first slide of this part of my introduction.]



Kouichi Nakamura (*), Noritaka Nakayama (Konica Minolta Technology Center), Hirotake Makino (*), Hideki Ohmori (*), Kazunori Aoki (Tokyo Keiki Kogyo), Etsuo Yamada (*), Osamu Kumasaka (Kumasaka Professional Engineer office), Minoru Takimoto (Fuji Xerox Information Systems Corp.), Tatsuhiko Atsuta (*), and Yuji Mihara (Creative Technology Institute) [(*) MPUF (Microsoft Project Users Forum) USIT/TRIZ Study Group] [J18, O-16] gave an Oral presentation with the title of "Application of USIT to Useful Paper Fastener". In the initial half of the Authors' Abstract, the nature and aim of the group is explained as follows:

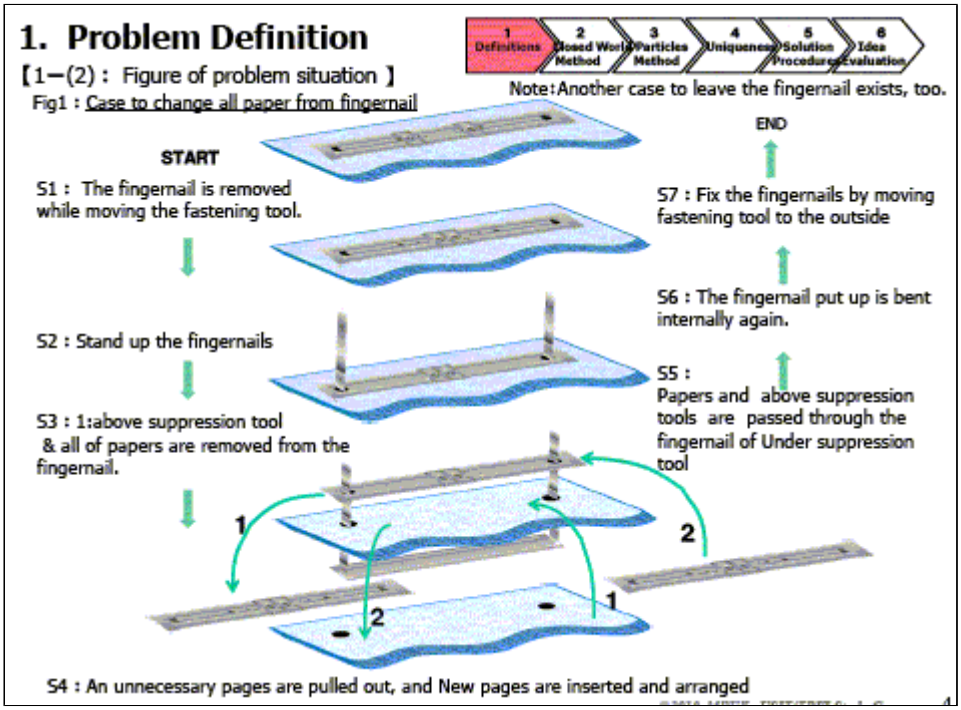
> MPUF (Microsoft Users Forum) is an NPO aiming at the improvement in the quality of Project Management. The number of study groups launched is about 20, and the USIT/TRIZ study group was launched in April, 2007. Members aim at improving through events, seminars, communities and study groups, about various subjects related to project management. The theme introduced this time is the achieved result through the Working Group activity of the study group.

[*** About the MPUF USIT/TRIZ Study Group, please refer to my explanation in the review of Oral presentation by its another subgroup, H. Kosha et al. Engl] The latter half of the Authors' Abstract is:

> The following result was able to be achieved by using the technique of USIT in the WG to cope with the issues facing the existing paper fasteners.
> 1. It became easier to advance discussion because the procedure and things to be done become clear by using the USIT workbook (announced from this society last year). And, the USIT template form was used to arrange the results. As a result, it was confirmed that the results could be effectively shared by using the USIT template form to summarize the process of each STEP.
> 2. Key Words of a wide viewpoint were obtained from this approach, and some ideas generated from these Key Words will be introduced.

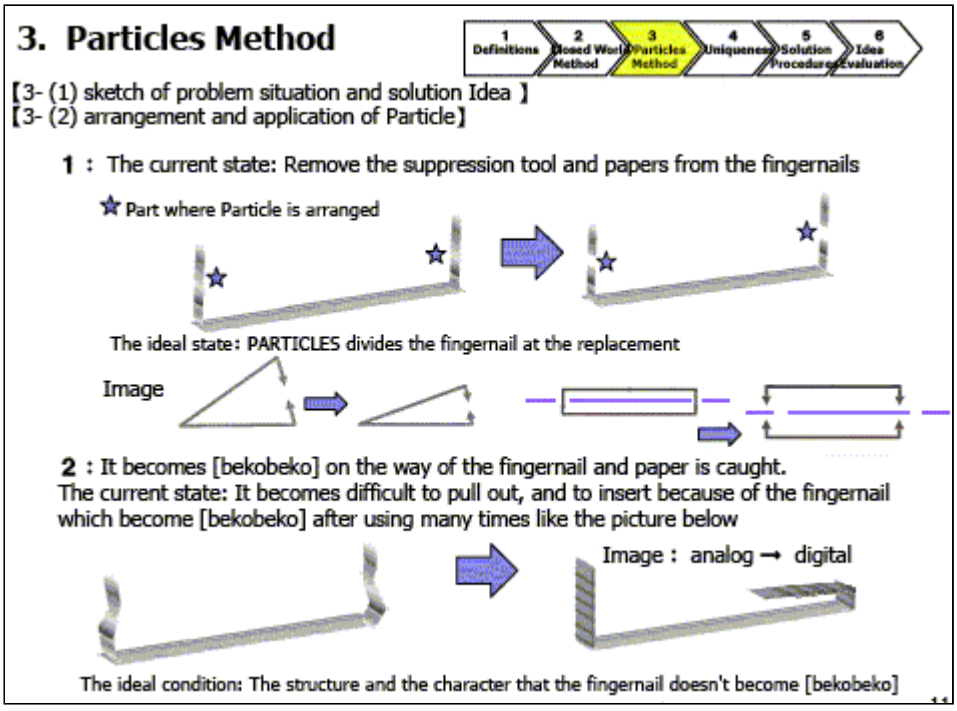
As described in the Authors' Abstract, one of the aims of their present work was to follow the steps of the "USIT Workbook" developed in the Study Group and reported a year before by Takuo Maeda et al. The Authors presented their results in detail with 32 slides following the steps. The slide (right), for example, is the description they wrote in the Workbook at the sub-

stage [1-(2): Figure of problem situation] in the stage: 1. Problem Definition. The problem was to improve the paper fastener for easier/faster replacement of the papers. To clarify the problem, the slide illustrates the whole process of handling the paper fastener for deleting/inserting several pages. The main difficulty of the process lies at the step (S4) of passing the fingernails through the holes of many pages.



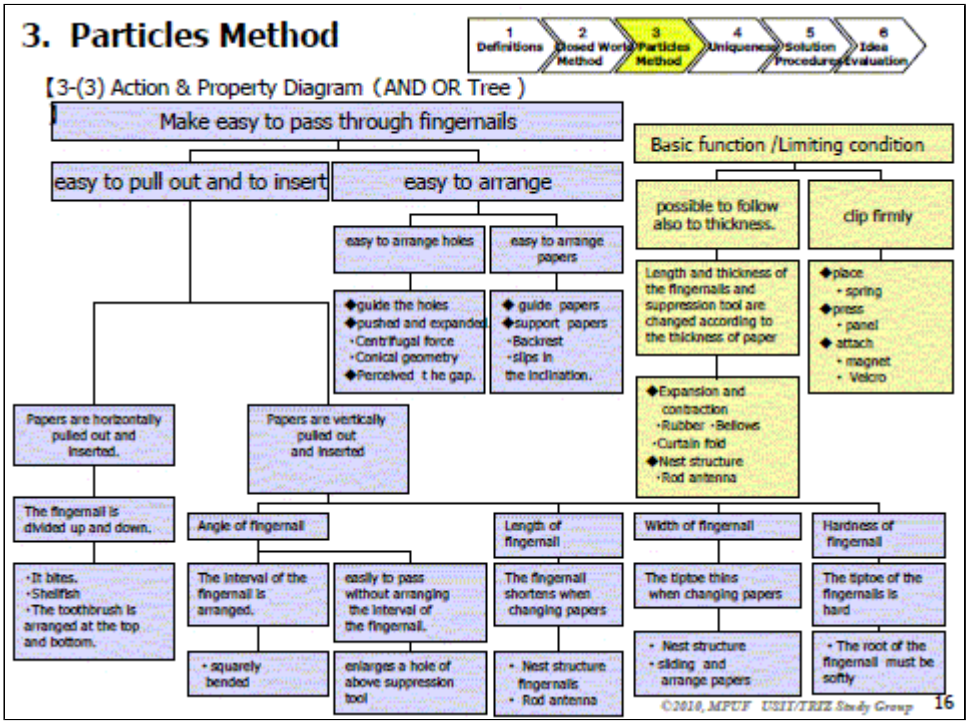
The USIT Process (in this Workbook) has 6 stages:
1. Problem Definition,
2. Closed World Method (for analyzing the present system in terms of Objects-Attributes-Functions),
3. Particles Method (for making image of ideal system),
4. Uniqueness Method (for analyzing the problem in terms of Space and Time),
5. Solution Generation, and
6. Idea Evaluation.

The slide (right) shows the initial steps of the Particles Method. Problem situation and corresponding ideal image are sketched, and then the Particles (i.e., imaginary magical substance or Field) are shown with Star marks at the places where the two sketches are different. We imagine that the Particles have some magical capability of achieving the ideal results, and try to understand how they could achieve them.



