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+ 44 (0) 20 8253 4011
ian@evaint.com

Address changes and subscriptions:
charlotte@evaint.com

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Tel: +44 (0) 20 8253 4000
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www.evaintmedia.com

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Editor's NOTES

Mike Bryant
Mike@evaint.com

Welcome to the Summer 2021 issue of *Airside International*, in which we look once again at how GSE manufacturers, ground service providers (GSPs), airlines and airport operators are fighting their way through what are some of the hardest times the global aviation industry has ever had to face.

But it is by no means all doom and gloom. Those suppliers supporting the sector continue to develop innovative systems and equipment, and one of the themes of this issue is GSE automation. We talk to ThorDrive and Aurrigo about their development of autonomous baggage tractors, as well as Stuttgart Airport, which is currently hosting trials of another autonomous baggage tug.

We learn more about Denmark-based Vestergaard's new electric e-BETA de-icer, while GSE manufacturer ADELTE talks about its state-of-the-art ARCOS Remote Control Operating System for passenger boarding bridges and India-based Transtec Overseas offers an overview of how it is meeting the changing needs of GSE operators in a pandemic-affected world.

We meet with GSE suppliers TCR and Aviaco, who offer customers a range of alternatives when it comes to equipment acquisition, as well as full-service maintenance provision.

Features include a look into the latest technologies available for preventing damage to aircraft and GSE on the ramp, the highly sophisticated and highly effective emergency firefighting vehicles used at airports to deal with fires and other emergencies, as well as how airport operators are going about wildlife and habitat management within their perimeters.

Another feature assesses the current medical lift market and how ambulift manufacturers are meeting its needs. In addition, GSP dnata offers an overview of how it goes about looking after the particular needs of passengers with restricted mobility. And the final feature looks at the evolving technologies associated with on-airport aircraft refuelling.

Finally, this issue's regular Buyer's Assessment looks at ground handler Bangkok Flight Services' use – and appreciation of – the wireless Minerva Ajax on-airport communications system.

We hope you enjoy the issue.

James Sheridan
Chairman
james@evaint.com

Parveen Raja
Publisher
parveen@evaint.com

Ian Talbot
Sales Manager
ian@evaint.com

Charlotte Willis
Office Manager
charlotte@evaint.com

Gemma Keen
Events Coordinator
gemma@evaint.com

Alpha Diallo
Graphic Designer
alpha@evaint.com

Shobhana Patel
Head of Finance
finance@evaint.com

Salam Raja
Producer
salam@evaint.com

Ed Robertson
Editorial Director
ed@evaint.com

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Oshkosh's Striker4x4

Emergency vehicles

Airports rely on their emergency services – and the latest equipment – for a wide range of responses to accidents and crises, potential and real. We meet two of the suppliers of state-of-the-art aircraft rescue and firefighting (ARFF) apparatus, and a couple of the airports that use it

One of the biggest global providers of ARFF equipment is Oshkosh/Pierce Manufacturing. Pierce Manufacturing and Oshkosh Airport Products are both Oshkosh Corporation companies and form part of its Fire and Emergency Segment.

All of Pierce and Oshkosh Airport Products' Fire and Emergency Segment vehicles are manufactured at Oshkosh Fire and Emergency facilities and, says Jack Bermingham, business unit director for Oshkosh Airport Products, "Our team benefits from many technologies, manufacturing techniques and procurement efficiencies that are shared amongst both brands, which ultimately allows us to provide better value to our customers."

The Striker ARFF vehicle is the flagship product for Oshkosh Airport Products and is available in three main models – the Striker 4x4, 6x6, and 8x8. The models each have different firefighting agent capacities as the number of axles increases, and each also offers a range of capabilities.

Bermingham says: "Our airport customers worldwide face many challenges to achieve their mission of keeping the travelling public safe.

The Striker ARFF vehicle has numerous options, configurations, engine selections, and safety features to help our customers achieve their mission while allowing airport operators and maintenance personnel to work efficiently."

In addition to its Striker vehicle, Oshkosh Airport Products also offers another ARFF product, the ARV, which is built on a European commercial chassis. Its rapid intervention vehicle, called the Stinger, is built on a Ford F-550 chassis to meet the Class 2 ARFF vehicle requirements of the Federal Aviation Administration (each FAA class represents different firefighting agent capacities, of water, foam, dry chemical, etc).

Lastly, Oshkosh offers a Striker ARFF vehicle simulator that is built with genuine cabin parts and utilises simulated computer scenarios to provide realistic ARFF training. The simulator can cut down on precious frontline vehicle time and wear, while also allowing firefighters to conduct real-life ARFF scenario drills.

In 2019, Oshkosh saw its 5,000th ARFF vehicle go into operation, and that number has continued to climb. Many of these vehicles are still in service; others will have been retired to reserve units. Oshkosh's parts and service departments still provide parts and technical assistance on vehicles that have been fielded for 30 to 40 years.

Rosenbauer's big cat: the PANTHER

Leonding, Austria-headquartered Rosenbauer describes itself as the world's largest firefighting technology provider. It offers vehicles, fire extinguishing systems, fire and safety equipment and digital solutions for fire services and prevention.

In its segment dedicated to airport applications, Rosenbauer offers the PANTHER 4x4, 6x6 and 8x8 ARFFs, the MT-Buffalo ARFF vehicle, its E8000 and E5000 rescue stairs and the Airwolf rapid intervention vehicle (RIV). Other Rosenbauer products (such as various digital solutions) are also used at airports to support their fire prevention and firefighting efforts.

More than 2,000 of Rosenbauer's

One of CAG AES's Rosenbauer ARFF vehicles; credit Changi Airport Group

Last line of defence

With more than 500 firefighters, the Airport Emergency Service (AES) of Changi Airport Group (CAG) – the operator of Singapore's Changi and Seletar airports – is responsible for aircraft rescue and firefighting across air stations in Singapore, including Changi Airport, Seletar Airport and the Republic of Singapore Air Force's air bases.

There are three main fire stations at Changi, a satellite station and a Sea Rescue Base, with AES officers split into three teams to provide round-the-clock firefighting protection.

Despite the impact on operations of Covid-19, flights continue to depart and land at Changi Airport and – as "the guardian of safety and last line of defence at the airport – it is critical for the AES to maintain its level of firefighting and rescue capability", says Puar Teck Jin, commander of civil operations at the AES.

"This is especially important as Changi Airport prepares for the gradual reopening of international borders and resumption of [normal] travel," he adds.

A growing fleet

Two new vehicles were added to the AES fleet in 2020 – a foam carrier and a Rosenbauer water tender. The foam carrier can hold 10,000 litres of foam, much more than foam tenders, enhancing AES's firefighting capabilities in the event of prolonged operations, Puar notes.

Vehicles operated by the AES include:

Foam tenders: AES has a fleet of 12 foam tenders at Changi, consisting of both Oshkosh Striker and Rosenbauer PANTHER vehicles. Despite their size, the foam tenders are able to reach a top speed of 120km/hr and can go from 0 to 80km/hr in under 32 seconds. These vehicles have a maximum discharge rate of 6,000 litres/minute, which allows the AES to control and extinguish large-scale aircraft fires.

To ensure the safety of firefighters, the foam tenders also have smart safety features such as Roll Stability Control and specially designed cabins which allow safe stowage of equipment while the team moves to the emergency site as quickly as possible.

Water tender: Time is of the essence during aircraft rescue and firefighting, and having a large water supply reduces the time needed for a response team to locate a water hydrant, Puar explains. The AES's water tender is able to carry up to 12,000 litres of water, and is thus able to provide extensive replenishment of water to foam tenders during prolonged firefighting.

Emergency air stairs: The AES was one of the first airport firefighting services in the world to place emergency air stairs equipment in its inventory. A new and improved version was added to the fleet in 2017. The vehicle can reach heights of up to 8.45m, enabling firefighters to access widebody aircraft such as the A380. During emergencies, this vehicle can be used not only to enable AES officers to enter the aircraft for search and rescue missions, but also for passenger disembarkation.

Mobile command bus: The AES's command bus acts as a roving field headquarters for different agencies and partners to monitor an ongoing situation and make critical decisions on site. It is equipped with advanced technologies including a live video feed system to transmit real-time footage from the site of an incident.

Mass casualty carrier: Designed and built to quickly evacuate casualties from an incident site for rapid medical attention, the AES's mass casualty carrier can accommodate up to 10 lying casualties or 40 standing and sitting persons at one time. It is also equipped with first aid equipment.

Hovercraft: The AES operates a Sea Rescue Base that is equipped to handle emergencies in the waters surrounding Changi Airport. Among the fleet of specialised emergency vessels based there is the unit's hovercraft, the only one of its kind in Singapore. The hovercraft has a top speed of 40 knots and a carrying capacity of up to 50 casualties (plus an additional life raft capacity of up to 325 casualties).

signature PANTHER ARFFs are to be found at nearly 100 airports around the world. In January 2020, the 2,000th PANTHER was delivered to Fort Lauderdale-Hollywood International Airport, Florida. According to Rosenbauer, the PANTHER is used in all types of airports worldwide. It complies with all relevant international standards and can therefore be used without restriction, the company notes.

Demand for Rosenbauer's ARFF vehicles has slowed as a result of the Covid-related fall in air traffic and the deferral of planned infrastructure investment in many parts of the world, the company confirms. Under these circumstances, many airport operators are keeping their vehicles in operation for longer and are investing in service instead.

However, airports' firefighting capability, including the ARFF vehicles on hand, must primarily be proportional to the size of aircraft passing through the gateway, rather than the number of flight movements at the airport. For those gateways handling a super jumbo, for example, an airport fire brigade/service must have the required quantities of extinguishing agent available for handling an A380 fire, regardless of whether 10 land each day or just one per week.

Thus, even during the pandemic, airports have had to maintain their firefighting capacity. And there were also countries in which procurement volumes rose, largely compensating for the general decline in demand, Rosenbauer observes. Markets in which there has been demand for its ARFF vehicles have included, for example, Japan and South Korea; the Spanish airport operator AENA has also placed a larger PANTHER order (to replace existing vehicles), as has Hong Kong International Airport (as new procurement to support operations on its third runway).

Furthermore, the investment backlog will certainly have to be caught up, as ARFFs are a requirement for maintaining flight operations, the company confirms. "The question will be how quickly the

Two of Toronto Pearson Airport's ARFF vehicles; credit Kyle Taylor

Toronto Pearson Fire & Emergency Services: ready to respond

In what might be considered a 'normal' non-pandemic year, Canada's Toronto Pearson International Airport handles nearly half a million flights carrying around 50 million passengers and more than half a million tonnes of cargo. Unsurprisingly therefore, it needs a robust and efficient emergency response capability, supported by modern and effective ARFFs.

In fact, Toronto Pearson Fire & Emergency Services has close to 90 staff, with 69 firefighters working on a four-platoon system. Each platoon has one platoon chief, two captains, two to three acting captains and 11 or 12 firefighters.

These firefighters operate out of three fire stations situated around the airport. Two are located close to the airport runways, with a third station close to the front of the terminals. "We also have a world-class fire prevention team that performs fire code inspections and fire investigations," observes Todd Aitken, the fire chief of Greater Toronto Airport Authority (GTAA) – operator of the Canadian gateway.

"What makes Toronto Pearson Fire & Emergency Services unique is that we also run a world-class training academy," Aitken continues, "the Fire & Emergency Services Training Institute (FESTI) – where firefighters from around the world train and develop their skills. FESTI is an accredited private career college that prepares students for a career in firefighting."

As might be expected, Toronto Pearson's firefighters respond to a wide variety of emergency responses. They are trained to be there for aircraft responses, structural fires, auto/car extrications, rope rescue, confined space rescue, hazardous materials spill and response, and medical emergencies. Pre-Covid, Toronto Pearson Fire & Emergency Services typically responded to an average of nearly 6,000 emergency responses a year.

Despite the pandemic and the reduction in flights through the airport, Toronto Pearson Fire & Emergency Services has maintained its staffing levels. As Aitken points out, whatever the airport's operational intensity, "We are still responsible for the safety of staff, passengers and all of the infrastructure at the airport."

As for the vehicles used by his firefighters, Aitken informs that his teams are equipped with four new Rosenbauer PANTHER ARFF vehicles, three Pierce structural apparatus, command vehicles and four Oshkosh Strikers that serve as reserve apparatus and training school apparatus.

The ARFFs are highly specialised; they can pierce through the skin of aircraft to apply water and foam, distribute high volumes of water/foam, carry dry chemical and have infrared cameras to detect hot spots. "They are state of the art," Aitken says.

No new acquisitions are planned at Toronto Pearson for the short-term. "We will need to slowly rotate out some of our older structural apparatus; however, there is no apparatus scheduled for delivery in the near future," Aitken confirms.

Finally, he points out the importance of Toronto Pearson Fire & Emergency Service's close collaboration with various partners. "We have great working relationships with all of our mutual aid emergency response partners: Mississauga Fire & Emergency Services (municipal services), Peel Regional Paramedic Services and Peel Regional Police."

various markets can recover and start procurement programmes.

"We are taking a close look at technological and social change and the impact on fire departments and their organisation and technology. ARFF demand will also be affected by megatrends such as health, connectivity and neo-ecology," a spokesperson says.

Like Rosenbauer, demand for Oshkosh's products has been impacted by the pandemic. "The downturn in the aviation industry is undoubtedly real, and many airports worldwide have felt the impact as a result of the Covid-19 pandemic," Bermingham opines. However: "ARFF vehicles are an essential piece of equipment for airports worldwide and no matter the volume of aircraft movement, airports still need to ensure their ARFF fleets are maintained and that they stay up to date with their planned fleet replacements to maintain commercial service."

