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# **SUPPORT**

## **Sustainable Innovation Tools**

### **Fostering methodical Product- and Process- Development by Combining TRIZ-Tools and Sustainable Development**

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#### *Abstract*

*Strengthening innovation power in European companies as well as encouraging sustainable development are two of the main future goals of the EU (see Lisbon goals, European Council 2000).*

*The training course SUPPORT has been developed in the framework of the European Leonardo da Vinci programme and shows companies different ways to build up several parts of an environmentally sound innovation management system. The approach combines “cleaner production” tools with some of the tools of the TRIZ method. Taken together, the two form the main part of the training course.*

*This article deals with the course aims, modular structure and target audience followed by the contents of the individual course modules.*

*A final section of the article provides a first short description of experiences made during the test training courses and details of how to obtain the course materials .*

## **1. Introduction**

Just about every enterprise on the planet has the word ‘innovation’ somewhere in its agenda these days. Innovation is the engine of survival in any competitive environment. Innovation, at least in the context of the Support programme, has been defined as the creation and delivery of products or services that present customers with a more ideal outcome than whatever it is that came before the innovation appeared. This is ‘more ideal’ in the TRIZ definition of benefits divided by the sum of cost plus harm.

Implied, then, in the ideality equation is a direction of success defined as more benefits, less cost and less harm. “Harm” in this direction is any kind of negative as may be perceived by either the customer or society at large. The term is intended to encompass any form of social or environmental negative. The good news as far as environmental issues are concerned is that sooner or later, things will inevitably head towards more ideal solutions with less negative impacts. The bad news, however, is that for the vast majority of customers, the ‘harm’ part of the ideality equation is placed at a much lower level of importance than benefits or costs. A large part of the reason behind this is that the customer never asked for the harm parts in the first place, and so, most figure, why should they have to compromise other aspects in order to achieve a product or service delivering less harm?

Given that global consumption is already exceeding the capacity of the Earth to sustainably allow us to continue in the way that we are (Reference 1), there is a growing awareness at governmental level that something needs to be done to address environmental and social issues in a more intensive manner.

The need to address sustainability issues, coupled with the fact that few consumers will willingly compromise on benefits or cost in order to achieve less harm, thus set the foundations of the Support project; our aim to put together TRIZ-based education materials that allow the achievement of more sustainable solutions that do not require consumers to compromise on either benefits or costs.

In order to become more sustainable, in other words, is far more likely to happen if people could be equipped with tools that would systematically enable the compromises between all the things the consumer wants and all the negative things they never asked for to be eliminated.

## **2. The Project SUPPORT**

**Grants:** The Project SUPPORT was granted and co-financed by the Leonardo da Vinci programme. The European initiative Leonardo da Vinci is the profession support programme of the European Union. Within the scope of this measure, the EU supports the development, testing and dissemination of new learning contents and materials.

**Partnership:** The Project was executed in a project partnership composed of 16 project partners out of 6 European countries. The project started at the end of 2002 with a duration of 24 months.

The following project partners were involved in the development of the course:

- ❖ University of Leoben, Austria
- ❖ Joanneum Research, Graz, Austria
- ❖ CREAX, Ieper, Belgium
- ❖ Fraunhofer IPT, Aachen, Germany
- ❖ AREA Science Park, Trieste, Italy
- ❖ University of Maribor, Slovenia

The project comprised the development, testing, and dissemination of the project idea and results.

### **3. The course goals and targets groups**

The most important goals of the SUPPORT programme have been:

- ❖ To highlight the advantages of a methodical approach to innovations
- ❖ To convey new tools for problem analysis and idea generation.
- ❖ To anchor the ideas concerning sustainable development
- ❖ To arouse interest for creative methods (with emphasis on TRIZ)

The main target groups are technical personnel within large and small manufacturing or service based enterprises. Additionally, the materials have been designed to be suitable for NGOs, consultants, academics, undergraduate level students or start-ups organisations.

### **4. The products and the course structure**

The main products of SUPPORT are:

- ❖ Written materials and CD-Roms for the course participants
- ❖ Presentation materials for the course trainers and
- ❖ Videos (sequences) of the whole project and its individual modules

All written materials are presently available in English and German.

In addition to that the participants are given other dissemination materials which may be found on the project's home page at [www.leonardo-support.com](http://www.leonardo-support.com).

SUPPORT currently consists of seven modules:

1. Introduction module: Innovation / creativity & sustainable development
2. Aspects of cleaner production for products and processes
3. TRIZ- tools for problem analysis
4. TRIZ- tools for idea generation I
5. TRIZ – tools for idea generation II
6. Tools for idea evaluation
7. Project Management Tools

The modules can either be taken individually (typically one module per day) or combined to form a fully integrated training course.