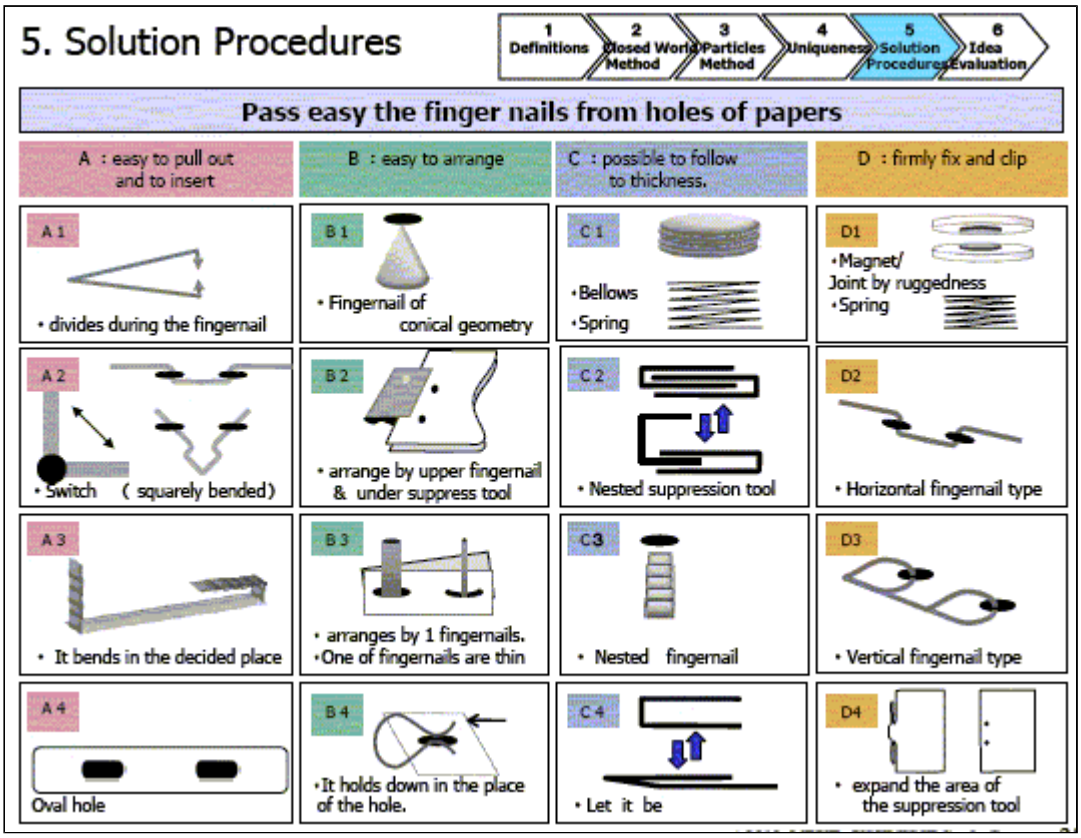
The slide (right) shows the latter half of the stage of the Particles Method. Now the Authors construct the Action & Property Diagram (or "AND/OR Tree" according to Sickafus' original naming). The ideal (or most desirable) solution to be achieve is written at the top of the tree

diagram. Then desirable partial solutions (which the Particles can achieve in a magical manner) are written step by step downward in the tree structure. The lower branches need to be combined with either AND or OR relationship to achieve the upper node. In the bottom half of the Action& Property Diagram, desirable possible properties are listed up. By using this method the Authors have obtained various suggestions to ideas/solutions.

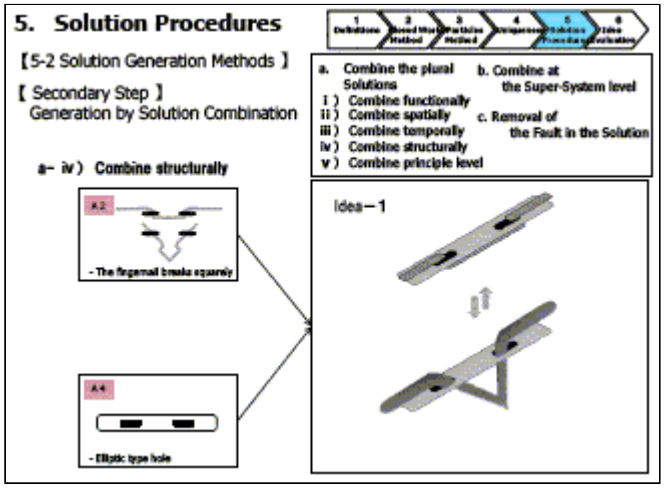


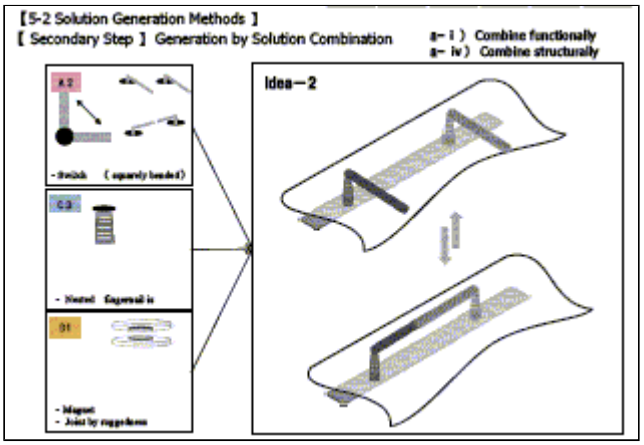
USIT has a system of Operators for generating solution ideas. The main 5 USIT Operators are: Pluralizing Objects, Dimensional Change in Attributes, Redistribution of Functions, Generalization of Solutions, and Combination of Solutions. They contain 32 sub-operators in total.

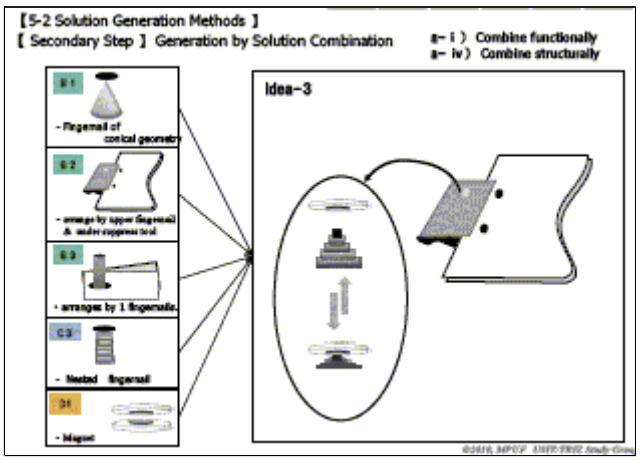
The slide (right) shows a summary of ideas which are generated in the analysis stages and in the solution generation stage by using various USIT Operators. They are classified here in terms of their intentions. The Authors have generated a large number of ideas.

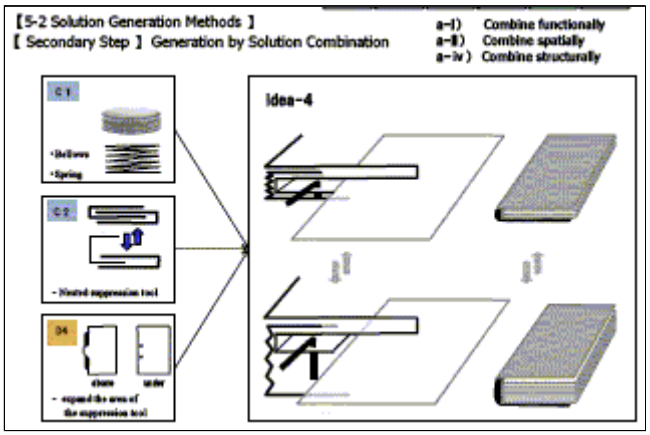


Then the Authors have tried to combine various ideas into feasible solution concepts. The following 4 slides demonstrate how the ideas are combined into solution concepts.



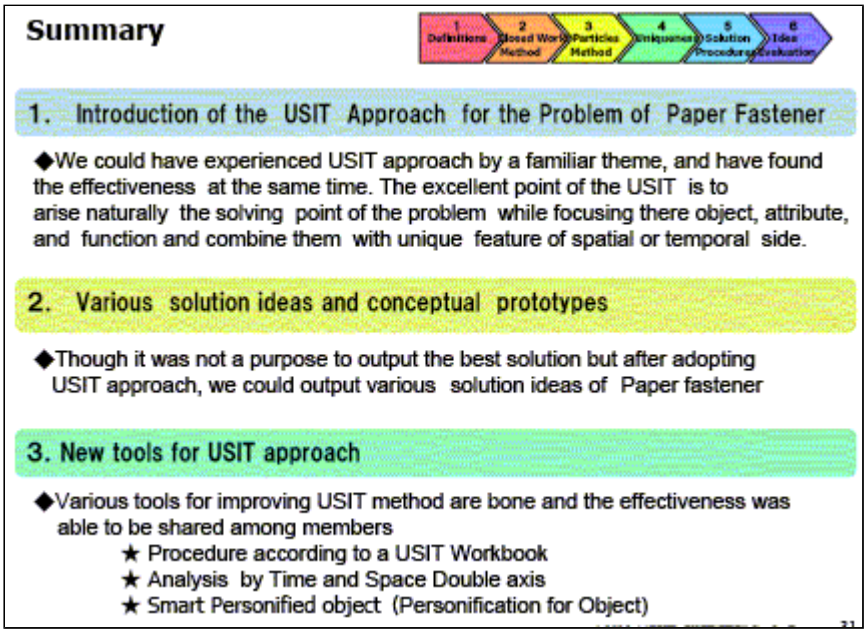






The Authors gives their summary as shown in the slide (right). They have demonstrated the whole process of USIT along their "USIT Workbook" as the template. Since they used a familiar item, a Paper Fastener, the Authors' presentation is easy to follow and good as a case study. They have generated many ideas and their way of thinking can be traced in the presentation. In this sense, the "USIT Workbook" has been shown effective.