Rosenbauer ARFFs at Düsseldorf Airport

Rosenbauer PANTHER ARFFs at Germany's Düsseldorf Airport

Pointing out that airports worldwide have to meet a similar minimum level of requirements to ensure ARFF protection is standardised, he adds that Oshkosh has positioned sales and service employees around the globe, along with a trusted network of sales and service partners, "to ensure the highest level of support for our customers regardless of the size or location of their airport".

Moreover: "At Oshkosh, we are confident the future of the aviation industry is bright. Aviation will recover and continue to be a growth market as the world continues to be more connected. ARFF will continue to be needed to ensure the protection of the traveling public, and airports will continue to grow as the gate for communities' economic access and leisure travel."

R&D

At Oshkosh Airport Products, its R&D team remains focused on "continuing to develop innovations, build relationships and maintain loyalty among our customer base by providing the most customised and highest quality ARFF vehicles", Bermingham confirms.

In January this year, Oshkosh Airport Products introduced the next generation of its Striker ARFF vehicle. Newly optimised features include a focus on the modular cab designed with the firefighter in mind. "The ARFF fire response is fast paced and needs to occur in a timely manner. The new Striker cabin offers operators a new approach to ease of use while also increasing their visibility and available safety features," Bermingham says.

As for the longer term, ARFF customers are always looking for additional capabilities to improve their firefighting efficiency, lower total cost of ownership and improve overall value to the airport, he considers. "Oshkosh is continuously looking at various industry megatrends and listening to the voices of our customer to ensure our innovations are preparing our customers for the future."

The success of the PANTHER has driven Rosenbauer to deal with evolving customer needs, constantly improve the product and make new capabilities available, the company asserts. "This is an ongoing process that takes place as part of our product optimisation and improvement process.

"It must be our task to work together with our customers on solutions for the future. That is why we are also convinced that we will be able to offer the right solution for our customers in the future," the spokesperson concludes.

Our airport customers worldwide face many challenges to achieve their mission of keeping the travelling public safe

Jack Bermingham
Oshkosh

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Ensuring that bird life presents the minimum possible risk to airport operations forms a key part of many airport operators' wider habitat management strategy; pictured here is one very small part of the wildlife around Vancouver Airport in Canada

Taking wildlife and habitat management seriously

Sustainability has become a key consideration for airport operators, just as it has for most other parts of the aviation industry. As well as being another element in ensuring that all airside operations are carried out safely and efficiently, it also means taking care of and managing the local habitat and its wildlife

For most airports, wildlife and habitat management forms part of a much wider remit than is generally recognised. A spokesperson for Airport Authority Hong Kong (AAHK), operator of Hong Kong International Airport (HKIA), explains this succinctly: "AAHK has a public service responsibility, which goes beyond revenue and financial performance, to focus on the public good and the community."

As such, sustainability is regarded as a key element of HKIA's ongoing operations. Its sustainability initiatives incorporate a broad array of responsibilities, including wildlife and habitat management.

AAHK adopts, it says, an "airport-wide" approach to environmental management; this entails working closely with its business partners to manage, reduce and mitigate HKIA's environmental impact.

Its Sustainability team members work on marine and terrestrial ecology and biodiversity issues. It also handles other environmental matters, such as carbon reduction – another big focus of the airport operator.

Partnership

"As a significant proportion of HKIA's environmental footprint is beyond AAHK's direct control, we place particular emphasis

on encouraging our business partners to participate in our environmental programmes," the airport spokesperson says. For AAHK, "On-airport habitats are managed with the aim of balancing a visually pleasing and colourful landscape for airport users with a safe airfield where birdlife is deterred from important operational areas. While on-airport habitats are carefully managed, AAHK also strives to avoid and minimise operation and works' impacts on biodiversity," the spokesperson continues.

AAHK has implemented a range of ecological enhancement and conservation initiatives to help protect and enhance important marine and terrestrial ecology and habitats.

In fact, in conjunction with several of its airport development projects, AAHK has made substantial commitments in numerous areas relating to habitat and wildlife management over the years, including the creation of a marine park of about 2,400 hectares, intended to link existing nearby marine parks to

Singapore Changi: making good use of innovative technology

Changi Airport Group (CAG), operator of Far Eastern hub Singapore Changi Airport, also makes significant efforts to prevent potential disruption caused by local wildlife. And it is using some interesting technology to help it to keep the skies above Changi Airport clear of birds so that flight operations can continue safely and smoothly.

Using that technology is CAG's Airside Management Safety Inspection Team (AMSIT), which consists of 12 people whose job is to ensure that the airport area is kept free of birds, as well as other wildlife – amongst other tasks.

From 6.30 every morning up to about 7.00 each evening, by which time birds have flown away to roost in the growing darkness, AMSIT personnel patrol the airfield, looking out for birds in areas around taxiways and runways, as well as keeping an eye out for other animals that might have wandered within the perimeter, such as dogs or monitor lizards.

Certainly, the most usual problem is birds, including swallows, mynas and swiftlets. Other species, like egrets, kites and eagles, can also be an issue, and each patrol can use different means to disperse the birds.

Among the more advanced technology available are Long Range Acoustic Devices (LRADs), large vehicle-mounted systems that project sound waves to a distance of up to 3km to frighten the birds away.

Also on hand are handheld aerolasers that can fire a laser beam up to 2.5km. The laser is harmless to birds, but they perceive it as a physical danger, and will seek to move away.

Another option is the stockwhip, one of the latest additions to the wildlife dispersal toolbox that AMSIT has available. Up to 8m in length, it makes a booming sound when cracked in the air, scaring wildlife away. Staff are specially trained to use the whip.

The measures to keep Changi clear of possibly dangerous birdlife are supplemented by other efforts made by the airport authority to keep the local habitat from impinging on operations. For example, CAG's horticulture team ensures that there are no fruit-bearing trees or plants, which would attract animals, planted in the airport, while the engineering team keeps the grass around the runways and taxiways cut short to deter birds from feeding on grass seeds, or nesting and hiding there.

Vancouver Airport is located on Sea Island, and takes its local environmental responsibilities very seriously

form a large interconnected protected area of around 4,500 hectares in waters near the airport.

AAHK is also working to enhance marine ecology and fisheries for the benefit of the marine environment in North Lantau waters (HKIA is an island in its own right linked by road and rail connections to the bigger Lantau Island) and beyond – including for the benefit of the local Chinese White Dolphin (CWD), which uses waters near HKIA as part of its range in the Pearl River Estuary.

In late 2016, AAHK established a Marine Ecology Enhancement Fund (MEEF) and a Fisheries Enhancement Fund (FEF) with an investment of HK$400 million (US$51.6 million), and these funds have collectively funded over 30 projects with a total value of over HK$44 million ($5.7 million) up to 2020-21.

Numerous projects have helped preserve the local wildlife habitat: not just the conservation ecology of CWDs across the Pearl River Estuary, but also programmes designed to optimise the value of peri-urban and small-scale mangrove forests in the Pearl River estuary as fish habitats.

Larger animals that are indigenous to Lantau Island (such as wild boar, porcupines, deer and others) rarely intrude on the managed airport landscape environment and therefore pose no risk to people working at or using the airport. However, AAHK confirms that it will continue to support and fund diverse research and conservation efforts that may help to improve wider understanding of important ecological resources in western Hong Kong and ultimately inform broader conservation efforts.

One such ongoing project it supports aims to strengthen measures to conserve the Tung Chung river catchment area right next to the airport. It seeks to engage the local community in raising awareness of the importance of protecting the ecology of this region.

The airport operator's pledge to become the world's greenest airport serves as a goal and a driver to continuously improve HKIA's environmental performance, it says, only part of which is wildlife and habitat management. As such, AAHK has a comprehensive sustainability strategy in place that includes initiatives aimed at reducing the airport's carbon emissions and reducing energy, as well as projects that serve to increase recyclables separation and reduce the quantity of airport waste sent to landfill for disposal.

Across the Pacific

On the other side of the wide expanse of the Pacific, western Canada's Vancouver Airport also regards wildlife considerations as a vital part of its overall strategy. Indeed, says David Bradbeer, a wildlife program specialist at the Vancouver Airport Authority (VAA): "At YVR [Vancouver Airport], our primary objective is to build, operate and maintain a safe, secure and environmentally sustainable airport, which is why we have one of the most dynamic airport wildlife management programmes in the world."

Vancouver Airport is located on Sea Island, a few kilometres from the city it serves, and this places it in a unique sort of environment. Sea Island's proximity to the Fraser River delta also means that it is home to several local bird species, as well as migratory birds. "We have a responsibility to ensure safe aircraft operations while conserving wildlife," says Bradbeer. To that end, a dedicated YVR Wildlife team patrols the airfield year-round.

For Bradbeer and his colleagues, "Habitat

management is any manipulation of the airfield environment to make it less attractive for hazardous birds. YVR's approach to habitat management models a Safety Management System. Risk assessments are necessary to determine which species pose the greatest hazard, and root cause analysis is used to determine how these animals use habitats at the airport.

"For example, we identified gulls and dabbling ducks as hazardous species based on a tabulation of strike events and their prevalence in bird surveys. Shortly after, we developed an integrated pest management programme to target several invertebrate species that make up the diet for these gulls and ducks. Special consideration was required to choose an insecticide that would meet the approval standards of YVR's Salmon Safe certification," he informs.

Any airport can benefit from identifying the habitats that attract hazardous birds. Analysis of bird strike data and bird survey data is key to identifying the most hazardous birds, and observations of the airfield can help to identify the most attractive habitats, Bradbeer believes.

Managing bird and other wildlife populations is also on the radar at Denver International Airport, in Colorado in the US. The airport authority there – which works under the aegis of the City & County of Denver Department of Aviation – takes managing the risks wildlife pose to aviation and human safety very seriously.

That responsibility encompasses aspects of habitat management, wildlife exclusion, hazing, partnership and education, explains the airport authority, through its collaborative team of operations staff, its sustainability team and US Department of Agriculture (USDA) employees.

All airside operations personnel at the airport are trained in identifying and managing wildlife hazards. In addition, the airport – popularly known as DEN – partners with four full-time wildlife professionals (from the USDA) to assist with managing wildlife and the airport environment.

DEN's habitat management includes managing, or excluding, the three basic needs of all wildlife – food, cover and water. Each of these needs is different for each individual species found within the greater ecosystem. Excluding or removing cover (such as mowing, installing security grates on culverts, removing trees and so on), as well as mitigating or managing water sources, form the keystones to DEN's approach, it notes.

Reduction of food availability is also regarded as important, and includes education of the public and airport employees about properly disposing of waste and keeping worksites clean.

Habitat management – the reduction of suitable wildlife habitat on airport property – by its very nature reduces wildlife's attraction to the airport; thereby, preserving the wildlife that might otherwise become a strike

DEN's operating authority carefully maintains the ecosystem around the airport

risk. DEN also participates in hazing/harassment of wildlife and a trap/relocate programme to move many species away from the airport environment.

Change over time

AAHK has been expanding the scale and coverage of its environmental initiatives over time to include more participants and aspects of the environment. As noted above, the airport authority has moved beyond areas under AAHK's direct sphere of control to proactively engage with airport business partners, multiplying its beneficial impact through various community-wide initiatives.

"We believe developing a robust culture of sustainability throughout the organisation and in the airport community will strengthen our ability to operate and grow in today's fast-changing environment," the authority asserts.

HKIA has also been mindful of environmental and habitat issues while developing and expanding the airport. For example, for the extensive Three-Runway System (3RS) project, a comprehensive Environmental Impact Assessment was completed with wide-ranging environmental mitigation measures and environmental enhancements stipulated in an Environmental Permit.

These commitments are relevant for the construction phase of the 3RS development programme and also include many commitments for future airport operations: for example, the expected conservation benefits of the aforementioned marine park and enhancement funds that support diverse research and conservation efforts.

Climate change is an ongoing issue for many airport operators. At Vancouver: "Drainage is a concern for wildlife hazards because of the heavy rains the airport receives in winter," Bradbeer notes. "The forecasted changes in our climate are projecting more intense periods of heavy winter rain, and this will in turn increase the prevalence of stormwater pooling on the airfield, attracting water birds."

Thus, he adds: "Consideration is being given to solutions for stormwater management in the face of these forecast changes."

New ideas are key to meeting changes in the local environment. YVR is "always working on new and innovative solutions to manage wildlife," Bradbeer says. "One example is our Raptor Trap & Translocation Program. The Fraser River delta is home to the highest density of wintering raptors in Canada. To manage this density, we operate a successful Raptor Trap & Translocation Program. Once captured, the birds are tagged with a unique numbered leg band and translocated to the east, away from YVR. Special wing tags on the larger hawks help us understand the movement of the birds."

Meanwhile, in the US, nature and scale continues to change due to many environmental variables as well as manmade variables, including but not limited to land-use changes on and around airport property, changes in demand for air travel, seasonal fluctuations of migrating wildlife, seasonal/annual climate variations (such as drought or higher-than-average precipitation), the team at DEN explains.

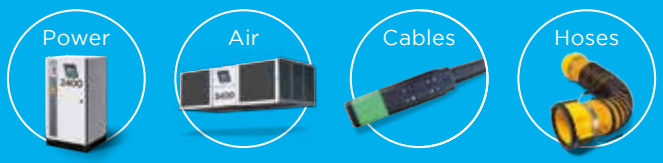
Being environmentally responsible

Making environmentally responsible choices is very important to DEN, the team there confirms. These choices include selecting the best re-vegetation options for water/soil quality (erosion), while minimising wildlife attractants to reduce strike risk and any management impact on local populations.

