Cracks in the Community

Solving the Valley's Pothole Crisis

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The Problem

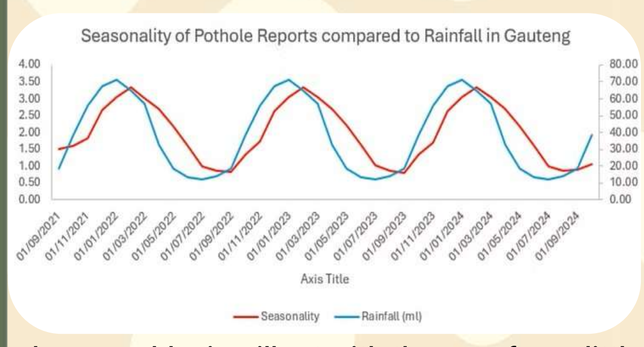
The roads of Maker's Valley are not built to last. Deteriorating infrastructure and the government's inability to solve the issue leave the public yearning to fix the road themselves – however, the people are helpless to do so as an unskilled repair leaves them at risk of litigation, which the people cannot afford on top of surmounting cost of living and low wages. This leaves them in a difficult spot – be liable for lawsuits from damage caused by at home repairs or let their car suffer. Most choose the latter; we aim to solve that. With specialised training on pothole repair from Johannesburg civil service workers the residents of Maker's Valley will finally be able to solve the pothole crisis themselves.

Context for Design

Social

Potholes pose a real and serious hazard to motorists, causing them to swerve and put themself in a dangerous position. The road fatality rate in 2023 sat at 19.39 per 100,000[1], 29% above the global rate of 15 per 100,000. If a motorist swerves to avoid a pothole and crashes, the accident is ascribed to human error[2], despite being a road safety issue. Here's a quote[3] from the local soup kitchen owner, Desiree Beukes: "Our roads are so bad now, and you don't see any improvement. We had once come together as a community and said, we're going to fill up the potholes and we were stopped by the councillor. He said we had no right to do that because the government will say that we are the cause of the cars [that get] broken, the tires get burst because ... we are not qualified to do that."

Environmental

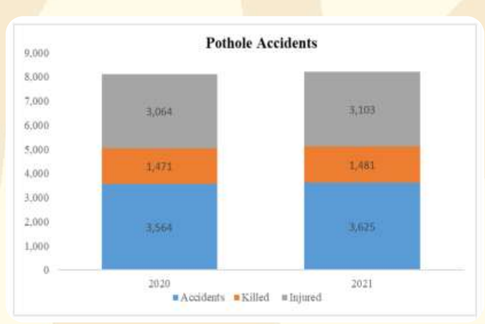


While it's an unequivocal fact that fixing potholes can contribute to greenhouse gas emissions, using cold mix to repair them has a lower environmental impact in comparison to the traditionally used hot mix, with the production of hot mix releasing far more CO2[4] into the atmosphere compared to Cold mix, 35.5 kg per ton compared to 7.1kg per ton, Hot mix also makes use of pollution-causing equipment,

whereas cold mix will set with the use of very little equipment, which doesn't have to be powered, hot mix also must be heated and transported at a temperature of 150-160 degrees Celsius, while cold mix does not, this adds up to a 95% chance[5] of cold mix having lower emissions compared to traditional hot mix pothole repairs. Potholes are only going to become a bigger problem as climate change continues as increased rainfall will increase the number of potholes. It should also be noted that CO2 emissions are higher on average for a journey on poor road conditions compared to one on repaired roads.[6]

Economic

Potholes cost everyone money; inadequate quality roads can lead to damage to cars, causing tyre punctures, wheel alignment issues, suspension damage, and more, which are currently costing the people of Johannesburg R500 million[7] ~ (£21.5 million) per month, and is of a significant enough cost that car insurance companies are attempting to finance their repair.[8] Potholes also pose a risk of injury or even death[9] to people, they can cause motor vehicle accidents and collisions, and they can be dangerous to pedestrians on the road causing potential trip and falls, this puts people out of work and puts strain on the South African healthcare system, which filling the potholes will help prevent at a lower cost.



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Design Process

After learning potholes were a long-time complaint from the community, we set out to find a cheap and effective way to make Maker's Valleys roads safer. We considered increased funding and new machines for Johannesburg's pothole patrol, but after watching Desiree Beukes' video we discovered the citizens of Maker's Valley wanted to solve the problem themselves, but due to lack of training they were unable. So, we then researched both how we could get them training and an easy way to fill the potholes. Training was simple – incentivize Pothole Patrol workers to train the locals through the option of reduced working hours or a stipend for each training session. For the method of pothole repair, we weighed hot asphalt against cold asphalt. Cold asphalt does not need to be transported hot, has a lower environmental impact and is much easier to use. We then finally had our idea: get Pothole Patrol workers to train Maker's Valley residents to fill potholes with cold asphalt.

