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Constant evolution

C&A knuckle booms and loaders

While the lockdown era may have cut opportunities to see new loader and knuckle boom cranes 'in the iron', development continues relentlessly. We take a brief look at some key innovations before delving into a specific application for these adaptable and increasingly popular lifting machines.



Effer 1000 - big up and over reach

On the corporate side, the biggest news in the sector has been the planned merger between Hiab /Effer owner Cargotec and Konecranes. The combined business will have sales of around €7 billion and a role in every step of the manufacturing economy, from manufacturing and raw materials such as timber and steel with forestry and overhead cranes, to port and marine cranes, loader cranes, demountable fork lifts and tail lifts used for transport and deliveries, and finally waste collection. The merger will complete in the new year

Long, light, and heavy

Effer has a reputation for innovation at the heavier end of the market, its latest crane, the 90 tonne/ metre Effer 1000, features a long 10 section boom, and seven section jib – the first crane of this size to feature nine boom extensions and six in the jib. Yet the overall crane weight is 9,300kg, which it says is low enough to be installed on a compact 32 tonne GVW chassis. The company says it will be a strong competitor for lifting heavy loads

in urban environments. Maximum capacity is 25.8 tonnes at three metres, or 2,300kg at 26 metres outreach at an up & over height of 26 metres, while the maximum tip height is 38.4 metres or 42.8 metres with manual fly.

"The Effer 1000 is a heavy loader crane with the reach and lifting capacity of a super heavy crane without needing the bigger truck, providing the flexibility to work in tight urban spaces and save money," says global product development director Marcel Boxem.

Automatic tip control

While small to medium knuckle boom cranes are often described as 'loaders' their real benefit is unloading. The challenge is rarely getting a palette of bricks onto the truck, at the supplier's yard, while unloading at a customer's premises and placing it where they want it is. One exception to this is waste collection, involving loading large recycling bins or tanks, where operators need to hook on to a top mounted lifting lug. Making this both quick and safe is vital in these days of driver shortages.

Palfinger is targeting the issue with its new Smart Control system. Conventional controls require several lever movements to reach the load. Palfinger's new system allows the operator to control multiple functions with a single lever, to move quickly and smoothly to the target. The logic of the movements is processed in the Paltronic control unit which independently calculates the direction of each function in conjunction with the HPSC-Plus Load system, which also compensates for chassis inclination and boom deflection. The Flow Sharing electronic oil distribution system constantly adjusts the hydraulic actuators to guarantee smooth, precise and efficient function movements. The Smart Control can be switched off or overridden when not needed.

East of Italy

The loader crane market has traditionally been split between Europe with articulated and Asia with straight booms, while the USA is completely different again. Italian manufacturer Fassi is targeting the Asian market with the new XR710 telescopic boom loader crane, developed for its Fassi Asia Pacific division, based in Nilai, near Kuala Lumpur, Malaysia. The new crane combines a telescopic design, popular in the region, with the manufacturer's high end control systems.

The crane has a maximum capacity of seven tonnes and is available in two versions, the XR714 with four section 13 metre boom and the XR716 with a six section 19 metre



Palfinger's Smart Control system allows the control of multiple functions with a single lever

boom – the final digit is the number of boom sections. Most lifting with telescopic loader cranes involves the use of a winch. So the XR710's winch is neatly built into the slewing column/post, just below the boom pivot point.

The crane has a choice of control positions, the high seat mounted on the turret post, or ground controls more typical on articulated cranes. Features include Fassi's FX200 load limiter with acoustic and visual warnings, dual motor slew drive, a winch limit switch system, and two halogen work lights.



The new Effer 1000 - big crane capacity and reach on a smaller chassis



Fassi's new XR710 telescopic

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Early adopter

What do you do when you can see a new way of working, but no-one can sell you the right tool for the job? That was the challenge Alistair Magee faced when he looked to bring a safe way of mechanised tree felling to the UK. Will North spoke to him, and his eventual supplier, Mac's Trucks.

Often, in the equipment industry, innovation comes when someone spots a profitable niche and develops a new tool to service it. That was certainly part of Magee's motivation to commission a large knuckleboom designed to work with a grapple saw, but it wasn't the main one. "I don't care about money. You can always make more money. But you can't make a new person, once you've hurt or killed them," he says.

Working as a subcontractor, largely on his own, it's Magee's life and livelihood on the line any time he climbs a tree. For a long time, he was prepared to take on those risks. That willingness, along with his skills at climbing and felling trees, let him work wherever he wanted.

