Incorporating stand properties and bucking objectives for bucking-to-demand harvesting

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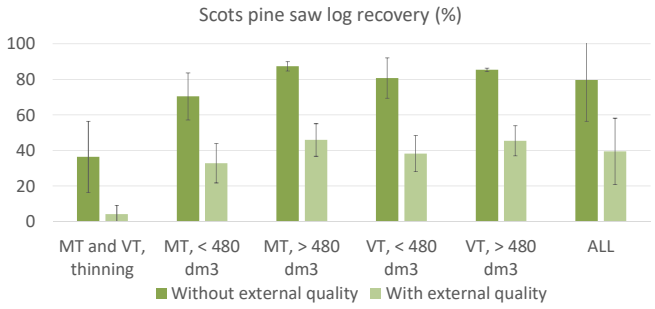
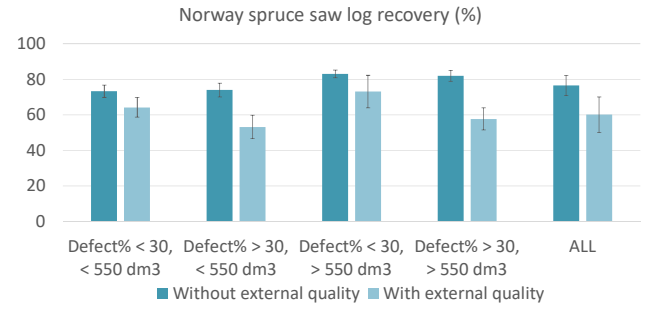
In the study, a fit between bucking objective parameters and stand and tree properties was investigated utilising developed bucking-to-demand simulator and extensive stem data including harvester measured stems and estimated external stem quality affecting bucking.

The aim of the study was to offer rule-of-thumps for forestry professionals constructing bucking-to-demand apt or pin files. More specifically, the objective was to classify Finnish coniferous dominated forest stands according species, fertility and size as these properties affect on the bucking outcome with different bucking objectives. External quality estimations were based on measured stem quality database and non-parametric Most Similar Neighbor (MSN) estimation. Stands were classified according average stem size, site fertility or proportion of defects affecting bucking.





The changes in saw log recoveries, that is grade A butt logs and saw logs, were minor when only demand matrices were altered. Adding new timber assortment, small diameter saw logs, did decrease notably the recoveries of sturdier sawable timber assortments. However, the reduction in saw log recovery was drifted into small diameter saw logs.

The cost of bucking-to-demand approach compared to bucking to value approach was saw log reduction of 0.48 percentile points (pp) for pine, and 0.28 pp for spruce, as the whole data was concerned.

The apportionment index (AI) was calculated by diameter classes, as the bucking-to-demand procedure was utilized in the same manner. As the average stem size increased, also the AI increased. AI's above 95% indicate very high fit between demanded log length-diameter distribution, when the bucking objectives utilized in practical Finnish forestry were used.

Apportionment indices (AI) and standard deviations (SD) for pine grade A butt logs and saw logs by stand classification. Site types: *Myrtillus* (MT) and *Vaccinium* (VT), or corresponding peatland types

	MT and VT, thinning	MT, < 480 dm³	MT, > 480 dm³	VT, < 480 dm³	VT, > 480 dm³	ALL
Grade A butt logs, AI	41.09	73.43	92.70	90.89	87.60	92.21
Grade A butt logs, SD	8.61	16.04	9.38	28.01	13.95	28.33
Saw logs, AI	70.36	88.21	99.10	94.64	97.53	98.71
Saw logs, SD	20.15	18.06	6.08	20.24	5.65	29.02

Apportionment indices (AI) and standard deviations (SD) for Spruce saw logs by stand classification.

	Defect% < 30, < 550 dm³	Defect% > 30, < 550 dm³	Defect% < 30, > 550 dm³	Defect% > 30, > 550 dm³	ALL
Saw logs, AI	96.70	96.20	97.99	97.81	98.31
Saw logs, SD	3.26	4.65	1.77	2.04	4.02

Some further findings and conclusions:

- Bucking-to-demand decreases saw log recovery 0.48 percentile points (pp) for pine and 0.28 pp for spruce.
- Bucking-to-demand increased AI 28.70 pp for grade A pine butt logs, 24.87 pp for pine saw logs and 26.25 pp for spruce saw logs compared to bucking-to-value approach.

⇒ Bucking-to-demand with moderate (3%) close-to-optimal value deviation is capable to steer log-length diameter distribution without notable saw log recovery reduction.

- When only certain log lengths are weighted, saw log recovery is compromised if the overall stem quality is poor, average stem size is low or both.
- Bucking simulations without external quality information affecting bucking produces unrealistic results.

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