DIVA®
Directed Variation
Solving Conflicts in TRIZ Part 1
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Keywords: language, conflicts, contradictions, properties, adjectives, functions, verbs, DIVA, CREAX

Introduction

'So advanced it is simple'
DIVA describes a way of conducting problem solving and innovation studies. DIVA aims at building an in-company competence in effective innovation.
Innovation is defined as creating value; value is defined as more of the good (performance, ergonomics, design) and less of the bad (danger, pollution, cost). We want products to *function* better (to perfect), safer (to harmless), greener (to ecological), easier (to automatic), nicer (to experience) and cheaper (to free). Applying the above to existing innovation methodologies and language has developed DIVA. The variation in products is expressed in **adjectives**.

Fig 1. DIVA® 2000-2005 research

Language

Products are **NOUNS**. An analysis of one month's USPTO patents (Jan 2005) shows that in a pool of 16,000 patents, there are less than 2,000 unique nouns. But we're not interested in a noun or a product; we're interested in the difference, the variation of the product, the **ADJECTIVE noun**. Not the toothbrush as such, but the hollow toothbrush, the flexible toothbrush, the protruded toothbrush, the transparent toothbrush. Adjectives define variations. The analysis of the same 16,000 patents revealed less than 800 unique adjectives. These adjectives are related to functions, which are expressed in **VERBS**. The 16,000 patents distilled less than 700 unique verbs.

Properties and Property Spectra

The difference between a product A and a better product B is that one or more properties of product B *functions better*. 'The importance is the difference'; varying properties (adjectives) results in new or better functions (verbs). Properties can be varied along a property spectrum: a group of stages along a property line. For example: 'a **hollow** toothbrush' conducted a variation within the **porosity spectrum,** which also includes porous, sponge or capillary.

Note the similarity with evolution trend space segmentation. Other property spectra include flexibility, geometry, symmetry, surface, state, time, colour, transparency, density, size, information, conductivity, dependability. Each of them has numerous variations called properties. Second example: property spectrum 'surface' will include protruded, carved, (nano) carved, smooth (adjectives). 'Surface' is not a property, but smooth is.

Properties and Functions

A property variation brings a new function(s). For example, a protruded product (surface spectrum) brings the function **holding or cooling** (verbs). A liquid product (spectrum state) brings **dissolving or mixing**. A porous product (spectrum porosity) brings **dissolving or filtering**. A powder product (spectrum fragmentation) brings **dissolving or filtering**. Note that different property variations can bring similar functions. Other functions include absorbing, joining, cleaning, connection, preserving, transporting, and floating. Note that the property variation is linked to the function but presented independent of the product. The variation chart below illustrates the connection of functions with a variation in the SURFACE spectrum.

Fig. 2 DIVA® software excerpt: variation chart: SURFACE SPECTRUM

Note the similarity with the trend 'Surface Segmentation'. One important difference is that variation spectra are abundant (in the hundreds), and property variations are indefinite, only limited by perception and language (vocabulary).

Patents and the internet

Since, in all of the above, no 'innovation-jargon' is locking communication; DIVA can be released on the patent database with a given NOUN, tracking down the amount of existing ADJECTIVES, fitting them into the variation spectra.

