

Hwa Chong Institution

Project Work

Category 3 Invention Log Book

Title of Project: Inflatable life-jacket for motorcyclists

Group Name:

Group Members:

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1) Problem Finding (The beginning...)

We looked around and thought of how certain things could be improved

Identify a problem you would like to solve with your intended invention. You may want to brainstorm for problems using different approaches e.g.s thematic, survey or general brainstorming etc.

1A) Document a list of problems you have identified. Your documentation should show clearly how your group came up with the problems.

1. Bubble wrap is environmentally-unfriendly.

Solution: Changing bubble wrap in shipping packages to silicone foam.

2. Knives are not child-friendly and sharpening a blade is not safe.

Solution: Making a heatable knife with a special cover that can sharpen the blade.

3. A lot of motorcyclists get injured when they are thrown off their bike during motorcyclists accidents.

Solution: Make an inflatable jacket for motorcyclists to break their fall

1B) You should have selected a problem based on some considerations. Identify and justify these consideration.

1. *Silicone foam*

- Silicone is flexible and rubbery, can be made into balls to replace styrofoam nuggets
- Styrofoam is not eco-friendly and takes a long time to decompose, while silicone does not hence silicone is more ideal

2. *Heatable knife*

- Cold ice cream cakes are hard to cut, so we planned to make a knife with a cover that has an in-built sharpener, and a heater (detachable)
- Heater can also be used to sterilise the knife (if needed outdoors)

3. *Inflatable motorcycle vest*

- A lot of accidents involving motorcyclists. One members grandfather was severely injured during a motorcycle accident while another member's father was a doctor who witnessed a lot of motorcycle injuries
- Wanted to make an inflatable jacket to cushion the motorcyclists' falls as the usual mechanism of injury for motorcyclists are when a car hits them and they

get flung off. Landing on the ground later injures them severely as their body absorbs the impact.

1C) Problem evaluation graph (4 stands for ideal, 1 stands for problematic/ineffective)

<u>Considerations for selection</u>	<i>Heatable knife</i>	<i>Silicone foam</i>	<i>Inflatable jacket</i>
Feasibility	2 (Hard to make something out of metal as you will need special materials)	3 (Need to buy silica sealant to craft balls and must model some wrap)	3 (Need to buy Co2 canisters and make a jacket)
Amount of improvement to people when rendered	2 (Only used for cutting cakes and maybe outdoors camping)	2.5 (Useful but too expensive)	4 (Very helpful as many motorcyclists suffer from injuries after they land on the ground after being thrown in the air)
Safety when building invention	2 (Might accidentally poke yourself, flame is not very safe either)	4 (Nothing can happen unless you eat the silica sealant)	3 (Small chance of jacket exploding but probably will not happen as the gases used are carbon dioxide and nitrogen which are less reactive)

Result: We chose the **inflatable jacket** as we felt it would be the most useful in everyday situations and potentially life-saving although it may appear as boombastic to some people.

2) Define the Problem:

Many motorcyclists get injured or killed a year which causes a lot of lives to be lost. It also has a bad impact on hospitals and relatives of the injured motorcyclists. Thorough explanation below.

2A) Extent of problem (Research and discuss the problem and write down the problem statement. Include in-text citation where appropriate.)

Deaths Statistics:

About 1 motorcyclist loses his life every week in Singapore, making up close to 40% of all traffic fatalities in 2017. This equvalates to 60+ deaths through motorcycle injuries in one year alone. From January to June in 2016, there were 32 fatal accidents involving motorcyclists.

In the same period in 2017, there were 24 fatal accidents. However, motorcyclists are still an extremely vulnerable group. (Cit. *The Straits Times* 2017)

Injuries Statistics:

In the first half of 2017, 56% (2165) of overall traffic accidents involved motorcyclists. Out of the 2165, 24 died and 2142 were injured. That's a staggering injury rate of 1 motorcyclists per hour!

In the first half of 2016, there were 24 fatal accidents involving motorcyclists and 2171 non fatal accidents involving motorcyclists.

