

Beyond Systematic Innovation

(Integration of Emergence and Recursion Concepts into TRIZ and Other Tools)

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ABSTRACT

Present day systematic innovation capabilities exist as the result of an amalgamation taking place between a host of different creativity tools, techniques and philosophies. Collectively, these tools have been brought together from all corners of the creativity spectrum – from the highly structured (TRIZ, Six Sigma, QFD, Theory of Constraints, Complexity Theory, Viable System Model) to the highly unstructured, from those rooted in the applied sciences to those built on purely psychological foundations (DeBono, Mind-Mapping, NLP). The paper describes an ongoing programme of research to distill best practice from these methods and create a unified creativity and innovation system. The basis of the paper is a discussion built around the high-level philosophical bases of the various techniques and strategies being integrated.

Introduction

The world of creativity and innovation research is filled with a wide variety of different tools, methods, techniques and strategies. Many operate at different levels. Many of them overlap with one another. Others suggest contradictory directions and strategies. Overall the message presented to the world at large is one of enormous complexity and, as a consequence, considerable confusion. The aim of the programme of research reported here has been to find a common structure into which all of the available systems fit, and to try and distill best practice from all into a unified whole.

Following an initial programme of work (Reference 1) aimed at identifying a common foundation for a unified creativity capability, it was decided that the Soviet-originated Theory of Inventive Problem Solving, TRIZ offered the most complete framework – offering not only a very comprehensive toolkit and systematic process, but also a significant philosophical backbone. Subsequent work has then sought to position other philosophies, methods and tools into the framework provided by TRIZ. Given that the aim was to generate a unified capability and not to assume that TRIZ was untouchable, where these other techniques did not fit the framework, the framework was modified appropriately.

Although integration between the different philosophies is not yet incomplete, it is becoming clear that the law of diminishing returns is a dominant factor in the drive towards achieving a more effective whole. In the terms of evolutionary S-Curves, the TRIZ-based systematic innovation

method is approaching some form of fundamental limit – Figure 1. To go beyond these limits – in other words, to find a new paradigm, higher level of creativity capability – requires an expansion of TRIZ in fundamental ways. Thus, while some integration activities look set to enable small-scale optimisation benefits to be accrued, more substantial shifts in capability seem likely only through more profound shifts in the underpinning philosophy.

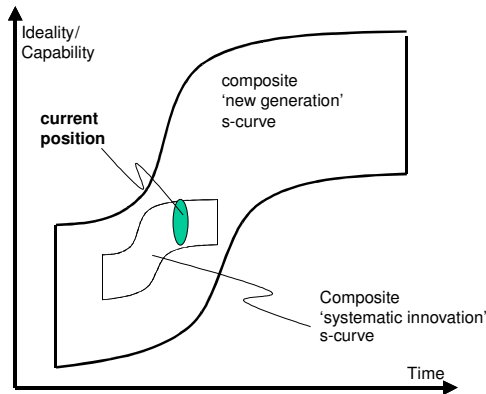


Figure 1: Evolution of Systematic Innovation Capabilities in S-Curve Terms

Two emerging sciences and one industry-based system – Six Sigma – appear to be offering the potential to deliver such philosophy shifts. The shifts they suggest are complexity emerging from bottom-up principles, recursion and customer focus respectively. The paper discusses all three concepts in the context of their impending impact on the world of systematic creativity and innovation, and in particular their potential to deliver completely new thinking paradigms.

Existing Systematic Innovation Capability

In order to begin the discussion, it is first necessary to discuss the framework provided by an evolved version of the TRIZ method. Figure 2 – taken from Reference 2 – aims to present the totality of TRIZ-based systematic innovation in terms of its philosophical roots, the overall methodology processes, and the individual tools that make up that overall process.

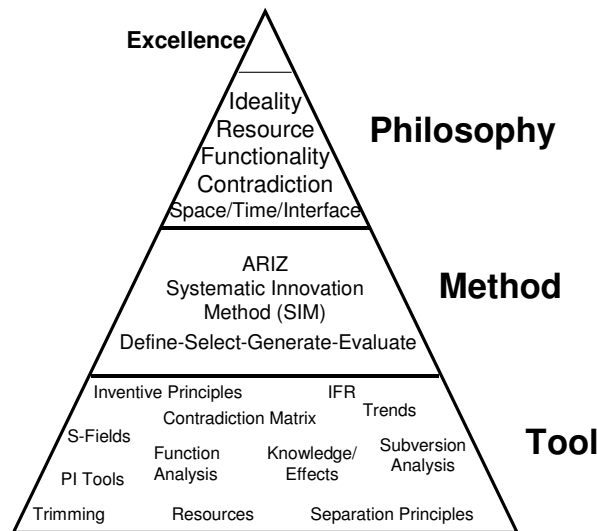


Figure 2: Current TRIZ-Based Systematic Innovation Operating Hierarchy

At the very highest level of the TRIZ philosophy is the concept of distillation of excellence from all sources of knowledge. This is the root enabling TRIZ to be receptive to other techniques. One of the commonly used TRIZ expressions is ‘someone, somewhere has already solved your problem’.