As shown in figure 3, one **spectrum chart** reveals the activity in the different property spectra or areas. It illustrates where most of the patents are, and equally important, it illustrates where there are no patents; i.e. the peaks reveal (competitor) activity, the gaps reveal opportunity. The searches can be directed to certain industries or any other current patent classification. The activity can be shown over time and regions. A similar search can be launched on a selection of the internet, or even on internal company data.
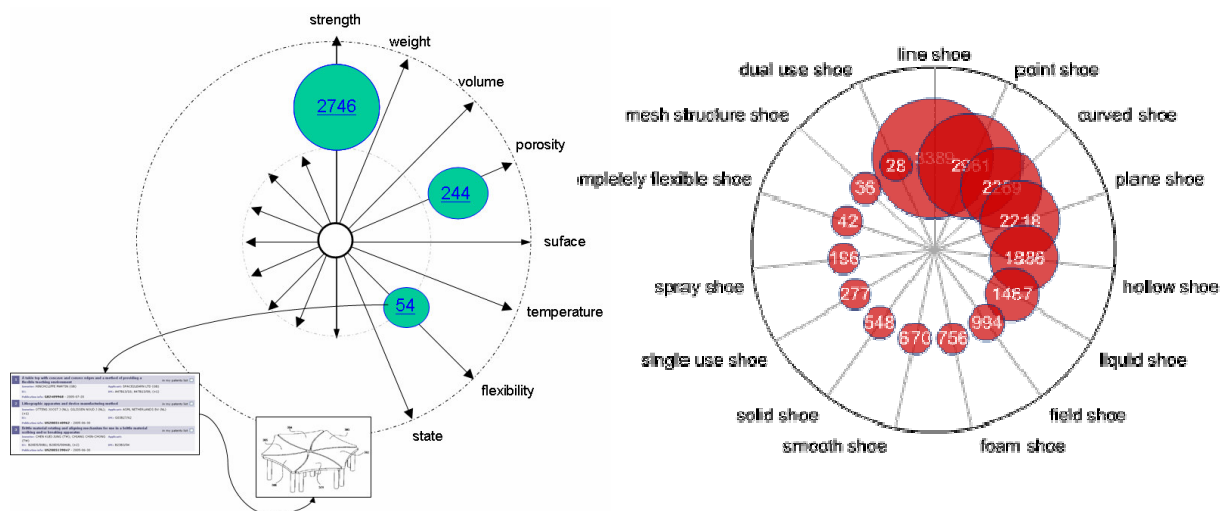
Fig 3. <u>Left</u>: Manually search 'property product' and indicate, place total number on each property variation in proportional circle
<u>Right</u>: Spectrum Chart Excerpt generated of DIVA® software, on shoe

Direction – Directed Variation

'*A trend goes forward unless it goes backwards? All stages are described but products may jump a stage?*' Those expressions don't really convince the user. For reactivity a solid may evolve in a liquid and a gas, for conservation or compactness a gas may go to a liquid or from a liquid to a solid. The **direction** in the variation spectra is defined by the **function**(s).

In the transparency spectrum, glass may reduce transparency for blocking harmful UV, or go opaque for privacy. Directed by functions, there is a possible grouping in conservative functions (e.g. protection, privacy, conservation) versus reactive functions (e.g. dissolving, igniting, and mixing), which match the left and right end of each spectrum. An example of a stage jump: if polymers have moved from full to foam, the variations of porous polymers (the jumped stages) still have tremendous opportunity. The process comes down to evaluating all variations – linked to the function. The process can be summarised in Fig. 4.
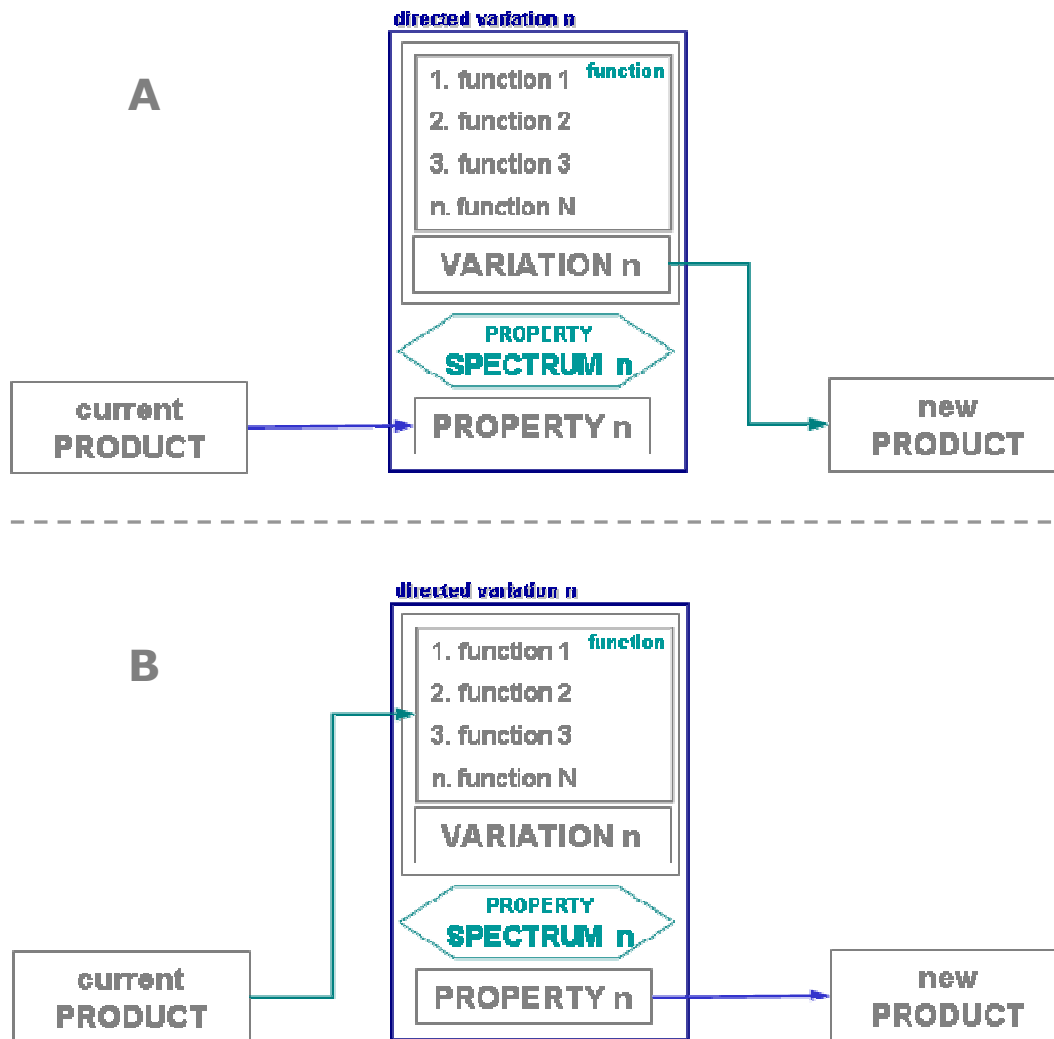
Fig. 4 the DIVA® process left from property to function, right from function to property

