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Off the beaten track

The market for road rail mounted lifting and work at height equipment is in many ways a niche of a niche, with the further specialisation of being able to travel on both road and rail. Despite this, it is very diverse, Will North takes a look.

Road Rail Vehicle (RRV) versions of lifting and work at height equipment range from excavator and 360 degree telehandler based machines with a wide variety of attachments, to cranes and aerial work platforms modified or built for the purpose. They all offer the ability to travel and work safely on both roads and railway lines.

The most obvious adaptation from routine equipment is the addition of the road rail running gear. Typically, these consist of a set of hydraulically driven rail wheels mounted at either end of the machine. Each 'bogie' raises the equipment, lifting its road tyres clear of the tracks with at least one set propelling the machine along the tracks. Some systems just take a portion of the machine's weight, leaving its road tyres to provide the propulsion, but these seem less popular.

In many markets, there will be a single ultimate end user, initiating projects and setting standards. In the UK, this is Network Rail, typically with a tier of contractors in between it and equipment suppliers. Rail networks cannot tolerate downtime, machine failure on a working line will rapidly ripple through the network, causing delays for passengers and significant economic disruption.

Even more importantly, the networks have increasingly high expectations for safety. The railway can be a dangerous environment for operators and crew working around them. While work can often be scheduled overnight, it also takes place alongside live tracks.

In order to avoid accidents and downtime, rail networks set rigorous standards for the equipment used by contractors which requires considerable work on the machines. Equipment owners and suppliers I spoke to for this article explained that this can often triple the cost of a machine. For example, adapting a standard £130,000 machine for use on the railway may cost £200,000 or more.

Given the complexity of rail networks, project plans are developed years in advance. Network Rail works in five year spending periods. One might hope that this would allow fleet owners to plan equipment purchases well in advance, confident in a steady flow of work. Instead, it often leads to 'lumpy' contracting, with projects not confirmed until the end of the spending period.

Early involvement

In general construction work, lifting equipment suppliers often lament being an afterthought in project



Suppliers of rail mounted equipment must often work at night while lines are closed. TXM's 'Monster Crane' can pick & carry loads from the nearest road access point

planning: whether all the loads on site can be lifted safely and efficiently is seldom considered at the start, but rather left as an issue for the crane rental company to solve.

Here, the rail equipment sector takes a different approach. In the UK, Network Rail's plant operations scheme (POS) demands equipment suppliers be involved in project planning from the start. That means equipment providers know what is needed and can be more confident that it will be used safely. But it also means they must employ POS representatives, with the expertise and experience needed to participate in the process.

Road rail innovators

While the UK's largest RRV rental companies, such as Quattro and TXM, profiled later in this article, typically mount excavators for rail use, a key innovation came from Sweden in the 1980s when engineers added RRV drive units to commercial trucks. UK based SRS Rail System was an early adopter of these machines, and now has 45 of them in its fleet.

It has some key advantages. By using a standard road vehicle as a base, the RRVs are truly road rail capable. An excavator based system can travel around site and between lines using its road wheels or tracks. However, it must travel to the job site on a trailer. SRS's system allows its machines to travel at regular road speeds.

Most RRVs are designed to tow trailers for personnel and materials. SRS's vehicles simply carry loads on the vehicle bed as well as being able to tow a trailer. This allows the equipment to collect loads from depots, travel to the rail access point, transfer to the track and take the materials directly to the work area. This reduces the need to double handle materials, saving time and, more importantly, money. While SRS's core market is the UK, it is also working in Ireland, and it has also supplied RRVs and labour to projects in other parts of Europe and the Middle East.

Within the rail industry, there are a number of regular jobs: material delivery to work areas, installing or maintaining overhead power lines,



SRS's road rail machines are truck mounted, allowing it to carry attachments or transport heavy loads to site on their flat beds



SRS has one of the few underbridge road rail inspection units in the UK. While due for replacement it is still finding regular work



SRS's rail crane features a Palfinger loader crane on a purpose built road rail carrier with an extending counterweight

post or tree handling or signalling. Each has its own specialised lifting requirements. Excavator and telehandler based machines can use different attachments to match the work. SRS, however, takes a different approach with a modular system, using a standard container locking mechanism to attach the equipment. This allows various machines to be quickly swapped as required, for example switching between a loader crane to the flat cargo deck of an aerial work platform in minutes.

SRS also has a couple of notable specialised units, including an underbridge inspection platform. This, SRS business development manager Gethin Thomas tells me, is the only known unit working in the

UK. While it will soon be replaced by a newer model, it is still out working every week.

