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The potential of intelligent operator tutoring systems in mechanised loggings

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Intelligent operator-tutoring system in this context:

A system, which generates machine-process or monitoring data into a form, which guides, assists and tutors the operator

System, which…

a) eases the decision making process of the operator

b) guides the operator to utilize effective working models and techniques

c) assists the operator to work with the machine economically efficiently without overloading the machine and its components needlessly

Few facts

WHY and HOW?

a) **Operating in mechanised loggings is highly demanding and takes time to become expert**
   - Learning takes 1-2 years in order to reach the performance capacity of each operator (Prufürst 2010, Ylimäki 2011)
   - 2 to 3 fold productivity difference between unexperienced and experienced (Ylimäki 2011)

b) **Forest machines monitor and record wast amount of machine function, work element, performance and spatial work condition data**
   - How to compile a manual for utilizing ”building blocks” of machine data?

Operator tutoring systems in other industry branches

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- Development has started in aviation, cargo shipping (autopilot, -navigation) and in military industry
- Car industry has been concentrated in safety, usability and navigation issues in last two decades
- Recently utilized more and more in heavy mobile machinery such as excavators, material handling machines, carriers in mining etc.

- According to the studies, the use of driver/operator supporting systems have reached:
  - Productivity, safety and quality improvements
  - The overall production costs have been decreased
  - According to the truck and heavy machinery operators, the uncertainty while operating has decreased and thereafter productivity levels have been increased (Huang et al. 2005, Meriläinen 2010)

Objectives:

- To obtain users opinions of **the potential and the need of the operator tutoring systems in mechanized loggings**
- To classify main problems hindering the logging operations

Material of the questionnaire based study:

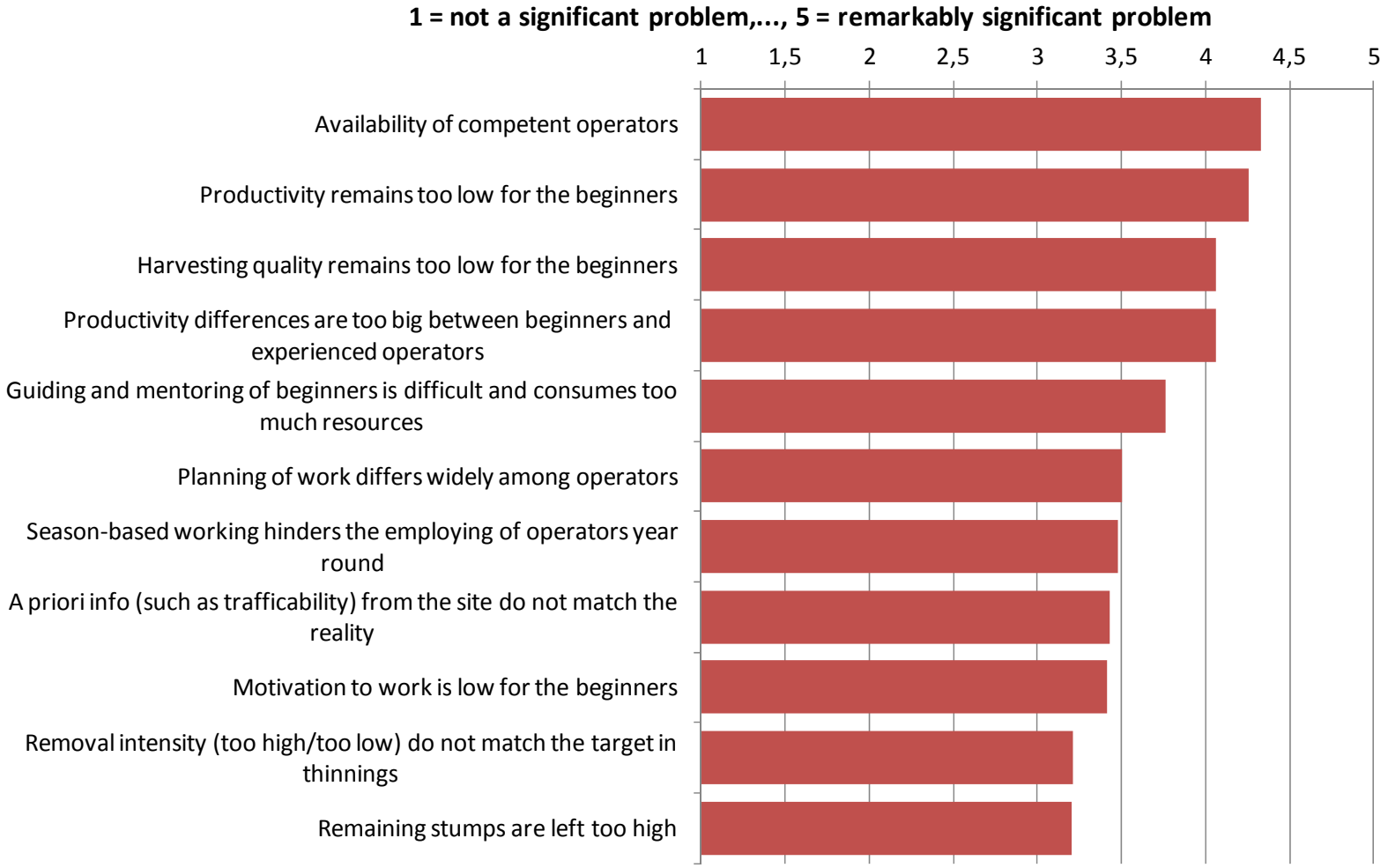
- Harvester and forwarder operators (208 responses)
- Logging contractors (47),
- Teachers (26) and students (39) of forest machine schools

