THE THEORY OF IDEAL SUPERSMART LEARNING:
A Versatile Holistic Framework for Rapidly Simplifying, Learning, and Applying TRIZ & Other Problem-Solving Methodologies – **Parts II & III**

Dr. Rodney K. King

www.supersmartnetwork.com

r.k.king@supersmartnetwork.com

THE THEORY OF IDEAL SUPERSMART LEARNING: A Versatile Holistic Framework for Rapidly Simplifying, Learning, and Applying TRIZ & Other Problem-Solving Methodologies – **Parts II & III**

Table of contents (for parts II & III)

5. VERSATILE AND SIMPLIFIED TOOLS FOR TRIZ & OTHER PROBLEM SOLVING METHODOLOGIES

This article approaches problem solving, creativity, and ideas management from a learning perspective and in particular, Ideal SuperSmart™ Learning. The Theory of Ideal SuperSmart™ Learning could be regarded as a generic methodology for rapidly learning about, studying, and mastering multifiarious subjects and disciplines. Here, the focus is on problem solving, creativity, and ideas management. The main roles of the Theory of Ideal SuperSmart™ Learning are as a **meta-methodology** (a methodology of other methodologies) and **problem-facilitating methodology** (a methodology for facilitating problem solving, creativity, and ideas management).

The discussions in the foregoing sections lay the foundation for a deep understanding of the Theory of Ideal SuperSmart™ Learning and its macro-tools. In subsequent sections, the focus is on a discussion of how to apply its meso- and micro-tools to methodologies such as *Creative Problem Solving (CPS), TRIZ, ASIT, USIT, Profit Patterns,* and *Software Design Patterns*. The discussions are largely conceptual and indicative. Nevertheless, it is hoped that the versatility and usefulness of the meso- and micro-tools will be seen.

The meso- and micro-tools of Ideal SuperSmart™ Learning could be used to obtain conventional as well as “unusual (out-of-the-box or improbable)” improvements, designs, and inventions. The tools are mostly synthesis of existing tools, particularly from the literature on creative problem solving and TRIZ. However, tools such as “CreaLogic”, “Paoisms”, and “Object-templates” are unique to Ideal SuperSmart™ Learning.

5.1 System of Problem Archetypes and Anti-archetypes

There are many approaches for identifying, describing, and structuring problems in systems. Ideal SuperSmart™ Learning focuses on identifying, describing, and analysing problems according to **problem archetypes**. *Problem archetypes* are universal patterns of problems in systems. The patterns are interrelated and could be regarded as different or multiple perspectives of the same system. Problems, which are unsolvable as a particular problem archetype, may be solvable when framed as other problem archetypes. Creative or out-of-the-box solutions to problems may be obtained by *bipolar framing*, i.e., framing a problem as its opposite. For instance, a problem of perceived need could be reframed as a problem of “excess” and possible solutions explored for eliminating excesses. Similarly, problems could be perceived as opportunities. If the *bipolar reframing* refers to the same variable, then the statement becomes a *physical contradiction*.

Ideal SuperSmart™ Learning recognises eight *problem archetypes*. They are as follows:

Problem archetype 1: Undesirable "largeness/presence"

- What are undesirably large or present?[1]

Problem archetype 2: Undesirable "smallness/absence"

- What are undesirably small or absent?

Problem archetype 3: Undesirable inefficiency/sub-optimality/waste

- What are undesirably inefficient, sub-optimal, or wasted?

Problem archetype 4: Undesirable conflicts/contradictions/ bipolarities/dilemmas/paradoxes/disunity

- What are undesirably conflicting, contradictory, bipolar, paradoxical, discontinuous, or disunited?

Problem archetype 5: Undesirable complexity/sameness/ standardisation/symmetry

- What are undesirably complex, uniform, standardised, or symmetrical?

Problem archetype 6: Undesirable identification/detection/branding

- What are undesirably identified, detected, or branded?

Problem archetype 7: Undesirable dimensions/properties/parameters/ attributes

- What are undesirable dimensions, properties, parameters, or attributes?

Problem archetype 8: Undesirable situations/side effects/consequences/ systems/elements/super-systems

- What are undesirable situations, side effects/consequences/ systems, elements, or super-systems?

The eight *problem archetypes* could be organised into three categories:

- **Mono-variable problem archetypes**: Problem archetypes 1 and 2
- **Bi-variable problem archetypes**: Problem archetypes 3 and 4
- **Multi-variable problem archetypes**: Problem archetypes 5, 6, 7, and 8

In TRIZ*, physical contradictions (dilemmas)* focus on mono-variable problem archetypes, while *technical contradictions (dilemmas)* and the *contradiction matrix* directly focus on bi-variable problem archetypes. *Ideality (ideal final result)* and the *40 Inventive Principles* deal with strategies for mono-, bi-, and multi-variable problem archetypes. *Separation heuristics* should, in theory,

[1] An alternative format for exploration: "Find many and different ways to get rid of or exacerbate [problem type]"

relate to mono-variable problem archetypes. In practice, however, *separation heuristics* deal with both mono- and bi-variable problem archetypes. The *76 Standard Solutions* and *database of effects* are also applicable to mono-, bi-, and multi-variable problem archetypes*.* TRIZs *patterns (trends/laws) of system evolution* implicitly consider all problem archetypes.

Based on the dialectical (bipolar) approach of Ideal SuperSmart™ Learning, especially in the exploration of problem spaces, each problem archetype has a corresponding anti-archetype. For instance, **problem anti-archetype 1** refers to *desirable* "largeness/presence" and deals with the question: What are *desirably* large or present? While *problem archetypes* facilitate the identification and classification of problems as well as corresponding solution-strategies, *problem anti-archetypes* facilitate the identification of resources and the formulation of objectives. Together, *problem archetypes and anti-archetypes* could be used to rapidly identify and classify problems as well as comprehensively explore *problem and solution spaces.*

For a given discipline, templates could be developed for recording elements and features of *problem archetypes* as well as *anti-archetypes*. The format of a mind map is recommended for such templates. However, prior to formulating *technical contradictions (dilemmas)*, possible parameters of the system could be summarised in a matrix as in table 2. Relationships between pairs of parameters could be investigated in order to find out which pairs demonstrate *technical contradictions*. A faster alternative may be to use **qualitative change graphs**[2] as templates for *mindstorming (brainstorming)* on pairs of parameters that constitute *case types I &II technical contradictions (dilemmas)*.

The formulation of problems as archetypes facilitates understanding of types of problems as well as generation of solution-strategies that specifically relate to problem-variables of a system. *Problem archetypes* 1 to 6 are directly related to **solution archetypes** in the *SCAMPER-DUTION matrix* in table 5. Consequently, corresponding solution-plots could be taken from cells of the matrix and applied to parameters of relevant *problem archetypes*. It is recommended that, before using the *SCAMPER-DUTION matrix,* a problem space should be dialectically explored and problems classified using the list of *problem archetypes* and *anti-archetypes*. The nature of *problem archetypes* may be more deeply investigated using methods such as *deeper questioning* (Why? What? Where? When? Who? How?); *root-cause analysis*; *interaction (functional analysis) diagram; Substance-field analysis; triads; systems archetypes; SWOT analysis.*

System archetypes and *profit patterns*, which generally focus on organisational (business) systems, belong to multi-variable problem archetypes. Organisational systems are open-ended and involve external recursive relationships, especially feedback. In contrast, artefacts are predominantly close-ended systems. In TRIZ, problems in systems are mainly treated as *inventive problems* or contradictions involving improvement

[2] See Sickafus (1997).

in mono- and bi-variables. The *SCAMPER-DUTION matrix* (see table 5) may be used to obtain conceptual solutions that correspond to identified problem archetypes in a situation.

5.2 The Creative Web

The *creative web* provides a descriptive as well as normative framework for problem-based learning, creative project planning, creative problem finding & solving, and creative ideas management. The creative web also provides a framework for using multi-methodologies.[3] Karl Popper once said, “All life is problem solving.” With due courtesy to Karl Popper, I’ll say: “All life is learning is problem solving is a creative web is …”[4]

The *creative web* consists of five spaces[5]:

- **Problem-definition space**
- **Methods-space**
- **Solutions-space**
- **Implementation-space**
- **Creative lifeSpace**

---

[3] For more information on the approach of multi-methodology, especially the matching and mixing of methodologies, see Rosenhead & Mingers (2001).

[4] This open-ended expression is in the format of a *paoism*.

[5] All problem solving approaches could be structured in the five spaces of the *creative web*. Eli Goldratt’s generic steps in his ***Theory of Constraints*** could be structured as follows: *Problem-definition space:* What to change?/1. Identification of system’s constraints; *Methods-space:* How to cause change?/2. Exploitation of system’s constraints; 3. Subordination of all other resources; *Solutions-space*: To what to change to?/4. Elevation of system’s constraints; Evaluation of alternative solutions (using criteria of throughput, inventory, and/or operating expense).

The **NLP Algorithm** (Hall & Bellnap, 2001) and **NLP patterns** could also be structured as follows: *Problem-definition space:* Present state; Content; *Methods-space:* Bridges and resources; Transformation processes (patterns); *Solutions-space*: Desired solution state; Evaluation criteria.

The **IDEAL** framework for problem solving (Bransford & Stein, 1984) could be structured as follows: *Problem-definition space:* Identify problems and opportunities; Define goals; *Methods-space:* Explore possible strategies; *Solutions-space*: Anticipate outcomes (and act); *Implementation-space*: Look back and learn.

According to the *creative web*, the structure of the phases of the **Breakthrough Thinking Process (Full-spectrum Thinking)** (Nadler et al, 1999) is as follows: *Problem-definition space:* 1. Determining the purpose that should be achieved; *Methods-space:* (not explicit) ; *Solutions-space*: 2. Generating potential solution ideas (or ideal system); 3. Selecting a feasible solution target; Developing (detailing) a recommended solution; *Implementation-space*: 5. Installing today’s recommended solution.

The elements of the *creative web* are shown in Fig. 3. Elements 1 to 7 are to be regarded as "modules" rather than as "steps" or "sequences."[6] The seven modules could be categorised into four spaces as follows:

- **Problem-definition space:**
1. Creative ("inventive")[7] problem finding
2. Preparation and immersion

- **Methods-space:**
3. Re-engineering, Exploration, and Generation/Incubation
4. (Unexpected) Synthesis/Illumination

- **Solutions-space:**
5. Execution (Experimentation) and Testing
6. Evaluation and Verification

- **Implementation-space:**
7. Presentation, Acceptance, and/or Implementation

The **creative lifeSpace** is synonymous with the environment and common to all other spaces and elements.

Fig. 3 shows recursive or "trial-and-error" relationships between the spaces of the *creative web*.[8] These relationships are consistent with the approach of Structured Intuition, Analysis, and Reflection (SIAR). The *creative web* assumes that trial-and-error or experimentation is an essential part of learning as well as problem solving, creativity, and ideas management. This assumption goes against the positivist epistemology of TRIZ which claims that TRIZ - unlike brainstorming [9]- is a methodology not dependent on trial and error.[10]

---

[6] This approach contrasts that of the **Creative Problem Solving (CPS) model** and **Wallas's model** where corresponding elements or activities of *preparation, incubation, illumination, and verification* are assumed to take place sequentially. Consequently, the CPS and Wallas's models are limited in their explanation of creativity in practice.
The process of **systems dynamics modelling** (Rosenhead & Mingers, 2001) could be structured as follows: *Problem-definition space:* Problem articulation; *Methods-space*; Formulation of dynamic hypothesis; Formulation of simulation model *Solutions-space*: Testing and validation; Using the model-policy design and evaluation.

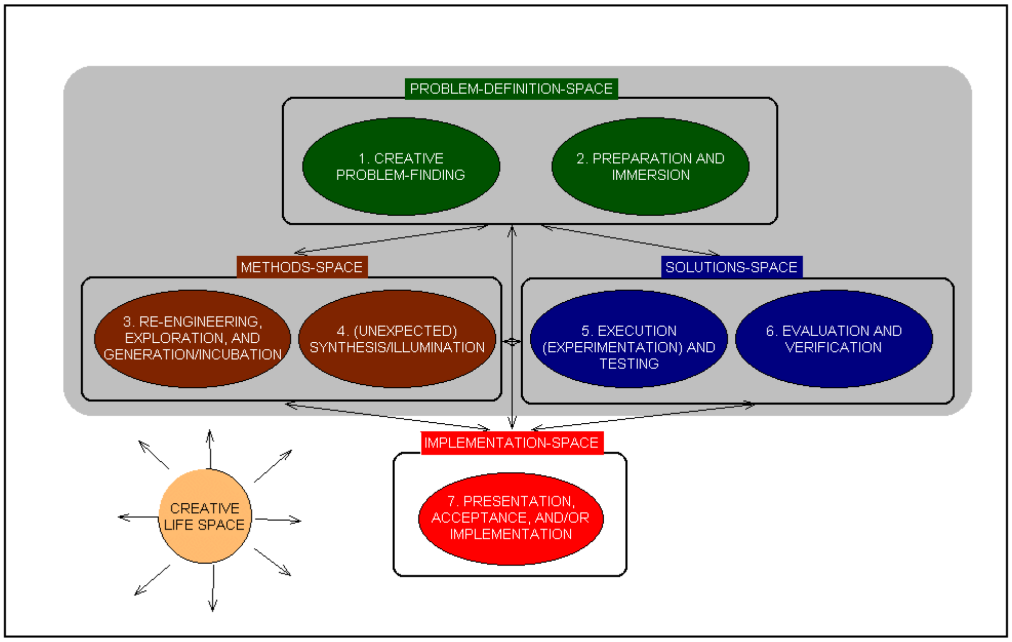
[7] The concept of an **"inventive problem"** is based on TRIZ. An *inventive problem* is assumed to have a physical and/or technical contradiction. Resolution of a hitherto unsolved *inventive problem* at national level will lead to a "patentable" product.

[8] Trial-and-error relationships are also emphasised in Karl Popper's three-stage model (Popper, 1972). Popper's model could be framed in terms of the creative web as follows: *Problem-definition space*: "Problem"; *Methods-space*: "Attempted solutions"; *Solutions-space*: "Elimination." Popper states that his three-stage model is applicable to the evolution of species (Darwinism) as well as the logic or methodology of science.

[9] In my experience, both TRIZ and brainstorming are dependent on trial-and-error processes; brainstorming more so than TRIZ as brainstorming uses a largely unstructured framework and focuses on the solutions-space. Brainstorming is an example of organic (unstructured) creativity and problem solving while TRIZ takes a systematic (structured) approach towards creativity and problem solving.

