EVERYONE DESERVES GREAT DESIGN: 
DESIGN TOWARDS THE 100%

BY
EHSAN NOURSALEHI

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Master’s Committee:
Professor David Weightman, Chair
Professor William Bullock
Professor Madhu Viswanathan
ABSTRACT

This thesis illustrates that everyone deserves great design and suggests methods on how to achieve it. A new mindset for product design is developed and presented here advocating for incentives, both economic and humanitarian, in order to create more equitable products around the world for people without discriminating based on traditional geographic, economic, or cultural stereotypes.

It is argued that it is possible to intentionally create great designs for everyone by using the following four principles:

1. **Simultaneously Embrace Desires & Constraints**
   
   *Create a solution that embraces and satisfies constraints & desires. It must be simultaneous. One cannot ignore the other.*

2. **Minimize Resource Inefficiencies**
   
   *Start with a systematic analysis of the product. Use first principles to reinvent problematic aspects.*

3. **Optimize Value**
   
   *Provide the maximum functional, social, and emotional value for a minimum initial investment and low long-term maintenance cost.*

4. **Dignify Everyone**
   
   *We are all human. Do not discriminate based on geography, culture, or economic status. A homeless person and the President should be treated equally.*

These principles are utilized to curate 40 examples of great design for everyone and discussed in relation to two case studies.
Dedicated to my colleagues, friends, brothers, and co-founders of Bump Nonprofit Design Studio for helping me discover the topic for my thesis through our incredible work on the OpenSocket prosthesis
ACKNOWLEDGEMENTS

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It would have been impossible to create such high fidelity prototypes of my shoe design without the advice and craftsmanship of my good friend Adam Booher. A special thank you to Sudeep Gowrishankar for spending countless hours listening to my thoughts and ideas and constantly challenging me to improve and refine my arguments. An additional thank you to Mona Ghadiri for skillfully editing and correcting my sloppy prose.

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Chapter 1 - Preface

“Discovery consists of seeing what everyone has seen, and thinking what no one has thought”

— ALBERT SZENT-GYORGYI, NOBEL PRIZE 1937

In 2009, my engineering classmates and I decided we wanted to spend our free time designing an affordable prosthetic arm for the developing world. One thing led to the next and we went from designing an arm in our free time to starting a 501(C)(3) nonprofit organization with dozens of volunteers and partners in over 20 countries around the world.

![Brainstorming ideas for an affordable prosthetic arm circa 2009](image)

We were engineering undergraduate students with a lot of ambition and a little bit of free time. I found myself thinking more and more like a designer everyday. I was skeptical of engineers just doing cool stuff and assuming that people will want it as a product. I kept thinking about the user and questioning what they would actually want.

We interviewed dozens of amputees in Guatemala & India over a four-year period as our prosthetic arm went from concept to reality. I got to know their life story, their families, what music they like, what made them tick, and even visited many of their homes.
I began to gain a new appreciation for what it meant to be both an amputee and to be an amputee in the developing world. However, one thing was predominantly clear, even though these individuals would accept any help they could get, when you would ask them what kind of arm they truly wanted, it was overwhelmingly clear that they wanted a lifelike robotic terminator arm. They wanted a prosthetic arm so good that it doesn’t even exist yet anywhere in the world.

![Image of a person wearing a robotic arm]

_Figure 2 - Testing our two earliest prototypes circa 2010_

Just like us, these amputees had ambition. Their circumstances were dire, but they had aspirations, desires, dreams, and vanity all the same. It would be unjust to look down upon these individuals and assume that they would gladly accept a poorly designed prosthetic arm as a miraculous lifesaver just because they were unfortunate enough to live in the "developing world".

We created a product that I am truly proud of—the OpenSocket. It is an "off the shelf" prosthetic socket for below elbow-amputees. It comes in three sizes, small, medium, and large and can be fit in 30 minutes using a few basic hand tools. This is an impressive process improvement to the current standard of custom-made arms, which take between a week to a few months to fabricate and fit.

The OpenSocket is a product that has exceptional value to amputees in both the developing world and the developed world. However, despite having a product with great design, our organization is struggling to endure to become more than just a 5-year project. Financially, it is very difficult to sustain an organization dedicated to providing prosthetic limbs internationally due to the dispersed nature and relatively small quantity of amputees around the world.
Figure 3 - I watch on after training a young lady how to use her new arm circa 2013

Nevertheless, I hope to share some of what I have learned over the past 5 years developing the OpenSocket so other engineers and designers get a jump start off my endeavors instead of having to start from scratch. That is the objective of this thesis.
Chapter 2 - Introduction

“Great design satisfies both our needs and our desires” (Brown, Design Thinking)

— TIM BROWN, IDEO

Every human being deserves to have their needs and desires met whether it is through faith, relationships, communities, services, or products.

Industrial designers have limited ability to influence faith, relationships, communities, or services etc. Instead, they focus on manipulating and assisting human capabilities, needs, & desires through the design of products. As Tim Brown, the CEO of IDEO, states, great [product] design simultaneously satisfies both human needs and desires (Brown, Big Idea 2013: Designing the Necessities of Life.).

