

Hwa Chong Institution
Project Work
Category 3
Inventions Log Book
(Revised for 2020)

Title of Project:
Shoes X

Group Name:
Handy Helpers (3-35)

Group Members:

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- 3) Wu Guanhe (102 26)
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1. Problem Finding

(The beginning...)

Identify a problem you would like to solve. You may want to brainstorm for problems using different approaches eg thematic, survey or general brainstorming etc.

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

- People who are involved in multiple sports or sports that require special shoes have to buy shoes that usually costs a lot of money. All of the team members have experienced this.
- People have to carry several pairs of shoes with them that are bulky and heavy. Some of the group members still experience this.
- There is a great hassle and inconvenience if one needs to change shoes according to the response from our classmates who need to change shoes for CCA.
- The excessive carbon footprint from the production of shoes. Sources online state that shoe manufacturing releases a huge amount of carbon dioxide.
- There is a large wastage created by shoes as 23 billion pairs of shoes are created each year.

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

- Firstly, we should save the earth from global warming. Studies show that the carbon footprint of shoes is an incredibly high 700 million tonnes of carbon dioxide emissions per year, and this contributes to global warming. We wanted to use this project to stop this as fabricating shoe soles have a significantly lower carbon footprint than crafting the whole shoe itself.
- Secondly, all of us have experienced the inconvenience of having to change into new shoes for different activities in a day.
- Lastly, new shoes always cost lots of money (on average \$50 to \$150). Every time our shoes become unusable, it is usually due to the soles being worn. Buying a pair of shoes costs lots of money. With our project, we hope to solve this problem by letting people only buy a new pair of shoe soles, which would reduce the money people spend.

(SG, Adidas 2020, May 28)

1 C List some problems your group would like to solve. List also the considerations for selection of problems in the evaluation grid below. Score the considerations, against

the problems, with points 1 (least significant) to 4 (most significant). Sum up the total points for each problem. Identify that problem you would like to solve.

Problem Evaluation Grid

Considerations for Selection	Problems		
	People who are involved in multiple sports or sports that require special shoes have to buy multiple expensive shoes	The fabrication of shoes releases a large amount of carbon dioxide into the air, which further accelerates global warming.	There is a great hassle and inconvenience if one needs to change shoes.
We have experienced how resentful it is to part with a huge sum of money for buying a new shoe after the sole gets spoiled (which is very often)	3	1	2
We have all experienced the inconvenience of changing into another pair of shoes for another activity.	1	1	3
We all have felt the impacts of global warming, be it through warm weather or otherwise	1	3	1
Total Score	5	5	6

2. Define the Problem

Now that the problem has been identified. It is important to gather information on the extent of the problem and/or evaluate the usefulness of existing solutions based on *some criteria*. You may need to conduct surveys and research on existing solutions.

2A Extent of the problem (Research and discuss the problem and write down the problem statement)

People around the world change shoes very regularly, as the polymer chains in the soles and shoes are split open by moisture. 23 billion pairs of shoes are created annually (Fagan 2019), emitting 700 million metric tons of carbon dioxide every year. Also, many shoes only serve one function, so people have to bring many shoes which are bulky. Surveys conducted by us show that many people change their shoes before and after a sports session. Having many whole shoes also results in a waste of space in luggage when you go

on holiday, having heavier and more luggage also means a waste of money to check-in more luggage. Many people also have to buy new shoes due to the soles wearing off over time despite the top part of the shoe being intact, resulting in wastage of material and money. (Dholakia 2015), (SG, Adidas, 2020)

2A Compare and contrast the existing or similar solutions.

One solution features hooks embedded in the bottom of the sole. This is riddled with problems, as the hooks may come off during exercise and injure the wearer or others due to the sharp ends of the hooks. Another solution uses friction to lock the shoe into the sole. The cloth of the shoe is pushed around the outside of the sole, using the friction to hold it in place. If the forces acting on the shoe exceeds the maximum frictional force holding the shoe together, it will cause the shoe and sole to separate, which is a hazard for the wearer. For the next solution, it features little studs to snap into the cloth. The studs easily come loose, especially as the materials contacting each other are not rubber, which would have very little friction holding the shoe together. This may result in the sole detaching under high-stress loads. This poses a danger for the wearer. The last solution has zips which connect the shoe to the sole. The zipper may come undone and separate the sole from the shoe. As there is no permanent attachment point, the sole would fall off. Also, the zipper tab may be stepped on or get caught on something and trip the user.

3. Your BIG IDEA[#]

(Developing the idea....)*

Write down your proposed invention and why you want to do it. State also how you think your proposed invention is better.

3A Describe your proposed invention.

It is a shoe that features a detachable sole. This would allow the user to switch soles. There would be multiple types of soles made of different materials. This would make the shoe multi-purpose, as the user could change the running sole with the court sole, which would prevent them from carrying and buying a pair of bulky court shoes.

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

The purpose of the shoe is for the reduced difficulty in switching shoes. Nowadays, people who participate in different sports have to purchase and carry bulky shoes, which is costly and inconvenient. With our product, people can just buy separate soles, which would be far cheaper and more convenient to carry. Another advantage is reduced global emissions. By

only producing soles, it would produce less carbon dioxide emissions, which would reduce the impact of global warming.

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

One of the designs uses hooks to attach the shoe at the side. This is a possible hazard as the hooks may slip or break off when under immense forces, which may cause the sole to fall off or hang loose. Our locking mechanism cannot be undone by itself, and therefore would not allow the sole to separate from the shoe without the user manually doing so.

