

AN EFFECTIVE PRODUCT DEVELOPMENT TRIZ BASED APPROACH

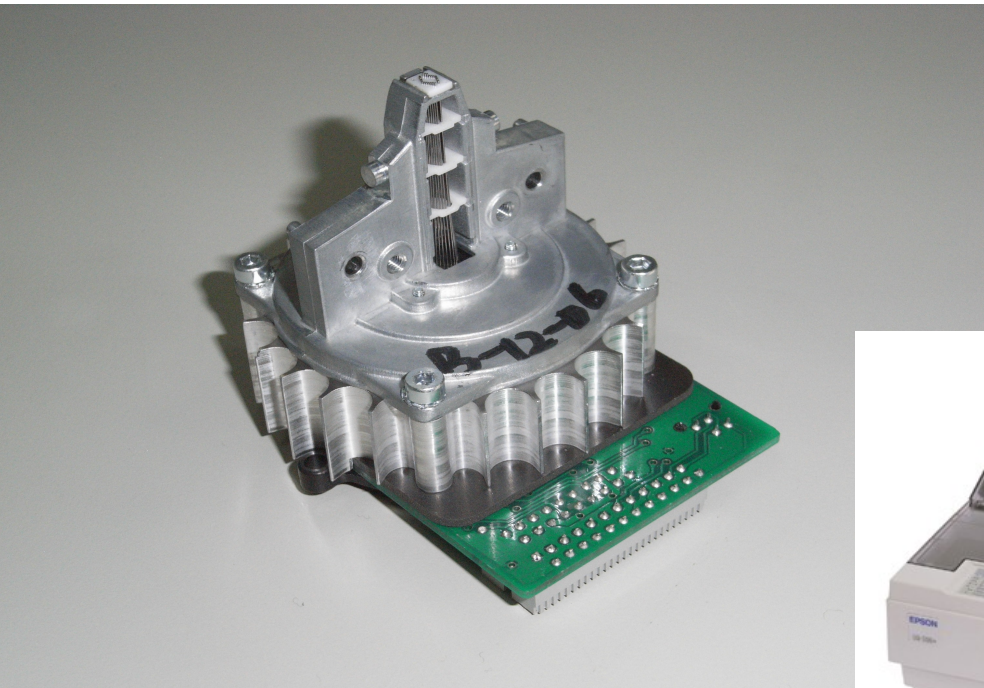
An effective product development Triz based approach

SUMMARY

1. Introduction
2. Applying the methodology
3. Design and development
4. Outcomes & Assessment
5. Conclusions

1 - INTRODUCTION

DOT IMPACT PRINTING TECHNOLOGY



2 - APPLYING THE METHODOLOGY

- analysis of the problem, according to the OTSM

(6 steps)

- *execution of the design*
- *dealing with prototyping, testing, iteration of evaluation and correction of problems*

2 - APPLYING THE METHODOLOGY

STEP ONE

Performance target settings for the development process

- support from a team of Triz Experts (University of Firenze)
- the leader of the development team shared product knowledge and related problems expertise

2 - APPLYING THE METHODOLOGY

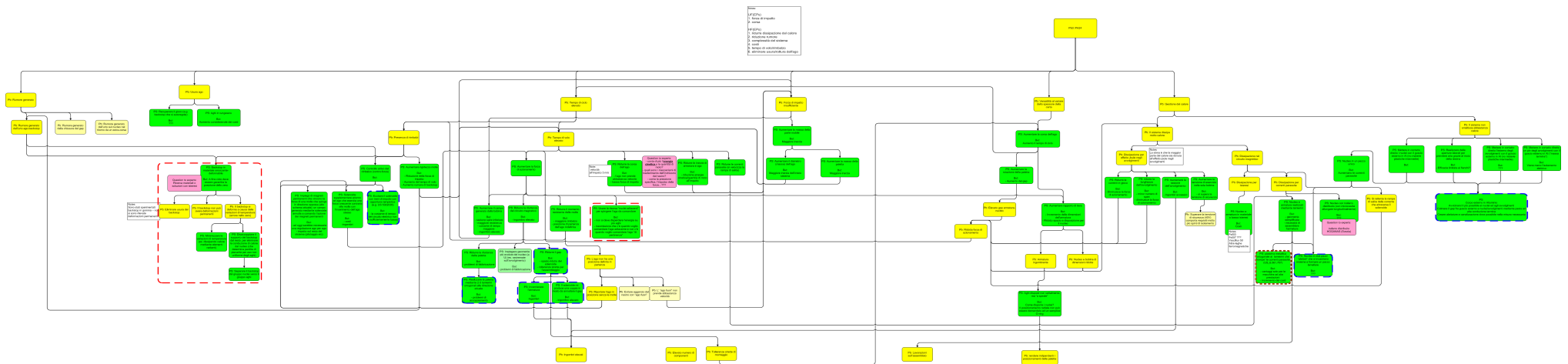
STEP ONE

Specific target was to improve “printing quality” and this was detailed by the main technical parameters affecting it:

- “static displacement” (distance between of the needle point in the offset position and paper)
- “needle force” in impacting paper

