Wyvern Project 2020 – Help!

The Wyvern Project is an experimental build aircraft to try fresh ideas and explore the possibilities of a multipurpose leisure vehicle so we can go and play on the road and in the air with a comparable performance level and extend its usefulness over a wider operational window and solve the problem of what to do when the weather excludes progress in your journey. We need a bit of fresh sparkle and capability in flexwing flying.
The challenge is making the machine work in the two different environments plus we would like to explore new ideas including electric drive. There is a strong opinion that the future of very lightweight flying is destined to be battery power and while the availability of systems catch up with the market we consider the Wyvern as the ideal platform for obtaining actual experience in this and other idea's.

The proposed aeroplane would be in the single seater class, the construction and approval of which is self-regulated under the CAA rules and has a legal maximum take-off weight of up to 300Kg. We hope for less than 100 meters ground operation and have set ambitious performance levels as this would make it more practical for longer journeys and safe operation from small fields so fresh thinking in the way we consider things bringing a more exciting choice to the market.

First Stage – In progress after construction of a mock up for packaging last year the current status is a single mechanical drive through the prop to develop and prove the concept of split use in the air and on the ground. Due to stability issues with the normal wheel configuration of this type of aircraft when used on the road this has been reversed with a single main wheel at the back. With no previous known experience using this configuration we are currently undertaking work after initial tests on the ground and in the air so far shows promise. We are continuing development before static load tests and proper trials when it is ready.

Second Stage – Work on the power train after deciding which option to develop, build and ground test from the mechanical option with a petrol engine directly coupled to a split drive gearbox including a one way centrifugal clutch system and 90 degree drive output or consider the possibilities of an electrical hybrid system with a small petrol engine driving a generator/motor using two motors with battery capacity for short operation. Electric only would be the eventual aim but we feel cost and performance limits excludes this at present. The Hybrid system will give us valuable experience for future development.

Third Stage – Progress the package to beyond the prototype stage with a fresh build using suitable manufacturing systems, tooling and consideration for materials and design including refinement of the controls, load/crash testing and build for dual purpose use and submit for single vehicle approval (SVA) to satisfy the legal road requirements, source a suitable wing assembly.

Notes

Steering and suspension.

At the moment we have a basic set up of the wheel arrangement to get feedback on the unconventional two wheels at the front arrangement. To help with landing the pedal steer to wheel ratio is high as we are using foot control.
To limit brake steer due to the imbalances expected in the present mechanical system the brakes will be changed to hydraulic to give a better balance together with lighter wheels It is hoped to make the front wheel assemblies retractable giving more options plus a site for the instruments and give clear access for the pilot.
The main front suspension is self-contained in the control arms with only the secondary suspension being chassis based. This gives flexible, easier adjustment which is a rising rate lightweight low cost system.
The rear main suspension is a beam system backed up by movement limiters.

Wheels are 10” diameter to aid rough ground handling with floating discs and twin pot callipers. The rear wheel may use the inboard motor to aid braking if the electric drive system is chosen using a drive via a toothed belt and if the regulations allow.

Chassis

We are using a prototype of the main triangulated chassis made out of steel with alloy rear swing arm. The design removes the normal front strut and replaces it with a rear strut under compression with adjustment to change the angle of the trike in flight. The pivoted mounting arrangement allows for quick changes to the layout to accommodate different wings together with wing demount and overnight tethering. Consideration is being given to material changes to aid weight reduction with the use of carbon and self-jigging to aid assembly. Sample parts are under test. A design review will be undertaken when we have a better understanding of the components we need to carry and the adjustments felt necessary.
Consideration will be given to the aerodynamics with an increase in the side area to the rear and continue the present high prop thrust line together with a low CG point.

Electric

Should we go for an electric drive with a duel supply from a petrol driven generator and batteries giving more possibilities as the battery and power packs evolve into the future.
The main advantage is more control giving the opportunity to split the power and explore rear wheel drive-assist on take-off and drive on the road plus drive in the air through the prop as a basic platform to then move on to consider more refinements with reverse prop drive for short landing. This will offer an increase in performance in the landing/take-off stage of flight. A parallel electric system gives an easily defined system and would be a generator driven by the petrol motor and then an electric drive for the prop with one for the rear wheel with the advantage of individual power sources giving backup and ease of control. There is a duplication with this and for the addition of a transmission coupling can be simplified to a motor driven by the petrol engine but placed in the drive line for the prop with a separate motor for the wheel drive. The main motor would be both generator and power boost for the prop and this would save both cost and weight by removing an electric motor but would need a more complicated control system. This option would allow a lighter (30HP) petrol

