

TILE TALE

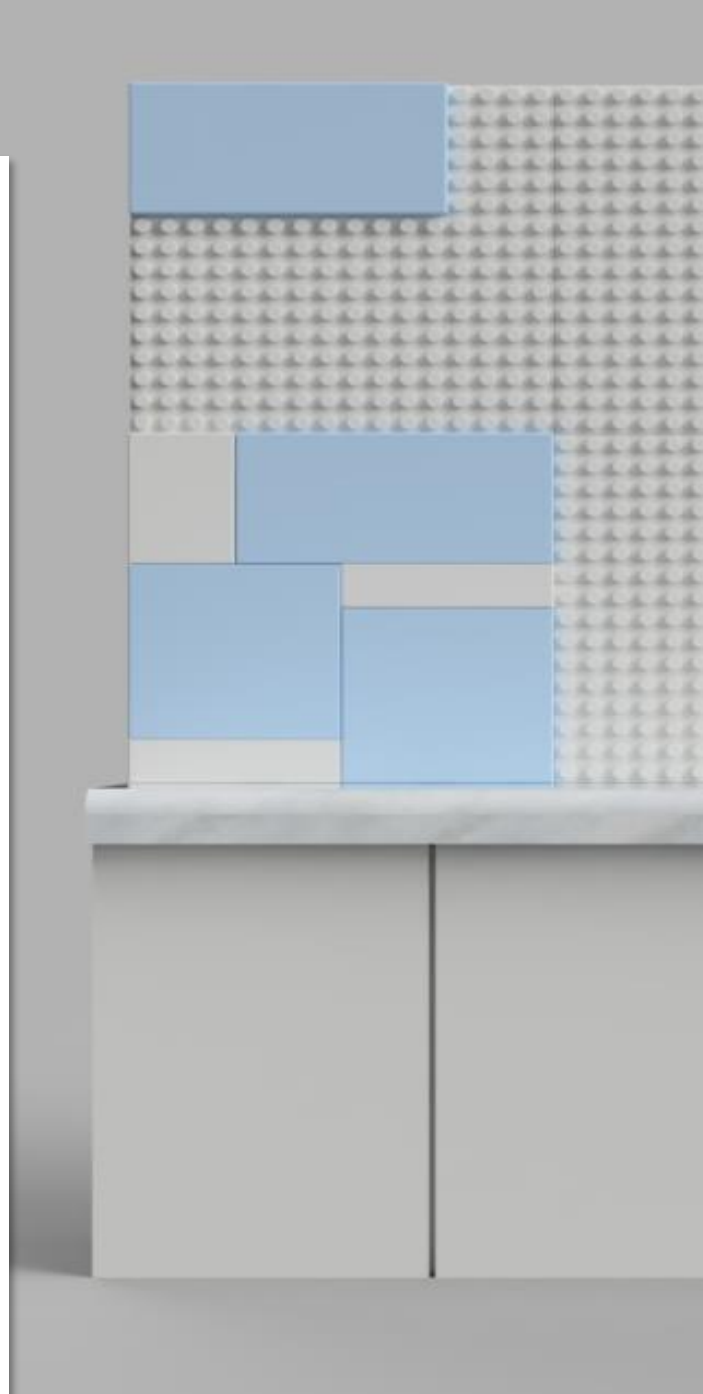
2019

MAY 13

UNIVERSITY OF WALES TRINITY SAINT DAVID

Authored by: Zuzanna Marika Kubicka
Course: BSc (Hons) Product Design and
Technology

DE^{Sue}SIGN



Tile Tale Report

Table of Contents

Abstract.....	3
Method	4
Introduction (Executive Summary).....	5
1. Material and Manufacturing	6
1.1 Material	6
1.2 Manufacturing	11
2. Fitness for Purpose	14
2.1 Functionality	14
2.2 Cost.....	14
2.3 Installation.....	15
3. Market Awareness.....	17
3.1 User	17
3.1.1. Anthropometrics	21
3.2 Current products.....	22
3.3 Inspiration.....	22
4. Sustainability	23
4.1 End of Life	23
5. Personal Design Manifesto.....	24
5.1 Use of colours	24
5.2 Home	24
Conclusion	25
References.....	26

Abstract

This report aims to provide a detailed description of the final Tile Tale design outcome in relation to fitness for purpose, market awareness, sustainability and personal design manifesto. The report will also provide the user with the specification and limitations of the product, method of installing and will compare it with current practices. It will give the user definition of the product, whom it is aiming at and the potential benefits. The report will also discuss how the most appropriate material was chosen and why it was decided upon a specific method of production.

The user will be given knowledge about potential costs associated with the production of the product, as well as end-of-life cycle and how it is sustainable.

Method

In order of getting the best design outcome the following software has been used:

- Autodesk Fusion 360
- SolidWorks
- Microsoft Office Excel
- Adobe Illustrator

In order of testing material limitation, samples have been ordered from the following website:

- <https://www.theplasticshop.co.uk/>

Also, the kitchen stove was used at a private house.