"DEN views habitat management as part of our broader environmental strategy, and has taken a more holistic approach to both land and wildlife management," it asserts. "We recognise the valuable ecosystem services that healthy landscapes provide and have been working with Colorado State University and the USDA to more effectively and responsibly manage our land while meeting operational and safety goals."

DEN also notes: "Increasing biodiversity on airport property makes an already complicated risk management issue even more complicated. Airport managers generally focus on reducing vegetative diversity, thereby making wildlife use of the airport environment, or risk, more predictable and manageable."

At a wider aviation industry level, AAHK is amongst those airport operators who have participated in the global dialogue supporting the sustainable development of aviation and airports. On this, AAHK works closely with airports and trade associations, including the Airports Council International (ACI) World Environment Standing Committee and the ACI Asia-Pacific Regional Environment Committee.



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Providing an essential passenger service

Medical lifts, also known as ambulifts, are a much-valued element of the service provided for passengers with restricted mobility (PRMs) boarding or leaving aircraft. A number of manufacturers offer this specialised equipment to the market and they have each navigated their way through the recent hard times as best they can, while continuing to supply medical lifts as and when needed

For Turkish GSE supplier DENGE Airport Equipment, "2020 was of course not as expected, due to the pandemic," recalls managing director Murat Denge. "However, we had enough orders from our valuable customers who did not cancel, and this helped us to get through the year safely. Moreover, since we have a wide range of products, we had sufficient orders to end the year fulfilling our decreased capacity."

Furthermore, "We had foreseen the consequences of the pandemic in advance, in early January 2020, and we took the necessary actions in terms of cost cutting, as well as balancing our financial performance, besides decreasing the capacity. As a result, we did not face a significant effect in 2020," Denge affirms.

Every cloud has some silver lining. "Since the workload in terms of production decreased, we used this to our advantage," he continues. "We have prioritised research and development (R&D) and we have started to improve our electric-powered GSE portfolio.

"Since we already offered electric stairs, we focused on self-propelled, electric-powered stairs. However, this does not mean that we did not have a change in our PRM-related equipment, and, this will be the second of our GSE types to be made available with electric power.

"This will happen soon and, in the meantime, our R&D department has updated the company's DENGE Aircraft Proximity Detection System (DAPS – the latest version of the safe docking system for our PRM vehicles), improving software and making necessary additions to hardware."

Vienna, Austria-based Bulmor airground technologies has also had to adapt during the Covid-19 pandemic. When head of sales Konrad Gruber spoke to *Airside International* in spring, the company had been in lockdown since November 2020. Demand had faded, as expected, over the course of 2020. Airport operators and ground service providers had cut back on their spend as the aviation industry fell away and, says Gruber, "A myriad of originally planned investments were cancelled in 2020 or postponed to 2021."

Nevertheless, Bulmor – which offers the

innovative SideBull and FrontBull medical lifts to the airport market – has by no means been idle, the company using the time to continue the development of a fully electric SideBull.

"With airports aiming to become CO2 neutral and battery technology advancing, we are seeing a shift from diesel-powered vehicles and a strong trend of increasing demand for electric vehicles – not just in the airport sector but also in all other business areas we are working in," Gruber explains.

"We therefore started a development process to electrify our entire vehicle and ambulift portfolio some years ago," he recalls. "The first fully electric-powered model was our small compact ambulift, the FrontBull, and that has been available with a lead acid battery system or lithium-ion technology since 2018.

"Our larger ambulifts models, the SideBull XL and SideBull XXL for the A380, followed and are now also available in fully electric-powered variants. After a two-year development phase, we are going into airport testing this summer [2021]. Both larger model types are equipped with a strong and long-lasting lithium-ion battery pack for full-day operation and a rapid and intermediate charging system."

The project is expected to be finished this summer, Gruber confirms, adding: "We will then have a fully electric ambulift portfolio, from small vehicles for regional airports right up to A380UD trucks – all powered by lithium-ion or lead acid battery technology."

As of spring, business remained quiet but, "We hope that business catches up again in the autumn," Gruber remarks – and he remains very positive. "We are sure that passenger numbers will rise to pre-pandemic levels and higher in the long run," he says.

"Leisure travel among senior citizens (who used to be the large majority of PRMs in the past but unfortunately are part of the high-risk group in this pandemic) will recover with progressing vaccination levels in each country.

"A short-term forecast on how quickly passenger numbers will fully recover is rather difficult," Gruber suggests. "On the one hand, there is a strong desire for leisure travel after a year of pandemic and several months of lockdown – giving us hope for a quick rebound.

"But, on the other hand, there are still so many travel restrictions in place, and quarantine requirements differ from country to country (and constantly change) – currently making air travelling unpleasant and difficult. Besides speeding up vaccination programmes governments need to set up steps to ensure free air travel with fewer restrictions again."

Will Bulmor be ready to ramp up production quickly, once demand does return to pre-pandemic levels? Indeed, it will, Gruber confirms: "We are ready and will increase production capacities as soon as we see demand rising."

In the meantime, "Electrification of our entire product portfolio will keep us busy for quite some time and is clearly our focus. However, we are also working on further improvements on our SideBull docking assistance system, full remote maintenance system and a cabin face-lift."

A Bulmor SideBull in action

Preparing for recovery

Oppenau, Germany-headquartered DOLL offers a wide range of GSE. Medical lifts are just part of its airport-related portfolio that also takes in catering trucks, recovery vehicles and cleaning vehicles.

Like other ambulift suppliers such as DENGE and Bulmor, it too can point to a downturn in demand because of the pandemic, but Pierre Marx, key account manager GSE for the Europe, Africa, Russia and Pacific regions, says that DOLL is using the time to focus on R&D and is "actively preparing for the market's recovery".

He believes that some of the otherwise expected investment in PRM vehicles stopped because of the pandemic will be relaunched, while other programmess will not. As for when that market recovery actually happens, for DOLL the key words will be "improved travel experience, safety and environmental friendliness", he says.

Marx is confident that the aviation industry will see a significant increase in leisure travel as soon as vaccination rates reach a sufficiently high level for

Japan's ANA is one of the customers for Northern Ireland-based Mallaghan's ambulifts

confidence to return and when borders are reopened. "Do we not all hear every day in our discussions with families or friends the many hopes and intentions to travel across the world after the recovery and enjoy the newfound liberty?" he asks.

Moreover, he believes the market share of vaccinated senior citizens and PRMs will be an interesting part of this recovery. Some senior travellers and PRMs will want to see their distant family again. Others will want to enjoy their retirement, take advantage of their purchasing power and take a trip around the world after the frustration of a long confinement.

What's more: "The trend for airlines and ground handlers to offer PRM travellers a more qualitative travel experience before a flight is very well identified."

When such a time comes, "Our DOLL production lines are very well organised and structured, with a remarkable production flexibility of between five and 10 vehicles per week if necessary," says Marx. "So a quick return to normal production rate is not a problem for us."

Mallaghan invests in new technology

Meanwhile, Dungannon, Northern Ireland-headquartered GSE supplier Mallaghan last year saw sales activity and revenue "in line with reduced activity within the sector", says Owen McKenna, the company's sales director.

"Nevertheless, PRM orders have remained steady," he adds. "We delivered PRM vehicles from our diverse range of self-propelled and truck chassis-mounted machines to countries and regions such as Japan, Germany, the Middle East and China, to name a few."

For example, Mallaghan delivered medical lifts to Japanese airlines ANA and JAL in preparation for the coming Olympics and Paralympics, which were postponed to 2021 due to Covid. It also delivered vehicles to Berlin in Germany for the opening of the new BER airport.

Mallaghan offers self-propelled as well as chassis-mounted ambulifts, with various options including low-height options, small and large passenger capacities, and A380 handling capabilities.

As well as continuing to supply new PRM vehicles, Mallaghan has also continued to invest in new technology and new capabilities for its ambulifts. Thus, explains McKenna: "In 2020 we resumed our electrification roadmap programme, and can now offer an electric chassis solution for high lifts including catering, cabin cleaning and PRM products.

"The electrification of our products has been and remains at the forefront of our business development and so we focused research and development and manufacturing capacities to further extend our product offering to customers and the market in 2020.

"Developing an electric high lift solution in partnership with Volvo has been a significant milestone in this strategy," McKenna informs. "Our own Mallaghan self-propelled chassis vehicles are either already converted or are in the process of being converted throughout 2021."

He continues: "True to our motto 'Innovation for Aviation', we are always focusing on research and development, and so we were one of the first GSE OEMs [original equipment manufacturers] to offer a fully compliant International Air Transport Association (IATA) [Airport Handling Manual] AHM913 Collision Avoidance System (CAS) for our relevant product groups including PRM vehicles."

Mallaghan offers the CAS system on a variety of commercial chassis as well as its self-propelled unit.

McKenna also reports good demand for single-operator PRM vehicles, so Mallaghan is working to develop that option further across its product range.

Looking ahead, he asserts that – despite the pandemic – there remains strong demand for PRM products, as well as the rest of Mallaghan's wider portfolio; "and as the market recovers we expect this demand to increase," McKenna says. Moreover: "As always, we can react efficiently and effectively to rising demands and changing conditions."

AVIOGEI offers additional control

Aprilia, Italy-headquartered GSE supplier AVIOGEI has also been improving its ambulift offering – which takes in the smaller PED and the sophisticated Thunderlift – over the past year.

In particular, changes have been made in order to offer an even greater degree of control for an airport operator. Now, airports can monitor the use of an AVIOGEI machine with a new 'registration' system, and receive an alert in the event of any incident.

The monitoring system can benefit from both internal (if allowed by relevant privacy policies) and external cameras. The system is very flexible and adaptable to a given customer's needs, says the company's CEO, Andrea Cesarini. There are various options for exporting the data collected as well.

The system can be managed by a fleet management platform that tracks any alerts raised in real time.

Another improvement to AVIOGEI's Thunderlift has seen passenger comfort increased through the introduction of a new seating arrangement and an air conditioning system suitable for all weathers. Plus, says Cesarini, "Our production department is preparing a new hydraulic system for the PED and the Thunderlift. The new system is designed to be more efficient in terms of energy consumption and less

An AVIOGEI Thunderlift in operation at France's Brest Bretagne Airport

polluting for the environment."

He continues: "With the aim of increasing the level of operational safety, our GSE integrates additional systems for monitoring working conditions (tyre pressure, anemometer, engine status, cabin temperature, etc). In addition, the Thunderlift can be equipped with air filtration systems and specific barriers compliant to anti-Covid measures to guarantee the passenger health and safety."

A recent addition to the AVIOGEI ambulift offering is the electric-powered Thunderlift E (it was first publicly shown at *inter airport* in Munich in 2017). The Thunderlift E has been "a great success in the market", says Cesarini, with orders for new ambulifts now frequently being for the 'E' version. "Customers are very satisfied with the higher quality of PRM service [it provides], because the equipment is quieter and more comfortable for the operator and passengers," he reports.

The electric variant has reduced maintenance costs and is very reliable. "Furthermore it is greatly appreciated for its long battery life," Cesarini says.

Not only are individual customers opting for the lithium-ion battery-powered Thunderlift E when acquiring new additional ambulifts, but at airports where electric PRM vehicles have been introduced they are "considering the conversion of the entire fleet", Cesarini confirms.

As for the trend towards greener equipment over the longer term, the intention of the EU Commission to make the EU carbon neutral by 2050 will require substantial efforts in terms of the development and introduction of clean technologies, he points out.

"Research and innovation will determine the speed at which this transition can take place. In Europe, with the Horizon 2020 [funding programme] and the European Green Deal [a plan to make the EU environmentally sustainable by 2050], the resources that governments will direct towards the renewal of vehicles for electric mobility could help to create a rise in the demand for electric equipment in general."

Certainly, AVIOGEI intends to extend its own electric GSE offerings into the self-propelled toilet service units and water unit elements of its portfolio, among others, to help meet what it anticipates to be ongoing increasing demand for battery-powered equipment.

Changing times

DENGE Airport Equipment is soon to begin offering electric-powered medical lifts. But the process is not a simple one, and there are many complexities that need to be considered when making the change.

Managing director Murat Denge believes that electrifying all GSE is a process that will take some time yet, not least because of the impact of the pandemic. Another problem is the cost and lifetime of batteries currently available, while another is the price of the technology: considering the profit margins both of handlers and GSE manufacturers, the sale price of GSE continues to play a critical role in most acquisition decision-making processes.

"Combined with the pandemic, I believe, in the short run, our industry will be more price-oriented, and I do respect procurement managers," says Denge. However, even if the roll out of battery-powered ambulifts – and GSE more generally – is somewhat delayed, there will certainly be more and more electric-powered GSE on airport ramps, he advises.

In time, alongside the transition to electric power there will be a greater presence of low-level autonomous machines, Denge suggests; this is another area in which his company is investing in R&D behind the scenes.

As for the short-term future and the move to what will hopefully be a post-Covid world, "While we regard 2020 as a year of problems, I believe that the effects on our industry will be even greater this year, and DENGE has taken all necessary measures to ensure that 2021 will not be worse than 2020."

He advises: "Pretty much all the big GSE manufacturers had some ongoing orders and production runs left over from the first quarter of 2020 which helped them to mitigate the pandemic's impact last year, but 2021 will be tougher, and we can see that even when vaccination programmes were initiated [in spring], the effects were not rapidly reflected in the aviation industry.