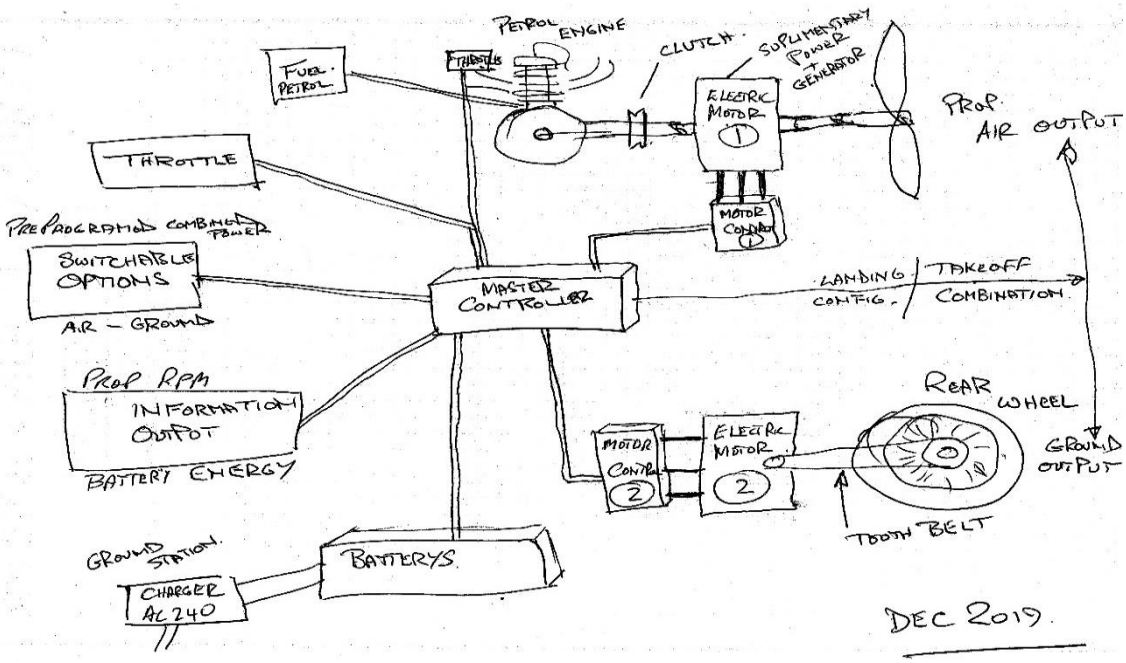
engine with a clutch driving a motor/generator by belt which would then be extended to drive the prop. The way forward will be to develop the system in two stages with the road drive first complete with electronic throttle control before progressing to the full system.

Weight for Electric System

Component list - 'estimate'

Motor one – main generator /prop drive	Emrax 188	7.00	Kg
Motor two – road wheel drive	Geiger HPD20	5.00	Kg
Motor control box *2	emdrive 500 and MC300	6.00	Kg
Batteries and container	2500 W hr	20	Kg
Master Controller		10	Kg
Cables and stuff		5	Kg

total 53-60KG



Throttle (hand /foot) drives prop rotation speed with base power being the petrol engine and then with battery boost for full power.
Electronic control of the petrol engine.
When not supplying short term boost the electric motor generates for battery top up.
Mechanical couplings in the transmission belt drive for control or electric only.
Ground station charger.

Control options

In the air prop drive only
On the ground – rear wheel only
Take-off selectable pre-programmed with the petrol engine plus electrical combined power to the prop and back wheel split proportions with considerations for the surface.
Landing pre-programed all electric to drive/reverse the prop and retard the wheel motor for brake assist and power generation.
Display for prop revs and battery energy.
Service and operational limits temperatures and speed.
Data logger for development and battery management.

General

Legal Requirement of the UK CAA is 300Kg Max Take-off Weight of the complete machine.
Chaser Wing currently being used with the trike is tested to 220Kg.
Present weights below wing (Dec 2019)
Trike Wyvern - as is 90Kg complete as seen in the photos fitted with the 50HP Hurth. The intended frame if found suitable is a carbon /alloy/titanium construction (presently steel) which should deliver measurable weight savings.
Pilot 80Kg Fuel 14Kg
This gives a possible 36Kg payload for electric drive on present wing or a max of 110Kg less wing weight for the legal limit. This higher weight capacity requires a new wing which is likely to be around 50Kg so giving a maximum of 60Kg with the current petrol engine.
Current petrol engine available to drive the generator/prop is 50HP @ 38Kg
Lower powered alternative is 36HP @ 20Kg both max power so continuous power would be somewhat lower to be established by test.
Heavier wing would need the higher power or a combination of smaller motor and battery boost for a limited time (takeoff), the wheel assist should reduce the run by 1/3.

Power Considerations

Dragon Chaser flying the present development wing at present is powered at 36 max HP – 26Kw (Polini engine) to fly with acceptable performance.
The Wyvern's present engine (Hurth flat twin) is 50Hp -37Kw max and about 28Kw continuous (Guess)
Range would be down to the fuel for the petrol engine/generator and 14Kg gives 20 Litres at say 8 ltrs /hour or 2.5 Hours. The present tank holds 26 Litres

Battery capacity of about 5 minutes full power should be ok to give safe operation. Goals are redundancy cover in case of engine failure and boost for take-off allowing a smaller and lighter petrol engine.

We would need to submit to full SVA approval to legally use the road performance in the UK.

This is just a basic '**help'** and **'can we do it'** with a fresh look at this type of machine. We have team strength in the mechanical design and construction and the ability and expertise in the air and ground performance but lack the electronic knowledge so this is to see if there is a way forward with this for us and find some contacts / answers
Thank you for your interest and please feel free to contribute to this project in any way you think useful, we need information or expertise to take it forward. We are looking for involvement on the electrical side in any capacity – any 3D cad input to detail the frame – help with the carbon body/framework. This is being treated as an open source exercise as it is not commercially viable due to present component costs and market size and so if you feel like being involved in this fun project in any way at whatever level or know someone who would hopefully for mutual benefit.
Please get in touch and leave your details.

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