"I've climbed trees all around the world. You can go anywhere you like climbing trees and felling them because there's so much demand. But people can get very, very, very forgetful and complacent with the risks that they're taking. Me included. I've done some crazy,

crazy stuff over the years in different environments, in different countries as well, because over the years I have lived in Sweden, Italy, and Holland, all the time felling trees."

Eventually though those risks begin to play on your mind. Magee says: "It's only when you start getting older that you start evaluating the risks properly. People have families, they start getting serious responsibilities, like mortgages, or they've got other employees and the risk taking doesn't actually look quite as acceptable."

So Magee began thinking about new ways of working: "I remember making the decision five or six years ago that I wasn't going to be somebody who was going to end up with a broken back."

Inspiration

He had already seen the sort of equipment he wanted to work with. "I first saw it back in about 2006, when working in Sweden. It was used in a different context, but it was very much the same principle. And this guy kept his cards really close to his chest and didn't show



Despite its compact chassis, the vehicle has plenty of space for other equipment



anybody. About 10 years later the same type of equipment appeared in America. When I first saw it, I thought that's really smart. Really quite clever. Definitely a massive improvement on climbing trees and taking lots and lots of unnecessary risk."

Magee knew what he needed. He wanted to be able to reach in from distances as far as 35 metres and

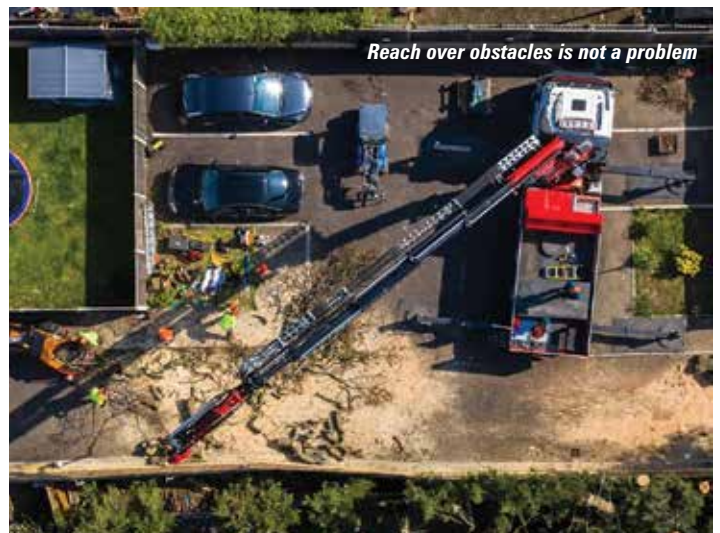
lift loads of up to 500kg. To do that safely, he needed to work to a two to one factor of safety after allowing for the weight of the grapple saw attachment.

What he didn't want to do - because it is unsafe, and illegal - was to work on the override key.

But it's something he says is happening with other contractors. He explains that, while he rates



Testing the new crane with Mac's Truck



Reach over obstacles is not a problem

knuckle booms and loaders **C&a**

360 degree telehandlers as base machines, they aren't the right tool for this job. "While they have the reach and maximum capacity, they overload it with a head that is not suitable. A machine like this might have 30 metres of outreach, but they're putting a 1,500kg implement on it, like a grapple saw or tree shears. And then inputting a false value into the overload control and bring load down on the override switch."

He took his idea to a number of UK truck bodybuilders. One, he says, seemed quite happy to sell him a machine that - looking back - he realises now would have been illegal to use. Others wanted to sell him a product they thought he needed, without understanding the job.

Bringing vision to reality

It was only when he came to Mac's Trucks in West Yorkshire that he found a supplier who could bring his vision to life. "Mac's Trucks are on a different level, in my opinion. It's actually really nice to have someone like that in your corner because nothing's too much trouble for them. Even if you change your mind, they'll just go with it and sort it out."

After looking at his requirements, Mac's proposed a 70.23 tonne/metre Fassi F820RA2.27 as the base crane which lifts 3,270kg at its maximum reach. An L426 jib extends the crane's reach to the 30 metre Magee needed, while leaving enough capacity for the Mecanil SG280 grapple saw, the anticipated 500kg loads, and the required 2:1 safety factor. The saw replaces the final jib section, with a rotating knuckle to allow a full range of movement. An additional V20 winch allows Magee to lift larger loads, for example when removing trees from back gardens.

