Lorenzo Duroux[1], Ezio Roppolo[2]
[1]Esc Engineering srl, Technical Manager, Italy
[2]Business Development Management srl, partner, Italy

# An effective product development Triz based approach

**KEYWORDS:** Dot Impact Printing, Problem Flow Network

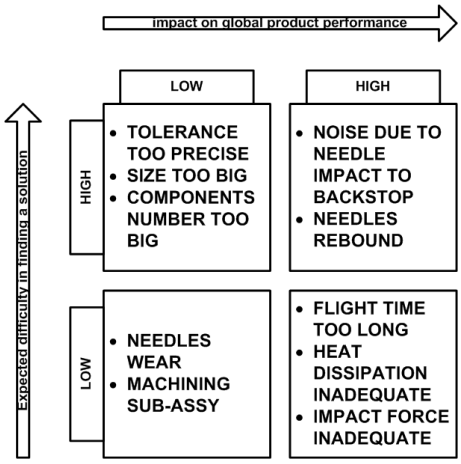
## Introduction

Esc Engineering, an Italian sme experienced with dot impact printing technology, was engaged with the design of a new printhead. Even if breakthrough solutions were not expected, for instance because the maturity of technology, the aim of the project was to outperform products in the market for product performances and price. A Triz based approach was applied in the earlier stage of the design process.

## Applicating the methodology

By means of a thorough Problem Flow Network analysis [1], the implicit knowledge of the design team was put on paper for the first time. Moreover, cause-effect phenomena were explicated very clearly and deeply understood in their complexity. A number of prospects solutions to single problems showed up in this stage.

In the meantime a patent investigation showed the evolution of technology both on product and process standpoints, giving a clear picture of the state of the art and directions of development. [2]

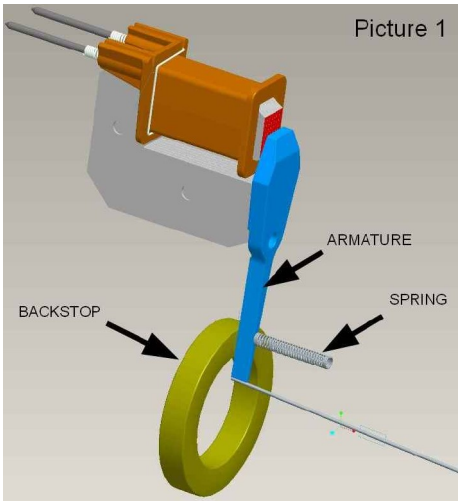



Following step was the prioritisation of problems to face: this process was based on a matrix were “impact on performance” and “difficulty in solving” were considered. Top priority was set for “high” on both criteria, since this would have led to best outcomes on the new product design.

In the paper are shown in deeper details the step of the process, as well as some examples of top priority problems that were subject to a deeper analysis, by means of a careful study of contradiction “clouds” and functional model analysis.

## Backstop example

The core of an impact printhead is an electromagnet where the armature has a particular shape and drive a needle to impact the paper. (see picture 1)




The initial position of the armature (zero) is very important and it is achieved by keeping the armature lying against a reference, called backstop, by a spring load.
While working, the armature position changes from zero to paper impact positions at a high frequency (up to 3 KHz). When returning to the zero position, the armature has abundant kinetic energy and a rebound effect happens.
This rebound is harmful for the printhead working and for the printout quality. Noise is a secondary harmful effect due to the armature impact against the backstop.

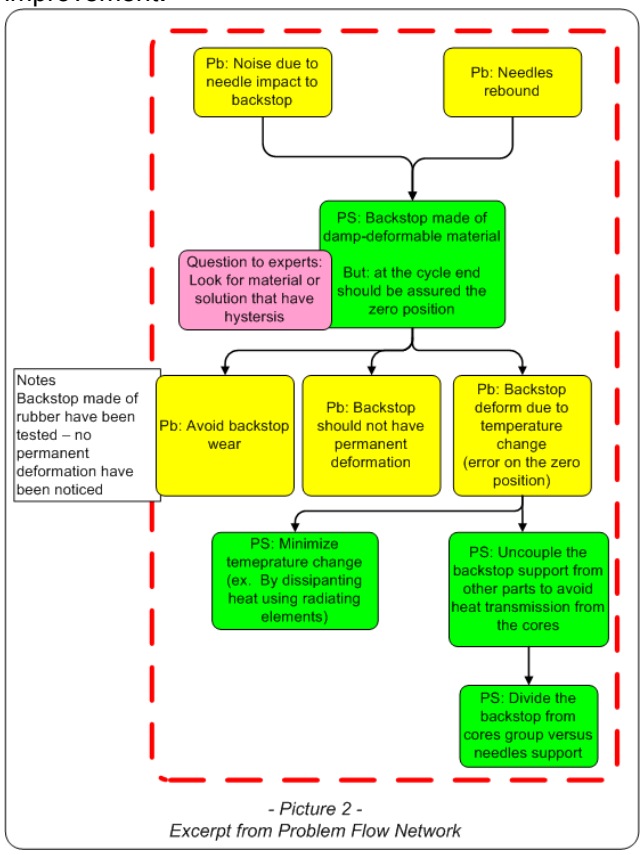
As shown in the diagram (see picture 2), the part related to the backstop was extracted for further analysis from the general Problem Flow Network.