RESULTS

- **Factors hindering efficient cutting (top 5):**
  1) under-growth disturbing the cutting
  2) unclear border-marking of the cutting site
  3) deficiencies in cutting orders
  4) poor bearing conditions of the terrain
  5) difficulty of estimating the distance between strip roads
- **Factors hindering efficient forwarding (top 5):**
  1) insufficient space for roadside storages
  2) poor bearing conditions of the terrain
  3) low bunching quality of log assortment bunches
  4) too narrow strip roads
  5) inefficient directing of strip road network

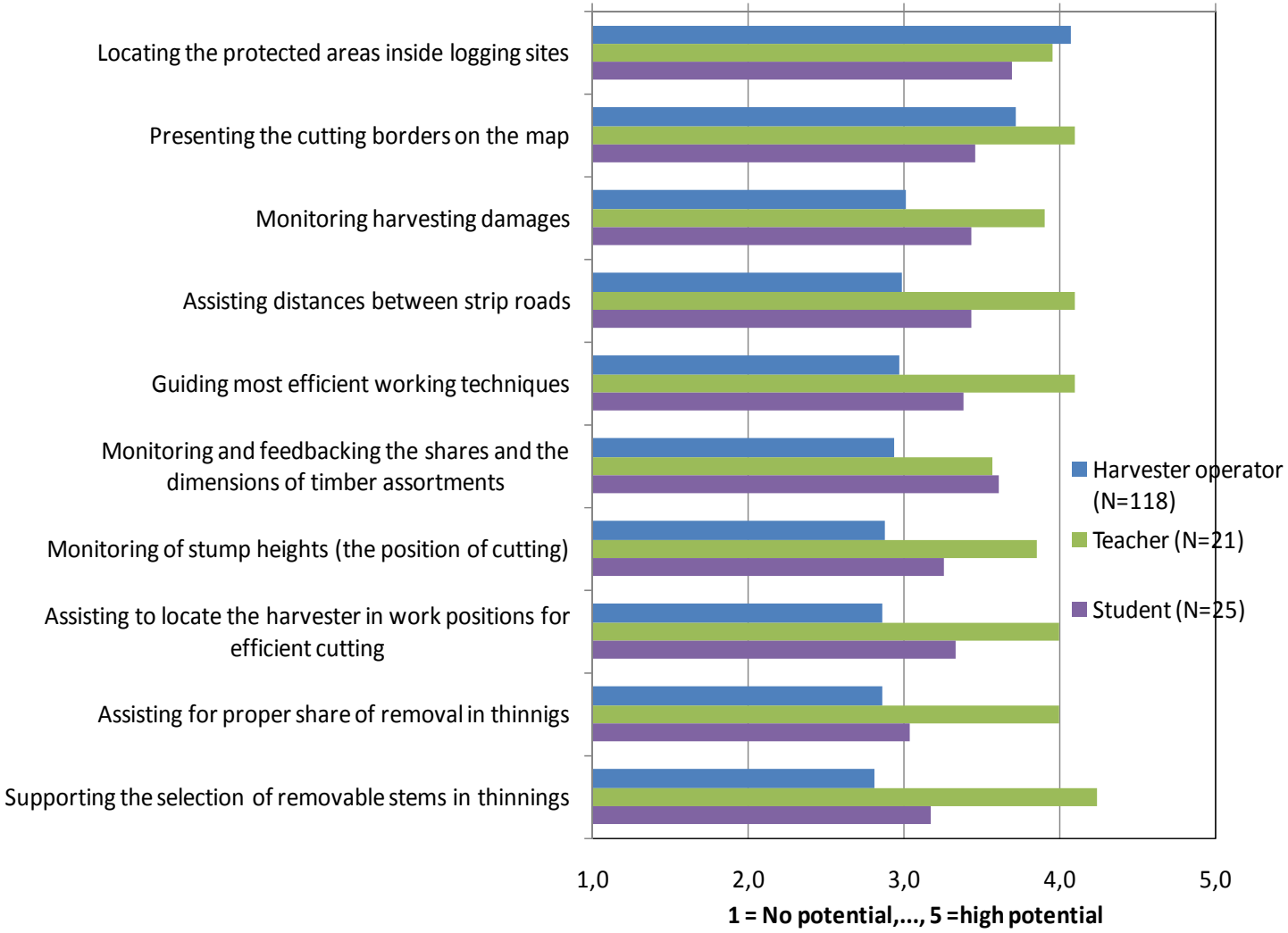
RESULTS

Main problems in wood harvesting hindering contractors' business



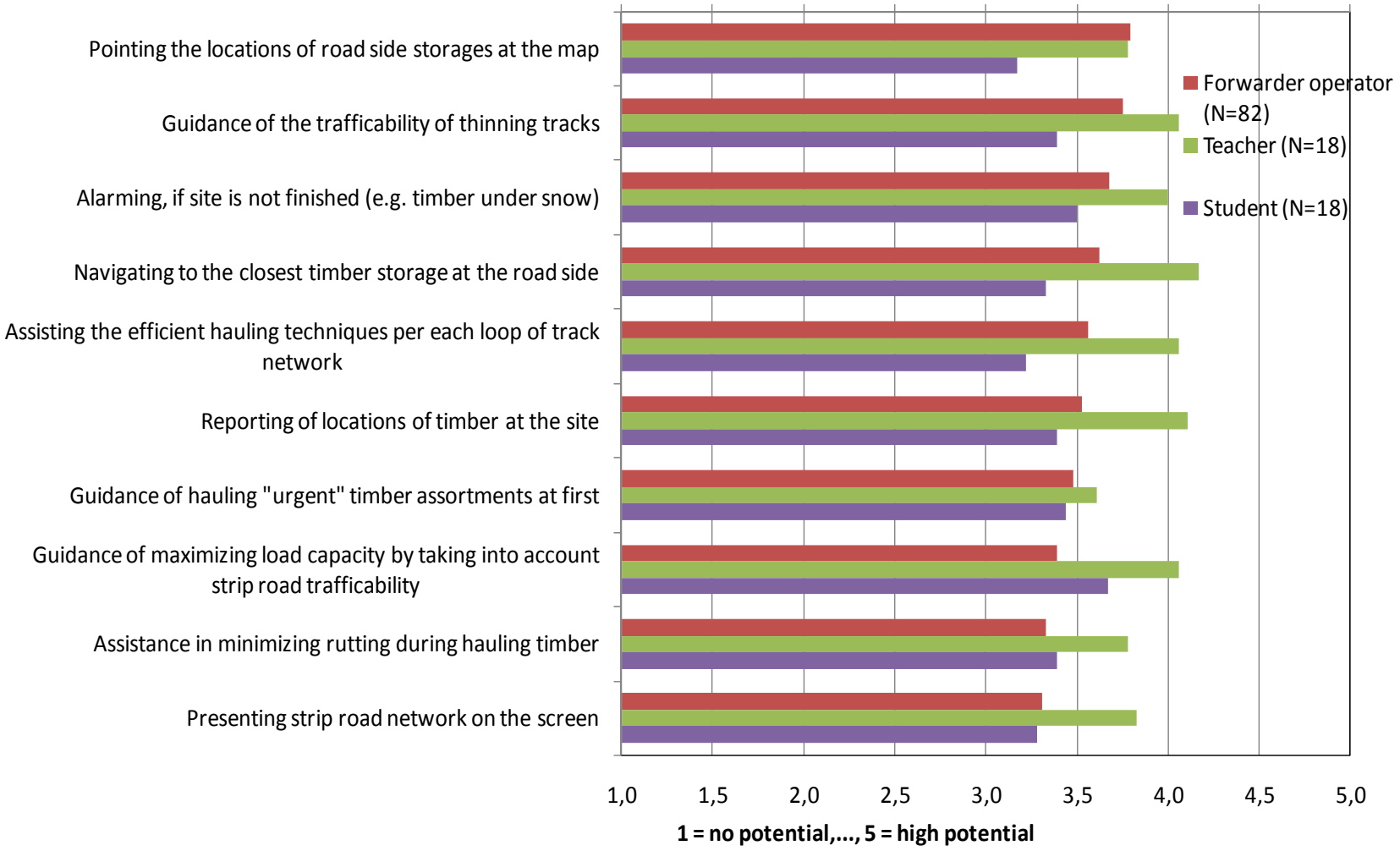
RESULTS

Potential and need of operator tutoring in cutting operations



RESULTS

Potential and need of operator tutoring in forwarding operations



Key findings from the operator interviews:

- Logging maps together with GPS-positioning have been experienced to be a big step forward
- According to operators, valuable additions would be
  - Pre-information of terrain mobility, soil trafficability in the stand (bearing of soil, terrain steepness)
  - Volumes of assortments distributed in the strip roads
- Operators with long logging experience were not so interested to have tutoring
    - Still the need to acquire some feedback from their performance was risen
- Audio-visual tutoring was estimated to be functional
  - beep-sound would inform operator to check the monitor

Concluding remarks

- Forest machine operators were stressed in the inquiry results (perceptions of others are important also)
- Harvester operators were slightly less willing to have tutoring than forwarder operators
  - Monitor-based decision support and information flow during cutting is already high
  - Timber forwarding could be improved by utilizing spatial cutting data produced by the harvester
- Substantial benefits are expected with intelligent tutoring systems in the future
  - By boosting the learning and education
  - Improving the overall performance in mechanized loggings

