THE TRIZ-FRACTAL MODEL:
Part 2 – Using the TRIZ-Fractal Model For Functional Modelling and Visual Ideas Management

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INTRODUCTION

As the second part of the series on the TRIZ-Fractal Model, this article addresses the question: "How can the TRIZ-Fractal Model be applied?" There are many and diverse applications of the TRIZ-Fractal model. This article, however, focuses on using the TRIZ-Fractal model for **functional modelling** and **visual ideas management**. These applications have been selected since they illustrate the basic uses of the TRIZ-Fractal model.

BRIEF DESCRIPTION OF THE SITUATION FOR FUNCTIONAL MODELLING AND VISUAL IDEAS MANAGEMENT

The situation, which is a hypothetical one, is as follows:

It is required, using the TRIZ-Fractal model, to produce a "function-model" of a traditional hammer driving a nail into a wooden object. The modelling is a task in the context of a product improvement project, which has commenced because of an increasing number of injuries to the hand is being reported by Do-It-Yourself (DIY) hobbyists using the hammer.

USING THE TRIZ-FRACTAL MODEL TO ILLUSTRATE THE SITUATION OF "HAMMER STRIKING A NAIL INTO A WOODEN OBJECT"

With regard to the existing situation, objects in the TRIZ-Fractal model are described as follows:

- **SYSTEM** (Product): Hammer
- **TOOL**: Hammer head
- **FUNCTION** (Operation): striking, hitting, or driving in
- **SUBSTANCE**: Nail (on wooden object)
- **FIELD (Energy)**: Mechanical (Compression/Kinetic)
- **ENVIRONMENT**: Person: arm, hand (fingers) etc.; Wooden object
- **FINAL RESULT**: Appropriately driven nail (into wooden object)
- **BENEFITS**: Attached wooden pieces
- **COSTS**: Possible injuries to hand
- **PARAMETERS**: Force; "Object-generated harmful factors"
- **ANALOGICAL SYSTEMS**: Pile; Bullet; Staple

The descriptions of the above objects are shown in the TRIZ-Fractal model in Fig. 1 as well as the matrix side of the Universal Thinksheet™ in Fig. 2. There is a "harmful interaction" between the tool (hammer head) and environment (person's hand/fingers).

Fig. 1: TRIZ-Fractal Model of: "HAMMER DRIVING IN NAIL (INTO WOODEN OBJECT)"

