

ShortCuts

FROM SKOGFORSK. NO 4 | 2016 | RESEARCH FOR TOMORROW'S FORESTRY



*Showing off
their moves*

TECHNO!

SEK 356 MILLION TO SUSTAINABLE FORESTRY | MORE EFFICIENT TIMBER TRANSPORTS

BIG TRUCKS PERFORM WELL IN THE FOREST | LOGGING RESIDUE HARVEST

SLOWS GROWTH | GOOD SUPPLY OF CONES | COMPREHENSIVE TEST OF LASER SCANNERS

Wanted! EXPERIENCE OF RAPIDLY GROWING DECIDUOUS TREES | IMPROVED CLIMATE ADAPTATION

CORRECT ORDER FROM SAWMILL TO HARVESTER

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PHOTO: SVEN TEGELMO, SKOGFORSK

Formas and Skogforsk have entered into an agreement on a new framework programme for the period 2017-2020. This will ensure a continued focus on development of sustainable forestry and its benefits for society

■ “This is a strategically good decision for everyone,” says Charlotte Bengtsson, CEO of Skogforsk. “Applied research and continued focus on innovations are necessary in the work to ensure sustainability in Swedish forestry. It also utilises Skogforsk’s strength in rapidly converting research results into practical implementation.”

Skogforsk’s framework programme is financed 50 per cent by the forestry sector and 50 per cent by the Swedish Government through the Swedish Research Council Formas. Under the terms of the framework

agreement, both funding bodies will increase their contributions in two stages, by SEK 10 million per year in 2017 and 2018 and then a further SEK 6 million per year in 2019 and 2020.

According to the agreement, top scientific quality and clear understanding of forestry needs will continue to be vital in ensuring rapid implementation of new results.

“This type of co-funding between research financiers and the forest owners is important so that we can ensure a long-term supply of knowledge in a sector that is very important for Swe-

den,” says Ingrid Peterson, Director General of the Swedish Research Council Formas

During the programme period, Skogforsk will develop genetically improved forest reproductive material adapted to a future climate. Other priority areas will be the need for raw materials, management of forest for various objectives, efficient operating systems with minimum environmental impact, the opportunities afforded by digitalisation, value chains, and raw material use that enables a growing bioeconomy. In addition, the new agreement will involve

increased focus on research into and communication about the benefits of forest and forestry for a sustainable society.

“We and Formas have reached a common view on the importance of developing productive forestry with minimum impact. This will enable us to develop many important innovations in the coming four-year period,” says Skogforsk chairman, Göran Örlander.

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MORE EFFICIENT TIMBER TRANSPORTS JUST AROUND THE CORNER

The Swedish Government has proposed allowing 74-tonne timber trucks on parts of the road network from March 2017. This is a welcome decision that will reduce carbon dioxide emissions and transport costs, and thereby contribute to a more sustainable society.

■ Skogforsk has been testing and evaluating timber trucks with a gross weight of 74 tonnes since August 2009. These vehicles have been shown to be more efficient, using approximately 6.5 percent less fuel than 64-tonne vehicles, while being as easy to handle on forest roads as traditional 64-tonne timber trucks.



PHOTO: SVERKER JOHANSSON/BITZER

There are no indications that 74-tonne vehicles have any negative impact on road safety. They have modern, efficient

braking and steering systems, and are just as safe on the roads as conventional timber trucks. And since fewer trucks are needed to transport the same

amount of timber, roads become safer. Skogforsk’s studies indicate that the number of timber trucks on the roads could be reduced by one-fifth.

But will the roads be able to cope? No problem! The 74-tonne trucks have two extra wheel axles. This reduces the weight per axle, so there is less pressure on the roads as it is heavy axle weights that wear out the road surface. However, there can be problems on long bridges, where the weight limit is the gross weight of the vehicle. Consequently, it will be some time before the entire road network becomes accessible for the 74-tonners.

Safer landings

The Swedish Transport Administration and Skogforsk have updated the guidelines for how timber and forest fuel should be placed on roadside landings to ensure road safety. ‘Timber and Forest Fuel Stacks on Public and Private Roads’ (in Swedish) can be downloaded from trafikverket.se.



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Watch the film at skogforsk.se/90ton

90 TON, 30 METRE TRUCKS

Perform well in the forest

PHOTO: ERIK VIKLUND, SKOGFORSK

Driving 30-metre, 90-tonne timber trucks on forest roads present no problems. The roads and the turning areas are adequate, and the drivers experience no major differences.