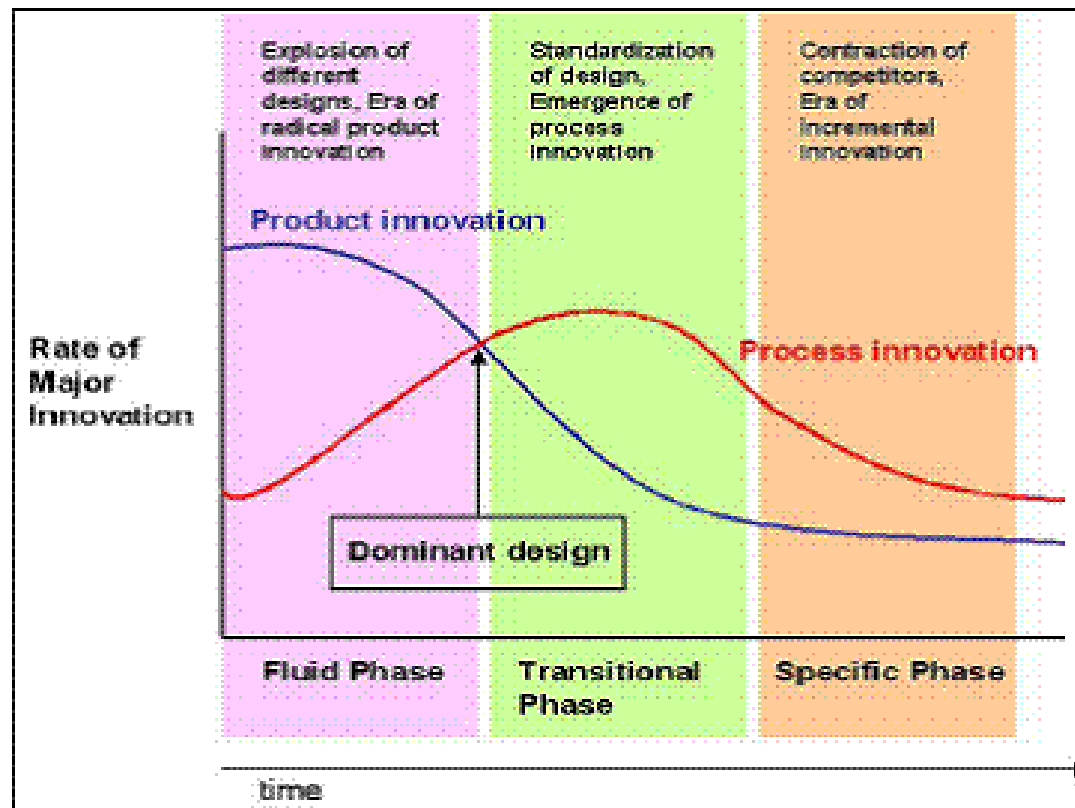
2 - APPLYING THE METHODOLOGY

STEP 2: Problem Flow Network of the product



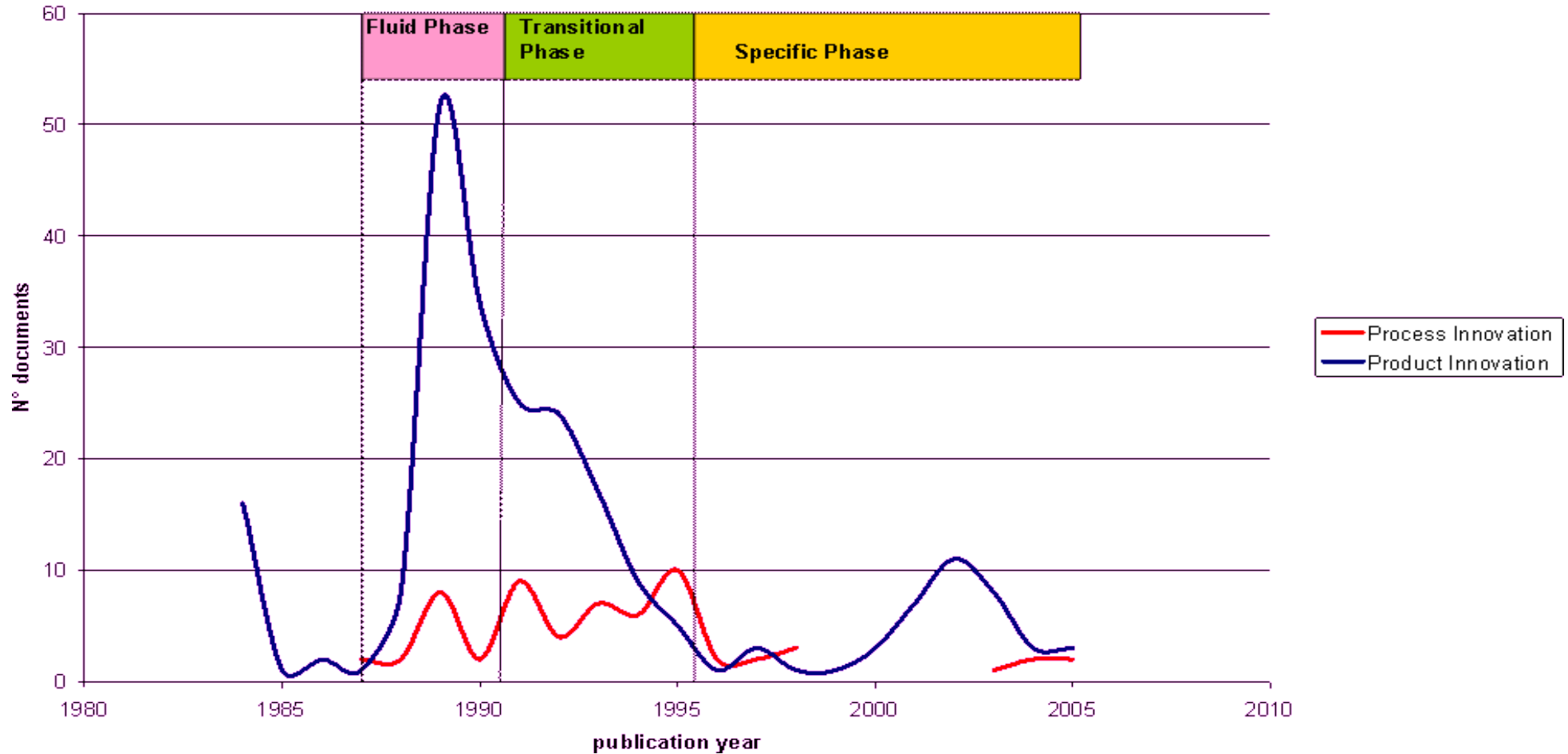
2 - APPLYING THE METHODOLOGY

STEP 3: a patent query



2 - APPLYING THE METHODOLOGY

curve di innovazione



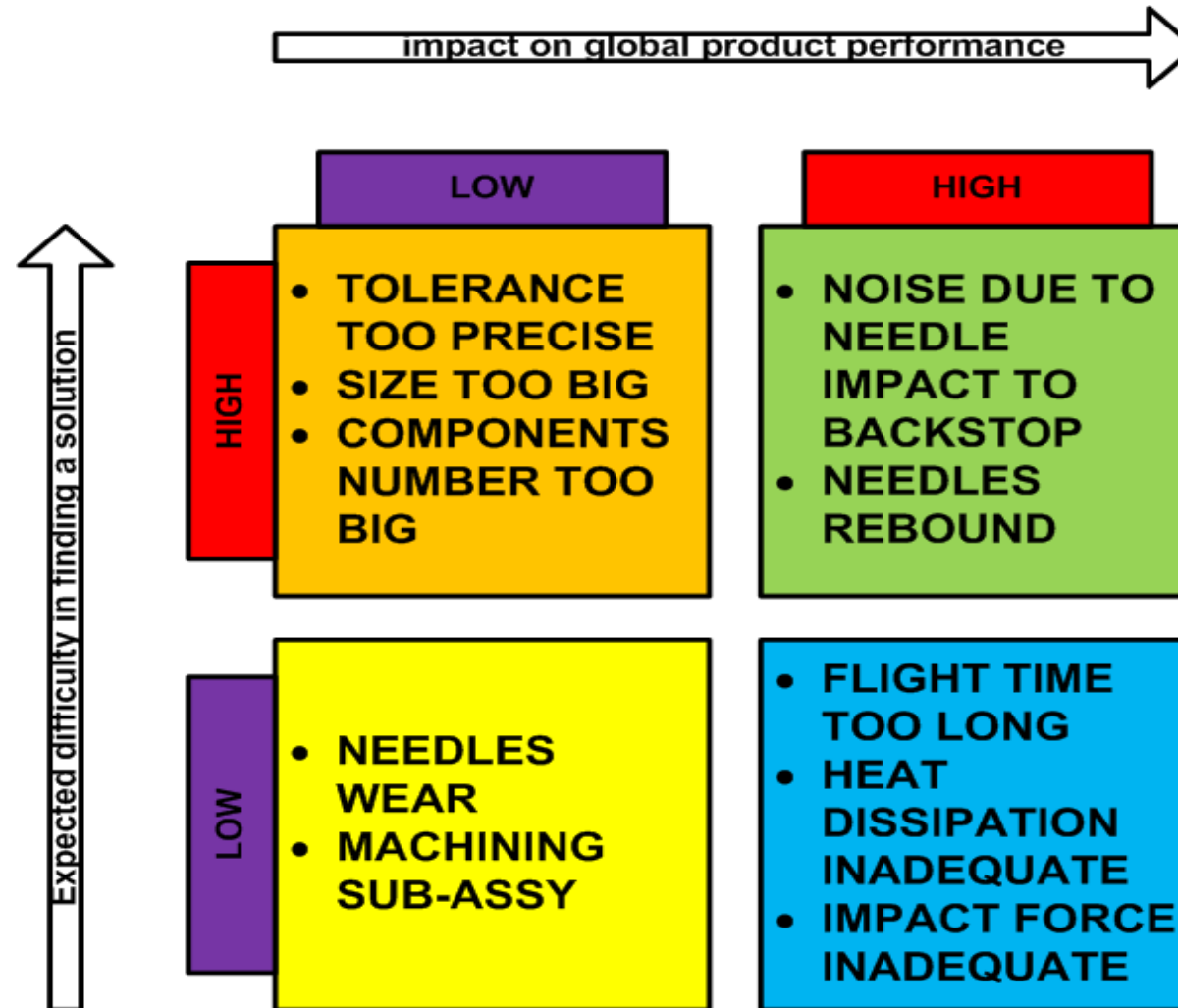
