

PETROZAVODSK STATE UNIVERSITY
FACULTY OF MATHEMATICS
DEPARTMENT OF APPLIED MATHEMATICS AND CYBERNETICS

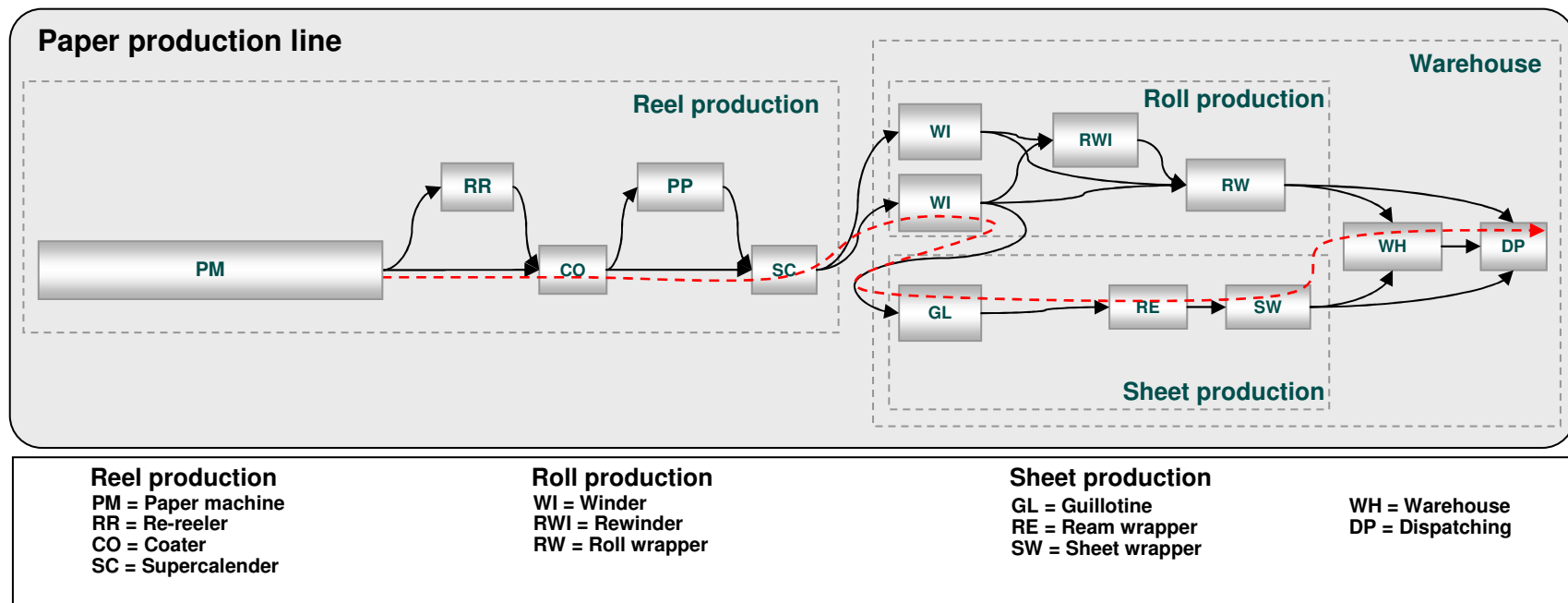
Search Problem of the Reels Cutting Optimal Sequence