[10] Although heuristics in TRIZ are derived from studies of existing patents and methods of inventive problem solving, the interpretation of heuristics is personal during the solution of detailed problems. The quality and contents of detailed solutions depend on a problem solver's technical knowledge base

Fig. 3: The creative web



As a descriptive model, the *creative web* could be used to generally explain processes of creativity, improvement, and invention. As a normative model, the *creative web* indicates how a novel, "wicked" or inventive problem may be approached as well as how a (creative) project or problem could be planned and structured, especially if a real-time dimension is introduced in a space-time matrix.[11] Time is implicit in the diagram of the *creative web* in Fig. 3. The *creative web* could be used for structuring and providing a holistic view of macro-projects involving the use of TRIZ.

The tool in TRIZ, which is generally comparable to the *creative web*, is the *"Algorithm for the Solution of Inventive Problems."*[12] This algorithm has the Russian acronym, **ARIZ**. The evolution of ARIZ is documented in Savransky (2000). ARIZ-85C is Altshuller's last version and consists of nine main stages. The relationships between the main stages of ARIZ-85C and the problem-definition, methods-, and solution-spaces of the *creative web* are shown in table 3.

---

and experience. Consequently, detailed solutions using TRIZ heuristics may not be unique. Given a set of evaluation criteria such as *ideality* and *ideal final result,* some solutions will be closer to the ideal than others. Problem solvers having less than ideal solutions will need to use a process of trial and error to obtain "more ideal" solutions. The thrust of this argument is that while TRIZ may minimize trial-and-error or experimentation when seeking conceptual solutions, TRIZ does not eliminate experimentation when one is seeking the best detailed solutions, especially in novel situations or open-ended problems. TRIZ simply minimizes *blind trial-and-error*. Except in routine situations, problem solving invariably involves *selective trial-and-error* (Simon, 1998).

[11] Models for ill-defined problem focus on situation-structuring rather problem-solving; see Rosenhead & Mingers (2001).

[12] The **closed world algorithm** of *USIT* (Sickafus, 1997) is conceptually similar to *ARIZ* and consequently, to the *creative web*.

Table 3: The creative web – ARIZ (multi-methodology) framework

Creative web	**Main stages of ARIZ**	**("Extended") tools of TRIZ**
PROBLEM-DEFINITION Space	Selection and description of problem (*unitary space*, including objective(s)) Determination of Ideal Final Result (IFR) and/or Technical/Physical/Administrative Contradictions Problem replacement (e.g., sub, mini-, or core problem)	**39 Parameters; Contradiction matrix** (Object-attribute-function diagram/ *Object-matrix for unitary space*) (Qualtiative change graphs/Evaporating cloud or Conflict resolution diagram) **Ideal Final Result (IFR)** (Multi-level objectives/*IVY-Final Result/ IVY-object)* **Multi (9)-screen approach** (Conflict or operative zone/ Closed (problem) world/*"Constraint" zone*)
METHODS-Space	Analysis of the problem (model) and resources Substance-Field analysis Utilisation of TRIZs ("invention"/patent) knowledge-base: Inventive principles; Database of effects, e.g., scientific effects and principles; 76 Standard solutions, etc.	(Multi-level resource analysis) **Substance-Field analysis** (Triads/*IVY-template*) (Object-function analysis/Closed-world diagram/Multi-level root-cause analysis/ Current reality tree) **Database of physical effects** (library of patents/"best practice" solutions) **76 Standard solutions** (Prerequisite tree) **Modelling of miniature dwarves** (Smart little people/Magic particles method/Agents method/*ObjectBots/ Scene-transformation matrix*) (*Versatile matrix*) **Size-Time-Cost (STC) operator** (*Extreme contingency scenarios*)
SOLUTIONS-Space	Proposal as well as evaluation of solutions to technical/physical/administrative contradictions Evaluation as well as reflection on ARIZ and process of problem solving	**Ideality/IFR** *(Multi-criteria/Level and degree of IVYalityIIVY-object/Closed-system solutions/*Future reality tree) **Separation heuristics** **40 Inventive principles** (Qualitative change principle/ *SCAMPER-DUTION matrix*) **Levels of inventions/solutions** (*IVY-pyramid of innovation*) Subversion (failure anticipation) analysis **Patterns (laws/trends) of technological evolution** *Expected Final Results (EFR) for* **evolution of technical systems**
IMPLEMENTATION-Space	Application of solutions obtained	(Generification of solutions/ Transition tree)

Table 3 illustrates a multi-methodology framework that relates to TRIZ. This framework allows the matching and mixing of methods in TRIZ as well as between TRIZ and other methodologies. In table 3, methods in classic TRIZ are embolded. Methods outside TRIZ such as in *ASIT*, *USIT*, and the *Theory of Constraints* are enclosed in parentheses. Methods of the Theory of Ideal SuperSmart™ Learning are italicized. Table 3 could be used as a "pointer" and checklist for tools when solving problems.

5.3 The Versatile Map™, Implementation Map, and Creative LifeSpace Map

For more specific problem solving, creativity, and ideas management, the *creative web* translates into three maps: the versatile map; implementation map; creative lifeSpace map. Fig. 4 shows a graphic version of the **versatile map™** in Axon file format. The *versatile map*™ consists of problem-definition-, methods-, and solutions-spaces. The *versatile map*™ provides a framework for using *multi-methodologies*[13] and could therefore be employed for structuring and solving a wide range of problems, including those in "soft" and "hard" systems.

As a file in the Axon software[14], the *versatile map*™ is hyperlinked to the *implementation map* as well as *creative lifeSpace map*. Each *object* on a *versatile map* could be a hyperlinked knowledge base on a computer or the Internet. The principles of *object mapping* apply to each *object* and *map*. Also, the "Generator" on a *versatile map*™ – in Axon format - could be used to automatically generate up to 200 solution-strategies for each parameter in a given system.

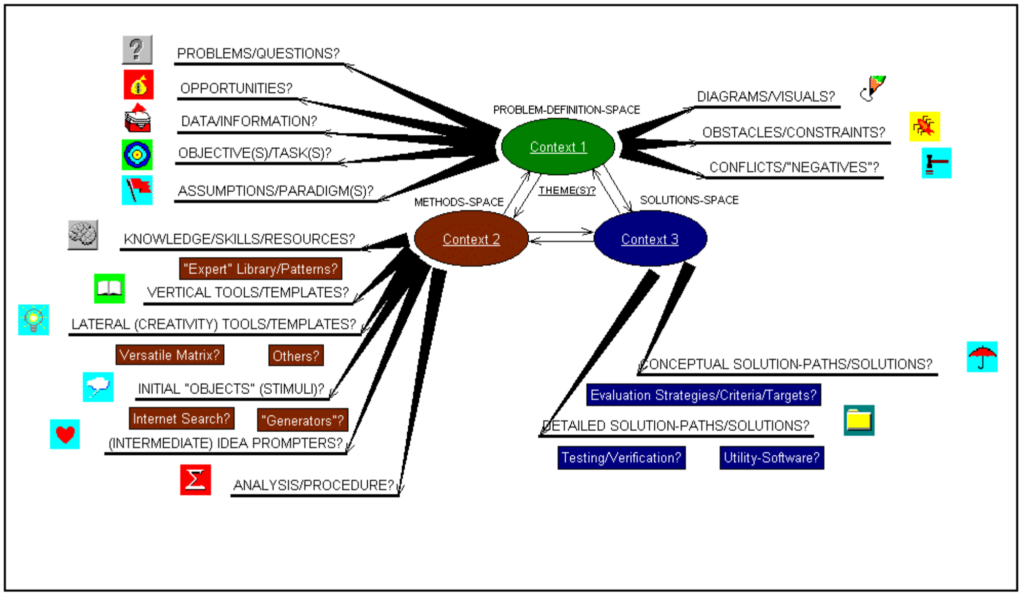
As indicated in table 3, the main stages of *ARIZ* could be mapped on to a *versatile map*™. A checklist of detailed steps of *ARIZ* or any problem solving methodology could be contained in "hidden" hyperlinked objects on the *versatile map*™. Currently, a template of the *versatile map*™ contains notes on elements, techniques, and procedures of methodologies such as TRIZ; strategic planning and management; creative problem solving. These notes provide a basis for rapidly learning, using, reflecting, and expanding on these methodologies. The icons, which are adjacent to descriptive categories or "basic ordering ideas" on the *versatile map*™, open-up as blank pages ("windows") for input of problem-related information by the user. Unlike in *ARIZ*, the user could input data and information in a non-sequential manner.

On a printed template of the *versatile map*™, a user could record information using the technique of *object mapping* and in particular, mind mapping. Each icon becomes the central object of a classic *mind map*.[15] I use A3 and A2 size papers for developing handwritten *versatile maps™ as well as implementation and creative lifeSpace maps*.

---

[13] For discussion on the concept of multi-methodology, i.e., the mixing and matching of problem solving methods especially in "soft" systems, see Rosenhead & Mingers (2001).
[14] Visit http://web.singnet.com.sg/~axon2000
[15] See Buzan & Buzan (2000).

Fig. 4: The versatile map™



The methods-space of the *versatile map*™ contains a **versatile matrix**[16] as an *object*. An abridged *versatile matrix* is shown in table 4. All strategies and techniques[17], which are described in the *versatile matrix*, could be used on the *versatile map*. The *versatile matrix* is a useful resource for finding alternative techniques for particular thinking strategies. *Ideal meta-cognition*, *meta-learning, and reflective learning* may be facilitated by use of the *versatile matrix*. Like in Edward de Bono's **Six Thinking Hats**™, the *versatile map*™ could be used for team problem solving, especially for structuring, discussing, and solving problems in meetings.

The set of versatile, implementation, and creative lifeSpace maps could also be used for documenting *software design patterns*. In software development, a **design pattern**[18] refers to a template or an *object* for documenting and storing "best practice (solutions)." There is currently no standard template or structure for recording design patterns. [19]

---

[16] The strategies are an adaptation and extension of the thirteen tools of the world's most creative people (Root-Bernstein & Root-Bernstein, 1999).
[17] Some techniques such as analogies and checklists are placed in more than one category of strategies.
[18] TRIZs *inventive principles* and *separation heuristics* may be regarded as *partial design patterns*.
[19] Different "schools" and systems of design patterns exist in the software industry. To date, there is no standard or a unique approach for writing design patterns.

Table 4: Versatile matrix of strategies for problem solving and creativity (abridged version)

Item No.	**Description of strategy** (Verbally/Visually/Olfactorily/ Kinaesthetically/Gustatorily)	**Tools for generating ideas and/or reengineering "objects"**
1	Observing, being curious, and reflecting	Deep questioning; Checklists; Meditation; *CreaLogic*; *Paoisms*; Observing anomalies and patterns
2	Envisioning and planning	Visualisation; Day-dreaming; Storytelling; Scenario-making; Goal setting; (Fantasy) Forecasting
3	Recording, managing, and presenting	Mind map; Concept map; Tables; Matrices; Graphs; Charts; Diagramming; Storyboarding; Record management; Mnemonics; *Object-map*; *Object-templates*
4	Exploring	Brainstorming; *Mindstorming*; PMI; Questions; Checklists; Analogies; Diagramming; "Roaming"; Lotus blossom; Categorising; Typologies
5	Abstracting, structuring, and classifying	Questions: How? How?; Why? Why?; Templates; Summarising; Analogies; *CreaLogic*; *Paoisms*
6	Escaping, speculating, and relaxing	Lateral thinking: Po; Random "objects"; Challenging/reversing assumptions and boundaries: What if? ;Travel; Sleeping; Taking breaks; *Bipolarity*
7	Deconstructing, analysing, and evaluating	Attribute (component) listing; Graphs; Matrices; Morphological analysis; Root-cause analysis; Fishbone diagram; Critical (dialectical) analysis; Force-field analysis; How? How? SWOT analysis; Systems thinking; Weighted index; Voting
8	Patterning and modelling	Copying; Imitating; Parallel worlds; NLP; Pattern language; Prototyping; *Discovering and creating templates*; Analogising; Composing
9	Using analogy, *creaLogic*, and *paoisms*	Analogies; Synectics; *CreaLogic*; *Paoisms*; Analogic; Metalogic; Similes; Metaphors
10	Using multi-level, multi-phase, and multi-dimensional "objects"	Multiple perspectives (roles); Six thinking hats; *Six colored eyes*; Spatial thinking; *CreaLogic*; *Paoisms*; Multi-temporal thinking
11	Empathising and body thinking	Personal analogies; Meditation; *Paoisms*; Acting; Introspecting
12	Acting, playing, simulating, and energising	Role playing; Tinkering; Humour; Experimenting; Visual Modelling; Poetry; Improvising; Dancing
13	Transforming	Manipulation or re-engineering verbs, e.g., SCAMPER; *SCAMPER-DUTION*; Reframing
14	Connecting, unifying, combining, and synthesising	Forced connections (fitting); Bisociating; Metaphorming; Circle of opportunity; Modelling; Sculpting
15	Possessing and displaying "creative" attitudes and behaviour	Affirmations; Practising "creative living": Idea Quotas; Creative journaling; Aphorisms; Lateral thinking puzzles; Creative hobbies such as conjuring and art
16	Enhancing creative life space	Joining creative people and Internet creativity groups; Creative adventure; Hobbies; General interests
17	Combining the above strategies	Creative problem solving (CPS) models; TRIZ; *Versatile thinking*™; Creative Whack Pack; Thinkpak; Theory of constraints; *PSLT Game*; *Theory of Ideal SuperSmart*™ *Thinking*
18	Using miscellaneous strategies	Domain-specific expertise; External consulting

Ordering ideas for various design patterns could be categorised as follows:

- **Problem definition-space:**
  (Pattern) Name/Problem/Context/Forces
- **Methods-space:**
  Rationale
- **Solutions-space:**
  Solution
- **Implementation space:**
  Resulting context (Consequences)/Known uses/Examples/ Related patterns
- **Creative lifeSpace:**
  Not available

Advantages of the approach of design patterns include the following: accessibility of *best practice solutions* to designers and problem solvers, especially those at low and intermediate levels of understanding; observation of evolution towards *ideal design patterns;* a structured and reflective approach towards software development. Although the explicit use of *design patterns* is most common in the software industry, there is no reason why *design patterns* cannot be used in other disciplines or domains such as product development and business management. In fact, the formal concept of *design patterns* originates from architecture and in particular, Christopher Alexander. In his classic book, *The Timeless Way of Building*, Alexander advocates the concept of *a pattern language (for architecture)*, from which the concept of *design patterns* emerges. The concept of pattern language is consistent with the *template theory for versatile creativity* and applicable to many disciplines.

In recent years, the pattern language movement in the software industry has developed the concept of **anti-patterns**. An *anti-pattern* encompasses lessons learnt from a “bad” solution as well as how to move from a “bad” solution to a “good” solution. *Anti-patterns* reflect the concept of anti-IVYality and how to move from *anti-IVYality* to *IVYality*. *Anti-patterns* encourage *bipolar and reflective thinking*.