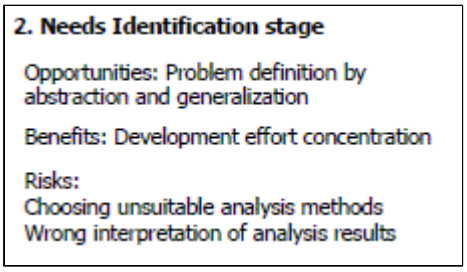
[*** Even though the Authors have generated many ideas and demonstrated four solution concepts, I am not satisfied in the effectiveness and feasibility of their solution concepts. In the USIT/TRIZ Study Group I suggested them that the main difficulty in using the current Paper Fastener is arranging/keeping many pages of paper in a neatly-stacked position in the process of passing the two fingernails through the paper holes. Thus my suggestion was to make a complementary device for arranging and keeping the pages in a neatly-stacked way and to use some cloth-like material with "magic tapes" at the ends for fastening them together.]

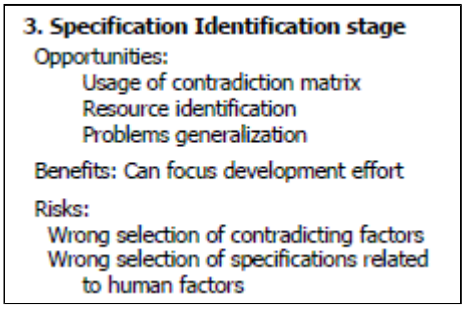


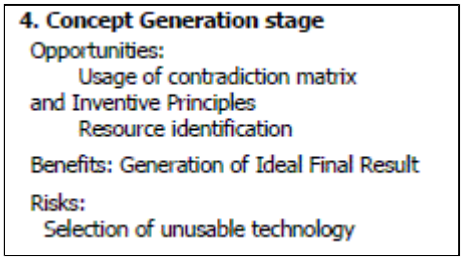
Masao Ishihama (Kanagawa Institute of Technology) [J19, O-4] gave an Oral presentation with the title of "Guiding Noise and Vibration Design along General TRIZ Process by Misunderstanding Case List". Here is the Author's Abstract:

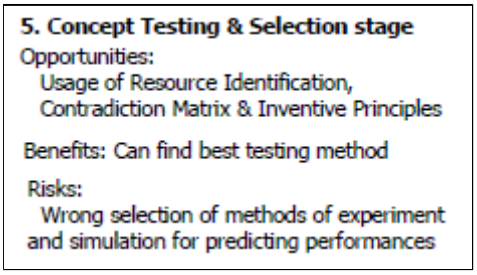
> To improve noise and vibration (NVH) performance is important in such products as motor vehicles and home electrical appliances. To improve NVH and other performances simultaneously requires inventive design solutions. The author presented his study on the effective application method of TRIZ on NVH design at the 4th Japan TRIZ Symposium. The method has two new and major tools. One of them enables the user classify particular problems into seven standard NVH problems and the other provides more than 40 standard NVH solutions. This paper discloses the results of study for improving this method further. The new feature is to place three kinds of knowledge bases (KB) in standard TRIZ process. The KBs prevent designers from side-tracking by showing negative examples. This method plays as a complement of normal TRIZ tools that attract people toward ideal directions.

The Author's work presented at Japan TRIZ Symposium 2008 was later posted in this "TRIZ Home Page in Japan", see Engl. The Author wants to discuss how TRIZ should be used effectively in the early stages of product development (see slide (below top-left)). The Author, as a specialist in the field of motor vehicles technology, he realizes the needs, opportunities, and benefits of applying TRIZ to such stages of product development, and yet finds possible risks in the TRIZ application. In the 5 slides (below) he summarizes his findings.

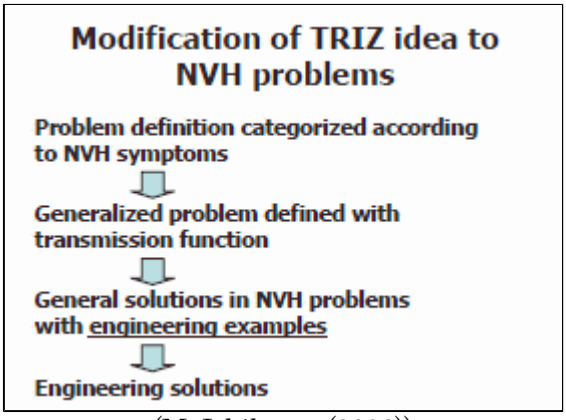




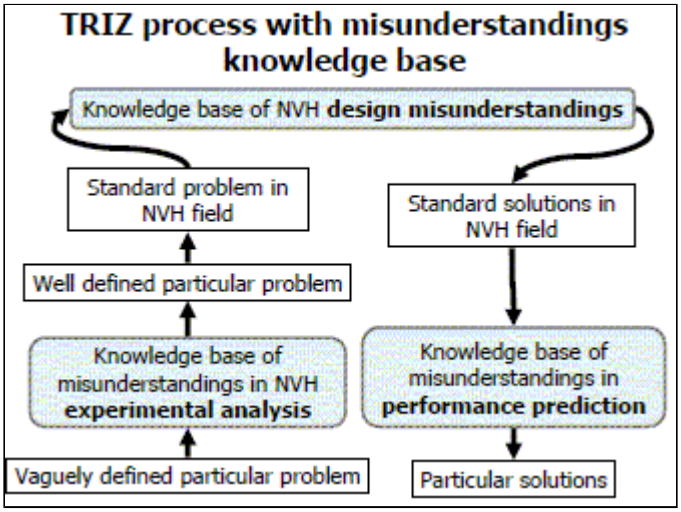




For addressing the Noise & Vibration (NVH) problems in motor vehicles, the Author built a guideline and knowledge bases of applying TRIZ (in a positive way) two years ago, as shown in the slide (below-left) which is taken from his 2008 presentation. However, for guiding engineers correctly by preventing from mistakes in the development process, the Author has found it useful to show them negative examples. Thus he built up Knowledge bases of misunderstanding in 3 stages. The slide (below-right) shows his new scheme of applying TRIZ in the NVH field especially complemented with the Knowledge bases of misunderstanding for avoiding from mistakes. He classified the NVH misunderstandings KB according to three phases of usage, i.e., for experimental analysis, for design, and for performance.



(M. Ishihama (2008))



The slide (below) shows a part of his Misunderstandings Knowledge Base. About 70 items are listed in this scheme, he says.

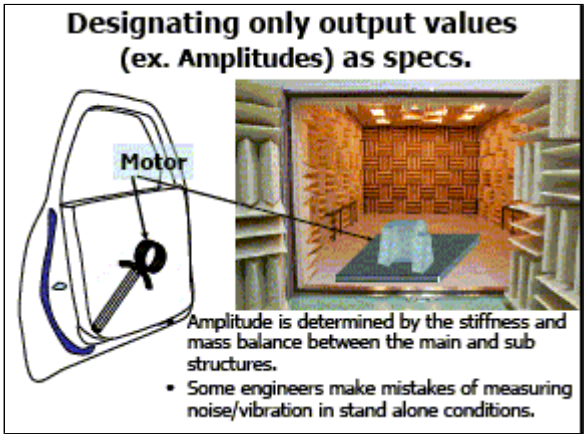
A List of Misunderstandings

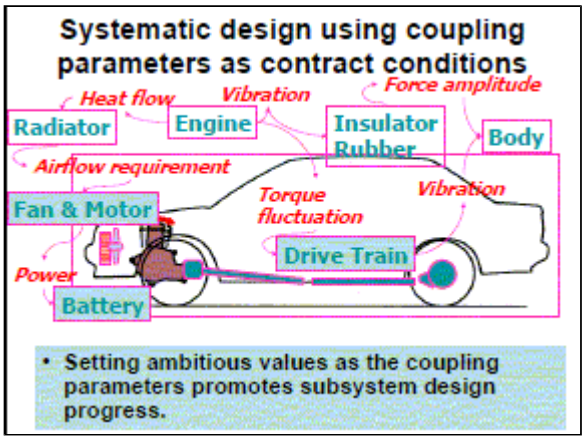
One part of the list for conceptual design stage.
There are about 70 items in all.

