Abstracts and Proceedings of the
48th Formec Symposium 2015

FORMEC

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## Symposium on Forest Mechanization
## Linz, Austria 2015

Forest Engineering Network

# Forest road network planning: a GIS-based evaluation in Italy

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**Abstract**
A well-developed road network permits sustainable management according to economic and productive rules. Moreover a good road network significantly reduces the impact on nature in forest operations. Forest operations need an efficient road network, in particular it has to satisfy the requirements to apply the best possible work method. Forest road building, management and maintenance requires a huge amount of resources, for this reason a forest road network plan has a key role in forest management in order to maximize the efficiency and the costs related to the roads. A field survey is the classical method to start developing a road network plan. Availability of terrestrial and dendrometric data, included in a GIS permits the calculation of different models such as Decision Support Systems (DSS). The aim of this study is to develop a model based on remotely sensed and field collected data, which estimates timber volumes moved on each forest road in a given period. It permits the estimation of timber flows on the road network. The study has been carried out in a public forest property located in Province of Trento, northern Italy. Thanks to a new methodology of data inventory a huge amount of dendrometric georeferenced information was available for homogeneous management units. Starting from Airborne Laser Scanner (ALS) data the Digital Terrain Model (DTM) and the slope map have been calculated. An up to date forest road network map has been generated with an arc-node representation, including a database containing all the structural information. A model able to allocate the expected timber volume to be harvested for each forest management unit on the best forest road has been developed. The model calculates the timber volumes transported for each node in each road, the movement according to transport direction, and accumulates these at arrival in correspondence with a node in a public road. Thanks to this model is possible to evaluate for the period of interest which roads much more used in terms of transit. This information facilitates the management during the planning of new roads, enhancement of the existing ones, and maintenance.

**Keywords**
forest road, forest geodatabase, timber flows, forest management

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