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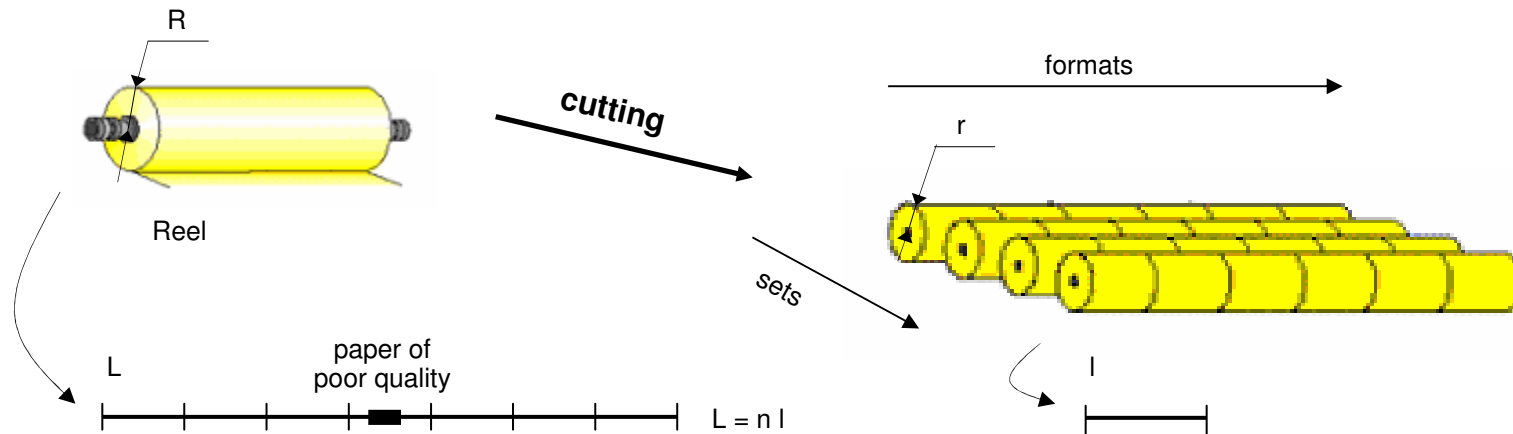
Paper production

- complex sequential engineering process
- reel is produced on paper machine
- reel passes production line of technological phases
- reel is cut on winder into great number of rolls

