General Approval Application Example:

Quad bikes

IMPORTANT NOTE

This is a fictitious example of a General Approval application. It is intended as a guide only to provide an indication of the level and type of detail required in the RDTI General Approval form.

1. PROJECT DESCRIPTION

1.1.Project Identifier

Dynamic wheels for all-terrain quad bikes.

1.2.Project Objective

This project seeks to develop a dynamic wheel movement and suspension mechanism for all-terrain quad bikes.

The proposed "split and tilt" mechanism will improve safety and efficiency by enabling each wheel to move independently of each other and across three dimensions – i.e. tilting left or right on the vertical axis; moving forwards and backwards on the horizontal axis; and rising up or down on the vertical axis.

Traditionally, quad bikes have static (and rotating) parallel wheels, which means they can be unstable when ridden on a slope. Sometimes the quad bike can tip over, resulting in severe injury or death.

Static, parallel wheels also mean increased drive power is needed for the wheels on the "uphill" side when the bike is ridden on uneven terrain. While the differential on the axles is able to vary the distribution of drive power to the wheels, this system is not optimal in terms of energy efficiency. The new concept will enable the weight of the quad bike as well as its rider and payload to be more evenly and consistently distributed when the bike travels over uneven ground, thus improving stability and enhancing safety.

In addition, there will potentially be reduced engine wear and fuel consumption.

The core challenge for this project will involve taking the initial small-scale proof-of-concept (PoC) and researching, developing and refining the design of the dynamic wheel mechanism, so that it works effectively within a quad bike body and drive system.

2. PROJECT CORE ACTIVITIES

2.1.Core activity

Dynamic split and tilt wheel mechanism.

2.1.1.DESCRIBE YOUR CORE ACTIVITY

The core activity involves working out a way to configure the dynamic split and tilt wheel mechanism. The mechanism will be activated whenever the vehicle travels over non-flat terrain, such as that experienced in hilly paddocks.

This novel approach to a new wheel system design will also work in combination with the balance and attitude of the rider. When the rider shifts their position, (for example, they lean into a turn) the wheel alignment will alter to the most optimal position, similar to how both the wheels of a skateboard change, relative to each axle's centre point.

The ability of each wheel to "split and tilt" independently will help ensure there is even weight distribution across the bike's four wheels at all times, thus assisting its ability to turn or keep on track.

This dynamic wheel action will be complemented by the quad bike's traditional steering and suspension mechanisms, making for a more efficient, controlled and safer ride.

Please refer to the attached diagram *[diagrams can be included]*.

2.1.2. DESCRIBE THE SCIENTIFIC OR TECHNOLOGICAL UNCERTAINTY THAT YOUR CORE ACTIVITY HAD A MATERIAL PURPOSE OF RESOLVING

A small-scale PoC has been created, which demonstrated that the dynamic wheel system appeared to make for a safer and more energy-efficient ride.

However, it is unknown:

☐ how the mechanism can be effectively scaled up for use on a comparatively large and heavy quad bike

how ☐ it will perform after sustained stress-testing.

It is also imperative that the quad bike meets industry safety standards.

The area of particular focus will be the suspension associated with the split and tilt mechanism, which needs to allow for controlled movement across three dimensions; horizontal forward and back split, lateral wheel tilt, and traditional up-and-down suspension.

There will also be challenges ensuring that the quad bike's steering and power drive systems work well in conjunction with the split and tilt mechanism. Adequate control, along with efficient operation, need to be maintained.

[It would be expected that more detail be provided here on how the suspension system actually works in conjunction with the steering and power drive systems, but that information is not included in this example.]

Our team includes a mechanical engineer and an industrial designer with a long history of quad bike use on farms. We have engaged with the Advanced Manufacturing team at Callaghan Innovation who will support us to develop this mechanism, particularly by developing 3D CAD models, then with fabricating and helping us test the second and subsequent prototypes.

After an extensive internet search and a freedom to operate (FTO) search, no similar mechanisms were found. The closest example can be seen in some skateboards, [link to example] where each pair of wheels can tilt independently of each other on the vertical axes. However this system uses compressed rubber, which cannot effectively be scaled for use on a quad bike. It is therefore concluded that the knowledge required to solve the problem does not exist, in the public domain or elsewhere.

2.1.3. DESCRIBE THE SYSTEMATIC APPROACH YOU TOOK CONDUCTING THE CORE ACTIVITY

Conducting the core activity will involve three key steps, or Statement of Works (SoW). These will be overseen by us, although the work will primarily be conducted by Callaghan Innovation's Advanced Manufacturing team. 1. **SoW 1:** Create a clear set of parameters for the PoC that guide the scope of the design in terms of functionality points, materials and performance, and create a 3D printed working model. Prototype 1. 2. **SoW 2:** Develop 3D CAD model for a scale PoC, conduct theoretical efficiency testing and build PoC model. Prototype 2.

3. **SoW 3:** Refine prototype 2 based on the analysis of results of earlier prototypes in preparation for subsequent testing in the field, with the quad bike body and drive system attached. This phase is expected to be extensive as it is unknown how the system will function under varying loads and stresses associated with movement across hilly terrain.

2.1.4. DESCRIBE HOW YOUR CORE ACTIVITY INTENDS TO CREATE EITHER NEW KNOWLEDGE OR NEW OR IMPROVED PROCESSES, SERVICES OR GOODS

The core activity aims to result in the development of a dynamic wheel movement and suspension system that can be incorporated into the design of a new quad bike.

3. PROJECT SUPPORTING ACTIVITIES

3. Supporting activity (1)

Literature review, freedom to operate (FTO) search, and regulation research.

3.1. DESCRIBE YOUR SUPPORTING ACTIVITY

We have conducted an FTO search through our IP lawyer, which revealed that no similar technology exists, besides what we found with the skateboards.

Next, we need to do a thorough literature review and regulation research for relevant standards.

3.2. DESCRIBE HOW THIS SATISFIES THE SUPPORTING ACTIVITY DEFINITION

Research of existing information will be integral to the core activity, as it will:

- ☐ inform whether or not we were potentially breaching existing IP provide
- ☐ guidance in design for compliance, function, material and use.

3. Supporting activity (2)

Monitor and analyse the results of the tests for Prototypes 1 and 2.

3.1. DESCRIBE YOUR SUPPORTING ACTIVITY

Prototype 1 will be tested in the workshop to establish its performance under various loads and over varying terrains. The data gathered here will relate to the forces required to cause the vertical tilt and the changes in horizontal wheel alignment. Predictions will be made as to how this may impact driveability and safety.

Prototype 2 will be tested in the field with a quad bike body and drive mechanism attached. The data gathered here will be compared to the results from prototype 1, which will inform subsequent design refinements. Measurements will take into account ride comfort, ease of control, drive efficiency and failure mode testing.

3.2. DESCRIBE HOW THIS SATISFIES THE SUPPORTING ACTIVITY DEFINITION

Monitoring the test results of Prototype 1 will be integral to the core activity, as it will be important to measure exactly how the system performs before a full-scale prototype is developed.

Monitoring the test results of Prototype 2 will also be integral to the core activity, as it is important to measure exactly how the system may perform in a real life environment.