KREATURK * 2005 CREATIVITY INSTITUTE, Istanbul

BRIDGING THE CHASM:
THE ROLE OF TRIZ IN HUMAN AND TECHNOLOGY PROBLEMS

DARRELL MANN

27 – 28 May 2005
Istanbul, Hotel Princess

Many human problems require technical solutions.
Many technical problems require human solutions.
Treat the human and the technological
as two independent and separated worlds
and we make many problems unsolvable.

A Little History

Teoriya Resheniya Izobreatatelskikh Zadatch or TRIZ is the Theory of Inventive Problem Solving. TRIZ is a philosophy, a method and a collection of problem definition and solving tools and strategies. The whole emerges from the biggest study of creativity ever conducted. That study currently comprises over 2000 person years of research and the analysis of close to three million of the world's most successful innovative solutions. In its classical incarnation, TRIZ was first and foremost aimed at the definition and resolution of technical problems. As indicated in Figure 1, however, in more recent times the core idea of distilling best practice into a single coherent whole has been extended beyond the purely technical arena to examine the way the world defines and solves almost any kind of problem.

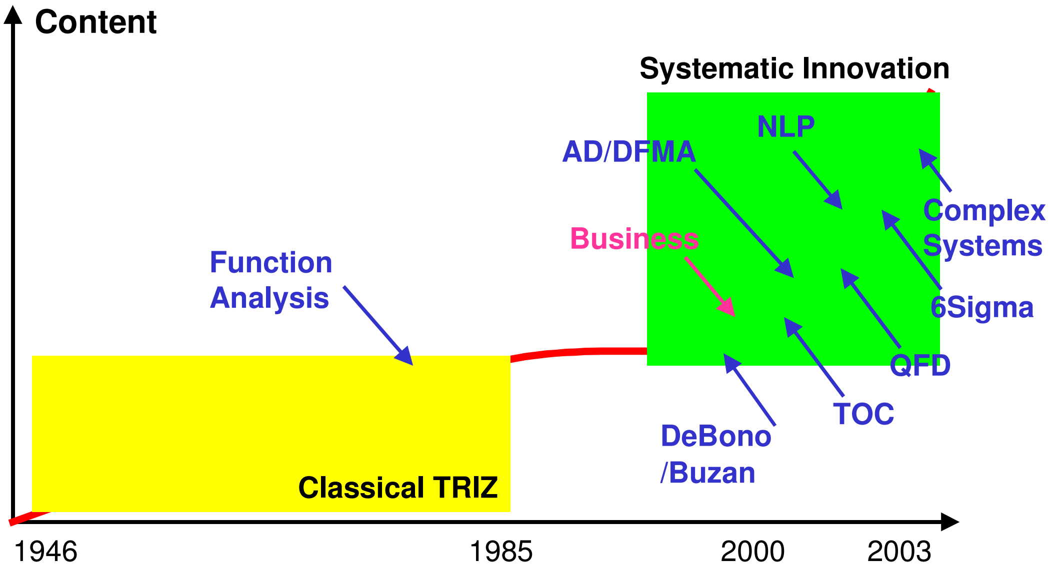

Figure 1: Evolution Of TRIZ And Systematic Innovation

As the research has extended into the worlds of psychology, social science and business, the general findings from the technical research have to all intents and purposes remained intact. While it is not possible to claim that this makes them 'universal', it does offer the possibility of at least a step towards such a capability. We hope that by understanding some of the key concepts in the modern-day version of TRIZ – increasingly being labeled 'Systematic Innovation' – users across a whole range of different disciplines are presented with a much more holistic view of the creative process.

In particular, there is the potential that Systematic Innovation permits some kind of re-unification of the technical and non-technical arenas. The 20th Century was quite clearly one of specialization. It was a century in which – necessarily – the education and working environment meant that an individual was required and expected to know progressively more and more about what turns out to be progressively less and less. It was during this period that a great chasm could be seen opening up between the technical and the non-technical disciplines.