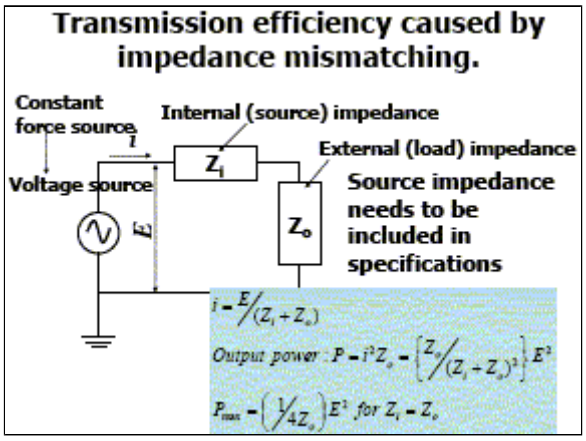
Stage	Phenomena	Examples of misunderstandings	Performance, hardware or software concerned	Problems caused by the misunderstandings	Origin of the misunderstandings
Concept Generation	NVH General	Designating only output values (ex. Amplitudes) as specs.	Auxiary equipment	Overlooking of transmission efficiency caused by impedance mis-matching.	Insufficient knowldege in electric circuit theory
		Designing filters always on frequency domain	Signal processing	Cannot realize time-domain filters (impulse response) that really act	Superficial knowledge of Fourier Transform
		Applying only absorption (damping) or insulation alone.	Architectural acoustics	Vibration that does not reduces by damping, sound that does not reduces by insulation.	Overlooking input & output power balance
	Noise	Collision noise is generated only by structural vibration	Machine noise	Noise caused by flow collision is untreated	Poor education on sound & vibration relationship
		Sound propagating speed exeeds sound speed	Exhaust system	Miscalculation of resonant tube length	Insufficient knowledge of supersonic fluid dynamics
		Fail to recognize particle velocity as a vector	Active noise control	Misselection and misarrangement of actuator	Forgotten basid acoustics
		Confusion of mono-pole and die-pole sound sources	Active noise control	Misselection and misarrangement of actuator	Forgotten basid acoustics
Concept Generation	Vibration	Belief that damping of suspension or mounting is always useful	Engine mounting, suspension damper	Increase of transmission in high frequency range	Forgotten basid mechanics
		Universal joint transmitts just axial torque	Drive line	Vibration excitation near universal joints	Insufficient understanding of torque as vector
		Cord tension and lateral vibration oscillates at the same frequency	Belt or chain vibration	Wrong tuning of structure resonance	Lack of imagining physical movement
		Spacial waveforms of cords are sinusoidal	Belt or chain vibration	Wrong application of modal analysis	Lack of imagining physical movement
		Believing only even order harmonics dominate in four cylinder in-line engine excitation	Engine vibration & exhaust noise	Unnecessary search for non-linear effect or non-existing excitation sources	A fixed idea that the system is always symmetric

In the presentation sides recorded in the Proceedings, the Author demonstrates 3 examples, as shown in the slides (right, below-left, and below-right).

[*** This kind of work must be important to make a solid basis for applying TRIZ to common and prevailing problems in specific fields. Author's suggestions about possible risks in applying TRIZ should also be considered carefully.]



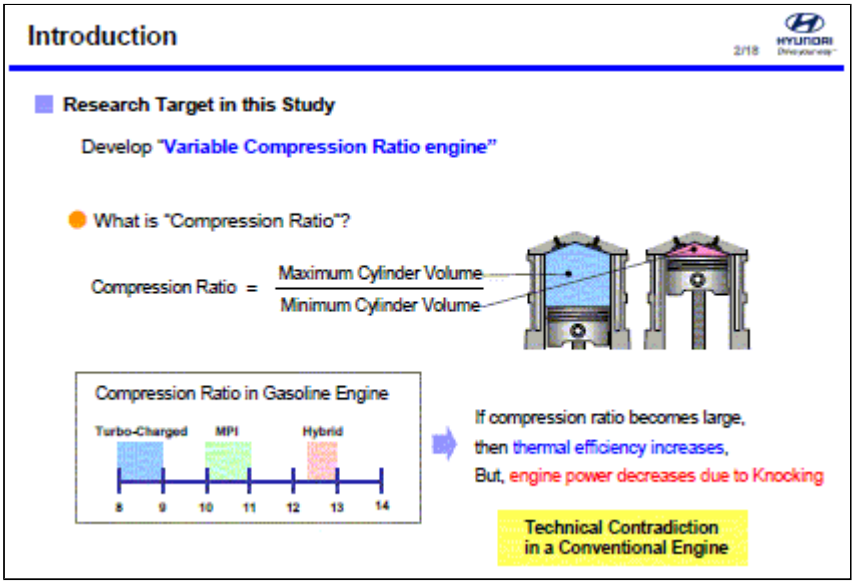




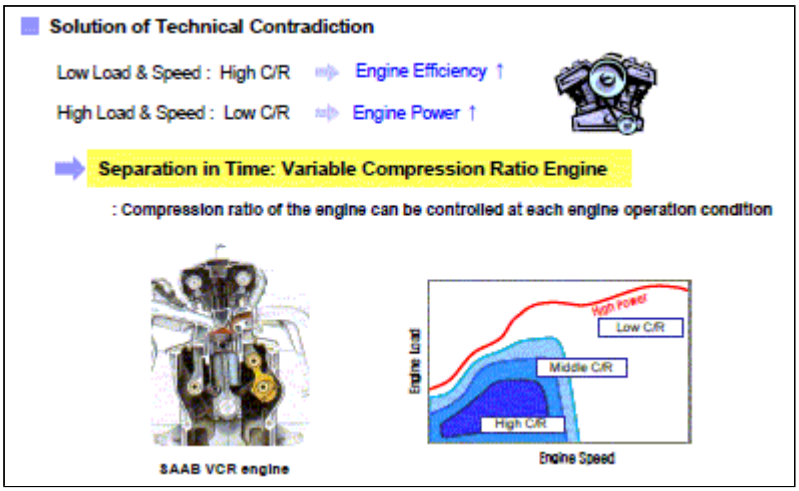
Hong-Wook Lee, Won Gyu Kim, Myung Rae Cho, Jin Woo Cho, and Sang Hee Lee (Hyundai-Kia Motor Co., Korea) [E11, O-6] gave an Oral presentation with the title of "Concept Development of a Variable Compression Ratio Engine Using TRIZ". This presentation was originally given in the 'Global TRIZ Conference in Korea 2010 (KoreaTRIZCON 2010)' in March 2010, and we are happy to have this excellent presentation again in our Japan TRIZ Symposium 2010. Dr. Hong-Wook Lee made his talk in Japanese, to our surprise; he had studied for 2 years at the Graduate School of Kyoto University, Japan. The Authors' Abstract is quoted here:

> The variable compression engine means that the compression ratio of the engine can be controlled at each engine operation condition. When the more power of engine is needed during high load, the compression ratio is decreased, and when the higher efficiency is needed during low load, the compression ratio is increased. Many companies have been carrying out their own research in to VCR Engines, so that each company has different type of VCR engine, but so far VCR engines have not been mass-produced. In this study, TRIZ is applied to develop new concept of VCR engine. Various tools of TRIZ have been used in this study: “Function analysis” is applied to analyze previous VCR models, and “Trimming” to make new contradiction, then “ARIZ” to solve this problem.

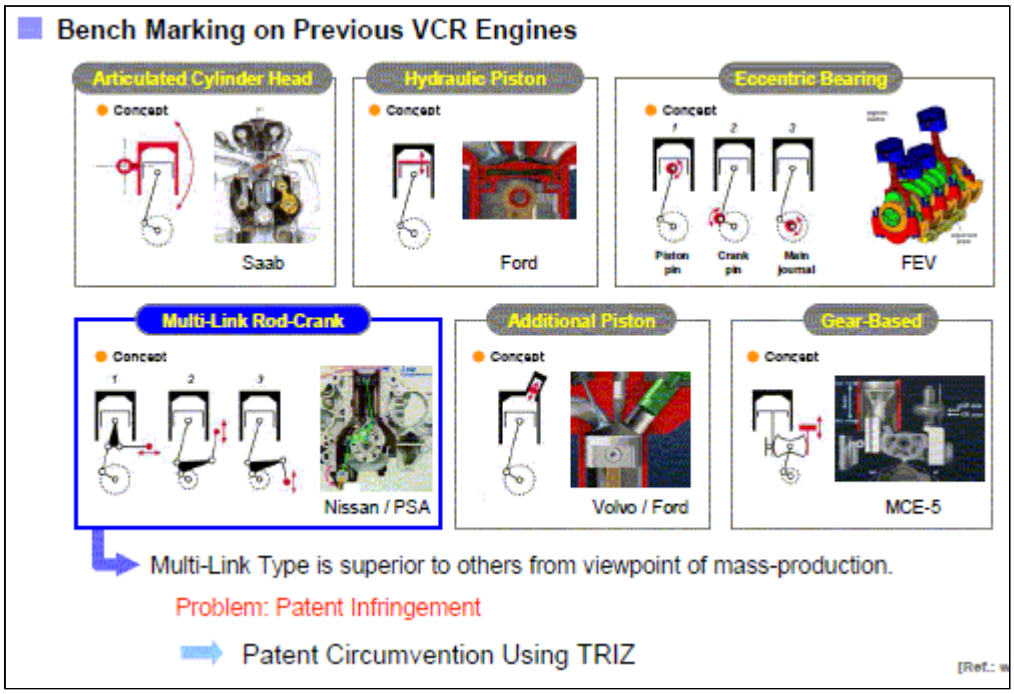
In the first slide (right) the Authors introduce the research target of their study. It is to develop "Variable Compression Ratio (VCR) engine". The slide explains the concept of Compression Ratio (CR). There is a common technical contradiction in the conventional engine that higher CR is desirable for higher thermal efficiency but undesirable because of the decrease in engine power due to Knocking.



The known solution of this Technical Contradiction is the "Variable Compression Ratio (VCR) Engine (slide (right)). It can be understood, in TRIZ terms, as the solution obtained with Separation in Time. The VCR engine can vary and control the CR according to the engine operation condition. In case of low load & speed, high CR is used for higher engine efficiency, whereas in case of high load & speed, low CR is used for larger engine power.

