

A JOURNAL OF HIDDEN CREATIVITY

# MAKE SHIFT

M

UPENN

FALL 2013

## Appropriate Technology

*IPD 561 Theories and Methods in  
Integrated Product Design*

CURATED WITH SARAH ROTTENBERG

# Makeshift keeps a keen eye on the street. We uncover creative solutions from the economic fringe, or informal economies.

Informal economies comprise the spectrum of unregulated commercial activity.



Aran operates a mototaxi in Bangkok and sells airtime for extra cash.



Isabel rents her Barcelona apartment out by the night via the Internet.

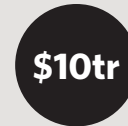


Jesus erects radio towers for a private cartel-run cell network in Mexico.

These “shadow economies” are invisible but all around us.



Two thirds of global employment



Annual “GDP” of USD 10 trillion

Informal economies vary by region—and on and offline. But they share common traits.



Network orgs instead of hierarchies



Reputation and trust instead of contracts



Ingenuity instead of financial resources

Future leaders need to pay attention to informality.



Design and policy interventions need to take account of people’s cultural, social, and technological context.



The way people do business in informal economies has implications for business models and strategies.



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**"Jua Kali" by Steve Daniels**

A Kenyan metalworker forges metal in Nairobi's Gikomba manufacturing cluster. *Jua kali* means "hot sun" in Swahili and is used to refer to informal businesses who are largely unregistered and unlicensed. Makers produce all kinds of good from housewares to farming tools to art.

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# Appropriate Technology

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# Whose Appropriate?

**WELCOME TO** the first edition of the Makeshift instructional magazine, co-curated by Makeshift and the University of Pennsylvania. Makeshift comes from a background of telling stories with meaning. These are stories of hidden creativity, most of which haven't been told before. You'll discover how entrepreneurs and makers in the furthest corners of the world think about their work.

This isn't a textbook. We're not going to teach you frameworks or include a glossary. Instead, we'll give you narrative data as fodder for reflection. We've curated stories from across all issues of the the Makeshift Quarterly and added informative callouts, prompts for discussion, and resources for further reading.

Makeshift began as an inquiry into the world of informal economies, where two-thirds of the global workforce makes a living yet little is known about the way business works. We pulled together a network of over 200 researchers, journalists, and photographers to document the full spectrum of activity.

The first edition focuses on Appropriate Technology, a term that dates back to E.F. Schumacher's *Small Is Beautiful* in 1973. He was searching for a new kind of technology between the "£1 indigenous technology" and the "£1,000 developed-world technology". He called this an "intermediate technology" and targeted it at rural communities in concert with ecology. But the ensuing decades have seen many appropriate technology initiatives flounder due to unsustainable business models and collective ownership of products.

Informal economies offer a different kind of appropriate technology—made by creative individuals solving their own problems in their

own environments, making them inherently appropriate to the context. Anthropologist Zach Hyman shows how Chinese street vendors modify their carts to their needs. Nokia researcher Younghee Jung tells a story of a Ghanaian hacker fusing SIM cards to afford his customers multiple phone numbers. Curator Ernesto Oroza recounts decades of self-sufficient making under Cuban trade embargoes.

Yet lack of regulation can make informal economies unreliable. Workers make do with hazardous conditions and irregular incomes. Despite the reliance on relationship-building, customers don't always get what they bargained for. That's why hybrid designs have emerged in recent years—design interventions that respect the norms embedded in the informal ways people conduct work. Journalist Rob Goodier interviews the inventor of the Tip Tap, which repurposes oil cans into water taps. Bicycle enthusiast Anthony Siracusa relays experiences at Maya Pedal, which converts old bicycles into income-generating machines. And Erin Siegal catalogs several "sneakernets", which modify motorcycles and boats to deliver Internet access to unserved areas.

Understanding these contexts can make or break an intervention. It's the difference between a well that sits unfixed for years and a mobile money service with adoption in the millions. Does your technology fit the way people work? Is it a platform? Can it be hacked to fit unseen use cases? The pages to come are meant for you to question what it means for technology to be truly appropriate.