Another special unit is SRS's 75 tonne/metre Palfinger PKR 750 rail crane. The crane is mounted on a purpose built articulated carrier, allowing it to be towed to site on road wheels and mount the track in around five minutes. The crane itself has a couple of key features, suiting it for rail work. One that will stand out to general knuckleboom users is the telescopic counterweight. Retracted to travel on the rails safely it can be extended once the crane is set up on outriggers to work, increasing the crane's capacity. The crane features a reverse knuckle joint, allowing the main boom to be raised almost vertically, outside

the centre line of the rail track, further increasing its ability to position loads while working safely in the constricted space available alongside a live railway line.

Taking responsibility

In the UK, suppliers of rail equipment must meet the requirements of Network Rail's on-track plant operations scheme (POS). Replacing an earlier set of regulations - the plant operators' licence - the scheme shares some key concepts with UK regulations such as LOLER covering general lifting. While LOLER and BS7121 demand an Appointed Person (AP) to take responsibility for lifting operations, POS requires that equipment suppliers have a designated POS representative. A Network Rail presentation explains that person's responsibilities, and the thinking behind the scheme. There must be effective local planning with 'those who do the work being involved in planning the work'. There must also be 'one accountable mind' for on-track equipment operations. The process for deploying equipment must be developed by those who use it. There must be live management of risks at the point of work, with independent monitoring

and checking of controls. And the process should be the same for Network Rail and contractors.

TXM Plant is a major supplier of RRVs to the UK's rail network, with over 260 units, and more than 1,000 complementary attachments. Steve Smith is director of cranes and Plant Operations Scheme (POS). He began his career as an operator on the railway and has worked for principal contractors on Network Rail, having started his career at Jarvis, and been with TXM for more than 20 years.

Each of TXM's clients is assigned a dedicated POS and lift planner so that continuity can be achieved, and a 'one point of contact' principle



Network Rail has increasingly strict rules about supervision and planning



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Interactions between people and equipment is always a risk. GKD's sensors and controls help keep workers and operators safe.

upheld. Smith says, "The planning stage of our work involves ensuring the machines and attachments we deliver are capable of completing the work in good time to for our customers' goals. Everything in between, from access point navigation to operator competency, reflects our hard work and openness to our customers."

POS representatives consider the size of the jobs, taking into account any hazards and risks. Once those risks have been accounted for, the company has a team of lift planners who plan every lift it performs in detail. Additionally, it maintains a well-stocked parts warehouse and offers a mobile workshop with parts inventory on major projects, meaning that many issues can be dealt with on site.

TXM has a 24 hour, seven days a week call centre, able to direct enquiries to the relevant POS representatives, or an on-call lift planner. Reliability and uptime are key when working on the railways, with equipment suppliers required to ensure they account for every possible risk onsite.

Trevor Hartnett is regional rail director for Quattro. The company offers an extensive range of RRVs, Demag All Terrain cranes adapted for rail work, as well as access equipment and other specialist kit.

He says: "Network Rail insists on our reliability, which is actually higher than what you get from

the manufacturer. So, for the likes of Caterpillar they will say their machines are 96 percent reliable, my machines must be 99 percent reliable. So, you've got a more intense obligation than even the manufacturer."

As a result, says Hartnett: "Our maintenance costs are a lot more than for those working on construction sites. We have to have stock levels of parts, to ensure we minimise downtime as much as possible." And, again, the 24 hour, seven day a week, working practices of the railways means that Quattro has to have staff on call at all times.

Heightened awareness

In addition to rail wheels and a wide range of specialised attachments, a third change is also required, less visible unless you are in the cab or at the controls. That is the addition of upgraded sensors and control systems. Excavators or telehandlers rarely offer the sophisticated rated capacity indicators and control systems that one would see on a modern crane. When working in the critical environment of the railway however, these must be added. To work alongside live railway operations, or in situations with restricted head room, they must also be equipped with fail safe limiters.

GKD is a leading supplier to the sector. The company's founder and director of innovation, Nick Ground,

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GKD's rated capacity indicators allow rail equipment to work with maximum safe lifting capacity at all positions, and to avoid overhead obstacles

says that when he joined the construction industry, excavators were being increasingly used as cranes in addition to their normal earth moving duties. They were not however equipped with the overload warning devices which have been required on cranes in the UK since 1939, posing a problem for safety regulators. Spotting the trend, Ground approached the owner of the business he was working for and offered to buy the division making rated capacity indicators, with the aim of developing them for excavators. At the time, legislation was promised that would, in 1986, enforce the need for this equipment. However, as his then business worked to develop its product range, the excavator industry successfully pushed for a delay. This left his

company with stock for which there was no immediate demand. Faced with the financial consequences of this change, Ground sold the businesses assets to a printed circuit board supplier and became an employee.