To check if the product would be successful, a questionnaire with relevant questions has been created using the following website:

- <https://docs.google.com/forms/u/0/>

Introduction (Executive Summary)

Tile Tale is a method of installing wall tiles without the urge to permanently damaging the wall. Tile Tale is using an interlocking system which is consisted of a series of tubes on the top of the base and studs on the bottom of each tile. When joined together they stay securely and reliable but can be easily uninstalled. The goal of such a product is to allow the user to change their environment more frequently in a few simple steps, saving user's time and effort. It will improve the aesthetics of their interior which will result in better mood and feeling of overall appearance of the interior being cleaner. Another beneficial aspect of installing Tile Tale is decoration. This decorative piece can simply be changed to fit the specific mood of the house or season of the year; for example- Christmas time.

To see if the product will potentially be appealing for the user, the questionnaire has been created where 65 participants from 2 different countries were asked questions related to current method and usage of wall tiling and possible innovative ways.

1. Material and Manufacturing

1.1 Material

Tile Tale must be strong, waterproof and heat resistant, so the material chosen for this product had to meet the same requirements.

Currently, the material used to produce wall tiles is usually ceramics, which is exceptionally resistant to heat, has excellent wear resistance, high hardness, corrosion resistance and it is waterproof.

To get a wider variety of materials heat resistance had to be lower than ceramics, as the wall behind the stove does not go as hot as 200°C.

I have decided to use polymer as it is very easy to mould and comes in a variety of colours, but not many polymers are heat resistant.

I have ordered a sample of PTFE, ABS, Perspex and Lexan. They have been left behind the stove for a whole day, and the stove has been used as usual.



Fig. 1.1.1.
Perspex
Vario (left
on the
picture),
Lexan
(middle on
the picture),
PTFE (right
on the
picture)
before stove
been used.

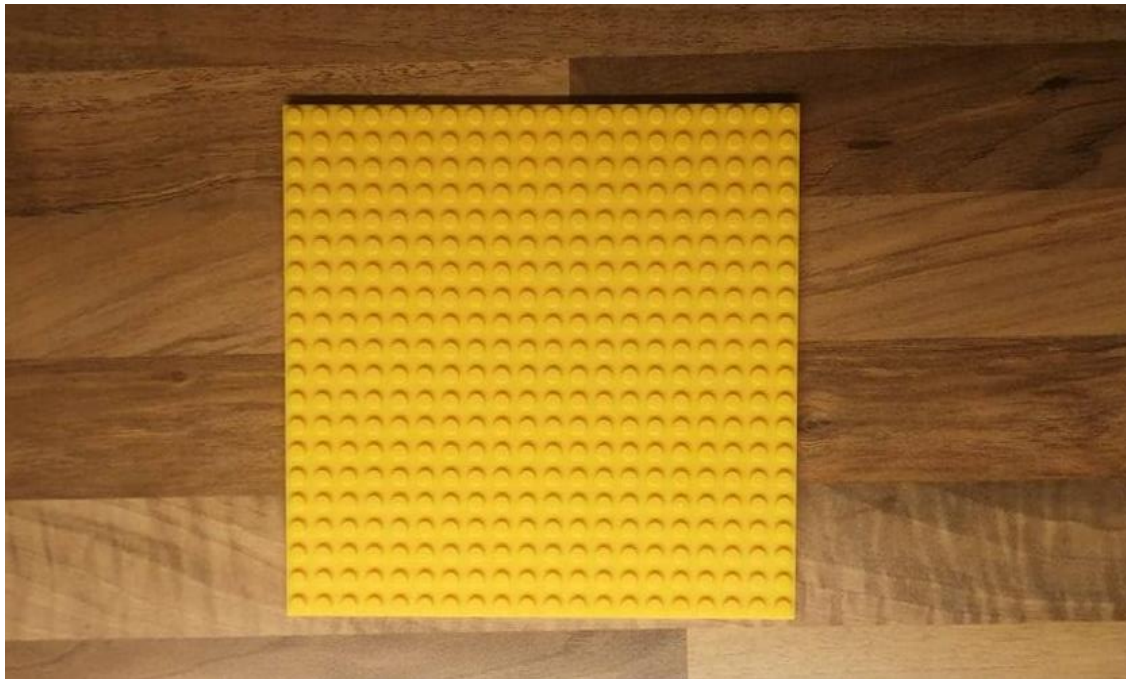


fig. 1.1.2 ABS toy before stove been used.



Fig. 1.1.3. 3mm Perspex (left on the picture) and 5mm Perspex (right on the picture) before stove been used.

Those materials were chosen because of their quite high hear resistance when comparing to other polymers.

Initially blend of PVC/ABS were chosen as this material has been selected in similar products. However, after the stove test was done, the results showed that ABS will not be heat resistant enough to be applied behind the stove all the time.



Fig.1.1.4. ABS after being exposed behind the stove for over an hour.

I could not finish the testing because after 1 hour of cooking ABS melted and lost its original shape.





fig.1.1.7.
5mm Perspex (on the left), 3mm Perspex (in the middle) and coloured 3mm Perspex (on the right) after being exposed to heat from stove.