## Steve Daniels

*Director, Makeshift*

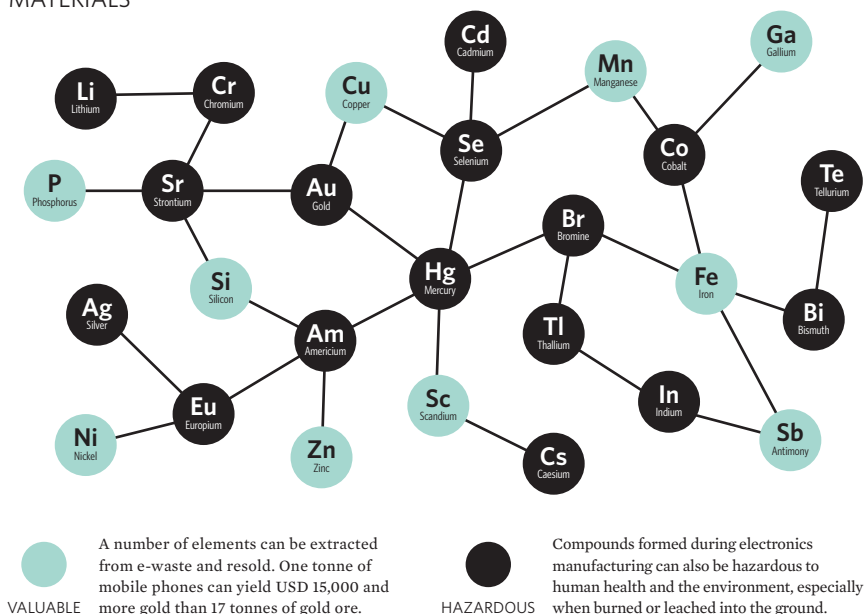
## Sarah Rottenberg

*Associate Director, Integrated Product Design Program at the University of Pennsylvania*

# The Electronic Afterlife

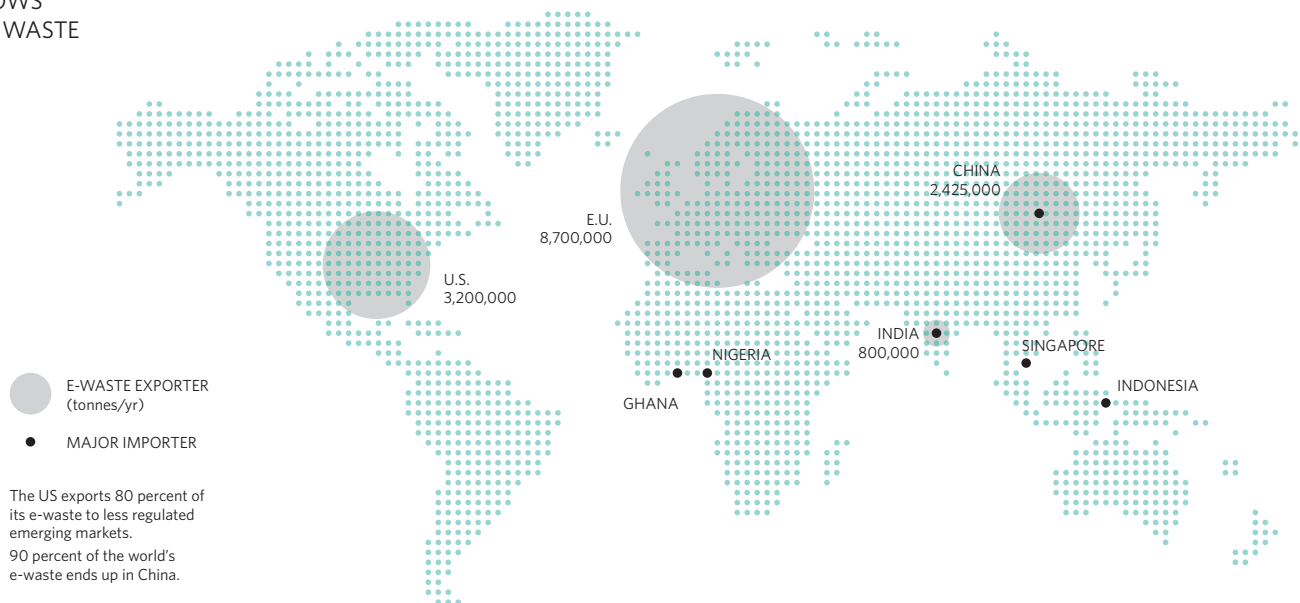
**MILLIONS OF TONNES** of electronics are disposed each year, triggering a chain of devastating effects. Most units end up in landfills, where hazardous components seep into groundwater. Of the units recycled, most are shipped to less-regulated emerging markets—often labeled as donations—where valuable components are extracted with little regard for safety. An analysis of e-waste reveals frightening truths about the relationships between consumption and waste and between formal and informal systems.