Starting from that diagram, the following cloud of contradictions was identified (see picture 3) and a (partial) Functional Analysis was examined, to better understand contradictions (see picture 4)

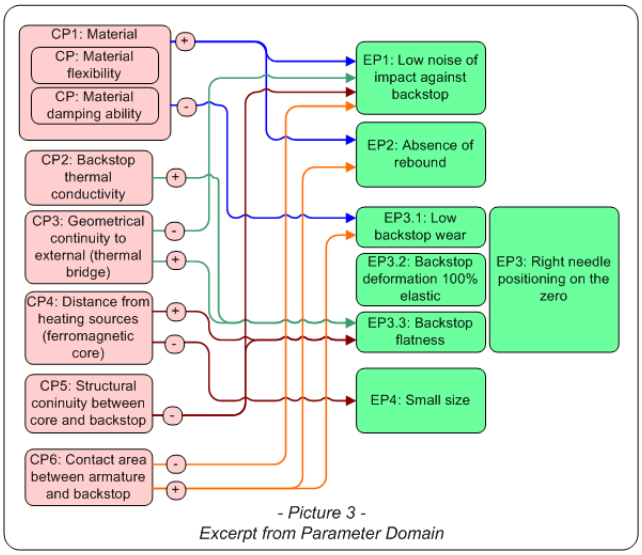
## Design and development

On the grounds of these outcomes, the design cycle was carried out and lead to a first prototype that showed a potentially good performance and a bunch of engineering problems.
The second iteration of design was by far easier than in previous experiences, because problems were not conceptually new, but already set on PFN chart. Solutions to them could be found in the PFN itself or with

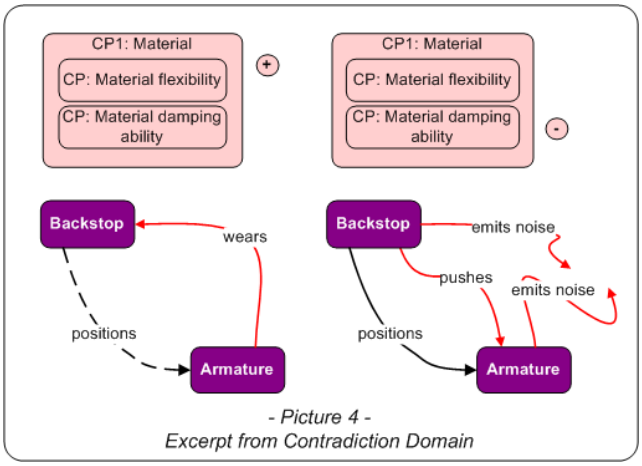
further methods already tested. Thanks to this situation, the second prototype lead to satisfying project targets and outreaching most of them.
Besides, team productivity in the whole project was better than in the past, even considering time and resources spent in preliminary analysis with Triz approach, since usually more than 2 design iterations were necessary. Last but not least, team "awareness" of product was increased, leaving open the road to further improvement.



*- Picture 2 -*
*Excerpt from Problem Flow Network*



*- Picture 3 -*
*Excerpt from Parameter Domain*



*- Picture 4 -*
*Excerpt from Contradiction Domain*

## Conclusions

The experience of application of Triz lead therefore the development team to remarkable and better than expected outcomes in:

- product performances
- manufacturing cost
- competitive factors
- development team performance (total time and cost)

A non trivial engineering and experimental work has however to be carried out to refine conceptual solutions provided by means of Triz methodology.
Applying a Triz approach to a new design cycle, the team benefited with remarkable improvement in ideality of the system and showed directions for further relevant increases.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### CONTACT AUTHOR


- Lorenzo Duroux - Esc Engineering srl - Via Baraggino-10034 Chivasso - TO – Italy
Tel: +39 011 0436265 - 393 246 5294 (mob) - e-mail: lorenzo.duroux@esc-engineering.com
- Ezio Roppolo - Business Development Management srl - Corso Francia 32, 10143 Torino – Italy
Tel +39 011 1950 0648 - 335 233458 (mob) - e-mail: roppolo@businessdevelopment.it ezio.roppolo@lep.polito.it