2 - APPLYING THE METHODOLOGY

STEP 4: choice of problems to face

following the PFN priority was defined as:

- expected difficulty in finding a solution
- impact on global product performance

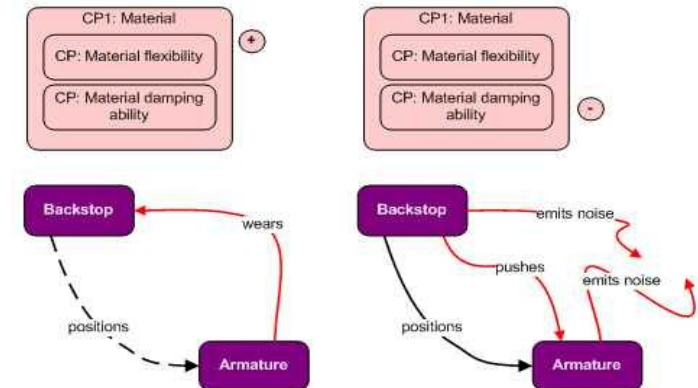
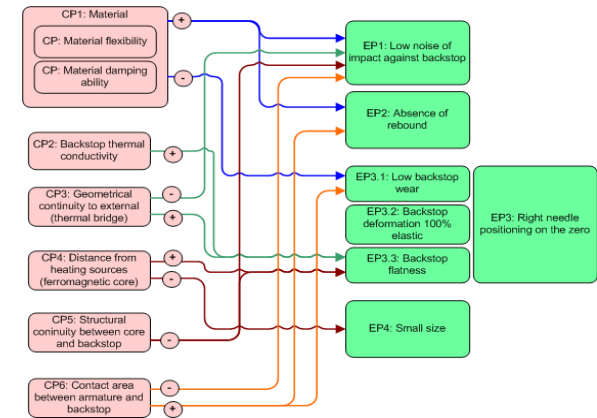
2 - APPLYING THE METHODOLOGY