The crane was mounted on an 8x4 Volvo FMX460 chassis. Andy Hall,

technical director at Mac's, said: "We built it on a super short 8x4 platform. It is basically the same sort of size platform as an 8x4 tractor. It's nimble, will go into a tight spot and has decent off-road capability." A front stabiliser jack allows Magee to work at full capacity through 360 degrees. The chassis has plenty of storage space for saws, ground mats, and other equipment.

That took care of the basics of lifting these loads and getting to site. But Magee and Mac's weren't done. A lot of Magee's work takes place overnight. Network Rail, one of his regular clients, might need a tree removed from alongside a train line. That can't be done during the day, without line closures. So, Magee spent almost £20,000 on lighting, to illuminate the working area around the crane. Mac's also added two cameras, on the saw and boom.

The final step was to tie everything together through the stability system and remote controller. Hall points out that many cranes are used right at their limits. That was not possible here, because of the difficulty of assessing loads, dynamic loading, and the risks associated with picking loads at height.

"You've got to allow for that potential overload," Hall says. "The machine is way beyond, from top to bottom. The crane works way under its actual potential. Most of the time, he's working at 50 percent capacity. I designed the stability of the vehicle around 60 to 70 percent above the actual overload capacity of the crane, to make it absolutely sound and solid on the ground. We have a special type of subframe that we use on some of the really big cranes. We used a version of that, but more compact, which makes it even more stable."

The control system for the crane was reprogrammed from scratch.

The lights on the crane allow safe work at night



The crane can work in restricted spaces

Hall designed the control system so that the saw was controlled from the crane controls. "It was a little bit tricky to do, but it works. There are no wires to get caught, just five hydraulic lines, and it's purely remote control. On the grapple itself, you've got the ability to rotate, tilt, grab, and the ability to saw. So, he's actually got four functions. It's very, very dexterous."

"There are three extra buttons for the saw on the remote, so if you just operate the grab, it simply grabs and releases. If you press one button and grab, it makes it tilt up and down. And then if you press another button and pull the grab, it operates the saw. So, it works like a deadman, so you can't accidentally set the saw running, or accidentally tilt. It's quite a simple but effective way of working. And once you've used it for an hour it becomes completely second nature."

Training Magee to operate the crane and grapple saw, for which

he is now ALLMI certified, and checking its performance, took Mac's out into the woods, letting them see first hand how it works. It's an impressive sight. As well as being a skilled tree surgeon, and innovative specifier of lifting equipment, Magee makes adept use of social media to promote this new way working: his Instagram feed 'a.mtreesurgeons' and similarly named LinkedIn account document his work.

Anyone who has ever arrived hungry at an Italian restaurant and worked their way through a stack of breadsticks will recognise how Magee takes down a group of trees: taking the ends off, a manageable piece at a time, and transferring them neatly to the ground. But his videos also show the wide range of uses the crane can manage, often in restricted environments.

His investment looks to have paid off. Since commissioning the crane a year ago, he has been constantly busy taking on work day and night.

A close-up of the saw at work





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COMPELLINGLY VERSATILE.

THE NEW AC 4.110-1 AND AC 5.120-1

The heart of both cranes is a reinforced 60-m main boom compared to the predecessors that provides extraordinary lifting capacities, particularly when fully extended. A tight minimum radius, greater lifting height, and 82° boom angle make it possible to work closer to the crane. This makes both crane models even better suited to work sites where space is at a premium, as well as to work at large heights. As a compact four-axle unit, the AC 4.110-1 is maneuverable on tight roads and work sites. As a light five-axle crane, the AC 5.120-1 is ideal for routes where staying under specific axle load limits is crucial. Thanks to their shared superstructure, 80% of the counterweights are fully interchangeable between both cranes – this applies to the boom extensions as well, with one of them being a new extension with reduced complexity.

Safety balance

Grapple saws attached to knuckleboom cranes can help avoid many of the risks arborists face. But they present a whole new set of risks. A group of industry associations are working to develop guidance for cranes - and other equipment - to be used safely for this application, Will North reports.

Arborists are beginning to discover that by mounting a grapple saw on a knuckleboom crane, equipped with remote controls, they can work from the ground, removing the risks of using a chainsaw at height. The device grabs the section to be removed, and the saw then cuts it, avoiding the need to tie it off to the tree prior to cutting. The use of this equipment poses a series of new risks though. On the crane side, there is concern about the unknown weight and balance of the load and how suddenly taking the weight at height affects the working of the rated capacity indicator. On the forestry side, experts also warn of risks associated with the saw itself.