The high level philosophies uncovered by the TRIZ research offer at least the first signs that what has happened in these two separate worlds is not actually that far apart after all. TRIZ, in other words, has uncovered a series of ideas that permit the construction of a bridge over the chasm.

The key findings of TRIZ research common to both technical and non-technical arenas are:-

- that all innovations emerge from the application of a very small number of inventive strategies
- that technical and non-technical system evolution trends are highly predictable
- that the strongest solutions transform the unwanted or harmful elements of a system into useful resources.
- that the strongest solutions also actively seek out and destroy the conflicts and trade-offs most design practices assume to be fundamental.

TRIZ is designed to provide means for problem solvers to access the good solutions obtained by the world's finest inventive minds across all fields of human endeavour. The basic process by which this occurs is illustrated in Figure 2. Essentially, TRIZ researchers have sought to encapsulate the principles of good inventive practice and set them into a generic problem-solving framework. The task of problem definers and problem solvers using the large majority of the TRIZ tools thus becomes one in which they have to map their specific problems and solutions to and from this generic framework.

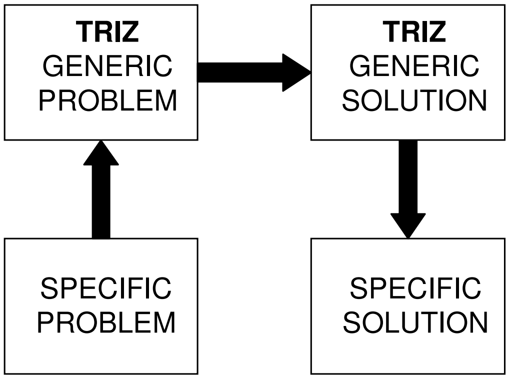

Figure 2: The Basic TRIZ Problem Solving Process

By using knowledge sources like the global patent database, peer-reviewed journals, trade publications and the 3500 management texts published every year as its foundation, TRIZ effectively strips away all of the boundaries that the 20th Century allowed to grow between different disciplines. The generic problem solving framework is thus aimed at allowing people working in any one field to access the good practices of everyone working in not just their own, but every other field of human activity.

Seven Pillars

Beyond the idea that '*someone*, somewhere already solved your problem' and that abstraction is the vital strategy by which we may locate precisely *who*, there are seven philosophical pillars upon which the systematic innovation framework rests. These pillars are illustrated in Figure 3.

