Technical Report – Cover Page

BIRD Ref. No.: 1472

To: The Israel – United States Binational Industrial Research and Development Foundation

Project Title: Pedaling Towards Zero Emissions: An Energy-Efficient, Low Maintenance, High Performance Cycle

Submitted By:

Israeli Company: Softwheel Ltd.

U.S. Company: Detroit Bikes LLC

Type of Report: Interim, Final: Interim

Project Start Date: _____

Dates of Reporting Segment Covered: from July 1, 2019 to December 31, 2019

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2. Objectives

SoftWheel's (which will be referred to as SW interchangeably) adaptive suspension technology will be integrated into Detroit Bikes's (Which will be shortened to DB for convenience purposes) uniquely-designed bikes, built with durable frames and a user-friendly variable ratio electric drivetrain. The result will be a powerful e-bike that is more reliable, agile, comfortable and energy-efficient than other bikes available on the market for fleets of first responders and fleets of cargo and last-mile delivery. These bicycles will solve the two major problems of products in this market: high maintenance costs and a sub-optimal riding experience.

3. Summary of Accomplishments

During the past segment we had several accomplishments.

As updated in the previous period, we focused our activities on the growing market segments of specialty e-bikes in 2 platforms:

- **Platform 1- First Responder E-bike**
- **Platform 2- Three Wheel Cargo E-bike**

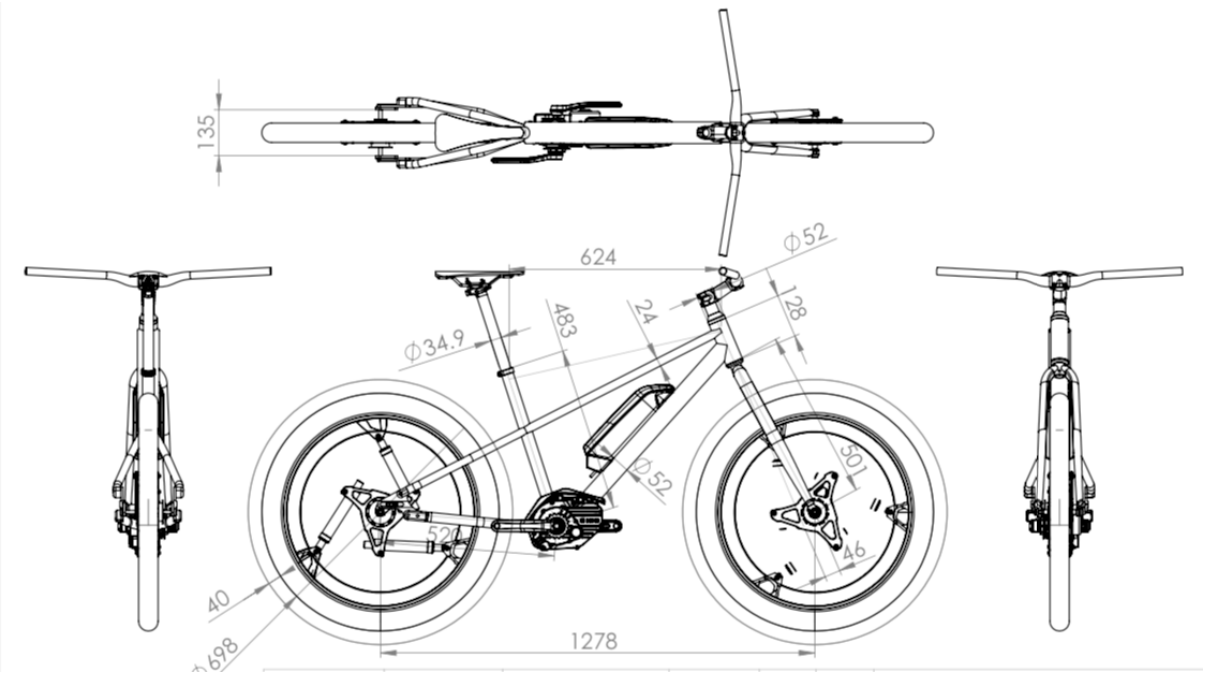
Significant Progress was made during the covered period in the design and prototype development of the bike platforms.