In order then to allow users to readily find those solutions, it has been necessary to cast the widest possible net.

Slightly below this level, the five main philosophical pillars of TRIZ are:-

IDEALITY: all successful innovations evolve in a direction of increasing ideality – more benefits; less cost, less harm. Evolution towards an ideal final result occurs through a series of patterns that are repeated across different industries.

CONTRADICTION: systems evolve in the direction of increasing ideality through the successive emergence and resolution of conflicts and contradictions. Evolution is therefore fundamentally discontinuous in nature. The contradiction-eliminating strategies of others have been mapped and can be used to accelerate the evolution of any system.

FUNCTION: customers primarily buy functions (benefits), therefore producers should focus on the function delivered by the products and services they deliver and not just the product itself. If customers find a better way of achieving a function, they will stop buying your product or service.

RESOURCES: anything in or around a system that is not being used to its maximum potential is a resource. Even the things we might think of as ‘bad’ or harmful in a system can become useful resources if we are able to change our perspective of them.

SPACE/TIME/INTERFACE: the human brain is subject to an effect known as psychological inertia; it fools itself into looking at situations from one specific angle. When we are looking to improve a system, we need to be able to change our perspective of it. Perspective shifts can involve physical (or virtual) space, temporal issues, or the way in which different elements of a system interface and relate to one another.

Taken together, these pillars offer users the capability to direct their creative efforts in directions that are known to deliver success. There are, of course, other ways to think about the creative process – very often in fact it is very desirable to employ deliberately unstructured approaches that permit drift in quite random directions. One of the big underlying concepts of TRIZ – primarily coming from the Ideality and Functionality pillars – is that when we wish it, there is a system that will systematically focus us in directions that are purely success-oriented.

In order to examine how other systems might compare and integrate with the systematic innovation structure, we may see that many operate at purely the methodological or tool level. We will individually examine the three that appear to offer most at the highest philosophical level. That process begins with Six Sigma:

Six Sigma

The Six Sigma methodology is primarily an industry created and industry deployed collection of best practices developed over the history of manufacture and service industries. In large part it is an assembly of tools, methods and philosophies from Statistical Process Control and Total Quality Management. Thanks to some significant bottom-line business benefits reported by lead users, Six Sigma currently carries a very high profile and is the subject of a variety of management texts (see for example References 3, 4). None of these texts has particularly sought to divide the whole into different hierarchical levels, but by extracting the appropriate knowledge from the best of the texts, we will arrive at an equivalent of the Systematic Innovation hierarchy map as shown in Figure 3.

By again focusing only on the high level philosophical tenets, we can observe the following as the main over-riding elements of Six Sigma:

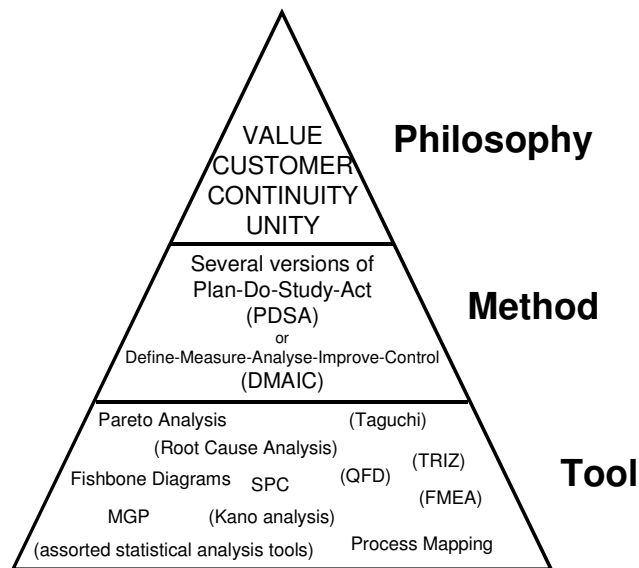


Figure 3: Philosophy-Method-Tool Hierarchical Perspective of Six Sigma

CUSTOMER: the main underlying philosophy of Six Sigma is the focus on customers and the satisfaction of the needs and desires of those customers, whether they be internal or external to an organisation.