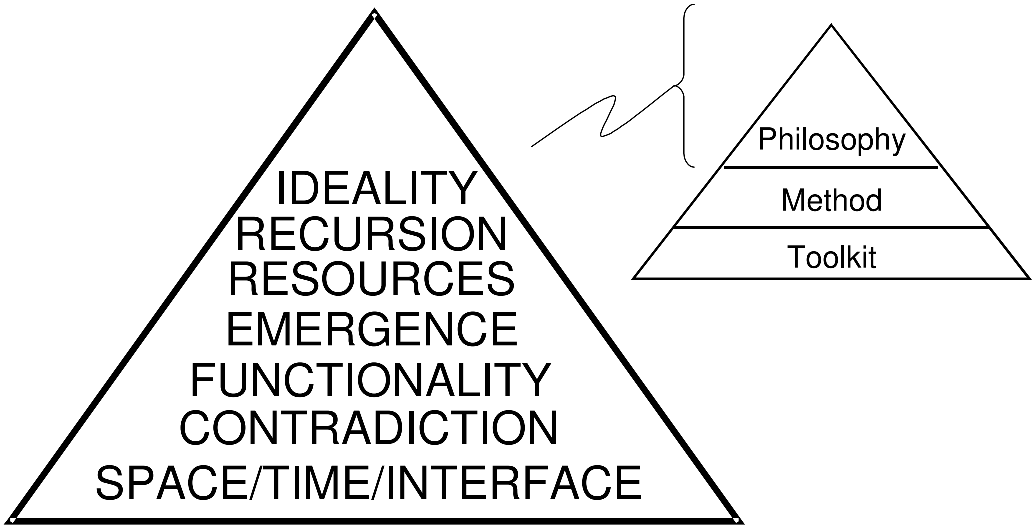

Figure 3: Systematic Innovation Pillars

We will now look at each of these seven pillars in turn in order to examine the influence they should exert on the way in which we deploy the TRIZ tools and processes. Thus, in no particular order, we have:-

Ideality

One of the first tests of a successful innovation uncovered by systematic innovation researchers was that they gave 'the customer' a more ideal solution than what had previously been available. 'Ideal' in this sense is defined as the benefits (or at least 'perceived benefits') that the customer receives divided by the costs and harms that are also present. The fact that successful innovations deliver more ideality implies that there is an overall direction of success. Hopefully this direction – give customers more of the things they want and less of the things they don't – may be seen as a fairly obvious one. While this direction is fairly obvious, what is less obvious is that this evolution process takes place through a series of discontinuous evolutionary jumps. We usually think of these jumps as steps from one way of doing things to another, or, more formally, jumping from one way of doing things to another, changing paradigm, or shifting from one s-curve to another. This s-curve characteristic that determine how all systems evolve are a central aspect of the innovation dynamic across all systems from economics to biological populations, from human behaviour to manufacture processes. A key finding of the systematic researchers beyond this is that the steps denoting a shift from one s-curve to the next are predictable. This fact emerges from the study of large numbers of biological, economic and business and technology system evolutions, and the analysis of what jumps take place as systems shift from one way of doing things to another. The overall dynamic of evolution – with systems making discontinuous jumps from one s-curve to another all the time heading in a direction of increasing ideality is summarized in Figure 4 below:

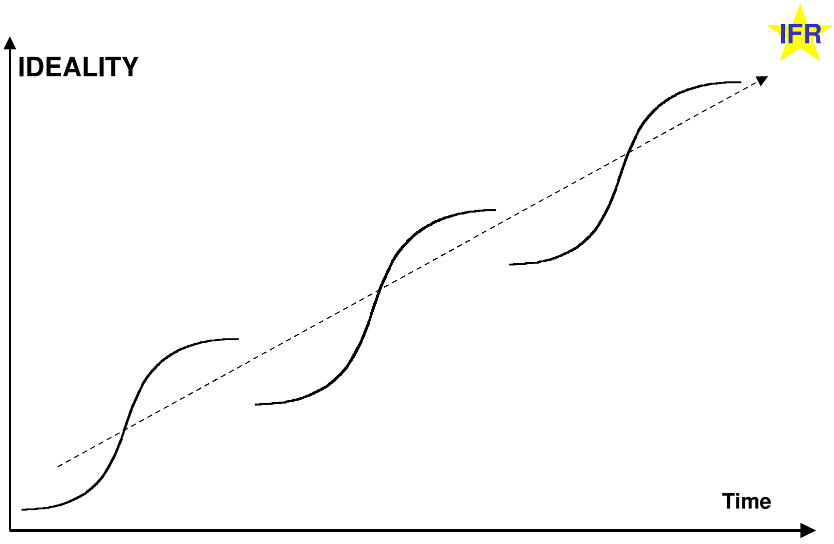

Figure 4: Evolution Dynamics – Systems Jump From One S-Curve To Another In The Direction of Ideal Final Result Outcomes

The figure actually takes the story a step further by suggesting that the evolutionary direction towards increasing ideality is driven by a destination – called 'Ideal Final Result (IFR) – where the customer has received all of the benefits they require and none of the costs and harms. In most senses the Ideal Final Result should be viewed as a theoretical attractor rather than as a practical limit (although we can see various examples of systems that have achieved this goal if we look hard enough). Practical use of the idea demands also that we take into account the fact that different customers, as well as different parts of a value network may have very different interpretations of what 'ideal' means to them. Nevertheless, there are certain common themes (e.g. 'free, perfect and now') that make the IFR a useful thing to think about when trying to determine a strategic direction.