Platform 1- First Responder E-bike

we completed the project including pre-production and production of an entire frame with the wheels. The outcome of the testing were very positive and we have started initiating business development activities with potential customers. To name a few: Michigan State police, Bikes for All People, Bulls Bikes (LAPD, ARI Fleet, Bolt Bikes.

The product is quiet and fast and enables required performance and riding experience while being durable and robust. As the bikes cater to fleets, the testing focused on enabling the widest range of riders to comfortably fit the unit. Additional information can be found below.

The FRB has been designed in three size options. The first option as shown in photos and attached drawing is for departments wishing to have a one size fits all approach. With an increasing number of departments utilizing both male and female patrol officers the bicycle must accommodate riders in a height range of 62-80 inches (157-203 cm) and each must be able to mount and dismount the bike quickly. This is why the frame of the bike has a dramatically sloping top tube, accommodating riders with shorter legs. For the shortest riders, the bike would be supplied with a seatpost (the component that holds the saddle) that positions the saddle farther forward to reduce the reach to further the comfort for all day patrol.



For larger departments two additional size options are available, one for average to tall riders and another for shorter riders.

The rear rack system has been designed to be robust, strong enough to accommodate a passenger along with saddlebags and necessary gear. The clearance above the tire (to the underside of the rack) is to accommodate the movement of the *Softwheel* suspension system as well as mudguards if desired.

Platform 2- Three Wheel Cargo E-bike

We conducted market research and business development initiatives to guide the concept design of the cargo bike. The production is constructed from high strength 7000 series aluminum alloys with steel being utilized only in the highest wear areas to keep weight to a minimum, while cargo capacity will be set at approximately 250 Kg. Over-all design assumes a one-size fits all configuration both for the frame and the wheels. SoftWheel configuration was done to adhere the heightened demands of delivery tricycles.
The testing of the final product was done separately on the frame and wheels – in the US and in Israel and the complete mounting will be done once adapted to the customer's needs.

During the testing phase, the trike proved to be easily capable of handling more than 400 lbs in addition to the rider and vehicle curb weight VCW). The structure would indeed be adequate to carry more than 600 lbs (plus rider and VCW) with increasing the size of the electric motor, lowering the gear ratios and adding additional battery capacity.

As the acceptance by the service business sector of the smaller, more efficient and nimble electric-assist vehicles continues to escalate, we can readily envision a range of modular options to accommodate the varied needs of these businesses. The in-wheel suspension technology extends the viability of this option by improving the handling and safety of the vehicle while protecting the cargo from damage.

The cargo area is extraordinarily strong and highly adaptable to a multitude of cargo options. The low center of gravity improves handling, safety and makes it easy to transfer lighter, portable shipment bins (such as utilized by Amazon/Whole Foods).

4. Results

Task 7. Pre-Production (FR Electric)

- Production of the entire solution**:**

Task 8. Production of the first bike sets (FR Electric)

This task includes the following activities:

- Wheel manufacture
- Bike manufacturing
- Integration

The performance of the outcome was very positive and beyond expectations in terms of performance, NVH and durability.