■ Skogforsk's positive results from earlier studies have now been supported by new test drives in the forests around Örnsköldsvik in northern Swe-

den. The design of the ETT vehicles gives a short turning radius, making the rig flexible in the forest. The drivers do not perceive any major differences

between a conventional timber truck and the more efficient ETT vehicles on forest roads, providing they follow established road standards and turning areas are built according to sector instructions.

Skogforsk is now working intensively with the sector to

construct more test vehicles longer than 25.25 metres and heavier than 74 tonnes for testing on the public road network.

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LOGGING RESIDUE HARVEST SLOWS GROWTH

New evidence that harvesting logging residue during final felling can have a negative impact on growth in the next generation.

■ A new study shows growth losses corresponding to 1–2 years' growth after harvest of logging residue in conjunction with final felling. The results are based on measurements over ten years in two field experiments at fertile Norway spruce sites

Growth losses after residue harvest have often been attributed to removal of nitrogen.

However, losses may also depend on the lack of composting that would otherwise take place beneath the residues, during which nitrogen would be released into the soil. Another possibility is that the logging residue reduces the growth of competing vegetation. The most probable explanation is a combination of the three.

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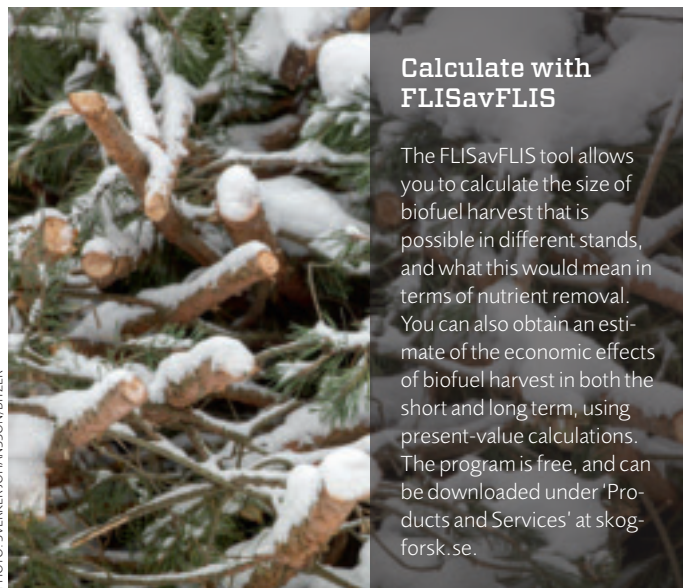


PHOTO: SVERKER JOHANSSON/BITZER

Calculate with FLISavFLIS

The FLISavFLIS tool allows you to calculate the size of biofuel harvest that is possible in different stands, and what this would mean in terms of nutrient removal. You can also obtain an estimate of the economic effects of biofuel harvest in both the short and long term, using present-value calculations. The program is free, and can be downloaded under 'Products and Services' at skogforsk.se.



GOOD SUPPLY OF CONES

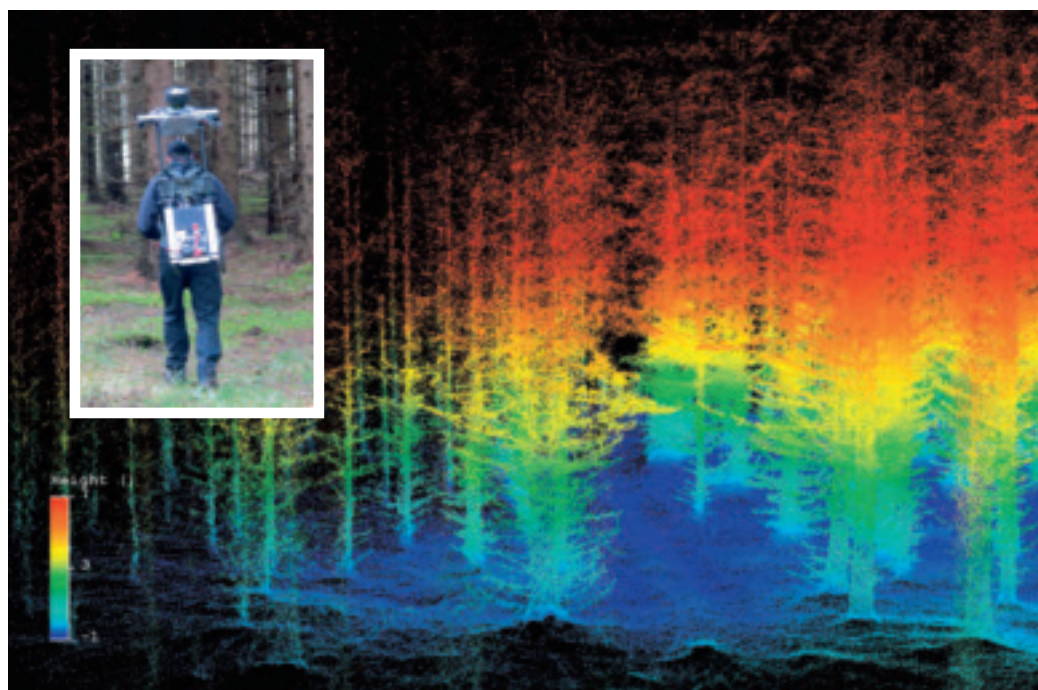
■ Skogforsk's cone forecast, based on an inventory of 5800 trees made by the Swedish National Forest Inventory, shows that the cone frequency of pine cones is average to abundant in most parts of the country. The germination capacity forecast, based on data from SMHI and analyses of collected cone samples, shows that the germinability of the seed is far better than average all over Sweden for both pine and spruce. The forecasts present useful data for the forestry sector in collections of stand seeds and in scarification under seed trees