VALUE: Added value is what makes a customer select one product or service over another one. Six Sigma thus places considerable importance on the addition of value, and more specifically, the reduction and elimination ‘non-value added’ activities of which variation is seen as a key element.

CONTINUITY: improvement of systems and processes must be a continuous activity; there is no justification for relaxation of efforts to eliminate variation and waste.

UNITY: a successful Six Sigma initiative needs to involve everyone working within the system. There can be no exceptions to this rule; buy-in is essential.

The Six Sigma philosophy can then be seen to have the following three impacts on the initial systematic innovation framework:

1) Successful innovation gives customers more ideality; all of the functions (benefits) they want at ever lower cost and harm. Every customer is different from every other customer and in the ideal world, every individual customer gets exactly what they want.

2) TRIZ has traditionally described evolution happening in discontinuous bursts and suggests that in large part these bursts are driven by market demands. Thus, there are times when an introduced innovation will succeed and other times when it will not. Whether there is an apparent ‘market need’ or not, the CONTINUITY pillar of Six Sigma suggests that the innovation process should be continuous. The idea of generating an innovation that does not have a market demand appears to make little sense. The parallel phenomena of increasingly rapid global change and the increasing importance of intellectual property (at least at the present time), however, do appear to suggest the validity of a continuous innovation philosophy; even if the market is not ready for an innovation, doesn’t mean that a company shouldn’t own the rights to it.

3) If you don’t get ‘buy-in’ from EVERYONE, an innovation will fail. Traditional TRIZ thinking pays no attention to buy-in. Lack of buy-in is probably the biggest single killer of TRIZ – or indeed

any – generated innovations – see for example our previous article on ‘if TRIZ is so good, why isn’t everyone using it (Reference 5).

Recursion

Stafford Beer’s Viable System Model emerged from the study of organisation structures and resulted in two very important conceptual findings. The first involved the identification of five essential elements that a system had to contain if it were to be ‘viable’. The second involved the idea of recursiveness – and the discovery that the five element viability test still applied at different hierarchical levels of consideration of a system organisation structure. Reference 6 describes how this first finding contradicts the TRIZ definition of ‘system completeness’ and how it ultimately therefore provides a stronger definition of completeness than TRIZ. The second concept of recursion is still only just being introduced into the systematic innovation framework.

The simple philosophical finding of Beer and others (see for example work on Spiral Dynamics – Reference 7) is that there are strong elements of self-similarity between systems as we switch our focus from the macro scale to the micro-scale and vice versa. As far as Beer was concerned, the key self-similarity feature in organisations was that ‘viability’ demanded certain elements to be present at each hierarchical level. From a technical perspective, to take the specific example of helical flow, what the recursion idea allows us to do is apply solutions from one scale to another. Several natural systems operating at the micro-scale often evolve complex helical geometry forms that maximise flow efficiency. Likewise, macro-scale study of interplanetary motion have highlighted the presence of similar helical effects. Designers of novel heat exchangers – i.e. operating at a scale between these two extremes – were able to hypothesise that the same effect may be able to be used in the design of highly efficient configurations, and in fact were able to create a paradigm-changing improvement in performance as a result. The helical flow effect is thus seen to be recurrent at different size scales.

Closer to the systematic innovation arena is another recursion idea, this time the recognition that as systems evolve through successive disruptive shifts from one system (s-curve) to another, the complexity of the respective systems passes through a characteristic increasing-decreasing profile – Figure 4. According to preliminary work (Reference 8), this recursive effect allows us to utilise the parts of the systematic innovation toolkit most relevant to a given phase in the complexity cycle.

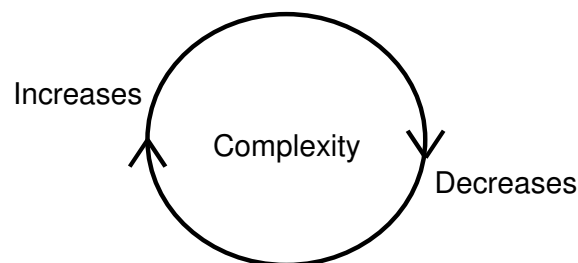


Figure 4: Recursion In System Complexity Evolution

Complexity Theory

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 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.

One of the main applications of systematic innovation involves the use of uncovered trends of evolution to predict what future generations of designs and systems will look like. In order to illustrate the likely impact of the ‘emergent complexity’ philosophy on systematic innovation, in this section we examine the process of system evolution through the lens of emergent market complexity.

