THE GLOBAL VEHICLE TRUST

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MEDIA INFORMATION

Contents

1. Background and inspiration for the project

- The first vehicle to be designed specifically to provide all-terrain mobility for the developing world
- Revolutionary OX™ flat-pack truck aims to help communities to undertake a range of crucial daily tasks
- Envisioned by entrepreneur and philanthropist Sir Torquil Norman; designed by renowned automotive engineer Professor Gordon Murray CBE

Across Africa there is intense need for improved transport, for both everyday living as well as emergencies. Even though 15% of the world's population lives in Africa, there has never been a vehicle specifically designed and manufactured in volume to meet the rigours of the continent.

On the contrary, across the automotive industry, there is a trend of supplying ever larger, heavier, more technically complex vehicles such as electric and autonomous cars to just a fraction of the world's population. What the developing world needs so desperately is a simple solution to a real transport problem.

Too often, the transport of food, water, medicine and people is dependent upon unreliable vehicles and uncertain availability. The vehicles that are available are frequently designed for quite different purposes, are too heavy, too complicated or are unsuited to local conditions.

This situation has inspired the creation and development of the OX, a highly unconventional 'flat-pack' all-terrain light truck, designed in Britain by renowned automotive engineer Professor Gordon Murray, that will benefit people living in remote villages and townships across Africa and other parts of the developing world.

Eight years of collaboration

The concept for the OX originated from the vision of one man – Sir Torquil Norman. A former pilot, banker, company executive and toy manufacturing entrepreneur; Sir Torquil

is also a passionate philanthropist, and is chiefly responsible for the rescue and renovation of The Roundhouse in Camden, north London.

Eight years ago, he founded the Global Vehicle Trust (GVT), in order to pursue his ambition to help people in the developing world by providing cost-effective mobility for all. The GVT briefed Professor Gordon Murray CBE, a world leader in automotive engineering design, on a unique humanitarian programme to create a lightweight truck for the developing world. The brief called for a low-cost vehicle with a substantial load capacity, superb all-terrain ability and a flat-pack design to make it more efficient to export in greater numbers at lower cost.

The result of this collaboration is the OX – a ground-breaking vehicle that encapsulates Sir Torquil Norman's vision and Professor Gordon Murray's unique expertise. By providing cost-effective mobility, the OX aims to tackle poverty and ill health in the developing world – particularly in rural Africa and parts of Asia.

Sir Torquil Norman said: "My inspiration for the OX goes back to seeing the 'Africar' project of the 1980s. This project shares some of the aims of that vehicle, but its execution is radically different. The OX was just a dream nine years ago, but it is now a realistic prospect for production with working prototypes that have completed a comprehensive testing programme.

"Our sole objective at the GVT is to help people in the developing world. As part of an aid programme, the OX could provide an essential element of infrastructure to enable the local population to raise the community's standard of living, and to assert its independence by gaining control of its transportation needs and costs."

The unconventional vehicle has been designed with a particular focus on helping these communities to undertake crucial daily tasks, such as collect drinking water and transporting grain, fertilizer or building materials. It is able to carry loads twice the weight that vehicles designed for similar tasks can manage, while also having the capability to traverse punishing terrain.

Professor Gordon Murray said: "The OX design and prototyping programme is undoubtedly one of the most interesting and challenging I have undertaken during my 50 years of car design, including my years in F1.

“The added challenge of a flat-packed vehicle design over the already tough targets for cost, durability and weight saving made for a fascinating and stimulating journey from concept to prototype.

“The most satisfying elements of the project for me are that the OX will make such a difference to so many people and that it has no competitor in any part of the world. It has been a privilege to work alongside Torquil to make his vision a reality.”

Biography - Sir Torquil Norman CBE

Torquil Norman studied Law and Economics at Cambridge and Harvard. He went on to work as a banker for over 10 years (1957-67), at J.P. Morgan and Company in New York and at Philip Hall, Higginson Erlanger’s in London, followed by a further five years as a General Manager of Mineral Separation Ltd, a large industrial holding company, with particular responsibility for their smaller companies.

From 1973, he became the Chief Executive of toy manufacturing company, Berwick Timpo Ltd and, between 1980 and 1996 was Executive Chairman of the successful Bluebird Toys plc, which during the years from 1980 to 1995 grew from zero to sales of almost £100m.