What is the situation in your region? Search in Kunskapsbanken at skogforsk.se/kottprognos

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PHOTO: SVERKER JOHANSSON/BITZER

COMPREHENSIVE TEST OF LASER SCANNERS



Skogforsk is currently evaluating three mobile laser scanners that can facilitate collection of tree data, but that can also be used to increase automation in logging.

■ Laser scanning is a rapidly growing technological area within measurement. In forestry, such scanners can provide rapid data collection regarding mean diameter, basal area, number of stems – and perhaps even tree species. They can help increase automation in logging.

In the next step, the researchers will examine whether all trees have been correctly identified, whether their scanned positions correspond to reality, and how well the scanners measure diameter at breast height and basal area. In spring 2017, the tests will continue in the various forest types of northern and southern Sweden.

PHOTO: ERIK WILLEN, SKOGFORSK

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Wanted

ANYONE WITH EXPERIENCE OF RAPIDLY GROWING DECIDUOUS TREES

Have you planted stands containing poplar, hybrid aspen, birch or alder? If so, please get in touch, as your experiences can help us learn more about the best methods for establishing fast-growing deciduous trees.

■ Skogforsk is currently running a project examining the possibilities for fast and problem-free establishment of deciduous trees for biomass production and energy. The work includes collecting practical experiences from regeneration of both forest land and agricultural land in different parts of the country. The results will be used in developing recommendations for more reliable regeneration.

The project runs until summer 2017. During the project period, results from research reports will be compiled and evaluated, and the researchers will be carrying out in-depth interviews with some key players.

Do you have experiences and tips you could share with the researchers? For example, some examples that have proved very successful, or perhaps some that have been less successful? We'd



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IMPROVED CLIMATE ADAPTATION IN NEW PLANTVAL

■ An updated version of the Plantval (Planter's Guide) program has now been released, with new climate-adapted models for pine, and a new design suitable for use in tablets and telephones. Plantval helps forest owners select forest reproductive material that is well-adapted, grows well, is high quality, and that will function in a future climate. Plantval gives recommendations regarding pine, spruce, silver birch and Lodgepole pine.

"In this new version, climate-adapted deployment models are used for pine that have been

developed together with the Luke Natural Resources Institute in Finland, climate researchers at SMHI, the Rosaby Centre, Future Forests and Skogforsk," explains Mats Berlin, plant breeding researcher at Skogforsk.

The program will shortly be extended to include both Sweden and Finland, with plant breeding material from both countries.

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CORRECT ORDER FROM SAW TO HARVESTER

■ When the forestry sector's communication standard is updated, it will be easier for mills to communicate with bucking computers in harvesters. With the new technology, saw mills will get their deliveries faster and the delivered timber will correspond better with the order placed.

Swedish forestry is now introducing a new generation of the standard for communication with forest machines, StanForD 2010. One important new feature is that saw mill orders can, in principle, be automatically updated in the bucking control in the harvesters.

"The new technology will mean faster deliveries, and the proportion of correct raw material will increase," says Skogforsk researcher John Arlinger, who is leading the work to develop and fine-tune the standard.

The first company to test the new standard on a broad front is Sveaskog, which has been using the system in around 15 harvesters during autumn 2016.