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

The soles are less noticeable than whole pairs of shoes, which would increase its chances of being misplaced or lost by someone. Also, the sole might slip out of the shoe due to the high amounts of stress put on the shoe.

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

- The decision of design of the shoes and the soles, from about March to May.
- Deciding on the method of presenting the project, from May to July
- Making the slides for both final evaluations

#must be able to be constructed based on current/emerging technologies, must not violate the laws of Science or go against the laws of nature.

4. Proposed Construction or Modelling Process*

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

You are now onto the fabrication of your prototype/ product. You need to select material and understand how to put them together so that your prototype/ product can perform its function.

4A Explain how and why the materials were chosen for the prototype/ product of your invention [Refer to Annex B]

We chose aluminium alloy for the pins of the locking mechanism. This would allow the nails to have an appropriate rigidity to not snap under the stress loads, which would be dangerous. The alloy is also lightweight, which would reduce the weight of the shoe.

Additionally, the nails will not rust and weaken. We used cloth for the top part of the shoe, allowing it to conform to the wearer's foot, making it more comfortable to wear, especially during prolonged periods of usage. The push locking mechanism is 3D printed, which would lower the shoe's weight and cost price. We chose to use a push locking mechanism over other options as it would be user-friendly, even if the user has motor function disabilities. A gel insole was used to help cushion the wearer's sole, as we decided that the shoe would be uncomfortable due to the locking mechanisms. Different types of rubber are used for the different soles. Court soles use a special type of rubber for added grip, whereas running soles use normal rubber.

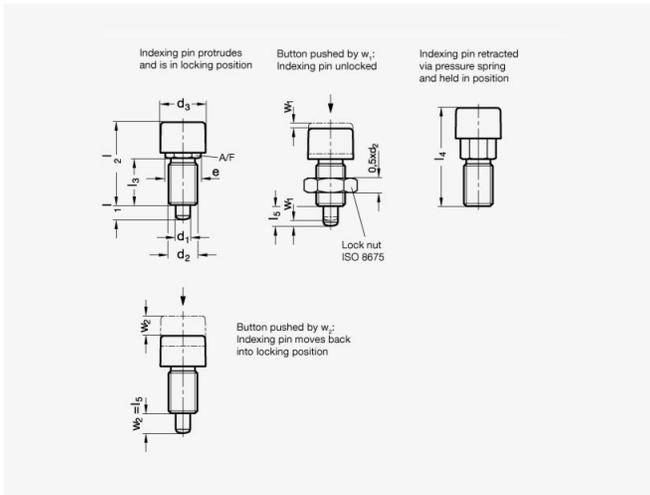
4 B Explore these considerations that may guide the construction of your prototype/ product.

- The comfort of the user when using the product, hence we bought gel soles to cater to the comfort level of the wearer.
- Availability of materials: we wanted the product to be made using materials that we can find easily available, so as to drive down the cost of production and make sure we do not harm the earth badly to extract materials for our shoe.
- Ease of use: The wearer just has to push the nail, and the soles will automatically click on or detach.
- Cost of production: We do not want the cost price to be overly high as it may make our shoe less appealing to some people due to a higher price tag.
- Portability of product: The soles would be less bulky and heavy than a pair of shoes. This would allow people to carry the soles around without having to bring a shoe bag.

4C Propose how the prototype/ product will be constructed or developed. You may use drawings and photographs.

It has to be manufactured in three parts, the top part, the bottom part and the locking mechanism. When making the top part, the insole has to be higher than that of other shoes. For the bottom of the shoe, a flap of rubber has to be made thin enough so that the mechanism is easily accessible for the wearer but firm enough to prevent anything from entering. When manufacturing the locking mechanism, the push-lock has to be glued onto the rubber, and the other rubber flap is partially covering it to secure its position. Finally, the aluminium alloy nail is added to the shoe via the rubber flaps.

Annex A



Annex B

Model of our product with labels



Warning:

- *Video / animated simulation only if prototyping is absolutely not possible.*
- *Video / animated simulation must be logical and convincing that the invention works.*
- *Constraints must be included in the logbook or the project will be heavily penalized.*

5. References

Read <http://www.bibme.org/citation-guide/apa/> on how to cite references.

6 A Cite the references you have used for your project work. Your source of reference should come from different types (eg books, magazine, websites, journal articles, interview, photographs, product brochure, reviews etc.)

- Dholakia, U. (2015, October 20). How Much Are Your Shoes Really Costing You? Retrieved August 2, 2020, from <https://www.psychologytoday.com/us/blog/the-science-behind-behavior/201510/how-much-are-your-shoes-really-costing-you>
- SG, Adidas. (2020, May 28). WHAT IF A SHOE COULD DECREASE YOUR CARBON FOOTPRINT? Retrieved August 19, 2020, from <https://news.adidas.com/sustainability/what-if-a-shoe-could-decrease-your-carbon-footprint-/s/6525d104-185e-461a-b480-e500e792c1d4>
- Picture of push-lock mechanism
https://www.nicepng.com/png/detail/203-2037060_locking-plungers-with-push-push-locking-mechanism-gn.png

- Picture of attachable soles which uses friction

Vibram. (n.d.) (August 19, 2020

<https://eu.vibram.com/en/shop/accessories/portable-performance-sole/portable-performance-sole/SP18IC01.html>