Incorporating the Notion of Context Into the ITRIZ Knowledge Base

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ABSTRACT

The I-TRIZ knowledge base consists of over 400 operators and hundreds of case studies and illustrations and is the culmination of the study of over 2 million patents begun by Altshuller and his colleagues over sixty years ago. Because the primary source material was patent filings, the case studies and descriptions contained within the knowledge base are physical, chemical, or mechanical in nature. While these are invaluable in helping practitioners understand and use the knowledge base, users desire to see case studies and language specific to their domain of discourse, which may not be strictly physical, chemical, or mechanical in nature. It is certainly advantageous to see examples from other domains as the cross-pollination of ideas often overcomes psychological inertia. However, in some cases, the meaning of the principles behind an operator is best conveyed in terms closer to the user's expertise. This paper describes the notion of adding support for different "contexts" to the I-TRIZ knowledge base allowing the addition of an unlimited number of case studies in specific domains and providing a way for I-TRIZ software to display material in the context of the user's domain.

1. INTRODUCTION

TRIZ (the Russian acronym for "the theory of inventive problem solving," pronounced "trees") is a methodology, knowledge base, and tool set designed to assist practitioners in generating innovative solutions to problems [1]. Began in 1946 by Russian engineer and researcher Genrich Altshuller and colleagues, TRIZ examined hundreds of thousands of patents (over the subsequent decades this number exceeded 2 million) in an attempt to identify the recurrent innovative patterns. Altshuller's insight was that if such patterns could be identified and distilled down to a set of generic principles, one could employ that knowledge to a new problem and arrive at superior innovative solutions. Some of the contributions from this, the so-called "classical" era of TRIZ, include [2] [3]:

- 40 principles of innovation
- Lines of Evolution
- 72 standard solutions
- Substance/field analysis
- ARIZ (algorithm to solve an inventive problem)

The "contemporary" era of TRIZ began in the late 1980s and early 1990's. This era began in Russia but moved to the USA with the start of a new company, Ideation International, which moved most of the principle TRIZ scientists to the USA. The result of development by this group of scientists is called "I-TRIZ" and features:

- Over 400 operators (superseding the 40 principles)
- Methodology for use by the masses
- Family of software applications
- Problem Formulator diagramming tool
- Documentation of case studies
- Compilation of knowledge base

The I-TRIZ knowledge base consists of over 400 operators, 1300 illustrations, 4000 individual screens, and 14,500 links [4]. Whereas each of the original 40 principles represents a general innovative approach, each I-TRIZ operator encapsulates a specific transformation. Associated with each operator are one or more case studies describing an example of the application of the operator, including an illustrated description of the problem solved. Because of the nature of the source material, patent filings, the case studies are heavily oriented to physical, chemical, and mechanical examples.

For example, the following case study describes an instance of the "pulverization" principle. Pulverizing used tires facilitates the separation of the rubber from metal and other materials in the tire, reduces the volume of material making it easier to handle and transport, and makes it easier to melt. This is a fine real-world example of applying the pulverization principle. Pulverization is an extreme form of segmentation, and as such, is one of the universal I-TRIZ operators meaning it is applicable to any domain. However, is the case study of the used tires as meaningful as it could be to someone using I-TRIZ to solve an information technology problem? Consider, instead, a case study discussing how images are processed on a pixel-by-pixel basis, such as the "swirl effect" shown here. Breaking an image into its constituent pixels is analogous to pulverizing a physical object.

In another connotation, pulverizing concrete into a fine powder permits it to flow in ways similar to a liquid allowing it to be handled, stored, and applied to surfaces in new ways. But would a case study about concrete cause an information technologist to make the connection with Internet communication? "Pulverizing" a Web page, database, video clip, or any data object for that matter, into bits allows that object to be sent in streams across the Internet.

As I-TRIZ becomes used in more diverse domains, we wish to see the collection of case studies in the I-TRIZ knowledge base expand accordingly. To make this a reality, the I-TRIZ knowledge base must be constructed to be extensible and the data representation within the knowledge base itself must be made to accommodate different categories of application domains. We call such a category a *context* and this paper describes a way in which the ITRIZ knowledge base can accommodate multiple contexts.

2. XML TAGS AND ATTRIBUTES

The extensible markup language (XML) is a data representation language that works by adding markups to data describing the data [5]. The hypertext markup language (HTML) is a similar markup language, but where HTML *tags* instruct Web browsers how to display the information, XML tags describe the information itself. In this example:

```
<name>
  <firstname>John</firstname>
  <lastname>Hancock</lastname>
</name>
```

"John Hancock" is the data, but the XML markups make it possible to identify which part of the data is the first name and which is the last name and even describes the entire ensemble as "name." This allows software to take different actions based on what kind of data is being processed. The following example shows how *attributes* make further description possible.

```
<phone type=”home”>555-1111</phone>
<phone type=”work”>555-2222</phone>
<phone type=”cell”>555-3333</phone>
```

There are three phone numbers represented here, each by the <phone> tag. The "type" attribute allows one to distinguish one type of phone number from the others. By using a combination of tags and attributes, we can represent all pieces of knowledge captured in the I-TRIZ database.