Many researchers have spent considerable amounts of time and energy failing to translate well known and well established trend directions – for example the list illustrated in Figure 5 – into useful predictions of how a market will evolve. In essence, they form the simple base rules upon the complex world we live in has emerged. We examine why predictions using these trends tend to be wrong and highlight a simple strategy for improving our chances of getting the predictions right in the future.

- * Increasing ELECTRONIC COMMUNICATION in private life
- * Increasing GAP between have’s and have-not’s
- * Increasing NEED FOR DIFFERENTIATION between business customers
- * Increasing INFORMATION VOLUME
- * Need for SIMPLICITY
- * Global AVAILABILITY OF SERVICES
- * Wish for INDIVIDUAL SOLUTIONS (private customers)
- * DEMOGRAPHIC TRENDS (aging population, DINKs)
- * Wish for SELBSTVERWIRKLICHUNG (‘making the most of one’s life’)
- * TIME as a valuable resource

Figure 5: Well Known Customer Trend Directions

The only sure-fire result of a ‘simple’ market evolution prediction method is that it will be wrong. The method being proposed here – if we use it correctly – is certainly not simple, but it does use the idea of constructing complexity from simple building blocks. The principles through which the method operates are simple enough to be described relatively quickly. In-line with complexity theory, what we are looking at here is a means of assembling highly complex models from some very simple ‘first principles’ building blocks. Our purpose here is to merely to describe some of those building blocks and the operating principles through which we can assemble them together to form a robust and reliable model of market evolution dynamics.

All of the trend directions suggested in Figure 5, or that we might find in the continuous stream of MegaTrends books (Reference 9 for example), or the output of Faith Popcorn (Reference 10), ‘work’ so long as the linear assumptions they make remain valid. Anyone living in the real world, of course, knows that any linear assumption is bound to go wrong sooner or later because the world is not a linear place. The predictions made from a single trend go wrong because something comes along and says ‘hey, you can’t keep going down that road anymore’. Something, in other words, comes along and stops the trend from working beyond a certain point.

We can very simply see what it is that comes along and stops a trend from working when we begin to consider multiple trends. For the sake of simplicity, we will examine just two. Figure 6 illustrates two of the market trend directions picked at random from the Figure 5 list. We could actually have picked literally any pair in order to demonstrate the point. In the figure, then, the two trends are progressing as a function of time as per prediction. As shown in the figure, their trajectories are slightly different.

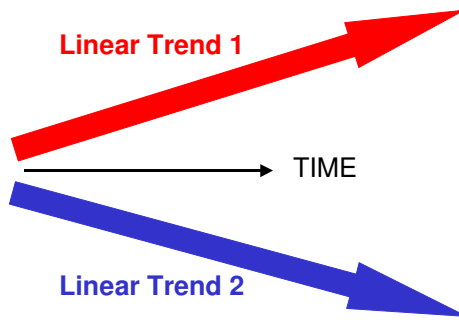


Figure 6: Two Linear Trends In Action

The progression along these two trend paths will continue as per prediction until such times as the differences between them result in some kind of mis-match – further advance along one trend becomes inconsistent with progress along the other. When this happens, there is a conflict. When a conflict occurs, one or both of the trends can no longer progress according to the predictions. Further progress, in fact, can only occur when the conflict has somehow been resolved – Figure 7.

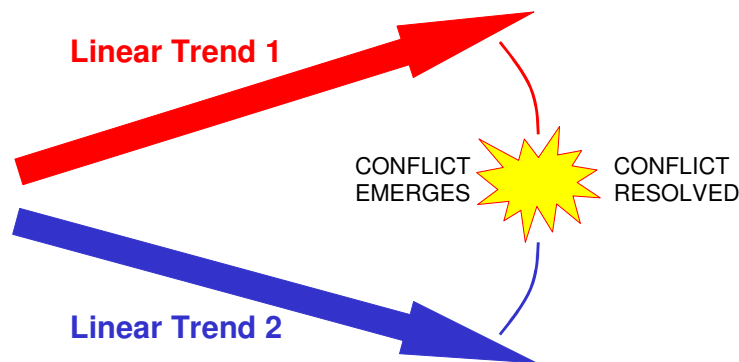


Figure 7: Two Linear Trends In Conflict With One Another

Despite the fact that this model is both generic and simplistic (it fails to recognize, for example, that every individual customer is different and has a different affinity to any given trend pattern), it forms a very solid foundation upon which really effective market evolution models can be constructed. The immediate link with the contradiction elimination philosophy of TRIZ is that we can systematically work to eliminate the identified contradictions using the successful strategies of others (Reference 2).