A rather more surprising of the IFR idea has been that as systems get closer and closer to their Ideal Final Result destination, the number of possible solutions capable of delivering the desired outcome reduces. Figure 5 illustrates this convergent evolution idea.

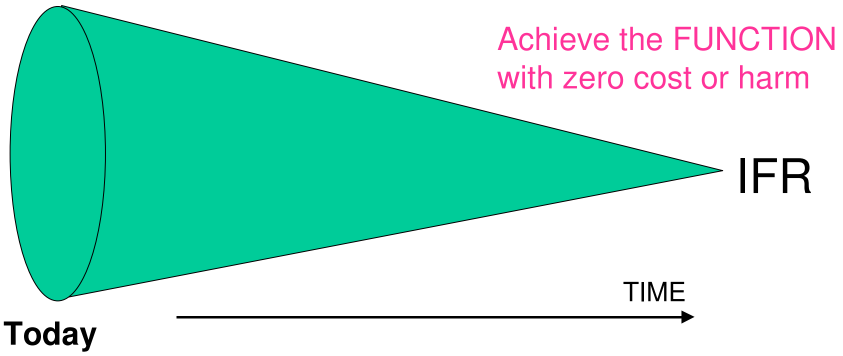

Figure 5: Evolution Is A Convergent Process

Used as a problem definition aid, the ideality part of the Systematic Innovation philosophy encourages problem solvers to break out of the traditional 'start from the current situation' type of thinking, and start instead from what is described as the Ideal Final Result (IFR). Generally speaking IFR-focused solutions incorporate the concept of systems solving problems 'by themselves'. The key word is 'self'; things that achieve functions by themselves – self-regulating, self-organising, self-correcting, etc – all represent, when incorporated in a true systematic innovation fashion, very powerful and resource-efficient solutions.

Contradictions

Taking the Figure 4 image of evolution occurring through a sequence of discontinuous shifts a step further, the systematic innovation researchers also identified the fact that what causes the flattened profile at the top of an s-curve is the emergence of a conflict or contradiction. The s-curve flattens at the top, not because we stop trying to improve a system, but because something comes along and stops us. One of the most important findings, then, of the research has been that the world's strongest solutions have emerged from situations in which a problem solver has successfully sought to avoid the conventional trade-offs that everyone else has taken for granted. Having uncovered a number of strategies whereby problems solvers have successfully eliminated compromises and trade-offs, Systematic Innovation offers tools through which problem solvers can tap into and use the strategies employed by such people. The most commonly applied tools in this regard are a series of trade-off elimination Matrices – currently one for business, one for technical and one for IT arenas. Probably the most important philosophical aspect of the contradiction part of Systematic Innovation is that, given there are ways of 'eliminating' contradictions', problem solvers should actively look for them. Instead of being seen as a threat, Systematic Innovation tells us that every unresolved trade-off and compromise we can find is an opportunity. This is a subtle but often profound shift in thinking for many people as it runs counter to just about all that is taught across the education spectrum.

Functionality

Although the functionality aspects of systematic innovation owe a significant debt to the pioneering work on Value Analysis, the method of defining and using functionality data is markedly different; sufficient at the very least to merit discussion as a distinct paradigm shift in thinking relative to traditional occidental thought processes. Three aspects are worthy of particular note:-

