



HOW TO CHANGE THE WORLD

What would happen if an Israeli invention replaced conventional internal combustion engines?

*You and I, we'll change the world
You and I, soon everyone will join
Others said it before but so what?
You and I, we'll change the world.*

Israeli pop icon Arik Einstein wrote and sang those words. Einstein died November 26, 2013 – he was 74.

This song could be the theme song of the Start-up Nation. With immense *chutzpa*, entrepreneurs tackle huge challenges with equally huge ideas, thumb their noses at the odds, ignore the nay-sayers and, at times, triumph, changing our lives and the world for the better. There is no greater adventure.

I recently encountered a remarkable example—a tiny start-up, known as Aquarius Engines based in Rosh Ha'ayin, dares to reinvent the internal combustion engine. This, at a time when huge global companies have for decades invested billions of dollars and immense brainpower trying to do the same.

If the four Aquarius entrepreneurs succeed, the world will be cooler, less polluted, and far less dependent on Arab oil. The resulting benefits to Israel could be game-changing.

The four entrepreneurs are three hi-tech veterans: Shaul Yaakoby, Gal Fridman and Ariel Gorfung, together with Maya Gonik. Yaakoby, Fridman and Gorfung are all over 50, belying the belief that start-up entrepreneurs are all twentysomethings. And they have all previously achieved success in hi-tech, meaning they really do seek to change the world rather than gain wealth.

Yaakoby is a serial inventor. Earlier, he invented a unique patented technology for

purifying water. He is the company's Chief Technology Officer and built the prototype Aquarius motor with his own two hands.

Gorfung, the CEO, is a veteran of several other successful start-ups, including Neocleus (virtualization) and Oris, an investment fund specializing in Cleantech (technology focused on environment-friendly products). Fridman, a graduate of the Bezalel School of Art and Design in Jerusalem, heads marketing. Gonik, who joined Aquarius right at the start, heads business development. She is an economist and has much industry experience, having worked for Mercedes and Audi.

WHEN YOU WANT TO CHANGE THE WORLD, IT'S NOT ENOUGH TO HAVE A GREAT PRODUCT. YOU NEED THE RIGHT BRAND

Sometimes, you can change the world by taking a very old product and rethinking it. To do so, you have to challenge sacred cows. This is what Yaakoby and Aquarius have done.

While conventional engines generate rotary power delivered to the car's wheels, the Aquarius engine is based on linear motion. A single 600cc piston moves from side to side, generates 86 horsepower and, unlike conventional engines, does not

directly power the wheels, but serves as an electricity generator that charges a small battery under the rear seat.

The battery, in turn, powers two electric motors, one attached to each of the two front wheels. The battery is small because it does not need to store a lot of power but simply delivers it to the electric motors.

Conventional internal combustion engines work at 18-20 percent efficiency – that means 80 percent of the energy produced by burning gasoline is lost. Aquarius's engine is 40 percent efficient because it never changes the up-down energy to round-and-round. The saving is huge.

“A leading engine-testing company reports that our initial results are astonishing by any measure,” Fridman tells *The Jerusalem Report*. “A lot of inventors try to think out of the box, but apparently, our inventor Shaul Yaakoby has no box at all!”

“The Aquarius motor is very small and compact,” he adds. “It has many fewer parts than a conventional engine; it has no valves or crankshaft.” The crankshaft is the device that turns the up-down motion of a piston into rotary motion for the wheels and it is where a lot of energy is lost.

Best of all – the Aquarius engine is very clean. Yaakoby found a way to inject additional air into the piston so that emissions are greatly reduced.

According to the US Environmental Protection Agency, motor vehicles account for nearly one-half of smog-forming volatile organic compounds, more than half of the nitrogen oxide emissions, and about half of the toxic air pollutant emissions in the US. Motor vehicles account for 75 percent of



COURTESY AQUARIUS

Shaul Yaakoby, in his lab, in the process of building the first version of the Aquarius engine, shows it to Gal Fridman and Maya Gonik

carbon monoxide emissions nationwide.

I imagine the numbers for Israel and other developed countries are not that different. This smoggy, polluted world definitely needs change. Will Aquarius be the catalyst?

Three unique patents have been registered. Initial tests on a mini car are in progress. “Fuel consumption is very low,” Fridman said. “And in two years, a European car producer will unveil a new model based on the Aquarius engine.”

Aquarius was launched in 2014 and raised initial funds. It is now engaged in raising a new round of funding. Fridman emphasized that the founders are careful not to dilute their shares so they retain control.

I ask him if Aquarius plans to build its engines in Israel. He explained that manufacturing car engines is a highly complex process so, instead, it will license its technology to companies already expert in making engines.

My private car is a hybrid car that uses

conventional engine power to charge a big heavy battery. It’s a wonderful car and very economical. But its huge battery, charged by a conventional engine, adds weight and sends only 14 kilowatts of power to the wheels. The battery is huge because it has to store power to drive the wheels when the engine is resting. In contrast, Aquarius’s engine and small battery generate an astonishing, measured 35 kilowatts of power. That leads me to think that the innovative new motor could find wide use beyond automobiles, perhaps in generating emergency power.

ENTREPRENEUR ELON Musk, founder of Tesla, which makes lovely all-electric cars, has been widely fêted. But Tesla sells only some 50,000 very expensive cars out of 90 million vehicles made worldwide annually, and electric cars charge their batteries using electricity often generated by high-pollution coal-fired plants – so where is the gain?

What, then, can we learn from Aquarius

about how creative entrepreneurs change the world?