To again stick with just two trends, we can begin to see how this might be so by examining a modified version of the process described in Reference 11:

- 1) pick two trends
- 2) define an ideal final result (IFR) end point to each of the trends
- 3) extrapolate along both trends in the direction of the two ideal final results and reveal the contradiction that emerges
- 4) use the Inventive Principles of TRIZ to explore means by which the contradiction can be eliminated.

Let's take an example using a pair of trends from Figure 5. Firstly the trend towards a desire for simple solutions, and secondly the trend towards individualized solutions. Extrapolating to the IFR in the first case might give us something like *'every system does exactly what the user wants without the user ever having to learn any set of instructions'*. Extrapolating to the IFR in the second

case might in turn give us something like ‘*every individual customer gets exactly the product or service they want*’.

Hopefully the contradiction between the two evolution directions suggested by these end points becomes clear very quickly; systems must be simple for any individual user, but must also be different to take account of the fact that every customer is different. Until this simple versus adaptive contradiction is resolved, one or both of the ‘increasing simplicity’ or ‘individual solutions’ trends can no longer continue to apply.

The smart forecaster will use this information to start identifying solutions to the conflict before they actually happen. For example, the increasing emergence of self-learning/adaptive computer systems is an increasingly used technology that admirably helps to solve the conflict. Combine this idea with organizations like Amazon that acquire more and more data about their customers the more they buy and we’re well on the way to learning systems that know what an individual customer is like before the product arrives on the doorstep.

In many senses, what we have just done here is similar to what we would have done in a traditional scenario planning exercise. There we would have taken two trends, extrapolated along them to some point in the future and used the resulting market situation as the environment in which our product or service should be designed to fit. The big difference here of course is that in the new method we are extrapolating two simple bottom-up trend directions to stably positioned end points (the two IFRs) and are actively looking to resolve the contradiction that emerges rather than trying to accommodate and trade-off.

Scenario planning sessions rarely extend to looking at more than two or three trends at a time due to the complexity involved. The net result of this is that scenario planning exercise deliver reliable outputs. The implication from the findings of TRIZ on the other hand – that the evolution process acts as the successive emergence and resolution of conflicts and contradiction – provides us with a number of clues that will help us to manage this complexity issue.

For this paper we will simply leave readers with the concept of identifying the two most dominant trends in a particular situation and using the conflict emergence and resolution strategy as a means of identifying and eliminating the conflicts before they occur in reality. We suggest this because early identification of emerging conflicts may well be enough to give us an edge in the competitive world we live in. If you think about it, ‘competitive edge’ is essentially the function and *raison d’etre* of the forecasting process anyway.

Thinking ahead a little bit, what the market trend conflict concept allows us to do when we start looking at the whole thing rather than just one or two select bits is to manage the complex future picture in rather more sophisticated ways. Here’s a final thought that you might like to consider before we return to it in a future paper (Reference 12): If we take all of the known market evolution trends and arrange them in a Matrix we can look at every pair in turn in order to see whether there might be any recurring patterns of conflict emergence. If there are such emergent patterns – certain contradictions that come up again and again for different pairs of trend directions – then we can probably begin to imagine that the process of designing the future will change considerably.

Final Thoughts and Future Work

The work reported here is still at a relatively early stage. It is believed that at the philosophical level, a solid foundation upon which a new generation of systematic innovation capability can be built has been created. The main tenets of that combined philosophy are illustrated in Figure 8. Taken together, the philosophical elements of TRIZ-based systematic innovation, Six Sigma, Recursion and Complexity Theory create seven main ideas that when used collectively will provide

a highly effective focused creativity capability. The next parts of the research will involve appropriate integration of the different systems at the methodological level. This work is currently underway in the form of the CREAX Innovation Suite software system. The main design principle of the system – which operates irrespective of whether it is deployed in software or other forms – is again the concept that someone, somewhere has already solved the problem. Or at least elements of the problem. What the Innovation Suite aims to do is integrate all of those individual elements into a coherent, easy-to-use whole.

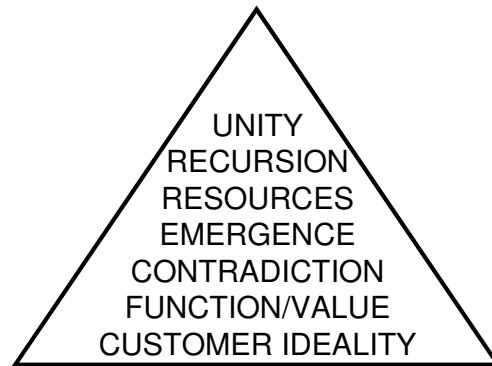


Figure 8: Collected Philosophical Concepts of New Generation Systematic Innovation

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