Using systematic innovation to develop a new hardwood harvesting tool

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This work is part of the ECOMEF project (Eco-design of mechanized equipment for hardwood harvesting) which aims to develop a tool designed to harvest broadleaved trees.

Context

Over the past 30 years, France has known a gradual decrease in the number of loggers linked to the hardship and danger of the activity. In response to the rarity of the manual workforce and its increasing cost, forest logging mechanization has been developing. Today, the softwood mechanization rate reached a substantial level of around 65% in France, whereas hardwood mechanization rate stagnates at about 6-7%, mainly due to the inadequacy of existing harvesting machines, which are initially developed for softwood. Despite the shortage of labor and the mechanization difficulty, increased French crop is expected and mainly in broadleaved stands. Therefore, the harvesting mechanization in hardwood stands becomes inevitable.

Problem determination

Detection of problems can be undertaken using information and data from customer surveys, published sources (reports, patents, research...) and at specific sites (laboratories, test benches, plants...).

The principal problems observed for harvesting mechanization in hardwood are:
- Crossing of sinuous trunks in the harvester head
- Delimbing large branched tree
- Gripping a tree in a clump

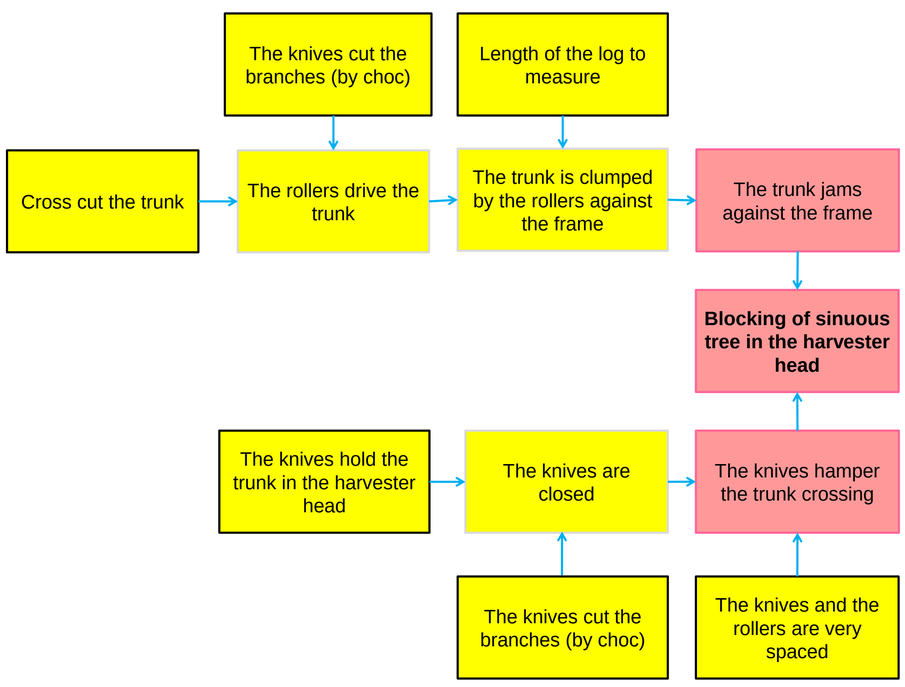
Sinuous tree (young oak)

Chestnut clump

Problem formalization

This phase tends to consider the noted problem and retain only the real problem.

The Root Cause Analysis is useful in understanding the problem and troubleshooting the root cause. The cause-effect model was used to support the RCA process. It enabled to show the relationship of the causes to the effect and to each other.



Cause-effect model of the problem "blocking of sinuous tree in the harvester head"

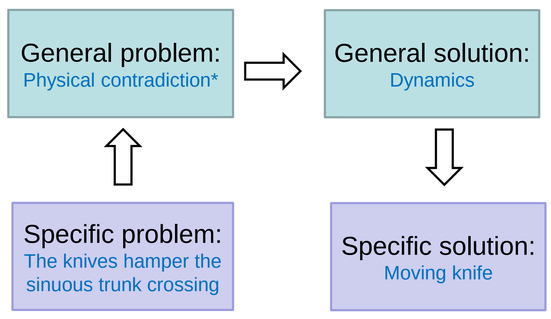
When the root cause is identified then the inventive challenge is to find a way to eliminate the problem by using TRIZ.

Concept generation by using TRIZ

TRIZ is a Russian acronym which means Theory of Inventive Problem Solving. It is a creative problem-solving methodology especially tailored to scientific and engineering problems.

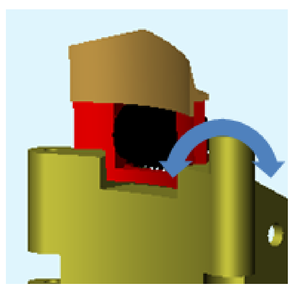
The TRIZ methodology consists in describing the specific problem, generalizing it, defining the general solution and then applying it to the specific problem. To generalize a problem, it is necessary first to conceptualize: this involves transforming the initial specific problem into a standard problem model. In this problem model, TRIZ theory matches one or more models of solutions. The solution models are then interpreted by the development team as technological realities, and evaluated in order to reach the solution that optimizes the available resources.

* The knives should be **closed** to hold the trunk and cut the branches and should be **opened** to let sinuous trunk cross in the harvester head

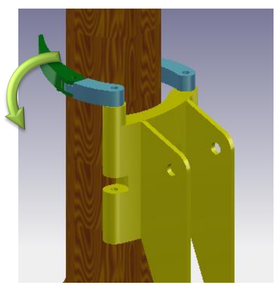


The TRIZ principle and its illustration for the identified problem "blocking of sinuous tree in harvester head"

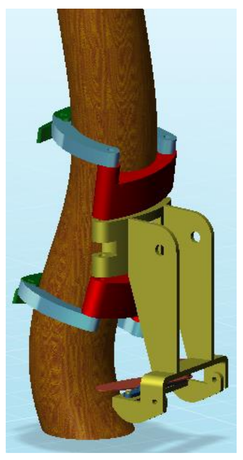
Some generated concepts for the problem "blocking of sinuous tree in harvester head":



Articulated knife



Moving knife



Articulated frame

Conclusion

- For the generation of ideas, the process is often stochastic. If an idea is bad, it is discarded and a new idea is put forward. In our study, it seemed necessary to use a method which rejects high randomness and systematize the innovation process such as the TRIZ method.
- Solution concepts generated through the systematic innovation are under development by the project partners.
- Field tests of the promising solutions are planned soon.

ECOMEF project approved by the competitiveness clusters

ECOMEF project partners

Financial backing for ECOMEF project