9. Field test of the full product (FR Electric)

- Wheel manufacture:

SW has established a foundation for specialized bicycle wheel manufacturing using several vendors, enabling various scales of volumes in accordance with demand.

a) The goal of the field test of FR Electric assist prototype was to provide validation to the concept that the combination of in-wheel suspension and the higher sustainable speeds that the electric assist “speed” motor enables, would make for a compelling option for police and EMT deployments.

b) The field tests were, as expected from the preliminary tests, very positive and beyond expectation in the following aspects:

   - Ride was improved enabling higher speeds and greater comfort
   - Noise was suppressed after some fine tuning

10. Concept design (electric cargo)

Moving from bike sharing to trikes means a complete redesign of the frame yet a moderate adaptation of current SoftWheel technology due to the different product usage. A trike must excel in its robustness and cargo carrying capacity and challenges SW's product since weight changes are a factor to be considered. Another facet of the design is the merging of rider and cargo area, which must both work seamlessly.

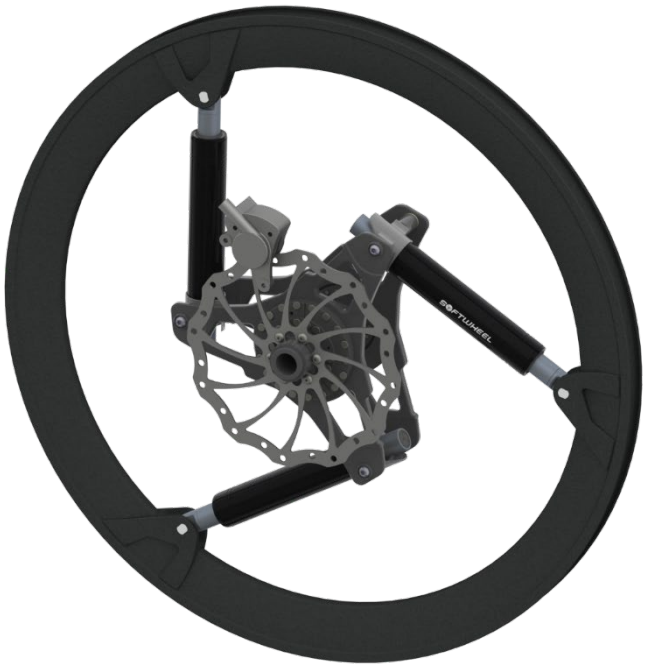
This task was successfully completed for the new product segment. We learned from the FR Electric product and made the necessary technical adjustments to align with the needs of cargo bike by the market.

Cargo bikes need to be more robust to support the load of the cargo and the suspension of the wheels needs to be adapted to allow a range of weight – when the bike is loaded and when it drives empty.

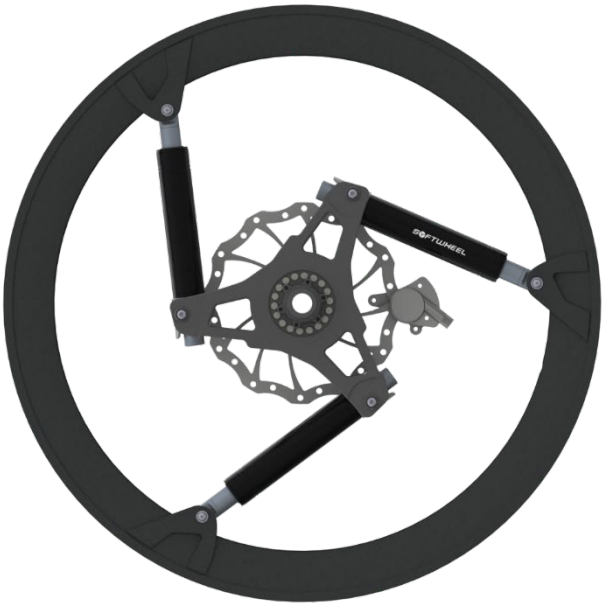
We completed the concept design accordingly.

11.Design (Cargo Electric)

With the move to a mid-mount motor and to a 3-wheel chassis Added torque and weight has to be handled by the wheels and brakes. This necessitates heavy duty components meant for hard use and substantial loads. Off the shelf items as well as make items have to be procured and designed accordingly. DB created 2D drawings and 3D models, incorporating an electric drivetrain into the bike frame, choose off the shelf items. SW developed heavy duty wheels and mechanisms.