"So we as DENGE foresee that 2021 will be the toughest year and the 'ramp' will only start to recover in the second quarter of 2022. This projection has led us to focus more on production of equipment such as baggage handling systems (BHS), as well as cargo solutions."

The benefit of having a broad product range for a GSE supplier is obvious and, despite Denge's belief that 2021 will be challenging, his company remains well placed to come through it stronger than ever.

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Preventing aircraft damage: the technological edge

Technological advancements continue to be made that mitigate the risk of collisions between GSE and aircraft during the turnaround process and a number of GSE suppliers now offer sophisticated anti-collision systems

JBT's JetDock forms part of its effort to minimise the danger of aircraft damage during the docking and turnaround proc

Amongst the numerous GSE suppliers that take the issue of aircraft damage very seriously is the globally active provider of GSE and gate equipment JBT AeroTech. As the company's director of business development and marketing, Todd Tanner, points out, every turnaround that involves boarding bridges, loaders and the like represents the possibility of unwanted 'ramp rash': of impact between GSE and aircraft.

Damage sustained on the ramp, as a whole, represented an estimated US$5.7 billion cost to the aviation industry in 2020, Tanner says, citing International Air Transport Association (IATA) figures, with that cost projected to increase in years to come.

These sums do not only derive from damage to aircraft or other assets but also include indirect costs such as lost revenue, the cost of redirecting flights, adverse public relations, and more.

Every effort should therefore be made to mitigate the risk, optimising safety and operational procedures, controlling human factors, introducing standardisation of equipment, and so on. Tanner observes: "Manufacturers can play a key role in this risk mitigation effort by developing automation technologies specifically designed to prevent ground damage." And he notes: "Today, the industry is very familiar with APD [aircraft proximity detection] technologies, which are designed to alert equipment operators to potential scenarios that could lead to an incident or accident."

For instance, JBT has been working with some of its long-term partners in the field on the future of ground damage prevention technologies and one result of that is JetDock. This is an automated operator assist docking system that has been designed for JBT's JetBridge passenger boarding bridges (PBBs) and its fleet of Commander cargo loaders.

JetDock does not rely on decals or markings on an aircraft fuselage, making it ideal for multi-use airport gates and fleets of aircraft. JetDock is designed to seamlessly dock the GSE with an aircraft while also detecting any ground

TLD loaders benefit from the company's ASD+ anti-collision technology

obstructions on the approach to the aircraft to prevent any and all incidents that could be caused directly by the docking GSE.

With the touch of a button or two, a JetDock-equipped boarding bridge or loader can locate the appropriate aircraft passenger or cargo door, correctly align itself, and then dock. It is fast, precise and safe, the manufacturer notes. As a result, docking operations can be conducted more quickly, more safely and with more convenience to passengers. "JetDock is the future to a safer ramp operation," JBT insists.

From a financial perspective, JBT believes that operators will soon start to consider APD and autonomous docking technologies, such as JetDock, as an investment that will allow them to retain more future earnings by mitigating the rate of risk that necessarily arises when any GSE is used to serve aircraft.

According to IATA, the implementation of simple APD systems can reduce the overall cost of ground damage to the industry by 10%. "We believe that JetDock will help to nearly eliminate all ground damage caused by the docking operation of our GSE and lead to immense savings for the industry," Tanner says.

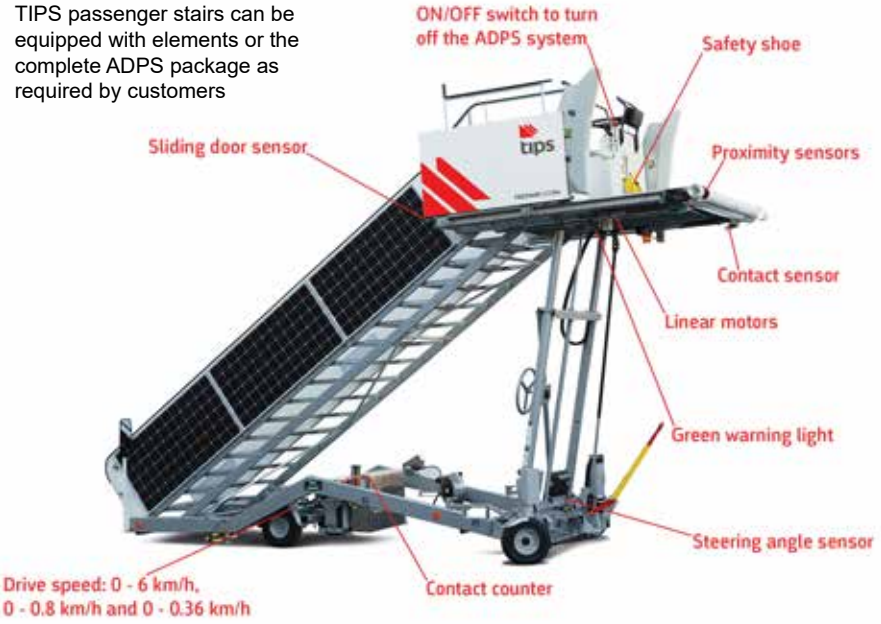
"With a relatively small initial investment in the technology, aviation companies can net significant returns with the savings generated from the almost complete reduction of GSE-caused incidents and accidents."

TLD: enhancing safety and efficiency

TLD, a French GSE manufacturer that forms part of the Alvest Group, is another of the globally active suppliers that offers sophisticated technologies on many of its equipment lines designed to avoid collisions between its GSE and the aircraft they serve. Its ASD+ (Aircraft Safe Docking +) technology aims to "enhance the efficiency and safety of operations on the ramp", explains Driss Mahjoub, group technical director at TLD.

"After the introduction of ASD some years ago, ASD+ brings additional features and increases the automation level of the equipment," he notes. TLD's ASD+ system controls the speed and direction of GSE on which it is installed and eliminates any adverse movement in crowded aircraft safety areas.

ASD+ enables the GSE's approach to an aircraft to be done right "the first time, each time", Mahjoub remarks. Recent improvements to the technology mean that, "We can achieve an impressive approach success rate superior to 95%," he continues. "That is far better than human-driven operation in which the success rate is generally inferior to 80%; this means fewer back and forth manoeuvres and a far higher level of safety when ASD+ is switched on."
The ASD+ system is designed to enable



TIPS passenger stairs can be equipped with elements or the complete ADPS package as required by customers

a very high degree of precision in the docking process (with less than an inch of platform/fuselage misalignment). It can achieve this in all weather conditions, thanks to a highly accurate calibration process and the smart trajectory algorithm used in the technology. Moreover, "Recently we have extended the ASD+ qualification list to additional aircraft models," Mahjoub informs.

The ASD+ was developed by TLD for its loaders and passenger steps, which it regards as the most relevant equipment for such a system. According to Mahjoub, "We see great attraction to ASD+ in several markets, including Europe, China and North America. "

TLD has worked closely with a number of large airlines to enhance the system's capability and most of the improvements it has made in recent times have been based on operators' feedback. Furthermore, "We cannot progress without a true collaboration with ground handlers. And we have accomplished a lot here."

But that does not mean the process of improvement has come to an end. "We keep running and introducing new innovation to improve ground operations safety," Mahjoub says. Areas of possible development for the future that he and his colleagues at TLD are investigating include the 'Link' telemetry system for fleet management and access control that offer "huge potential to improve safety and prevent aircraft damage".

Geofencing, which allows for GSE speed auto-control, and hence significantly reduces hazard risks around an aircraft safety zone, is an area of significant interest for TLD in terms of minimising the possibility of ramp rash.

TIPS's ADPS damage prevention system is available for installation on its belt loaders

For Mahjoub, preventing aircraft damage is one of the primary concerns for those involved in ramps operations today. Moreover, the increased public awareness of the issue, as well as the environmental impact of airport operations certainly favour greater investment in both more efficient technologies and safer GSE, he continues, adding: "Making airport operations leaner and greener means more control, more precision. The more rigorous you are with those controls, the better will be the level of safety on the ramp."

TIPS: ADPS damage prevention system

Slovenia-based TIPS has more than 50 years of history in manufacturing GSE and during this time it has been more than aware of the value of technologies that can minimise or even eradicate incidents of GSE/aircraft collision.

It has offered systems that alert GSE operators to the danger of impending collision for more than 10 years, alongside automated speed control and automatic stopping options, says technical service engineer Marjan Smole.

Such systems have been fitted to many of its passenger stairs and belt loaders sold into markets around the world, especially into countries like Germany and the Scandinavian nations.

More recently, TIPS has brought the various elements into a single Aircraft Damage Prevention System (ADPS) that can be installed on new TIPS stairs or belt loaders, or retrofitted to older equipment (it has in fact been successfully retrofitted to TIPS GSE that is more than 10 years old).

The ADPS consists of a combination of sensors and activators that control the approach of GSE to an aircraft, including both speed and stop control procedures. ADPS offers not only safety systems required by IATA but in addition systems that actually eliminate the need for an operator's presence.

ADPS installed on TIPS stairs or belt loaders constantly monitors movements of the aircraft and makes corrections to the location of the GSE unit as it moves (through weight changes caused by fuelling, baggage loading/unloading, and so on). TIPS is, it says, especially proud to offer the system on the parallelogram passenger stairs which it claims are unique to the market.

The system already offers more capability than that laid down in IATA's Airport Handling Manual (AHM) 913, in line with TIPS's general policy – and it is being improved all the time, says Smole. "No matter the system, we are always looking to make it better," he remarks.

Because the various elements of ADPS are not new, "We know it is reliable," Smole says. Indeed, the feedback received on ADPS from customers in markets like Germany and Scandinavia demonstrate its value, he points out. TIPS is now looking to sell it more widely into markets like the Middle East, where the supplier is already active, and in the US, where TIPS wants to launch a presence.

No matter the system, we are always looking to make it better

Marjan Smole
TIPS

Some of the T135 EVO baggage tractors that made up the Schiphol order

Aviaco GSE delivers electric baggage tractors into Schiphol

Late last year, GSE supplier Aviaco won a contract at Amsterdam Airport Schiphol for the provision of 15 electric tractors under a full-service rental deal. All the units have since been delivered and are in use with the airport operator. The deal represents another important step for the company's GSE full-service rental business

"This will be a big door-opener for us, not only enabling us to build our footprint at Schiphol but also offering the hope of other similar rental projects in the future," says Danny Vrankcx, CEO of Aviaco GSE.

The tender for the electric baggage tractors was put out by Amsterdam Airport Schiphol last year and, with Aviaco proving victorious, it has now become the third GSE repair and maintenance provider at the Netherlands' biggest air gateway.

The maintenance and repair station at Amsterdam is an addition to Aviaco's other facilities located at Heemsekerk in the Netherlands and in Tarragona, Spain.

The 15 brand new Charlatte electric baggage tractors comprise a number of both the France-headquartered manufacturer's T135 EVO and TE206 NEO vehicles. All have now been delivered and are in operation at Schiphol, Vranckx confirms. Schiphol is using the vehicles to handle baggage in the airport's luggage room: the place where all baggage is brought together either being flown into the airport or prior to the departure of their flight. Here, baggage is sorted for the appropriate flight or prepared for passenger pick-up at the carousel.

There are many other Charlatte tractors in operation at the airport, but only these 15 are operated by the Royal Schiphol Group, the rest being used by handlers at the gateway such as KLM, Swissport, Aviapartner and Menzies, explains Paul Groot, service owner aircraft at Schiphol.

The 15 baggage tractors were handed over

Some of the TE206 NEO units

to Aviaco in mid-February at the Charlatte Manutention factory in France, where the GSE manufacturer's chief commercial officer Yassine Belkaid formally transferred the units to Vranckx. They were soon on their way to the Dutch capital.

According to Groot, Schiphol is more than happy with the brand-new GSE, having previously rented in their place much older models. Moreover, he adds, the operator has also been more than happy with the service provided by Aviaco.

Vranckx sees this deal as a very positive sign for the future. While Aviaco is perhaps best known for supplying customers with refurbished GSE, it also offers brand new equipment with full-service repair and maintenance support, a growing element of its product and service mix.

Amsterdam-based financial services company ING Group is now providing financial support for the implementation of Aviaco's expansion plans. ING has highlighted Aviaco's prioritisation of greener electric GSE, as can be seen in this latest Schiphol deal, as a particular factor in its interest in the company and its plans for the future.

Buyer's Assessment (BFS)

Ground services provider Bangkok Flight Services (BFS) is both a user and admirer of dBD Communications' Minerva Ajax wireless communication system. Colin Temple, director – ramp operations at BFS, tells *Airside International* why...

dBD Communications' Minerva Ajax is in use with many customers, including BFS

BFS offers a wide range of ramp handling, passenger handling, operational support, cleaning, cargo handling and warehousing services at Bangkok Suvarnabhumi Airport, Thailand's largest and busiest air gateway. It is a joint venture of globally active handler Worldwide Flight Services (WFS) and Bangkok Airways.

BFS is using Basildon, UK-based wireless communications specialist dBD Communications' Minerva Ajax system. Minerva Ajax can enable communications at a wireless range of up to 100m for operations such as pushback, wing walks, engineering and maintenance tasks, where a ground crew needs to stay in communication with an aircraft's flight deck.

BFS currently has a total of 20 Minerva Ajax headsets. It initially took a tranche of 10, and ordered a further 10 soon afterwards. The pre-pandemic plan had been to convert all of BFS's 40 headsets used for aircraft/pushback handler communications to the Ajax system, but the impact of the Covid-19 crisis has meant a temporary delay in fulfilling that plan.