## VALUABLE AND HAZARDOUS MATERIALS

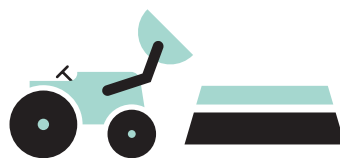


Note: All hazardous elements are also valuable because they are used to manufacture electronics.

## FLOWS OF WASTE



## DISPOSAL AND RECYCLING PROCESSES



### Landfiling

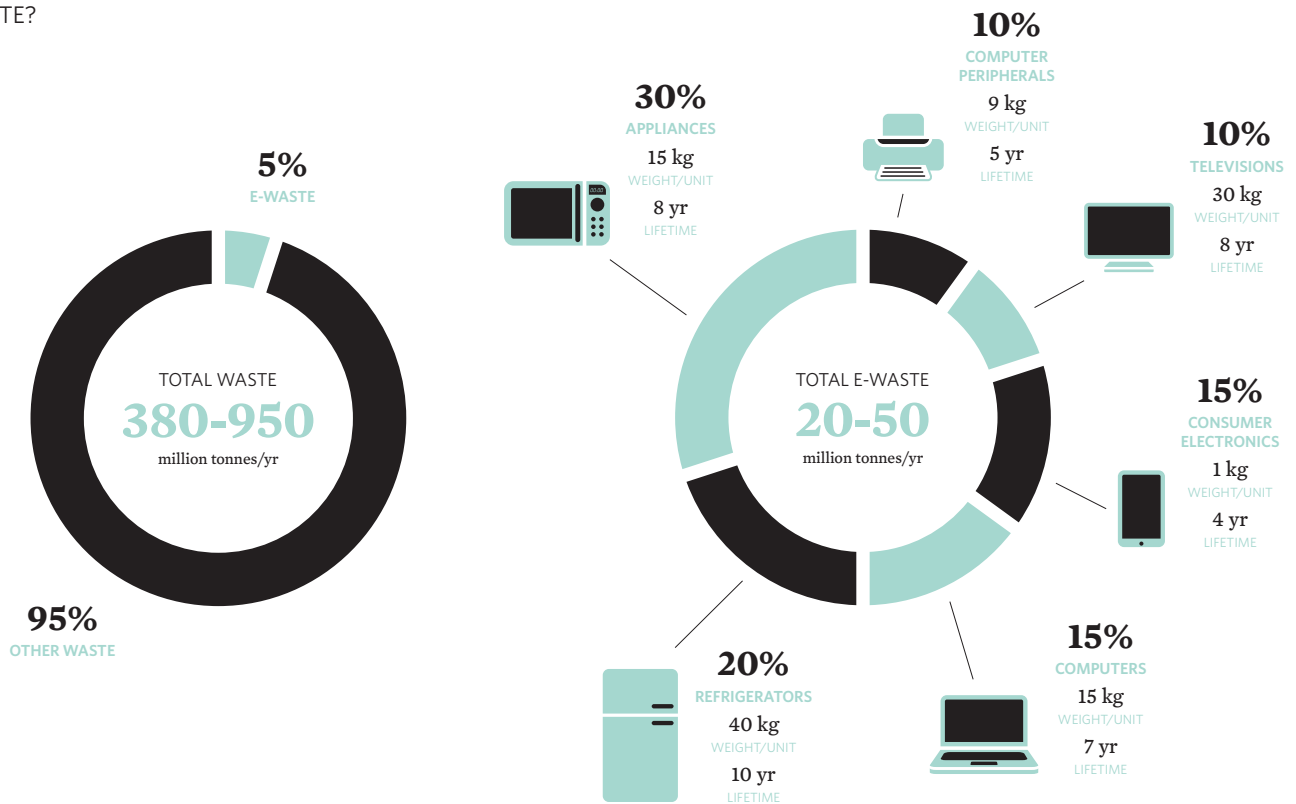
Landfiling is the most widely used method of disposal, though dangerous because all landfills leak. Heavy metals and other toxins can contaminate ground and water resources.



