TRIZ Association of ASIA

GEN TRIZ

Organization wide Innovation Portfolio Analysis

GEN TRIZ Tutorial Pune, India,
November 29, 2018
2:00pm to 5:30pm

About the Tutorial

Today, due to globalization and other mega-trends, competition between companies become more and more intensive. To win this race, even temporarily, they need to invest more and more to innovations. While having limited resources, companies try to focus their effort to the most promising directions.

There are number of obstacles of selection of the most effective innovation directions. First, usually companies produce large number of different products. What product should be selected for immediate innovation? To make a right decision, it is necessary to compare competing products, as well as different products (like bicycles and refrigerators). Second, the question is, what parameters of selected product should be improved, and to what level?

Usually comparison of competing products (benchmarking) is done using the weighted sum method: every engineering system scored for every criterion, the scores are multiplied by weighting coefficients representing relative importance of the criteria, and the results are summed into a final score. The system with the highest score is considered best.

Important weakness of the weighted sum method is linearity: it implies the possibility of compensating for a fatal (limiting) disadvantage with multiple minor advantages. In addition, using normalized weighted criteria does not take into account the fact that the user's response to a particular parameter is not linear with respect to its value. Moreover, existing approach ignores product's potentials: probably, current outsider is the most perspective.

For example, it is necessary to select the most promising method of drying sneakers after washing. Here is typical Benchmarking table:

Table 1

Drying device	Criteria (MPVs) with point values and weighting coefficients				Total
	Time to dry К=9	Defects К=5	Convenience К=3	Price К=2	
Centrifuge	2x9=18	3x5=15	7x3=21	9x2=18	62
Hot air dryer	5x9=45	7x5=35	8x3=24	2x2=4	108
Heater	3x9=27	7x5=35	8x3=24	3x2=6	92
Ventilator	4x9=36	8x5=40	8x3=24	3x2=6	106
Moisture absorber	4x9=36	8x5=40	3x3=9	7x2=14	99

Practically all scores are so close to each other, than it is impossible to make educated decision.

In this tutorial, we present GEN TRIZ approach that is much more effective. We take into consideration everything: non-linear relation between parameters and their perception, various types of potentials, and even level of market niche saturation. All formulas are incorporated into convenient software.

Presented methods will allow decision makers to select right directions of innovations and thus get maximal ROI.

The tutorial includes brief case studies illustrating the proposed approach.

Proposition 1. Comparing systems by achieved practical value

We will take into account the user's response by introducing into the formula for weighted normalized parameter an additional coefficient L representing degree of market saturation (1):

$$s = \left(\frac{P - P_{\min}}{P_{\max} - P_{\min}} \right)^{\frac{KL}{1-L}} \qquad (1)$$

where s – user's satisfaction with the achieved value of parameter P;

P_{min}, P_{max} – the minimum allowable and maximum necessary value of the parameter;

K – weighting coefficient, $0 \le K \le 1$

L – market saturation coefficient, $0 \le L \le 1$

If units for the parameter are chosen so that the system improves with parameter's decrease (e.g. electric car's energy consumption measured in kilowatt-hours per 100 km driven) the formula changes only slightly (2):

$$s = \left(\frac{P_{\min}(P_{\max} - P)}{P(P_{\max} - P_{\min})} \right)^{\frac{KL}{1-L}} \qquad (2)$$

where P_{min}, P_{max} – minimum necessary and maximum allowable values of the parameter (i.e. the limit of improvement in this case is P_{min} rather than P_{max}).

Further, the article proposed computing the overall characteristic of the engineering system called "practical value" as the geometric mean of satisfaction values of different parameters (3):

$$V_p = (\prod_{j=1}^{n} s_j)^{1/n} = (s_1 s_2 ... s_n)^{1/n} \qquad (3)$$

where V_p – practical value;

s_j - user's satisfaction with achieved value of parameter P_j;
n – number of parameters.