The problem with using Perspex is that it gets dirty, and all oily marks can be easily seen, but the same problem occurs with ceramic tiles and LEXAN. Another possible issue with LEXAN is that it only comes in transparent colour, which can be ideal for the base but not for the tiles. The best results had PTFE, as it did not have any marks, and it did not get hot, but it is non-recyclable as it is thermoset plastic and it only comes in limited colours (black, white, cream). The limitation of the colour is not as ideal as the primary purpose of Tile Tale is that the user can easily change the colour, depending on the mood or trends.

At this point, I was keen towards Perspex, but its chemical resistance had to be checked.



fig.1.1.8. (Top left corner) Dettol Multipurpose chemical was used for testing



fig.1.1.9. (Top Right corner) Material reaction to a chemical used.



fig.1.1.10. (on the left)
The material after contact
with a chemical.

For the final Tile Tale, material coloured Perspex was chosen. This material can be easily recycled (thermoplastic), it comes in an unlimited variety of colours, it can be easily moulded to a desired, complex shape and it can stand the heat coming from the back of the stove. This material is also waterproof and chemically resistant.

1.2 Manufacturing

As Perspex was chosen for final material, the processes which could be used were the following: CNC, Injection Moulding, 3D printing.

The final manufacturing process chosen is injection moulding because the cost of making each tile will be radically faster and cheaper than producing the same tile using CNC or 3D printer.

Using CNC machinery, the product will not have the same amount of details. Another issue with using the CNC method is that coloured Perspex sheet thickness is 5 mm maximum currently on the market, whereas the product will need at least 15 mm thickness. I have looked on websites such as SimplePlastic, Perspex or ThePlasticShop. Furthermore, CNC machinery bed can machine 380 x 380 mm maximum, whereas Tile Tale base is bigger- 622 x 622 mm.

Using 3D printing technique will take a long time for each part of the design. The test was done on Ultimate Original + and the estimated time for printing tile size 155 mm x 155 mm was approximately 5 hours with settings set to low-quality print. To get a high-quality print with layer 0.1mm, it will take around 13-14 hours for the same size tile. Furthermore, 3D Printing bed have a size limitation, so the base (622 mm x 622 mm) would not be possible to print, and if so, it would take approximately 20 hours to print, which is not ideal for mass production.

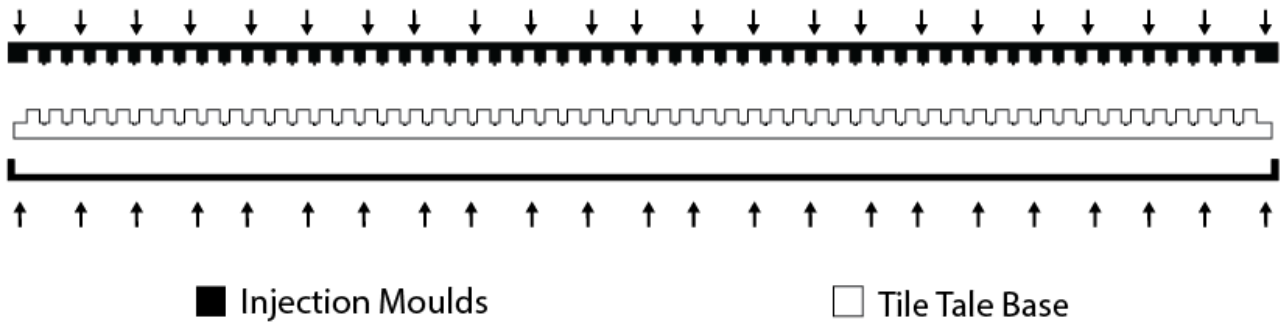
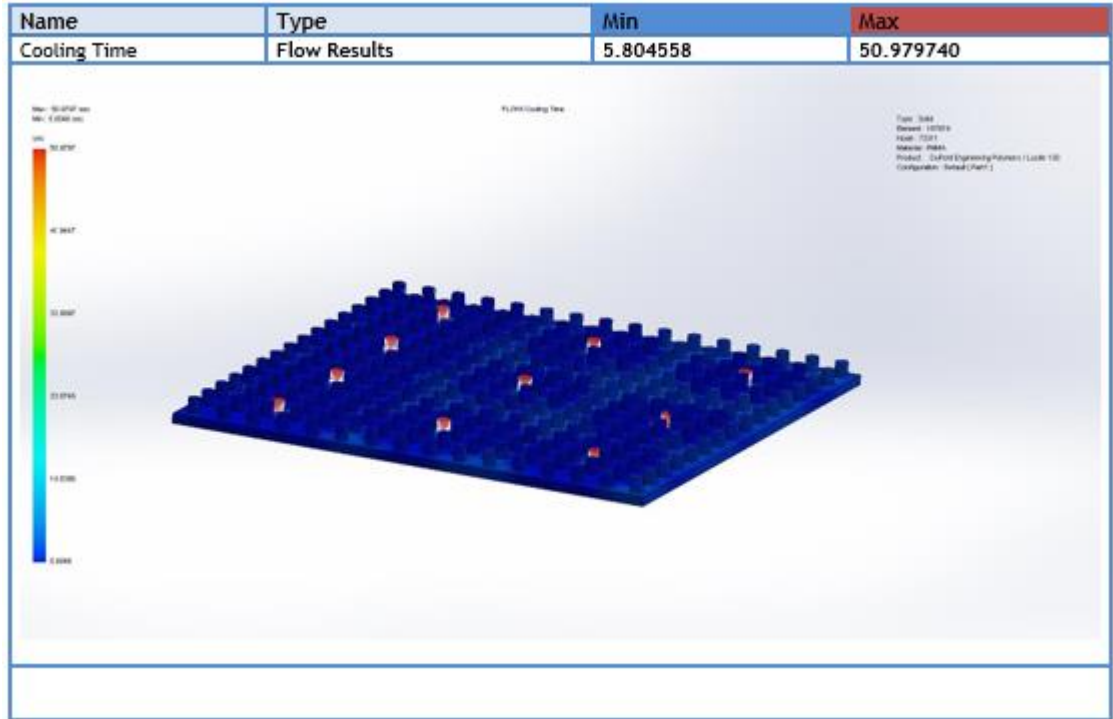
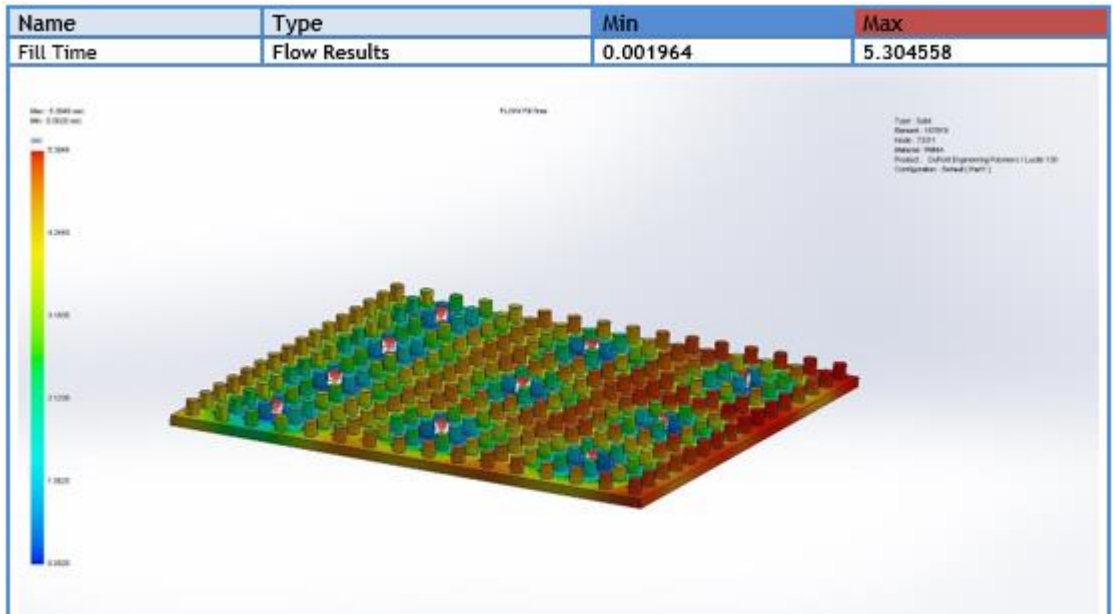