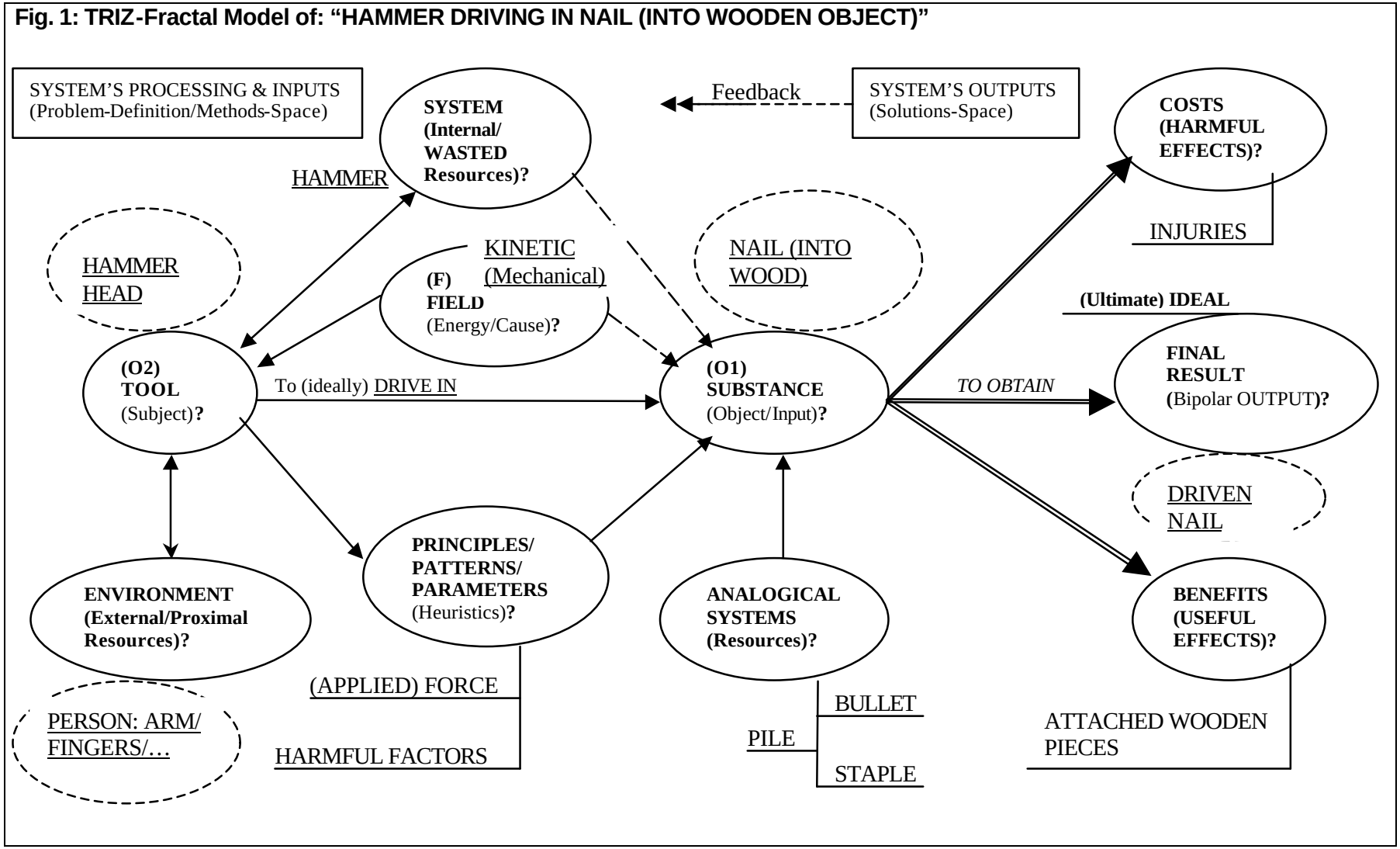

Fig. 2: Matrix Side of the Universal Thinksheet™ Showing Information on Situation of: "HAMMER DRIVING IN NAIL (INTO WOODEN OBJECT)"

Framework	*Processing 1*		*Input*	*Processing 2*	*System*	*Environment*		Output 1	*Processing 3*			*Output 2 (Effects)*	
Creative Web	Methods-Space 1		Problem Definition-Space	Methods-Space 2	*System*	Creative Life-Space (Life Cycle)		Solutions-Space 1	Methods-Space 3			Solutions-(Bipolar/Dialectical/Conflict-) Space 2	
Object/ "Thinking Hat"/ Theme/ Reference:	**P1: Principles/ Patterns/ Paradigms (Noun/Verb)**	**Disruption-Description: Adjective [(anti-) convention/ disruption/ vision]**	**O1: Substance/ Problem/ Constraint/ Target**	**O2: (Functionally equivalent) Tools/ Devices/ Means/ Strategies**	**O3: System(s)/ Elements/ Internal (WASTED) Resources**	**O3.1: Environment/ External or Proximal (PESTLIED/ Space/Time) Resources**	**O3.2: Switching/ Analogous or Anti-Objects/ Competing Typology**	**O4: Final Result (Technical/ Emotional Output)/ IVY-Object/ 8020-Result**	**P2: Parameters/ Attributes/ Variables/ Features/ (Un)changing Dependency**	**F: (Multi-level) Fields/ Causes/ Motivation (Subtext)**	**Verb1: (Positive; Negative; Neutral) Function/ Purpose/ Processing**	**O(+): Unexpected (Potential) Advantages - Strengths/ Opportunities/ Wins (Gains)**	**O(-): Unexpected (Potential) Disadvantage: Weaknesses/ Threats/ Losses**
Problem-definition Space/ Existing Situation	Inventory of system/ Functional decomposi-tion		Nail (into wooden object)	Hammer head	HAMMER: Hammer head/ Handle	Person: Hand (fingers)/arm Wooden object	Pile Bullet Staple	Appropriate-ly driven nail (in wooden object)	#10: Force #31: Object-generated harmful factors	Mechanical (Compre-ssion/ Kinetic)	Driving in/ Striking/ Hitting	Attached wooden pieces	Possible injuries to hand
Solutions-Space: INVENTIVE PRINCIPLES								**"Perfectly driven nail without hand injury"**				**Attached wooden pieces & no injuries to hand**	
Solution-Pole 1	#13: Other way round		Actions/ Properties								Reversing		
Solution-Pole 2	#3: Local quality		Local conditions								Optimising		
Solution-Pole 3	#36: Phase transition		Phase transition								Employing		
Solution-Pole 4	#24: Intermediary		Intermediary between finger & hammer head								Introducing		
INVENTIVE STANDARDS	*"Harmful Effects"*		Tool and/or Environmt.								Modifying		
SEPARATION HEURISTICS	"Separation in Space/Time"		Finger & hammer head in space/time								Separating		

COMMENTS ON MODELLING "HAMMER DRIVING NAIL" USING THE TRIZ-FRACTAL MODEL AND MATRIX SIDE OF THE UNIVERSAL THINKSHEET™

The situation of a hammer driving a nail into a wooden object is modelled using the TRIZ-Fractal model in Fig. 1 and on the matrix side of the Universal Thinksheet™ in Fig. 2. There are many uses of such **functional modelling**. The model in Fig. 1 could be used to explain fundamental concepts in TRIZ such as "tool"; "substance"; "field"; "substance-field analysis"; "ideality"; "ideal final result"; "patterns"; "principles"; "parameters"; "resources"; "self-X."