Dieback demand

Recent years have seen the spread of a new fungus, *Hymenoscyphus fraxineus*, which causes Ash Dieback. The fungus originated in Asia where local varieties of ash trees have a resistance to the disease. The past 30 years have seen it spread through Europe where varieties have little or no resistance. The UK is the latest country to see it, with the first cases



Ash Dieback is spreading

recorded in 2012. According to the Woodland Trust some 80 percent of ash trees are likely to die from the disease in the coming years.

Trees killed by Ash Dieback will often need to be removed, particularly when they are close to roads and railways. This drives demand for the skills of tree surgeons. But cutting down dead trees manually can be risky.

Gillian Clark, chief executive of FISA, the Forestry Industry Safety Accord, explains: "Dead ash, particularly the longer it's been affected by disease, becomes incredibly challenging to fell. The felling of dead and dying Ash in effect makes an already hazardous operation much more dangerous: the tree can snap off; the tree can explode when it hits the ground and bits of branch fly everywhere. It is essential that every effort is made to fell these sites mechanically and keep chainsaw operations to an absolute minimum."

Simon Richmond, of the Arboricultural Association (AA), highlights a recent tree felling incident. He said: "The tree fell sideways and crushed the tree worker. Experienced operators know how to fell trees. So, this was highly unusual and is one of the reasons why more arborists are looking at using tree shears or grapple saws, because they say, 'the best way to avoid hurting myself is to get out of the way and mechanise it'."

As the disease spreads, large numbers of trees that are close to roads and railways will need to be removed, and ideally without closures. Crane based solutions could be ideal for this work, but they do pose their own risks.



Grapple saws, like this GMT TTC (Total Tree Care), can be safely used when attached to telehandlers and other equipment. But it is important to make sure the equipment has the capacity for saw, load, and a 2:1 safety factor

A warning too late

One of the most devastating ways a crane can fail is through overloading and tipping. There are two ways to avoid that happening, the first step is to know the load you are lifting and the capacity of the crane. The second is to use an overload device. But with tree removal work you cannot be sure how much a section weighs until it has been cut and is on the 'hook', and then it's too late. Dynamic loadings as the weight transfers suddenly from the tree to crane can also be a factor. The overload device may then cause a cut out, which leaves the crane in a perilous situation.

On tree work, neither of the mitigating steps are straightforward. Alan Johnson, chairman of ALLMI, the UK Association for Lorry Loader Manufacturers and Importers, points out: "There are no means of assessing the weight when you are attaching a load of this nature. In normal lifting operations, the stability warning device will tell you whether it's stable or not and the Rated Capacity Limiter will tell you whether you're overloaded

and prevent it. But this type of application carries the risk of both those devices being defeated. If you're suddenly lowering uncontrollably at a rate of knots, no stability protection system on earth will stop you from tipping over in that scenario."

Trees also grow unpredictably. A steel erector can look at a beam and - knowing its dimensions - make a very close estimate of its weight, usually he will already know the exact weight. An experienced tree surgeon can only make a well informed guess.

When a tree surgeon uses a grapple saw to remove the top of a dead or dying tree, the rated capacity limiter's warning offers no real protection. The alarm may sound, but with the crane suddenly taking on a load, as high as 30 metres above the ground, if it is too heavy there is little the operator can do. The crane will follow the load. Anyone in the way, or working from the crane, risks fatal or life changing injuries.

Chainsaws have their own risks, which will only be immediately



A Mecanil SG280 saw, similar to that used by Alistair Magee (see profile) in action

apparent to those in the tree sector. This is known as 'chain shot'. Clark explains: "It's caused by high velocity separation, basically ejection, of a piece of the cutting chain when chains break. The whip effect which occurs as the broken chain passes the ends of the saw bar accelerates small pieces of broken chain to ballistic speeds. It's like being shot by a bullet." And current safety screens cannot fully protect against this.

A report by Washington State's Department of Labor and Industries, highlights the risks chain shot poses. A forestry worker, 47, was removing trees using a mechanical harvester. After felling a tree, he began cutting it into smaller pieces. As he did so, the saw attachment on his Timberland harvester failed. Three pieces of chain hit the cab. Harvesting machines typically use thick polycarbonate windows such as Lexan's Margard to protect against this risk. It offers around 250 times the impact strength of glass, and 30 times that of acrylic.

One piece of chain penetrated the 17mm polycarbonate screen and was still moving at speed when it struck the operator in the neck. He was able to call a co-worker for

help, who contacted emergency services, however by the time they arrived, he was dead.