We should note that the selection of the best engineering system among several competing ones using several criteria is an example of multi-criterion decisionmaking [3]. Ibid recommends comparing engineering systems using geometric mean of weighted criteria, which precisely corresponds to formula (3). Hence we conclude with the first proposition – **using practical value V_p computed using formula (3) as the final score in benchmarking table.**

This method makes sense for short term analysis where engineering system's potential advantages have no significance and only already achieved parameter values matter.

Proposition 2. Comparing systems according to full potentials

Definition 1

Engineering system's full potential for a parameter that should be increased is user's satisfaction S_{total} from the system's achieving either the smallest of the development limits P_{lim}, if $P_{max} > P_{lim}$ (computed using formula (4)), or P_{max}, if $P_{max} \le P_{lim}$:

$$s_t = \left(\frac{P_{\lim} - P_{\min}}{P_{\max} - P_{\min}} \right)^{\frac{KL}{1-L}} \tag{4}$$

where S_t – full potential for this parameter;

P_{lim} – parameter value equal to the nearest development limit.

Definition 2

Engineering system's full potential for a parameter that should be decreased is user's satisfaction S_{total} from system's achieving either the biggest of development limits P_{lim}, if $P_{min} < P_{lim}$ (computed with formula (5)), or P_{min}, if $P_{min} \ge P_{lim}$:

$$s_t = \left(\frac{P_{\max} - P_{\lim}}{P_{\max} - P_{\min}} \right)^{\frac{KL}{1-L}} \tag{5}$$

Definition 3

Engineering system's full potential for all parameters is practical value of the system $V^t{}_p$, computed based on full potentials of all parameters using formula (6):

$$V^t{}_p = (\prod_{j=1}^{n} s_{t\,j})^{1/n} = (s_{t1} s_{t2} \ldots s_{tn})^{1/n}$$

(6)

Thus we propose **using full potential value V^t_p computed using formula (6) as the final score in benchmarking table.**

It makes sense to use this method for prognostication projects when choice of the optimal system is driven by potentially achievable values of the parameters while their current values are not of the essence.

Proposition 3. Comparing systems by practical potentials

If engineering system is, for some parameter, located on the 1st or transitional stages of the S-curve, it is difficult to estimate ahead of time the amount of time and effort needed to move this parameter to a high level (if at all possible).

For instance, let's consider two alternative approaches to increasing driver safety in a car accident: fixing the body in place better (by improving seat belts and airbags - 2nd stage on S-curve) or allowing for emergency evacuation e.g. with a catapult like in military aircraft (1st stage). In theory the second approach has greater promise than the first e.g. because parameter "distance to crumpling or burning car" can be significantly increased and in a serious collision airbags wouldn't help anyway. But a practical implementation of such a catapult would require solving many secondary problems (how to deal with objects above and near the road e.g. wires, bridges, houses and rivers, how to avoid landing in the path of a nearby truck, would people agree having an explosive charge under the seat), and there is no guarantee that they all can be resolved. So if one has a choice, the parameters for which the engineering system is on the 1st or transitional stages should best be left without change and considered as a fall-back for future reference.

If the engineering system is on the 3rd or 4th stage for some parameter, the possibilities of improving it for this parameter are almost exhausted; at the very least that would take serious changes necessary to get through the development limit. The seat belts are an example here - everything doable seems to have already been done, and it is unlikely that with them a radical improvement in fixation could be achieved. Consequently improving such parameters also should not be assigned high priority in R&D plan.

Meanwhile the 2nd stage parameters are just what is needed here. On the one hand, improving them does not usually entail much risk or uncertainty as is common for 1st and transitional stages; and on the other hand, unlike the case of 3rd and 4th stages, possibilities for improvement are still available and do not require radical changes to the engineering system (further, on the 2nd stage palliative solutions and even regular optimization may be justified - there is little risk and results are not insignificant). Consequently it is these parameters that should be improved first of all. Based on these simple considerations we can formulate the notion of practical potential of engineering system within the limits of which it is possible, in the general case, to improve the system without excessive difficulty:

Definition 4

If engineering system is located on 2nd stage of S-curve for a particular parameter that should be increased, the practical potential is user satisfaction S_p from system's achieving either 0.8 of the smallest of development limits P_{lim}, if $P_{max} > 0.8P_{lim}$ (computed with formula (7)) or P_{max}, if $P_{max} \leq 0.8P_{lim}$:

$$s_p = \left(\frac{0.8P_{\lim} - P_{\min}}{P_{\max} - P_{\min}} \right)^{\frac{KL}{1-L}} \tag{7}$$

Coefficient 0.8 is introduced to avoid parameter value crossing to the 3rd stage of S-curve.