The ground services provider uses the Minerva Ajax system for communication between an aircraft flight deck and the BFS pushback controller. Hence BFS typically employs just the one headset for communication, although the system allows multi-way communication between more than two headsets and BFS has used it – and continues to use it – in this configuration for training, during audits and so on.

BFS initially acquired the Minerva system in its boom microphone variant but found that, on occasion, the noise of an aircraft engine – if the crew had fired up the engines during pushback contrary to usual policy – could be heard through the pushback controller's mike and therefore caused a problem for the flight crew trying to hear a handler's voice.

The problem was more noticeable for narrowbody pushbacks where the pushback controller would be closer to the aircraft than in the case of a widebody pushback, and BFS handles a lot of narrowbodies in the course of its work.

Hence the ground services provider switched to the Minerva Ajax headset variant with a mouth shield, or closed cup, that can be used in higher noise environments for aircraft pushback, where background noise needs reducing.

Temple first saw the system at an industry event a few years ago and was impressed with the dBD Communications system. He was even more impressed when managing director David O'Connell visited Suvarnabhumi to demonstrate the system's value and to show just how well it could work as part of BFS's day-to-day operations. "He made sure that it was exactly what we required," Temple recalls.

Plus, on the rare occasion when a

headset has needed repair, the after-sales service provided by dBD Communications has been excellent, he says.

Minerva Ajax has been well received and proved its worth, Temple continues. As a wireless system, it enables handlers to move freely without being restricted by any cable. That means the BFS pushback controller can always maintain a completely safe distance from any potential hazard and can always perform a full aircraft walkaround as necessary with no encumbrance from a communications cable.

Another safety benefit of a wireless communications system is important at a place like Bangkok, where thunderstorms are not rare and lighting comes with the territory. It is not unknown for handlers to receive a small shock through a wired system if lightning strikes close by, and this problem is averted with a wireless system such as Minerva Ajax.

Colin Temple, director – ramp operations at BFS

TCR supplies a wide range of GSE to airports around the world

Partnership in times of Covid

Kristof Philips, chief operating officer of Brussels, Belgium-headquartered TCR, believes that in these pandemic-impacted times it is critical for the different elements of the airside industry to work more closely together than ever, and to put their faith and trust in each other

TCR is a globally active provider of GSE rental solutions and services, including full service rental, maintenance and ramp assistance, as well as GSE fleet services. It supplies GSE to airports, airlines, ground handlers and cargo handlers, and currently has a presence at more than 150 airports around the world.

Philips says that TCR's strategy is to work with airports and their stakeholders to optimise fleet size and equipment use for safer, sustainable and more efficient airport operations. This includes providing optimal equipment and maintenance packages, technology-driven management systems and strategic advice to meet varied GSE needs.

The aviation industry has suffered hugely both this year and last, of course, as passenger numbers have plummeted. The evolution of the aviation sector has been one of pretty much continuous growth over the decades since the early 20th Century, but being confronted with something as disruptive as Covid-19 has pushed many airside stakeholders into what might be regarded as 'survival mode'. In fact, the contrast with the many years of 'good times' has made the current precipitous downturn that much more of a shock, Philips believes.

The typical effect is that people and businesses alike tend to become defensive and feel they have to fight for their own survival, often seemingly necessarily – they believe – at the

We have been able to act as a true partner and enter into agreements that have delivered cost reductions and increased flexibility for our customers

Kristof Philips
TCR

expense of others, including perhaps their suppliers and customers. However, says Philips, if stakeholders sincerely look for solutions that address their customers' needs while at the same time adhering to their company's own long-term vision, business success can be achieved – if partners work together and trust each other, he argues.

In fact, it is vital that partners in the industry collaborate and have faith in each other: if they do, deals can still be struck even in these tough times, Philips says.

How can that trust be secured? By talking with each other and by the parties involved genuinely understanding each other's needs, Philips insists. That is how he and his colleagues at TCR have approached the issues thrown up by the collapse in the aviation industry.

Indeed, he remarks: "TCR is extremely proud that – thanks to the customer relationships it has – we have been able to act as a true partner and enter into agreements that have delivered cost reductions and increased flexibility for our customers."

Ramping up

The challenge the pandemic poses for the airside industry is now twofold, Philips suggests. At the outset of the Covid outbreak last year, there was a need for almost all those active airside (and for those that supply them) to revise business models and cut costs drastically in response to the collapse in

TCR is seeing an ever-increasing trend towards 'greenification' in the GSE market

passenger numbers and – consequently – airside operations.

But, says Philips, today there is another issue that also needs to be addressed. "Now we see that there is a need to start thinking about the ramp-up of flight operations. Here, the challenge is that the recovery will be slow and uncertain, and that the process will probably feature many hiccups along the way.

"So, in order to support our customers in the latter, we have developed what we call the 'Triple R' model: Reserve – Ramp up – Rent. The model starts from a joint commitment to work together with our customers when it comes to GSE leasing but without any initial commitment on final volumes.

"This means customers can reserve assets from our inventory list (Reserve). When activity picks up, an extremely flexible invoice model is applied until a more stable run rate is achieved (Ramp up).

"Once a certain level of normality is achieved, this fleet will be incorporated into a long-term partnership agreement which incorporates clauses to deal with future flexibility requirements resulting from seasonality, business loss, mothball requirements and so on (Rent)."

This process is a fairly complex one and involves a change in mindset for TCR as well as for its customers and their normal acquisition procedures. Getting GSE back into operation that has been laid up for some time takes a little bit of time; there are safety issues to be addressed, for example. Operators may need some refresher training on more complex types of powered GSE (tugs, for example), while equipment that has been in store for some time needs to be carefully checked over and carefully brought back to full working efficiency: TCR offers a 'deep service' for just this reason.

Whatever the GSE, every TCR customer – whether handler, airline or airport operator – will have different requirements in terms of their 'ramp up' of GSE, and once again in this regard Philips reiterates the importance of working closely with its customers in order to fully understand their needs and how these requirements can best be met.

"It is all about thinking about how we can get through this and about how we can grow together with our customers," Philips summarises. In fact, he says, the industry's collapse has actually led, in some cases, to strengthened relationships. As in any crisis, you tend to find out who you can trust when the chips are down, he observes.

Greenification

As well as customers needing to 'ramp up' as and when the recovery gathers pace, TCR is also seeing in the market an ongoing increase in GSE operators' focus on more environmentally friendly equipment – part of the process that Philips describes as 'greenification'.

"We recognise that the world is changing, and we face new and emerging challenges and increased expectations from stakeholders and global communities," he says. "We are committed to continually evolving and ensuring we operate and grow our business, as well as those of our customers, responsibly and sustainably."

TCR has a business model that informs the way it approaches the subject of sustainability with its customers. Its 'Apron Trilemma' has, as the name suggests, three elements, namely: continuity of operation, affordability and sustainability.

In terms of continuity, Philips emphasises that in an airport environment everything must run smoothly and continuously. Affordability is about achieving objectives in an affordable way for all stakeholders. Finally, TCR's focus on sustainability aims to ensure that the apron as an ecosystem is safe as well as environmentally friendly.

He adds: "As most of our operations take place inside airports, our ambition is to collaborate with our partners – airports, airlines and handlers – in addressing sustainability issues such as noise, air quality, biodiversity and water management, and also more global environmental issues – particularly the aviation industry's greenhouse gas and carbon emissions."

As with the Triple R model, the Apron Trilemma concept is primarily an issue of mindset and about how TCR goes about interacting and consulting with its customers. In this case, it's about discovering how the process of 'greenification' can be made to benefit all: to more than compensate the GSE procurer for the additional cost of electric equipment, for example.

TCR expects to partner with major airports, airlines and infrastructure companies to further develop various sustainable solutions. Critical to these projects will be to keep in mind the Trilemma and how TCR delivers customer solutions that are "affordable, sustainable and ensure business continuity", Philips concludes.

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Transformative technology

Digitalisation is an inescapable trend across many industries, and aircraft refuelling is no exception. More and more digital tools are becoming available, besides other changes aimed at improving the process. *Megan Ramsay* reports

One area that is benefiting from digital developments is aviation fuel contamination testing.

The presence of microbial contaminants in jet fuel can have costly – and dangerous – implications. Microbiological growths can affect fuel quality, aircraft performance and safety. Potential problems include clogged filters, aircraft tank corrosion or malfunctions in aircraft fuel quality indicator systems.

In response to industry requests to improve the efficiency of microbial fuel testing, biosciences company Conidia has launched an upgraded digital verification tool. FUELSTAT® Result is a mobile app that allows operators to complete compliance testing on site, without paper and without the need to register.

The free, iPhone and Android downloadable app works alongside Conidia's FUELSTAT® test kit, which has been on the market for 20 years.

Owen Busch, senior vice president – sales and business development at Conidia, says the kit has undergone extensive development over that time as fuels have continued to evolve.

"All fuels – not just jet fuel – change all the time because the regulations that govern them change. We actively test all types of fuel, including sustainable aviation fuels, to see how they respond to contamination so that we can make sure our product is fit for purpose."

Conidia's goal, Busch says, is to streamline a process that can be cumbersome, by taking steps and time out of fuel contamination testing – without, of course, sacrificing accuracy.

The original FUELSTAT® app was launched in 2017. Since then, a constant cycle of feedback between Conidia's team and customers has culminated in the latest major update of the app, which Busch describes as providing "the best user experience yet".

FUELSTAT® Result is a mobile app that allows operators to complete fuel contamination compliance testing on site, without paper and without the need to register

The FUELSTAT® test kit with the free Result app enables the operator to take a sample, run a test, and get the results in less than 15 minutes. Users can instantly create a report that they can print or email from their phone or tablet straight away – rather than waiting hours or even days for laboratory results and reports.

FUELSTAT® thus detects contamination early, and makes immediate intervention, such as the addition of a biocide, possible.

Airport operators, ground handling agents and fuel handling companies have all brought their own experience in the field to the design of FUELSTAT® Result. One new, customer-driven capability that the FUELSTAT® Result app offers is a threshold indicator that helps support proactive, preventative fuel maintenance.

Busch explains: "A test may detect negligible amounts of contamination, but those quantities could still be close to a moderate amount. So, rather than simply a distinct green, amber, red traffic light system, indicating negligible, moderate and heavy contamination, FUELSTAT® Result now has caution alerts which indicate that contamination levels are approaching the next level and may require action soon.

"Timely information such as this helps our customers to make well-informed decisions to support their operations. With the threshold caution indicator, they can choose to act early – or not, depending on their schedule and other variables."

Such agility is vital in an industry that involves huge investments in operational assets that must be up and running to justify their expense.

Busch sums up: "Our task is to ensure business continuity and asset reliability for our customers. When an airline has an AOG [aircraft on ground] event, time is money. In extreme cases, microbial contamination can cause problems with engine performance and filters, for example. Therefore a robust, preventative fuel maintenance process is essential."

FUELSTAT® Result is "not a static product", he points out. The product will continue to evolve as Conidia works to keep pace with the market's changing requirements and priorities.

Regarding the acceptance of digitalisation, Busch observes that there is always a dichotomy around the availability of digital data, in any industry. "Some customers in every industry want to digitalise everything and gain real-time data and insights," he says. "Others are more sensitive, perhaps because they have security concerns or their IT maturity isn't quite where it needs to be.

"FUELSTAT® Result now caters for both groups: it has high standards for data security, and customers don't have to register in order to get the full benefits of the app – they can use it anonymously."

Preventing misfuelling

Aviation fuel suppliers are also offering digital tools for their customers. One example is Air bp's Airfield Automation, which is designed to enhance safety, reliability and compliance in airport fuelling operations.

Valerio Ferro, vice president, aviation customers at Air bp, points out: "Misfuelling overwing-fuelled aircraft is one of the biggest risks our industry is faced with. Air bp's Airfield Automation safe2go app is a pioneering application that provides additional fuel grade checks, including an

engineering barrier to automatically check aircraft fuel grade decals, which greatly reduces the risk of human errors that can result in misfuelling a plane."

The safe2go app consolidates the data related to airport fuelling operations and inputs via an app on a handheld device in the fuelling vehicle. It has been deployed at over 139 locations – and this number is increasing.

The safe2go app works by capturing fuel volume readings and provides fuel grade checks to add an extra misfuelling barrier. The app also electronically captures customer details, fuel volume readings, tax and charge details, which are confirmed with an electronic signature from the pilot or airline representative on a tablet computer. By using this automated, end-to-end, paperless system, accuracy is enhanced, and any potential mis-keying errors are minimised.

The initial Airfield Automation service launched in 2020 was a transaction data service, Ferro says. He explains: "It was a first step in supporting our customers in the digital transformation. The data service enables airlines to receive fuel ticket data electronically.

"Air bp has been working with industry stakeholders to deliver an operational data service: enabling real-time two-way communications from receiving an airline's preliminary fuel order through to a revised final order, concluding with a fuel summary and remote digital acknowledgement of fuel received by the airline.

"The use of the International Air Transport Association (IATA) fuel operational messages standard provides for efficient and cost-effective implementation."

The key benefits for Air bp's customers include significant operational efficiencies both at the airport and in their back-office processes, which may contribute to a greater likelihood of on-time departure, optimisation of fuel load and administrative savings.

"Air bp aims to work with its stakeholders to radically transform the fuelling process for customers, allowing much faster aircraft turnaround with optimum fuel load, reducing delays and improving profitability for each flight," Ferro adds.