2 - APPLYING THE METHODOLOGY

STEP 5

- study of contradiction “clouds”
- functional model analysis



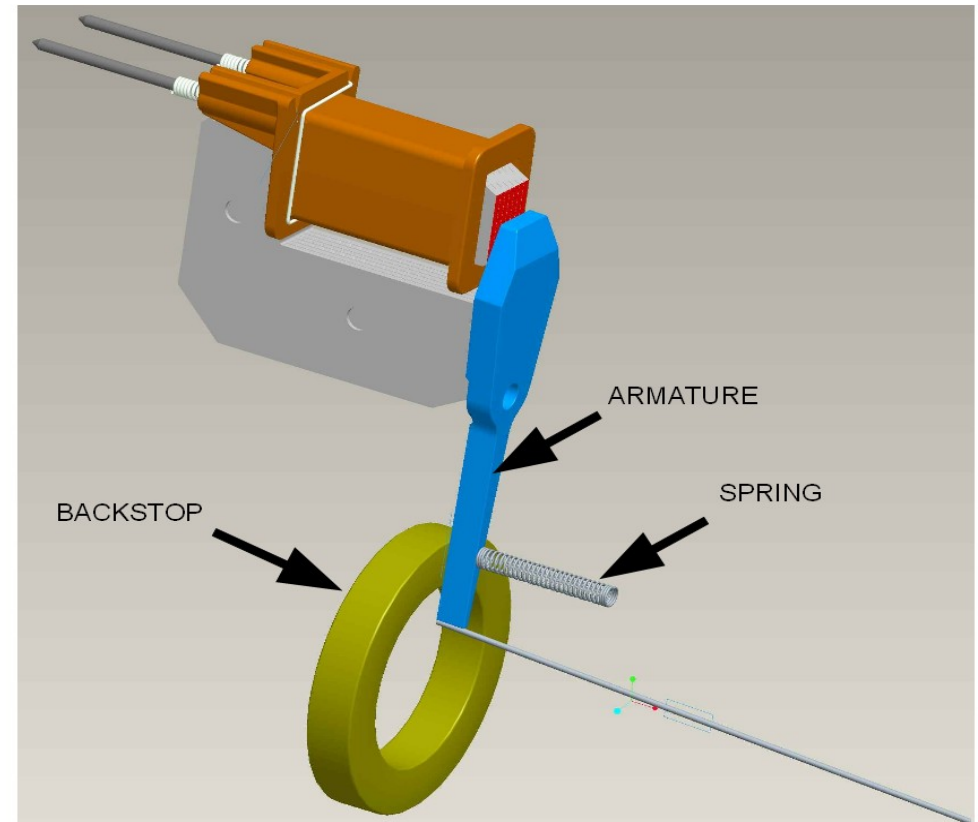
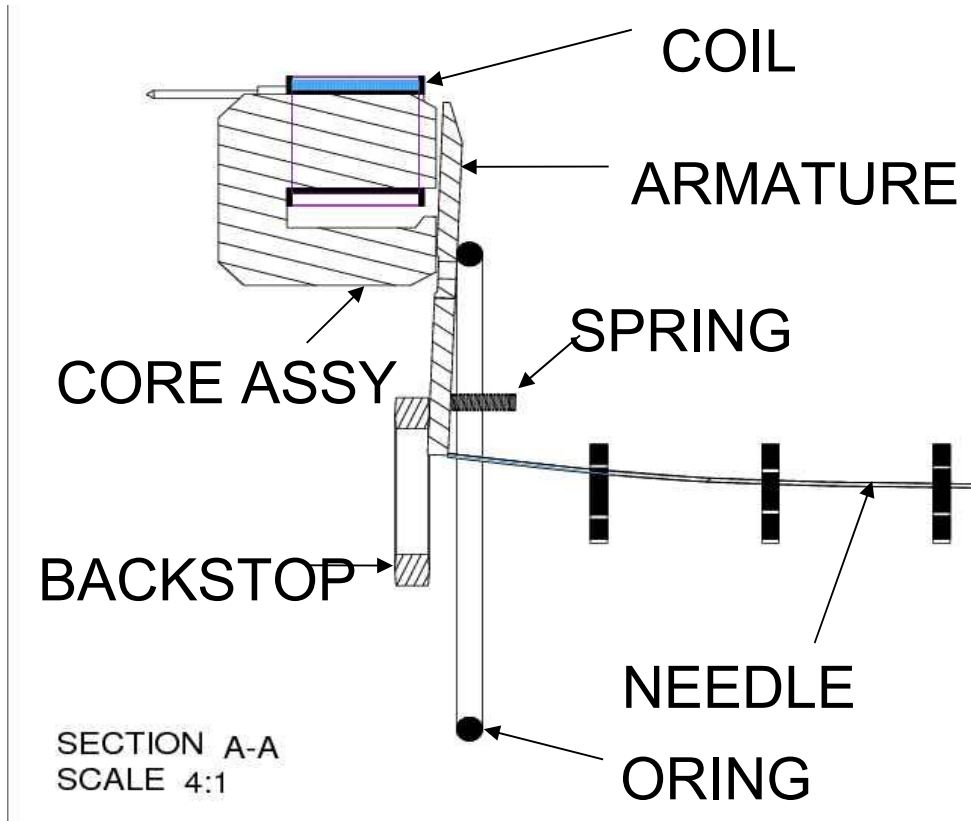
2 - APPLYING THE METHODOLOGY

STEP 5

Definition of conceptual solutions and their supposed technical viability

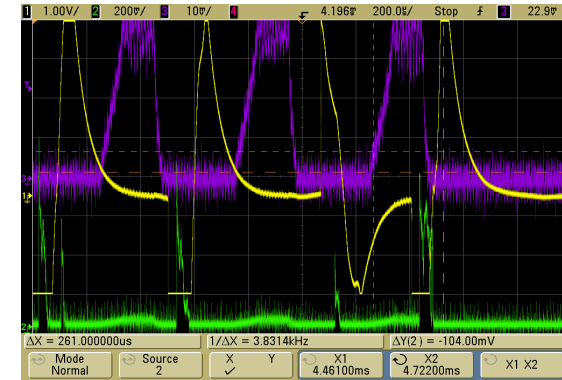
- separation in time and space
- macro-micro
- exaggeration of contradictions
-