The DIVA process

Fig. 4 A: Select a property of the product; explore the variations in the spectrum; they will indicate new function(s), which results in your new product. For example a sugar cube has a shape; varying the sugar cube shape into a beam may bring new functions like stirring or dosing.

The process can be repeated for every defined property (see Fig. 5). Fig. 4 B shows the process from the desired function to the property. For example if the function (rapid) dissolving is required in a solid sugar cube it will direct you to liquid in the state spectrum, powder in the fragmentation spectrum, or very porous in the porosity spectrum.

Process A opens new functions or improved function(s) in the product; process B brings new ways to achieve desired function(s). A third option is to identify new markets. As sugar powder has the functions mixing and dissolving, it is also used in road works to create the necessary porosity in the road as it dissolves. Variations have functions that can solve other problems.
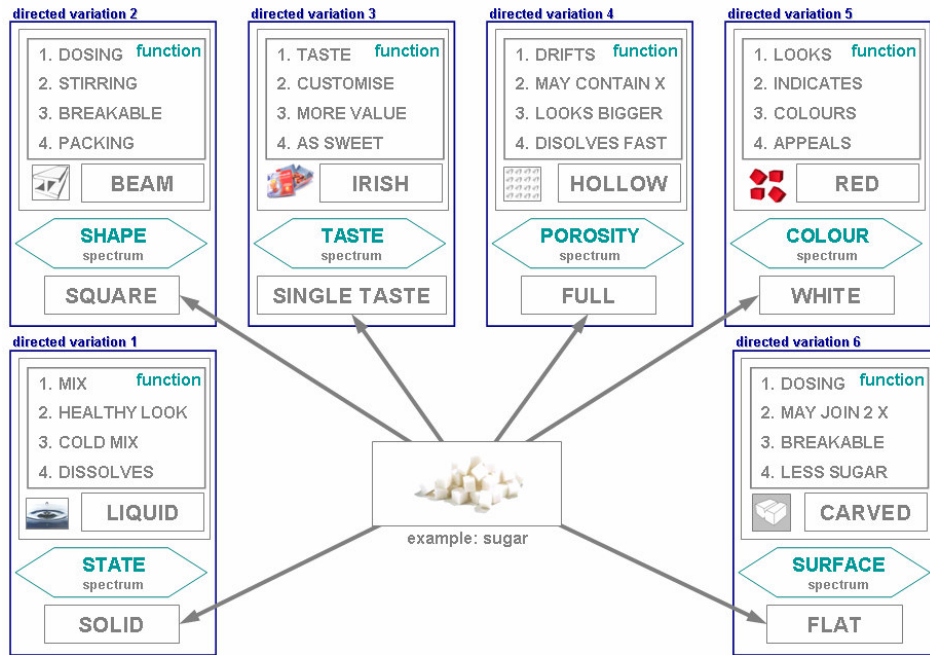
Fig. 5 Excerpt of the DIVA® process applied to sugar

Figure 5 is a mini case in sugar, 6 properties were identified and varied in their spectrum. Example the surface of a sugar cube is flat; variation to a carved surface gives breakability or dosing. The variation in taste gave customisation in coffee.