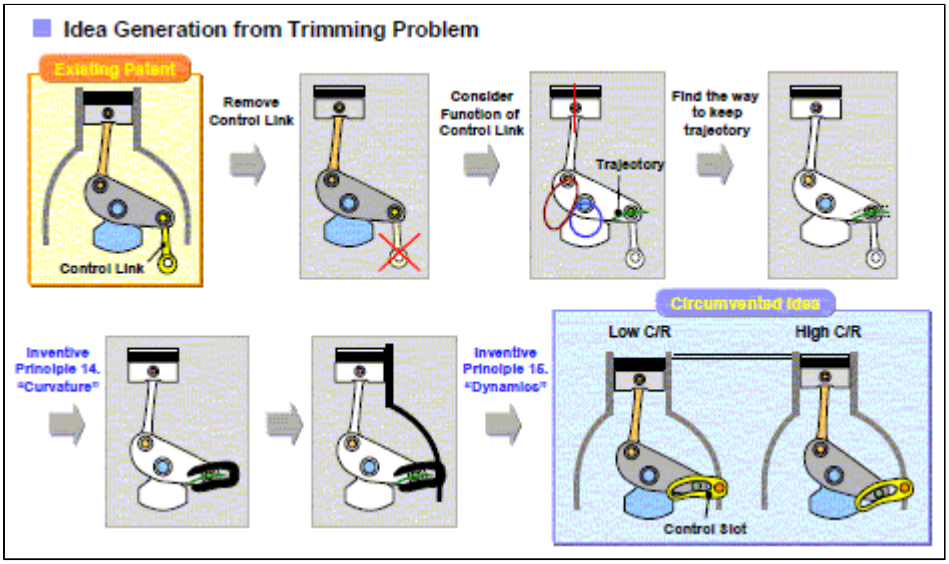


Various types of VCR engines have already been developed by other companies. So the Authors carried out bench marking on them (see slide (right)). Among the six types of VCR engines, they have concluded that the Multi-Link Rod-Crank type is the most suitable from the viewpoint of mass-production. The known models of the type were of course patent protected by the developer. Thus the next problem for the Authors was how to circumvent the patent. For this purpose they used TRIZ.

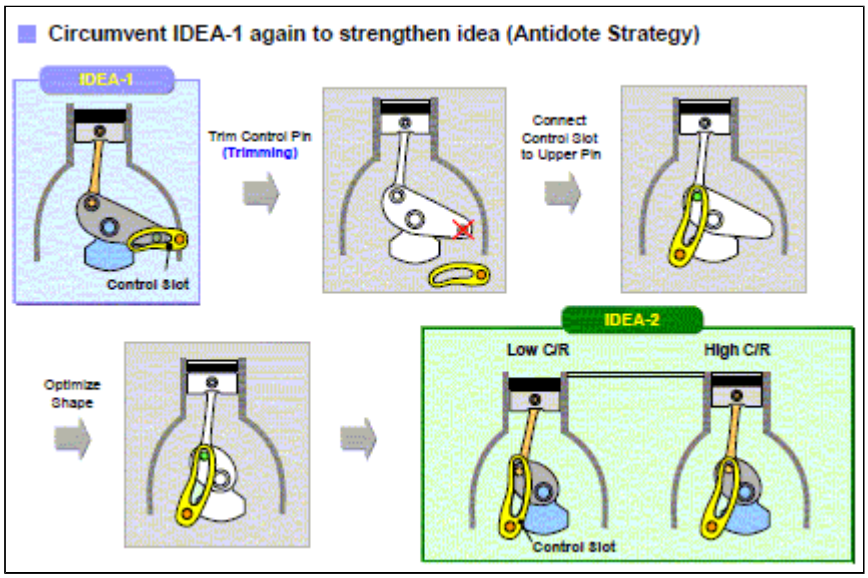


The typical way of using TRIZ for patent circumvention is to apply the Functional Analysis of the patented system and then to trim the key element (s) in it. Thus they trimmed (or removed) the control link in the system of the existing

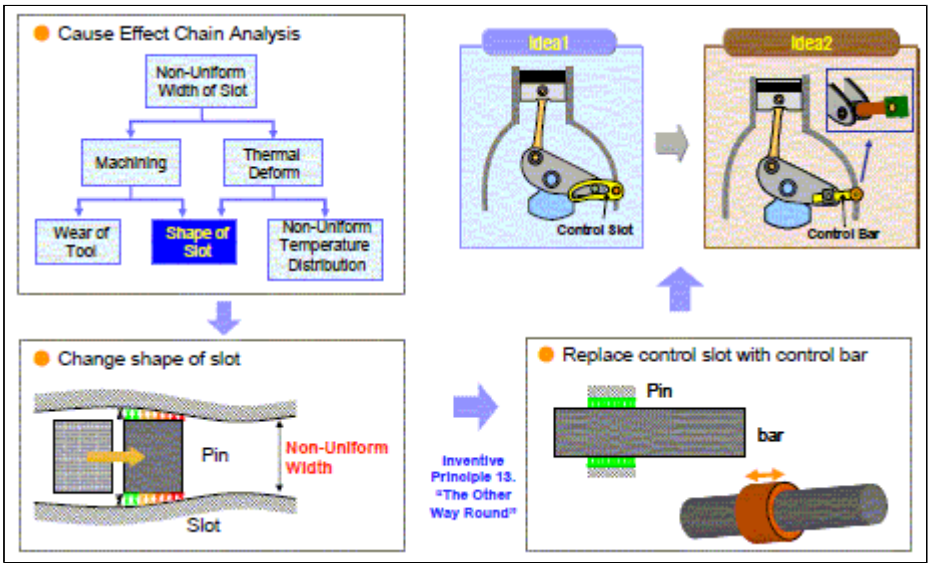
patent. The slide (right) illustrates their thinking process in detail. [*** This presentation is very valuable in this feature as a case study. We can vividly trace and learn how the Authors thought in their mind.] They considered the function of the (trimmed) control link and found that they should just manage to reproduce the trajectory of the control pin. Thus they devise the Control Slot (controlling the trajectory of the pin) and attached it at the side of the cylinder block. (IDEA-1)



The strength of this work is that the Authors went further to think better ideas, as shown in the slide (right). They tried to strengthen the idea further by trimming the Control Pin. They found the Upper Pin could also work for controlling its trajectory with a Control Slot. Thus they have obtained a second solution of new VCR engine, IDEA-2, as shown in the slide.

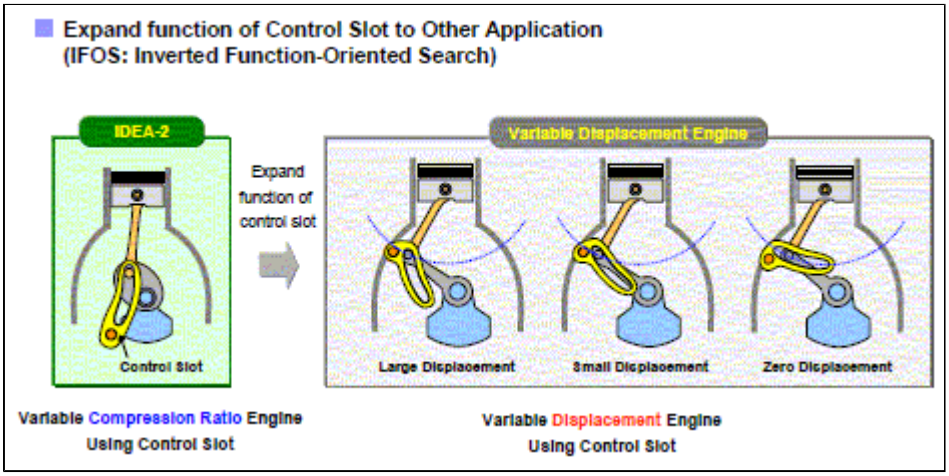


Another route of their thinking was to consider about possible problems in the new solution. One of the possible problems in IDEA-1 wa found the manufacturing precision of the Control Slot. If the Slot is too tight, the friction between the pin and the slot will cause inefficiency of the engine. If the Slot is too loose, the motion of the piston can not be controlled well. They tried to change the shape of the Pin from round to square, but found the idea is not good enough. Then they got the idea of using a bar and a holder. They have found a straight Control Bar is useful, as shown in the upper-right figure in the slide. (IDEA-3)

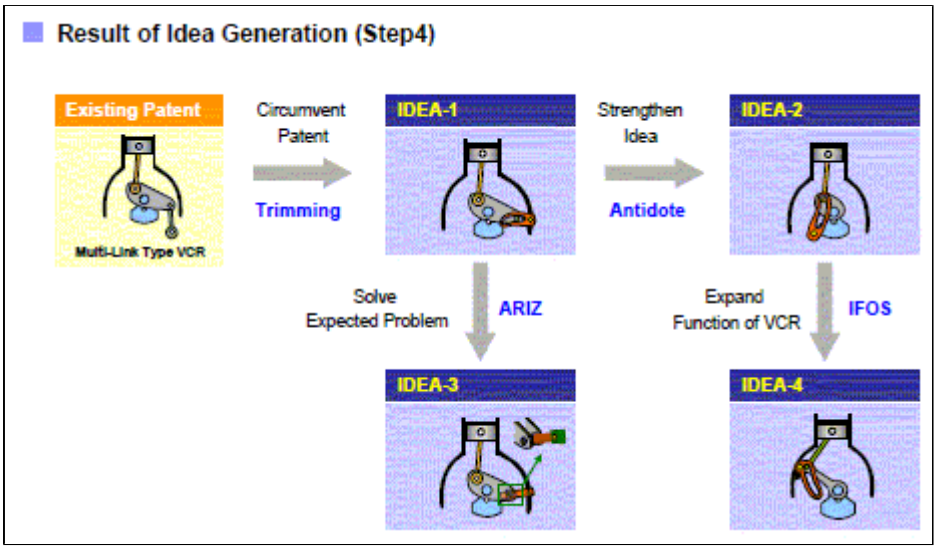


Further, the Authors tried to expand the function of the Control Slot to other applications. As shown in the slide (right), they have obtained a new concept of

"Variable Displacement Engine" (instead of Variable Compression Ratio Engine) using the Control Slot. By setting the Control Slot at different positions, the displacement length of the piston can be changed; large, small, and even zero displacement lengths. (IDEA-4) [*** I do not know for what purpose this change is useful.]