BACKSTOP EXAMPLE



BACKSTOP EXAMPLE

HARMFUL FUNCTIONS



- REBOUND

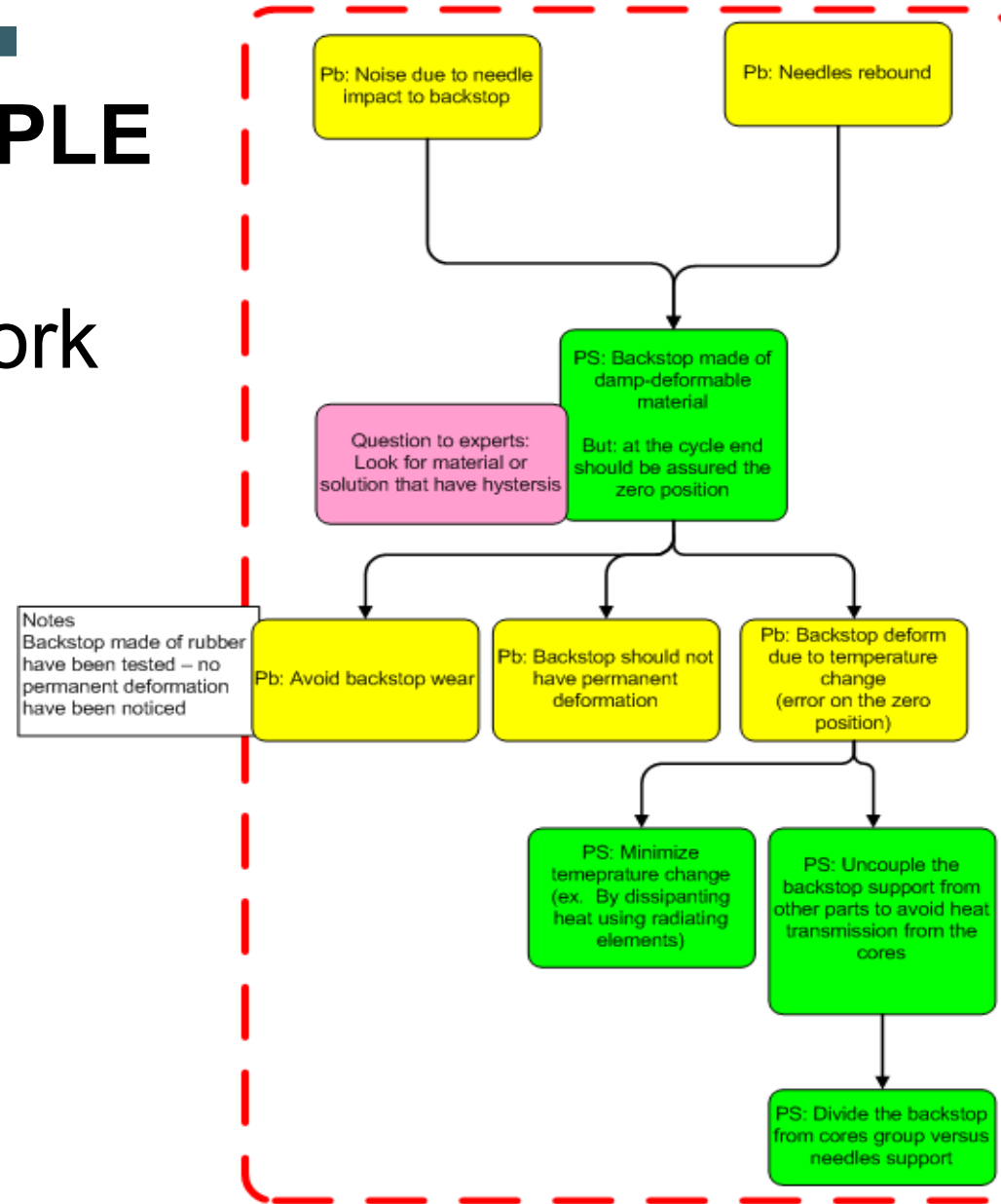
- It depends also on the backstop material properties and it is harmful for the printhead working and for the printout quality

- NOISE

- As a secondary harmful effect due to the armature impact against the backstop is noise