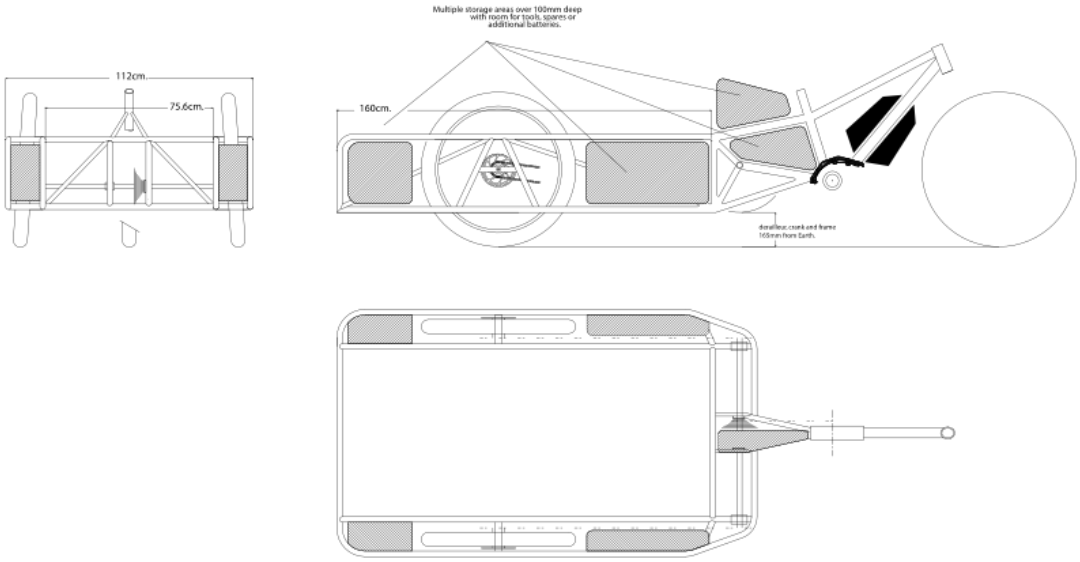



SOFTWHEEL


SOFTWHEEL

Carry-all trike concept.

Cranks, chains and chains omitted for clarity. Cross bracing deleted from top view as dependent on configuration. Configured for 500% gear spread with long cage derailleur though not required. 27.5" wheels with dual rear disc brakes. Slowest turning wheel is driven in turns just like automobiles. Unique drivetrain allows lowest center of gravity.