### Incineration

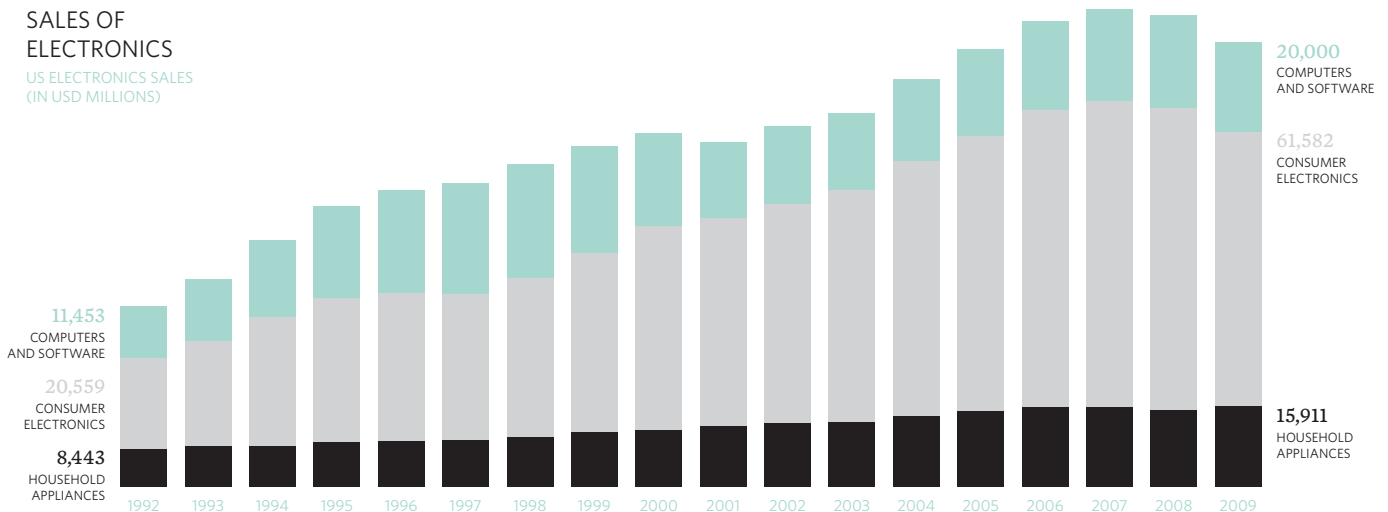
Incineration of e-waste can release hazardous components into the air and destroy valuable ones. In particular, copper and PVC have been found to release toxic dioxins when burned.

## HOW MUCH WASTE?



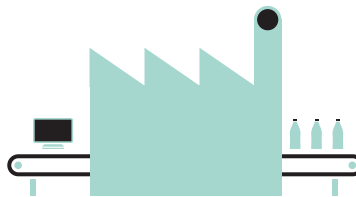
## SALES OF ELECTRONICS

US ELECTRONICS SALES  
(IN USD MILLIONS)



### Open burning

Open burning, a common informal practice, releases far more toxins than controlled incineration. Inhalation by workers in "e-waste villages" can lead to lung disease and cancer.



### High-end recycling

Safe high-end processes include the extraction of valuable components, mechanical shredding and separating, and refining to obtain raw metals, plastic, and glass.