Fig.1.2.1. Showing how injection moulds will combine to inject the finished product. Filled black shapes- Moulds, Outlined shape- product (base).



Filling time of injecting the base of the product will not take longer than 5.3 seconds. The cooling time of the base will take approximately 5 seconds, but some areas will need as long as 51 seconds to cool down after being injected in temperature of 230°C. Initial costs and time scale might be seen as a negative aspect, but when considering mass production, the price will be divided.

2. Fitness for Purpose

2.1 Functionality

The initial design idea was to create magnetic tiles. Those tiles would be easy to apply, comes in an unlimited variety of colours, and would be waterproof and heat resistant. However, magnetic tiles could interfere with electricity and wires which are hidden in the wall.

Original toy blocks are made out of ABS, but through my previous discovery I found out that ABS will not be the best material, in this case. Thus I knew I had to use some sort of another polymer. Perspex meets the functionality aspect of the product as it can be easily cleaned, it can be easily removable from the wall, it comes in a variety of colours, and it keeps its shape. Moreover, it is less brittle than traditional ceramic tiles, so when dropped it will not break.

2.2 Cost

The initial cost of such a product will be high. Moulds essential for injection moulding could reach a cost of up to £1000 for each tile. However, the current price for granules of Perspex is approximately £800 per tonne.

The Perspex granules cost approximately 0.40 GBP/ lb, the hot runner mould approximately £3000 and the maximum wall thickness will be 6.5mm one base (311 x 311 x 15 mm) will cost £4.39 to produce.

Cost Breakdown

Material:	0.72 GBP	16%
Manufacturing:	3.33 GBP	76%
Markup:	0.00 GBP	0%
Mold:	0.33 GBP	8%

fig.2.3.1. Breakdown of Injection Moulding costs of 311 mm x 311 x 15 mm base.

The base will not need to be painted or have any other finish, due to the finish quality of Perspex. The prediction of manufacturing the base of Tile Tale is based on production 15000 parts- if the parts number increase the cost per piece will decrease. Additionally, the cost of transportation, labour and advertisement need to be added, as well as profit.