### **5. Overview of the contents of each module**

### 5.1 Introduction Module 1: Innovation / Creativity & Sustainable Development

The introduction module is divided into two half a day seminars, each giving a short and precise overview of the topics innovation / creativity on one hand and the meaning and goals of sustainable development on the other.

In the first short introduction

- ❖ the terms innovation and creativity
- ❖ the phases of product development or rather the “innovation process”
- ❖ the individual demands in the creative process  
(the 4 roles: explorer – artist- judge – warrior) -> Figure 1
- ❖ the possible contribution of the Theory of Inventive Problem Solving – TRIZ – within the scope of a product innovation strategy of a company
- ❖ an allocation of terms / tools of the course modules to the creative roles are examined and illustrated.



**Figure 1: The 4 Creative roles (Roger von Oech, 1986)**

In his books Roger von Oech suggests that in an creative process all 4 roles have to be supported (Reference 1).

- 1 – The explorer, who searches for interesting and useful details → analysis
- 2 – The artist, who sees connections where others do not → development of ideas
- 3 – The judge, who discards, balances up and makes decisions → evaluation and choice
- 4 – The warrior, who has the temperament of a lion and who never rests → realisation

The goal of the second half of the introduction module is to introduce the participants to the fundamental physical laws of sustainability, and, building on this, to show that sustainable development is an imperative of nature and that no other form of development is possible in the long-term.

An important aspect of this module half is a review of the evolutionary history of industrial environmental protection. Figure 2 shows a number of distinct modes of environmental thinking, starting with repair-what-is-there type ‘strategies through to the emerging ‘rethinking’ stage; in which innovation becomes an essential enabler.

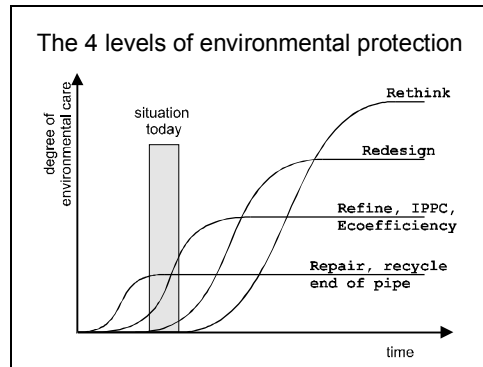


Figure 2: The 4 level of environmental protection

### 5.2 Module 2: Aspects of Cleaner Production for products and processes

The main objectives of the second module are, first, to answer the question, what does the requirement „sustainability“ mean for product development and producing enterprises and then second, to describe and provide simple tools for the assessment of economic impacts. These tools comprise input/output analysis, material flow analysis (Sankey diagrams) and material flow accounting.

Material flow analysis – for example – provides a comparison with the best available techniques and can show the weak points of any production process under investigation (Figure 3). The material flow analysis also provides information on costs of manufacturing of wastes and emissions.