"We carried out a test where we sent a new instruction to a har-



vester. Two minutes later, the message arrived in the harvester computer, and the operator was asked whether the machine's pricelist should be updated," says Thorbjörn Westman.

Wood Value Trials 2016

Skogforsk has tested the new StanFord functions together with machine manufacturers during the Wood Value Trials 2016. The results were presented at Skogforsk's VIRKE16 conference in December. If you missed it, you can read about it in the next edition of VISION/SHORTCUTS.

Text & Photo: SVERKER JOHANSSON | sverker@bitzer.se



The Xt28 eases gently over the ditch on its pendulum arms.

A forwarder that improves the operator's work environment, causes less ground damage, and yet moves faster and easier in tough terrain than a normal forest machine. One that is constantly horizontal and that can easily be driven by an inexperienced operator? Too good to be true? Not at all. The demonstrator is already at work in the forest.

Development of the pendulum-arm suspended forwarder has not followed a straight path. LL-maskiner in Trollestorp exhibited their Troll at SkogsElmia 1989. Skogs-Janne then developed the 2000 Soft in the 1990s. Six different machines were built and most of them have 35,000-50,000 hours on the clock. CAT displayed its Timberking LF14, built in Australia, at Elmia Wood 2001.

The new demonstrator, the Xt28, has been designed and built by exTractor AB in Bollnäs. The owner, innovator Rolf Volungholen, is the man behind the revival of the pendulum-arm suspended forwarder. Mechanically, the design is very similar to that of its predecessors, but beyond that there are few similarities. However, the objective is the same, that the machine will benefit both the environment and the operator.

Sophisticated control

The wheels are placed on pendulum arms. But that is where the similarities end, because the arms and wheels are now controlled automatically by a program using pressure and position sensors. The pilot's job is to steer. The software helps the operator to do this.

exTractor has been responsible for the mechanical development, and Skogforsk researchers Olle Gelin and Fredrik Henrik-

sen, both machine engineers from Linköping University, have developed and programmed the electronic control system in the prototype machine that is now being tested in forest terrain outside Jälla in Uppsala. And already when the Xt28 eases its way across the ditch without the slightest lurch, it is clear that the control technology has taken a major step forward.

It looks rather different. So the wheels are constantly seeking contact with the ground?

"All the wheels are raised and lowered to maintain the same load on all wheels against the ground," explains Fredrik Henriksen. "With pressure sensors on the cylinders and position sensors, we constantly feel the vertical forces on the axles and down towards the ground, so we can vary the height of the pendulum arms in relation to the terrain.

"If the vehicle rolls up on a rock and the wheel is then left in the air, there's no force acting on the axle. The wheel automatically seeks contact with the ground again – unlike the bogie which just hangs in the air. And the machine does this for every wheel at every given moment through individual hydraulic control of each pendulum arm, in combination with control of the two central chassis parts.

"Because there is a motor on each wheel,



A gyroscope always keeps the machine level, and means that the load does not swing back and forth. This significantly improves the work environment, and reduces ground impact. In addition, the forwarder can be driven faster and in places where machines cannot normally reach.

they are controlled individually. The outer wheels roll faster when the machine turns, and tachometers tell us if any wheel is slipping. We can then switch off that wheel to avoid slipping."

Technical breakthrough imminent

Another type of hydraulic control of the wheel motors is being tested on the machine, called secondary regulation.

"The technology gives greater control over

the wheels, which would give us a new standard level for an anti-slip system. Here, we've done some more development to do before we can make it work in forest terrain, but we've tested it successfully on Skogforsk's test track. And that's a real technological breakthrough – the risk is we'll have to travel around the world telling people about it..."

Always level

A gyroscope keeps the machine horizontal at all times, and this also means that the load does not swing back and forth. This also significantly improves the operator's work environment, and reduces impact on the ground. It also enables the forwarder to be driven faster and in places where machines cannot normally get to.

"The technology can make inaccessible areas more accessible, because you can drive at an angle with a full load," says Olle Gelin.

Up and down hills?

"The software can even help with that. You put in a counter-force, which levels the machine to a certain extent, even on hills.

Isn't this a bit like a JAS jet fighter plane, where the pilot steers and the computer does the calculations?

"Yes, the operator really just needs to steer, accelerate and brake. The machine maintains the balance and an even pressure on the ground, and turns so smoothly that the operator doesn't need to worry about shearing. The two mid-chassis parts have sensors, and the computers ensure that the rear wheels follow the tracks of the front ones. In practice, the operator doesn't need to worry so much about the actual procedure."