Cost Breakdown

Material:	0.22 GBP	6%
Manufacturing:	3.33 GBP	92%
Markup:	0.00 GBP	0%
Mold:	0.05 GBP	1%

Fig.2.3.2. Breakdown of Injection Moulding costs for 155 x 155 x 15 mm tile.

To calculate the cost of 155 x 155 x 15mm tile I have used similar parameters. 0.40 GBP/ lb as the cost of material (Perspex granules), £3000 for mould and I have imputed 60000 parts to be made because one base (311 x 311 x 15 mm) will fit for 155 x 155 x 15mm tiles. The cost of production of such a tile will come to £3.61 per tile.

Cost of:

- 155 x 77 x 15mm- $\text{£}0.22/2 = \text{£}0.11 + \text{£}3.33 + \text{£}0.05 = \text{£}3.49$
- 155 x 155 x 15mm- $\text{£}3.61$
- 311 x 155 x 15mm- $\text{£}0.22 * 2 = \text{£}0.44 + \text{£}3.33 + \text{£}0.05 = \text{£}3.82$
- 311 x 311 x 15mm- $\text{£}0.44 * 2 = \text{£}0.88 + \text{£}3.33 + \text{£}0.05 = \text{£}4.26$
- Base- 311 x 311 x 15mm- $\text{£}4.39$

2.3 Installation

To install Tile Tale onto the wall there are 3 options; first option is to use cement-based adhesive- this method is more permanent, and it will suit more the owner of the house, as the base is applied permanently- just like currently used tiles, but tile themselves can be easily changeable, the second option is to use cement-based adhesive as well as screws- this option is also aimed towards homeowners, but it is more

secure than option number 1. Third- last option- is screwing the base onto the wall using screws. The head of the screws cannot be bigger than 15mm.

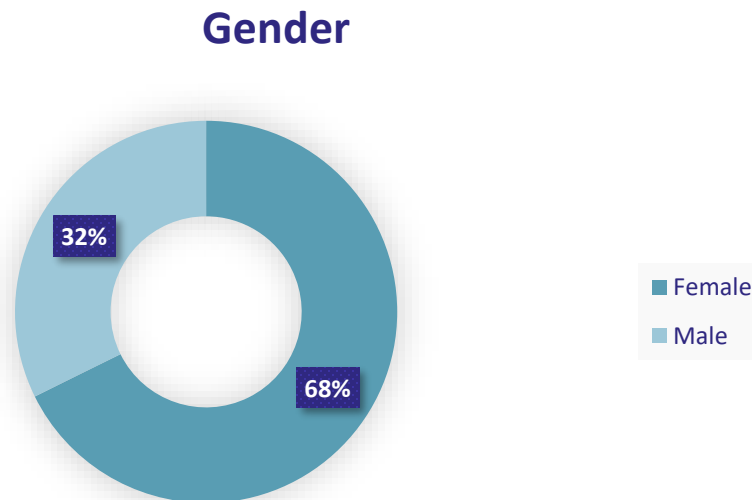
STEP-BY-STEP INSTALLATION OF TILE TALE		
1. Remove old tiling from the wall		
2. Clean the wall (remove any sticking parts)		
Glue	Glue and Screws	Screws
1. Apply cement-based adhesive on the bottom (flat area) of the base	1. Apply cement-based adhesive on the bottom (flat area) of the base	1. Screw the base (flat area touching the wall) by applying screws onto pre-drilled holes
2. Apply another base, ensure that base 1 and base two are touching each other	2. Screw the base (flat area touching the wall) by applying screws onto pre-drilled holes	2. Apply another base, ensure that base 1 and base two are touching each other
	3. Apply another base, ensure that base 1 and base two are touching each other	
3. Cut silicone sheet to suit the size of all bases		
4. Apply silicone sheet onto the base		
5. Apply tiles onto base and silicone		

3. Market Awareness

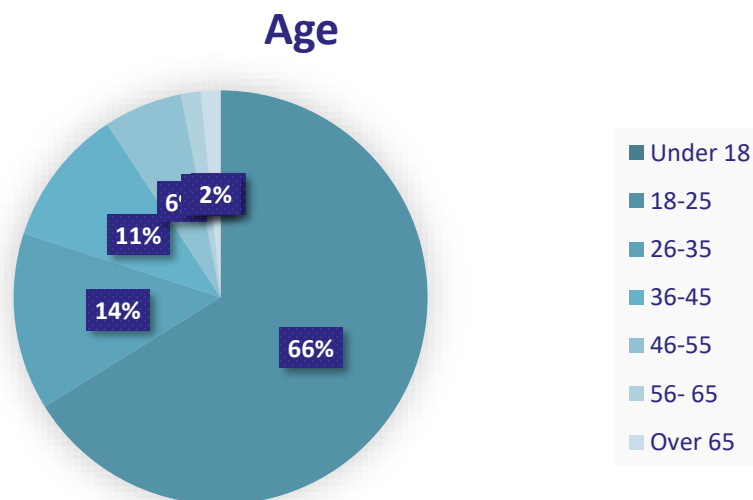
3.1 User

To gain information about the potential buyer/ user the survey has been created. It was generated using Google Forms. Following questions have been asked;