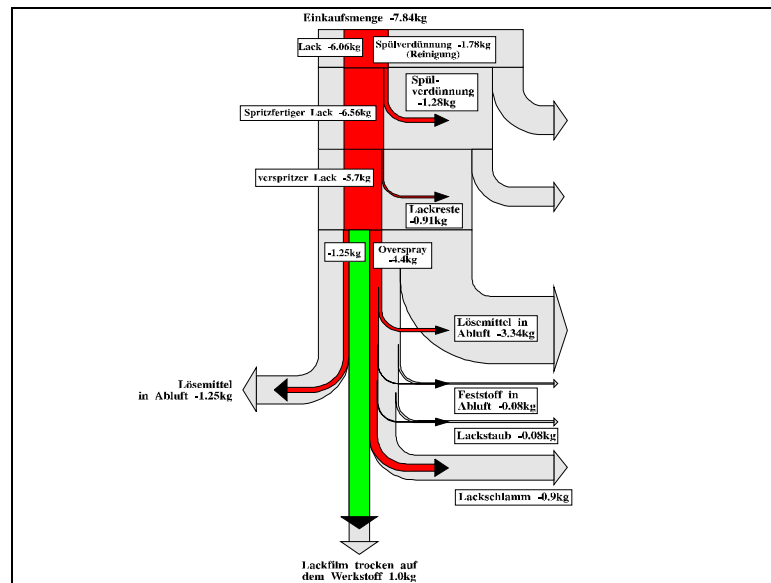


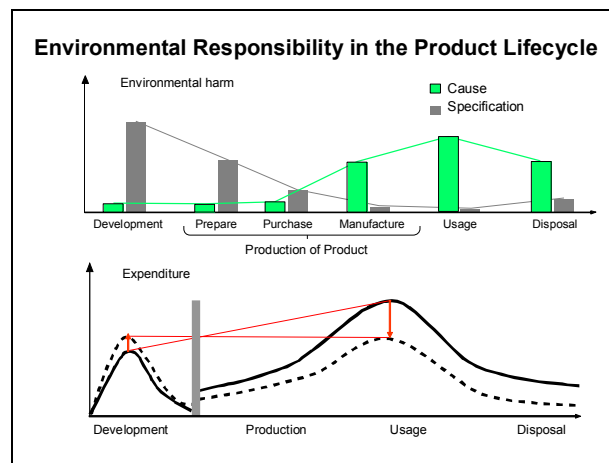
Figure 3: Material flows of paint and solvent in a spraying plant - comparison

### 5.3 Module 3: TRIZ- tools for problem analysis

The primary objective of the “Problem Analysis” module is to provide a comprehensive understanding of problem and opportunity situations. This main objective and the tools used to do this give rise to other sub-objectives:

- ❖ Defining task, problem and optimisation potential.
- ❖ Identifying useful and harmful functions.
- ❖ Analysing system and system surroundings; describing interconnections between various aspects of system
- ❖ Eliminating expensive, harmful and environmentally damaging components.
- ❖ Identifying and using available resources to their best effect.

At the beginning of this module it is shown again that the decisive leverage effect for reducing harm to the environment is in the first phase of the lifecycle of a product. (Figure 4) A potentially small increase in expenditure during development may be expected to result in a noticeable decrease in expenditure in later phases. Potential optimisations that have been recognised at an early stage can be efficiently implemented here. This applies to ecological and social as well as to economic aspects.

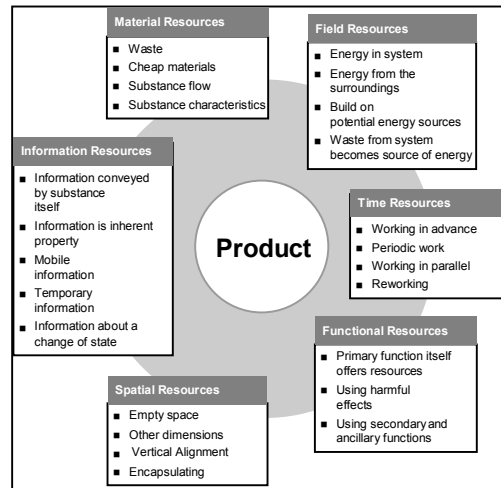


**Figure 4: Environmental Responsibility & Leverage Effect of Expenditure**

The TRIZ methodology provides a variety of tools to efficiently support product development and to thereby both promote sustainable environmental protection and the success of a company.

In this module the following TRIZ tools are presented:

- ❖ Innovation Checklist and Situation Questionnaire
- ❖ Resource Checklist – se Figure 5, for example.
- ❖ System Operator (9 Windows)
- ❖ Ideality (incl. useful and harmful functions)
- ❖ Function Analysis



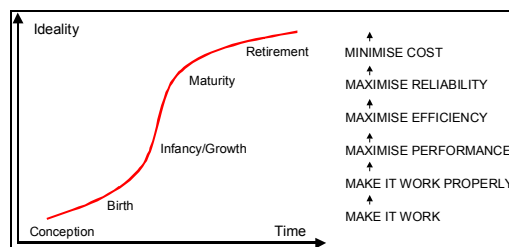
**Figure 5: Resource Checklist**

#### 5.4 Module 4: TRIZ- tools for idea generation I

This module shows how:

- ❖ projects benefit from the ‘ideality’ concept by focusing on increasing overall benefit whilst decreasing costs and harmful effects.
- ❖ to actively seek and define contradictions within a system
- ❖ Contradictions and the 40 Inventive Principles can be used to speed up problem-solving and innovation.
- ❖ sustainable design practise can be improved by resolving conflicts within and around the system.