1) The idea that a system possesses a Main Useful Function (MUF) and that any part of the system which does not contribute towards the achievement of this function is ultimately harmful. In a banking institution, for example, the MUF is to manage the flow of money; everything else in the system – like personnel, sales or marketing departments are there solely because we don't yet know how to achieve the MUF without the support of the ancillary components.
2) In traditional function mapping, the emphasis is very much on the establishment of positive functional relationships between components. Systematic innovation places considerable emphasis on plotting both the positive and the negative relationships contained in a system, and, more importantly, on using the function analysis as a means of identifying the conflicts, contradictions, in-effective, excessive, harmful and missing tangible and intangible relationships in and around a system. Function and attribute analysis thus becomes a very powerful problem definition tool.
3) Functionality is the common thread by which it becomes possible to share knowledge between widely differing sectors. A matrix management structure is a specific solution to the generic function 'organise people', just as a training department is a specific solution to the generic function 'disseminate knowledge'. By classifying and arranging knowledge by function, it becomes possible for organisations to examine how other businesses in very different disciplines have achieved the same basic 'organise' function. '*Solutions change, functions stay the same*' is a message forming a central thread in the systematic innovation methodology: People want a hole not a drill; benefits not features.

Resources

The Resources pillar of systematic innovation relates to the unprecedented emphasis placed on the maximization of use of everything contained within a system. In systematic innovation terms, a resource is *anything in the system which is not being used to its maximum potential*. The method demands an aggressive and seemingly relentless pursuit of things in (and indeed around) a system which are not being used to this maximum potential. Discovery of such resources then reveals opportunities through which the design of a system may be improved.

Space, Time And Interface

Psychological research clearly shows that the human brain is not designed to be creative. It undoubtedly *can* be creative, but that is not one of its main functions. Its main function is to develop and store patterns so that we know how to react in a given situation. Hence, we don't have to think when we get dressed in the morning, or when we drive to work, because we have performed both actions so many times that we have a pre-stored 'program'. Only when something out of the ordinary happens do we have to jump out of these patterns. One such time when the patterns don't help is when we are trying to be creative. This is one of the reasons for the cliché expression 'thinking out of the box'. And it is undoubtedly not an easy thing to do. In particular, our brain very quickly makes assumptions about what a problem is. Very often we only discover later on that we have been solving the wrong thing. An important finding of the systematic innovation research has been that the strongest problem solvers have found ways of overcoming this type of rapid assumption-making phenomenon. The effect is known as 'psychological inertia' or 'paradigm paralysis', and the tools for overcoming the effect involve techniques for forcing problem solvers to shift their perspective on situations. As suggested in the title of this section, there are three dimensions to these perspective-shifting techniques. Experienced Systematic Innovation users are thus continuously changing their perspective on problems – zooming in to look at the fine details, zooming out to see the bigger picture, thinking about how the situation is affected by changing time – whether that be nano-seconds or decades – in both the past and future – and also thinking about how different parts of systems interface and relate to one another.

Recursion

Related in some ways to the space-time-interface viewing perspective pillar, the concept of recursion relates to the phenomenon of self-similarity in systems. Specifically, recursion encapsulates the idea that many systems repeat as we switch our focus from the macro scale to the micro-scale and vice versa. By 'repeat', we mean that features that are present at one scale will also exist at other scales. Among many examples of recursion in action, two specific instances are worth mentioning here as a way of explaining their significance from a holistic problem solving perspective:

The first relates to the cybernetics work of Stafford Beer. Stafford Beer's Viable System Model emerged from the study of biological and organisational structures and resulted in the identification of five essential elements that a system had to contain if it were to be 'viable'. Beer also determined that this five-element viability test was equally relevant at different hierarchical levels within a system structure. There are, in other words, certain elements that will determine the viability of a department, a division, a company, a corporation, or, to take a technical or biological perspective, an atom, molecule, cell or organism.

The second involves the recognition that as systems evolve through successive disruptive shifts from one system (s-curve) to another, the complexity of the respective systems recursively passes through a characteristic increasing-decreasing profile as shown in Figure 6. The significance of this characteristic is primarily seen when we attempt to solve a problem using reduce-complexity strategy at a time in the evolution cycle when the complexity is in its increasing phase.