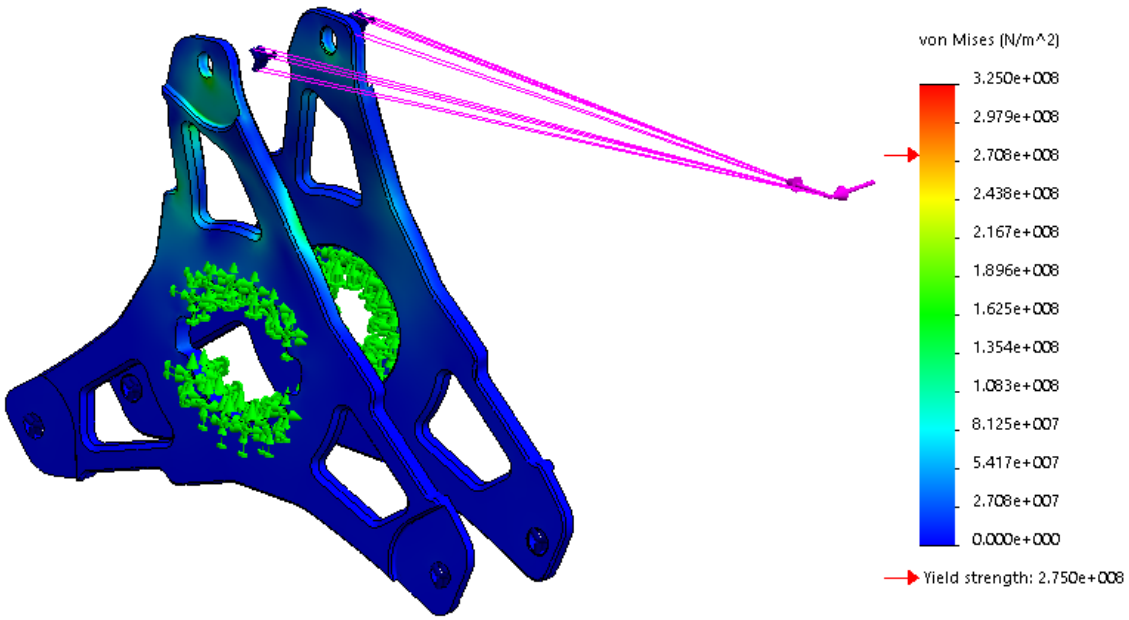


12.Prototype (Cargo Electric)

We completed the integration of the cargo electric. This included two main parts:

a) Integration of parts fabricated

b) Preliminary riding tests to check load bearing, rideability, etc.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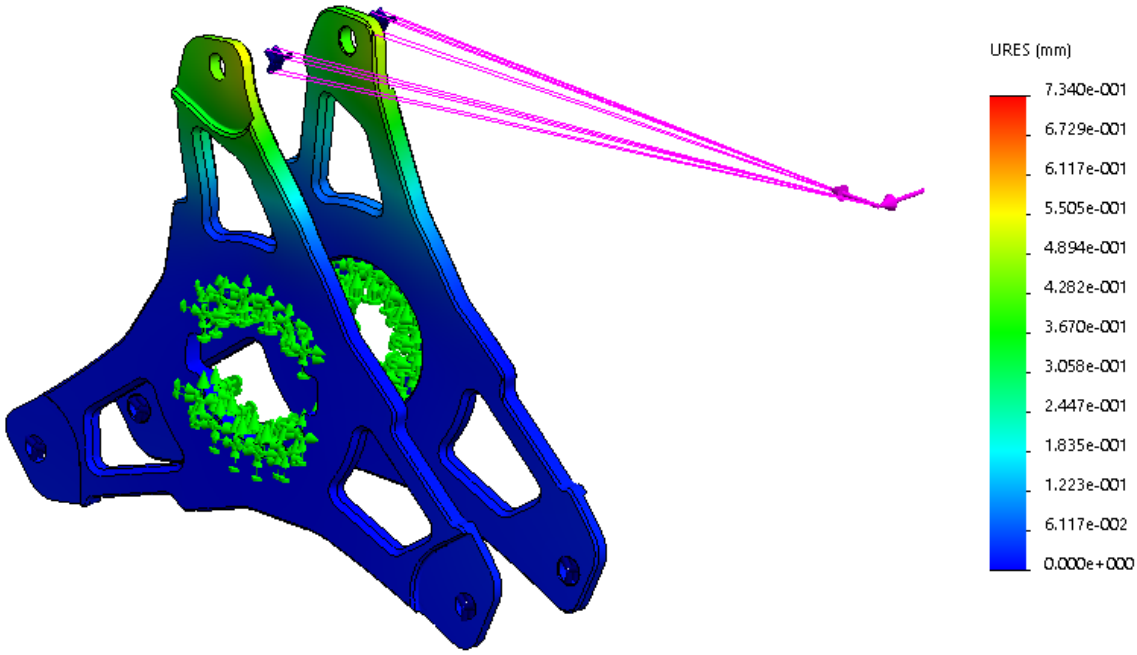
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0.000e+000

13. Quality assurance and testing (Cargo Electric)

We completed the quality assurance and testing of the cargo electric.