It is possible to develop, for a particular discipline or domain, a library of generic and domain-specific *design patterns* as well as *anti-patterns*. Such a library would be a useful resource for problem solving, creativity, and ideas management in the discipline or domain.

Worst patterns could provide materials for learning and reflective exercises. With time, *best practice design patterns* or highly inventive solutions are expected to evolve towards *ideality*, while *worst patterns* move towards *anti-ideality*. A patent database could be regarded as a library of best practice *design patterns* for specific products or artefacts. The use of versatile, implementation, and lifeSpace maps should facilitate the organisation and management of a *design patterns library*, especially on the Internet, for any discipline.

5.4 The Basic IVY-Template for Strategic Problem Solving

Like the *versatile map*™, the basic IVY-template could be used as a tool for learning and teaching creativity as well for problem-finding, structuring, and solving. Both the *versatile map*™ and the IVY-template strongly relate to problem-definition, methods, and implementation-spaces. In the IVY-template, however, there is no "boundary" between the problem-definition and methods-spaces. An example of an IVY-template is shown in Fig. 5. The IVY-template could be presented on A4, A3, and A2 size papers; I often use A3 paper.

The *versatile map*™ is suitable for solving strategic problems in both "human-activity systems"[20] and "designed physical (product) systems", while the IVY-template focuses on strategic (conceptual) problem solving for artefacts or in *designed physical (product) systems*. The IVY-template is predicated on the basic functional relationship:
[object or pattern] [interacts with] [object or pattern] to obtain [result/"emergent" object or pattern]

In my view, all dynamic systems reflect the above relationship. The symbols in Fig. 5 are explained below. The description of "core" may refer to resources or the *unitary space* at the system level, while "peripheral" and "remote" may refer to resources at "neighbourhood"/super- and supra-levels respectively. Archetypal tasks regarding "verb 1" include descriptions of a main problem as well as the following primary functions: "improve"[21]; "design"; "invent"; "identify"; "detect"; "brand"; "exploit"; "exhaust." Such archetypal tasks or functions facilitate not only the categorisation and solution of problems but also pattern and analogical thinking. The term "focus" may refer to a sub-system or element.

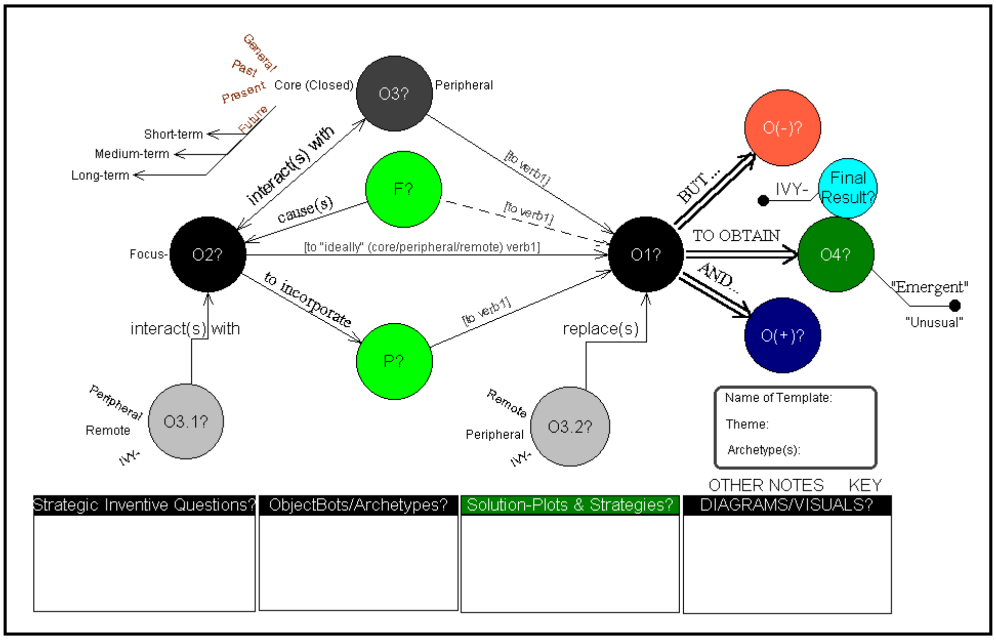
Complementarity exists between the use of the *versatile map*™, within which open-ended, "wicked", or ill-defined problems can be addressed, and the use of the IVY-template, within which conceptual solutions can be directly generated for more specific or well-defined problems. The IVY-template could be used to depict and more thoroughly understand a problem situation with a view to identifying principal root-causes. The IVY-template may also be used after an ill-defined problem has been transformed to a well-defined problem using a *versatile map*™. However, final solutions, after using the IVY-template, may be summarised, evaluated, and presented using a *versatile map*™.

The IVY-template may be used to carry out multi-level analysis either holistically (intuitively) or sequentially, e.g., using, one at a time, the framework of *triads*, *substance-field analysis*, and *root-cause analysis*. Multi-level analysis is highly recommended as it provides a comprehensive view of situations, systems, and problems.

---

[20] According to Checkland (2001), "human activity system" is a term borrowed from industrial engineering and used to describe systems in which humans are trying to take purposeful action.
[21] Problems, which require the use of TRIZs *contradiction matrix*, predominantly deal with improvement tasks.

Fig. 5: Basic IVY-template for strategic (conceptual) problem solving



The IVY-template illustrates the fact that there are two categories of solution-systems and three generic ways of solving any problem. The details of these systems and solution-paths are presented below.

Closed (self-contained)-system solutions[22]: internally-driven reengineering using given (and "freely available") elements and resources of the system.

Solution-path
O3/O2 -> O1

---

[22] *ASIT* gives priority to **"closed-world" or closed-system solutions** due to the assumption that more innovative solutions are obtained under *closed-world conditions* than in open-system conditions; visit http://www.sitsite.com/method/inpages/frame_solving_articles.html
While *closed-system solutions* may appear highly efficient and novel, *ASITs* assumption contrasts the thinking of Ideal SuperSmart™ Learning, which argues that after closed-system solutions have been saturated, breakthrough solutions would emerge by making the system open; see the *IVY-pyramid of innovation* in section 6. It is important to note that many *open-system solutions* could be converted to closed-system solutions by **"function transfer" or "squeezing"** of elements from the open-system to one or more elements of an original closed system.
USIT explicitly considers both closed- and open-system solutions. TRIZ implicitly advocates closed-system solutions through its concepts of *(utopic) ideality* and *ideal final result*.

Open-system solutions: using external (non-system) elements and resources

(a) *Externally-driven reengineering of given system:*

Solution-path
O3.1 -> O2/O3 -> O1

(b) *Complete replacement of given system or problem:*

Solution-path
O3.2 -> O1

Each description on the IVY-template in Fig. 5 could be regarded as an *object*. Letters on the IVY-template could have the following interpretations:

* O: "Object" (in the sense of the *principle of object equivalence, a unitary space, or system of resources*)

* F: Factor(s); Field(s)[23]; Force(s); Function(s); Failure(s)

* P: Pattern(s); Plot(s); Principle(s); Procedure(s); Process(es); Properties; Parameter(s); Prompter(s)

The IVY-template could be related to and used within the context of many problem-solving methodologies. For instance, when using TRIZ and in particular, **Substance-Field analysis[24]**, the *objects* could be regarded as follows:

- O1: Substance (S1); "Constraint"; "Weakest link"; ("Passive")[25] Resource 1
- O2: Tool (S2)/"Miniature Dwarves"; *objectBots*; Means; "(Non-)Contacting Agent(s)"; *targeted variable(s)*; ("Active") Resource 2
- O3: Given System; "Super-agent(s)"; ("Enabling") Resource 3
- O4: Ideal Final Result (IFR); IVY-Final Result; Resource 4
- F: Field – Mechanical; Thermal; Electrical; Electromagnetic; Electronic; Acoustic; Optical; Magnetic; Nuclear; Chemical; Biological
- O3.1: External elements; "Additives"; Resource 3.1
- O3.2: New (substitute/replacement) system; Resource 3.2
- O(-): Undesirable (harmful/negative) effects; Disadvantages;
- O(+): Desirable (useful/positive) effects; Advantages; Opportunities

---

[23] A field could be regarded as the "ultimate root cause." In the format of a *paoism*, a field could be defined as "a cause of a cause of a cause of a cause is …"
[24] In Ideal SuperSmart™ Learning, **Object-FieldBot analysis** corresponds to *Substance-Field analysis.*
[25] The description of objects as "passive", "active", and "enabling" is an idea from Kovalick (1997, 1998). Kovalick uses these descriptions for elements in the framework of *triads*.

It must be pointed out, however, that graphic representation and use of the IVY-template are closer to those of **Triads**[26] and **Object Functional Analysis (OFA)** than the classic *Substance-Field model*. *Triads* are especially useful in the illustration and improvement of systems with dominant functions or core problems. The IVY-template could draw on the *triads* approach to initially document a system that is problematic and is to be consequently improved or redesigned. Like in *Triads*, the network of *objects* on the IVY-template could be expanded[27]. Unlike the *triads* approach, however, the IVY-template illustrates the ideal or IVY-Final Result and thereby gives a holistic view of the problem solving process. Also, using the technique of *object (mind) mapping*, diagrams as well as texts could be used to describe objects on an IVY-template.

Other methods of TRIZ such as **"Miniature Dwarves"** and **"Multi-screen Approach"**[28] could be applied within the framework of the IVY-template. Fig. 5 shows, for the core object (O3) as well as a 1x3 screen: past; present; future. This 1x3 screen could be used for the method of *miniature dwarves* as well as the *ideal final result*, which could be depicted as a scene in the long-term future (O4).

The IVY-template could be used to comprehensively illustrate each of TRIZs *40 Inventive Principles*. As presented in classic TRIZ, the *40 Inventive Principles* appear difficult to understand and interpret, especially in the context of problems that are not related to mechanical engineering or product development. It is difficult to see which dimension of a system's *ideality* is enhanced by many *inventive principles*. Some examples, which are associated with specific *inventive principles*, neither describe the initial state of the system nor state the relevant dimension of *ideality* or targeted-variables, i.e., variables on which the principles operate. Targeted-parameters may be different from TRIZs list of *39 parameters*, pairs of which are featured in the *contradiction matrix*.

Using the IVY-template and *object-mapping*, one could prepare **vertical and lateral IVY-templates** for TRIZs *40 Inventive Principles*. A *vertical IVY-template*, in Axon format, deals with a single *inventive principle* and involves "nesting" of examples on application of a specific principle. In contrast, a *lateral IVY-template* describes two or more *inventive principles*. Lateral templates facilitate comparison of heuristics (*inventive principles*) in and between problem-solving methodologies, e.g., between TRIZ, *ASIT*, and *USIT*. IVY-templates also enable myriad solution-paths to be automatically generated using the Axon software.

---

[26] Information on triads could be in sources including archives of the TRIZ journal at: www.triz-journal.com. See, for example, the following articles by James Kovalick: "Triads: Their Relationship to TRIZ" at www.triz-journal.com/archives/1998/06/a/index.htm and "Altshuller's Greatest Discovery - And Beyond" at www.triz-journal.com/archives/1997/08/a/index.html.

[27] In Ideal SuperSmart™ Learning, the method of expanding a chain of "subject-verb-object" is referred to as "Natural Language Mapping." In theory, the IVY-template could be extended as in *influence diagrams* that facilitate the identification of systems archetypes in *human-activity systems*.

[28] For a comprehensive treatment of the multi-screen approach, see a series of articles by Darrell Mann in the web site of Triz-journal, e.g., www.triz-journal.com/archives/2001/09/c/index.htm

In *ASIT* and *USIT*, “P” could represent patterns of “solution-techniques.” Using the technique of *object- or mind-mapping* with “P” as a central *object*, one could summarise solution-techniques of *ASIT* and *USIT* using the following acronyms as “basic ordering ideas:”

* *ASITs* solution-techniques: **D.R.U.M.S.** - **D**imensionality; **R**emoval; **U**niversality; **M**ultiplication; **S**ymmetry.

* *USITs* solution-techniques: **D. /D.U.P.T.** - **D**imensionality; **D**istribution; **U**niqueness; **P**luralization; **T**ransduction.

The IVY-template provides a holistic framework for solving conceptual problems, especially using the *ASIT or USIT* methodology. The IVY-template facilitates the use of *multi-methodology* or “multi-techniques” when solving a given problem. Thus, rather than using the “multiplication” technique of *ASIT* to solve a problem, one could also use techniques of “segmentation” and “dimensionality.” Based on the concept of *multi-methodology*, solution-techniques of *ASIT* could be combined with those of *USIT* and TRIZ in order to generate a wider range of solutions.

Other applications of the IVY-template include the preparation of templates for *Profit Patterns* as well as *Scenario Planning/Learning*. In *Scenario Planning/Learning*, the “F”-object could represent “driving forces” while the “P”-object could denote “Plots.” The “end states” of scenarios could be represented by object O4, which is equivalent to the “IVY-Final Scenario.”

Problems could be solved using a *problem (root-cause)-led approach* and/or *solution-led approach* in conjunction with *the IVY-template*. *Brainstorming* is usually presented as a solution-led approach.[29] Ideas generated from *brainstorming* could be recorded in the window of or next to the object, “IDEA LOG.” Questions, which are related to a system and come up during problem solving, could be recorded under “Strategic Inventive Questions.” Like in the case of a *versatile map*™, IVY-templates of best as well as worst solutions could be maintained in a library of patterns for a particular discipline. The *SCAMPER-DUTION matrix* (see section 5.6) is a useful resource for generating ideas and solution-paths.

[29] Another form of brainstorming is “negative brainstorming.” *Negative brainstorming* involves brainstorming for ideas that negate solutions; see Majaro (1991). The objective of *negative brainstorming* is similar to *failure anticipation analysis* which is used in product design.