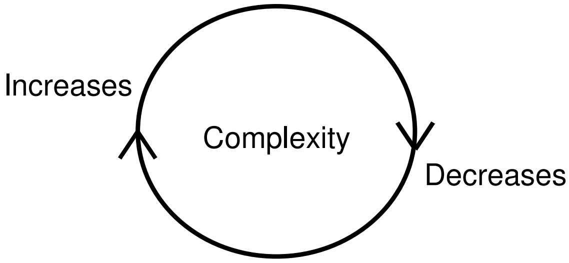

Figure 6: System Complexity Recursion

Emergence

To reduce the entire scientific and mathematical base of complexity theory to a single philosophical foundation is probably a little unfair given the breadth and depth of work being devoted to the subject. Nevertheless, there is at least some justification for suggesting that the whole field emerged as a result of a very simple idea; that enormously complex systems may emerge from what may be extremely simple base rules and principles. The interaction of individually simple elements, in other words, can produce some highly unexpected outcomes.

Technical systems are frequently complex in their behaviour. Social, business and organisational systems are fundamentally complex; take just two people and you have the makings of a system acting on the edge of chaos. Complexity theory is everywhere in the chasm-bridging Systematic Innovation methodology. The great implication of emergent systems on any system design is that the success or failure of that system will ultimately depend on the 'DNA' from which it is built. In the organisational context, that 'DNA' comprises things like the mission and vision statements, value systems – both formal and informal – and the beliefs of the individuals present. In a technical system, it is the design decisions that get encoded into the physical manifestation of a component and the algorithms that determine how we wish that component to behave. Many business problems, for example, occur due to conflicts between what managers wish the system to deliver and what the DNA says it is capable of delivering. A key idea that emerges from this in the context of innovation and inventive problem solving is that it is much easier to achieve success if the innovation comes *from* the DNA rather than *despite* it.

Putting It All Together

Figure 7 summarises the seven pillars that currently support a bridge between technical and non-technical worlds. In the Kreaturk workshop session we shall explore how these pillars combine to create a comprehensive problem definition/solution methodology, and from there, get some hands-on experience of one or two of the main problem definition and solution generation tools contained within that methodology.

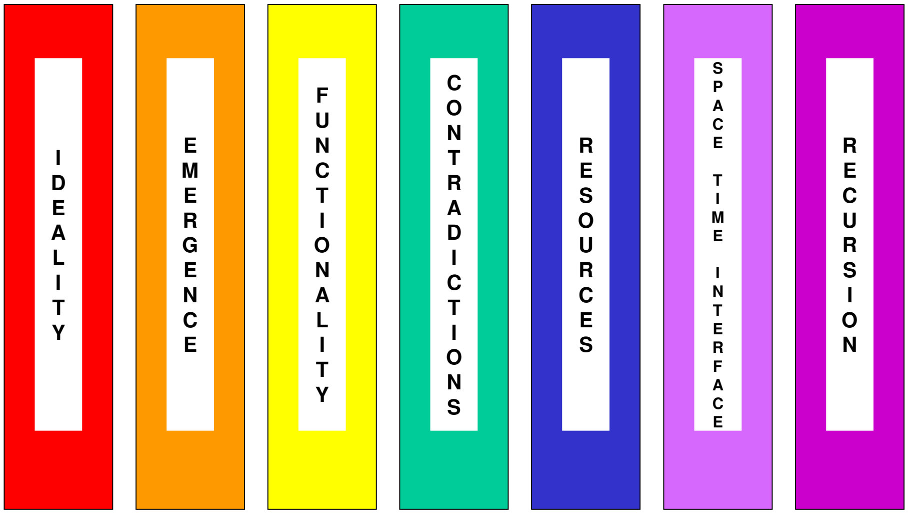

Figure 7: Seven Pillars Of Systematic Innovation

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