1. Gender

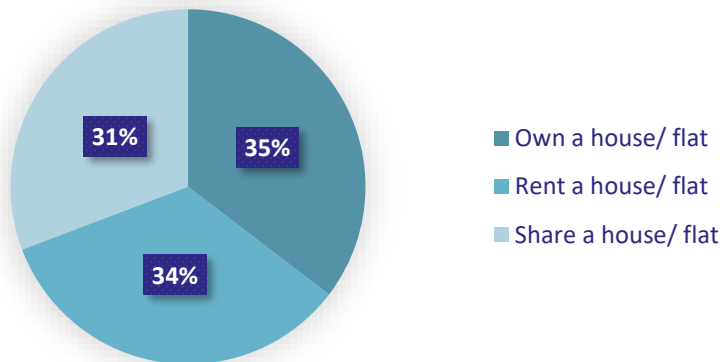


2. Age



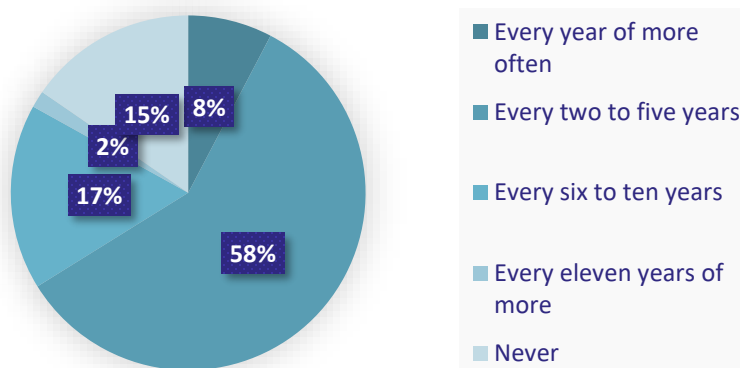
3. Living Situation

Living Situation



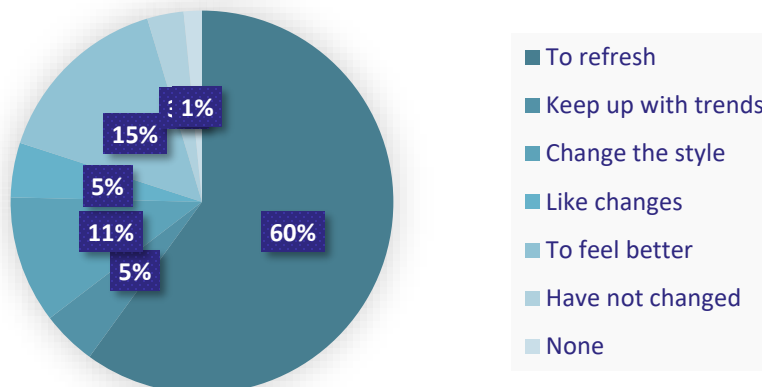
4. How often do you change the wall colours in your house?