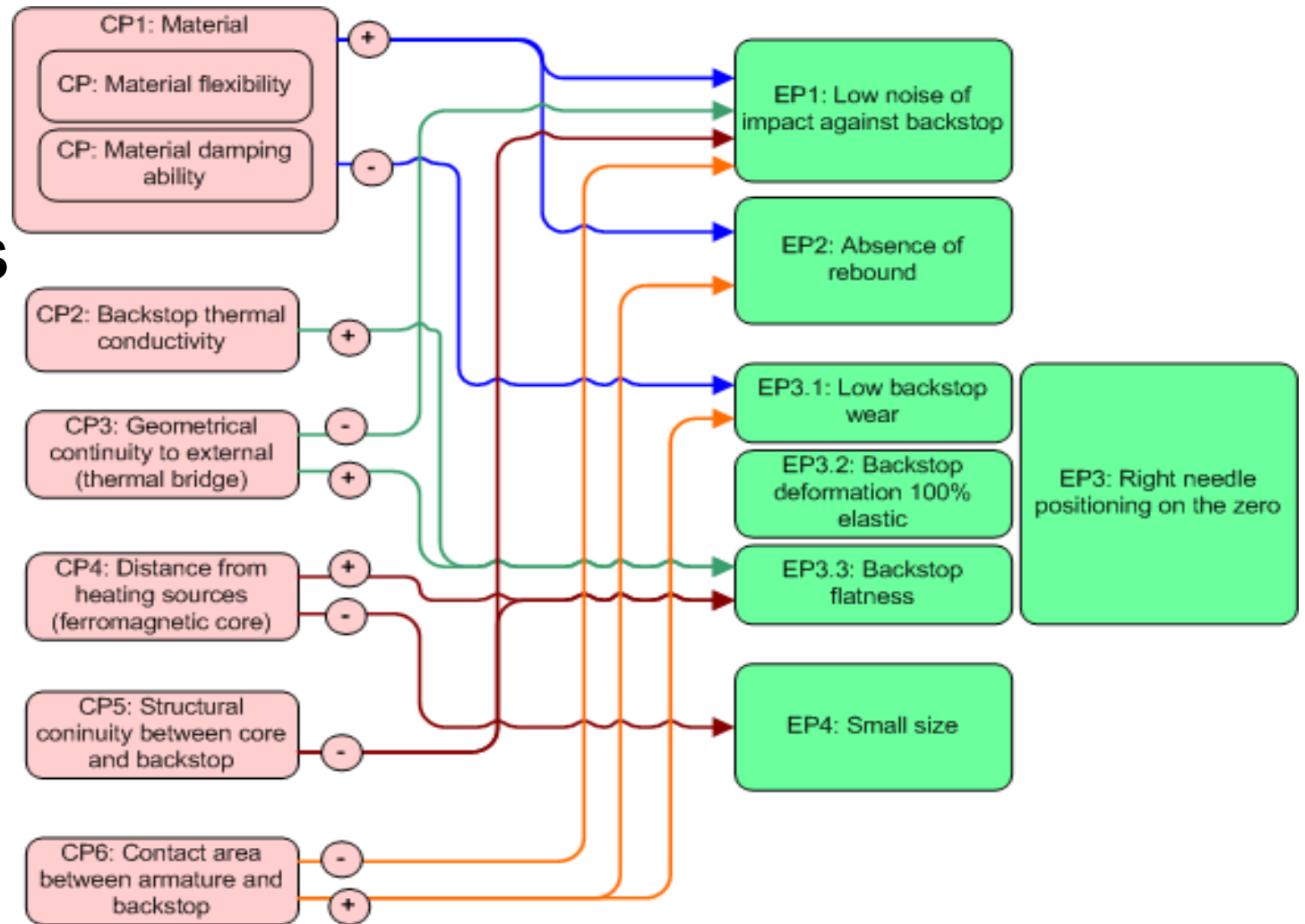
BACKSTOP EXAMPLE

Problem Flow Network



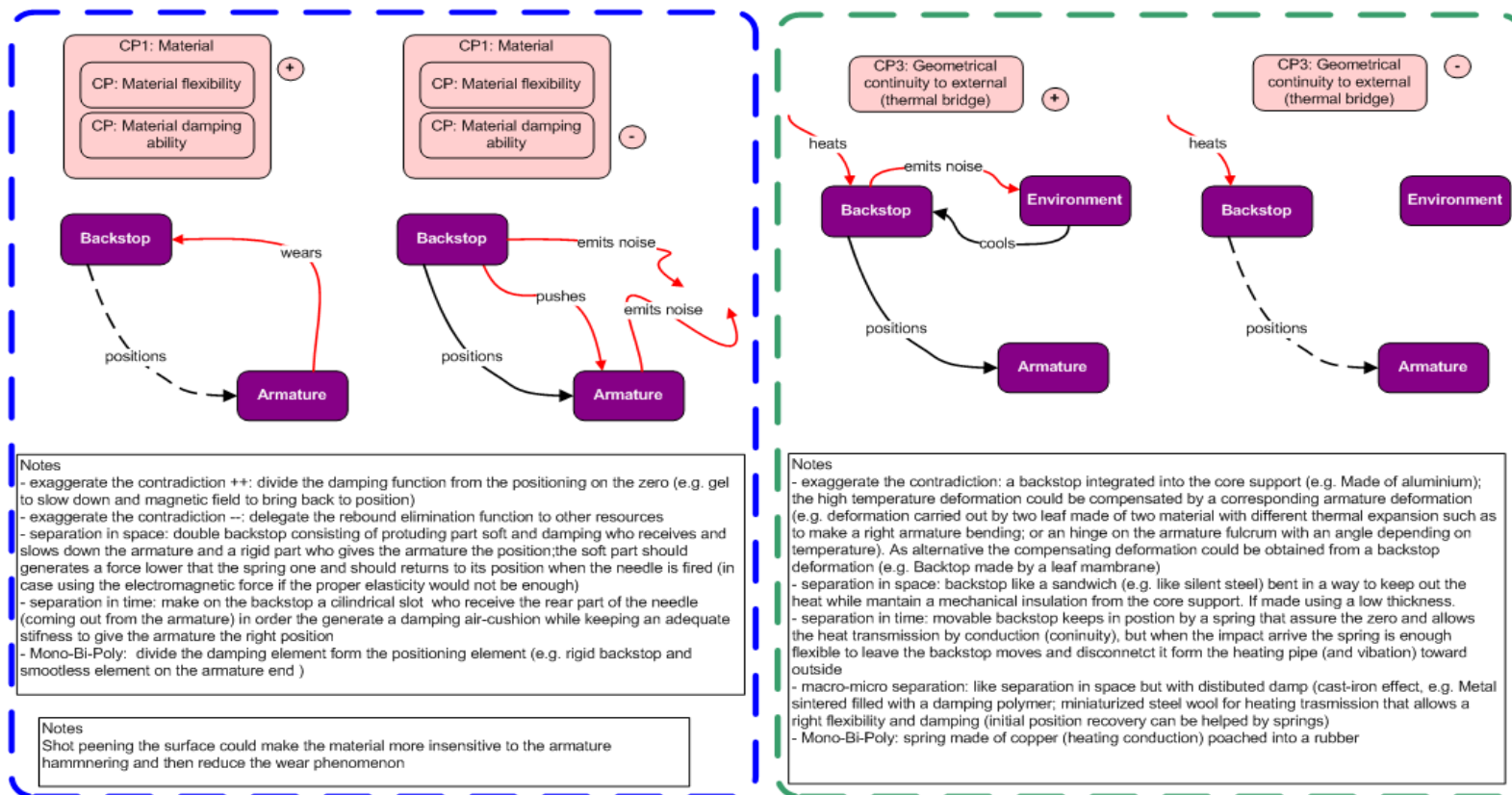
BACKSTOP EXAMPLE

cloud of contradictions



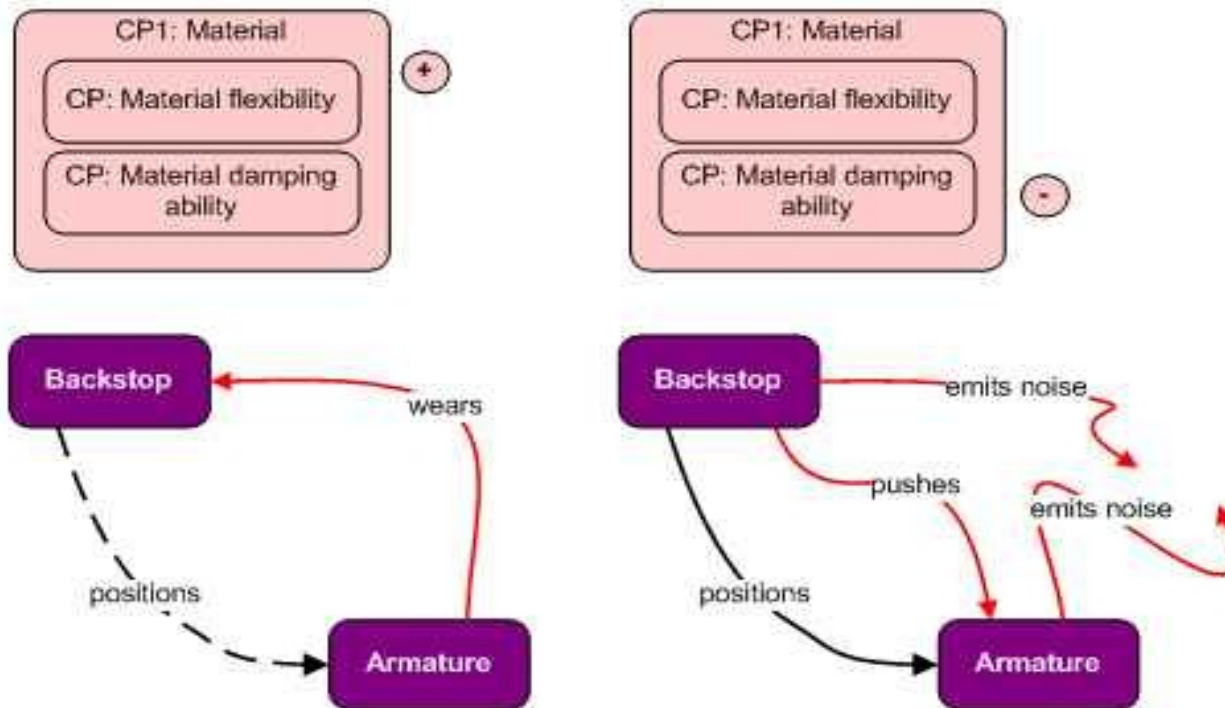
BACKSTOP EXAMPLE

partial Functional Analysis



BACKSTOP EXAMPLE

partial Functional Analysis



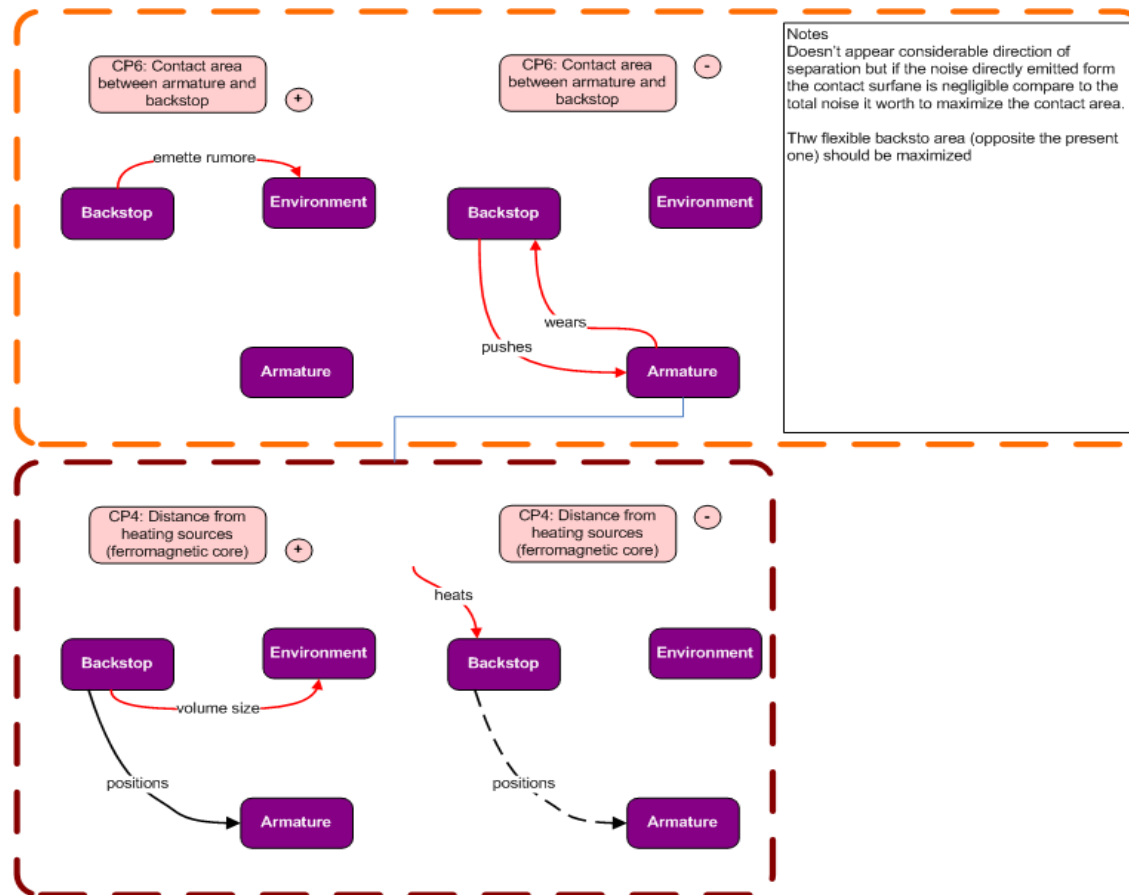
BACKSTOP EXAMPLE

partial Functional Analysis

Notes

- **exaggerate the contradiction ++** divide the damping function from the positioning on the zero (e.g. gel to slow down and magnetic field to bring back to position)
- **exaggerate the contradiction --**: delegate the rebound elimination function to other resources
- **separation in space**: double backstop consisting of protruding part soft and damping who receives and slows down the armature and a rigid part who