Operators have reported increased speed, accuracy and efficiency and Airfield Automation received the Excellence in Application Modernisation Award, the Product Innovation Award and was declared the Overall Winner at the 2020 UK Real IT Awards.

According to Ferro: "Since launching in May 2018, one million fuellings have been processed using Airfield Automation technology. Air bp should soon be celebrating the installation of the technology at 300 network locations across 27 countries and four continents."

Contactless compatibility

Thomas de Boer, head of operations at Shell Aviation says: "With the aviation industry operating on finely balanced operating margins, our customers are constantly challenged to maximise efficiency and look for innovations that could help improve turnaround times. Incorporating digital technologies into the refuelling process is an area where we believe there is huge potential for uncovering greater operational efficiencies."

According to de Boer, there is a clear trend towards collaborative technology development in aviation. For example, different airlines have different cockpit apps, which often makes transmitting data from system to system challenging and the integration of new technology very complex.

Shell SkyPad Data Exchange, launched last year, not only facilitates an automated end-to-end touchless refuelling process; it also enables compatibility with a wide range of airlines' own digital platforms, allowing integration with airline systems that adhere to IATA Fuel Data Standards, de Boer outlines.

"In addition, as our Shell SkyPad technology is already in operation at airports across our global refuelling network, we are able to instantly connect to airlines' systems at any of the participating airports based on a single integration. This means we can offer a simple, paperless solution to our customers with no additional admin required per location."

From an airline perspective, "The currency of refuelling is seconds", de Boer observes. Therefore, minimising delays in aircraft turnaround times is one of the most critical aspects of maintaining profitability and delivering the level of service demanded by passengers in today's busy world.

"That's why we made a huge step towards Shell Aviation's vision of fully digitised operations by introducing Shell SkyPad, connecting our operators who provide the fuel on the apron with office staff and customers throughout the refuelling process," de Boer says.

"The complete and fully integrated solution links the tablet to a cloud-based computer platform, simplifying and speeding up critical aspects of the process, as well as reducing administration and human error."

The real-time communication Shell SkyPad Data Exchange now offered reduces the time aircraft spend on stand. From the initial fuel order from the pilot to take-off, the exchange between Shell SkyPad and an airline's own system allows potential issues during critical moments of the refuelling process to be predicted and averted. Airlines integrating Shell SkyPad Data Exchange can save up to 13 minutes during the refuelling process, which can cut delays in turnaround time and associated costs.

"In addition to efficiency gains, digital refuelling, enabled by Shell SkyPad Data Exchange, means that the whole process is now contactless, giving staff greater protection as the aviation industry looks to recover from Covid-19," de Boer says.

The first airline to implement Shell SkyPad Data Exchange (in August 2020) was Lufthansa, which – along with software specialist SAP – was involved in the development of the solution.

Kai Liedtke, head of fuel purchasing at Lufthansa Group, describes SkyPad as "another important step into fully digitalising and automating the apron. The established real-time communication makes the fuelling process significantly safer, faster and more efficient."

More recently, Cathay Pacific has been working with Shell Aviation at Singapore

Changi Airport to integrate the airline's internally built application Flight Folder, which has all the information that a crew needs for a particular flight, with Shell SkyPad Data Exchange.

The two systems communicate directly with each other, sharing information and creating a real-time link between the pilot and the refueller.

Clearly, the industry is continuing to invest in the future, despite lingering uncertainty over just what form that future will take. Ferro believes that in the post-Covid world, aviation will need to adapt to a new operating environment, with tight budgets and fewer staff – and without compromising on safety – and that includes refuelling.

"To recover quickly, businesses will have to re-design existing processes as they are forced to do the same with fewer people," he says. "Digitalisation and process automation will play a vital role, especially if existing affordable technology can be used."

Protection

Microbial growth is not the only source of contamination. Superabsorbent polymer (SAP) particles can also be a problem.

Most aircraft refuellers today are fitted with filter monitors that prevent water and dirt particles from entering the fuel and engine. While water is rarely present in aviation fuel, when this does occur, SAP has been used to prevent it from getting into the aircraft, explains Thomas de Boer, head of operations at Shell Aviation.

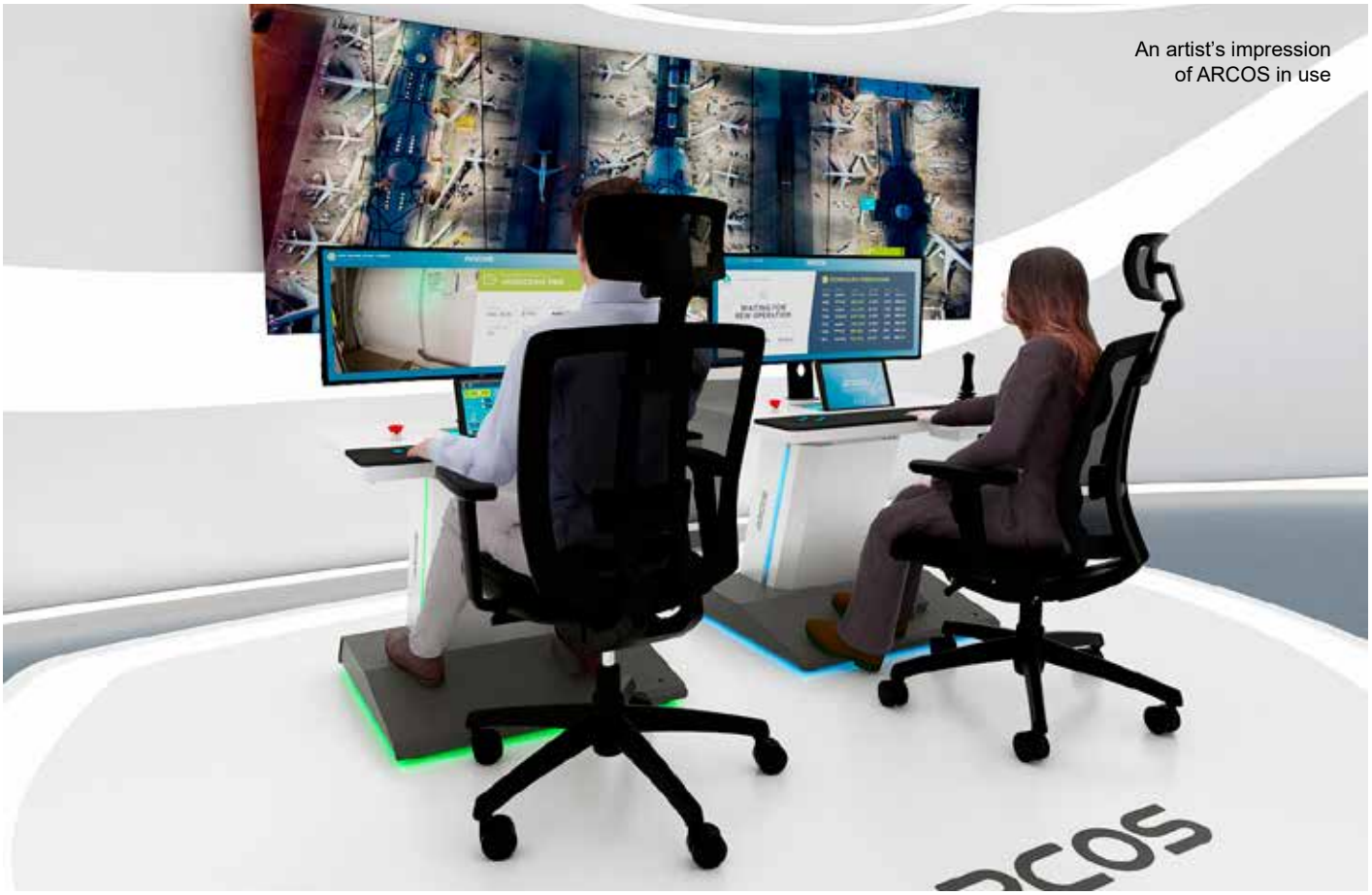
"It is rare that SAP particles move into the aircraft during fuelling," he says. "However, if it does, it can cause significant operational issues in engines.

"It was after Shell had been engaged as an independent, third-party expert by a major international airline that the potential associated risks of SAP were discovered," de Boer continues. "We investigated why one of their flights had lost thrust control of both engines, resulting in a forced landing at twice the normal speed."

Seven further incidents were documented, prompting the launch of IATA's SAP Special Interest Group in May 2014. The group's investigation found that the use of SAP-based systems in aviation fuel handling could not reliably meet aircraft and engine operating requirements.

"As a result of these findings, the aviation industry committed to phasing out SAP-based water filters used in the refuelling process," de Boer says, adding that the Energy Institute's withdrawal of its EI 1583 specification for SAP-containing filter monitors on 31 December 2020 removed any sort of technical standard or oversight of them.

Shell has been working with filtration specialist FAUDI Aviation since 2015 to find alternatives to SAP. The resulting Shell Jet Protection system replaces the SAP-based water filter with a separate AFGUARD electronic water sensor (EWS) used in combination with a dirt defence filter (DDF). It "guarantees a safe and secure flow of fuel every time", according to de Boer.



An artist's impression of ARCOS in use

Seville Airport opts for ADELTE's ARCOS system

Spanish national airport operator AENA is to acquire ADELTE's ARCOS passenger boarding bridge (PBB) remote control operating system as part of a contract for Seville Airport

Barcelona, Spain-based ADELTE is to design, manufacture and install a total of six PBBs, six pre-conditioned air units (PCAs), six ground power units (GPUs) and 14 visual docking guidance systems (VDGS) under the contract.

ARCOS – or ADELTE's Remote Control Operating System to give it its full name – allows a PBB to be remotely operated from an airport's control room and manoeuvred autonomously to and from all types of commercial aircraft.

It is designed to reduce operating times while accurately docking and undocking PBBs in all weathers. By centralising such operations, the expectation is that an airport's operating costs will also be reduced in comparison to traditional methods of PBB operation.

ARCOS went into development in 2015, ADELTE confirms. Last year, it underwent trials at Seville Airport with a number of different airlines and with PBBs that were not manufactured by ADELTE, showing – the company says – that its system can be used with any PBB.

Patxi Artiz, airport business unit director at ADELTE, observes: "ARCOS is the solution that will mark a turning point in PBB handling and have an impact on airport operations around the world.

"ARCOS stands for highly efficient procedures, significant cost savings and reduction in docking and undocking times which benefits both passengers and airport operators".

Years in the making

Artiz explains that ARCOS first underwent concept testing at ADELTE's manufacturing facilities in Monzon in Spain. It was then unveiled as a "minimum viable product", he says, during the *inter airport* trade show 2017 in Munich, where ADELTE gathered feedback from potential customers.

At the beginning of 2018, ADELTE brought AENA into the project, enabling the system to go into field testing in a live airport environment. These trials were indeed launched at Seville Airport last year, with real PBB docking operations

being undertaken with ARCOS.

During the final phase of the product development process, ADELTE also engaged Bureau Veritas, a company specialising in testing, inspection, and certification, to verify the product 's compliance with the EU's Directive 2006/42/EC on machinery.

AENA provided very positive feedback on the various tests, Artiz recalls, as did the three airlines involved – Iberia, Vueling and easyJet. The ARCOS system drastically changes the way that PBBs are operated, and it was therefore "critical to have the system aligned with the needs and interests of airlines, airport operators, handling companies, etc.

"In that sense, we used all the feedback to improve the system so that it meets the requirements of all stakeholders."

Expanding the ARCOS footprint

Of course, ADELTE hopes that Seville Airport is only the beginning for the ARCOS system. "With the news of the implementation at Seville Airport, after successful trials in 2020, we are now actively promoting ARCOS," says Artiz.

"We have started conversations with large airport operators, in particular operators who have shown interest in ARCOS and are seeking to reduce operational expenses. By centralising operations, airports can reduce their workforce by 65% while improving docking time by 20%."

The Covid-19 crisis that has so decimated the airline industry will have some sort of silver lining, perhaps. Artiz considers: "We see that the current health crisis is forcing businesses to become very efficient, more than ever before.

"In terms of businesses, Covid makes all of us think every day about various ways to improve operations, to be more efficient, to attract value, to set ourselves apart from others. In that sense, airport operators can really benefit from ARCOS to become more efficient, and be able to survive in the long run."

In terms of businesses, Covid makes all of us think every day about various ways to improve operations, to be more efficient, to attract value, to set ourselves apart from others

Patxi Artiz
ADELTE

Transtec's lithium battery-powered belt conveyor on trial with Indian carrier SpiceJet

Transtec meets changing customer needs

Mumbai, India-based GSE manufacturer Transtec Overseas is offering a range of different equipment suitable for those looking to support the global air movement of Covid-19 vaccines, and other cargo

Transtec director Adesh Shah tells *Airside* that the last 12 months have certainly been tough. The passenger aviation business in its core markets has collapsed since the start of the pandemic.

India accounts for about 40% of Transtec sales, and – of the remaining 60% – a large proportion derives from other South and South-east Asian markets; in these regions, 2020 saw airline passenger numbers collapse, especially among the low-cost carriers (LCCs) that dominate the Indian domestic aviation industry.

But the company has not stood still, instead using the time wisely to develop new products adapted to where demand has remained strong: namely in air cargo generally, and also the booming vaccine transport business.

In fact, it has developed a number of entirely new products as a result of specific demands put to it by freight-carrying or freight-handling customers. One of these is a 10-tonne heavy duty cargo trolley that is particularly suited to the loading and unloading of (10) standard 1-tonne pallets. The trolley's pneumatic tyres benefit from a leaf spring system for a smooth ride on rough surfaces. The unit is available either as an open-sided model or with both sides curtained to protect the unit's payload from the elements.