How often

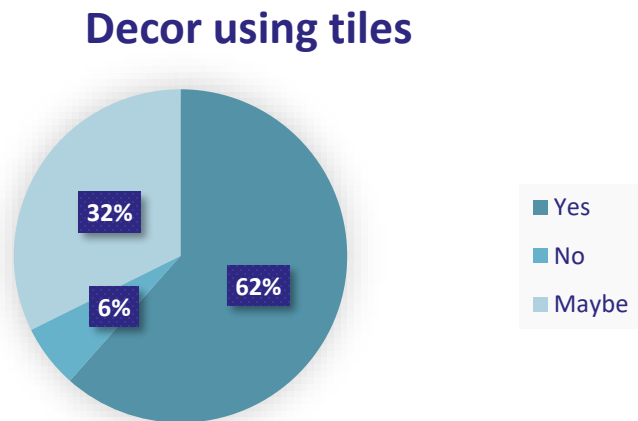


5. Why do you change the colours of the walls?

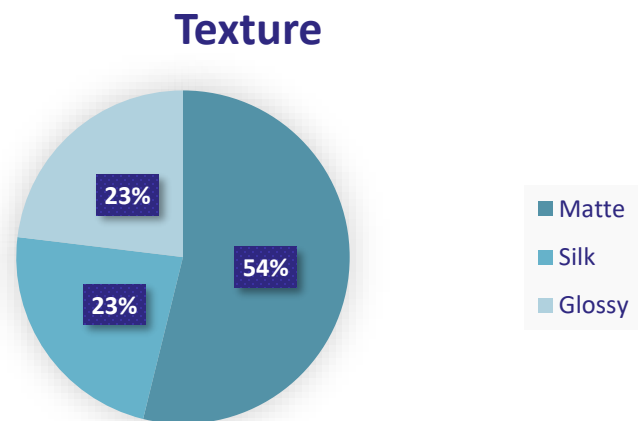
Why



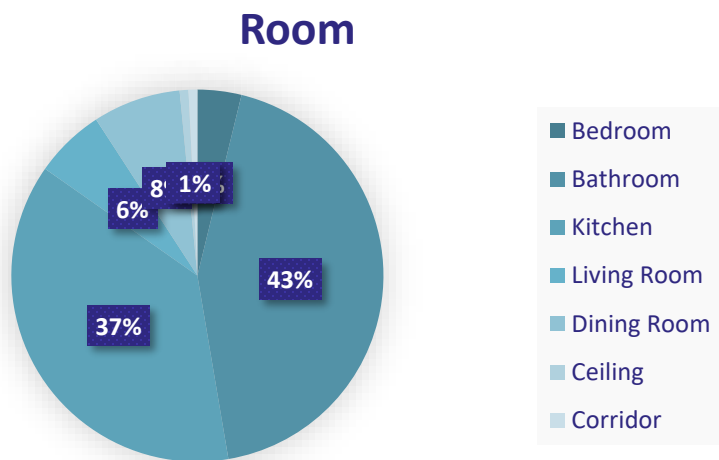
6. Would you use tiles to decor your house?



7. Which texture of the tile do you prefer?

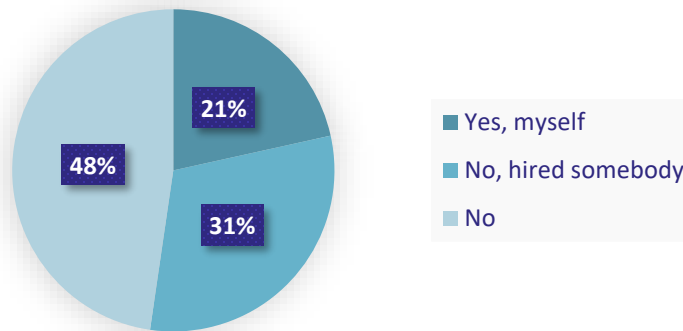


8. Where in your house would you use wall tiles?



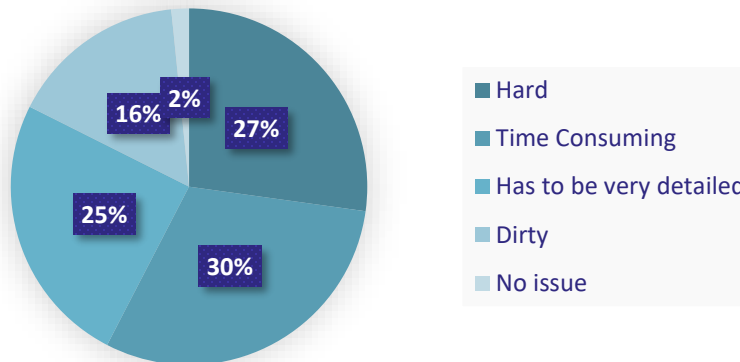
9. Have you ever changed yourself wall tiles in your house?

Changing Tiles



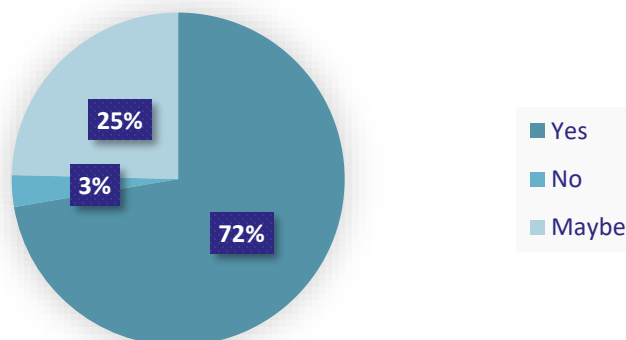
10. What do you think is the main issue with installing tiles?

Issues



11. If installing tiles would take approx. 20 minutes, would consider buying them?

Consider buying Tile Tale



In this survey, 65 took participation, from the United Kingdom and Poland. The results are shown on the pie charts emphasis that the customer who would be most interested in decorating/ changing the house is woman age 18-25 who live in the owned house. People usually change their interior décor/ colours between two to five years often to refresh. At the moment most of the people do not change their tiles at all, or they are hiring somebody to change it for them. 62% agree that they would use wall tiles to décor their interior and would use tiles in bathroom or kitchen the most. Currently, the main three issues with applying wall tiles are that it is laborious, time-consuming and must be done very detailed.

3.1.1. Anthropometrics

The weight limit of handling at shoulder height for an average woman is 3kg and for man is 5 kg considering that the arm is stretched straight.

To calculate the mass of final product I have used the following formula:

$$m = pV$$

(Density Calculator, n.d.)

The volume (V) of 311 x 311 x 15mm tile is – 689.71261 cm³. The density (p) of Perspex is 1.18 g/ cm³ which means that the total mass of base is 813.86g which is 0.81kg.

The volume (V) of 155 x 155 x 15mm tile is – 212.57163 cm³. The density (p) of Perspex is 1.18 g/ cm³ which means that the total mass of tile is 250.83 grams which is 0.25kg.

The mass of 155 x 77 x 15 mm will be approximately 0.175kg, the mass of 311 x 155 x 15mm will be approximately 0.5kg and the mass of 311 x 311 x 15mm will be approximately 1 kg.

The results show that the average woman or man will be able to safely hold and install Tile Tales, without any injuries.