In fact, the accidents have far-reaching consequences and affect many of the relatives of the injured motorcyclists. (Cit. The Straits Time 2017 and Channel NewsAsia 2016)

Impact on others: (E.g. relatives and hospitals)

Many of these motorcyclists who get injured are Malaysians who come to Singapore to work. After they get injured, they are unable to sustain their family so their whole family suffers, in fact a lot of their savings may be used for the hospital treatment. Many motorcyclists injure their upper bodies and therefore are unable to work after the accidents. As such, the whole family suffers.

For Singaporeans, the government will graciously help them, however the government will definitely lose some money and accidents definitely damage the people emotionally too. For Malaysians however, the story is much more complicated. When Malaysians get injured while working in Singapore (E.g. for delivery companies), they are rushed to Singapore hospitals and therefore are treated in Singapore. Motorcycle injuries are usually severe so the hospital fees are usually exceeding \$5000 and some go well over the 5-digit mark even up to \$50000 and over. However, as the motorcyclists are not very well to do already, who then pays for the motorcyclists bills? The answer, sad as it is, is Singapore's government again. The Malaysian government does not need to pay as the person was injured in a foreign country. This is a bad debt for Singapore and causes Singapore's hospitals to lose a lot of money which they need as they are a non-profit organisation.

2B) Compare and contrast existing or similar solutions with your invention. Include in-text citation where appropriate.

Currently, there is only one brand which is authorised to sell products similar to that of ours and it called Helite. It has been tested and does reduce impact by up to 70%, however it is rarely used. The major flaw which makes Helite's products so inaccessible is their extremely costly price.

While our product costs about \$40 to build, Helite sells their products at about \$900-\$1200! Here is our logic: A motorcycle costs about \$2000 if bought from Malaysia. Most people buy motorcycles as they cannot afford cars. If a Helite jacket costs half the price of the motorcycle, one is highly unlikely to buy the jacket as buying the motorcycle alone is hard enough. Therefore, the huge majority who do not have enough money are unable to afford the jacket and cannot have access to this potentially life-saving device. Our device is as effective and is only \$50, making it effective and affordable.

So exactly how did we make the jacket cheaper?

Firstly, our target audience are motorcyclists while Helite's target audience are rich motorcyclists. Therefore, our products prices are drastically reduced to cater their needs. We do not increase the prices as we are not out to make money but to help community. Secondly, we find cheap but effective items. For example, Helite uses crocodile skin leather to make their jackets however we use cheap but effective materials like plastic. Thirdly, Helite's jacket infrastructure is different from our jacket's infrastructure as we will explain below.

What is the difference in the structure of the jackets?

Firstly, while Helite directly inflates the jacket with Co2 canisters, we inflate the jacket by inflating a float inside the jacket (an invention within an invention). Helite uses several small Co2 canisters while we use two Co2 canister and one big nitrogen canister. Therefore, our product can be cheaper as we reduce the number of canisters needed. Furthermore, nitrogen is thousands of times more abundant than nitrogen and

therefore is cheaper. Therefore a nitrogen canister is much cheaper than a carbon dioxide canister.

Helite inflates the whole jacket while we only inflate select parts using floats. This severely reduces the amount of gas needed to inflate the jacket as a whole, therefore drastically reducing our jacket's cost price.

Helite uses fancy skins and furs while we use the basic, plastic. Both of them are waterproof, have extremely small pores making it very hard for air to escape. Therefore, both plastic and leather have the same effect

Considering the changes, is our product still as effective?

Although our product is much cheaper, we believe it is just as effective.

Firstly, nitrogen and carbon dioxide canisters are pretty much the same. Both gases are equally unreactive to other chemicals, making them very safe to work with. In fact, they are very similar in their physical and chemical properties although they have different uses.

Secondly, having floats within the jacket is as good as inflating the whole jacket as in motorcycle accidents, only the vital organs really need to be protected and our jacket protects all of them (spine, heart, lungs, ribs).

In conclusion, our product is as good as Helite's while maintaining a low cost price of \$50, 20 times cheaper than Helite's, making it much more available.

3) Your BIG IDEA (Developing the idea....)