Imagine working with these risks in an urban environment, felling dead ash along a busy motorway or train line, or on a high street or school playground? How do you decide the best method of work - manual operations that might see an operator fall from height? Or mechanised operations that may send pieces of chain or exploding lumps of dead ash flying at ballistic speeds towards members of the public?

Some grapple saws are designed to work at lower chain speeds which do not produce the potential for chain shot, provided they are used at the recommended hydraulic pressure. Others are fitted with chain shot protection measures to control the risk. However, as the required risk exclusion zones are extensive to protect bystanders from chain shot, there is concern that using these attachments in populated areas will introduce unacceptable risk.

Alerting the industry

The first public warning of these risks came in April of this year, when FISA and the Arboricultural Association issued a safety alert 'Tree Shears and Grapple Saws' warning of the risks of chainshot and gave advice on equipment selection and risk zones. It also, significantly, pointed out that lifting equipment with grapple saw attachment is engaged in lifting operations. Therefore, regulations like LOLER (Lifting Operations and Lifting Equipment Regulations 1998) apply. There remain concerns over the suitability of the types of base machines (such as excavators, telehandlers and lorry loaders) selected for such operations due to potential instability.

On the crane side, many manufacturers and installers have taken the decision not to fit grapple saws. One such is Palfinger UK, the Austrian manufacturer's independent UK distributor where ALLMI's Johnson works, and Mac's Trucks, who built the crane featured in this issue's profile.

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While they are confident Magee's crane could serve as a model for this equipment configuration, they won't be building more until the guidance is complete.

UK safety regulator, the HSE, also played a part in preparing the FISA/AA safety alert. Along with ALLMI, and others, they are helping FISA and AA develop a new best practice guide, which was entering the final stages of review as we went to press. An HSE spokesman told Cranes & Access: "Both the forestry and arboriculture sectors have one of the highest workplace injury rates, with a rate of fatal injury some 18 times as high as the average across all industries. The use of machinery based felling aids such as grapple saws, which can reduce risk by the removal of the need for motor manual (chainsaw) work, is currently being worked on by an FISA working group which will shortly produce industry guidance in the form of a FISA Guide which is currently in final draft."

"This is particularly important, not only because of the work at height risk but also because of the need to deal with ash dieback which can result in brittle and unstable trees. However, the introduction of these machines, which are interchangeable equipment mounted on a variety of base machines (cranes, excavators and telescopic handlers etc.), are not without risks hence the need for the new FISA Guide.

"The key issues are selection of a suitably stable and adequately protected base machine CE

marking to the forestry standards, provision of manufacturer's safety information on use including safe lifting capacities, risk zones for both operators and members of the public and potential chain shot and associated risk zones which can be up to 90 metres. The last issue is particularly important as these machines are often used in urban environments increasing the number of people who are potentially at risk."

Dual skills

Safe working using these machines requires two key sets of skills. The operator should be competent to plan safe operation and a safe site. They must also prepare a lift plan which risk assesses the likely load of the tree or section of it to ensure it is within the lift capacity of the base machine. Typically, that would require expertise in both tree work and competence in lift planning equivalent to that of an Appointed Person (AP).

Clark notes though that while a trained AP may be considered competent for lift planning under LOLER, that doesn't mean they are competent to assess all the risks of this work. "The traditional risk element checks: steep banks, not putting a leg through a gas main etc... are still required, but I don't think people are aware how much more involved the tree shear or grapple saw is, as opposed

to a range of other heads and attachments they may use on a given base machine."

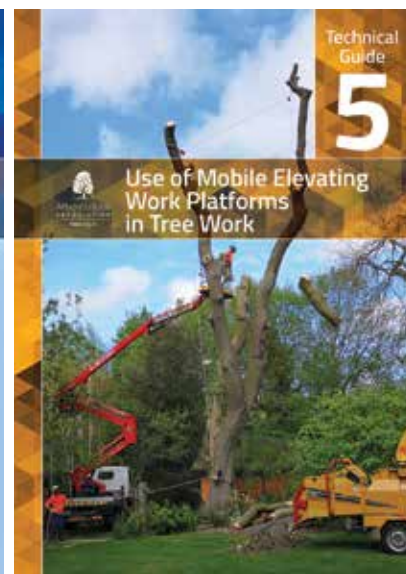
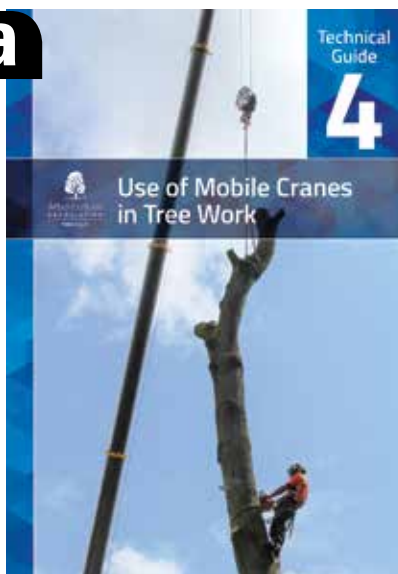
"Even though they may legally be the Appointed Person under BS 7121, if they have never had anything to do with one of these heads before they should really question their own competency to act in that position eg: assessment of sectional timber weights and drop/risk zones etc... They clearly wouldn't have the competency to do so."