A few years later, he saw the chance to strike out on his own again, and, in 1992, set up GKD. The company did not initially focus on excavators though, but rather on articulated loader cranes. At this time, companies like Palfinger and Atlas were moving beyond their traditional uses as mere loaders, offering the equipment for more general lifting duties. That meant they required more sophisticated sensors and control systems, and GKD was able meet those needs.

"And then," says Ground: "In the late 1990s, we were approached by a major international excavator manufacturer to develop a rated capacity indicator for rail converted machines." While the initial project didn't get off the ground, as the manufacturer faced separate challenges with selling its machines in the sector, the project boosted GKD's expertise in the field, and set a new direction for the company.

At the time, indicators used a multi-sector approach: capacities around the machine were split into separate zones. GKD's innovation was to offer continuous rated capacity, calculated for the exact position

of the machine as it lifted. While that is now familiar in the crane industry, the rail industry offers another challenge: railway lines are often canted, in order to keep trains stable as the track curves. For lifting operations, that means an RRV may often have to work on quite a steep side slope, with a height difference between rails of as much as 150mm on standard lines and 200mm on high speed lines.

GKD has also developed indicators for devices such as TXM's Monster Crane, which mounts a Palfinger knuckleboom on a road-rail excavator which are often used to replace overhead gantries and



The view from the cab of a GKD RCI showing the wealth of information available to operators

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in f t y i



Promax supplied equipment on an overnight shift

to perform other lifts. Ground says: "All of a sudden the system has to understand that there could be 800mm or more of deflection when the boom takes the load at height. We have to accommodate the change as it extends and the fact that centres of gravity move differently."

Another challenge for contractors on railways is ALO, or 'Alongside Live Operations', working. This carries a risk of collisions between equipment and trains (the tragic consequences of which can be seen from a recent accident in Taiwan, when a train hit a truck that had slid down an access road close to the entrance of a tunnel, killing 49 people), as well as rail workers being struck by trains.

GKD offers ways to address collisions risks, between the lifting equipment and trains, and personnel and working machines. Its devices incorporate modern zoning systems, restricting the crane or platform's movements so that they don't interfere with nearby trains or overhead obstacles.

There is also a risk of collisions between the road rail equipment and those working in the area. GKD has developed a hybrid helmet mounted RFID tag, which monitors the position of those working in the area and alerts them, whenever they get close to working machinery. The Proximity Warning Sensor has already become a market leading device in construction and has now been approved for railway use.

Purpose built

So far, all the equipment we've covered has been adapted: trucks, platforms, cranes etc... mounted on road-rail bogies. UK based Promax Access has worked closely with its Italian manufacturing partner, Platform Basket, to develop purpose built road rail platforms.

Promax owner Shaun Day says: "When we started the majority of working at height equipment had a platform attached to a large piece of equipment - big heavy stuff. We supplied some of the first machines from Platform Basket back in 2003 having been approached for an alternative. Once customers started seeing the savings from proper aerial work platforms on rail it revolutionised the industry a little bit, because it was designed and built as a road rail access platform rather than being a conversion."

Designing equipment for the railways introduced new challenges. On road going mobile equipment, a key issue for designers



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An overhead line electrification job for Promax in Maidenhead, UK

is making sure each axle stays within a maximum loading. On rail equipment, this is reversed: each wheel must put down a minimum load.

Day says: "They are looking for minimum loads on all points of contact with the railhead. The weight for the dispersion and the way the machine operates, and transfers weight is very, very important, because we have to maintain minimum weights on the lightest wheel at all times. This is why conversions have always had a bit of a problem because you end up reducing outreach and limiting other features, to try and accommodate the requirements of the testing for use on the Network Rail infrastructure."

Telehandler or excavator based multipurpose machines can, of course, handle a wider range tasks than purpose built road rail platforms. But, as well as having to make compromises in performance to meet rail infrastructure demands, they come at a cost. With adaptations for road-rail use costing up to £200,000 alone, a typical purpose built Platform Basket RR14

EVO2, with a 14 metre working height, costs a third of typical 360 degree excavator base machine and is ready to go without requiring a conversion.