Transtec also developed a new cargo baggage trolley that can take a payload of up to 7 tonnes. It has sliding side doors through which freight or baggage can be loaded or unloaded.

Another new offering is what Shah describes as an air cargo pallet cum pallet dolly. This comes with pallet locks that can be used to secure the cargo.

Each is a very cost-effective alternative to similar GSE available on the market, Shah remarks.

Dedicated to vaccine transportation, Transtec can now supply a standardised model refrigerated truck that can keep vaccines as cool as –25 degrees, which is now being sold to logistics businesses. Also available to either self-handling airlines or ground service providers (GSPs) is a towable refrigerated vaccine container based on a 20ft or 40ft dolly, ideal for


Shah in front of one of Transtec's heavy-duty cargo trolleys

moving vaccines from an aircraft to a truck or warehouse (or vice versa).

Again, these are relatively low-cost alternatives, in this case to other cool dollies available in the market, Shah asserts.

Away from the cargo sector, Transtec continues to develop other new GSE. One such is a narrowbody 5m towable belt conveyor powered by a lithium battery. A charge enables between five and six hours of operation. This model is currently on trial at Hyderabad International with airport operator GMR.

Transtec has offered lead acid battery-powered GSE for some time now, but this represents the first time it has ventured into lithium battery technology. Given the rising price of diesel in India right now, it offers a very viable total cost of ownership (TCO) alternative to conventionally powered GSE, Shah suggests.

During the downturn, the company has invested heavily in new technology, and especially into investigating charging systems, battery live saving technologies and other greener power options, he adds.

Finally, Transtec has upgraded its non-powered passenger stair unit such that the unit – which can reach up to heights of between 3m and 5.5m – now comes with LED lighting and aircraft approach warning system.

"We are continually trying new things, constantly trying to improve our products," Shah says. And, while the market is certainly depressed right now, there are causes for optimism. Airport Authority of India (AAI), the national airports authority, has issued tenders for ground handling licences at no less than 54 airports across the country, for example: this is the first time it has conducted such a wide-ranging process for new handling contracts.

Those GSPs that prove successful may well be looking to acquire new GSE, Shah believes, not least because AAI requires handlers that acquire GSE to acquire equipment that is no more than two years old.

While this year may again be very challenging, Shah hopes that 2022 may see something like a return to normality in the aviation industry and better news for GSE suppliers. In the meantime, Transtec will continue to innovate, he says, to meet changing demands.

dnata focuses on the individual

Complementing the medical lift feature of earlier in this issue, *Airside* talks to air service provider dnata about its provision of ambulifts and other equipment and services that assist its regular passengers with restricted mobility (PRMs)

Robert Powell, dnata's vice president for technical services, and GSE planning manager Bartu Korgul tell *Airside* that the handler – part of the Dubai-headquartered Emirates Group – places a high priority on PRMs and the equipment that it uses to support them.

In fact, rather than PRM, dnata prefers the term used by the Dubai Government: 'people of determination'. At dnata, Powell says, "We focus very much on the service, which is very much focused on the individual. People of determination deserve the same ease and convenience in their air journey as any other passengers."

At the core of dnata's Dubai service offering for people of determination are its 28 medical lifts. These are mainly Mallaghan models but also include DOLL ambulifts for serving A380 super jumbos and some DENGE medical lifts in use at Dubai World Central (DWC).

Due to changing operational intensity in flight operations, some of these DENGE lifts are going to be repositioned in Pakistan to support dnata operations there.

The most recent acquisition of ambulifts by dnata in Dubai involved five Mallaghan ML4000T truck-mounted medical lifts purchased by the handler in 2019. These units are now in operation at Terminal 2 at Dubai International Airport (DXB), primarily serving flydubai and other narrowbody customer airlines.

dnata's international operations beyond Dubai involve a total of nine medical lifts across six stations elsewhere in the Middle

East and in Asia, Korgul informs. There are plans for new medical lifts to be acquired at some point in the future, he advises: replacement units for older models that will offer higher technical specifications.

On that subject, Korgul notes that the handler makes acquisition decisions against a range of both technical and commercial criteria. Requirements vary widely, and depend on the nature of the station involved (station size, airport layout and the positioning of gates, for example); on the aircraft that need to be served (the range of aircraft types will determine the heights that need to be reached and the level of flexibility required: whether the vehicles should be half-cab or full-cab, self-propelled or truck-mounted, and so on); and on the number of PRMs/people of determination who will be handled.

Other factors that have to come into consideration when making acquisition decisions include dnata's determination to keep up with all international requirements and recommended standards, from bodies including but not limited to the European Union (EU), the International Organization for Standardization (ISO) and the International Air Transport Association (IATA); that the medical lifts incorporate the latest in technological safety measures to minimise risks of aircraft collision; and that any new equipment meets the needs of dnata's corporate strategy to standardise its GSE technical specifications as and when possible.

Delivery lead times from a supplier may also be a consideration. Finally, while dnata is sensitive to price, it is "very sensitive to the particular needs of PRMs/people of determination", Powell says.

Powell emphasis Korgul's thoughts on the importance of the range of factors that have to be considered when acquiring medical lifts. As part of its strategy of standardisation of equipment types, dnata offers stations looking to acquire new GSE a range of options – a "menu", he says – of options against which they can make their purchasing decisions, all within the context of a transparent and fair tender process.

Each acquisition of new medical lifts needs to be very carefully considered, he says, given that the requirements of each station can differ dramatically. Flexibility might be very important at some stations, more so than at others, for example. At the end of the day, though, "At dnata we fully focus on the needs of our customers and the quality of our equipment reflects our standing on this."

Medical lifts are not the only evidence of dnata's focus on PRMs. For example, it has no less than 600 wheelchairs of various types available across the four terminals of Dubai's two airports (DWC and DXB). Each is inspected and sanitised before use in these Covid-19-affected times, as are the ambulifts and passenger buses that its people of determination might use.

All the passenger buses that dnata has acquired over the last couple of years for use in Dubai have wheelchair ramps and tie-down points for wheelchair restraints, and dnata attendants are available for PRMs even when dnata's full ambulift service is not required.

For the future, dnata is considering further improvements to its capability to handle PRMs in Dubai. Acquiring Aviramp passenger boarding platforms that are easier for PRMs than passenger steps is one option under consideration for its DWC operation; another is a transport ambulance service for airport transfers.

The e-BETA undergoing trials in Oslo

Vestergaard's e-BETA leaves the launch pad

The environmentally friendly Elephant e-BETA aircraft de-icer from Vestergaard underwent tests at a number of airports across Europe and North America over the course of the last 2020-21 Northern Hemisphere winter, and is now available to the market

According to the Roskilde, Denmark-based supplier of de-icing, aircraft washing and toilet and water servicing units, the e-BETA offers users the potential to reduce greenhouse gases, including carbon dioxide and nitrogen oxides, by 87% per truck every year.

One of the trial programmes saw Menzies Aviation, a longstanding Vestergaard customer, test out the e-BETA at Oslo Airport. Menzies operates 11 Vestergaard rigs as part of its de-icing fleet at the Norwegian gateway, where in a typical (non-Covid-affected) year it handles some 5,000 or so turnarounds over a typical season between the months of September and May.

Vestergaard is hoping to produce a fully sustainable version of its product line for performing carbon neutral ground handling operations by 2030 and, it says, "The electrically operated Vestergaard Elephant e-BETA is a critical part of this journey, reducing environmental footprint by significantly reducing greenhouse gas emissions."

Thomas Hoff Andersson, vice president Northern Europe at Menzies Aviation, comments: "The successful trial of this electrically-driven de-icer promises to bolster not only the sustainability of our de-icing operations at Oslo Airport, but the sustainability of the industry at large."

Ole Petter Storstad, director of airport services for Norwegian state-owned airport operator Avinor, observes: "Avinor has a goal that its own operations at Oslo

Airport will be fossil free by 2030. We are therefore pleased that our partners are working in the same direction and have a green focus when they further develop their services."

Lars Barsoe, vice president sales and marketing at Vestergaard, says that as one of the busiest de-icing hubs in Europe, "The choice of Oslo was an obvious one, as there would be great opportunities to test the unit in action."

Feedback from Menzies in Oslo [regarding this winter's trials] has been positive, he says. "We are very happy with the feedback we have received. From January to April this year the unit has been used for de-icing operations in Oslo alongside Menzies' regular Elephant BETA units and has performed with the same efficiency and reliability as our customer is used to from our other equipment."

According to Barsoe, the battery capacity of the e-BETA has lived up to expectations and over the course of the test period, the built-in diesel 'range extender' has been required only to a very limited extent, while "the customer reports that 'We have not had to refill the diesel tank a single time'," he confirms.

Trials have not been restricted to Oslo and to Menzies. Other tests of the e-BETA held during the 2020-21 winter season put the de-icer through its paces at airports including Stuttgart, Munich and Frankfurt in Germany, Paris in France and Montreal in Canada.

Oslo proved an excellent testing ground for the e-BETA

Munich Airport was another site for e-BETA testing

Ongoing improvement

"At Vestergaard Company, we pride ourselves on continuous development of our products," Barsoe informs. "This includes the Elephant e-BETA and our other new, sustainable products. After successful customer tests, the first version of the e-BETA is now launched as a commercial vehicle and will be a part of our de-icer portfolio for the coming 2021-22 season."

The potential market for the new unit is large, he believes. "All winter operation markets focusing on sustainable ground handling operations are markets for the Elephant e-BETA," Barsoe suggests. "We hear from our customers that sustainability is a key area for development of airports in many regions – in North America, Asia, the Middle East and Europe.

Vestergaard currently offers sustainable versions of the e-BETA (the company's largest de-icer), a new glycol recovery vehicle and a small electric towable water and toilet service unit as well as fully electrical full-size toilet and water service units – both winterised and non-winterised.

And, "With a forthcoming electric version of all our products we will be able to meet the demand for sustainable ground handling products from GSE customers in all regions," Barsoe notes.

"We believe that sustainable solutions will overtake conventional fossil solutions in the near future. We can see that there is a lot of political pressure on the entire sector to move towards greener solutions. We aim to be part of that solution," he concludes.

Aurrigo launches innovative autonomous Auto-Dolly

Earlier this year, Coventry, UK-based autonomous vehicle specialist Aurrigo launched Auto-Dolly, an autonomous electric transport platform for on-airport work. Available as either a baggage dolly or a cargo dolly able to move pallets or unit load devices (ULDs), Aurrigo believes it offers significant operational benefits alongside much-wanted cost savings

The Aurrigo Auto-Dolly (Cargo), with a BA ULD

Aurrigo claims that the Auto-Dolly could reduce the number of traditional tugs and dollies used at an airport by up to two-thirds. This figure is derived from recent simulations conducted with "a leading Far Eastern airport", part of whose physical footprint was measured, recorded and fed into a computer model that simulated potential Auto-Dolly operations at the gateway.

This possible reduction in on-airport equipment would mean not only cost savings for operators but also a significant reduction in harmful emissions otherwise created by diesel baggage and cargo tractors.

The electric Auto-Dollies can navigate autonomously, moving from one task to another, being available for picking up and then dropping off items without the need for any human operators. Moreover, they are able to move baggage or cargo in either interior or exterior airport operating environments in all weathers, the company asserts. All-weather operation is enabled by "weather-hardened sensors and innovative software processes" that allow the machine to operate in snow, heavy rain, direct sunlight and fog, Aurrigo notes.

Plus, Aurrigo's sales director Miles Garner tells *Airside* that Auto-Dolly, with its powered roller deck, offers the unique ability to 'crab' sideways when docking and parallel parking, making the most of the available space in cramped and/or congested airport conditions.

Evolution

The design of the Auto-Dolly recently launched onto the market represents a significant evolution in the dolly that was tested at London Heathrow's Terminal 5 with International Airlines Group (IAG) a couple of years ago (see https://www.airsideint.com/aurrigo-develops-worlds-first-self-driving-baggage-dolly/).

That model was a 'proof of concept', Garner recalls, and significant changes have been made to the unit's design since then. These include: the development of a much lighter weight chassis design (the Auto-Dolly can be lighter than more traditional baggage and cargo dollies because traditional dollies have to be sufficiently robust to weather the bumps and crashes that they are expected to suffer); the introduction of a new battery power pack that is much more suited to an autonomous vehicle such as the Auto-Dolly and that offers up to 120 miles of operation on a single charge; and an improved Autonomous Control System (ACS) that has been custom-designed and made for the Auto-Dolly.

The Auto-Dolly's ACS incorporates GPS, inertial measurement units, cameras and light detection and ranging (LIDAR) systems on an A-frame structure above the unit's flat baggage/cargo platform area. They tell the Auto-Dolly where it is located on the pre-programmed mapped area of an airport stored in the Auto-Dolly's memory, as well as giving it the awareness of its changing surroundings and alerting it to any obstacles or potential problems nearby.

Each of the Auto-Dollies communicates with a cloud-based Fleet Management

System (FMS), which co-ordinates the optimal efficiency of the vehicle fleet. The FMS also controls vehicle platooning using software developed by Aurrigo, with communications based on Local Private Networks or via encrypted data over standard cellular communications technology, Garner informs.

The Auto-Dolly is ready for production and Aurrigo is currently talking to potential customers amongst handlers, airport authorities and logistics service providers, Garner continues. One airline that continues to show an interest is IAG, with which Aurrigo worked on the pilot at Heathrow.