This task included the following activities:

a) Validation of wheel compliance to ISO 4210 – 7:2014

b) Drop testing

c) Drum fatigue testing

d) Riding trials to determine range and performance

14. Pre-production of first bikes sets (Cargo Electric)

The pre -production of the frame and the wheels were completed by each of the parties at their specific factories: the wheels were manufactured, and the Bikes were manufactured. The integration of the two was not yet concluded and we expect to present it to a coming interested customer.

15. Production of first bike sets (Cargo Electric)

as for the pre-production, each party completed their tasks and we moved to the production of the frame and the wheels.

16.Field tests of full product (Cargo Electric)

We did not complete this task due to lack of time. We did not estimate the project length in a timely manner, efficiently enough.

17. Business Development

DB has started the business development activities with potential customers. Softwheel attended 2 industry events to estimate the interest level of the product and conducted a meeting with Streetscooter (DHL) in Germany.

Customers are evaluating our cargo electric bike solution. Yet, the competition is fierce and pricing in of great concern for the customers. Given the solid frame and robust wheels, the pricing is not so competitive and the value proposition to customers is to present their savings in downtime of the cargo bike when using the DB/SW solution versus any other solution that does not have such solid frame and suspended wheels. In addition, the value proposition shows an improvement for the rider which is most significant in countries where the union is active.

5. End of Project outcome

We conclude the project is a very positive manner.

6. Graphical Comparison of Actual/Planned Activities Versus Program Plan

	Task	Due Date		Completed
		SoftWheel	Detroit Bikes	
1	**Technical mapping**	Feb 11 2018	Feb 11 2018	Feb 15 2018
2	**Concept design (FR Electric)**	April 20 2018	April 20 2018	April 15 2018
3	**Design and test protocols (FR Electric)**	March 30 2019	March 30 2019	March 30, 2019
4	**Mockup (FR Electric)**	April 30 2019	April 30 2019	April 30, 2019
5	**Prototype (FR Electric)**	June 1 2019	June 1 2019	V1 – April 30, 2019 V2 w/SW July 15, 2019
6	Quality Assurance and Testing (**FR Electric)**	June 30 2019	June 30 2019	August 15, 2019

7	Pre-production of first 6 bike sets (**FR Electric**)	Aug 1 2019	Aug 1 2019	October 15, 2019
8	Production of first 6 bike sets (**FR Electric**)	Sep 1 2019	Sep 1 2019	October 1, 2019
9	Field tests of full product (**FR Electric**)	Oct 30 2019	Oct 30 2019	On target
10	Concept design **(Cargo Electric)**	April 1 2019	April 1 2019	June 1, 2019
11	Design and test protocols **(Cargo Electric)**	April 21 2019	April 21 2019	June 15, 2019
12	Prototype (**Cargo Electric**) Prototype of the wheels and the frame separately	May 15 2019	May 15 2019	August 31, 2019
13	Quality assurance and testing (**Cargo Electric**) Quality Assurance of the wheels and the frame separately	June 30 2019	June 30 2019	September 15, 2019
14	Pre-production of first 6 bikes sets (**Cargo Electric**) Did not complete	Aug 15 2019	Aug 15 2019	November 15, 2019
15	Production of first 6 bike sets (**Cargo Electric**) Did not complete	Sep 15 2019	Sep 15 2019	December 15, 2019
16	Field tests of full product (**Cargo Electric**)	Oct 31 2019	Oct 31 2019	**Partial completion**
17	**Business Development**	Oct 31 2019	Oct 31 2019	10%

7. Cooperation Between the companies

We conducted conference calls regularly to discuss the progress of the developments on both sides. After receiving specs and interfaces from DB, SoftWheel was able to specially design wheels for the FR bike, incorporating lessons learned from past versions of its in-wheel suspension solutions. Those wheels were preliminary tested on SoftWheel's test rigs

and after passing the tests were sent to DB for further testing and feedback so the design could be further refined if need be.

