General Approval application example: Mechanical Device (Boat Cleaning System)

RESEARCH + DEVELOPMENT TAX INCENTIVE

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.

For information about R&D activities that are eligible for the RDTI, and the RDTI application process, refer to the **RDTI Hub** and the *Research and Development Tax Incentive: Guidance* **IR1240**.

1. PROJECT DESCRIPTION

1.1. Project Identifier

R&D for an autonomous underwater cleaning system for boats.

1.2. Project Objective

Cleaning the hulls of boats is an integral part of their maintenance programme, as many varieties of marine species can cover them over time, including barnacles, slime and fan worms. The growth of these organisms can increase the drag, causing the vessel to slow down and use more fuel, as well as damaging the hull's surface. Marine growth can also restrict the movement of boats, preventing them from entering regions that have strict biosecurity controls.

The traditional method of cleaning boat hulls involves manual labour, which is expensive. The boat is either moored or dry docked. Cleaning a moored boat carries inherent Health & Safety risks, while the process of dry- docking a boat is generally very costly.

Our solution was to create a new product that consisted of an automated and autonomous hull-washing device that is both highly effective at cleaning advanced marine growth, and is low risk and low cost when compared to existing manually-focused methods.

The core challenge for this project involved researching and developing the suction-based adhesion system, and then researching and developing and testing the related individual components and the full prototypes.

2. PROJECT'S CORE R&D ACTIVITIES

2.1. Core R&D Activity

Develop the suction-based adhesive system.

2.1.1. Describe your Core R&D Activity

A reliable suction-based adhesion system needed to be created to ensure that the unit remained in close contact with the hull, while enabling effective cleaning and maneuverability.

2.1.2. Describe the Scientific or Technological Uncertainty that your Core Activity has a Material Purpose of Resolving

The technological uncertainty was centred around the suction-based adhesive system, which needed to work on rough surfaces and accommodate the opposing forces of the cleaning system (which pushes away from the hull) and the maneuverability system (which pushes along the hull) while still enabling effective removal of advanced marine growth.

Our experienced team of electrical and mechanical engineers were initially unsure if and how this problem could be solved. Various suction mechanism technologies existed *[hyperlink to example for Company X]* however they could not operate underwater, or if they did (such as an underwater camera-based inspection system) the systems did not have to accommodate the opposing force from a cleaning mechanism. Therefore, we needed to carefully consider and plan our approach to solving this core problem.

The knowledge required to solve the problem did not exist in the public domain. Companies that had created autonomous vehicles that inspected the hulls of boats (and other underwater structures) that had mastered both adhesion and maneuverability, had strong IP protection in place, which prevented us from adopting similar technology. Company X was approached regarding the potential supply of componentry or licensing of their adhesion system, however they declined to enter into any sort of commercial agreement. Please see email evidence in Appendix A.

2.1.3. Describe the Systematic Approach you took to Conducting the Core Activity

We followed a predetermined product development programme, in collaboration with our team of engineering experts. This approach (as illustrated in a Project Gantt Chart) provided us with the best chance of achieving the desired outcomes for the technical challenges. Comprehensive records have been kept.

The approach involved:

1. **Concept Design** 11/01/20 – 05/05/20, which involved the development and prototyping of suction componentry, along with failure mode analysis.
2. **Create Prototype 1** 05/05/21 – 18/06/20, which involved overseeing the manufacturing and building of the prototype.
3. **Evaluate Prototype 1** 18/06/20 – 06/07/20, which involved testing of the prototype, including gathering data relating to the suction forces.

4. **Detail Design** 06/07/20 – 08/10/20, which involved breaking down each of the technical challenges into individual components, further failure mode analysis and the improvement and further development of the existing concepts.
5. **Create Prototype 2** 08/10/20 – 11/11/20, which involved a similar process to Prototype 1.
6. **Evaluate Prototype 2** 11/11/20 – 17/12/20, the final step was to test Prototype 2, including assessing how suction forces were impacted in situ in relation to the cleaning performance.

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 contributed significantly to the development of a device that we have proven to be effective at cleaning docked boats that have heavy marine growth coverage. We now intend to manufacture and distribute this new device to the local and international boating community. The key benefits for this community will be the ability to have their boats cleaned more effectively and cost effectively.