5.5 System of Solution Archetypes

<u>Basic Solution Archetypes</u>

In section 5.1, eight *basic problem archetypes* were identified in a problem-definition space. Corresponding to those *problem archetypes* are **basic solution archetypes** in a solutions-space. The *basic solution archetypes*, which are largely based on *conditions of IVYality* or *ideality* (see table 1), are shown below:

Solution archetype 1: Ideal (“functional”) nothingness

- Eliminating (or minimising/decreasing/reducing) an *undesirable largeness/presence*

Solution archetype 2: Ideal infinity

- Infinitely increasing (or maximising/”creating”) an *undesirable smallness/absence*

Solution archetype 3: Ideal efficiency & “automaticity”

- Achieving infinite (or maximum) efficiency;
  Making completely automatic or self-operating (self-working)

Solution archetype 4: Ideal conflict resolution & unity

- Absolutely – without “trade-off” or compromise - resolving all conflicts, contradictions, paradoxes, dilemmas, and disunities (to the satisfaction of all *objects*);
  Achieving perfect (network) unity or integration

Solution archetype 5: Ideal simplicity, variety, & beauty

- Achieving absolute simplicity, *absolute/requisite variety*, beauty (elegance)

Solution archetype 6: Ideal identification, detection, & branding

- Achieving universal identification, detection, & branding

Solution archetype 7: Ideal dimensions, properties, parameters, & attributes

- Obtaining ideal dimensions, properties, parameters, & attributes

Solution archetype 8: Ideal situations, effects, & *objects*

- Achieving ideal situations, effects, consequences, systems, elements, & super-systems

Basic solution archetypes describe solution patterns at a macro-level and could be used after identifying particular *problem archetypes*, for example, in brainstorming sessions and through detailed causal analysis. *Basic solution archetypes* provide a framework for universally organising existing as well as normative solution strategies in systems, including disciplines. In other words, a library of methods and solutions - in a system or discipline - could be based on the system of *basic solution archetypes.* Descriptions of sub-categories for each *solution archetype* are referred to as *closed-system solutions* and *open-system solutions*. Eco-systems are predominantly cases of closed-system solutions. In fact, Humberto Maturana and Francisco Varela argue that “all living systems are organizationally closed, autonomous system of interaction that make reference to themselves.”[30]

A template for generating and exploring conceptual solutions could have the format:

“Consider [solution archetype] using [field-based][31] means relating to variable(s)”

A *basic solution archetype* could “operate” on one or more variables, i.e., (causal) parameters, of a given system. Categories of variables include the following: materials/substances; functions/actions/processes; fields/forces; artefacts devices/tools); *naturfacts*. These variables, which are similar to *objects* on the IVY-template, could be used to create a matrix of *solution archetypes*. More specific solution-strategies for each *solution archetype* – at a meso-level - could be obtained by either repeatedly asking, “How?” or using the *SCAMPER-DUTION matrix*, which is discussed in the next section.

<u>Basic SCAMPER-DUTION Matrix of Patterns for Solution-Plots, Properties, and Devices</u>

A **SCAMPER-DUTION matrix** is a tool for organising as well as summarising solution-patterns, plots, properties, devices, and tools. The basic matrix is a 14x8 table, i.e, it consists of fourteen rows and eight columns; see table 5. The letters of the acronym “SCAMPER-DUTION” and the description for the rest of the alphabet, “Miscellaneous” make up the rows. **SCAMPER** is a well known acronym that summarises manipulation verbs and is attributed to Osborne and Eberle; my contribution is the acronym, **“DUTION.”**

The development of the matrix is my idea as well as the introduction of columns with the following headings: “Ideal (“functional) nothingness”; “Ideal infinity”; Ideal efficiency & “automaticity”; “Ideal conflict resolution & unity”; “Ideal simplicity, variety, & beauty”; “ideal identification, detection, & branding”; “Targeted variables.” The majority of the columns cover *conditions of ideality*, i.e., *basic solution archetypes* 1 to 6. The remaining *solution archetypes* could be subsumed under the heading of *“Targeted variables.”*

---

[30] See Morgan (1997). Maturana and Varela coined the term **“autopeisis”** to refer to the *capacity for self-production through a closed system of relations*.
[31] Field-based is synonymous with the following terms: Mechanical; Thermal; Electrical; Electromagnetic; Electronic; Acoustic; Optical; Magnetic; Nuclear;Chemical; Biological.

While contents of *targeted variables* vary from discipline to discipline, *conditions of ideality* are constant. In TRIZ, *targeted variables* include "engineering parameters" and causal factors in given situations. Higher-level *targeted variables* could be elements and super-systems of a given system. The level of abstraction of *targeted variables* influences the level of detail in proposed solutions.

In the *SCAMPER-DUTION matrix*, each letter in a row is an abbreviation that represents patterns that begin with that particular letter. A pattern could be expressed as follows:

Patterns at Level 1: Keyword (idea prompter/trigger/hint)

- Verb/Action: Operations; Manipulations; Reengineering actions
- Noun/Nominalisation: Devices; Tools; Substances; Materials; Artefacts; Persons; Organisms
- Adjective/Description: Properties; Attributes; Characteristics

Patterns at Level 2: Phrases/Sentences/Paragraph/Diagrams/Multimedia

- Phrase: Title of "solution-plot"[32], heuristic, or means; (in two or three words)
- Sentence: Brief description of "solution-plot", heuristic, or action
- Paragraph: Context-specific elaboration or example of "solution-plot", heuristic, or means
- Multi-paragraphs: Story; Detailed "solution-plot", heuristic, or means; Algorithm
- Diagrams/(Interactive) Multimedia

The higher or further down the level of pattern is, the more detailed and relevant is the solution-pattern to a given problem. Osborne and Eberle's technique of *SCAMPER* and various lists of manipulation or reengineering actions deal with "verb/action"-patterns, i.e., at level 1. TRIZs *40 Inventive Principles* deal with patterns at both levels 1 and 2. The descriptions of thirteen *inventive principles* are at level 1 (single nominalisations), while twenty-seven are at level 2 (phrases and sentences). TRIZs "Examples", which are associated with each principle, are all at level 2. In the Axon software, each keyword at level 1 could be hyperlinked to patterns at level 2. *Examples* clarify and give deeper, i.e., situation-relevant meanings to patterns at level 1. In Ideal SuperSmart™ Learning, TRIZs *40 Inventive Principles* are regarded not only as strategies for resolving *technical contradictions (dilemmas)* but also as *idea prompters* or *hints* for generating ideas (for *IVY-objects*) and operationalising *basic solution archetypes*.

The description of five solution-techniques of both *ASIT* and *USIT* deal with noun-patterns at level 1. For simplicity in presentation, level 1 solution-patterns for TRIZ, *ASIT*, and *USIT* are presented in table 5. This table also contains *manipulation (reengineering) verbs*. The numbers, which are

[32] The discussion in this section focuses on "solution-plots." In theory, a *SCAMPER-DUTION matrix* could be developed for *anti-patterns* and "problem-plots." An *anti-pattern SCAMPER-DUTION matrix* facilitates *(extreme) failure analysis.*

adjacent to keywords, refer to those of TRIZs *inventive principles*. In a way, the *SCAMPER-DUTION matrix* could be regarded as a creative web that is structured as follows:- *Problem-definition space*: Problem archetype(s); Targeted variable(s); *Methods-space*: Operators (contents of cells) of *SCAMPER-DUTION matrix*; *Solutions-space*: Operator(s) + Targeted variable(s).

The summary of some principles in table 5 involves the introduction of a keyword with a different starting letter from that in TRIZs *inventive principles*. Some *inventive principles* (such as TRIZs "segmentation (1)" and "combining (5)" and manipulation verbs fall into more than one category. In order to facilitate comparison between solution-patterns of TRIZ, *ASIT*, and *USIT,* properties and devices as well as TRIZs *Standard Solutions* and *Database of Effects* are not summarised in table 5.

The matrix in table 5 shows that a particular *solution archetype* could be achieved using several patterns. Combination of patterns could be "means" for achieving other patterns, which could be regarded as "ends" or "goals." The largest proportion of TRIZs *inventive principles* deal with *ideal efficiency and automaticity*. A pattern such as "Dimensionality" is common to TRIZ, *ASIT*, and *USIT*. Also, some manipulation verbs such as "combine", "divide", and "remove" are synonymous with TRIZs keywords. From the perspective of TRIZ, an advantage of the *SCAMPER-DUTION matrix* in table 5 is that it is independent of the *contradiction matrix*. Consequently, *technical contradictions* need not be found before using the *inventive principles*. Patterns in the *SCAMPER-DUTION matrix* could be used intuitively, e.g., after brainstorming on *problem archetypes* or logically, e.g., after determining root-causes of problems; alternatively, *object (mind) maps* could be used. Solution patterns or *inventive principles* can therefore be more rapidly selected from table 5 as well as applied to a wider range of problems.

In table 5, the contents of cells may be augmented by a user in a specific discipline. For instance, the cells could be filled in - especially at level 2 - by extracting and summarising solution-patterns or strategies from a library of *best solutions* such as in a patent database or a "best practice" database. Also, the *SCAMPER-DUTION matrix* could be used as a pattern object, i.e., a "P"-object in the IVY template; see Fig. 5.

The *SCAMPER-DUTION matrix* could serve as a resource for idea generation as well as problem-solving that involves the resolution of *physical and technical contradictions*. The matrix goes beyond TRIZs *inventive principles* and facilitate goal-oriented problem solving as well as brainstorming. For instance, if a certain "object" is to be eliminated, a problem solver could review as well as generate solution-patterns for "Ideal (functional) nothingness" in core, peripheral, and remote domains. In idea generation, it is recommended that the matrix also contain properties, tools, and devices for each dimension of *ideality*. More creative (unusual) ideas may be obtained by using *bipolar problem-reframing*, *bipolar solution archetypes* in the IVY-template, and variables from the IVY-matrix.

Table 5: SCAMPER-DUTION matrix of patterns for solution-plots, properties, and devices

Solution Archetype Acronym	**1: Ideal nothingness patterns**	**2: Ideal infinity patterns**	**3: Ideal efficiency & automaticity patterns**	**4: Ideal conflict resolution & unity patterns**	**5: Ideal simplicity, variety, & beauty patterns**	**6: Ideal id., detection, & branding patterns**	**Targeted variables (elements of unitary space)**
S	*Segmentation (1) Separation/Suction Stacking/Smoking Squeezing/Subtract Subordinate Submerge/Siphon*	*Segmentation (1) Separation Stretch Serialization Share*	*Spheroidality (14) Skipping (21) Self-service/Self-organisation (25) Substitution (28) Shells (30)*	*Separation: in space/time; Synthesising Synchronise Structuring Satisficing*	*Symmetry Standardisation Simplify/Scale Shape/Structure Surprise/Serenity Specialisation*	*Stabilize Substitute Separate Simulate Store Screen*	Substances Space/Strata Shape/Structure Suppliers/Staff Solutions Systems/Strength
C	*Cease/Compress/ Compact/Cancel Counteract*	*Continuity (20) Copying (26)/Clone*	*Combining (5) Converting (22) Composites (40)*	*Cushion before-hand (11)/Cen-tralize/Channel*	*Change: colour (32); parameters (35) Contrast*	*Change Cartoon Calculate*	Controls/Casing/ Connections/ Constraints/Cost
A	*Anti-weight (8) Anti-gravity/Adapt*	*Add/Attract Aggravate/Attach*	*Automate Accelerate*	*(Anti-) action (9/10)/Alignment*	*Asymmetry (4)/Adapt Adaptive/Abstraction*	*Assemble Analyse/Add*	Actions/Artefacts/ Attributes/Advant.
M	*Minimize Miniaturize/Melt*	*Maximize/Modula-rise/Multiplication*	*Merging (5) Mixing/Multiplex*	*Maxi-mini Mirroring*	*Modify/Morph Manipulate*	*Measure Move/Model*	Materials/Man-power/Methods
P	*Periodicity (19) Porosity (31)*	*Pluralization Production*	*Pneumatics (29) Prunning/Pareto*	*Partial (16) Preparation*	*Put to other use Provocation*	*Protect Picture*	Parts/Process/ Parameters
E	*Extraction (2)/Equi-potentiality (12)*	*Exaggerate/Expand Exploit/Extend*	*Expansion: thermal (37)*	*Eliminating Excessive (16)*	*Elegant/Echo Extreme/Escape*	*Extract Experiment*	Elements/Equipt Expenses/Energy
R	*Removal (2)/Repel*	*Recovering (34)*	*Reengineering*	*Reduce/Reframe*	*Reverse(13)/Random*	*Replace*	Resources
D	*Division (1) Discarding (34) Decrease/Decay*	*Division (1) Dimensionality (17) Distribution*	*Dynamism (15) Downsize Decentralize*	*Displacement Differentiation Distance*	*Distorting Differentiate Diversify*	*Destroy Deduce Direct*	Dimensions Devices/Deficits Disadvantages
U	*Undermine*	*Ubiquitous*	*Universality (6)*	*Unify*	*Uniform/Uniqueness*	*"Unusality"*	Unknowns
T	*Trimming/Transfer: Function/Resource*	*Tilt (17)/Transpose/ Telescopic*	*Transition: phases (36)*	*Transformation Transduction*	*Twist/Tessellation Turn off/Tranquility*	*Transfer Transform*	Tools/Time/ Throughput
I	*Inexpensive (27) Inert (39)/Inactivate*	*Increase/Innovate Improve*	*Invention Innovation*	*Intermediary (24) Integrate*	*Invert/Interrupt Idealise/Interlocking*	*Introduce Imitate/Invert*	Inventory/Inputs IVY-matrix/Infra'
O	*Obliterate*	*Orientation (17)*	*Oxidant (38)*	*Optimising*	*Outline/Order*	*Observe*	Objects/Organisn
N	*Nesting (7)/Nullify*	*Nebulous/Net*	*Nesting (7)*	*Negotiating*	*Non-uniformity (3)*	*Notice*	Nexus
Miscella-neous	*Homogeneity (33)/ Free/Heat*	*Fractal/ Galaxy*	*Feedback (23) Lean*	*Win-win/BATNA Hybridization*	*Vibration (18)/Field/ Void/Bipolarity*	*Vary/Freeze*	Functions/Links Forces/Fields
Problem Archetype	**Undesirable presence/ "largeness"**	**Undesirable absence/ "smallness"**	**Undesirable inefficiency/ sub-optimality**	**Undesirable conflicts/ contradictions**	**Undesirable complexity/ sameness**	**Undesirable identifica-tion/detectn**	**Causes/ causal factors/ problems**

The contents of the matrix could serve as "trigger words", *idea prompters,* or *hints* for generating solution-strategies. Various high level solution-patterns or plots may therefore be generated using words in one or more cells of the *SCAMPER-DUTION matrix*. Such generated solution-patterns or plots may directly relate to actual problem-solving, developing a database of solution-patterns, or practising creativity.

With the aid of the *SCAMPER-DUTION matrix*, solution-patterns in any system, subject, or discipline (e.g., solution-strategies in business management, total quality management, business process reengineering, biomimetics, and patent database) could be documented. The *SCAMPER-DUTION matrix* also lends itself to activities as diverse as magic tricks, graphic design, origami, art, drama, and humour. The Fantogram[33], one of the tools for creative idea generation in TRIZs course of *Creative Imagination Development*, is subsumed in the *SCAMPER-DUTION matrix*. As a file within the Axon software, a *SCAMPER-DUTION matrix* could be used to generate myriad fantasy ideas and higher-level solution-patterns.