Fredrik Henriksen agrees.

"Exactly. After getting used to the Xt28, I then drove an ordinary forwarder. I was a bit nervous, of course, because I was testing the technology that we, in practice, were competing against. I made it five metres onto the clear-cut before the machine got stuck against some rocks," he laughs. "I had no idea how to plan the driving, because the software in the Xt28 normally solves the problems I was encountering. This really brought home to me that we're doing something new and valuable here."

What is the life expectancy of this technology? The same as that of a forest machine, do you think? Or must key components be replaced after, say, 10,000 hours?

"Simulations show a number of advantages in terms of strain on the structure compared with a bogie structure. The pendulum arms reduce impacts that would otherwise be transmitted up into the chassis – this could increase life expectancy by reducing mechanical stress. In the long term, it may be possible to use a thinner structure in the chassis, which would allow greater payloads. Today,



Less impact on the ground – and the operator.

the payload is no higher on the Xt28 than on traditional forwarders.

"Another possibility, because the pendulum arms constantly maintain an even pressure on the ground, is to lower tyre pressure, which would reduce ground impact," adds Fredrik Henriksen. "Normally, the ground is easily damaged when all the weight is placed on one wheel."

How can such an innovation be advanced to the market?

"The machine has been built to demonstrate the potential for the sector and the manufacturers," says Olle Gelin. "We can help any manufacturers interested in the technology. We can transfer our knowledge and help them with testing. For anyone interested in taking the technology further, drawings and CAD documentation can be obtained from exTractor. And we've already seen some tentative interest."

"There are also a number of scientific studies taking place regarding the technical solutions in the machine, both at KTH Royal Institute of Technology and Linköping University. These concern hydraulic simulations and dynamic models to optimise the solutions before they are built into the prototype machine."

Are more sectors interested?

"Naturally, it could be interesting for mine prospecting, dumper technology and military applications on undulating land, particularly where the surface is poor. The military sector is already showing interest."



Fredrik Henriksen and Olle Gelin can lift Swedish forest technology to a new level.



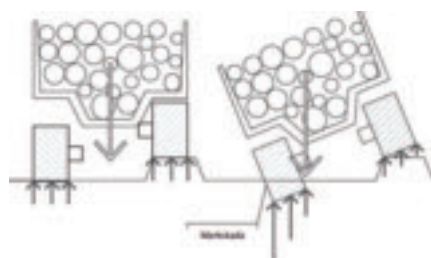
GIANT LEAP FORWARD!
See the film at skogforsk.se/xt28

Xt28

**funded by
the forestry
sector's
technology
focus**

The Xt28 project is supported by the forestry sector's strategic focus on technology and reducing environmental impact. The objectives of the project have already been attained in terms of reduced impact on the ground and operator. What the forwarder can deliver in terms of performance remains to be seen. In addition, Skogforsk wants to describe the commercial benefit of introducing innovative, new technology, in terms of both the business potential and the return that such a project investment can generate over a production cycle.

Four aims of the project



1 | Less ground impact by:

- Reducing roll
- Reducing shearing
- Distributing the load over all wheels

2 | Less whole-body vibrations

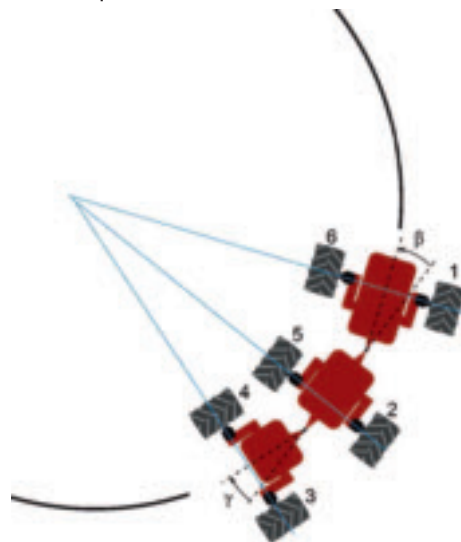
- Measurements show up to 20 percent less vibration, but there is potential for further reduction.

3 | Increased productivity

- This requires further studies.

4 | Commercial benefit

- To be evaluated in the longer term.



The Xt28 (red) has two mid-chassis sections, where the software positions the wheels so that they follow each other's tracks. Result: less shearing and less ground damage than for a traditional machine (green).



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