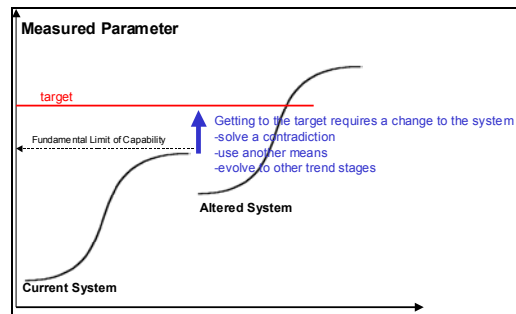
At the beginning also the S-curve analysis is presented as a tool to identify promising problem solving strategies. (Figure 6)



**Figure 6: Typical product life-cycle S-Curve**

If, for example, the S-curve has plateaued the system has reached a fundamental operational limit of capability. No amount of optimisation of a system in this state will produce any further increase in performance. Also, if the performance target is above this limit of capability described by the S-curve then the current system will not be able reach that target and the system will have to be changed. The next figure shows how when a new system is

introduced, it is described by the start of a new curve. (Figure 7) These ‘S-curve jumps’ are characteristics of step-change innovation processes.



**Figure 7: Altering the system is required to reach the performance target**

The TRIZ methodology identifies three main different ways of making these jumps:

1. Find another means of delivering the function
2. Solve a contradiction or conflict
3. Move to next stage along the evolutionary trend

Step by step instructions are provided within the SUPPORT education materials to help the participants in the first attempts using the concept of the ideal final result and the concept of contradiction elimination using the inventive principles.

#### 5.5. Module 5: TRIZ – tools for idea generation II (evolution lines)

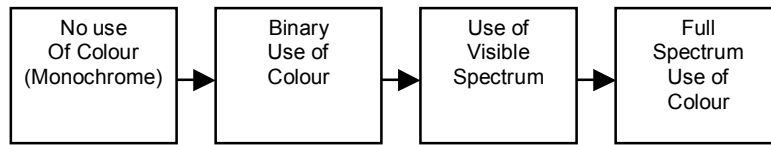
This module

- ❖ introduces the Trends of Evolution as described in an evolved version of TRIZ (Reference 3).
- ❖ provides many different examples of products and systems that illustrate how the Trends of Evolution work. This section includes specific examples of more sustainable products and systems resulting from deployment of the trends.
- ❖ provides a step-by-step way to use the Trends of Evolution in problem solving.
- ❖ discusses the use of the trends in strategic decision-making and introduces the ‘Evolution Potential’ tool.

This module also contains a detailed description of each trend along with a checklist of reasons why a system might advance from one trend stage to another.

Example:

INCREASING USE OF COLOUR



Examples: Photography, film, thermal management on space systems, manufacturing inspection systems, pressure/temperature sensitive paints, active camouflage systems.

Reasons For Jumps

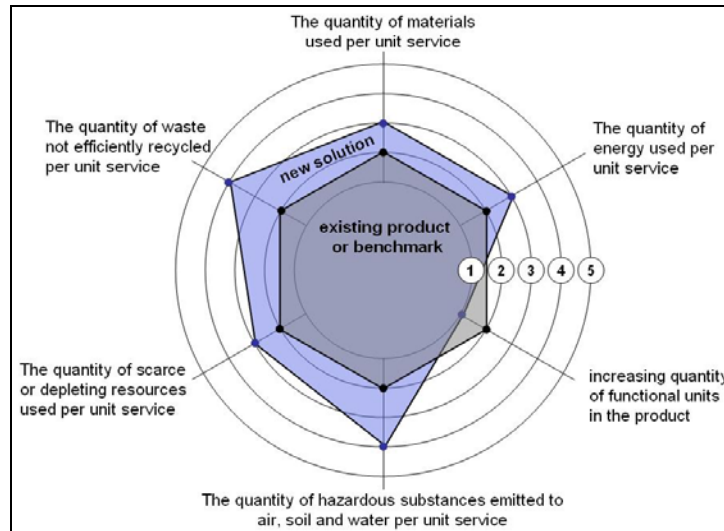
<u>Evolution Stage</u>	<u>Reasons for Jumps</u>
<i>Monochrome to Binary</i>	<ul style="list-style-type: none"> <li>- ability to make simple yes/no measurement</li> <li>- warning indicator</li> <li>- improved aesthetic appearance</li> <li>- improved radiation heat management</li> </ul>
<i>Binary to Visible Spectrum</i>	<ul style="list-style-type: none"> <li>- increased flexibility of measurement</li> <li>- improved aesthetic appearance</li> </ul>
<i>Visible to Full Spectrum</i>	<ul style="list-style-type: none"> <li>- eliminate interference with human interfaces</li> <li>- add new function through employment of effects present (e.g. use IR to achieve heat-seeking capability)</li> <li>- increased range of measurement possibilities</li> </ul>

Notes: Full spectrum includes infra-red and ultra-violet - both of which are increasingly being used to achieve previously untapped benefits. Colour is rarely viewed as a resource in many engineering systems; the trend shows that someone, somewhere has found an advantage in making use of colour.