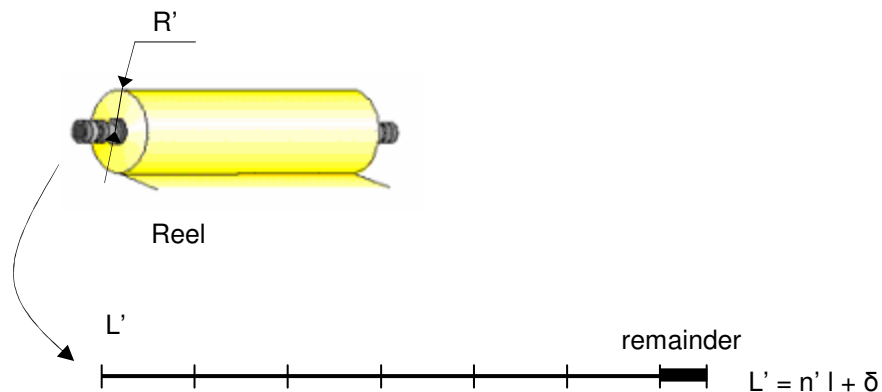


Non-standard reels formation

Standard reels



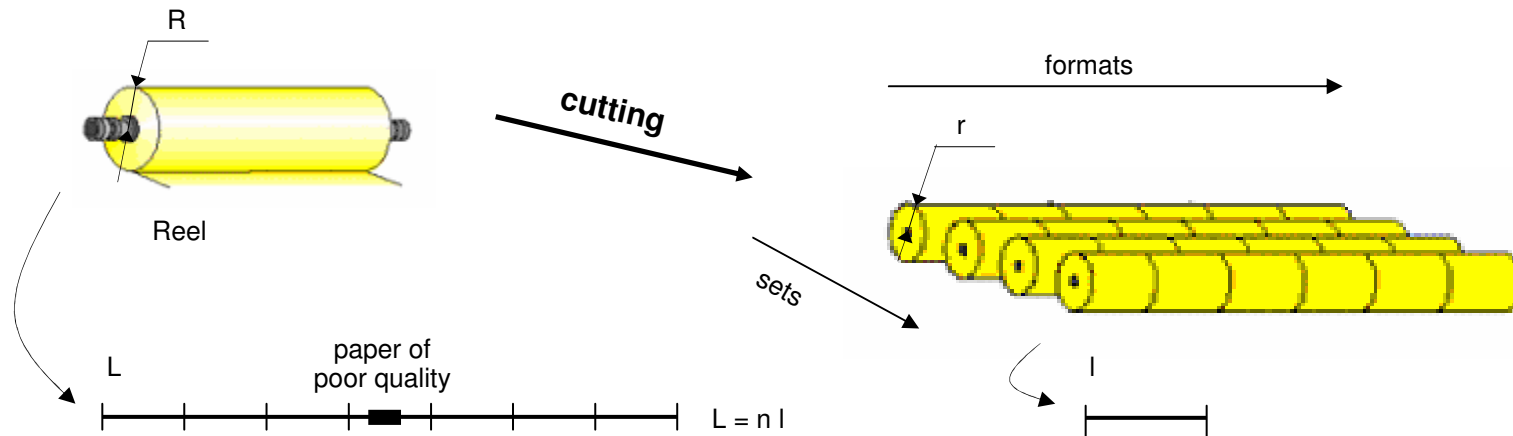
Non-standard reels



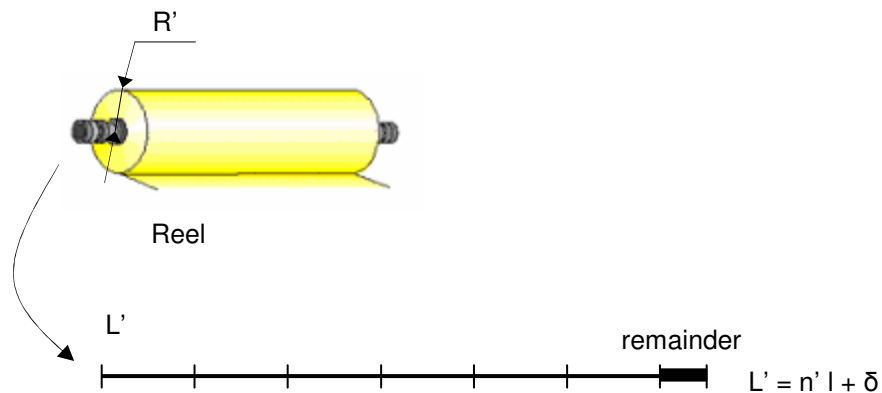
- reel is cut on winder into great number of rolls with certain lengths of generatrixes are called formats
- set of rolls – the number of rolls, which are born at the same time as the result of unwinding and cutting paper web
- paper web length should correspond to the all sets, which are forming its cutting, such reels are so called standard reels

Non-standard reels formation

Standard reels

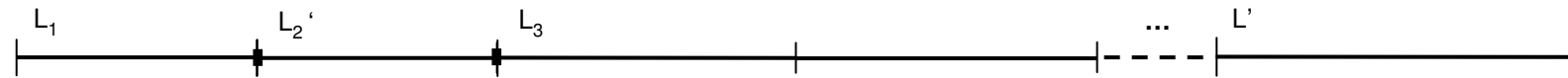
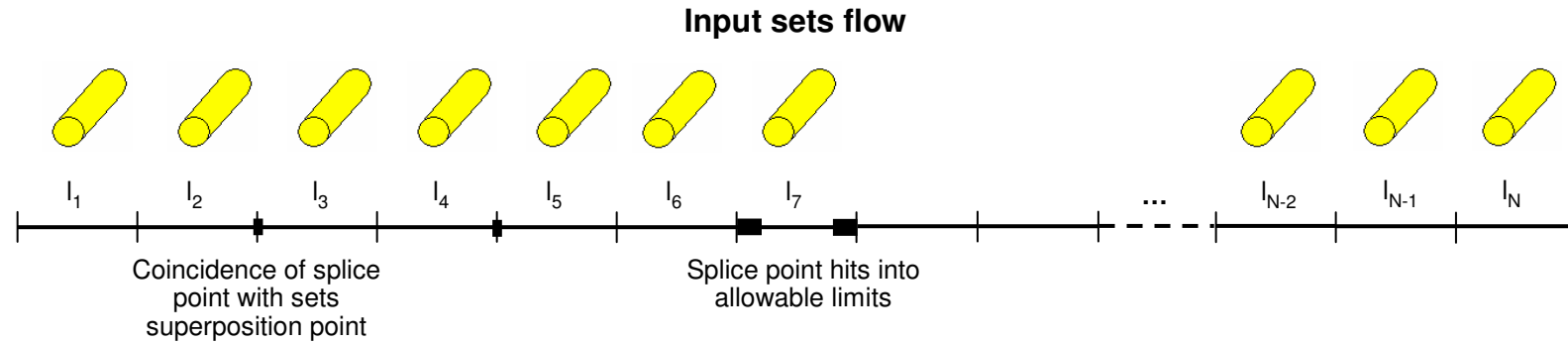


Non-standard reels

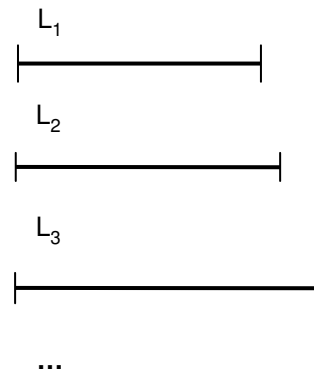


- not all produced reels could be considered as standard, because paper web break could happen during production process, otherwise paper could have bad quality or damages
- such reels are called non-standard, after cutting which some paper is left on the spool
- paper web reminders are spliced together in such a way that obtained paper web could be used in the production