### Reuse

Reuse and resale of products can prolong their life with minimal impact. The most environmentally friendly products are easy to maintain, last long, and avoid obsolescence.





01

# Mei Banfa Engineering

## Abstract

Chengdu's street vendors hack their way through any problem.

Text and photos by Zach Hyman

**In Chinese**, mei banfa means “there is nothing that can be done”. This phrase comes out in response to queries like, “Is there any possible way to buy a train ticket now?” or “Does your accounting error really mean my apartment will be without electricity for the entire weekend?”

These concerns are tripping, however, compared to those whose machines drive the street trade. Engine overheating in a traffic jam? Hack a

radiator together to cool it. Or weld a water tank to the roof to pipe water in. Something, it appears, can always be done.

I learned the breadth of possibilities in Chengdu. After an afternoon working in a factory assembling electric vehicles, still in a grease-coated, undersized factory uniform, I set out down the town's singular street in search of food.

Parked on a corner, I spied a full-sized rotisserie cooker spinning lazily, bathed in a dim yellow glow from the adjacent street light. The apparatus sat mounted on the back of a three-wheeled vehicle, a radiant beacon of food under neon light. “Hey foreigner!” shouted the owner, Wei Fang, not expecting me to speak Chinese. “Try some duck!” 22 yuan (USD 3.50) later—after explaining my research between spicy mouthfuls—he agreed to an interview as he closed up shop.

During daylight hours, he powers his rotisserie (and a small portable radio) from the adjacent

mobile phone store, for which he pays 460 yuan (USD 75) a month. Once the phone shop closes around 7 p.m., he switches to a car battery run through an inverter. Natural gas heats his rotisserie, with the canister set on the curb, protected by the vehicle's front wheel. His cook shack was originally designed as a cart, but he retrofitted it by setting it upon a pair of logs and using bicycle tires and plastic bags to cushion the punishment of the city's potholed roads. Overall, a rugged cooking machine.

## Hacking Language

Jury-rigged solutions with whatever materials are at hand are a phenomenon around the world, and many languages have a term for them: English - *hack*  
Hindi - *jugaad*  
Portuguese - *gambiarra*  
Swahili - *jua kali*  
Mandarin - *zizhu chuangxin*





02

## Rocky Relations

Since their foundation in 1998, the chengguan have been a public relations nightmare. Tasked with enforcing local ordinances like sanitation, dispersing crowds at protests, and cracking down on unlicensed street vendors, the bureau has become known for overzealous and violent methods. Videos and photos spread on social media show chengguan officers abusing street vendors and citizens, cementing their reputation as bullies. Desperate to improve their image, one district in Chengdu has replaced the ranks with tall, attractive young women, hoping to display the department's softer side.

After poring over the vehicle's specs, we turned to motivation. "Why did I modify my vehicle in this way?!" he asked, gesturing to his vehicle with one hand, brandishing a fried duck with the other. "I have to make a living, right? So mei banfa!" He paused for a beat, then, breaking into a grin, added: "I've always wanted to make it big, though—ever since I was 10, all I wanted was to buy a BMW or a Mercedes."

Lacking access to fully functional equipment, his hacks to pushable food dispensers were the only way. Yet if ingenuity alone fulfilled goals, this vendor would surely already boast a stable full of German auto imports.

Before departing for the suburbs, I met another graduate of the Mei Banfa School of Engineering. Liu Minfeng's rig is a pedal-powered cargo tricycle from which he sells "Brazilian barbecue": pork carved from a rotisserie, mixed with lettuce and scallion, topped with a dash of chili powder and stuffed neatly into a pita—all for six yuan (less than USD 1).

As with the duck vendor, mounting a rotisserie on to his

cargo tricycle was not without its difficulties. "When I bought the cooker three years ago, I had to remove that part so I could turn it by hand," he said, pointing to one side. "Electricity would be more convenient, but there's no room for a battery, so mei banfa."

He only sells Brazilian barbecue in winter when the weather calls for hot food. In summer, he removes the entire rotisserie cooker, throws his tools in the back of a stripped-down version of the same trike, and cycles across Chengdu advertising his services as an all-around repairman.

