

THE NEW VALMET 801 COMBI FIRST OPERATIONAL TEST RESULTS UNDER CENTRAL EUROPEAN CONDITIONS

Ekkehard von Bodelschwingh

Department of Forest Work Science and Applied Computer Science
Technical University of Munich, Freising/Weihenstephan
Am Hochanger 13, D - 85354 Freising
bodelschwingh@wzw.tum.de

Abstract: *This year first operational tests of the new combimachine Valmet 801 Combi were carried out under German conditions. In co-operation with Partek Forest Germany first performance figures of the working method and the productivity of this machine have been compiled by several work studies. By using one machine only for processing and extraction further potentials for rationalization can be expected especially in thinnings with lower felling volumes.*

1. Introduction

The combimachine Valmet 801 (harwarder) is not the first model of its kind, which combines a harvester and a forwarder in one machine.

First prototypes have already been developed in the late 80ies without a real breakthrough in practice. Besides constructional deficits a major disadvantage was that it was not possible to load logs directly into the trailer while processing. Therefore the loading had to be carried out in a separate working process. A further problem was the opening of a strip road: Trees on the extraction line had to be cut and processed in a first step and loaded afterwards in separate forwarder function.

2. Technical data

The chassis looks like one of a forwarder, only the crane is designed for special use of a combimachine. The crane, Cranab CRC 15, with an active tilting mast is placed on the right side of the drivers cabin and has a scope of 11 meters. The full-circle slewing allows a large and effective working pattern around the entire machine.

The load space of the test machine provides a lengthwise and transverse loading with an average capacity of 10 m³. (see figure 1)

Beside the crane the dual function harvester head is an outstanding feature of this machine. With a weight of only 650 kilograms it allows a maximum felling diameter of 50 cm and in grapple function it provides a capacity of 0.2 m².

The test machine of this project was powered with a 4 cylinder turbo engine with a performance of 95 kw (129 hp), while the latest models came up with a 6 cylinder version with 140 kw (190 hp).



Figure 1: Direct processing into the load space of the Valmet 801 Combi

3. Experimental methods

A combined method of standardized daily records and cyclical work studies was used to analyze important variables to the combimachine's productivity. On the one hand it relativizes peaks, which are usually observed during work studies, on the other the operator's learning curve with the new harvesting system can be described.

The driver had experience as a harvester operator for more than 10 years but was absolutely inexperienced in operating and working methods of the combimachine. The studies have been carried out in a pine (*pinus sylvestris*) dominated forest area south of Berlin. The mid tree volume of the stands was $0,20 \text{ m}^3$ (without bark), mid cutting intensity was $60 \text{ m}^3/\text{hectare}$ with an average skidding distance of 320 meters. During the studies four different assortments and 1.400 m^3 in total have been harvested. An additional time study with a Valmet 901 harvester and a Valmet 820 forwarder was carried out in order to compare both harvesting systems. In total 28 daily records of the combimachine have been registered and seven time studies carried out.

4. Processing and Loading in one Process

In case of opening a new extraction line the operator will move the machine backwards (with the trailer) to the tree and begins to cut the strip road first. Therefore the tree will be felled towards the opening skid road. The single logs were processed lengthwise from the back of the trailer directly into the load space. By using this working method, all trees on the skid road can be processed and loaded. The full circle slewing mechanism of the crane always provides a good overview for the operator. Felling, limbing, cross-cutting and loading is done in one process which saves time and energy.

In terms of an efficient unloading process more than two assortments should be avoided. A sidewise and lengthwise orientation of the logs on the load space enables a simplified separating of the assortments. The skid road will not be cut further than the processing of trees from both sides of the extraction line produces an optimal cart load.

Now with forward driving direction (to the forest road) the harvesting proceeds with the processing of trees from the crane zones. At this stage the predominant 3 meter bucking also allows a transverse loading of trees from the sidewise crane zones. This working step is similar to a regular harvester, with the only difference that the logs are processed directly into the load space, as shown in figure 1. In case of mixed cart loads with two loaded assortments an unloading to both sides of the forest road reduces additional machine movements by increased unloading performance.

Due to the combined working method a significant reduction of the driving intensity on the strip roads is possible. Especially in terms of dead-end skid roads almost a doubled total driving distance was observed for the two-machine-system.

5. Research Results

In terms of felling and processing productivity, the performance of the crane and the harvester head represents a major influencing factor. Based on the time study results it could be proven, that the opening of strip roads causes no problem for the combimachine and has no major influence on the productivity. In addition, the performance of the harvesting unit Valmet 330 Duo is equal to a harvester head of a comparable category. A decisive point for an optimal productivity of the Valmet 801 Combi is a preferably high rate of logs processed directly into the load space, which reduces additional loading in forwarder function. Depending on the tree volume between 40% and 90 % were processed directly into the load space.