Graphical interpretation of reels and input sets flow correspondence

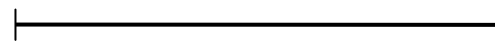


Non-standard reels



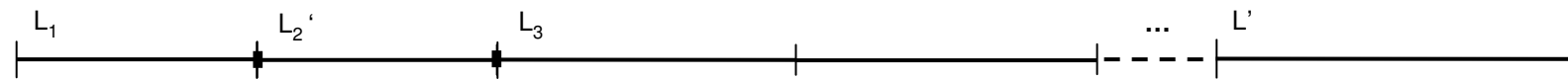
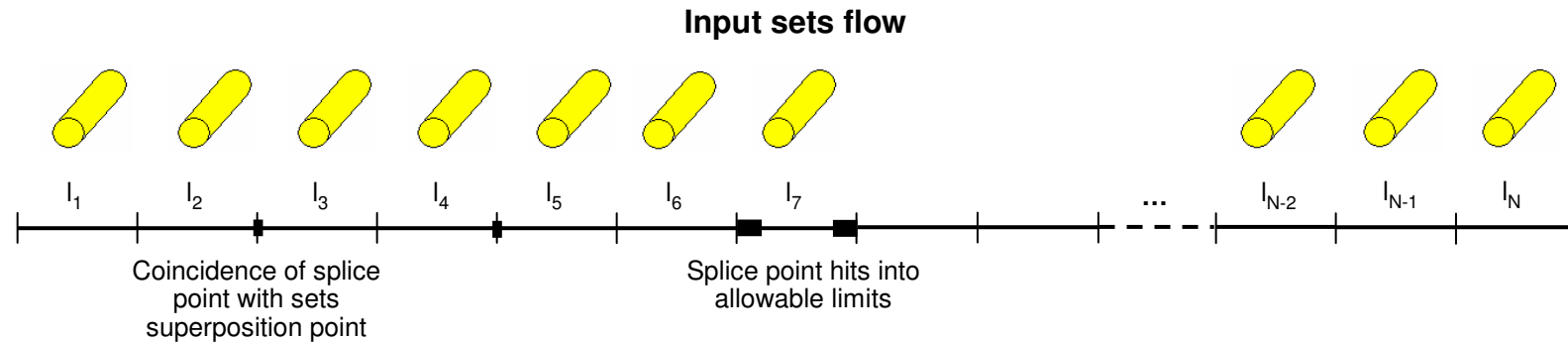
Standard reels

$$d \leq L \leq D$$

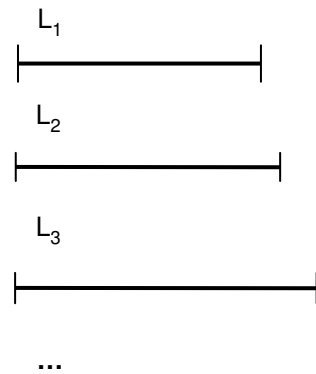


- initial data are information about sets to produce, as well as about available standard and non-standard reels
- let us to consider sequence of spliced reels as one logical reel
- after cutting such long logical reel it is necessary to take into account locations of splicing points

Graphical interpretation of reels and input sets flow correspondence

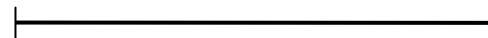


Non-standard reels



Standard reels

$$d \leq L \leq D$$



- ideally it would coincide with the points of sets superpositions
- for some sets splices are allowed at the beginning, in the middle and at the end of roll
- problem is concluded into synchronization of two flows, reels and products (sets), with taking into account the limitations for splices locations

Consideration must be given to

- Specific characteristics of the production line and equipment, including well-defined sequence of paper processing machines for one separately taken reel
- Limitations for possible reel dimensions, which can be processed on machines
- Handling of parallel machines

Solution methods

- Brute force method, when problem dimension allows it, or the exact result is required, and the time is insignificant
- Branch-and-bound method, in which solution set is reels permutations, and criterion function – minimum amount of waste
- Method of local optimization of an initial trajectory constructed by “greedy” algorithm on the base of a number of heuristics
- Genetic algorithm as the basis of method, where the sequence of used reel numbers is considered as the chromosome