A basic template for generating solution-patterns is the following:

"**Consider or change** (a)symmetrical **means for** [*field-based*[34]] **["SCAMPER-DUTION"]** of (micro-/meso-/macro-) [Targeted variables]
in space and/or time **to obtain [solution archeype] or [IVY-object]**"

To generate higher level conceptual solutions, only the highlighted words need be considered. As more words are included in the template, solution-patterns become more specific but thinking becomes more restricted and convergent. Templates with few keywords are useful in sessions of *structured mindstorming (brainstorming)*. More specific features of given situations could be related or *hyperlinked* to *targeted variables* in table 5.

Creativity games and quizzes could be developed for a *SCAMPER-DUTION* matrix. When filling in the cells of such a matrix, questions may include the following:

- Which "S" may satisfy the objective of *ideal infinity*?
- Which *targeted variables* or objects begin with a "T?"
- Which solution-plots and/or parameters of the *object* could satisfy the objective of *ideal efficiency & automaticity*?
- Select known (intriguing) *objects* and explain, using the *SCAMPER-DUTION matrix*, how the products could have been designed, improved, or invented.

---

[33] See Savransky (2000), pp. 178-179. "Phantogram" is an alternative way of spelling *Fantogram*.
[34] Field-based is synonymous with the following terms: Mechanical; Thermal; Electrical; Electromagnetic; Electronic; Acoustic; Optical; Magnetic; Nuclear;Chemical; Biological. Fields could also be described as abstract and physical. Descriptions of fields facilitate analogical thinking.

5.6 IVY-Matrix of Bipolar Variables, Dimensions, and Criteria

The IVY-Matrix consists of thirty **"spectra of bipolar dimensions."** Each spectrum or row is divided into bands on an ordinal scale. Alternatively, a spectrum may be "calibrated" using an interval scale and specific values from a family of *objects*. Table 6 shows an **IVY-Matrix™ of bipolar variables, dimensions, and criteria**. The dimensions are based on categories of *IVYality* as well as common attributes of parameters in both physical and non-physical systems. Variables such as quality, safety, and beauty/ergonomics are regarded as bipolar dimensions. The variables in the IVY-matrix could be used to describe dimensions about which the evolu-tion of products take place as well as a range of dimensions for parameters. Like in the *SCAMPER-DUTION* matrix, the descriptions in the IVY-matrix refer to patterns at level 1, i.e., keywords. The IVY-matrix may be extended and made more discipline-specific by *hyperlinking* patterns at level 1 with patterns at level 2, i.e., phrases, sentences, and paragraphs that refer to specific examples.

Each spectrum in the IVY-matrix is bipolar and ranges from "Anti-[Dimension] through "Nothing" to "[Dimension]." The extreme value for Anti-[Dimension] is "minus infinity", while that for [Dimension] is "plus infinity." The bands of *Anti-[Dimension]* and *[Dimension]* could be sub-divided into three parts that may be ordered as "Low", "Medium", and "High/Extreme." However, in the IVY-matrix in table 6, only [Dimension] is so finely divided. Anti-[Dimension] is considered as a single band in order to simplify the presentation and subsequent discussion. It is assumed in the IVY-matrix that *ideality* or *IVYality* could be bi-directional. Cells or "states" that unanimously reflect *ideality*, are embolded. Using the *SCAMPER-DUTION matrix* in combination with the IVY-matrix, one could generate ideas as well as alternative solution-paths and processes for moving from one *state* to another.

Several tools of TRIZ could be mapped on to and demonstrated using the IVY-matrix. For instance, the **Size-Time-Cost (STC) operator** refers to spectra nos. 2, 12, and 20. The STC operator is useful for *extreme contingency ("what if?") analysis*. The IVY-matrix indicates that *extreme contingency analysis* could be carried out for other dimensions, including those in TRIZs list of *39 engineering parameters*.

Like in the *patterns (laws/trends) of technological evolution*, TRIZs extended **"level design"** or **"stepwise heurithm"**[35] could be depicted on the IVY-Matrix. Thus, fantasy ploys such as in science fiction could be developed using the IVY-Matrix. An advantage of the IVY-Matrix is that a user could develop templates or story plots other than the one presented in the *extended heurithm*. This use of the IVY-matrix could encourage *creative visualization* as well as *improbable thinking* and consequently, reduce *psychological inertia* in problem solving and creativity.

---

[35] According to Salamotov (1999), TRIZs original "level design" or "stepwise heurithm" consists of four levels. In Salamotov (1999), this heurithm is extended to nine levels.

Table 6: IVY-Matrix of bipolar variables, dimensions, and criteria

Name of system ("object"): ……………………………………………………….

Main function(s)/objective(s): …………………………………………………….

Supersystem(s): ……….………………………………………………………….

No.	**Bipolar Variable**	**Anti-[Dimension]: - 8**	**Nothing: Neutral/ 0**	**[Dimension]: + 8**		
				Low	**Medium**	**High/ Extreme**
1	Quantity (Number/ Amount): *bidirectional*	*Negative; indebted*	*None; no*	*One; mono-; bi-; few*	*Several; multi-*	*Multitude; multi-; poly-; ubiquitous; myriad*
2	Size (3-DSpace/ Scale): *bidirectional*	*Anti-matter*	*Nothing; invisible; void*	*Micro-; nano-; atomic; molecular*	*Meso-; average*	*Macro-; mega-; giga-; galactical*
3	Efficiency	*Anti-efficiency*	*No value added; 100% waste*	*Low efficiency; high waste*	*Moderate or average efficiency*	***High/infinite efficiency; closed (self-contained); complete recyclability; 0% waste***
4	"Automaticity"	*Anti-automaticity*	*Human-operated/ contact*	*Mechaniza-tion*	*Moderately mecha-nized; semi-automatic*	***Fully automatic; machine-operated; self-operating; self-working; no contact***
5	Conflict/ Contradiction	*Anti-conflict/ contradiction*	***Friction-less; no conflict; Peace***	*Minor conflict, contradiction, or dilemma*	*Moderate conflict, contradic-tion, or dilemma*	*Major conflict; all-out or perpetual war*
6	Unity/ Integration/ Structure	*Anti-unity/ integration/ structure*	*Stone-heap-unity; separated; discrete*	*Chain-unity; linear; open; weak integration*	*Tree-unity; non-linear; nested; stacked; hierarchical*	***Web- or network-unity; closed; net-worked; total integration***
7	Simplicity	*Absolutely complex*	*Complex; convoluted*	*Barely simple*	*Moderately simple*	***Absolutely simple***
8	Variety: *bidirectional*	*Anti-variety*	*Completely homoge-neous or symmetri-cal; rigid; complete standardi-sation; no degree of freedom; Oblique*	*Low degree of freedom; High standardisa-tion*	*Moderate degree of freedom or variation*	*Completely heterogeneous or asymmetri-cal; absolute degree of freedom or variation; No standardisa-tion; extremely modularised or flexible*

9	Beauty/ Ergonomics	*Ugly; shocking*	*Plain; unadorned*	*Mono-chrome*	*Modera-tely beautiful*	***Multi-coloured; awesome***
10	Identification/ Detection/ Branding: *bidirectional*	*Anti-identifi-cation/ detection/ branding*	*Incognito; invisible; transparent*	*Plain*	*Conspi-cuous; selectively recognised*	*Globally recognised; glaring*
11	Versatility	*Anti-versatility*	*Nowhere; punctiform*	*1-D; 2-D; uni-, bi-lateral*	*3-D; multi-lateral*	***Multi-lateral; ubiquitous***
12	Time (Speed): *bidirectional*	*Reversal of time; past*	*Instanta-neous; stationary; present*	*Momentary; Slow; birth*	*Fast; growth*	*Speed of light; future; maturity*
13	Function	*Anti-functional*	*Dys-functional*	*Mono-, bi-functional*	*Multi-functional*	***Multi-, poly-functional***
14	Material/ Substance/ Physical State	*Anti-matter*	***Gas; vacuum; field; void; wave***	*Liquid; soft; foam*	*Elastic; plastic; porous; gel powder*	*Solid; hard*
15	Orderlinesss: *bidirectional*	*Perfect chaos; high entropy or asymmetry*	*Chaos; entropy*	*Low order*	*Interme-diate order*	*Perfect order; no entropy; perfect symmetry*
16	Flexibility	*Anti-flexibility*	*Monolithic; rigid; jointless; No joint*	*Soft; Single/double-jointed*	*Softer; Multi-jointed*	***Extremely flexible or mobile; fluid***
17	Vibration: *bidirectional*	*Anti-resonance*	*No frequency or periodicity*	*Pulsating; small amplitude or oscillation*	*Average periodicity*	*High resonance; large frequencies*
18	Weight	*Counter- or anti-gravity*	***Weight-less***	*(Ultra) light*	*Heavy*	*Quasar-like*
19	Energy (Power):input	*Potential*	***None***	*Least;*	*Average*	*Maximum*
20	Cost	*Loss; debt*	***Free***	*Inexpensive; cheap*	*Expensive; cosly*	*Astronomical cost*
21	Safety	*Dangerous; risky*	*None*	*Low*	*Moderate*	***High***
22	Length (Width/thick-ness/ Height)	*Anti-linear dimension*	***None***	*Low*	*Average*	*Maximum*
23	Quality/ Advantages	*Anti-quality*	*None*	*Low*	*Moderate*	***Total***
24	Emotion: *bidirectional*	*Anti-emotion*	*None*	*Low*	*Moderate*	*Total*
25	Colour	*Anti-colour*	*None; invisible*	*Plain; mono-; bi-*	*Multi-*	***Whole colour spectrum***
26	Reality: *bidirectional*	*Anti-reality*	*None*	*Fictitious*	*Virtual; artificial*	*Physical; visceral*
27	Coordinates (Position)	*Anti-coordinates*	*None*	*1-D; 2-D*	*3-D*	***Multi-/poly-dimensional***
28	Environment: *bidirectional*	*Fictitious*	*Virtual*	*Inert*	*Quasi-physical*	*Physical*
29	Temperature: *bidirectional*	*Absolute zero*	*Zero; freez-ing point*	*Cold; room temperature*	*Hot*	*Extremely hot*
30	Form/Shape: *bidirectional*	*Anti-form/shape*	*Amorphous*	*Linear; geons; simple; 1D;2D*	*Hierarch-ical; 2D; 3D*	*Web; network; 2D; 3D*

Perhaps, the most valuable use of the IVY-matrix is with regard to **"object profiling."** Using the IVY-matrix, one could carry out horizontal and vertical profiling of products. The uses of *object profiling* include idea generation, benchmarking, and fantasy exploration.

Horizontal profiling deals with ascertaining the various "states" of a family of products on a chosen bipolar spectrum. *Horizontal profiling* often deals with "morphing" or transforming a singular dimension of an *object* and observing a new "dynamic" scenario containing the morphed or transformed *object*. Consequently, *horizontal profiling* bears some similarity with *extreme contingency (what if?)analysis.* The objective of each, however, is different. In *horizontal profiling*, one may consider a family of products, choose a "state" in the bipolar spectrum, and "plot" or describe categories of the dimension for the products. For instance, plotting the size of playing cards may reveal that "mega-" and "molecular" sizes of cards have not yet been produced! *Extreme contingency (what if?) analysis* is a type of sensitivity analysis.

Vertical profiling is carried out for a specific product item rather than a family of products and involves visually connecting cells of all spectra that describe the dimensions of the product. Some ideal states are highlighted in table 6 as embolded cells. A few dimensions have no unique ideal state.

Vertical profiling relates to *ideal benchmarking*, i.e., benchmarking an *ideal object*. From a product's vertical profile, one could determine how far the current dimensions of the product are from each ideal as well as determine alternative scenarios for evolution of the product. Also, the method of vertical profiling could be used for facilitating the formulation of *inventive problems* and design specifications for a product as well as *mission statements* for organisations. In generating ideas for product development, the maxim of "novelty before utility or justification" is recommended. In other words, "modify object's state or form before reviewing advantages, functions, properties, or opportunities of emergent object."

TRIZs eight **"patterns (laws/trends) of technological evolution"** could be summarised as **meta-patterns** using variables from the IVY-matrix. Table 7 shows categories of *meta-patterns* for *patterns of technological evolution*. Some meta-patterns refer to single variables like quantity and time while others combine two or more variables. Table 7 contains seven *meta-patterns*. Two patterns of evolution, which have similar descriptions and expected final results, are classified under the *conflict meta-pattern*.

Table 7, in particular expected final results (EFRs), could be used to develop heuristics for generating ideas on product development. A possible heuristic for the *quantity meta-pattern* is: "Change to, consider, or introduce *bisociation* of subsystems, elements, or parts." For the *conflict meta-pattern*, a heuristic might be: "Change to, consider, or introduce a contradiction between parts, subsystems, or elements."

Table 7: Summary of existing patterns for technological evolution of systems

Name of system ("object"): …………………………………………………………

Main function(s): …………………………………………………………………..

Supersystem(s): ……………………………………………………………………

Meta-pattern (Bipolar variable #)	**Pattern of technological evolution**	**Expected Final Result (EFR)**
QUANTITY (#1) Meta-pattern	From system to *("bisociated")* sub-system	"Bisociated" subsytem, element, or part
SIZE (#2) & FORCE/FIELD (#27) Meta-pattern	Transition from macro-system to (field-based) micro-system	(Micro-) system using fields
AUTOMATICITY (#4) Meta-pattern	Decreasing human involvement with increasing automation	Automatic system
SPEED (#12B) & AUTOMATICITY (#4) Meta-pattern	Increasing dynamism and controllability	Dynamic and automatic system
CONFLICT (#5A) Meta-pattern	Uneven development of subsystem (*"lifecycle of parts or elements"*)	Contradiction between subsystems, elements, or parts
CONFLICT (#5B) Meta-pattern	Matching and mismatching of parts	Contradiction between parts, subsystems, or elements
SIMPLICITY (#7) & UNITY/INTEGRATION/ STRUCTURE (#6) Meta-pattern	From complexity through simplicity to integration	Simple and integrated system
TIME (#12A) Meta-pattern	Lifecycle curve of system and supersystem (*"global" lifecycle*)	Matured/declining system; rebirth/ Next-generation

The **evolution of technical systems**, which is presented in graphical (network) form in classic TRIZ, is presented below as a matrix of meta-patterns in table 8. For examples on the *evolution of technical systems* in classic TRIZ, see Savransky (2000, p. 116) and Salamotov (1999, p. 193).