For the separate loading with the grapple no significant difference was observed between the combimachine and the Valmet 820 forwarder.

Because of a lack of accumulated logs, processed by the harvester, the forwarder can't take advantage of it's bigger grapple capacity. Further the forwarder's unloading performance is significantly superior to the combimachine. Despite of comparable crane velocities the Valmet 820 can clearly take advance of it's almost doubled grapple capacity.

5.1 High Productivity

In order to facilitate the operator's training of this new harvesting system, stands of a mid tree volume of just 0,12 m³ (without bark) have been harvested during the first week. The very experienced harvester operator was able get familiar with in this combined harvesting method within a short time. Due to the standardized steering mechanism, quite similar to a regular harvester, the operator gained a performance of about 4 cubic meters per productive machine hour (pmh) from the beginning on, as shown in figure 2.

During the last third of the observation an average productivity of 10 m³/pmh including extraction was accomplished in stands of a mid tree volume of 0,22 m³.

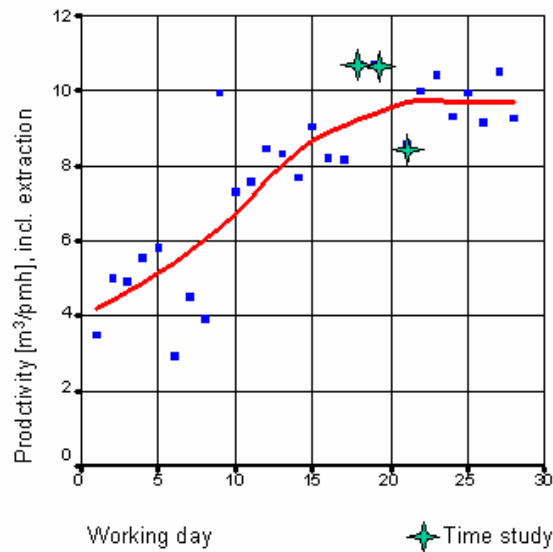


Figure 2: Operators learning curve

Depending on the single tree volume the machine's productivity was calculated based on the data of the time studies. Figure 3 shows the mean productivity for each single machine by a cutting intensity of 60 m³/hectare and a delay rate of 15 %. In comparison to the combimachine, the slightly increased performance of the Valmet 901 harvester is obvious. The productivity of the forwarder Valmet 820 constantly seems to be on a level of 3 to 4 m³/pmh above the combimachine Valmet 801.

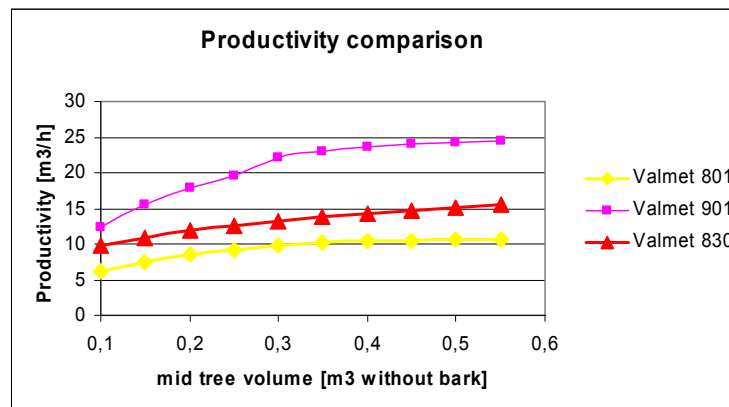


Figure 3: Machine Productivity, Valmet 801 Combi including extraction

5.2 Saving potentials

According to the FOA standard scheme the machine costs for all three machines were calculated based on an annual utilization of 2.000 hours. Therefore the charge for the combimachine is 105,73 €/pmh, for the Valmet 901 harvester 95,44 €/pmh and 69,72 €/pmh for the forwarder.

Based on the time study data all statistical relevant correlations between time consumption of the different work activities regarding every individual tree were compiled. From this data collection a model was created which calculates the individual time consumption under different conditions for the combimachine as well as for the two-machine-system.

Regarding to a varying felling volume a comparison of costs between the two-machine-system and the combimachine was calculated.

A cutting intensity of 60 m³/hectare, a skidding distance of 200 meters and the bucking of three different assortments cause a cost difference as shown in figure 4.