The cooperation between the parties became closer once each side had to manufacture his parts and cooperate with the other party to finetune the total solution.

Task distribution:

	Task	Objective	Done by:
1	**Technical mapping**	Market Research	Both
2	**Concept design (FR Electric)**	Wheel/Suspension Concepts Bicycle Concepts	SW DB
3	**Design and test protocols (FR Electric)**	Wheel/Suspension Design Bicycle Design	SW DB
4	**Mockup (FR Electric)**	Wheel/Suspension Mockup Bicycle Mockups	SW DB
5	**Prototype (FR Electric)**	Wheel/Suspension Prototype Bicycle Prototypes	SW DB
6	Quality Assurance and Testing (**FR Electric)**		SW (Wheels) DB (Bicycles)
7	Pre-production of first 6 bike sets (**FR Electric**)		DB
8	Production of first 6 bike sets (**FR Electric**)		DB
9	Field tests of full product (**FR Electric**)		DB
10	**Concept design (Cargo Electric)**	Wheel/Suspension Concepts Bicycle Concepts	SW DB

11	**Design and test protocols (Cargo Electric)**	Wheel/Suspension Concepts Bicycle Concepts	SW DB
12	Prototype (**Cargo Electric**)		DB
13	Quality assurance and testing (**Cargo Electric**)		DB
14	Pre-production of first 6 bikes sets (**Cargo Electric**)		DB
15	Production of first 6 bike sets (**Cargo Electric**)		DB
16	Field tests of full product (**Cargo Electric**)		DB
17	**Business Development**	Market research and industry events (Eurobike) primary police bike tested the bikes concept	SW DB

8. Risk analysis

TABLE 1A

			Impact		
Risk #	Name/Description	Ranking	Duration[1]	Budget[2]	Commercialization Potential[3]
1	Prototype failure	Medium	Medium	Medium	Low
2	High Production costs	High	High	Medium	Medium
3	Market penetration difficulties	Medium	Medium	Low	Medium
4	Policies	Low	High	Low	Medium

5	Competition on IP	Low	Medium	Low	Medium

TABLE 1B

Risk #	Description	Type*
1	Bike together with in-wheel suspension prototype failure	T
2	High Production costs	T
3	Market penetration difficulties	M
4	Policies affecting bike market	E
5	Competition on IP	E

*Type: Technical (T), Project Management/Resources (M), External to the Project (E) Risk Analysis Tables Original Submission

TABLE 2A

			Impact		
Risk #	Name/Description	Ranking	Duration[1]	Budget[2]	Commercialization Potential[3]
1	Prototype failure	Medium	Medium	Medium	Medium
2	High Production costs	High	High	Medium	Medium
3	Market penetration difficulties	Medium	Medium	Low	Medium
4	Policies	Low	High	Low	Medium
5	Competition on IP	Low	Medium	Low	Medium

TABLE 2B

Risk #	Description	Type*
1	Bike together with in-wheel suspension prototype failure	T

2	High Production costs	T
3	Market penetration difficulties	M
4	Policies affecting bike market	E
5	Competition on IP	E

Impact	**Duration[1]**
High	Above 6 months
Medium	3 to 6 months
Low	Below 3 months

Ranking	**Probability of Risk Occurring**
High	Above 50%
Medium	30 – 49%
Low	10 – 29%
Very Low	1 – 10%

Impact	**Commercialization Potential[3]**
High	Above 50%
Medium	30% to 50%
Low	1% to 29%

Impact	**Budget[2]**
High	Above 20% increase
Medium	10% to 20% increase

Low	Below 10% increase

1. Duration of project extended by the given amount
2. Cost of project increases by the given percentage

Forecasted sales in the next 3 or 5 years reduced by the given percentage

9. Market and commercialization plans

There have been no changes to the plan since last reporting period.

10. Published material

There were no publications released.