3. PROJECT'S SUPPORTING ACTIVITIES

3.1. Supporting Activity (1)

Developed the chassis and body.

3.1.1. Describe your Supporting Activity

We needed to develop a chassis and body that provided the framework for mounting and protection of all working components of the unit, including the critical suction-based adhesive and propulsion system (core activity), the washing mechanism, and the electrical control systems. Additionally, the body needed to withstand the hostile environmental elements experienced in the sea. The chassis and body also needed to be engineered to be of high strength, corrosion-proof and a low profile design.

3.1.2. Describe how this satisfies the Supporting Activity definition

Developing the chassis and body was integral to the core activity, as without the body and chassis the suction mechanism would not be able to be mounted or propelled. The body and chassis was developed and iterated concurrently with the suction mechanism.

3.2. Supporting activity (2)

Develop the mobility system.

3.2.1. Describe your Supporting Activity

The mobility system involved development of electromechanical devices and active robotic functions that provided vertical and horizontal mobility over obstacles, while ensuring adequate suction was maintained. This system involved a drive system with variable speed and forward/reverse functions which was challenging as it required designing it from scratch to meet the necessary requirements such as weight, duty, output speed and torque.

3.2.1. Describe how this satisfies the Supporting Activity definition

Developing the mobility system was integral to the core activity, as it was important to take into account how to ensure the system was adequately maneuverable while ensuring suction was maintained.

3.3. Supporting activity (3)

Develop the cleaning system.

3.3.1. Describe your Supporting Activity

Development of the cleaning system involved creation of a cleaning element; a system to clean into internal corners which no existing machine possesses. An electronically controlled fluids system was challenging because it required testing for spray pressure, nozzle arrangement and cleaning additives, to determine the most effective cleaning.

3.3.2. Describe how this satisfies the Supporting Activity definition

Developing the cleaning system was integral to the core activity, as it was important to take into account how the physical forces and fluids generated from the cleaning system impacted the suction and propulsion mechanisms.

3.4. Supporting activity (4)

Develop the central control system and the controls.

3.4.1. Describe your Supporting Activity

The central control system required development of software that allowed both manual function and automatic functions. The software needed to provide automation based on circumstance to minimise power consumption. It also needed to provide automation to increase safety, for example a setting that is activated during turbulent conditions, remote operation of the unit, video feed to operator, remote control design and failsafe systems.

3.4.2. Describe how this satisfies the Supporting Activity definition

Developing the cleaning system was integral to the core activity, as it provided direct control, monitoring, adjustment of settings, and feedback to the operator onshore. Without these systems being developed concurrently it would have been extremely difficult to assess the performance of the suction and power drive systems.

3.5. Supporting activity (5)

Planning for the prototype manufacturing.

3.5.1. Describe your Supporting Activity

This activity involved the Design for Manufacture (DFM) prior to Prototypes 1 and 2. This activity involved a comprehensive literature review relating to various manufacturing techniques, along with discussions with a range of potential manufacturers to better understand the capabilities and limitations of their processes. Following this, detailed manufacturing plans were established.

3.5.2. Describe how this satisfies the Supporting Activity definition

Planning for prototype manufacturing had the main purpose of supporting the development of the prototypes, which were core activities. Planning was a necessary and integral step as without it, the prototypes could have been manufactured in a sub-optimal way, meaning the prototypes would have been less successful.

3.6. Supporting activity (6)

Monitoring tests and analysing data.

3.6.1. Describe your Supporting Activity

This activity involved the evaluation and review of the in-situ performance of Prototypes 1 and 2. It involved evaluation of the unit's controls, observation of how the unit navigated around the boat's hull, and accurate data collection regarding the cleanliness of the hull. The resulting data was analysed using a combination of qualitative and quantitative methods, and the results informed subsequent improvements to the unit.

3.6.2. Describe how this satisfies the Supporting Activity definition

Monitoring and testing data had the main purpose of informing improvements to the design and the manufacture of the prototypes. Without the resulting findings, the design of the unit could not be optimised.