Sir Torquil has been involved with a wide range of charitable enterprises including the Airborne Assault museum, The Fleet Air Arm Museum and the Tavistock Clinic Foundation. In 1986 – with the support of his wife Anne and their five children – he founded the Norman Trust, a charity to support children and young people.

After retiring from Bluebird Toys plc in 1996, he acquired the famous old railway engine shed in Camden, the Roundhouse, through the Norman Trust. Over the following 11 years, in addition to its own contribution of over £7million, the Trust raised over £30 million to buy the building and its adjacent car park and refurbish the entire complex. It was relaunched as a centre for young people from all backgrounds to work and learn in a wide range of the arts, from music and theatre to all modern media including radio, TV production and other skills.

The Roundhouse Studios have since supported tens of thousands of young people from all backgrounds, and the Roundhouse main space has become one of London’s most popular entertainment and education venues.

After retiring from the Roundhouse, Sir Torquil devoted two years to writing the well regarded book '*Kick the Tyres, Light the Fires'*, which collated his personal thoughts on the way Britain was being governed, and he how felt it should be governed.

Since completing the book, Sir Torquil has devoted his time to the OX project in collaboration with Professor Murray.

Biography - Professor Gordon Murray CBE

Gordon Murray was born in Durban, South Africa in 1946 and gained a Mechanical Engineering Diploma from Natal Technical College. He designed, built and raced his own sports car (the IGM Ford) in the National Class in SA during 1967 and 1968.

In 1969, Gordon moved to the UK and joined the Brabham Formula One Team as Technical Director, winning two world championships (1981 and 1983) during his 17 years with the team. Gordon joined McLaren Racing as Technical Director in 1988 and three consecutive championship wins (1988, 1989 and 1990) followed. In 1990, he moved away from Formula One – after 50 Grand Prix wins – to enable him to concentrate on establishing a new company for the group, McLaren Cars Limited.

The company's first project, the F1 road car, is still regarded as one of the world's best engineered cars. A racing version won two world sports car championships and the Le Mans 24-hour race on its first attempt in 1995. McLaren Cars then completed several other successful projects culminating in the Mercedes-Benz SLR McLaren programme.

Gordon left McLaren in 2005 to set up his new company Gordon Murray Design Limited, of which he is CEO and Technical Director. The innovative British company operates from Shalford in Surrey, and aims to be the world leader in automotive design. It reverses the current industry trend for sub-contracting by having a complete in-house capability for design, prototyping and development.

2. Design and key features

- Unrivalled carrying capacity with superb all-terrain ability
- Pioneering ‘flat-pack’ build system and utilitarian body design
- Full of smart design innovations to fulfil a range of requirements

The OX has been designed by one of the world’s leading automotive engineers, Professor Gordon Murray, and is specifically aimed at tackling a host of transport challenges in the developing world. It is unlike any other vehicle and has no direct competitor – whether from a concept, performance or pricing point of view.

The brief for the vehicle called for high ground clearance, excellent approach and departure angles, large wheel movement, a multi-purpose layout and a three-person cab. Gordon Murray’s design for the OX is nothing short of revolutionary, and the flat-pack format fundamentally changes the way a vehicle can be bought and transported, providing specific advantages to lead times and overall unit cost.

The OX has been designed to offer superb all-terrain ability, but it also has a huge and adaptable load carrying capability. The packaging is a key triumph of the OX project: the overall vehicle length is shorter than a large SUV, and yet it can carry a payload of 1900kg (approximately twice the capacity of most current pick-ups) with a load volume of 8.87 m^3. Based on EU size guidelines, it can seat up to 13 people or carry eight 44-gallon drums or three Euro-pallets.

Therefore, the OX not only addresses the problems with the roads (or often lack thereof); it also addresses the specific need to transport large volumes of goods and people at low cost.

All-terrain ability is crucial for the developing world, and the OX has been engineered to perform as well as, or better than, a four-wheel drive vehicle across a range of surfaces, while offering durable mobility with two driven wheels.

Two-wheel drive, all-terrain ability

Four-wheel-drive systems add weight, complexity and cost to a vehicle. They also reduce ground clearance and increase tyre wear and fuel consumption. Through clever and

innovative design, the two-wheel-drive OX has most of the attributes of a four-wheel-drive vehicle, but without any of the compromises.