Definition 5

If engineering system is located on 2nd stage of S-curve for a particular parameter that should be decreased, the practical potential is user satisfaction S_p from system's achieving either 1.25 of the biggest of development limits P_{lim}, if $P_{min} < 1.25P_{lim}$ (computed with formula (8)) or P_{min}, if $P_{min} \geq 1.25P_{lim}$:

$$s_p = \left(\frac{P_{\max} - 1.2P_{\lim}}{P_{\max} - P_{\min}} \right)^{\frac{KL}{1-L}} \tag{8}$$

Coefficient 1.25 is introduced to avoid parameter value crossing to the 3rd stage of S-curve.

Definition 6

If engineering system is not located on 2nd stage of S-curve for a particular parameter, practical potential of the system is user satisfaction S_p from currently achieved parameter value $S_p = S$ (computed with formulas (1) and (2)).

Definition 7

Engineering system's practical potential for all parameters is practical value of the system $V^p{}_p$ computed from practical potentials for all parameters with formula (9):

$$V^p{}_p = \left(\prod_{j=1}^{n} s_{p_j}\right)^{1/n} = \left(s_{p_1} s_{p_2} \ldots s_{p_n}\right)^{1/n} \tag{9}$$

Relationship between the current state of engineering system and its practical and full potentials is illustrated on the following radar chart (Figure 1):

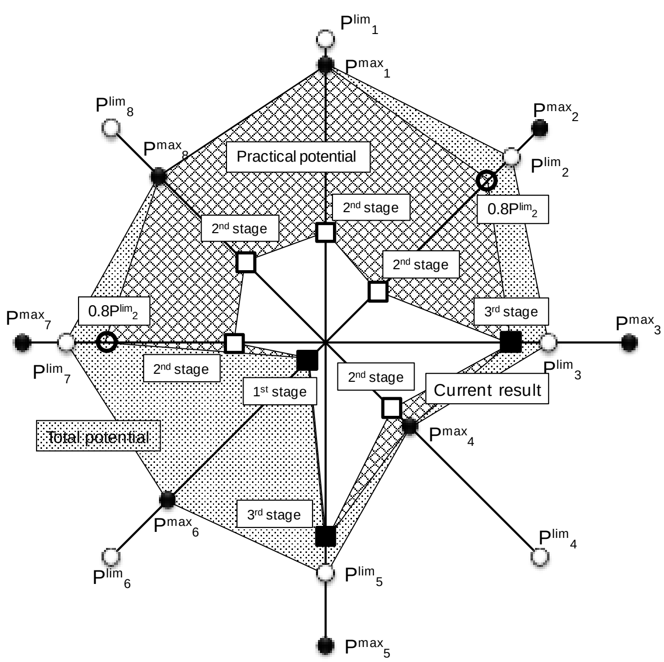

Figure 1. Engineering system's current state and its potentials

Here the axes correspond to parameters of the engineering system under consideration (axes' scales are irrelevant because diagram serves only as qualitative illustration). On axes are shown current/achieved values of the parameters, maximum necessary values and development limits. It can be seen in the diagram that the practical potential exceeds the result currently achieved by the system but is significantly smaller than the total potential. On the other hand, improving the system within the limits of practical potential involves the least effort and minimum risk.

Thus we propose **using practical potential V^p_p computed with formula (9) as final score in benchmarking table.**

This method makes sense in doing majority of regular projects where decent results (not minor but also not revolutionary) need to be achieved in a reasonable time with average restrictions on changing the engineering system.

Results of computations with the proposed method are presented in Table 2. As can be seen in the table, hot air dryer is best suited for an express-project, while centrifuge and the exotic moisture absorber are not worth considering. Conversely, for a regular project it is better to concentrate on moisture absorber; for a prognosis project we should consider a synthesis of absorber and regular dryers.