In Fig. 1, the principal system is the "hammer" and it may be generally said that it is the hammer that drives in the nail into the wooden object. However, this statement is not precise as it is the tool of the system, i.e., the hammer head that drives in or makes final contact with the nail. Thus, the link between the system and the substance is shown in dotted lines in Fig. 1.

The **minimal "complete" system** for realising the functionality of driving the nail into the wood consists of the classical triangle of Field-Tool-Substance: Mechanical Field (compressive kinetic energy) – Hammer head – Nail. If the field is omitted, we have an "incomplete" substance field. It is important to note that, in the absence of descriptions of the type of interactions between field, tool, and substance, the classic triangle of Field-Tool-Substance could be said to focus on the problem-definition space of the situation. Including interactions such as harmful effects, insufficient relationships, and excessive relationships superimposes the solutions-space on the classic Field-Tool-Substance or Substance-Field model. In the TRIZ-Fractal model, these problem-definition and solutions-spaces are physically separated.

The **ideal technical system** for driving in the nail would be a minimal system without a tool but with a field and substance. In terms of the hammer situation, the ideal system would consist of a mechanical field or kinetic energy driving the nail. A hammer head will not exist and consequently, there would be no harmful interaction between the tool (hammer head) and environment (person's fingers). This ideal technical system is shown as a dotted line between the field and substance in Fig. 1. Such an ideal system would produce the desired benefit with no cost or harmful effect.

It is important to note that the harmful effect or injuries could be eliminated by eliminating or completely neutralising the harmful interaction between the tool (hammer head) and the environment (person's fingers). A host of strategies including more guidance and control of the tool (hammer head) could be applied to make the negative interaction non-existent. TRIZs **Standard Solutions** provides a resource for eliminating harmful effects, while the **separation heuristics** may be used to eliminate physical conflict. However, the main targets of such solution strategies should be the tool (hammer head) and/or environment (person's fingers).

Fig. 1 also shows "(applied) force" and "object-generated harmful factors" as significant **parameters** of the tool and system. These parameters are related to the **Contradiction Matrix**: the *improving feature* is the force while the *worsening feature* is object-generated harmful factors. Consequently, **inventive principles** could be obtained for eliminating the harmful effects. As Fig. 1 involves modelling the existing/problem situation, it is best to present relevant inventive principles in another TRIZ-Fractal model that focuses on solution-modelling.

Systems that are analogous to the substance (nail) are recorded in Fig. 1. **Analogous systems** to a nail include a pile, bullet, and staple. These analogies could provide triggers for similar solution strategies.

Although the TRIZ-Fractal model in Fig. 1 clearly illustrates the problem situation, the diagram would become cluttered and unwieldy if solution strategies were to be added to it. In contrast, the matrix side of the Universal Thinksheet™ (see Fig. 2) could be used to summarise a lot more information including models of the problem and solutions-spaces. Both diagrams should be used together and appear on separate sides of a single Universal Thinksheet™. Understanding of the TRIZ-Fractal model facilitates understanding and use of the matrix side of the Universal Thinksheet™.

Fig. 2 replicates the problem situation in Fig. 1 as well as includes solution strategies. Based on the **technical contradiction** involving the *improving parameter* of Force (#10) and *worsening parameter* of Object-generated harmful effects (#31), the **Contradiction matrix** suggests the following inventive principles:

- #13: Other way round
- #3: Local quality
- #36: Phase transition
- #24: Intermediary

These strategies are described and elaborated on as "solution-poles" in Fig. 2. Other solution strategies, which are based on **Inventive Standards** and **Separation Heuristics** are also summarised in Fig. 2. No effort has been made to generate detailed solution strategies as the basic aim is to illustrate uses of the matrix side of the Universal Thinksheet™. However, the above solution strategies could be expanded, especially using **analogies** in column O3.2.

CONCLUSIONS

A situation of "hammer driving in nail (into wooden object)" is modelled using the TRIZ-Fractal model and matrix side of the Universal Thinksheet™. Both the model and the matrix could also be used for visually managing ideas that relate to the given situation. Although the TRIZ-Fractal model facilitates understanding of the problem situation and could be used for failure analysis, it is limited in terms of the amount of information that could be put on it. For instance, it is not advisable to use a single TRIZ-Fractal model for both problem and solution modelling as the diagram would be cluttered.

The matrix side is more accommodating in terms of space. However, its efficient use and interpretation demand a thorough understanding of the TRIZ-Fractal model. As a qualitative spreadsheet, the matrix side of the Universal Thinksheet could be used not only for documenting and modelling problem situations but also for solving problems and deconstructing product solutions. The TRIZ-Fractal model in conjunction with the matrix side of the Universal Thinksheet™ offers users of TRIZ an opportunity to holistically model, document, and solve problems against the background of concepts and principles in TRIZ. Use of the TRIZ-Fractal model and Universal Thinksheet™ could facilitate the diffusion of TRIZ as more TRIZ-based problems and solutions could be available in a "standard" and easy to understand format.

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Acknowledgement
The author would like to thank Dr. Ellen Domb of the TRIZ-Journal for her editorial comments and suggestions in the writing of this article.

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