Variation Charts with Examples

Figure 6 shows a variation chart. Across the main point the variation spectra like state, surface or flexibility can be modified. For example the first spectrum state can vary products in solid –liquid – gas –field solutions. Fig. 6 shows the spectrum examples TRANSPARENCY. The examples include transparent concrete (CREAX newsletter 03/05) transparent home ware, transparent milk (CREAX newsletter 05/05), transparent packaging or the UV transparent swimsuit. The functions include viewing, inspecting or illuminating.
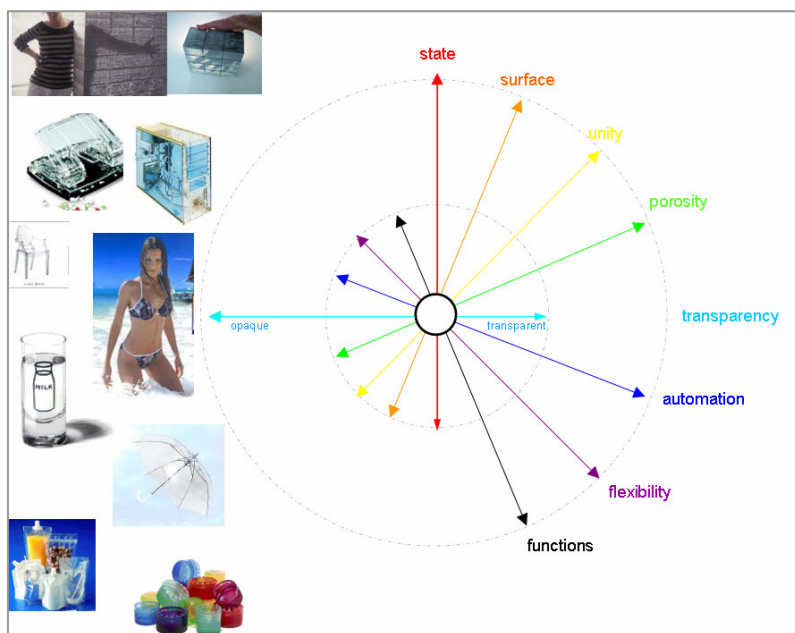
Fig. 6 DIVA ® Variation Chart with spectrum examples TRANSPARENCY