Few tree surgeons will have all the skills needed to work as an AP. The Arb Association's Richmond says: "I think in many cases, they wouldn't necessarily have an appointed person as part of their team. But they'll be absolutely aware that that's what's required in order to carry out the work."

Few APs will have all the expertise needed to assess the risks of working with a grapple saw. The

FISA/AA alert offers one approach, saying: "Due to the significant hazards and risks posed by tree felling operations a generic (lift) plan may be produced, however the plan will need to be reviewed on a site by site basis, following the carrying out of a risk assessment, to ensure that it remains relevant and, where necessary, additional controls are put in place."

What most clearly shouldn't be happening is general construction companies buying grapple saw attachments, fixing them to otherwise unmodified excavators, and sending their operators out to clear dead ash trees from a job site. But, speaking to experts for this article, it's clear to me that in some cases this is happening. If a fatal accident occurs as a result, the equipment owner is likely to find themselves in court, with a death on their conscience and with no legal defence.



The Arboricultural Association has produced technical guidance on the use of cranes and access equipment in tree work.



BIK Hydraulics' PM crane with Mecanil grapple saw in action





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knuckle booms and loaders **C&a**

A rule of thumb

One of the questions being considered by FISA, the Arb Association and HSE as they work together on the upcoming safety guidance is the use of a 'rule of thumb' to help operators or supervisors to predict the load of cut tree sections.

Clark says: "We've put a rule of thumb into the new draft guidance; but some are unhappy at it being in there. At the moment, it's still in and I'm hoping it will stay in. I just want people to understand that it is very difficult to guesstimate the unique loading of timber/cut tree sections. The rule of thumb is certainly not thorough, so if it remains in the guidance, would have quite a strong caveat to say that."

Ultimately, whether a rule like this is defined in the guide or not, operators will need to in some way assess the load to be lifted. ALLMI's Johnson says: "If there is such a rule of thumb guide that states 'if it's x metres long and y metres diameter, therefore it weighs x', which is the logical way of doing it, then, I imagine there will also then

be a need to build a safety factor of e.g. two to one. So, if you assess the weight at 500kg, you'll have to use a crane that is capable of doing at least a tonne at that radius."

What can you do?

The requirement is likely to grow substantially as Ash Dieback spreads. Many tree surgeons who are used to working manually are considering equipment to help them take on the expected workload, general construction companies may be considering including ash removal in the services they offer; and equipment suppliers should be considering how to offer mechanised tools for this work.

If you want to take on this work, start with the FISA/AA alert, and then make the right equipment selection, ideally a machine that can reach over obstacles, such as a knuckle boom, the right attachment for the job, with the necessary protective measures installed, including operator protection and remote controls to see the load from the best location. On top of that you'll need skilled



Sennebogen offers a range of material handlers suitable for use with grapple saws. Germany's Schumacher Garten & Landschaftspflege use this 718 E.

staff that can assess all of the risks, including the weight of loads and the risks associated with the specialised attachments. That may

require employing or contracting experienced tree surgeons, who have been thoroughly trained to use both a crane and a grapple saw.

Resources

Tree Shears and Grapple Saws safety alert
www.ukfisa.com/Safety/Safety-Alerts/tree-shearsgrapple-saws

Arboricultural Association guidance:

Use of mobile cranes in tree work
www.trees.org.uk/Book-Shop/Products/Technical-Guide-4-Use-of-Mobile-Cranes-in-Tree-Work

Use of mobile elevated work platforms in tree work
www.trees.org.uk/Book-Shop/Products/Technical-Guide-5-Use-of-Mobile-Elevating-Work-Platforms-in-Tree-Work

Timber Harvester Operator Killed Following a Chain Shot Incident
www.cdc.gov/niosh/face/pdfs/10WA048.pdf

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