Covering rough ground depends less upon the number of driven wheels and more upon the balance and the ground clearance of the vehicle. The OX's two-wheel-drive system allows a great deal more ground clearance, with 400mm at the mid-wheelbase point, without the need for larger and more expensive wheels and tyres. In addition, its wide wheelbase allows it to follow the tracks of larger vehicles on unpaved roads.

An approach angle of 40 degrees beats almost all light off-road vehicles currently in use, while the 53.5 degree departure angle is class leading by a substantial margin. With wading capability in a water depth up to 780mm, OX also has the ability to traverse flooded terrain with ease.

The OX grips the surface over which it is travelling very effectively because it has fully independent OXGlide™ suspension on all four wheels, using a leading- and trailing-arm setup. This also makes the vehicle much more stable over rough ground than is usually the case with off-road vehicles.

Flat-pack and stack design

The OX's revolutionary nature extends beyond the vehicle design because, uniquely, it is capable of being flat-packed within itself, enabling it to be transported more efficiently around the world.

At the heart of the vehicle is a strong but light steel chassis, and the external shell consists of all-flat, extremely strong and waterproof bonded wood composite. The three glass windscreen panels are also flat and identical in size, so can be interchanged in case of breakages.

The main body panels, including the doors, are interchangeable left-to-right, which means one spare part can be used on either side of the vehicle, and these parts can be easily stacked to save space. Innovative thinking has also been applied to the design of the suspension arms, with wishbones that are identical on both sides.

These carefully considered components keep initial costs low, and facilitate compact storage in the replacement-parts supply chain, thus keeping maintenance costs down as well.

WISA®-Trans body panels

The OX's main body panels are constructed from a highly durable and specialised 'waterproof wood'. WISA-Trans is a multilayer laminated ply panel with a slip resistant finish. The panels are intended for exceptionally heavy duty use, where the special wear resistant coating helps to prolong the service life of vehicles.

The base panel plywood is made solely from hardwood veneers. It is then built up using phenolic resin cross-bonded weather-resistant gluing. The surface faces are impregnated with a phenolic resin moisture barrier, with one side finished in a hot-pressed high-friction pattern.

Interior and controls

The OX's cabin provides spacious accommodation for three people, and the driver is seated centrally. While the concept of a central driving position is not unfamiliar to Gordon Murray, it has specific advantages in supplying a vehicle to the world's developing countries, some of which have right-hand traffic, while others drive on the left of the road. The central driver's seat also enables more accurate placement on the road, especially on narrow tracks where overgrown vegetation may otherwise prevent a clear view ahead.

There is no shortage of headroom as the cabin is deliberately very tall, designed to accommodate a wide range of head and shoulder 'bounce' on bumpy roads. In front of each passenger is a huge storage bin, with two pairs of directional air vents above them, across the bottom of the windscreen.

The central dashboard column casing between the driver's legs is a complete sub-assembly that contains all the controls for the power-assisted steering, cable gearshift and braking system. By building this up during the flat-packing stage as a single unit, it saves time and complexity during the assembly stage in the importing country.

The dashboard is designed to reflect the ‘T-shape’ graphic of an ox’s head and horns, and uses reliable toggle switches as well as centrally-sited speedometer, fuel gauge and water temperature dials.

Key design innovations

Beyond its revolutionary packaging design and two-wheel-drive all-terrain ability, the OX is full of design innovations that are specifically designed to meet the varied requirements of potential users in the developing world.

The tailgate does not merely contain the load in the back; it detaches completely from the OX and can be rotated lengthways to double as a loading ramp. The low angle of the ramp approach means that two people can roll a 44-gallon drum full of fluid up it. It could also be used to facilitate easy loading of livestock for transport.

The rear bench seat bases also have a dual purpose. The long ‘egg crate’ frames can be removed from the vehicle and used as sand ladders under the wheels to help the OX traverse challenging soft ground. A giant off-road jack can also be stowed neatly under one of the rear benches.

3. Chassis, suspension and powertrain

- Custom chassis and innovative suspension design
- Full testing on custom-built chassis rig at Gordon Murray Design
- Compatibility with a range of proven, off-the-shelf powertrains

The platform for the OX is a bespoke welded steel ladder chassis with folded ‘C’ sections across the rails, diagonal cross-bracing and lightening holes. The chassis has undergone significant development throughout the OX project, with design input from CAE analysis and a thorough twist cycle test programme on a custom-built rig.