Meta-patterns in table 8 relate to variables in TRIZs *evolution of technical systems* as well as those in the IVY-matrix. It may be noted from table 8 that TRIZs *evolution of technical systems* does not explicitly describe bi-functional states. Also, the primary progression of a system is from a *quantity meta-pattern* to a *simplicity meta-pattern*. There seems to be a logical inconsistency in this scale of progression. Table 8 may be used as a template for documenting states in the evolution of technical systems as well as for generating ideas for technological forecasting.

Table 8: Expected Final Results (EFR) in evolution of technical systems

Name of system ("object") : …………………………….………………………..

Main function(s): ……………………………………………………………...

Supersystem(s): …………………………………………………………...

Quantity & Simplicity Meta-patterns Quantity, Function, & Variety Meta-patterns	Quantity Meta-pattern			Simplicity Meta-pattern
	1. Mono-system	**2. Bi-system**	**3. Poly-system**	**4. Complexity**
.1 Mono-functional	1 *(details are not available)*	2.1	3.1	4 *(details are not available)*
- Homogeneous		2.1.1 *(go to 2.3)*	3.1.1 *(go to 3.3)*	
- Biased characteristics		2.1.2 *(go to 2.3)*	3.1.2 *(go to 3.3)*	
.2 Multi-functional		2.2	3.2	
- Heterogeneous		2.2.1 *(go to 2.3)*	3.2.1 *(go to 3.3)*	
- Inverse		2.2.2	3.2.2	
.3 Partially convoluted		2.3	3.3	
.4 Mono-Supersystem		2.4 *(go to 4)*	3.4 *(go to 4)*	

5.7 ObjectBots and the Scene-Transformation Matrix

<u>ObjectBots</u>

The concept of "**objectBots**" has its roots in *PAO thinking*™, *IVY-paradigm, TRIZs modelling of miniature dwarves (smart little people*), and *(molecular) robotics*. An o*bjectBot* could be an IVY-object and is related to the following TRIZ-derived concepts*: SITs* "inanimate particles"; *USITs* "magic particles", and Savransky's "agents." TRIZs concept of *miniature dwarves,* which is based on personal analogy models in the creativity technique of **Synectics**, is useful for reframing a given problem. Often, an *object* of focus is replaced by *miniature dwarves* that possess multi-dimensional characteristics and behaviour that would lead to solution of a problem. In some cases, emergent functions in the solved problem may be transferred to the original *object* of focus. *ObjectBots* are useful for reducing *psychological inertia* in problem solving.

In *PAO thinking*™, an *object* refers to both tangible and intangible items. An *objectBot* is synonymous with an *object* and could be regarded as a "gimmick" for problem solving. An *objectBot* may be represented by a symbol, "x." It could be of any size – from molecular to galactical – and could ideally perform any desired function. An *objectBot* could be animate and have magic-like properties. The *IVY-matrix of bipolar variables, dimensions, and criteria* could be used to select a range of properties and orders of magnitude (scales) for specific *objectBots*.

The behaviour of *objectBots* is governed by a set of bipolar tenets:

(i) **The logic of IVYality**, i.e., Ideality, Versatility, and "Ympossibility."
An objectBot could be an IVY-object and therefore have ideal, versatile, and apparently impossible properties.

(ii) **Laws of conservation of energy (matter) and momentum**.
Energy (matter) can neither be created nor destroyed.

The total momentum of an objectBot in motion is constant.

From both tenets above, one could say that the working space of an *objectBot* ranges from the mundane through cutting-edge (undiscovered) technology to "probable impossibilities." The first tenet indicates that an *objectBot* could be anything and have any desired property or behaviour. The second tenet, in particular the *law of conservation of energy (matter)*, is a constraint and ensures that *objectBots* operate within known physical worlds, even though they may behave magically. A problem solver should therefore account for the existence, introduction, transformation, and removal of all *objectBots* in a system.

Ideally, *objectBots* should already exist or be obtained through replacement or transformation of existing resources in the system, or be freely available. In other words, closed (self-contained)-system solutions should be sought when using *objectBots* to solve problems. Ideal solutions in a given system are obtained when *objectBots* in open and closed-system solutions transfer their emergent functions, properties, and parameters to elements of the given system.

ObjectBots are useful for typifying *objects*. For instance, *objects* which produce undesirable effects could be described as "**villainBots**." In contrast, objects that experience deleterious effects could be described as "**victimBots**." An advantage of such classification is that, like in *problem archetypes*, a set of corresponding strategies could be developed to deal with particular classes of *objects*.

Any item could be perceived as and translated to an *objectBot* by attaching the suffix "-Bot" to a description of the item. Thus, for analysis using the *IVY-template*, we may have "materialBots", "FieldBots", "ForceBots", "ToolBots", and "IVY-Bots"[36].

For problem solving involving processes in physical systems, the following *objectBots* may be useful: "bodyBots"[37]; "manualBots"; "mechanicalBots"; "biologicalBots"; "thermalBots"; "electricalBots"; "chemicalBots"; "acousticBots"; "opticalBots"; "magneticBots"; "nuclearBots." Any ideal state or *Ideal Final Result (IFR)* could be achieved by a system of *objectBots*.

ObjectBots are also useful for conceptually analysing "Scene-Transformation Matrices." The next section discusses the tool of *Scene-Transformation Matrix*.

---

[36] An "IVY-Bot" is a powerful concept for innovative product design and technological forecasting. Artefacts generally evolve towards an *IVY-object*. Thus, using an *IVY-Bot*, which is a self-contained, self-organising, self-informative, self-regulating, and versatile *object*, could facilitate the solution of "impossible" problems as well as the generation of many interesting and novel options.

[37] "Body" as in "bodyBot" is used in a similar sense as in physics. A *bodyBot* may have any size, be mobile, and have volition. A *bodyBot* could therefore act like and be human but is not restricted to the human species. *BodyBots* may also be entirely inorganic. Consequently, the concept of a *bodyBot* subsumes that of TRIZs *miniature dwarves* and SITs *inanaimate particles*. To reduce *psychological inertia* in problem solving, the generic but vague description of *objectBots* could be replaced by *bodyBots*, which are represented by a symbol of a circle on top of a rectangle. This representation facilitates modular arrangements of *bodyBots.*

<u>Scene-Transformation Matrix</u>

A **scene-transformation matrix** refers to a table that contains not only multiple visio-verbal scenes or scenarios arranged in a timeline but also descriptions of key assumptions and possible solution-paths for attaining a desired result in the future. *A scene-transformation matrix* is essentially non-linear and solution-paths could be obtained by combining scenes from different "epochs" or time-bands. The simplest form of a *scene-transformation matrix* is a **storyboard**[38]. A classic storyboard, especially for final presentation, shows scenes in a row or sequence, i.e., one solution-path for the unfolding of an event. In contrast, a *scene transformation matrix* may show multiple solution-paths for an event.

The template for a *scene-transformation matrix* is shown in table 9. A *scene-transformation matrix* may serve the following purposes:

- Presentation of scenes, scenarios, or strategic action plans in a timeline; illustration of a storyline
- Visual conceptual (strategic) problem solving, including change analysis for personal and business development as well as explanation of how things work in time
- Idea generation and object (product) design, especially those based on *ideal objects* or *IVY-products*
- Illustration of the evolution of a product or system
- Tool for *scenario learning*[39], especially using *IVY-final results* from the *IVY-matrix of bipolar variables, dimensions, and criteria*
- Illustration, exploration, and analysis of *change patterns* in Neuro-Linguistic Programming (NLP)
- As an *object* on an IVY-template

Although the *scene-transformation matrix* may be used for many purposes, this article focuses on using a *scene-transformation matrix* for conceptually solving problems and/or inventing *objects*. This use of the matrix is similar to TRIZs graphic use of *miniature dwarves* and *USITs* **morph cartoons**. While TRIZ and *USIT* use the "And/or Tree" to generate ideas, Ideal SuperSmart™ Learning uses **CreaLogical Object-FieldBot Analysis** *and Structured Intuition, Analysis, and Reflection (SIAR).*

[38] See, for example, Forsha (1995).
[39] For more information on scenario learning, see Fahey & Randall, (eds.) (1998).

Table 9: Template for scene-transformation™ matrix

Item	**Past Scene(s)**	**Present Scene(s)**	**Future Scene(s)**		
			Short-term	**Medium-term**	**Long-term/ Ideal**
STORYBOARDS (Multi-level/strata)					
KEY ASSUMPTIONS - Materials/ Substances - Tools - Fields/ Forces - Multi-level Resources - Miscellaneous					
NARRATIVE (DESCRIPTION) OF ALTERNATIVE SOLUTION-PATHS					
MISCELLANEOUS					

When a scene-transformation matrix is used for conceptual problem solving or design, scenes may be sketched for initial (present) and end (long-term) situations of the system, like in the graphic method for *miniature dwarves* and *morph cartoons*. The end, desired, or long-term situation may be a sketch of the *Ideal Final Result (IFR)*. Adjacent scenes on a timeline – past and/or medium-term – may then be inserted in cells of the scene-transformation matrix. Next, consecutive scenes are examined and the differences marked using an "x."

Each difference indicates a change in position, materials, and/or equilibrium of forces. Such changes are referred to as **changeBots** and may involve the use of existing *objectBots* (*bodyBots*) as well as the introduction, transformation, and removal of *objectBots*. Introduced *objectBots* are also represented using an "x", while removed or redundant *objectBots* are represented using a strike-through symbol (-) on the symbol "x".

Like in TRIZs *Substance-Field model*, *creaLogical object-fieldBot analysis* assumes that *materialBots* and *fieldBots* (*forceBots*) are the fundamental causes of changes in scenes. *MaterialBots* may be represented using a circle on top of a rectangle (as for *bodyBots*) and *forceBots* using arrows.

In a *scene-transformation matrix*, *forceBots* are introduced within the framework of **Newton's laws of motion**. Of particular use is *Newton's third law of motion*, which could be interpreted as: "To every action (*forceBot*), there is an equal and opposite reaction (*forceBot*)." Thus, the *forceBots* in each scene should be in equilibrium.

Scenes are visually analysed using the *logic of IVYality* as well as *the laws of conservation of energy (matter) and momentum*. *BodyBots* and *materialBots* could therefore acquire "magical" properties that obey physical laws. The magical properties of *materialBots* may be described as "technologically highly advanced." The aforementioned statement is a reflection of Arthur C. Clarke's statement: "Any sufficiently advanced technology is indistinguishable from magic."

For conceptual problem solving using *the scene-transformation matrix*, the following questions may be useful:

- What are the initial (present) and end (desired/long-term/ideal) scenes?

- What are the other scenes, past and/or medium-term?

- What are the basic assumptions for *materialBots* (*bodyBots*), *forceBots*, interfaces (connection/joints), and multi-level resources in each scene?

- What are the changes between consecutive scenes?

- What do the changes or *changeBots* represent?

- What *fieldBots* (*forceBots*) and *materialBots* are responsible for these changes? How could *forceBots* and *resourceBots* be introduced to cause the changes?

- What (side) effects, in terms of forces and materials, are caused by the *materialBots* and *forceBots*? And how?

- What (ideal) properties as well as parameters of *materialBots*, *forceBots,* and *resourceBots* are required to cause desired changes as well as side effects?

- How to introduce, transform, remove, and neutralise *materialBots* and *forceBots*, especially those that are undersired?

- To what other transformation-events, situations, or patterns could selected solution-paths be applicable?

5.8 CreaLogic

"CreaLogic" is a concept I developed for classifying *objects* according to certain criteria of equivalence or coherence. *CreaLogic* is strongly related to the *principle of object equivalence*. *CreaLogic* may be used to multi-dimensionally improve one's perception of situations and *objects* as well as to explain instances of sudden insight and breakthrough thinking.

It is my experience that many creative insights that appear logical in hindsight reflect the concept of *creaLogic*. For example, Kekule's discovery of the benzene molecule as a result of an alleged reverie is more convincingly explained using "bisociation" and *creaLogic*. The discovery is a case of "morphoLogic", i.e., the equivalence of shapes (a snake biting its tail & a "ring"), that occurred after Kekule had implicitly established the criteria for the structure of the benzene molecule.

MorphoLogic is a category of *creaLogic*. Common categories of *creaLogic* are stated below:

- **MorphoLogic:** similarity and equivalence of shapes (forms), e.g., number-shape system for mnemonics; ambigrams; fractals; topological shapes; digits/letters-parts of human face; visual metaphors; "impossible" objects; metonymies; icons.

- **StructurLogic:** similarity and equivalence of structure, e.g., Noam Chomsky's "phrase-structure" template; object-templates; isomorphic objects.

- **FunctionLogic:** similarity and equivalence of functions, meanings, or uses; this is often the basis of symbolic logic or rationality. Examples are mathematical equations and formal scientific proofs; synonyms; similar functions of artefacts; functional metaphors; abbreviations.

- **AuraLogic:** similarity and equivalence of sounds, e.g., puns; rhymes; number-sound system for mnemonics.

- **KinesLogic:** similarity and equivalence of movements, e.g., sign language; digit-letter system for mnemonics; equivalence in kinetic paradoxes.

- **SynaesLogic:** similarity and equivalence between different sensory representations or forms of *creaLogic*, e.g., synesthesia; logograms; nomograms or Root-Bernsteins' pictograms (equivalence between a picture/shape and a word); concrete poetry (equivalence between a picture/shape and sentences/paragraphs).

- **MisceLogic:** similarity and equivalence of the miscellaneous, e.g., *temporaLogic*, *spatioLogic*, and *colourLogic*.

The concept of *creaLogic* may share some similarities with "analogic" (Holyoak & Thagard, 1996) and Ulam's "metalogic" (Root-Bernstein & Root-Bernstein, 1999). Like in analogic, creaLogic – especially *morphoLogic*, *auraLogic*, and *kinesLogic* – may be innate and intuitive. Holyoak & Thagard state that, "[A]ll vertebrates have implicit knowledge of similarity and can make use of it to react adaptively to their environments."

Related to the concept of *creaLogic* are isomorphism (which refers to both *morphoLogic* and *structurLogic*) and Holyoak & Thagard's multiconstraint theory for interpreting analogies. In the language of *creaLogic*, the multiconstraint theory deals with *functionLogic* ("similarity" and "purpose") and *structurLogic* ("structure"). *CreaLogic* is also strongly related to "paoisms." Both *creaLogic* and *paoisms* facilitate "creative seeing", multi-level thinking, and knowledge transfer through analogies. And both could be used as tools for idea generation and creative exploration, especially if one decides to develop a thesaurus and dictionary of *creaLogic*.