gives the armature the position; the soft part should generate a force lower than the spring one and should return to its position when the needle is fired (in case using the electromagnetic force if the proper elasticity would not be enough)
- **separation in time**: make on the backstop a cylindrical slot who receives the rear part of the needle (coming out from the armature) in order to generate a damping air-cushion while keeping an adequate stiffness to give the armature the right position
- **Mono-Bi-Poly**: divide the damping element from the positioning element (e.g. rigid backstop and smooth element on the armature end)

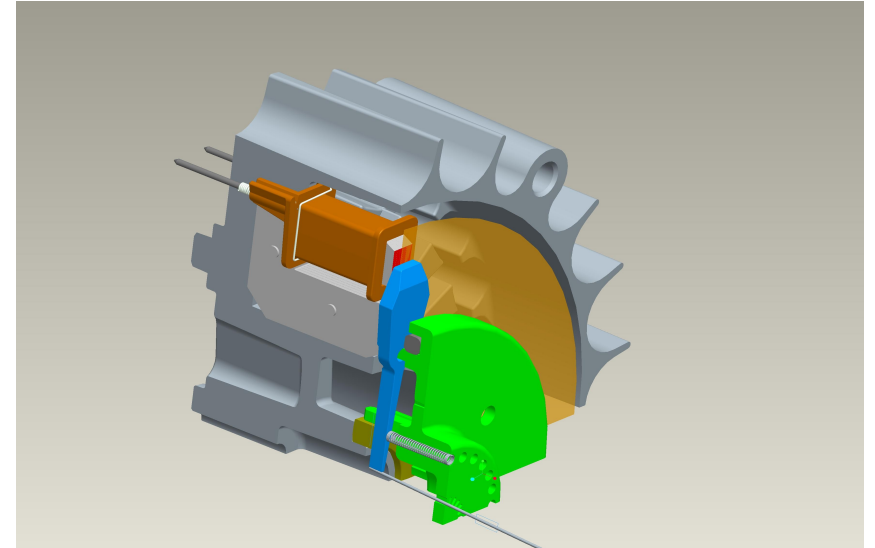
BACKSTOP EXAMPLE



2 - APPLYING THE METHODOLOGY

STEP 6

Choice of priorities or constraints to be considered in following stage of design.



