## *Identifying Discontinuities for Strategic Research*

**Jack Hipple**, Innovation-TRIZ, 18222 Collridge Dr., Tampa, FL 33647

R&D and technology planning frequently is done via extrapolation of past businesses and technologies, using the core competencies of the existing organizations. When a business is expanding along its original paths, this is a perfectly acceptable way of doing short term strategic planning. Examples of this kind of approach might be finding new ways to modify the thermal profile of a polymerization reaction to optimize yield, molecular weight distribution, or toughness structure. The switch to a catalytic system that was more specific in its targeting of molecular properties would not necessarily be obvious to one thinking only about optimizing thermal profiles. We have seen much activity in the area of very sophisticated chemical catalytic systems over the past 10 years. We now see some research into microwave catalytic systems that are not yet economic, but are certainly moving into a new “field” for providing the polymer properties that are desired. Extrapolating past technologies as the only approach to strategic research planning can have disastrous consequences when a given technology is totally displaced by a replacement technology which is totally foreign to the organization. The skill set required may be totally absent within an organization, allowing too much tunnel vision about the best way to problem solve or provide the next generation of technology. Other everyday examples include the evolution of "image capturing" from etching to painting to printing to wet chemical photography to electronic photography. Each of these approaches uses different skills and competencies and significantly different technical approaches.

When one studies the evolution of breakthrough inventions, a predictive set of technology development lines can be deduced, which allow improved strategic and R&D planning that stays one step ahead of discontinuities and anticipates them. These patterns of evolution are a key part of the TRIZ "Inventive Problem Solving" process which has been derived from the study of the global patent literature. This allows an organization to plan much more effectively in terms of budgets, types of technical disciplines needed, and types of customers and potential customers with to partner.

In addition to the field evolution line briefly mentioned above (mechanical, thermal, chemical, electronic, electromagnetic), there are others that can be deduced that are of everyday practical value. Three of these are:

1. Contradiction resolution. The evolution of products and technologies shows that systems achieve their next breakthrough by resolving contradictions in performance and design, and that breakthrough patents always resolve a major contradiction. These principles can be captured in a useful, retrievable way in a series of contradiction tables that can be used

for idea stimulation as opposed to random brainstorming. An example of this is the evolution of the automobile and its various sub-systems. When the automobile was first invented, its speed was minimal. At some point in time, probably when the car could go more than 5 MPH, the contradiction of speed vs. safety (stopping) was obvious and brakes were invented. As speed increased further, the need for smooth roads and shock absorbers became evident. Transmissions and disc brakes came along later, all in response to a contradiction in system performance. Even within these specific inventions, there are contradictions in detailed design that needed to be resolved.

In the chemical process industry, we see reaction processes changed as a function of stochiometry, equilibrium, and desired product distribution.

2. Dynamism. The study of inventions and technology evolution over time shows that all systems become more dynamic and responsive over time. Examples would include power steering and automatic transmissions in cars, chemical process control systems whose parameters are changed according to process or feed conditions. In the chemical industry we see automatic control systems that can respond to incoming raw material quality changes.

3. Field evolution. This line of development has already been briefly described above. Given the fact that this line of evolution exists, we can also ask the question about the effect of next generation fields on product quality, product purity, and process control—putting us one step ahead of competito9rs who are not aware of these lines of evolution.

This talk will review these basic patterns and demonstrate their use in strategic technology planning through further illustration of their applicability within the chemical process industries and the use of chemical products and systems.