He explained how the neighborhood's astronomical rents made getting his own space a far-off dream, his analysis revealing the depth of his familiarity with all of his costs. "Each barbecue pita," he explained, "uses two mao (USD 0.03) of natural gas."

A shrill ringtone interrupts our conversation. He answers his phone, speaking in clipped monosyllables, scanning the street. It's his wife, calling to share news of more pedestrians—slang amongst fellow mobile vendors for both potential customers

and greater risk of *chengguan*. Chengguan is the municipal force tasked with "ensuring a beautiful city". Until recently, they were infamous across China for their ruthlessness against informal vendors. Though rumored to have eased, they won't hesitate to impound a vendor's cart, vehicle, or inventory if the mood strikes to enforce rather than disperse.

I moved with him down the street to join his wife and fellow wary vendors. Among them, an elderly man with a modified ricecooker on the back of his tricycle, filled with hard-boiled eggs marinating in warm tea. Another's electric bicycle sat covered with multiple split soda bottles and hollow bamboo segments, each bursting with bright blossoms for sale.

After several brisk minutes of sales, however, the vendors frantically began to pack their wares. Across the street, a white truck with municipal insignia emblazoned on its doors rolled to a stop, its roof-mounted loudspeakers blaring orders to disperse.

"Time to move again?" I ask. "Mei banfa," he replied, with a knowing grin. ●

Chicken and pork, hacked onto tricycles, provide the essential moveable quality to their respective feasts (01, 02).



**Mei Banfa**  
**Engineering**  
p. 10

## For Discussion

1. Wei Fang modified his vehicle to suit his specific situation. How can products be designed to suit the needs of most but still be extensible?
2. Some view hacks and improvised solutions as an ingenious use of resources, while others see them as slipshod. What cultural factors breed each position?
3. Liu Minfeng's trike does double duty, acting as a food truck in the winter and a handyman's transport in warmer months. Might consumers pay more for products that fill multiple roles? Why do multifunctional products remain relatively unpopular?
4. Many city governments view street vendors as a noisy, street-clogging nuisance, especially since relatively few pay taxes. From the vendors' perspective, their unregulated
- hawking is often the best employment option available. China's government sends the chengguan to forcibly oust the sellers, some cities seek to license and regulate vending, and still others take a laissez-faire approach. What might be a reasonable balance?
5. Wei is allowed to hack his truck as he sees fit, but many companies are increasingly restricting what owners can do with their devices. Apple now uses tamper-resistant screws, and Sony has taken legal action against a user who published hacks for the PlayStation. Should users be able to do what they wish with purchased products? What are the risks?
6. As demand wanes seasonally for one of Liu's businesses, he focuses on another. What sectors or companies could expand by repurposing existing capabilities? Or by maximizing
- underutilized capabilities?
7. Wei mentions that since the age of 10, he has aspired to "make it big" and one day buy a Mercedes or BMW. The author notes, "If ingenuity alone fulfilled goals, this vendor would surely already boast a stable full of German auto imports." How does a street vendor's innovation create upward social and economic mobility? Are there limits? What strategies would you recommend to stabilize and grow Wei's business?
8. What would happen if Wei or Liu shared his product hacks with others? Would shared innovation benefit every vendor more than individuals keeping trade secrets? How does this play out in other industries, such as software development or consumer goods?

## Further Reading

**Basinski, Sean; Candy Chang; John Mangin; Rosten Woo (2009) Vendor Power.** A multilingual, highly visual guide aimed at New York City's street vendors, helping them navigate a complex system of regulations. [bit.ly/HS8WT9](http://bit.ly/HS8WT9)

**Radjou, Navi; Jaideep Prabhu; Simone Ahuja (2012). Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth.** How can Western companies look to places like India, Brazil, and China for a new approach to innovation? This book describes

the six main principles of jugaad innovation with case studies. [bit.ly/HWCRd4](http://bit.ly/HWCRd4)