Conflicts

When two properties are **conflicting**, only **variation of (other) properties** can make them coexist. Example strength and lightweight are conflicting in a table, as illustrated in Fig. 7 A.
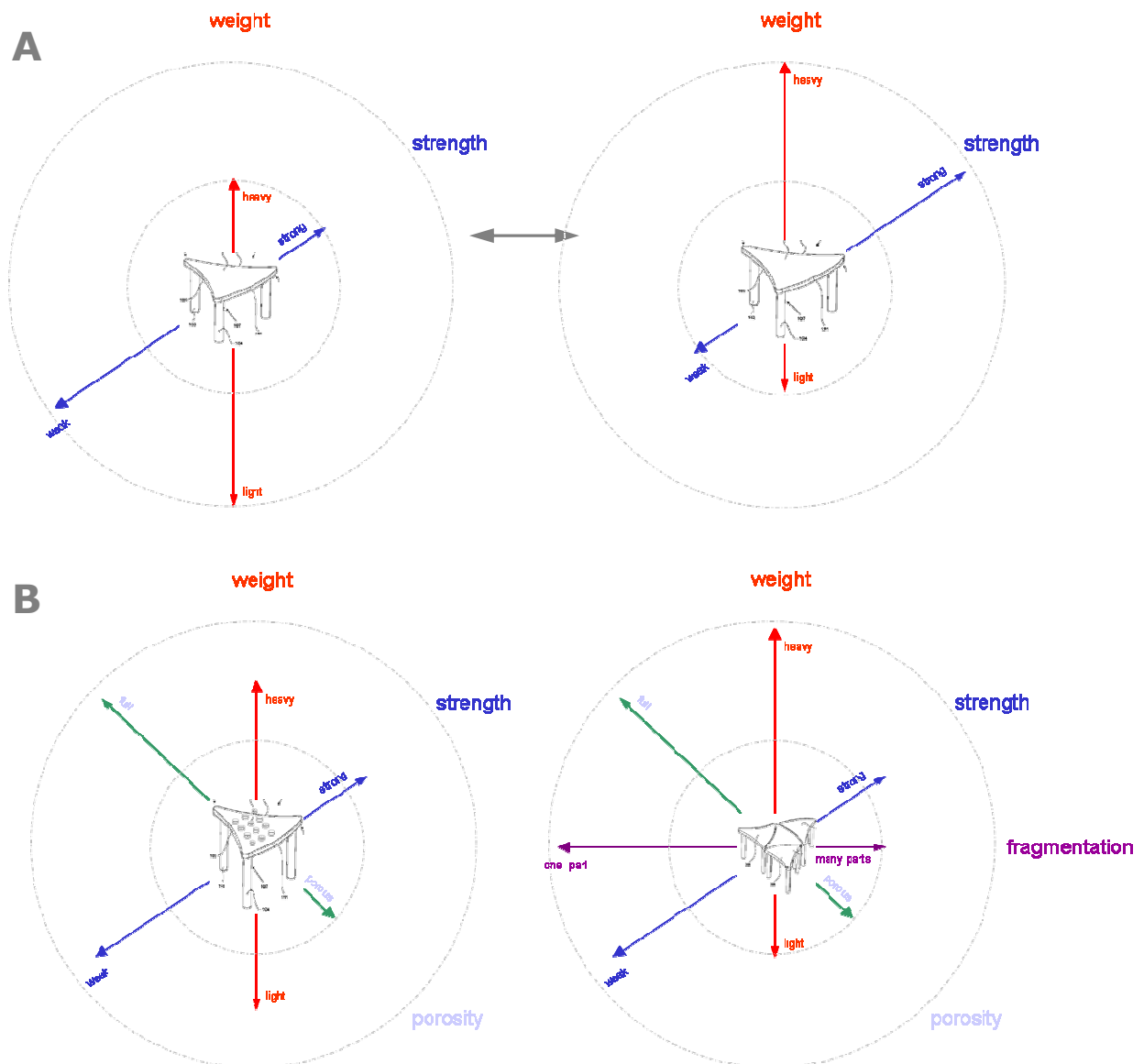

Fig. 7. A: Table conflict expressing strong but heavy OR light but weak.
B: Conflict resolution directions property spectrum porosity (left) and fragmentation (right)
Mechanism is described in part 2.

In order to solve the conflict property variations can be suggested (as shown in Fig. 7 B. on the left). DIVA indicates a solution direction in the porosity spectrum. Making a porous table brings a relatively strong and light table. On the right a further direction indicates a variation in the fragmentation spectrum. Effectively, the table in 4 parts is as strong but lighter per unit. *Note the similarity with contradiction matrix and principles.* An important difference is that within TRIZ systems you want A (strength) and not B (weight), here you want A (strength) and –B (lightweight).
This reinstalls symmetry in conflicts as lightweight and strength is the same as strength and lightweight. (Strength and no weight is not the same as weight and no strength). Conflicting properties can thereby be 3 or more dimensional, e.g. strength AND lightweight AND transparency AND flexibility; which greatly enhances the power of conflict resolution tools.

Conclusion

'So advanced, it is simple' DIVA integrates the performance of existing innovation methodologies. The interface of the tool allows more of the good (performance, integration, ergonomics, design) and less of the bad (complexity, confusion, time). One of the key factors of DIVA is the **integration** of innovation tools with **language**. A limited amount of nouns (products) can be varied with a distinct amount of adjectives (variations) giving new verbs (functions). Perception and vocabulary will therefore play an important role in Part 2 of this paper.

Process A:
Select a property of the product; explore the variations in the spectrum; they will indicate new function(s), which results in your new product.

Process B:
Select a desired function, explore the available property variations out of different spectra, that are enabling to this function, creating your new product.

Directed variation is a simple and effective way to value creation. Process A opens new functions or improved function(s) in the product, process B brings new ways to achieve desired function(s). Importantly the connection between properties and functions are **independent** of the **product**. The DIVA tool can therefore be applied to any product, as long as the properties are variable, the new functions will emerge. The conflict resolution tool (problem solving) of DIVA **integrates** with the property variation tool (innovation). It is when changes are required within the properties that conflicts are occurring, or new products solve old conflicts. When two properties are conflicting, only variation of (other) properties can make them coexist.
Finally, since no 'jargon' is locking communication, DIVA has opened a whole new capability in data mining for value creation.

Note that this paper is followed by Part 2 (October 05) and 3 (November 05).