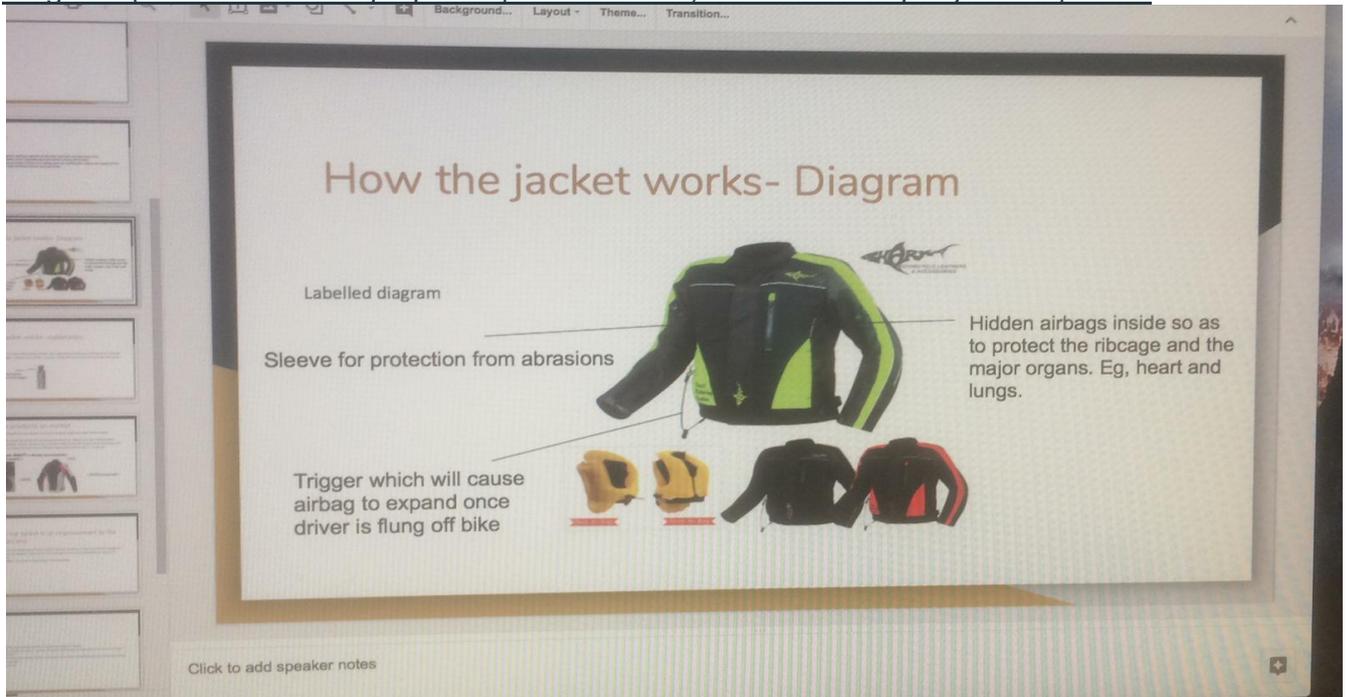
Therefore, we propose making a special motorcycle vest that can help save lives. It is an inflatable jacket which expands when the driver is flung off his bike. Therefore, it becomes similar to that of an airbag and can significantly reduce the impact of the collision. This will help minimise injuries and save lives. Instead of the rib cage of a motorcyclists absorbing the impact, our air-bag will absorb it.

3A) Describe your proposed invention.

How it works:

Inside the jacket are many carbon dioxide and nitrogen canisters (gas under pressure) within floats. Therefore, when the driver is flung off the bike, the trigger is released so the canister is opened. The floats will be inflated, absorbing the impact of the fall. The gas will rush out and few the floats within about half a second.

Diagram: (Below is how our proposed jacket will look) Cit. Shark company textile jackets



3B) Explain the purpose of your proposed invention and its potential benefits to users.

The usual mechanism of injury for motorcyclist are as follows. The motorcyclists crashes into/another vehicle crashes into the motorcyclists causing the motorcyclist to be thrown off the bike and flung into the air. This will cause a heavy impact and therefore severely injures the motorcyclist. Our invention helps to cushion the motorcyclist from the impact and helps to reduce injuries. The main purpose of our invention is to save lives by allowing their fall to be soft. For the users, our proposed invention will protect them from severe injuries during accidents.

3C) In what ways would your proposed invention be different and/or better than existing solutions, if any?

Currently there aren't any other existing products similar to ours other than Helite (as clearly explained above) however that product is much more expensive than ours as the materials they use are much more expensive for those who can afford while our jacket aims to be cheaper to be affordable for all.