**McDonough, William; Michael Braungart (2002). Cradle to Cradle: Remaking the Way We Make Things.** This book asks readers to rethink the entire life of a product and encourages designs that can be upcycled into other, equally useful products. [bit.ly/1buVnQY](http://bit.ly/1buVnQY)

**Zhang, Yueran (2013). Can China's Hated Local Police Reform Their Image? The Atlantic.** This story

outlines several measures the Chinese government has taken in order to resuscitate the image and legitimacy of the chengguan—tasked with enforcing urban beautification ordinances and cracking down on unlicensed vendors. [bit.ly/17bkNoL](http://bit.ly/17bkNoL)

**Badger, Emily (2013). Inside the Thriving World of Bangkok's Semi-Legal Street Vendors. Atlantic Cities.** This video tells the stories of two men: a corporate refugee who sells earrings and a recent immigrant to Bangkok from rural Thailand who sells sugar cane juice. [bit.ly/1aK7x7C](http://bit.ly/1aK7x7C)





## Kabul, Afghanistan

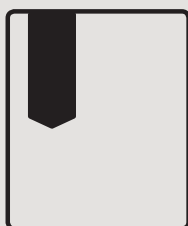
*Massoud Hassani*

Equipped with a GPS receiver, Hassani's "Mine Kafon" rolls over Afghanistan's most dangerous tracts of land. With 10 million mines and a specialist killed for every 5,000 removed, the homemade device could be a life saver.



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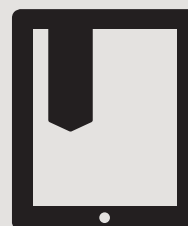


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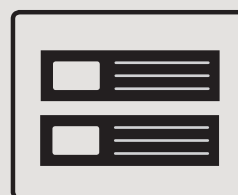
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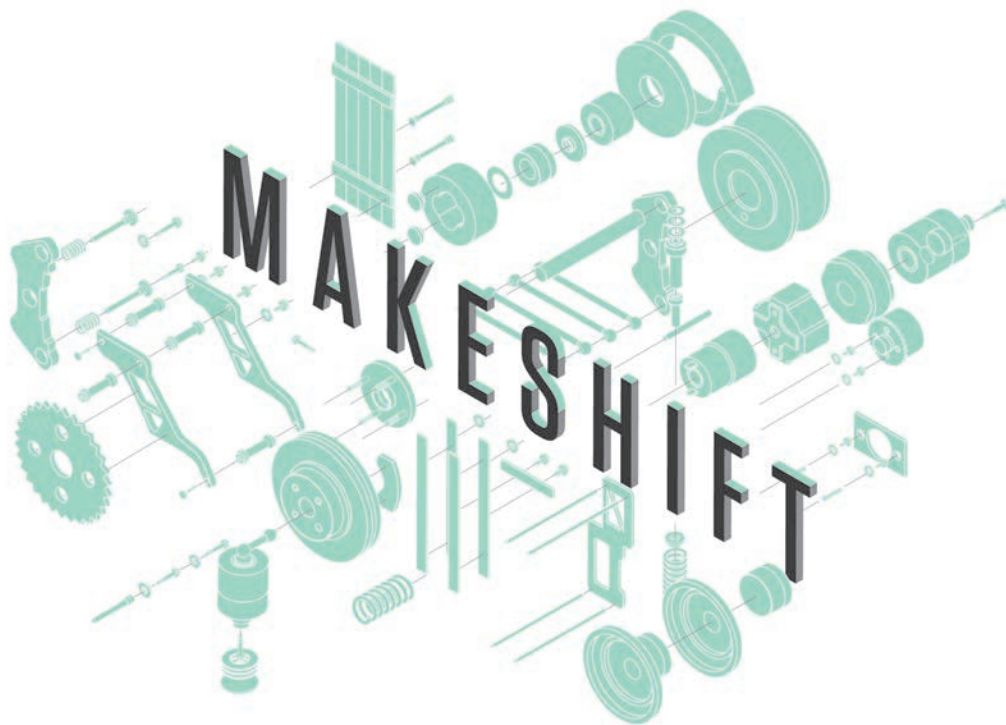


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