Once again operating on a 'cant' slope or banked track is an issue. That 200mm difference in track height equates to a slide slope of around eight degrees. The Platform Basket booms incorporate a tilting superstructure with up to eight degrees of levelling capability, so the top half is always level. As well as ensuring stability it protects the slewing mechanism and other components. Platform Basket and Promax continue to innovate and develop the original machine. The latest version of the RR14 - the EVO2/400RR14 - features a higher, 400kg/three people platform capacity, while a new development - the RR14 EVO2/Hybrid - has a Tier V diesel, along with a 400Ah lithium battery pack, sufficient to power the machine, emissions free, for between four and eight hours, enough for a typical shift.

Road rail cranes

While typical road rail lifting equipment can handle a range of



TXM's 'Monster Crane' - a Palfinger telescopic boom installed on a Kobelco SK200 road-rail base can pick & carry up to 17t

attachments, there are times when more capacity or reach is required. Each of the suppliers I spoke with cater for this need, including SRS's Palfinger on its purpose built carrier, with extendable counterweight.

Quattro has taken a different approach and modified two Demag City All Terrain cranes, a 40 tonne AC40 and 55 tonne AC55, with road rail bogies. When lifting they work like the standard crane, setting their outriggers either side of the track, rather than relying on the track and weight distribution.

Andy Johnson, rail operations manager for Quattro, says: "There are occasions where you can't always get a mobile crane close enough and may be looking at using a 500 tonne crane, working from a distance. Whereas our cranes can travel down the track and get close into the lift - then set-up and carry on lifting."

A good example of this occurred in April, when Quattro supplied an AC55 for a job on the Isle of Wight. Beaver Bridges had been contracted to remove and refurbish a passenger bridge, crossing the railway between the towns of Shanklin and

Sandown. Quattro supplied its AC55 to remove the bridge while working from the track and will return once it has been refurbished to reinstall it.

In another example Quattro was called in to help with an emergency bridge repair. A truck had hit a bridge crossing a road and three railway lines. With the bridge damaged, trains could not pass below it and had to be removed - fast. The AC40 was quickly deployed, travelling to site mounting the tracks, traveling into place and lifting the bridge away.

TXM takes another approach with its 'Monster Crane', a 100 tonne/metre Palfinger boom installed on a rail adapted Kobelco SK200 tracked excavator base. The machine can pick & carry loads of up to 17 tonnes and uses GKD safety systems, with zoning restriction interlocks, needed for working alongside live operations as well as a tandem lifting programme.

The machine proved its worth on a job in Stockley, to the west of London, on the Crossrail project. TXM needed to deliver and place 189 U-shaped prefabricated concrete structures that form an



Quattro's has two modified Demag City cranes - an AC40 and AC55 - fitted with road rail bogies. 'On-tracking' takes just a few minutes, the cranes can then travel to the work area on its rail wheels, before putting down outriggers alongside the track and working at its full capacity



The TXM Monster Crane uses a GKD RCI with tandem lift programme



overpass. The 'Monster Crane' lifted each structure from a tractor trailer at a safe location and then carried the load along the line with a one in twenty gradient, while trains continued to travel at full speed on the adjacent line. This enabled the job to be completed in 12 weeks. The traditional solution would have involved a 400 tonne crane lifting the loads across the tracks, requiring it to be shut to trains. The severe limits on the time available for closing lines would

have substantially extended the project. TXM's Monster Crane is able to travel under live overhead electric lines and capable of towing three trailers of up to 56 tonnes, without the need for additional RRV vehicles. With no outriggers required, full pick & carry duties are available on the rail, preventing potential damage lineside. The company has won a string of jobs for the crane, replacing bridges, and installing walkways and passenger lifts.

Beyond innovation

Road raiing lifting equipment has evolved over the years into a highly adapted products, perfectly suited to the railway environment. But as we've seen here, merely owning the right kind of equipment, and the specialised attachments needed for specific jobs, is not enough.

Companies supplying equipment to the sector must be ready to meet all of the regulations and standards needed in order to work safely in this challenging environment and have personnel who can contribute to every project from the start, helping identify and avoid risks, and to plan every lift in advance.

On top of being ready to avoid safety risks, they must be able to withstand a feast and famine order cycle, due to long term project planning and emergencies leading to a 'lumpiness' in project starts, requiring suppliers to maintain equipment stock levels for which there is not always work. On top of this they must guarantee extremely high levels of uptime regardless of issues such as Covid-19 lockdowns, the Suez blockage, and a surge in demand for silicon chips, which can easily create parts shortages. All of the companies I spoke with had plans in place for this sort of thing, but it adds another headache to an already challenging sector.



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