How is our invention better?

Firstly, our invention is more suited for those who have a lower income. It is not made to look fancy but rather is safe and practical. It is 20 times cheaper.

Secondly, our invention provides more protection for the spine. It has one specified protection for the spine so as to reduce the impact on the spine. However, Helite specifies more on protecting the front part of the upper body, making our product better for the back.

Lastly, our product is lighter as it contains less canisters. Instead, of several small canisters, we have one big canister, reducing the weight.

3D) What are some problems you expect in the course of constructing/designing your proposed invention?

For the inflatable life-jacket, there will be two layers of material that holds the Co2 canisters and the rest of the mechanisms of the jacket. The Co2 canisters are quite big and would need to place in a position where it wouldn't affect the user. We might also have problems attaching the wire/string to the pin which will be pulled off to allow the Co2 to escape from the canister.

3E) What are the major milestones (project timeline) in your invention process?

Sourcing of materials---Buying of materials---Planning of building structure---Building of 1st prototype---Test it out---Building of 2nd prototype---Test it out

4. Construction Process

(This first... then that...).

Firstly, we measured the exact length required for the jacket.

Next, we cut out the shape and sizes for the jacket.

Thirdly, we sewed the layers together to make the jacket.

Next, we put the floats into the jacket.

After that, we put the canisters into the floats.

4 A Explain how and why the materials were chosen for the prototype/ product of your invention.

We used plastic as the jacket as it was the cheapest material yet tough and durable and it was easily found in many ponchos to set a foundation of the jacket.

We used the carbon dioxide and nitrogen canisters as they are not reactive to other gases chemically.

4 B Explore the different considerations that may guide the construction of your prototype/product.

We had to consider the measurements of the wearer for the jacket to be comfortable and fit the person and to carry out its function.

If we were to add the floats and the canisters how much bigger does one layer have to be to store them.

Approximately how long do I have to cut extra to fit every object into the jacket.

How should I start to sew the jacket?

4 C Document the development stages of your invention. You may use drawings, photographs or videos (insert a link of the video / animation).

Time lapse:https://drive.google.com/open?id=1RH_CC3fthDKTCsh_ZeUr3uYN0HyqDLZJ



5. Modification and Evaluation

Problems with mid-term evaluation prototype:

1. It inflates in about 5 seconds, too slow to protect the driver.
2. It's bulky as there are too many floats.
3. It's not strong enough to withstand the force of the victim when he falls of the motorcycle.
4. It's not very convenient to use as the trigger requires a lot of energy to inflate the air pocket.
5. The jacket itself is not very comfortable as it is made out of a poncho ,making it quite uncomfortable for the driver especially if he is travelling for Long distances.

5 A

Test Iteration: Tick Remarks (suggest possible modification(s) for improvement)

Test Date: Pass Fail Potential

Failure

Test Criteria 1: Effectiveness (Absorbing impact)

Test Criteria 2: Speed of inflation

Test Criteria 3: Cost

*Add more rows for more criteria

** Repeat table for next test iteration

	Prototype 1	Prototype 2
Effectiveness	Can prevent an egg from breaking when dropped from about 4m from ground (2 levels off the ground)	Cna prevent an egg from breaking when dropped from about 6m off the ground (3 levels above ground)
Speed of inflation (S)	4.6	2.1
Cost (S\$)	27	35

6 Cite the references you have used for your project work in APA format. Your source of references should be varied (e.g. books, magazine, websites, journal articles, interview, photographs, product brochure, reviews etc.)

Ng Huiwen, (AUG 19, 2017) The Straits Times (Online version). Retrieved from <https://www.straitstimes.com/singapore/transport/motorcycle-deaths-make-up-close-to-40-of-traffic-fatalities-in-2017>

Leong WK, (December 06, 2016) Channel News Asia (Online Version). Retrieved from <https://www.channelnewsasia.com/news/singapore/a-motorcyclist-is-killed-or-injured-every-2-hours-in-singapore-t-7646858>

Healite Co, (April 05, 2018) Helite product description (Amazon). Retrieved from <https://www.amazon.com/HELITE-LEATHER-AIRBAG-JACKET-BROWN/dp/B06WWL4W5B>

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