3. THE context ATTRIBUTE

The basic components of an I-TRIZ operator are:

- Name (or "title")
- Description (can have multiple)
- Associations to other operators
- Case studies (any number)

Currently in the I-TRIZ knowledge base, an operator is encapsulated in a standalone HTML file and hyperlinks are included which reference HTML files containing a case study. We propose to capture all information relating to an operator in a structured XML format as the following snippet demonstrates:

```
<operator>
 <title>Abandon Symmetry</title>

 <descriptions>
  <description context="Default,
   Mechanical">If an object is symmetrical,
   try to reduce its weight by making it
   asymmetrical.
  </description>

  <description context="IT">If loading on a
   network is symmetrical, try adding
   segments with different  bandwidth
   capacities.
  </description>

  <description context="Medical">Some
   medical-based description goes here.
  </description>
 </descriptions>

 <casestudies>
  <casestudy context="Default, Mechanical">
   <file>EAsymmetrical_mounts.htm</file>
   <label>Asymmetrical mounts</label>
  </casestudy>

  <casestudy context="Default, Mechanical">
   <file>EEconomical_ski_pole_b.htm</file>
   <label>Economical ski pole</label>
  </casestudy>

  <casestudy context="IT">
   <file>Asymmetrical_Bandwidth.htm</file>
   <label>Asymmetrical Bandwidth</label>
  </casestudy>

  <casestudy context="IT”>
   <file>Prioritizing_Tasks.htm</file>
   <label>Adjusting task priority
   Multitasking operating systems</label>
  </casestudy>
 </casestudies>

</operator>
```

The <operator> tag encapsulates a single operator— “Abandon Symmetry” in this example. (For brevity, not all information for this operator is shown.) The descriptions for this operator are contained in the <description> tags. The context attribute differentiates the various connotations as they apply to different domains. Currently in the I-TRIZ knowledge base, every operator has at least one description. This description is assigned the context “default.” The tag:

```
<description context="Default, Mechanical">
```

establishes the description contained in the tag as the default description. But in this case, the default description is also a decidedly mechanical one, so we also label the default description with the “Mechanical” context. An operator can have any number of descriptions and any number of contexts can be associated with a description. Also, contexts can be associated with any number of descriptions.

A similar markup with the <casestudy> tag is employed. Each case study has an external HTML file, a label, and one or more contexts. In the example, the “Asymmetrical Mounts” and the “Economical Ski Pole” case studies are the default case studies (meaning they are the ones found in the current I-TRIZ knowledge base). The other two “IT” examples represent additions to the knowledge base and are decidedly IT in nature. Specifically, these are case studies demonstrating the use of the “Abandon Symmetry” operator in the IT domain. All case studies are encapsulated in the <casestudies> tag and like with descriptions, contexts and case studies share a many-to-many relationship.

4. APPLICATIONS

Representing the I-TRIZ knowledge base in XML affords a great deal of flexibility. Basically, a user interface can selectively (or not) display portions of the knowledge base depending on the context. This section describes some applications of such flexibility for future I-TRIZ software implementations.

Domain-Specific UI

The obvious application is one already discussed in this paper. People from every imaginable domain are using I-TRIZ. With descriptions worded appropriately for different domains and case studies demonstrating domain-specific applications of I-TRIZ operators, future software applications can be made to display material most meaningful to the user. We imagine giving the user the ability to select the domain(s) to view and also to turn off domain-specific filtering altogether, resulting in the display of only the “default” context (i.e. the original I-TRIZ material).

Verticalization

We envision future I-TRIZ software applications to be “verticalized.” Verticalization in this case means the application will be tailored specifically to a single kind of analysis. For example, we can envision a process improvement tool that uses I-TRIZ methodologies and the knowledge base but whose user interface is designed to be used by practitioners engaged in process design. We can also envision an IT-specific tool for innovative thinking specifically designed for the IT industry. Any verticalized application like this can use the same I-TRIZ knowledge base as the backend and use context-based filtering to tailor the material. Because the knowledge base is encoded in XML, the user interface will be in control of the presentation of the information. This supports the creation of any kind of specialized user interface in the future.

Open-Sourcing the Knowledge Base

The current I-TRIZ knowledge base is the result of the work of many I-TRIZ and TRIZ specialists. However, the future should support the addition of case studies from different domains by any practitioner. XML encoding and the ability to tag material with different contexts allow this to happen. We envision a core I-TRIZ knowledge base augmented by the community of users across the world. This user-generated collection of case-studies will quickly out grow the core knowledge base and could eventually contain millions of items (like Wikipedia).

Multiple Domain Adoption

To date, attempting to introduce I-TRIZ to a new set of users working in a different domain has proven difficult. One reason for this is that these new users do not, at first, appreciate the applicability of I-TRIZ to their domain. Adding domain-specific material to the knowledge base and the ability to filter the material based on context allows I-TRIZ to be customized to a new domain by the practitioners in that domain. We envision "first adopters" in a new domain to come together and form the initial collaborative ensemble. This activity should attract other adopters into the collaborative. No single entity, like a private company or a group of general practitioners, could grow a domain-specific knowledge base better than the practitioners in that domain. Incorporating context into the I-TRIZ knowledge base and making the knowledge base extensible empowers subject matter experts to evolve I-TRIZ organically.

5. Works Cited

1. About TRIZ. *Altshuller Institute for TRIZ Studies.* [Online] [Cited: May 8, 2008.] http://www.aitriz.org/ai/index.php?page=triz&article=about.

2. **Shulyak, Lev.** Introduction to TRIZ. *Altshuller Institute for TRIZ Studies.* [Online] [Cited: May 12, 2008.] http://www.aitriz.org/ai/articles/40Ptriz.pdf.

3. **Alla Zlotin, Boris Zlotin.** History of TRIZ and I-TRIZ. *Ideation International.* [Online] [Cited: May 12, 2008.] http://www.ideationtriz.com/history.asp.

4. **Zlotin, Alla Zlotin and Boris.** An Integrated Operational Knowledge Base (System of Operators) and the Innovation Workbench System Software. *Ideation International.* [Online] September 22, 1992. [Cited: May 12, 2008.] http://www.ideationtriz.com/paper_Integrated_Operational.asp.

5. XML. *Wikipedia.* [Online] [Cited: July 10, 2008.] http://en.wikipedia.org/wiki/XML.