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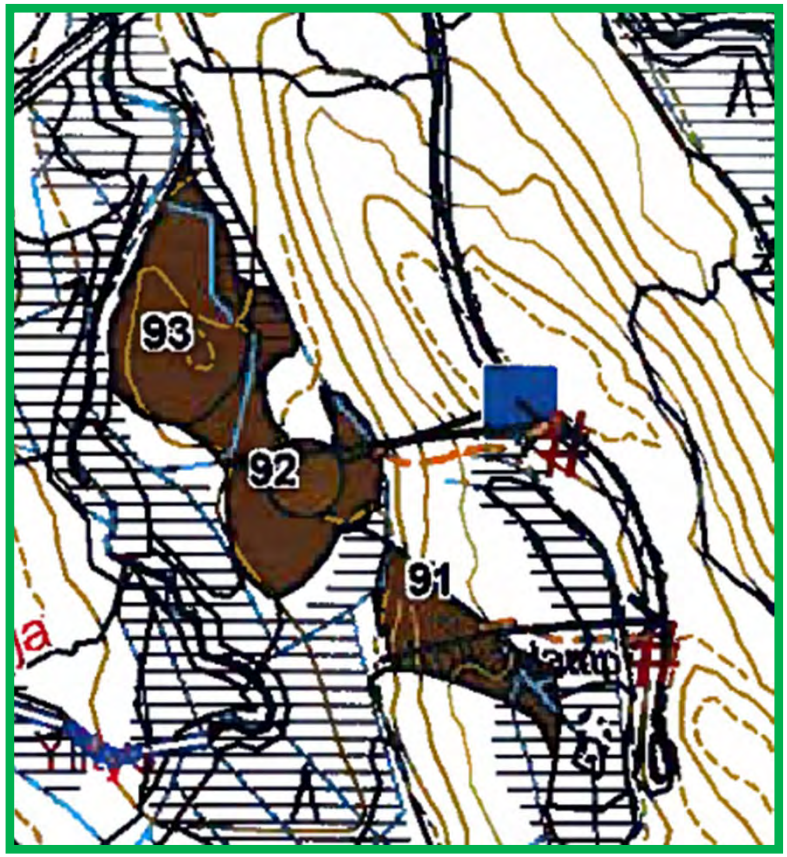
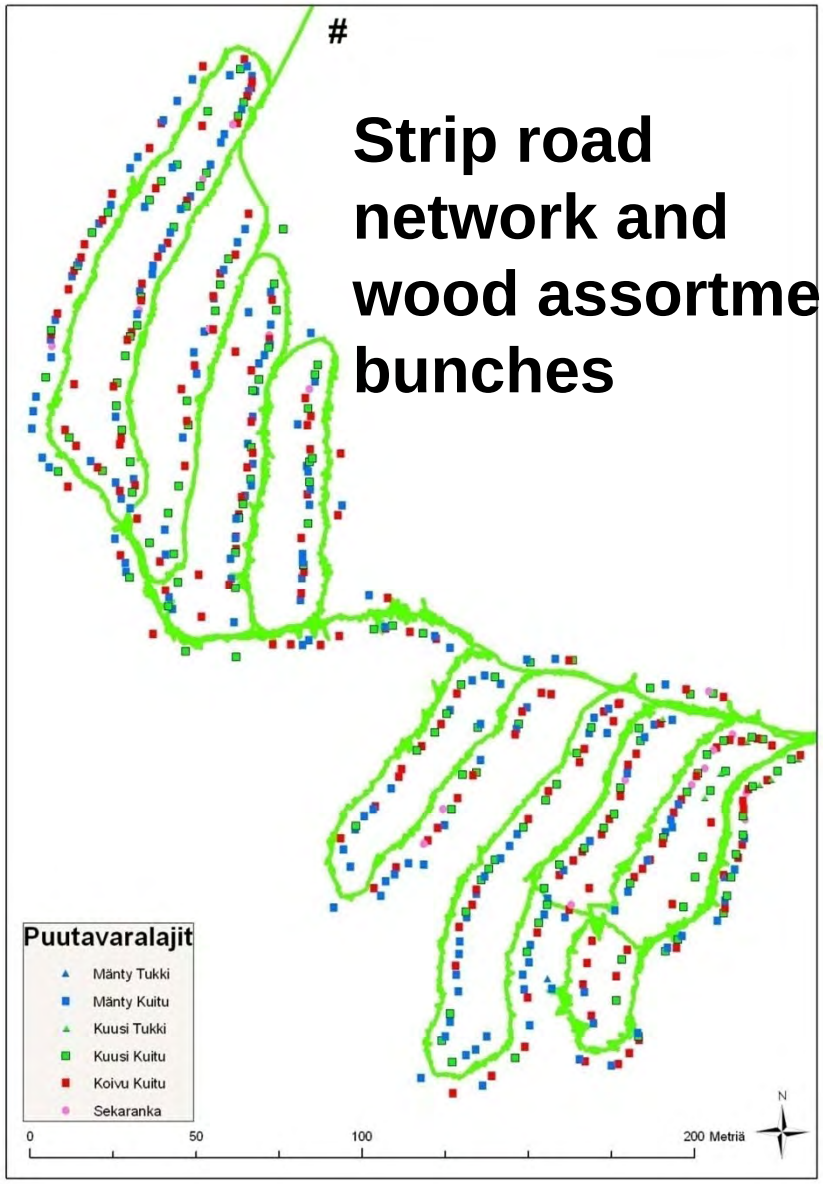
Hauling support system





EffFibre-project "Intelligent operator tutoring systems in wood harvesting" – What it's all about?

1) **Collecting background information** of operator-tutoring systems used in other industry branches
   - Benefits, challenges, experiences
2) **Clarifying the potential and the need** of intelligent tutoring systems among forest machine operators and contractors
   - Where to direct the development?
3) **Developing demo applications** for testing features for tutoring systems and for acquiring operator feedback
4) **Exploring the potential** of different tutoring systems in wood harvesting
   - Tests and field surveys in order to magnify benefit potential
5) **Further development studies** of operator tutoring applications together with partners (Ponsse, Creanex)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KNOWLEDGE
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Thank you