3.2 Current products

A lack in the market has been discovered. The current method of applying tiles is using strong cement-based adhesive and ceramic tiles, which cannot be changed as quickly as wall paint. This method of applying tiles has been used since tiles were first introduced. Nowadays users enjoy having customised/ changeable products. Having a wall cover which can be easily changeable can be beneficial for the company and enjoyable for the user.

Current alternatives to ceramic tiles, which can be easily removable are: Peel and Stick tiles, Magnetic tiles (Diy Or Buy: Moveable Magnetic Plywood Tiles, Artworks, 2017), (Retile, n.d.) Ceramic tile paint (DIY, n.d.), Gypsum tiles (Gypsum Plaster 3D Wall Panels, n.d.) and Plexiglas Splashbacks (Screwfix, n.d.)

3.3 Inspiration

The inspiration came from LEGO toys and its interlocking system. When two clocks are combined, they hold each other firmly. Initially, magnetic tiles were considered as an alternative to a standard ceramic tile. Magnets can be applied anywhere on a flat surface and can be shaped in any form. The problem occurred when research has been done about magnet contact with wires in the kitchen, as it does not work.

4. Sustainability

4.1 End of Life



Fig.4.1.1. The diagram of Life Cycle Assessment of the product.

Perspex is a thermoplastic which means it can be easily recyclable. This material can be melted and reshaped unlimited amount of times, which means that potentials users can give back their old Tile Tales for a discount, and the company can re-shape new tiles, out of old material. Old tiles can be shredded into granules and used again, to form a different shape.

5. Personal Design Manifesto

5.1 Use of colours

In the manifesto, one of the four main points was the use of colour. I believe that seeing colours can decide upon your mood and reactions to certain things. My design allows the user to interact with the colours, and to create their own environment depending on their current mood. Tiles can be customised and arranged in the pattern which user thing meet their mood best.

“The perception of colour is indeed very personal. The combination of two or more colours can be perceived as harmonious by one person, but stressful or unbalanced by another.” (Family & Holmberg, 2017).p.139. The example is that when the weather is sunny, white tiles will reflect the light and give even more brightness and will make the room feel warmer. Whereas if there is rain outside white tiles will make the user feel more sad/ depressed, but if they decide to change the tiles for something brighter, for example, mustard or dark green complemented with gold, the room will give the feeling of a positive environment.

5.2 Home

“ The way you paint the walls to suit your needs, the furniture you have chosen to feel the most comfortable and the way you have décor this building. YOUR home defines YOURSELF.” In my manifesto, I have defined that home/ house and its décor define person living in it. By allowing the user to change the tiles in their own way, the owner can express himself/herself to the visitor. If the tiles applied will be all white/ grey the visitor will know that the person likes simplicity, cleanness and brightness, whereas if the user decides to use some darker/ brighter colours the visitor can see that the owner of the house it more expressive, fun or open towards new things.

Conclusion

Tile Tale is a product which can be used in any interior, and it will suit any style. This product is made from Perspex (PMMA) as its properties meet the requirements of everyday usage. The product will be able to withstand the heat of the stove as well as the splash of running water. Thermoplastic can also be re-heated and re-shaped which means that the product can be fully recycled. The costs associated with the manufacturing of Tile Tale can be high at the beginning but will drastically decrease, so the price of one tile will not go up over £5 to produce. Once the moulds are manufactured, the time of production will also be low, as it will not go any longer than 1 minute to be injected and cooled.

The installation of such a product can be done in 5 relatively easy steps. Once the base is applied to the wall, the installation of tiles will be very easy, and the pattern and shapes can be changed very fast.

Currently, there is not any similar product to Tile Tale on the market, but there is undoubtedly a gap in the market for such a product.

Although Tile Tale can be an innovative solution for installing wall tiles, the end solution still needs some improvements. The tubes on the bottom of each tile should be equally placed on each side rather than being closer to one side. Also applying wax on each stud of the base could bring some positive results as removing each tile can be more comfortable. Furthermore, diagonal tile could be developed to introduce a new range of tiles.

References

(n.d.). Retrieved from Screwfix: <https://www.screwfix.com/c/bathrooms-kitchens/splashbacks/cat820372>

(n.d.). Retrieved from Matweb: <http://www.matweb.com/>

Density Calculator. (n.d.). Retrieved from Calculator Soup:

<https://www.calculatorsoup.com/calculators/physics/density.php>

DIY. (n.d.). Retrieved from B & Q: <https://www.diy.com/departments/painting-decorating/paint-wood-treatments/specialist-paint-treatments/tile-paint/DIY1624520.cat>

Diy Or Buy: Moveable Magnetic Plywood Tiles, Artworks. (2017, April 13). Retrieved from Improvised Life: <https://www.improvisedlife.com/2013/04/17/diy-or-buy-moveable-magnetic-plywood-tiles-artworks/>

Family, I., & Holmberg, S. (2017). *We Love Home*.

Gypsum Plaster 3D Wall Panels. (n.d.). Retrieved from 3D Wall Panels UK: <https://www.3dwalls.co.uk/en/8-gypsum-plaster-3d-wall-panels>

Retile. (n.d.). Retrieved from Anchor Magnets:

<https://www.anchormagnets.com/cms/uploads/retiler-magnetic-tiling-system.pdf>