5.9 Object-Templates

There are four basic types of structural templates: stone-heap, chain (linear), tree (hierarchical), and web (network)-templates; see item 6 in the IVY-matrix (table 6). Categories of descriptions for each of these templates include the following: visual, verbal, kinaesthetic, olfactory, and gustatory. Brief explanations of functions of the basic structural templates are given below:

- **Stone-heap-Templates:** for individual “objects”, i.e., discrete elements that appear not to relate to each other.
- **Chain-Templates:** for “objects” that are in a sequence or form a “chain.”
- **Tree-Templates:** for “objects” that are in a hierarchy or form a “tree.”
- **Web-Templates:** for “objects” that are in a network or form a “web.”

Object-templates may be used to classify objects and patterns as well as visually record, explore, and generate ideas in diverse domains. All node-link diagrams could be classified using the four templates. Examples of *object-templates* are shown in table 10.

As could be seen in table 10, *object-templates* exist in and could be applied to diverse domains. Mintzberg & van der Heyden (1999) note that the basic forms of organising business as well as the four **philosophies of managing** could be described as the **“set”, “chain”, “hub”, and “web.”** These concepts of organising and managing are respectively similar to the templates of *stone-heap, chain, hierarchy, and web*. Mintzberg & van der Heyden present their tool of **organigraphs**, which deal with visually presenting the structure and activities of organisations using the *set, chain, hub*, and *web*. According to Mintzberg & van der Heyden, *organigraphs* are far more useful than traditional organisational (hierarchical) charts.

The *principles of object equivalence and multi-polarity* could be used to draw several conclusions from table 10. For example, *objects* in a particular cell of the table could be considered equivalent so that one *object* could be transformed into another “equivalent” *object*. With regard to creativity tools and techniques, the classic mind map, fishbone diagram, toothache tree, and a table may be considered structurally equivalent. Consequently, information expressed in any of these forms could be converted to another equivalent form. Of course, there are advantages and disadvantages associated with each form with regard to the purpose, ease of use, and understanding. Another conclusion is that systems such as in writing and production generally evolve from chains through hierarchies to networks.

Table 10: Examples of object-templates

Structure Domain/Area	Stone-heap (Array) Templates	Chain (Linear) Templates	Tree (Hierarchical) Templates	Web (Network) Templates
LANGUAGE: Writing/ Speech	Unordered words, phrases, or sounds (written/spoken)/ Babble/Alpha-numeric data	Sentence; phrase; paragraph/ Musical scale/ Oral stories	Hierarchically ordered lists: table of contents; sections and sub-sections/ Chomsky's phrase-structure	Text with cross-references such as footnotes/ Semantic nets
DIAGRAMS/ VISUAL THINKING	Discrete points, dots, or nodes/ Array of "geons" (inventive parts)/ Set of object-templates/ Elements of "organigraphs"	Line (sequential combination of points)/ Paths or "open" shapes/ Step/Ladder/ Spectrum of colours/Arc/ Wave/Spiral	Tables/Matrices/ GridsGraphs (2D)/Tree diagrams: organisational charts; decision trees; tree of evolution/Strata, e.g., in pyramids/ "Chinese boxes"/ Octopus (sun) diagrams	Network diagrams: critical path analysis/Flow charts/Closed" shapes: rings or cycles/Gantt charts/Geogra-phical maps/ Venn diagrams/ Spider web
OBJECTS FOR RECORDING INFORMA-TION	Assorted paper, index cards, computer desktops/ Walls; ceilings/Tiles (magnetic)/Other artefacts/Body parts	Sequentially (alphabetical-ly) arranged objects: paper, files, or story-boards/Voice -recorder and player/Film	Literature (booklet or book) with sections and sub-sections but without cross-reference/Diary/ Calendar/Hier-archical (tree-) file managers	Literature with cross-references: encyclopedia/ Computer disk/ Hyper-linked documents/ Dice
CREATIVITY TOOLS & TECHNIQUES	Random objects: words; sentences; pictures; artefacts/Array of multiple perspectives: "Six colored eyes"; Six thinking hats™	Techniques with step-by-step (linear) procedures: SWOT analysis	Classic mind map/Fishbone diagram/ Toothache tree/ Lotus blossom diagram/ Techniques with tabular format: morphological table; force-field analysis/Repeat-ed abstractions:	Concept map/ Cognitive map/ Object-map/ Systems diagrams
MISCELLA-NEOUS	Peg mnemonic system/"Junk"/ Disparate objects/ Array of icons/ Randomly chosen objects, e.g., letters of (different) alphabets	Time/Link (journey/ place) mnemonic system/ Chain; stack; wave; stages; steps/Alpha-bet/Food chains	Periodic table/ Cellular organism/Nested portals or ovals/ Hierarchy of objects or creatures in a family/Spinal column	Web sites/ Cycles/Eco-systems/Neural networks/ Artefacts/ Organisms "Naturfacts"/ Food webs

6.0 RAPIDLY EVALUATING STRATEGIC (CONCEPTUAL) SOLUTIONS

There are many methods for evaluating alternative solutions to *open-ended problems*. Evaluation methods could be categorised as qualitative and quantitative. **Qualitative evaluation methods** are quick and relatively easy to use, especially for shortlisting and group evaluation of alternatives. Common qualitative methods include the following:

- intuition (aesthetic sensibility or visual inspection using binary categories such as impressive/not impressive; beautiful/not beautiful; acceptable/not acceptable)
- classification or sorting (using spider diagrams; grids; tables; affinity diagrams; sticking dots; clustering);
- voting or (experts'/peers') consensus on preferences
- checklist (using binary categories of yes/no; satisfied/not satisfied; symmetrical/asymmetrical)
- negative brainstorming
- critical analysis (advantages/disadvantages; SWOT: Strengths/Weaknesses/Opportunities/Threats; force field: forces for/forces against)

The rating scales for qualitative evaluation are mainly nominal and ordinal. In qualitative evaluation, objectives are usually subsumed in the selection of rating scales, especially in critical analysis. This approach contrasts that of quantitative evaluation.

Quantitative evaluation methods use explicit objectives and criteria such as "zero- or minimum" variables (cost/energy/time/defect) on the one hand and "maximum or infinity-" variables (benefit/profit/quality/safety) on the other hand. Quantitative criteria are usually rated on ordinal and interval scales. In general, quantitative methods are more time-consuming than qualitative methods and therefore more applicable to shortlisted alternatives and the phase of detailed analysis. The most commonly used quantitative approaches belong to the category of multi-criteria methods. As the focus of this section is on rapidly evaluating conceptual solutions, quantitative approaches are not considered in detail.

Ideal SuperSmart™ Learning is primarily based on the objectives of *ideality*, *versatility*, and *impossibility*. Ideal SuperSmart™ Learning uses both qualitative and quantitative criteria. Archetypal or macro-criteria of Ideal SuperSmart™ Learning are based on the following *conditions of (practical) ideality*:

- *ideal ("functional") nothingness*, e.g., zero defect; zero tolerance; least effort; minimum energy; free (external) resource
- *ideal infinity*, e.g., total quality; infinite versatility; perfect information
- *ideal efficiency & automaticity*, e.g., maximum efficiency; self-containment[40]; self-organisation; self-regulation; self-working; self-operating; automatic
- *ideal conflict resolution & unity*, e.g., win-win; no trade-off or compromise; no conflict, contradiction, dilemma, or paradox; perfect unity, integration, or networking
- *ideal simplicity, variety, & beauty*, e.g., the most simple (Occam's razor); requisite variety; symmetry; beauty; asymmetry; elegance
- *ideal identification, detection, and branding*, e.g., universal recognition or branding

To rapidly classify and assess alternative solutions that are related to the objectives and criteria of Ideal SuperSmart™ Learning, the **IVY-pyramid of innovation** is presented; see table 11. This pyramid of innovation uses concepts from TRIZs *levels of inventions (solutions)* and Magaret Boden's *levels of creativity*[41]. The concepts of ideality, versatility, and impossibility are subsumed under **"Unusuality."** [42]

Like in TRIZs *level of inventions*, the IVY-pyramid of innovation has five levels. Thus, the IVY-pyramid could be directly related to *the levels of invention*. Unlike the levels of invention in TRIZ, categories in the IVY-pyramid reflect ordinal rather cardinal (empirical) relationships between levels.

[40] In Ideal SuperSmart™ Learning, *self-containment* implies having inputs, processing/functions, interfaces, and the environment operating as a single *IVY-object* or in a network of *unitary (all-in-one) space*.
[41] See Boden (1996). However, Boden categorises creativity as follows: Psychological (P) creativity and Historical (H) creativity. In the IVY-pyramid of innovation, P-creativity is occurs at level 1, while H-creativity occurs at level 5.
[42] "Unusuality" is synonymous with *IVYality*. It is important to note that TRIZs *level of invention* subsumes the concepts of *ideality* and *Ideal Final Result (IFR)*. In other words, as the *level of invention* increases so does the *level of ideality, efficiency, or IFR*. Products at level 1 display a low *level of invention (ideality)*, while products at level 5 display the highest *level of invention*.

Table 11: IVY-pyramid of innovation

Name of system ("object"):……………………………………………..……………..

Main function(s): …………………………………………………………………………

Supersystem (Family of products): ……………………..………………………...

Level of innovation	**Reference**	**Features of innovation**	**Circle of resources**
Level 1: Local "unusuality" or improbability	Closed-system solution(s)/ Mini-problems	Non-structural change (basic "CreaLogical" substitution); "cosmetic" progression; small quantitative changes and improvements; use of common domain ideas, tools, and technology; low-order or linearly predictable (1-D) emergent properties	Core domain; System
Level 2: Regional "unusuality" or improbability	Closed-system solution(s)/ Midi-problems	Minor structural change (intermediate "creaLogical" substitution); significant quantitative and qualitative changes; intermediate-order or surprising (2-D) emergent properties; Intermediate (rarer) tools and technology	Core domain; System
Level 3: National "unusuality" or improbability	"Extended" closed-system solution(s)/ Maxi-problems	Major, radical, non-linear structural change (advanced "creaLogical" substitution); Advanced, little known, or rarest domain-technology; largely unforeseen (3-D) emergent properties	"Extended" core domain; Extended system
Level 4: International "unusuality" or improbability	Open-system solution(s)/ Mega-problems	Emergent (bisociated/ hybrid/transition) system; cross-fertilisation or "bisociation" of tools, technology, and resources in apparently disparate domains	Peripheral domain(s); Super-system
Level 5: Global "unusuality" or improbability	Open-system solution(s)/ Giga-problems	Completely unforeseen (3-D) emergent properties; new invention or genus; paradigm shift; discovery or application of new ("original") principle or technology	Remote domain(s); New system

The IVY-pyramid of innovation in table 11 could be regarded as an inverted pyramid.[43] At level 1 is the base of the pyramid. Closest to the apex or vertex of the pyramid is level 5. The pyramid indicates that the highest levels of *unusuality* are obtained in **open-system solutions.** Nevertheless, **closed (self-contained)-system solutions** can also be strikingly unusual, especially those at level 3. Albert Einstein, the great physicist, is reputed to have said: “The significant problems we face cannot be solved at the same level of thinking we were at when we created them.” My interpretation of this comment is that if a problem in a *paradigm*[44] or closed system is intractable, then its solution would be found at a higher level or in a more open-system. In other words, solutions to intractable problems are likely to involve a *paradigm shift*. This interpretation is consistent with the evolution of solution-spaces in the IVY-pyramid of innovation.

In Ideal SuperSmart™ Learning, *objects* that move towards *ideality*, *ideal efficiency*, or level 5 would loop through the IVY-pyramid in a **spiral or dyadic cycle of closed- and open-system solutions**. A “first-time ever” solution or genus is initially regarded as a closed system at level 1. However, the system may have disadvantages, deficits, or undesirable side effects. The system is easily improved using core knowledge in the domain. Many and mostly superficial variants of closed-system solutions exist at levels 1 and 2. Variants of closed-system solutions, however, reach their limit or saturate at level 3 where available core domain ideas would have been exhausted. Nevertheless, the system may still have unresolved disadvantages, deficits, or side effects. Further improvements of saturated closed-system solutions may result in added complexity (*technical contradictions*) in other parts of the system; the situation is similar to that in a *wicked problem*. Rare core domain ideas and “limited” peripheral knowledge must therefore be applied. At level 4, a “knowledge impasse” is therefore imminent. Consequently, major breakthroughs in saturated closed-system solutions would require more external knowledge, which is likely to be available in peripheral domains.

As the complexity of saturated closed-system solutions increases, more refinements may be obtained by using little known or available knowledge, especially knowledge from remote domains. At full maturity and complexity of the solutions, further refinements are inefficient and the highest level solution – of which a *paradigm shift* is a prerequisite - may produce a next-generation object or genus which subsequently emerges at level 1. This cycle of closed and open-system solution is analogous to a product’s “extended” S-curve. Level 1 corresponds to the *birth* of a product; level 3 is the stage of *growth*; level 5 is *maturation*. If further improvements are not made to solutions at level 5 to obtain a contiguous S-curve, the product may “die” in time. This latter description corresponds to the decline and death phases of the life cycle curve.

---

[43] The structure of TRIZs level of solutions (inventions) is like an upside-down “bishop” piece in chess; the base at level 1 is flat, the intermediate levels are the broadest, and level 5 is the narrowest leading to a point.

[44] In Ideal SuperSmart™ Learning, a *paradigm* is regarded as a shared but closed system of coherent thoughts and assumptions, especially in a discipline.

The IVY-pyramid of innovation is both descriptive and normative. It could be used to describe, classify, and determine the level of innovation of single product, a family of products, system's outputs, generated ideas, and alternative solutions. The pyramid could also be used to "guesstimate" or forecast[45] next-generation solutions and consequently, gaps in the solution-space for improving a product or system. Thus, artefacts or products need not progress directly or sequentially through the pyramid. Finally, the IVY-pyramid of innovation could facilitate the finding of *inventive problems* and identification of *knowledge deficits* as well as the formulation of strategies for product development and system evolution.

[45] For an integrated approach to forecasting using tools of TRIZ, see for example, Ellen Domb's "Strategic TRIZ and Tactical TRIZ: Using the technology evolution tools" at http://www.triz-journal.com/archives/2000/01/e/index.htm

7.0 CONCLUSIONS

The Theory of Ideal SuperSmart™ Learning is many things to many people. To me, the Theory of Ideal SuperSmart Learning is like a "theory of everything" for personal, business, product, and institutional development. The Theory of Ideal SuperSmart™ Learning places "understanding" at the core of personal, business, product, and institutional development. At a personal level, the result of successfully applying the Theory of Ideal SuperSmart™ Learning should be a **"SuperSmart-understanding" individual**. At an institutional level, successful application of the theory should result in a **"SuperSmart-understanding" organisation**. At an operational level, the Theory of Ideal SuperSmart Learning could be regarded as a tool for uncovering as well as creating patterns for practical problem solving, creativity, and ideas management, much like in algebra. The Theory of Ideal SuperSmart™ Learning may also be considered as a multi-faceted learning approach.