2 - APPLYING THE METHODOLOGY

Development team got remarkable advantages:

- Much clearer and complete view of the subject
- Easy ranking of priorities and constraints for consideration in following stage.

2 - APPLYING THE METHODOLOGY

The whole stage:

- deploying time : 1 quarter (1 man/month of work)
- cost : 20.000 euro, about

Time & cost can be seen as "extra" compared to previous experiences in design process, but ...

3 - DESIGN AND DEVELOPMENT

detailed design work and first prototyping:

- required a quarter
- same as previous experiences

2 more months loop to reach design targets

**.... in the previous design cycles AT LEAST
two loops were necessary**

4 - OUTCOMES & ASSESSMENT

- trial & error was the underground method followed in previous projects
- advantages taken by Triz approach:
 - To have ready solutions to problems emerged from first prototype
 - or, at least, likely causes generating them

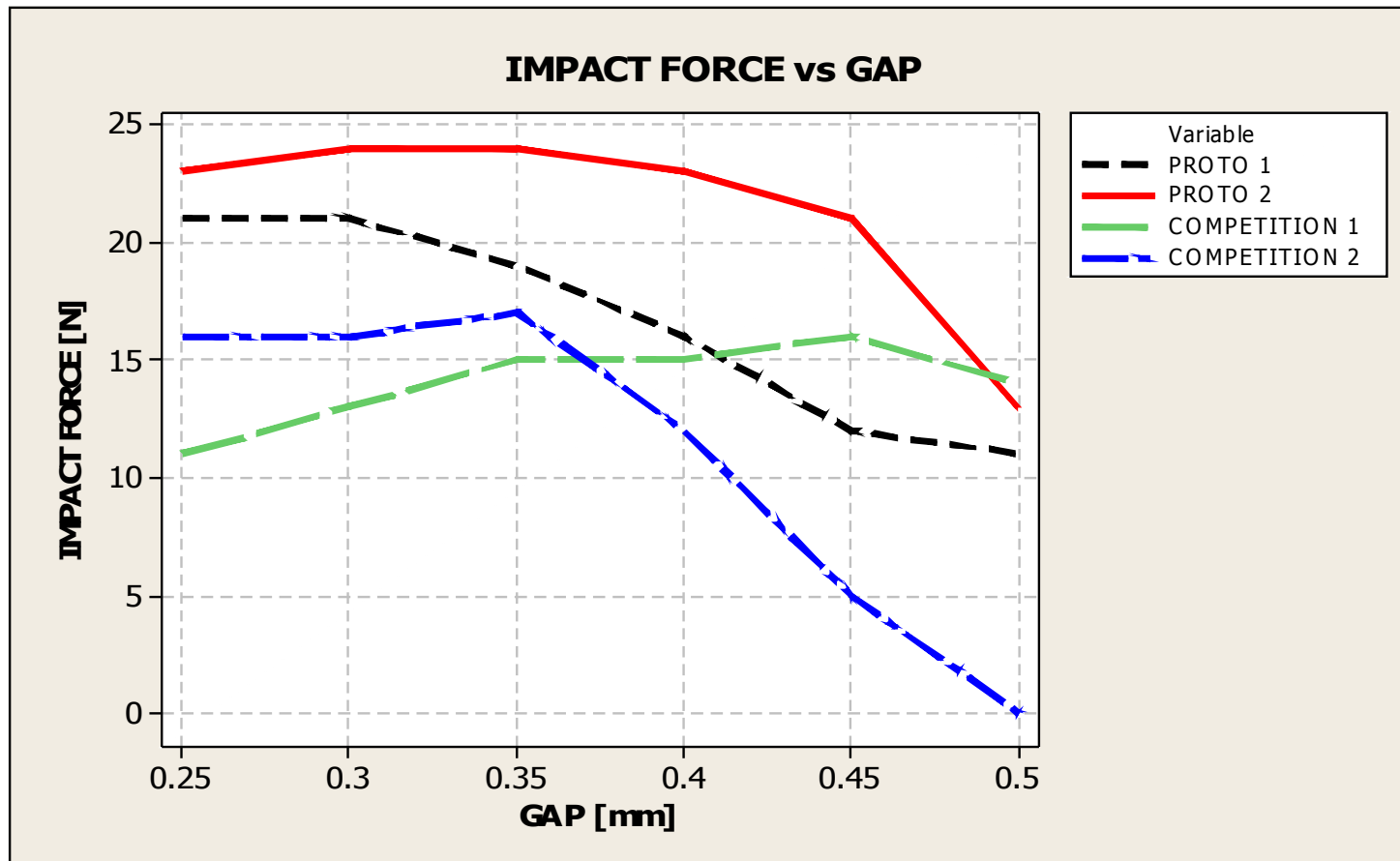
4 - OUTCOMES & ASSESSMENT

- Successful corrections of design concepts in second prototype
- Corrections did not “capsize” the design concepts, but were just refinements of “second level”

4 - OUTCOMES & ASSESSMENT

- Increase in performance was substantial in the second prototype (from first and from previous).
- Conceptual solutions found by means of Triz needed a non trivial work of engineering “to be put at work” effectively

4 - OUTCOMES & ASSESSMENT

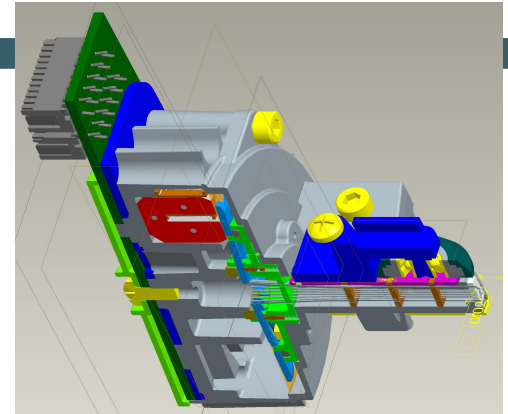


5 - CONCLUSIONS

The experience of application of Triz lead the development team to a better than expected outcome under all different standpoints:

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

5 - CONCLUSIONS



Dot matrix impact printing technology is considered mature and the specific development team considered itself deeply acquainted with it.

Notwithstanding that, and even if breakthrough solutions were not really on target, Triz approach lead to a remarkable improvement in ideality of the system and showed directions for further relevant increases.

Product itself deserves a further reflection !

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ACKNOWLEDGEMENTS

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Thank you !

Q&A