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On the identification of contradictions using Cause Effect Chain Analysis

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Abstract

Modern TRIZ has evolved from a methodology used to solve technical problems to a method that increasingly incorporates tools to analyze initial problem situations before deciding on core problems formulating contradictions and problem solving.
One of the tools used for this purpose and assimilated into TRIZ is the Root Cause Analysis (RCA) [1] in its various forms and derivatives: Fishbone or Ishikawa Diagram [2], Cause Effect Chain Analysis and Root Conflict Analysis [3] (RCA+).
From a practitioner's viewpoint it is not always easy how to link these analytical tools to TRIZ problem solving tools, and particularly to the formulation of contradictions. The present paper investigates this issue, and gives some advice on how the results of the analytical tools can be directly used as input for the problem solving tools.

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Keywords: TRIZ, Cause Effect Chain Analysis, CECA, Root Cause Analysis, RCA, Fishbone Diagram, Ishikawa Diagram, Root Conflict Analysis, RCA+, Contradictions

1. Introduction

The analysis of initial problem situations is one of the key elements that allow the powerful TRIZ problem solving tools to be used to their full extent. Indeed, the saying goes that many TRIZ professionals don't solve the problems that they are initially presented with. TRIZ practitioners use a wide range of analysis tools for a variety of different purposes: from ideality via S-curve analysis and the analysis of technology trends to Function Modeling (FM) and Cause Effect Chain Analysis [4].

The Cause Effect Chain Analysis has proved to be one of the more popular tools for a number of reasons: its principles are easy to learn and use, it is extremely flexible in that it can be applied to a variety of problems of differing nature, it can drill deep – to the size of atoms if necessary - where other tools often stop, and its results are easy to communicate.

However, it seems not always easy to translate the findings of the Cause Effect Chain Analysis into problem formulations – contradictions – that can be directly used and integrated with the TRIZ problem solving tools. Root Conflict Analysis is a commendable exception and will be discussed as well.

It is the purpose of this paper to elucidate how the Cause Effect Chain Analysis can be used and tweaked to directly lead the user to the formulation of contradictions.

2. Cause Effect Chain Analysis and its variants

The general purpose of Cause Effect Chain Analysis and similar tools is to investigate the underlying causes and their interdependencies for an observed effect and to visualize the result in a graphic way. In most cases this is a negative effect, some disadvantage or problem that the project tries to overcome.

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2.1. Fishbone diagrams

Root cause analysis is used to investigate the underlying causes of a specific event and is often applied to quality issues in manufacturing and industry. A well-known graphic representation is the Fishbone or Ishikawa Diagram [2]. Related causes (or ideas for causes) for a specific problem are grouped together into categories and are organized into a diagram that resembles the skeleton of a fish, hence the name fishbone diagram. Typically those categories include items such as Machines, Material, Methods, People and so on (Fig. 1).

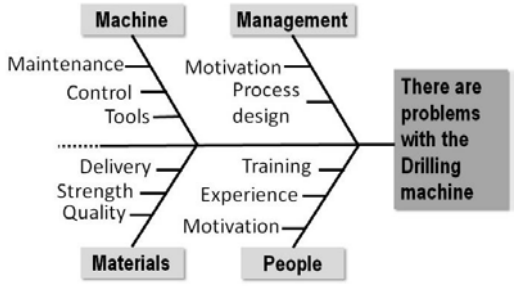

Fig. 1. A typical Fishbone Diagram investigating a problem with a drilling machine (incomplete overview).

The Fishbone Diagram is an excellent way to represent an easy and standardized way of investigating the underlying causes, be they of a technical or other nature. However, the result does not lend itself to be seamlessly integrated in a typical TRIZ project. In particular there is no intuitive way to re-formulate any of the found underlying causes into contradictions which can then be solved with TRIZ tools.

2.2. Cause Effect Chain Analysis

Another simple but effective tool for root cause analysis is the Cause Effect Chain Analysis. In a Cause Effect Chain Analysis, the Problem to be solved is taken as the starting point and written into a box [5]. It is next asked: "what causes that problem"? Possible answers are written down into new boxes inserted below the original one, and those new boxes are connected with the original problem box by arrows. If there are more than one cause underlying the problem, those are connected by an AND statement if they both need to be present to cause the problem, and by an OR statement if they independently lead to the problem. The figure shows a Cause Effect Chain Analysis for the unreliable drilling machine. In the context of TRIZ projects Cause Effect Chain Analysis are mostly done focusing on the technical causes (Fig. 2). To avoid ambiguity, care has to be taken to describe the contents of each cause – each box – carefully and clearly.

In its basic form the Cause Effect Chain Analysis is an effective and easy to use tool to explore specific problems or to investigate products for general improvement. It is easy to communicate; people who have never used it can intuitively understand and add to it. However just like the fishbone diagram it does not lend itself easily to the formulation of contradictions.

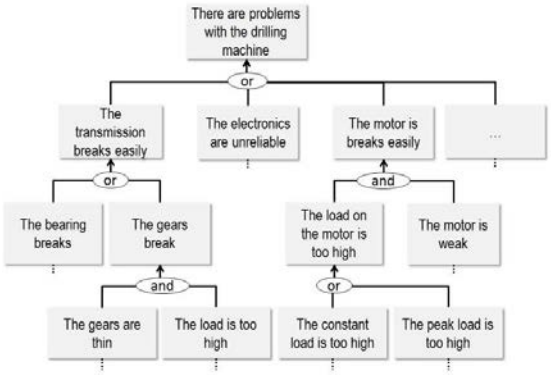

Fig. 2. A typical Cause Effect Chain Analysis for investigating an unreliable drilling machine (incomplete overview).

2.3. Root Conflict Analysis

The Root Conflict Analysis was developed by V. Souchkov [3] to investigate the root cause(s) of a problem in the same way as the Cause Effect Chain Analysis, but taking a way to formulate contradictions into account. It uses a graphic format that illustrates contradictions directly. Apart from minor differences in the graphic representation it is identical to the Cause Effect Chain Analysis. For example negative effects are denoted with a minus sign, positive effects with a plus sign, contradictions with a plus and minus sign etc. For each cause one asks the question if this cause is present because of any positive effect that it produces. If present, these effects are added into the graphic representation, by adding a box containing the positive effect above the box containing the cause, and connecting it with an arrow (Fig. 3).

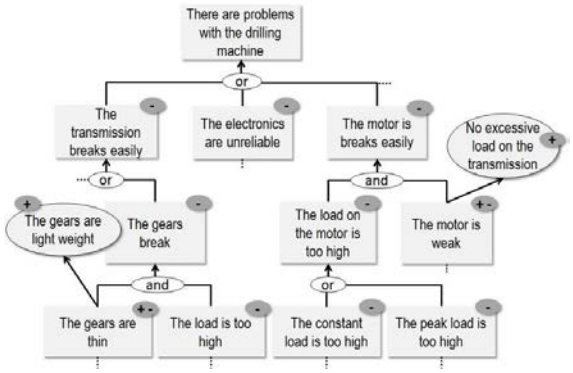

Fig. 3. A Root Conflict Analysis is shown (incomplete overview)

Causes which have both, a positive and a negative effect form the basis for formulating a contradiction. In the example the gears of the transmission are very thin, which has the positive effect that the gears – and the drilling machine is of light weight, but has the negative effect that the gears break easily (Fig. 4).