



# USAGE-NG

Up-skilling Agricultural Engineering  
Next Generation

## Farm machinery decision making algorithms

Work Package n°: **4**

Activity n°: **4.4**

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## 1 Executive Summary

Activity 4.4. was more experimental as we used exercises, tests and algorithms to assist in the decision-making regarding agricultural technologies and machinery. The approach is promising and provided useful results. With a more elaborated database, testing and programming, the exercises may further increase the range of use.

## 2 Overview

In this activity we have modified and subsequently perfected existing exercises from the realm of agricultural engineering. After substantial modification, the exercises were turned into interacting learning files, individualized to single students/LLL. The learning files were used during modules with LLL students in form of didactic material and at the end of regular university lectures to test the knowledge and learning outcomes of students. The learning files served in exam situations, with students present in person or remote to obtain a graduation. The learning files currently under consideration for being further modified into AI agents that respond to even more detailed to students as tested in WP5 (see there).

So far we have developed four types of exercises/learning files in MS Excel format. The topics of the exercises concern, for example:

- a) Energy: consumption of forage dryers
- b) Kinematics: work performance of a tractor during mowing
- c) Mechanics: Verification of weight and traction requirements
- d) Dynamics: Forces and acceleration

Topics of the exercises are closely linked to real problems in South Tyrolian farming – often with regard to energy and machinery. The exercises consist of a descriptive part that introduces a typical complex problem of agricultural machinery, energy efficiency or typical digital technologies. Understanding information on farm machine sizing and selection through these exercises to calculate key working parameters.

The problem is then solved through interrelated calculations. The calculations enable the learner to draw conclusions and suggest a solution or informed decision to the general problem.

Each file is a stand-alone exercise, tailored to a single student through semi-random algorithms. This allows the use of the learning files in exam situations, in presence or remote, as tasks and results are individualized. The exercises were done with second year students of the BSc programme in Agricultural, Food and Mountain Environmental Sciences of unibz. After completion by the students, the files are revised and evaluated by a subject matter specialist. This step is can in future at least partially automated with the help of AI.

The exercises are in use since several years. An updated version of the learning files is in use since about 2 years. We have collected experiences with LLL (ca. 25 in total) and regular unibz students (ca.20/year). So far we received good feedback and no technical or other problems occurred. On average, more than 4/5 of annual students have passed the exam.

After an extensive testing phase, we have decided to not publish the files open source online, as this would reduce their value in student exam conditions, but also deprive them of their originality. However, we value further development options. One way is the integration of a database and further development of the algorithm towards the conceptual comparison of core parameters of agricultural machinery. It became clear during the project that database will be filled with data taken from research set ups and instruments available in the AFI-Lab. Our data set is unique, as we use data collected from those machines that were put on the mobile platform in the unibz AFI-Lab, i.e. data on machinery behavior (tilting point, point of gravity) and data on engine performance. We are taking stock of machines and implements that are available to us and retrieve the respective data.

First tests in this direction showed that this step is prone to be enhanced by AI agents, which ensures also its use for practical learning processes.

### 3 Results

#### Quantitative indicators

Number of agricultural machines in the database	21
Number of algorithms developed	4
Number of requests	90
Number of exercises developed	4
Exercise available in languages	2 (IT, GER)
Number of students that worked with exercises over 3 years	80

#### Qualitative indicators:

- Student evaluation and feedback generally good, without problem statements
- Teacher feedback is positive, efforts for exam correction are moderate
- Learners are better informed on technical, safety or energetic parameters of agricultural machinery, technologies
- This knowledge contributes to the preservation of resources

### 4 Conclusion

Four exercises were developed and tested in two different languages. The exercises were used to work with students at BSc level.