The late management consultant Peter Drucker wrote a seminal article two decades ago in the *Harvard Business Review*, titled “The Theory of Business.” In it, Drucker offered a highly practical method for using theory to change the world.

Theory, he noted, is based on assumptions. Assumptions are things we assume are true. For instance, engines have to convert up-down motion to rotary motion. But Drucker urged you to challenge all your sacred-cow assumptions! If you don’t, someone will and you or your assumption may disappear.

Every business has a theory. Much of the theory is built on tacit assumptions. Businesses rarely reexamine them. And then, they fail because they keep on “doing the wrong things, even though they do existing things right,” Drucker wrote.

Drucker offered a kind of template for examining every type of assumption,

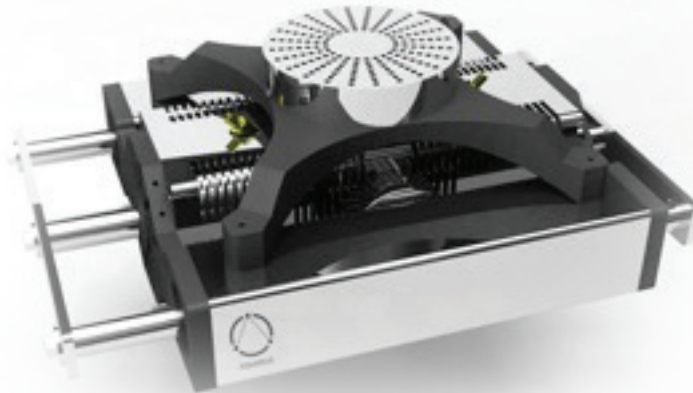
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about company products, processes, values, culture and, indeed, everything. I think it is a formula that could serve individuals well, too. At his trial, the Greek philosopher Socrates observed that the unexamined life is not worth living. Yet, most of our lives, and most of our businesses, are mostly unexamined, often until it is too late, and ideation becomes autopsy instead.

The hard part of applying Drucker's method is explicitly identifying all the things you believe are true, because you cannot challenge assumptions if you are unaware of them, and many of these set-in-concrete precepts are unwritten and simply taken for granted. For instance, we usually eat an appetizer, then main course, then dessert. Why? Because, that's how everyone dines. So why not start with dessert? I haven't had much luck in peddling that idea, but I'm not giving up.

There are many business examples. A company called Netscape challenged the idea that when you sell a product, you need to get money for it. Why? Why not give it away? Netscape made a fortune by giving away its main product, an Internet browser.

The company sold expensive software for servers and used the browser as a marketing and advertising device. Netscape's record-breaking initial public offering of stock on August 9, 1995, based on its widely-used web browser, came just 16 months after the company was founded. On that day its stock opened at \$28 a share and soared to \$75 within hours.

So, how can you change the world? Perhaps, by asking "dumb" questions. The questions are perceived by others as dumb, because they challenge things everyone knows are true and never change.

Conventional car engines have worked on the same principle for at least 150 years.

Nikolaus Otto, a German engineer, built the first practical internal combustion engine a century and a half ago – gasoline is burned in a piston when combined with air, driving the piston up and down.

The up-down motion is converted into rotary energy to turn the car wheels. The conversion process loses huge amounts of energy. Yaakoby asked why? Why convert up-down piston action to rotary wheel energy? Uh... because, like, wheels go round and round, right? Dumb question?

For many decades, and many billions of dollars in research, huge companies have tried to improve car engines, without asking that dumb question. It's obvious – because wheels are round, you need rotary energy.

OFTEN, THE key to changing the world is to find non-experts who look at challenges with fresh eyes. The art of asking "dumb questions" can change the world because "dumb questions" asked by non-experts often lead to revolutionary ideas – as in the case of the Aquarius engine. Automotive engineers are unlikely to challenge the up-down-to-rotary notion because they invest time and effort in learning it, and because that's how it's done, always has been, always will be. A principle of team-based innovation is always to have a non-expert on the team to ask those basic "dumb" questions none of the experts even think of.

I think this is what many authors, especially Dan Senor and Saul Singer in their best-selling book "Start-up Nation" mean by *chutzpa*. It is simply the impudence to challenge basic truths that everyone accepts as Gospel. Apparently, Israeli entrepreneurs have a *chutzpa* gene.

One can have big dreams about this little Aquarius engine. With some 90 million cars and trucks being produced worldwide

every year and about a billion vehicles already on the roads – one for every seven persons in the world – spewing fumes and carbon into the air and burning a trillion liters (about 250 billion gallons) of fuel, what would happen if this new-fangled engine, born out of a "dumb" question, were to replace many of the conventional engines?

Would crude oil drop to \$10 a barrel? Would carbon emissions stabilize and decline? Would the Arctic ice cap stabilize? Would the people of Delhi, Beijing and even Haifa breathe air instead of particles? Would the oil-rich nations hostile to Israel have to use their meager resources to feed their people instead of fueling terrorism? And, at last, would the world pay homage to Israel as a creative nation that is changing the world for the better, rather than, as so many ill-wishers claim, for the worse?

I'm fully aware that Aquarius can still stumble, and that the shift from the prototype engine to a full production version is fraught with challenges. Fridman knows that marketing Aquarius's idea is crucial. "When you want to change the world," he asserts, "it's not enough to have a great product. You need the right brand."

A friend of mine, a world-changer himself, told me that an automobile expert with whom he spoke doesn't think the Aquarius engine is truly viable, despite the tested working prototype. But, my friend recalled, there is a Chinese saying, "The world has two kinds of people, those who say it can't be done and those who are doing it."

My sympathies are with the latter. ■

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