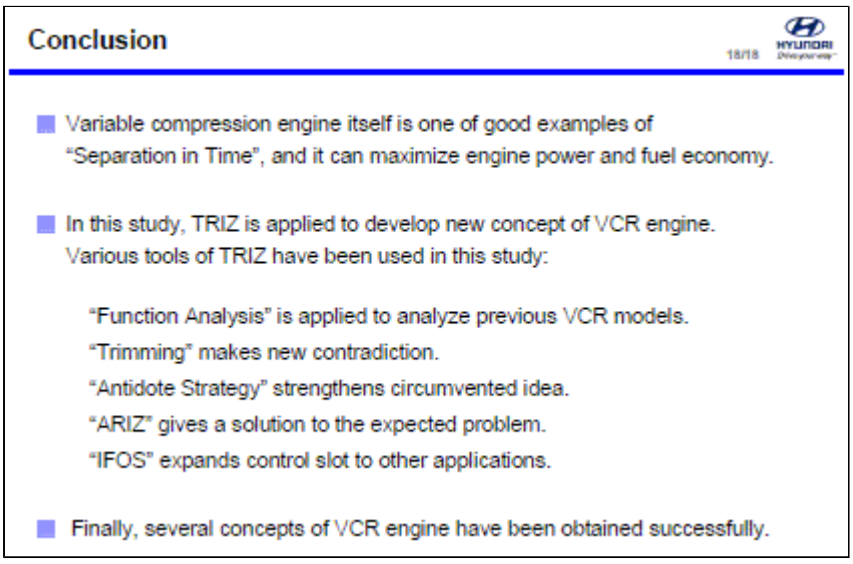


The Authors illustrate the results of their idea generation process. They have worked for the development of new types of VCR engine. Their first step was to circumvent other company's patents, by using the Trimming method. Then they went ahead to strengthen the idea, to solve expected problems in the new solution, and to further expand the function of VCR. [*** The strength and value of this presentation is the Authors' attitude to think and develop further and better solution concepts, I think.]



The Authors conclude their presentation with the slide (right). They have used various TRIZ methods as listed here and explained in their previous slides cited above.

[*** This is an excellent case study from which we can learn a lot about how to think. I wish that the PDF file of their presentation slides may be posted in this Web site under the permission of the Authors and their company, Hyundai-Kia Motor Co., Korea.]

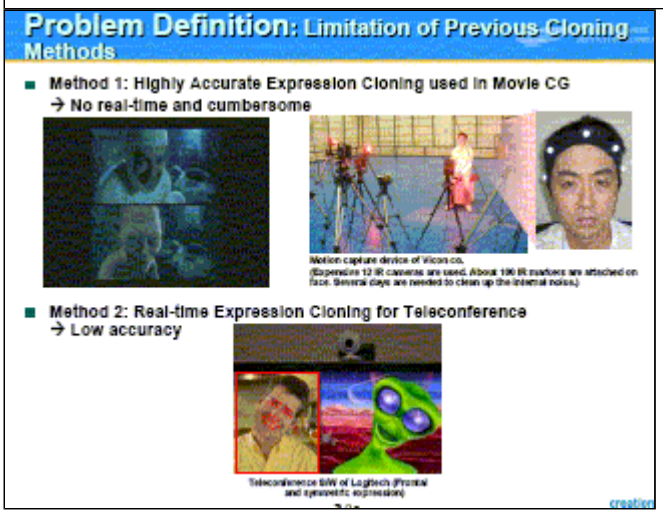


Jung-Bae Kim, Youngkyoo Hwang, Won-Chul Bang and James D.K. Kim (Samsung Electronics, Korea) [E13, P-A6] gave a Poster presentation with the title of "Real-Time and Realistic 3D Facial Expression Cloning". This is another nice case study presented by Korean industry. The Authors' Abstract is quoted here first:

> 3D virtual world has been researched intensively. In particular, animating facial expression of an avatar, representative for a user, has been issued. There are two kinds of interface to clone the user's facial expression: mocap-based interface using lots of IR cameras and markers, and vision-based interface using only one color camera. The vision-based interface would be desirable for most users at home. However this interface has very challenging problems to capture and track the user's subtle 3D expression in real time. We present a novel method to deal with those

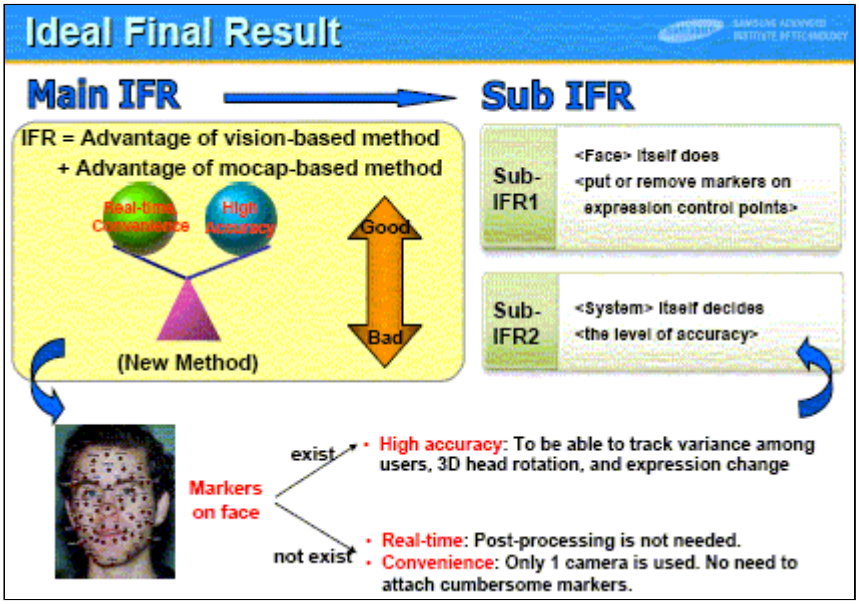
difficulties by using TRIZ methodology. We use a personalized 3D expression model to do real-time cloning, and make a muscle model to track 3D movements on cheeks and forehead having no outstanding features.

The Authors show their task for their research in the slide (below-left). They are working for the development of realistic 3D Mixed Reality (MR) software. Mixed Reality is the world where user's Real World can be projected smoothly onto the Virtual Reality (VR) World. They show possible applications, e.g., Virtual sports, Virtual entertainment, Virtual commerce, etc. For such applications, the Authors want to build a method for cloning (or imitating) user's natural face expressions to his/her avatar's, as shown in the bottom part of the slide (below-left). For such a purpose, two methods were known (slide (below-right)). First method is used for movie CG, by attaching a large number of markers on the face, using ten or so cameras, and spending days for accurately capturing and transferring the face expressions. Second method is used for real-time teleconferencing, by using just one camera and no markers on the face, where low accuracy is accepted.

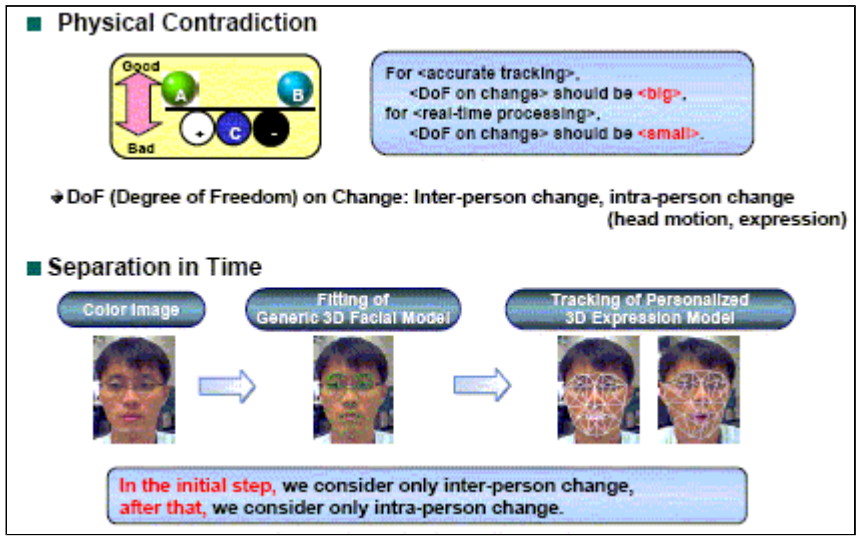


The goal of the Authors' study is to develop a new method overcoming the limitations of the previous methods. The Motion Capture (Mocap)-based method (Method 1) has high accuracy but lacks convenience and real-time feature, whereas the Vision-based method (Method 2) is convenient and real-time but lacks high accuracy. The Ideal Final Result is to achieve high accuracy, convenience, and real-time nature, the Authors say (slide (right)). They reconsider the roles of the markers on face. With the markers, the software tracks the variance among users, 3D head rotation, and expression change, in

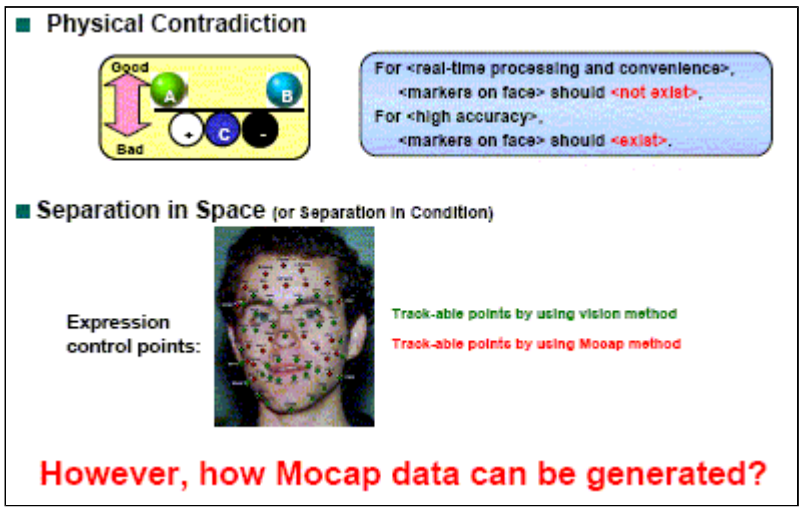
an accurate manner. However, they become obstacles in achieving convenience and real-time processing.