5.6 Module 6: Tools for idea evaluation

The aims of this module are to:

- ❖ Explain the role of evaluation within the innovation process
- ❖ Give a general introduction into indicators and their functions within evaluation and analysis processes
- ❖ Present an overview of sustainability indicators within the three dimensions of sustainability
- ❖ Provide examples of generic tools to assist in the evaluation stages of innovation processes, describe their strengths, when and how they should be applied.
- ❖ Provide specific examples of each of the evaluation tools (→ Figure 8)
- ❖ Discuss how they can be used to evaluate the potential sustainability performance of new ideas and innovations.



**Figure 8: The eco-compass after Fussler and James (1996)**

### 5.7 Module 7: Project management

The last module of the training course SUPPORT has the twin objectives of enabling users to:

- ❖ Become familiar with the theoretical background and the “philosophy of project management”
- ❖ Become familiar with certain project management techniques and tools in order to be able to carry out and complete projects, as well as actively taking part in them and playing a part in their success

In this module the participants get information (and learn) what are projects, what is project management, which phases are included in the project lifecycle? which planning tools are available in the individual phases of the project, what sort of project organisation is available, how does project controlling work and how to successfully complete a project?

### 5.8 Video Sequences

All of the education modules in SUPPORT portfolio are accompanied by video demonstrations. These Videos are available on a CD-Rom and on the Web and are composed of

- ❖ an introduction sequences about the project idea
- ❖ two introduction sequences about sustainable development and the TRIZ method
- ❖ a short sequence for each module (incl. theory and practice)

The main aim of these videos is to demonstrate the practical applicability of the tools and strategies described in the written materials. Each module features case study examples of problems being tackled using the various different TRIZ and other tools.

## 6. Experiences Test Training Courses

A number of pilot workshops have been run in Germany, Austria and the UK during the latter stages of the project (Figure 9). The aims of these workshops has primarily been to obtain feedback on the quality of materials from a variety of different evaluating organisations from the different participating countries.



**Figure 9: SUPPORT Evaluation Workshops**

The different enterprises enlisted to evaluate the materials were deliberately selected to cover a spectrum of capabilities. This was difficult to achieve with respect to prior TRIZ capability, since the spread of the method is still relatively sparse across Europe. A broad spread of ‘sustainability’ capability was somewhat easier to achieve, and so the workshops were able to span a range from companies with no sustainability initiatives in place, to those with a well established and committed social and environmental strategy.

It was encouraging to observe that the materials were well received by the large majority of participants. Corrections and changes in emphasis were included in the materials as a result of the constructive criticisms received. On a general level, one of the main findings emerging from the broad range of evaluating companies was the need for the different modules to be as autonomous as possible, in order that users could readily tailor a specific programme to meet the needs of their organisation.

More specifically, it was interesting to note that the Contradiction tools were consistently the ones viewed as offering the potential to deliver the biggest impact on the achievement of more sustainable solutions.

## 7. Further development of the training course

The success of the SUPPORT programme has prompted the Leonardo da Vinci programme sponsors to support a follow-on programme which will see the SUPPORT education materials translated into several other European languages. The project “European SUPPORT” with new transfer partners from Sweden, Estonia, Bulgaria, Cyprus, Rumania and Slovenia started in October 2004. Translated versions of the SUPPORT materials will be available within the next 9 months.

## **8. Access To Materials**

Both the English and German versions of the SUPPORT education materials are available as integrated packages comprising written materials and CD. This package is priced at 60Euros (80USD) plus postage and packing per set.

Parties interested in the English version should contact Darrell Mann:

[darrell.mann@systematic-innovation.com](mailto:darrell.mann@systematic-innovation.com)

or download and complete the fax-back order form at [www.systematic-innovation.com](http://www.systematic-innovation.com).

Parties interested in the German version should contact Jürgen Jantschgi:

[juergen.jantschgi@unileoben.ac.at](mailto:juergen.jantschgi@unileoben.ac.at)

In-house workshops comprising some or all of the SUPPORT modules are also available in both English in German. Again, interested parties should contact wither Darrell or Jürgen to discuss their needs.

## **9. References**

- 1) [www.wwf.org.uk/filelibrary](http://www.wwf.org.uk/filelibrary)
- 2) Von Oech, R., ‘A Kick In The Seat Of The Pants’, HarperPerennial, 1986.
- 3) Mann, D.L., ‘Hands-On Systematic Innovation’, CREAX Press, [www.systematic-innovation.com](http://www.systematic-innovation.com), 2002.