The latest chassis is treated with the highest level anti-corrosion coating, and has been proven through full durability trials in the hands of independent validation engineers at the UK’s Millbrook Proving Ground.

The OX has superb grip over challenging terrain because it has fully independent OXGlide™ suspension on all four wheels, using a leading- and trailing-arm setup. The range of wheel travel available makes the vehicle much more stable over rough ground than is usually the case with off-road vehicles.

When unladen, 70% of the weight sits over the front wheels. Even when fully loaded, the careful design of the chassis and suspension means it shifts to a 55:45 balance from front to rear – so it retains very good traction and stability in both circumstances.

For the purposes of proving the concept and conducting durability trials, the GVT team identified the need to use a tried-and-tested engine and gearbox combination. The current powertrain in the OX prototypes is a reliable 2.2-litre diesel unit producing 99bhp and 229lb ft of torque. The latest prototype, XP4, uses a five-speed manual transmission.

This specific powertrain helps to demonstrate the capability of the OX, but it is not a requirement for production. Future versions of the OX could conceivably be powered by a range of engines, or even alternative fuel systems.

4. Build, distribution and assembly

- Flat-pack kits take less than six hours to create for transport
- Six OX vehicles and their powertrains fit inside a high-cube 40ft shipping container
- Final assembly of the OX takes approximately 12 hours with a team of three people

The OX is the world's first flat-pack vehicle. The components and sub-assemblies of the OX are tightly arranged within its own frame, with a separate transport crate housing the engine and gearbox. It takes three people less than six hours to create the flat pack in the UK prior to shipping.

The flat-packs are then transferred to a shipping container, which can accommodate six OXs. This is effectively three times more efficient than transporting fully-assembled vehicles, of which only two would normally fit in a 40ft high-cube container.

Beyond the financial and environmental benefits of shipping more vehicles in one container, the flat-pack system means that OXs can be transported in greater numbers to where they are needed more quickly, and may benefit from reduced import duty.

Assembly labour is transferred to the importing country, where local professional companies will be employed to assemble and maintain the finished vehicles. Three skilled (but not necessarily expert) people can put an OX together in approximately 12 hours.

One of the hardest challenges in the flat-pack design was enabling the engine to be installed without needing to supply a crane or hoist in the kit. The design team came up with an innovation solution, packaging the engine on the base of the transport crate in precisely the correct angle for installation. When unpacked, the chassis can be lifted over and down onto the engine, where it is fixed in position, before the whole frame and powertrain is jacked up to enable the suspension and wheels to be assembled.

Gordon Murray Design has created a language-free system for assembly, using graphics and colour coding to communicate clear instructions and procedures for the build team, with all of the 'safety elements' pre-assembled in the flat pack.

5. Servicing and maintenance

- Easy access to key servicing and maintenance points on the OX
- Interchangeable body panels mean lower spare parts count to stock
- OX is ideal for markets where traditional dealer network is not present

The low-cost simplicity of the OX extends beyond the construction and transportation. The running costs are also expected to be far lower, thanks to easy access for servicing and maintenance, as well as more cost effective replacement parts.

It is designed to be easily serviced and maintained in areas where there is limited access to conventional workshops and spare parts supplies. Access to internal components around the vehicle is made as simple as possible, with enough ground clearance to perform basic tasks underneath and consumables such as the air filter located within a locker door behind the cabin.

Clever thinking has been employed in the cabin, where access to the engine cover is under the bench seat base. Thumb screws secure the panel in place, so no tools are required to gain access to the top of the engine.

The OX's body panels are made from extremely strong and waterproof bonded wood composite, many of which are interchangeable from side to side, enabling more efficiency in stocking spares. The glass panels at the front are flat, which keeps manufacturing and supply costs low, and are also identical in size, meaning they can be swapped around as a temporary fast-fix if they are damaged.

In countries where the traditional dealer service network model is not present and where vehicles often fail due to neglect, the simplicity of maintaining an OX, and the ease of storing and installing replacement parts if required, makes it an ideal mobility solution.

6. Vehicle testing and durability

- Four prototypes have been completed, with more than 200 modifications over the course of development
- Hot weather testing carried out at the IDIADA Test Facility in Spain
- Full durability trials completed at the renowned Millbrook Proving Ground in Bedfordshire, UK

Extensive component selection, benchmarking and testing was undertaken by the GVT's partners to ensure that OX will cope with all of the environments that it is likely to be put to work in.