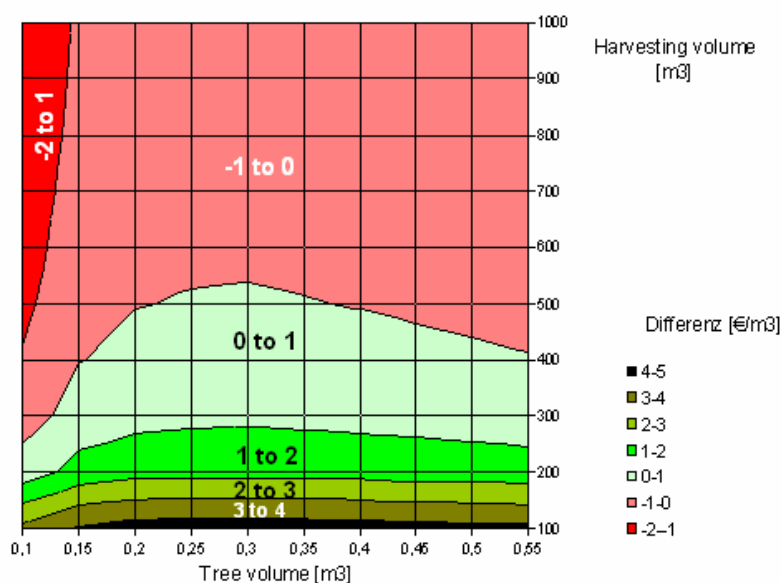


Figure 4 : Comparison of costs two-machine-system vs. combimaschine with a cutting intensity of 60 m³/hectare

Under these conditions the harvesting with the Valmet 801 Combi is cheaper in green colored areas in comparison to the two-machine-system but is expensive in red colored areas. In this calculation a total driving distance of 250 kilometers for the transfer of the machine(s) with a flat bed truck is included which costs 547 € per machine (highway truck toll not included). With an increasing felling volume the two-machine-system becomes more and more competitive. Because of the higher productivity (see figure 3) the higher costs of the two-machine-system can be compensated by a bigger felling volume. Up to a total harvesting volume of 200 m³ a significant benefit of 2 to 4 €/ m³ can be achieved by the combimachine. The optimal performance of the Valmet 801 Combi is between 0,2 m³ and 0,4 m³ mid tree volume because in this span, 60 % to 90 % of the logs can be processed directly into the load space and therefore the law of piece volume has no negative influence.

It has to be considered that this calculation represents an abstract model which does not include specific personnel and cost structures of an individual company as well as diverse machine utilization rates. For example costs for a second service car, spare parts storage and organization have to be mentioned in this context.

Because of this, light green (0-1 €/ m³) as well as light red (-1-0 €/ m³) colored areas have to be considered as a kind of transition area that needs an individual calculation for a specific company.

6. Conclusion

The direct processing of the logs into the load space represents a procedure optimization in mechanized timber harvesting. The high performance and scope of the crane enables an effective felling and processing in front of the machine as well as behind the load space of the trailer and the sidewise crane zones of the stand. The opening of strip roads and a direct processing into the load space is no problem for the Valmet 801 Combi. In comparison to the two-machine-system the profitability of the combimachine increases significantly with a decreasing felling intensity and a decreasing total felling volume. This new harvesting method provides a more varied work for the operator than the rather monotonous work on a harvester. In terms of a high productivity of the Valmet 801 Combi the skills of the machine operator are playing a decisive role.

Considering logistics aspects this new harvesting system also offers further advantages. Generally the whole planning and organization could be a reduced process for just a single machine. In addition, the onboard harvesting measure offers a very precise measurement for disposition because all harvested timber is usually stored and extracted besides the forest road instead of laying along the skid road. So, the forester or timber supply manager receives daily reports about disposable timber volume and assortments. For a small entrepreneur or a forest owners co-operative the Valmet 801 Combi offers a possibility to provide a complete mechanized harvesting with one machine only. For a bigger forest corporation the combimachine can enlarge the existing harvester fleet as a kind of a 'customer-service-machine' to offer an efficient harvesting for small fellings or salvage cuttings.

The Valmet 801 Combi does not only represent an innovative concept for rationalizing timber harvesting but also a capable technology to compete with the two-machine-system and to fulfill a certain market niche.

7. References

Andersson, J. (2002) Harwarder productivity in final felling – a comparison of three harvesting methods, Students Reports Nr. 56/2002.

Lilleberg, R. (1997) Harvester-forwarder for logging in first-thinning stands, Metsäteho report 28.

Pröll, W. (2000) Machen Forvester Sinn?, Österreichische Forstzeitschrift, 01/00.

Riechsteiner, D. (1998) Harwarder – Eine modellhafte Betrachtung zur Bestimmung des Einsatzbereiches in der Schweiz, Semesterarbeit ETHZ 1998.

Von Bodelschwingh, E. and Pausch, R. (2003) Untersuchung zur Kombimaschine Valmet 801 Combi, Abschlußbericht.