Table 1

Proposed benchmarking table

Criteria (MPVs) and their weighting coefficients		Centrifuge	Hot air dryer	Heater	Ventila-tor	Moisture absorber
Drying time, min К=9	Current value	120	90	180	180	150
	Dev. limit	100	60	100	100	30
	S-curve stage	3	2	3	2	2
Defects,% К=5	Current value	6	1	2	1	1
	Dev. limit	0	0	0	0	0
	S-curve stage	3	3	3	3	2
Convenience, points К=3	Current value	7	8	8	8	3
	Dev. limit	10	10	10	10	10
	S-curve stage	3	3	3	3	2
Price, points К=2	Current value	2	7	6	6	4
	Dev. limit	0	0	0	0	0
	S-curve stage	3	3	3	3	2
Practical value, %		48	67	54	57	46
Practical potential,%		48	69	54	66	93
Full potential, %		92	100	92	92	100

Benefits

Participant would appreciate that GEN TRIZ approach takes into consideration:

- Non-linear relation between parameters and their perception,
- Various types of potentials
- Level of market niche saturation

Moreover, it is not necessary to make calculations manually. All formulas are incorporated into convenient software, so the analysis does not require significant effort to implement.

Participants will also get some knowledge and practical skills in GEN TRIZ Portfolio Analysis.
Application of these skilled gained during the Tutorial will allow participants to effectively address business challenges of their companies by developing new products that will be market winners.

Investment & Venue

- ✓ The fees per participant is INR 6500 + applicable Govt. taxes per candidate.
- ✓ Group discount for 5 participants above form the same organization.
- ✓ The fee must be paid before the course.
- ✓ Payment of a course fee is done at least 30 days prior to a course starting date.
- ✓ This is a non-residential course
- ✓ We shall be providing the participants with lunch, and snacks during the course.
- ✓ Venue for the master class is Hotel Holiday Inn, Pune.

Who Should Attend

Marketing Professionals, Senior Decision Makers / Heads of Design, Research & Development, Innovation, Engineering, Chief Technology Officers, Chief Innovation Officers, Process Heads, NPD, Six Sigma Specialist, Black belt Champions, Design Thinking Experts, Value Engineering heads, Chief Operating Officers and Chief Executive Officers to name a few

This tutorial is a must attend for TRIZ LEVEL 1, TRIZ LEVEL 2 & TRIZ LEVEL 3 professionals.

About the Mentor

- ✓ **Alex Lyubomirskiy** – Chief Scientific Officer GEN TRIZ , **TRIZ LEVEL 5** Master
- ✓ Mr. Lyubomirskiy has about 30 years of experience of in-depth research and development of the Theory of Inventive Problem Solving (TRIZ), Value Engineering (VE), Innovative Technology of Design (ITD), TRIZplus, and GEN TRIZ. He was a major contributor to the development of such post-TRIZ tools such as Function Analysis, Trimming, Feature Transfer, S-Curve Analysis, and Evolutionary Trends.
- ✓ Over the years, Mr. Lyubomirskiy has lead mentorship and facilitation programs for a number of Fortune 500 companies (e.g. General Electric, Intel, Siemens, British American Tobacco, Alcoa, Wrigley, etc.) in countries like USA, Germany, UK, China, South Korea, Colombia, etc. Since 1983, Mr. Lyubomirskiy has trained thousands of people to become innovation professionals. He is the lead instructor for seminars that grant MATRIZ Level 3 certification (the highest level achievable through learning).
- ✓ **G. Altshuller, the founder of TRIZ, awarded Mr. Lyubomirskiy with his certification for TRIZ Master.**
- ✓ **Mr. Lyubomirskiy is one of the Co-Creators of the TRIZ methodology**
- ✓ He is the author of more than 20 patents and multiple publications.
- ✓ He is also a member of TRIZ Master Certification Board, Methodological Expertise Board, and Editorial Board of the TRIZ Journal.

For more details please write us on info@trizasia.com