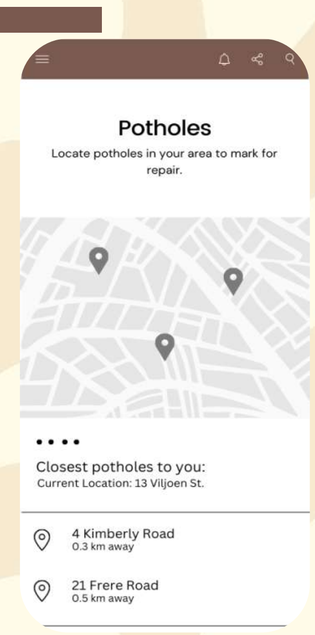
Main Elements of Design

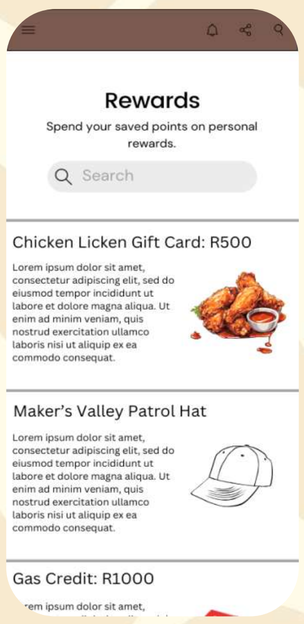
The App

Login and Membership – Any citizen with a South African phone number (or some other verification for location) can sign up to report potholes. A special login will be granted to citizens who attend the Pothole Patrol workshops.

Reporting – Anyone can report a pothole if they provide their location and a photo of the pothole (to prevent clogging the app). An AI or human moderator will then review the photos to see if it is a pothole.

Map – For regular users, the map will display red zones with potholes, so they know which roads to avoid. For special users, they can see the exact location of the potholes and register to repair them.





Equipment and Material Inventory - Special users can access a database displaying information about available equipment for pothole repair (e.g. asphalt saw, diamond sawblades, broom) and available materials (e.g. cold asphalt, sand/gravel, asphalt sealer). They can then check out these materials (for security, there will be a deposit for renting, returned if equipment is returned safe) to repair potholes.

Tutorial – Once a user registers to repair a pothole, it will give in-depth instructions with troubleshooting to repair the pothole, with a function to calculate the amount of cold asphalt needed once given measurements. It also shows the times of pothole workshops, which will be hosted by civil service workers and take place for 5 hours once a year.

Rewards System – Based on the number of potholes repaired, a user can be rewarded with gift cards, gas credits, public transport discounts, chance to name a street, merchandise etc.

Deploying the Design

The following data is a full cost breakdown of our solution. The table to the right indicates yearly costs to maintain the solution for years to come, and the table below is start-up costs for equipment needed (It is worth noting that if the cost is too high, you can omit the equipment as it is not necessary). The values are obtained from various hardware shops and web hosts online.[10]

Category	Item	Quantity needed/annm	Cost per unit (£)	Cost (£) /annum	Cost (R) /annum
Materials	Cold	502kg	272/tonne	141.44	3306.60
	Sand	80kg	78/800kg	7.80	182.35
	Asphalt	10l	85/l	35.36	826.65
	Plywood	10 sheets	5	50	1168.91
Wages	Training	2 people for 5hrs	11.17/hr	117.20	2739.925
Hosting	Web App	1	N/A	47	1098.77
Maintenance (10% of total equipment cost)	Equipment	N/A	N/A	147.30	3443.90
Total				545.10	11,866.18

Item	Quantity needed	Unit cost	Total cost (£)	Total cost (R)
Asphalt	2	420	840	19637.64
Saw	2	294	588	13746.35
Sawblades	5	9	45	1052.02
Total			1473	34439.01

Our solution is eligible for the following grants:
Infrastructure Fund DBSA – eligible for all public sectors from government to council[11]
Critical Infrastructure Programme – 10 to 30% of qualifying development costs[12]
IIPSA – Direct grants up to 100% for non-toll road projects[13]

We also plan to campaign to insurance companies like Auto&General who would benefit from our solution to sponsor us. Other ideas involve crowdfunding through community events and campaigning to large companies for CSR funds. As for deployment, civil service workers will host a one-week pothole repair workshop once a year in the Maker's Valley MVP studio, which is ideally where the pothole equipment would be stored.