The multi-methodology framework of the Theory of Ideal SuperSmart™ Learning facilitates the integration of tools for problem solving, creativity, and ideas management. In particular, the theory could be used to rapidly simplify and learn TRIZ as well as integrate TRIZ with other problem solving methodologies, for example using the *creative web – ARIZ framework*. The simplification of TRIZ is mainly obtained through deconstruction, restructuring, and generification of classic (C-) TRIZ, not through the elimination of parts of TRIZ. I have termed as "S-TRIZ" the combination of the Theory of Ideal SuperSmart™ Learning and classic TRIZ.

S-TRIZ is different from C-TRIZ in many ways. First, S-TRIZ does not depend on a technical knowledge base such as in a library of patents or detailed algorithms as in ARIZ. Thus, S-TRIZ could be more easily and rapidly applied to a wider range of situations, such as in product development, strategic management, and software development. Second, the epistemology of S-TRIZ is different from that of C-TRIZ. While C-TRIZ abhors the trial-and-error (experimental) approach to problem solving and creativity, S-TRIZ considers trial-and-error, in particular *selective trial-and-error*, as inherent in learning, creativity, and problem solving. The epistemology of S-TRIZ is therefore more suited to dealing with ill-defined or personally novel problems. In these latter cases, S-TRIZ advocates a structured intuition, analysis, and reflection approach (SIAR) as well as use of the *creative web*.

S-TRIZ is also a multi-level approach. On the one hand, S-TRIZ could be simple and provide an overview of TRIZ together with application of some basic tools. On the other hand, S-TRIZ could be deeper and provide a more comprehensive view of TRIZ, especially in combination with other methodologies. The use of a particular level of S-TRIZ depends on a user's expertise and demands of a problem situation.

The Theory of Ideal SuperSmart™ Learning could be used for conceptual as well as detailed problem solving and creativity. A user could select tools from the "menu" of tools and apply them to a given situation. However, for rapid problem solving, the following "quartet" of tools could be particularly useful: *IVY-template; IVY-matrix; SCAMPER-DUTION matrix; IVY-pyramid of innovation*. If a user is thoroughly familiar with heuristics and algorithms of problem solving or creativity, then only the IVY-template may be used within the framework of structured intuition, analysis, and reflection. The IVY-template also provides a framework for comprehensively managing ideas.

In this article, only one part of the cycle of the *PSLT game* is covered, i.e., *expository learning*. For completion of the basic learning cycle for the *PSLT game* as well as proficiency in the Theory of Ideal SuperSmart™ Learning or S-TRIZ, the modules of *problem-solving learning, experiential learning, and hierarchy of reflection* should be completed by a user, for example, by applying the tools to problems in real-life situations and reflecting on the process. More practical, theoretical, and reflective experiences on the Theory of Ideal SuperSmart™ Learning could be obtained by joining a learning community (network) at the following web site: www.supersmartnetwork.com.

The presentation of the Theory of Ideal SuperSmart™ Learning in this article places emphasis on a systematic (structured) approach to problem solving, creativity, and ideas management. In other words, I have focused on one end of the bipolar spectrum of learning. At the other end of the spectrum is an organic (unstructured) approach. The overall shape of s*ystematic creativity* is characterised by convergent thinking, while *organic creativity* focuses on divergent thinking, "chaos", and intuition. My experience is that both approaches are useful and should be accessible when solving problems. Using this bipolar approach which is espoused in the B.E.A.R strategy, I have managed to develop a software prototype that invents not only magic tricks but also humourous pieces, story plots, and aphorisms.

The more *ill-defined or wicked* a situation is, the less useful may be detailed systematic approaches. In an "impossible" or a "goalless" situation, *organic creativity* may be a most desirable option. The *creative web* could also be useful. However, as *organic creativity* is difficult to describe, I have summarised my experience of it in a poem below. So end my ruminations on the Theory of Ideal SuperSmart™ Learning.

THE MAGIC OF ORGANIC CREATIVITY

You are in the jungle.
You are walking.
But you don't know exactly where you are going.
You are searching.
But you don't know exactly what you are looking for.
Meanwhile, you're gathering, picking up, discarding, and carrying forward pieces, pieces of an unknown jigsaw puzzle.
Perhaps, a 1050-piece Photomosaic Jigsaw Puzzle.
Some pieces may in fact not relate to the final picture.
But you're unaware of this.
You continue your blind adventure,
roaming, picking up, discarding, carrying forward, and rearranging pieces.
Suddenly, you realise that you've formed a novel, harmonious, beautiful but rough picture.
You smile to yourself, "Aha! That's it!"

That's Organic Creativity!
It's fun, it's mysterious, it's magic, and
it's a joy!

REFERENCES

Alexander, C. (1979) *The Timeless Way of Building*. New York: O.U.P.

Altshuller, G. (1996) *And Suddenly the Inventor Appeared*. Massachusetts: Technical Innovation Center.

Barker, J.A. (1993) *Paradigms*. New York: HarperBusiness.

Barrow, J.D. (1999) *Impossibility*. London: Vintage.

Barrow, J.D. (2000) *The Book of Nothing*. London: Jonathan Cape.

Biggs, J. (2000) *Teaching for Quality Learning at University*. Buckingham: Open University Press.

Boden, M. (1996) *The Creative Mind*. London: Abacus.

Bowman, C.F. (ed.) (1996) *Wisdom of the Gurus: A vision for object technology*. New York: SIGS.

Bransford, J.D.; Stein, B.S. (1984) *The IDEAL Problem Solver*. New York: W.H. Freeman and Company.

Brockbank, A.; McGill, I. (1998) *Facilitating Reflective Learning in Higher Education*. Buckingham: SHRE & Open University Press.

Buzan, T.; Buzan, B. (2000) *The Mind Map Book*. London: BBC Books.

Campbell, J. (1993) *The Hero with a Thousand Faces*. London: Fontana.

Checkland, P. *Soft Systems Methodology in Action* in: Rosenhead, J.; Mingers, J. (eds.) (2001) *Rational Analysis for a Problematic World Revisited: Problem structuring methods for complexity, uncertainty, and conflict*. West Sussex: John Wiley & Sons, Ltd, pp. 91-113.

Clarke, T.; Clegg, S. (2000) *Changing Paradigms: The transformation of management knowledge for the 21st century*. London: HarperCollinsBusiness.

Cowan, J. (1998) *On Becoming an Innovative Teacher*. Buckingham: SHRE & Open University Press.

Covey, S. (1999) *The Seven Habits of Highly Effective People*. London: Simon & Schuster UK Ltd.

Dawkins, R. (1988) *The Blind Watchmaker*. London: Penguin Books.

De Bono, E. (1994) *De Bono's Thinking Course*. London: BBC Books.

De Bono, E. (1995) *Serious Creativity*. London: BBC Books.

Delp, P.; Thesen, A.; Motiwalla, J.; Seshadri, N. (1977) *Systems Tools for Project Planning*. Indianna: PASITAM.

Domb, E. (2000) *Strategic TRIZ and Tactical TRIZ: Using the technology evolution tools*. http://www.triz-journal.com/archives/2000/01/e/index.htm

Domb, E.; Dettmer, H.W. (1999) *Breakthrough Innovation in Conflict Resolution*. http://www.triz-journal.com/archives/1999/05/b/index.htm

Edwards, B. (1995) *Drawing on the Artist Within: How to release your hidden creativity*. London: HarperCollinsPublishers.

Eysenck, H.; Keane, M.T. (1999) *Cognitive Psychology*. Sussex: Psychology Press.

Fahey, L.; Randall, R.M. (eds.) (1998) *Learning from the Future*. New York: John Wiley & Sons, Inc.

Fisher, R.; Ury, W. (1991) *Getting to yes: Negotiating an agreement without giving in*. London: Business Books Limited.

Fitzkee, D. (1989) *The Trick Brain*. USA: Lee Jacobs Productions Publication.

Forsha, H.I. (1995) *Show me: The complete guide to storyboarding and problem solving*. Wisconsin: ASQC Quality Press.

Goldratt, E.M. (1994) *It's Not Luck*. Hampshire: Gower.

Greenfield, T. (ed.) (2002) *Research Methods for Postgraduates*. London: Arnold.

Gross, R.; McIlveen, R. (1997) *Cognitive Psychology*. London: H & S.

Hall, L.M.; Bellnap, B.P. (2001) *The Sourcebook of Magic: A Comprehensive Guide to the Technology of NLP*. Carmathen: The Cromwell Press.

Heller, R. (2000) *Bill Gates*. London: Dorling Kindersley.

Hermann, K.R. (2001) *Visualizing Your Business*. New York: John Wiley & Sons, Inc.

Higgins, J.M. (1994) 101 *Creative Problem Solving Techniques*. Florida: The New Management Publishing Company.

Hirshberg, J. (1999) *The Creative Priority*. London: Penguin Books.

Holyoak, K.J.; Thagard, P. (1996) *Mental Leaps: Analogy in creative thought*. Massachusetts: The MIT Press

Horowitz, R. (2001) *ASIT's Five Thinking Tools With Examples*. http://www.triz-journal.com/archives/2001/09/b/index.htm

Horowitz, R.; Maimon, O. *Creative Design Methodology and the SIT Method* in: Proceedings of DETC '97 – 1997 ASME Design Engineering Technical Conference. Sacramento: September 14-17, 1997.

Jones, J.C. (1980) *Design Methods*. Bath: The Pitman Press.

Kelly, T.; Littman, J. (2001) *The Art of Innovation*. London: HarperCollins.

King, R. *Synthesis and Evaluation of Creativity* in: Greenfield, T. (ed.) (2002) *Research Methods for Postgraduates*. London: Arnold, pp. 126-136.

King, R. *When to use Creativity* in: Greenfield, T. (ed.) (2002) *Research Methods for Postgraduates*. London: Arnold, pp. 121-125.

Koestler, A. (1971) *The Art of Creation*. London: Pan Books Ltd.

Koestler, A. (1976) *The Ghost in the Machine*. London: Hutchinson & Co. Ltd.

Kolb, D.A. (1984) *Experiential Learning*. New Jersey: Prentice Hall, Inc.

Kovalick, J. (1997) *Altshuller's Greatest Discovery – And Beyond*. http://www.triz-journal.com/archives/1997/08/a/index.html

Kovalick, J. (1998) *Triads: Their Relationship With TRIZ*. http://www.triz-journal.com/archives/1998/06/a/index.htm

Kuhn, T.S. (1996) *The Structure of Scientific Revolutions*. Chicago: The University of Chicago Press.

Laurillard, D. *The Changing University*. The Open University. http://itech1.coe.uga.edu/itforum/paper13/paper13.html

Majaro, S. (1991) *The Creative Marketer*. Oxford: Butterworth-Heinemann.

Mann, D.; Stratton, R. (2000) *Physical Contradictions and Evaporating Clouds*. http://www.triz-journal.com/archives/2000/04/b/index.htm

Mann, D. (2001) *Systems Operator Tutorial 1) 9-Windows on the World.* http://www.triz-journal.com/archives/2001/09/c/index.htm

Mann, D. (2001) *Systems Operator Tutorial 2) Between the Boxes – Changing Perspectives.* http://www.triz-journal.com/archives/2001/11/b/index.htmMichalko, M. (1998) *Cracking Creativity*. California: Ten Speed Press.

Michalko, M. (1998) *Thinkertoys*. California: Ten Speed Press.

Mintzberg, H.; van der Heyden, L. *Organigraphs: Drawing how companies work* in: Harvard Business Review, September – October 1999, pp. 87-94.

Morgan, G. (1997) *Images of Organization*. California: Sage Publications, Inc.

Nader, G.; Hibino, S.H.; Farrell, J. (1999) *Creative Solution Finding*. California: Prima Publishing.

Popper, K. *The Logic and Evolution of Scientific Theory* in: Popper, K. (1999) *All Life is Problem Solving*. London: Routledge.

Root-Bernstein, R.; Root-Bernstein, M. (1999) *Sparks of Genius: The 13 thinking tools of the world's most creative people*. New York: Houghton Miffin Company.

Rosenhead, J.; Mingers, J. (eds.) (2001) *Rational Analysis for a Problematic World Revisited: Problem structuring methods for complexity, uncertainty, and conflict*. West Sussex: John Wiley & Sons, Ltd.

Salamotov, Y. (1999) *TRIZ*. Hattem: Insytec B.V.

Savin-Baden, M. (2000) *Problem-based Learning in Higher Education*. Buckingham: SRHE & Open University Press.

Savransky, S.D. (2000) *Engineering of Creativity: Introduction to TRIZ methodology of inventive problem solving*. Florida: CRC Press.

Schön, D.A. (1983) *The Reflective Practitioner*. USA: Basic Books.

Schön, D.A. (1987) *Educating the Reflective Practioner*. USA: Basic Books.

Schragenheim, E. (1999) *Management Dilemmas: The Theory of Constraints approach to problem identification and solutions*. Florida: CRC Press.

Senge, P.; Kleiner, A.; Roberts, C.; Ross, R.B.; Smith, B.J. (1999) *The Fifth Discipline Fieldbook*. London: Nicholas Brealey Publishing.

Sickafus, E.N. (1997) *Unified Structured Inventive Thinking*. Michigan: NTELLECK.

Siler, T. (1997) *Think Like a Genius*. London: Bantam Press.

Simon, H.A. (1998) *The Sciences of the Artificial*. Mass.: The MIT Press.

Slywotzky, A.J.; Morrison, D.J.; Moser, T.; Mundt, K.A.; Quella, J.A. (1999) *Profit Patterns: 30 Ways to anticipate and profit from strategic forces reshaping your business*. West Sussex: John Wiley & Sons, Ltd.

Sternberg, R.J. (ed.) *Handbook of Creativity*. New York: C.U.P.

Taylor, D.A. (1992) *Object-oriented Information Systems*. New York: John Wiley & Sons, Inc.

Von Oech, R. (1992) *A Whack on the Side of the Head/Whack Pack.* California: Creative Think.

Wallas, G. (1926) *The Art of Thought* in: Vernon, P.E. (ed.) (1970) *Creativity*. Middlesex: Penguin Education, pp. 91-97.

About the author

Dr. Rodney K. King

www.supersmartnetwork.com

r.k.king@supersmartnetwork.com

* Meta-inventor
* Inventor/Author of many items including the following:
  Theory of Ideal SuperSmart™ Learning;
  Versatile Thinking™ (including PAO Thinking™ and Versatile Map™);
  Six Colored Eyes
* Developer/Teacher of "S-TRIZ"
* Conjurologist
* Civil Engineer; Infrastructure Planner; Regional Development Planner
* Problem Solving, Creativity, and Ideas Management Consultant/ Facilitator