The prototyping stage of the OX development has seen four versions built: XP1, XP2, XP3 and XP4. The latest prototype showcases the evolution of design and the engineering effort that has been put into making the OX a truly ground-breaking vehicle.

A full testing programme has been successfully undertaken throughout the development of OX, including rigorous durability and reliability trials at the renowned Millbrook Proving Ground in Bedfordshire, UK and at the IDIADA Test Facility in Catalonia, Spain.

Following the development of the first vehicle, XP1, the chassis and suspension were tested to destruction and modified accordingly. Three new prototypes were built – XP2, XP3 and XP4 – incorporating approximately 200 modifications. Many of these changes were done to reduce build costs and assembly time.

Hot weather testing was undertaken at the IDIADA Test Facility and across rural and off-road terrain in Catalonia, Spain. Back in the UK, durability testing was carried out at the world-class Millbrook Proving Ground, to gauge the longevity of the vehicle components.

The Millbrook tests incorporated extensive wear tests on a variety of surfaces (including more than 4000km on the notorious Belgian Block Pave), as well as an accelerated corrosion test programme and vehicle quality assessments. Further rounds of modifications were implemented and parts redesigned after each testing stage, with all changes incorporated into the two latest prototypes.

7. Project funding and next steps

- £4m investment has produced four prototypes
- Global launch event in 2016 highlighted the need for investment and support
- Huge potential for the developing world, but also commercial opportunities in some developed markets

Four OX prototypes have been built by Gordon Murray Design and put through rigorous testing with an investment of approximately £4 million from the Global Vehicle Trust and its partners.

The global launch of the OX highlighted the need for investment and support in order to progress the project to completion. The Global Vehicle Trust believes that the OX project will attract a wide range of interest from potential backers.

For example, vehicle manufacturers will recognise the obvious benefits that OX can bring as a substantial and tangible demonstration of their commitment to global corporate social responsibility. On a smaller scale, philanthropists looking to address humanitarian issues have the opportunity to directly fund a whole vehicle project that can make a real difference in the developing world.

Sir Torquil Norman said: “Feedback we have had so far from contacts in Africa and with aid agencies has been very positive. The OX is about making a difference now, being part of something ground-breaking and unique. Most of all it presents a real opportunity to make a fundamental and lasting difference to people’s lives.

“Our priority now is to raise the funding to complete the testing and take the project to fruition. We believe that the OX has huge potential for charities, aid organisations and development programmes. My dream is to one day see an OX in every village in Africa.”

Although initially planned and designed for developing countries, there has subsequently been a realisation that there is likely to be demand for fully-assembled vehicles in some European markets. It is anticipated that OX will appeal to farmers, estate owners and others due to its huge carrying capacity and ability to traverse rough terrain with ease.

Any profits generated by selling fully-assembled vehicles in Europe would be ploughed back into the Global Vehicle Trust charity to fund future developments of the OX and subsidise further vehicles for countries most in need.

Following the recent success of a crowdfunding campaign and the support and partnership with Shell, the OX has been showcased in India, generating huge enthusiasm and interest.

8. Technical specifications – XP4 prototype

- *All technical information is preliminary and subject to change*

Engine

	2.2-litre 16v Diesel
Type	4 valves per cylinder
Capacity (cc)	2198
Bore x stroke (mm)	86.0 x 94.6
Compression ratio	17.5:1
Power	100 PS at 3,500 rpm
Torque	385 Nm at 1,300 - 2,100 rpm

Transmission

Manual, All Synchromesh	+ reverse

Suspension and damping

Front	OXGlide™ telescopic dampers and coil springs
Rear	OXGlide™ telescopic dampers and coil springs

Steering

Type	Rack and pinion steering box
Turning circle	11.7m

Brakes

Front	300 mm ventilated disc
Rear	280 mm solid disc

Wheels and tyres

Wheel size	Tyres - Front	Tyres - Rear
x 16-inch	205/80 R16	205/80 R16

Dimensions (mm)

Exterior	(mm)
Overall length	4,681
Overall width	2,450
Overall height	2,385
Wheelbase	3,045
Track	1,788

Capacities

Luggage	3.95 m^3 (to sides) / 8.87 m^3 (maximum)
Fuel tank	120

Weights (kg)

Dry weight	1600 kg
Payload capacity	1900 kg