Now the Authors formulated the problem with TRIZ and generated ideas for the solution. For accurate tracking of expression, the software should be able to accept big change in the face expression, whereas for real-time processing it should accept only small change. The Authors notice there are two types of changes (or differences): one is the inter-person change (i.e., differences by person), and the other intra-person change (i.e., head motion and face expression change of a person). Thus they divided the software processing into two steps (or time periods). In the initial step, a user's image is processed to fit to general 3D facial model for adjusting to the person; and after that the user's face expression is to be tracked real time by considering the intra-person change.

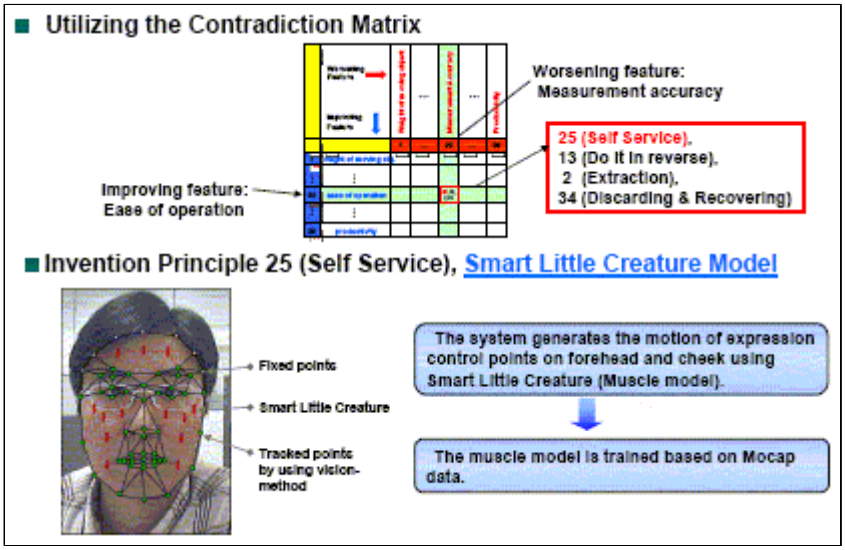


The next problem was related to the role of the markers. The markers should exist, and they should not exist. The Authors noticed that among the expression control points, where markers are usually placed, some are track-able by using ordinary vision method. They include eyes, nose, lips, ears, bottom of chin, etc. Since they are clearly locatable in the vision image, they do not need markers to be attached. However, there are some other expression control points which can only be located with the markers in the Motion-Capture method. They include middle places in forehead, cheeks, etc. Since they are flat parts, their exact position cannot be located well. Anyway the distinguishment of these two types of control points gives an important key.

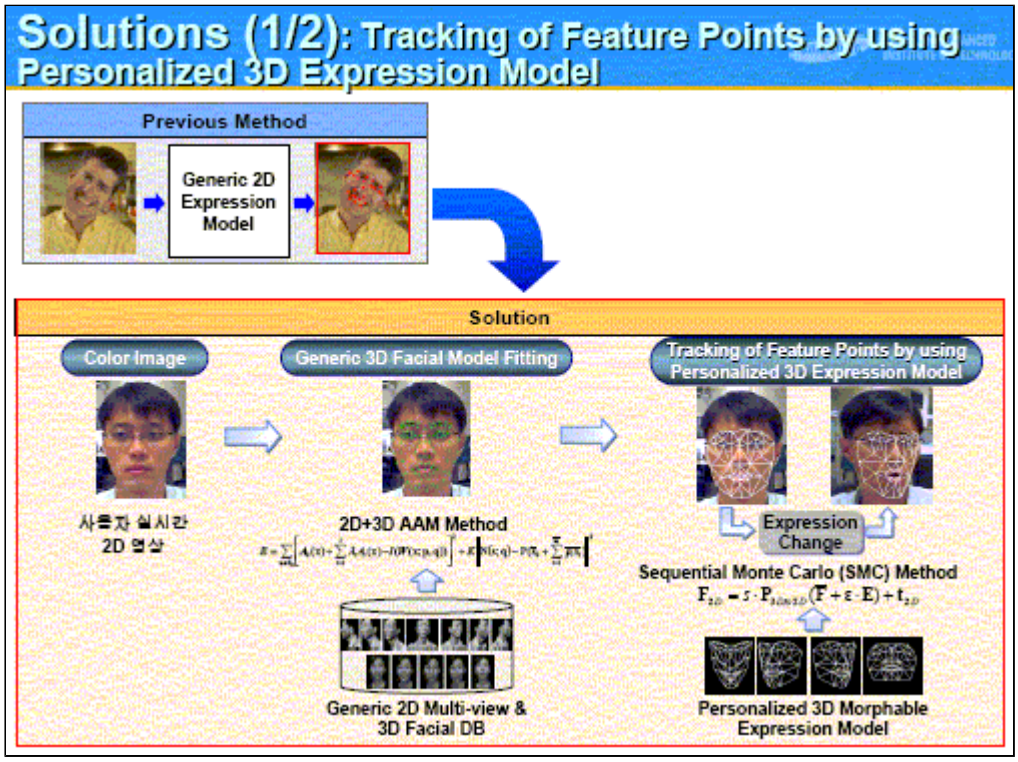


Thus the next problem was how to locate the control points in the middle of forehead, cheeks, etc. The Authors

used the Contradiction Matrix and found the Invention Principle 25 'Self Service' as the recommendation. So they applied the Smart Little People (SLP) modelling method. The Authors set up a spatial network of the control points, belonging to the two types together, and assumed smooth change in their displacements which are calibrated by the locations of track-able points. [*** They named this 'Muscle Model', but actually have not used any model of physical muscle structure.] The smooth changes in the Muscle Model software are trained on the basis of Motion-Capture data, the Authors say.

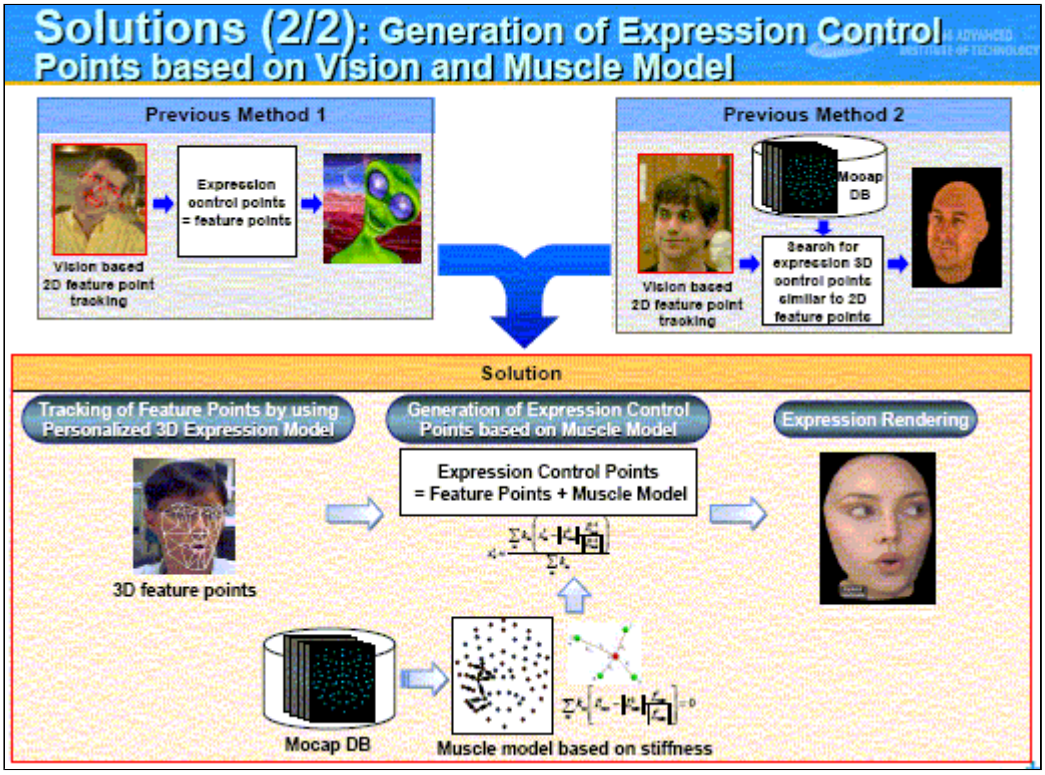


On the basis of the ideas so far obtained, the Authors built up the solutions as follows. The first part of the solution is the tracking of Feature Points (slide (right)). A color image of the user (a) is processed to build up a Generic 3D Facial Model of the user (b) by using the databases of generic 2D multi-view and 3D Facial records. Then the model (b) is used for tracking the Feature Points (c) of the user's face expression in real time. [*** At the bottom-right part of the slide, they mention about the use of 'Personalized 3D Morphable Expression Model' without any explanation. I wonder if this is obtained by use of the user's expression images of 12 actions, e.g. lifting eyebrow, closing eyes, opening mouth, etc., which are shown in the Authors' experiment slide (omitted here).]