Despite widespread optimism about the technology, the development of self-driving cars over recent years has not been smooth due to the complexities of autonomous driving on busy public roads. However, Garner feels the challenges for vehicles such as the Auto-Dolly that are expected to operate in airport environments – areas that are not limited in scale but are closed to the public, closely controlled and low-speed environments by their very nature – are much more manageable. As a result, uptake of autonomous vehicles in the aviation industry could be that much greater.

Furthermore, he points out, while the actual benefits of autonomous private cars are neither obvious nor particularly attractive to many drivers, the potential cost savings of the Auto-Dolly make it a very enticing proposition to possible users at airports around the world, Garner argues.

"We are really proud of the innovation of the Auto-Dolly," he adds, concluding by saying that if demand for the unit was sufficient, Aurrigo could offer large numbers of Auto-Dollies by partnering with manufacturers it has already consulted.

We are really proud of the innovation of the Auto-Dolly

Miles Garner
Aurrigo

Stuttgart Airport moves ahead on SmartFleet programme

Early this year, initial trials of an autonomous baggage tug began at Stuttgart Airport as part of the gateway's wide-ranging ambitions to modernise GSE operations at the gateway by implementing a high degree of GSE electrification (the efleet programme), as well as exploiting the potential of autonomous equipment (the SmartFleet programme)

The tug, manufactured by Germany's VOLK Fahrzeugbau, can drive certain routes across the apron independently. The trials at Stuttgart, which represent the first testing of an autonomous baggage tug at a German airport, are examining capabilities including navigation to a pre-defined destination, lane keeping, obstacle detection, acceleration and braking.

The vehicle is fitted with four 3D cameras, with infra-red capability for night vision, two safety laser scanners and a highly precise GPS system. As a result, the tractor knows its location to within 2cm. The new tug also complements the airport's growing electric GSE fleet: a lithium-ion battery supplies its power.

In its early phases of testing the tug has continued to be manned, an operator remaining near the controls to stop the tug if required for safety reasons.

The SmartFleet project, which is examining the prospects for using autonomous commercial vehicles for safe and efficient airport operations, is funded by the German Federal Ministry for Economic Affairs and Energy. Besides Stuttgart Airport and VOLK, the vehicle manufacturer Aebi Schmidt Germany also forms part of the consortium. The research project is funded to the value of 3.9 million euros (US$4.6 million).

Deliverables

Martin Hofmann, SmartFleet project manager at airport operator Flughafen Stuttgart, confirms that testing of the as-yet unnamed autonomous baggage tractor at the German gateway is the latest stage in a process of collaboration between Stuttgart Airport and VOLK that has been ongoing since 2019.

The two partners worked together in the very first stage of GSE electrification at Stuttgart Airport, which formed part of the

Stuttgart Airport's busy ramp

gateway's efleet project, which was launched in 2013 (covered in *Airside* previously; see , for example, https://www.airsideint.com/issue-article/stuttgart-looks-to-a-greener-future/). Just five years later, the entire baggage tug fleet at Stuttgart had become fully electric.

SmartFleet is a research project with two prototype applications: a) winter service and b) baggage/cargo transportation. Flughafen Stuttgart expects to use the outcomes of the project to steadily increase the degree of automation in its ground fleet. And it will have a close look at other suitable ground handling processes too.

GSE manufacturer Aebi Schmidt Group's part in the programmme relates to the winter service aspect. It is working on autonomous jet sweepers for winter maintenance, and these are also soon to be tested at Stuttgart Airport.

"The common goal is to develop self-driving commercial vehicles that are safe and efficient to use at the airport," Hofmann remarks, adding that the first trials of an autonomous winter maintenance vehicle developed within the SmartFleet programme will probably take place this year.

There are currently two ground handling firms working in baggage handling at Stuttgart. Flughafen Stuttgart subsidiary Stuttgart Airport Ground Handling is one of them and it, too, is bringing its ground handling expertise to the ongoing SmartFleet programme and the trials at Stuttgart.

The research project ends in 2022. Trials at different stages of automation will take place at Stuttgart until then, Hofmann confirms. For the moment, the deliverables that the partners hope to see from the trials are:

- Analysis of different operational uses, such as outdoor operation on the apron as compared to indoor operation in the baggage basement; intersection and crossing traffic with other GSE, passenger buses and aircraft; autonomous hitching of baggage trailers; and so on
- Autonomous navigation and routing
- Study of the effects of automation on the working environment
- Study of the effects of automation on handling processes and workflows
- Investigation of alternative approaches to a fully-automated future scenario, including consideration of suitable intermediate steps

"Autonomous vehicles have the potential to make ground handling processes more efficient and safe," Hofmann asserts. "The traffic situation on the ramp is challenging and ground handling employees have a tough job – it is physically hard work. Self-driving GSE could support them in the future.

"[Autonomous] GSE could even contribute to accident prevention on the ramp. While humans can make mistakes when not fully concentrating, perhaps due to extreme weather or tiredness, these machines will be less influenced by such conditions."

ThorDrive's autonomous baggage tractor is based on a Wollard M40 diesel unit; credit John Kim

ThorDrive tests autonomous baggage tractor at Cincinnati

Technology developer ThorDrive has trialled a Wollard baggage tractor equipped with autonomous driving technology at US gateway Cincinnati/Northern Kentucky International Airport

Now based in Cincinnati, ThorDrive was founded in South Korea by a Seoul National University chairman in 2016 as a specialist in robotics and artificial intelligence. Its autonomous driving technology is said to be built on more than 15 years of development by software engineers and robotics specialists, with the systems used in its autonomous baggage tractor trialled at Cincinnati/Northern Kentucky Airport based on software that has been operationally tested for three years over more than 80,000 miles of driving.

In 2016, ThorDrive was involved in a robotic cab project in downtown Seoul and in 2018 it established a presence in Silicon Valley in California, gaining some success in last-mile delivery systems.

ThorDrive specialises in using its proven technology to support markets where efficiencies can be quickly realised, including – but not limited to – passenger vehicles and commercial trucks. Thus, while its technology has been successfully deployed into passenger cars, delivery vans and small electric utility trucks, industry, logistics and the aviation industry are also now prominent in its thinking.

The collaboration with Cincinnati/Northern Kentucky International Airport dates back to February 2020. According to ThorDrive vice president – business development Eddie Shelton, Cincinnati/Northern Kentucky is extremely innovative in its thinking, with autonomous baggage tractors and shuttles considered to be potentially important elements of future airside operations there. The airport operator has also looked into the possible use of various robotic technologies landside. Installed in a Wollard International M40 diesel tractor, the ThorDrive autonomous driving technology uses both cameras and light detection and ranging (LIDAR) to scan its operating environment. This is compared to the picture of its environment that the unit has scanned into its memory – the result of pre-mapping of the location undertaken by the ThorDrive team and scanned into the unit's software – to enable it to pinpoint its location, navigate and identify possible hazards.

While GPS also helps the unit to precisely identify its location, unlike some of its autonomous technology peers because it 'identifies' and 'recognises' the surroundings picked by up the cameras and LIDAR (in the future the system will probably call upon radar as part of the process of building up a 3D picture of its environment), the unit does not rely completely on GPS for determining its position. That is something that might be vital if the GPS feed ever goes down, for example, Shelton points out.

When Shelton spoke to *Airside* in April, after more than a year of airside testing the trials at Cincinnati/Northern Kentucky International Airport were still ongoing. Although, he says, "we're about 90-95% of the way there now, with just a little bit of tweaking to do, the process of testing and

developing never really ends".

This is because, while an airport ramp is a very controlled environment, unexpected situations do occur and the autonomous software can always be further improved with programmed responses to such eventualities, he suggests.

Moreover, because of the potential for constant improvement, ThorDrive will always be there post-sale for any customer who requires assistance, Shelton confirms. And that day might not be too far away – ThorDrive is hopeful of entering into commercial sales in the fourth quarter of this year.

The biggest issue in the testing at Cincinnati/Northern Kentucky International Airport actually turned out to be ensuring that the system could always identify an aircraft, as well as other GSE, wing walkers, other handlers and all the other entities that can be found on an apron. ThorDrive had plenty of experience of autonomous driving, but the airside environment was new to it and lessons had to be learned.

Mating the old-style analogue technology of GSE equipment with the digital technology of today required by sophisticated autonomous driving technology was also a challenge.

Avoiding collisions is of course critical in terms of safety. It is also important in terms of avoiding the financial impact of damage to equipment and especially to aircraft – and, Shelton notes, the value of autonomous airside operations lies not only in cost savings through efficiencies and labour-saving but also through avoiding the GSE/GSE and GSE/aircraft collisions that are an unwelcome feature of today's ramp operations.

Gathering interest

While ThorDrive has only recently begun marketing the airside applications of its autonomous driving technology, interest has been keen, Shelton says. With an ambitious expectation of commercial launch before the end of the year, ThorDrive is already talking to several ground service providers and cargo companies about the technology (various industrial and warehouse logistics-based applications are also being promoted for the software).

While Cincinnati/Northern Kentucky International Airport would not be a potential customer – because it does not actually operate GSE – it has proved vital as a partner (as has Wollard, Shelton notes) and can "open doors" for ThorDrive as it seeks potential customers.

Moreover, while the current tests have involved the M40 diesel tractor, ThorDrive is also looking to begin project developments that might involve a battery-powered variant of the M40 or a more cargo-focused tractor.

The way of the future?

The ThorDrive trials at Cincinnati and the Aurrigo development (see the Aurrigo article earlier in this issue) are only two examples of testing programmes for autonomous baggage tractors that are proving the potential for autonomous GSE.

Earlier this year TractEasy – the autonomous baggage tractor that is jointly built by GSE supplier TLD and autonomous software developer Easymile, and that is commercialised by Smart Airport Systems (part of TLD) – underwent trials at Amsterdam Schiphol Airport with the aim of validating how safe and efficient use of such technology will enable self-driving vehicles to be integrated alongside manned vehicles at the Dutch gateway.

The trials, which took place in early Spring this year, were carried out by Royal Schiphol Group in collaboration with KLM Ground Services and Smart Airport Systems.

The test began with the tractor operating in a defined area in which the baggage handling process could be simulated. In the second phase, the trials moved to an operational environment that saw the tractor bring baggage to an aircraft. The self-driving vehicle was loaded in the baggage area, after which it navigated to an aircraft stand via a fixed route.

During all the trials with the baggage tractor, there was an operator in the autonomous vehicle who could stop the vehicle if necessary.

The Royal Schiphol Group – owner and operator of the Netherlands' biggest airport – has said that it anticipates that by 2050, daily operations on the apron at airports will have changed significantly. Ground-based airport activities such as baggage transport, passenger transport and aircraft towing will not only be "clean, but also smart and autonomous", it considers.

Its aim is ultimately to replace all vehicles operating airside with an interconnected fleet of self-driving, emission-free vehicles, in order to guarantee and improve quality in the long term.

Hassan Charaf, head of innovation at Royal Schiphol Group, remarks: "Despite the coronavirus crisis, we are continuing to invest in quality and innovation. We have launched the 'Autonomous Airside Operations' programme in order to work with airport partners step by step towards smart and future-proof ground handling.

"In this early phase, we are focusing on knowledge development through trials at various airports. This will allow us to combine insights and determine which bottlenecks require particular attention and which steps must be taken in the future as we work towards an autonomous airport. On this basis, we will then determine the concrete follow-up steps."

credit Amsterdam Airport Schiphol

Ingenuity

Meanwhile, also in Spring this year, another round of tests saw Japan's All Nippon Airways (ANA) trial an autonomous towing tractor in collaboration with Toyota Industries.

The trials took place at Tokyo Haneda Airport from late March 29 into April and were the first of their kind at Haneda. ANA had previously conducted tests of autonomous vehicles at Kyushu Saga Airport and Nagoya Chubu Airport and – by building on the information gained from those prior tests – at Haneda the unit's navigational capabilities were trialled in open spaces as well as congested environments.

The autonomous towing tractor was equipped with 3D LIDAR and a 2D laser scanner to enable it to constantly track its position via road pattern matching as well as by its own GPS.

The latest model trialled is able to transport a large amount of cargo, even in the congested driving conditions found at Haneda. As well as offering increased location tracking abilities and improved towing capacity even on adverse slopes, a plastic glazing window developed by Toyota Industries is now used for the cabin to enable greater safety while reducing the unit's weight.

ANA has said that it aims to begin utilising autonomous technologies from this October. The carrier has commented that it believes projects that are capable of autonomous operations will be widespread by 2025 and will form a crucial component of the 'Simple & Smart' airport of the future.

ANA has worked with Toyota Industries to conduct tests of autonomous towing tractors since 2019 as part of an effort guided by the Japanese Government's Ministry of Land, Infrastructure, Transport and Tourism.

"Our work with Toyota Industries has led to several successful autonomous towing tractor tests that we have continually learned from," informs Masaki Yokai, senior vice president of ANA. "As we work with Toyota Industries to create the Simple & Smart airport of the future, ANA remains committed to integrating advanced technology in order to improve the travel experience."

Hisashi Ichijo, executive officer of Toyota Industries, adds: "We are making important breakthroughs that bring us one step closer to our goal of establishing autonomous driving technology that is able to make airport logistics smarter around the world."

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Danny Vranckx
CEO
Tel. +32 471 942 780
danny@aviaco-gse.com

Bart Kroonenberg
COO
Tel. +31 653 765 332
bart@aviaco-gse.com

www.aviaco-gse.com
info@aviaco-gse.com

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