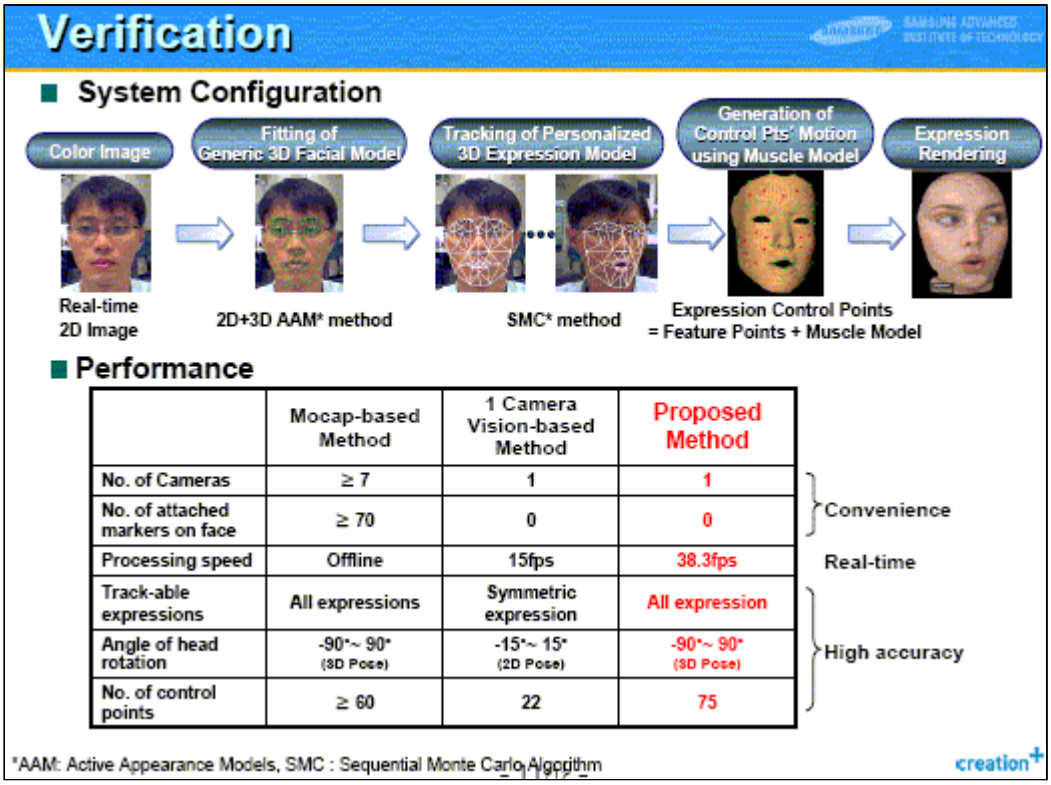


Then in the second part of the solution, the positions of the Expression Control Points (d) are generated on the basis of the Feature Points which are tracked in real time. For this generation, they apply the Muscle Model,

which has been derived by the processing of the Motion-Capture DB. Then the generated date of Expression Control Points (d) are transferred to those of the Avatar's [probably by using Avatar's personalized 3D facial model], and then are processed by expression rendering to get a cloned expression (e) as shown at the right end of the slide (right).



In the slide (right), the Authors show the verification of the solution system they developed. At the top of the slide, they summarize the system configuration. At the bottom half, they compare the performance of their solution method with those of the previous methods. The new method uses only one camera, no attached makers on face, and processes 38.3 figures/sec, can track any expression, with head rotation of angle -90 to +90 degrees, using 75 expression control points.



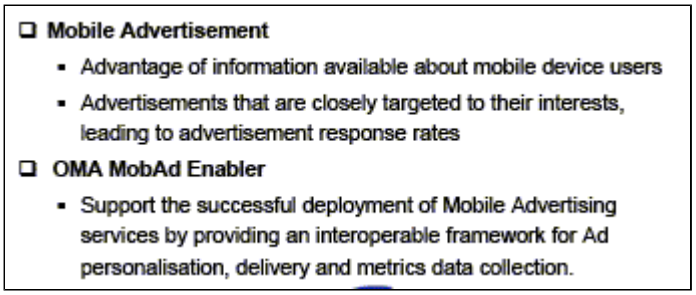
[*** I think this is an excellent case study where TRIZ is well applied to a software problem. I wish to post the PDF file of the Authors' presentation slides in this Web site under their kind permission.]

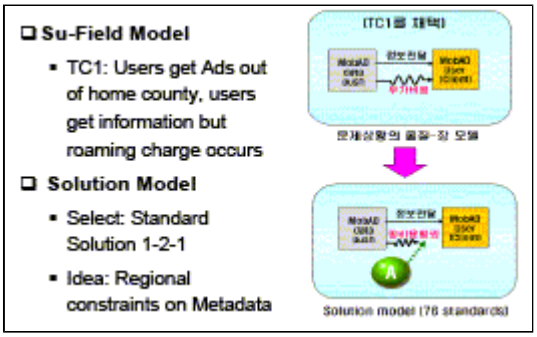
Song-Kyoo Kim (Samsung Electronics, Korea) [E14, P-B5] gave a Poster presentation with the title of "Design

of Regional Code Adaptation for Mobile Advertisement by Using Theory of Inventive Problem Solving".

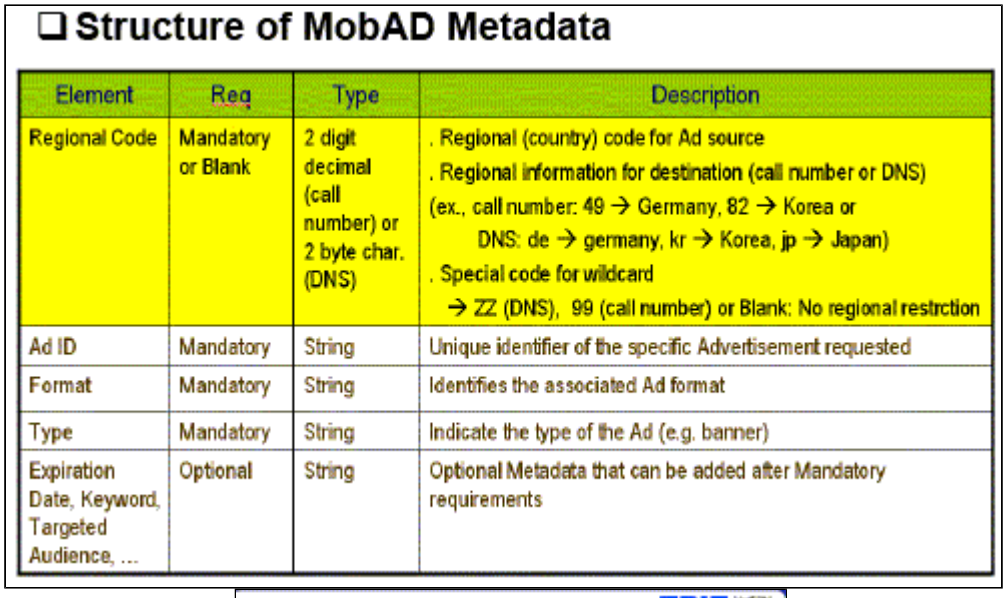
> The paper deals another practical TRIZ applications for information technologies that is similar with the previous adaptation. Mobile Advertisement (MobAD) enabler is considered as the target to apply the TRIZ for enhancement. The enabler can make usage of a variety of advertisement delivery methods and also specify a standard set of advertisement metrics data that are recorded and then collected to enable the measurement of the response to ad contents and ad campaigns. MobAD regional code is the new MobAD technology that is designed to give flexible operations by using TRIZ method for the revenue generating of operators.

In this review, I will quote the 4 slides that the Author used for introducing his presentation in the Poster Introduction Session. The slide (below-left) introduces the background of the present work in the field of Mobile Advertisement. The slide (below-right) shows the focus of the present work. If users receive Ads when they are out of home country, they are forced to pay roaming charges for the Ads information.



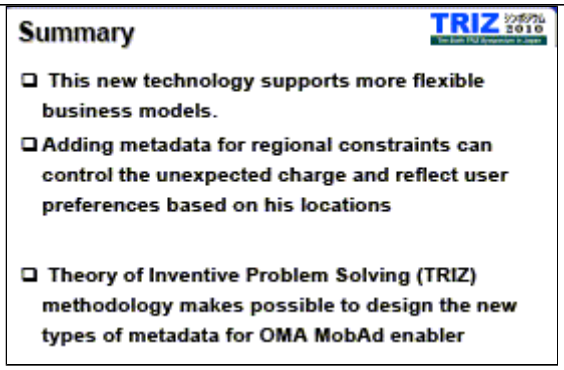


Thus the Author proposed a solution of adding the Regional Code in the metadata (i.e., protocol part) of the Mobile Advertisement. See the yellow part in the slide (below-left). The slide (below-right) is the Author's summary of the presentation.



Structure of MobAD Metadata

Element	Req	Type	Description
Regional Code	Mandatory or Blank	2 digit decimal (call number) or 2 byte char. (DNS)	. Regional (country) code for Ad source . Regional information for destination (call number or DNS) (ex., call number: 49 → Germany, 82 → Korea or DNS: de → germany, kr → Korea, jp → Japan) . Special code for wildcard → ZZ (DNS), 99 (call number) or Blank: No regional restrction
Ad ID	Mandatory	String	Unique identifier of the specific Advertisement requested
Format	Mandatory	String	Identifies the associated Ad format
Type	Mandatory	String	Indicate the type of the Ad (e.g. banner)
Expiration Date, Keyword, Targeted Audience, ...	Optional	String	Optional Metadata that can be added after Mandatory requirements



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