The current model of product design assumes only the most wealthy individuals in the world, the top 10%, have needs and desires, or only these individuals’ needs and desires that are worthy of satisfying. That is an inappropriate assumption. Non-wealthy humans, the other 90%, have needs and desires, same as anyone else.

The following thesis makes a case for why everyone deserves great design and provides a working methodology and new mindset for product design that advocates for economic and humanitarian incentives to create more equitable products for people around the world without traditional discrimination based on geographic, economic, or cultural status.

This thesis will explore three incentives for why such a mindset is worth implementing:

1. **Large multinational companies** are afraid of being disrupted by smaller companies practicing reverse innovation.
2. **Social designers** have a desire to help make widespread impact but often do not know how.
3. **The poor** are not simply looking for handouts and want to better themselves and seen as **equals** in society.

Designers must ask themselves:

A. Why are products designed for the “poor” so bad that no one else wants them?
B. Why are most traditional products so inefficient and expensive that poor people cannot afford them?

Fundamentally, everyone deserves great design. It is a matter of how to achieve it.
Chapter 3 - Mindset

“Whether you think you can or you think you cannot, you are right”

— HENRY FORD

3.1 THE POWER OF A MINDSET

**mindset** noun – a particular way of thinking; a person's attitude or set of opinions about something; a mental inclination, tendency, or habit

A mindset is intentionally or unintentionally adopted over time. They are filters on life, shaping perspectives on what is right and wrong, influencing emotions, and even affecting who and what is believed to be in our power to control.

Religious beliefs, laws, science, pop-culture, or our own experiences shape mindsets. Regardless of how, they exist and they have influence. Mindsets trigger incentives to react or behave in particular ways.

![Diagram: Thoughts, Actions, Mindset, Beliefs, Results](image)

*Figure 4 - At the core of our beliefs, thoughts, actions, and results, is our mindset (Shanks)*

Consider this: What is the role of a priest other than to create a powerful mindset in the minds of his fellow worshippers? He wants to entice and encourage certain recommended behaviors.
Product designers must ask themselves: what is their mindset? Are they aware of what mindset or stereotypes they have adopted? How do these mindsets influence perspectives and behaviors in product design? How do designers ultimately influence the millions of people in this world that consume and utilize products on a daily basis?

3.2 THE NEGATIVITY OF “DESIGN FOR THE OTHER 90%”

“Too often we objectify people living in poverty. We paint them as two-dimensional characters that we pity” (Timmerman)

— KELSEY TIMMERMAN, WHERE AM I WEARING?

The inspiration for this thesis arose from strengths and weaknesses of “Design for the Other 90%” presented by the Smithsonian in 2007 as both an exhibit and companion book. It embodies the mindset of numerous social designers that rally behind the needs of underserved peoples in developing countries (Smith, Design for the other 90%). The Smithsonian and its partners increased visibility and helped numerous individuals and designers shift their focus to less fortunate people around the world. They took a very important first step in the right direction. However, caring is just the first step to solving any problem.
Figure 5 – The cover of Smithsonian’s “Design for the Other 90%” book visually belittles the user of an otherwise great product by having her drink water from next to her own feet using the personal LifeStraw water filter (Smith, Design for the other 90%)

Unfortunately, the ideas behind “Design for the Other 90%” unintentionally give designers a mindset that looks down upon the very people they are trying to help. This type of mindset, and similar ones such as “Design for Extreme Affordability” at Stanford, often contribute in producing products that few individuals desire to own. Social designers let images form in their minds all too easily of “rescuing” a helpless consumer desperate for aid without questioning their own potentially discriminatory assumptions or biases (Illich).
Figure 6 - Advertising images used by LifeStraw to advertise their $19.99 personal water filter on Amazon.com. In both Western and Non-western contexts the individual drinks water out of a form of water bottle. The product features an exceptional rating of 4.6 out of 5 stars from 690 customer reviews (LifeStraw).

There is no inherent derogatory flaw in the LifeStraw product per se – however, the marketing is flawed. One only has to compare Figure 2, generated by the Smithsonian, and Figure 3, generated by LifeStraw, to see the stark contrast arising from something as simple and overlooked as a mindset.

This type of mindset results in a mentality that approves products designed for the poor/minorities as "good enough", and it’s a bonus if anyone else wants them. Also, as many of these products are given away as charity to their users, there is no feedback loop from consumers to business (or usually nonprofits) in order to measure and refine product quality. We applaud products such as the LN-4 prosthetic arm and the Free Wheelchair despite their shortcomings.
Figure 7 - The LN-4 prosthetic arm designed and distributed by the Ellen Meadows Foundation. The arm costs about $50 to produce and is given away for free to recipients. It was designed for children [left] but the same product is today widely and primarily distributed to adult recipients [right]. The LN-4 arm is a suitable product for a child – it is dimensioned relative to a child’s proportions and can assist in lifting a few pounds. However, the same exact product, which is distributed to adults, is insulting – the arm looks like a toy on a grown man and the three Velcro straps come undone if the user attempts to lift more than 5 lbs (Ellen Meadows Foundation).

The charitable organizations behind each of these products (Ellen Meadows Foundation & Free Wheelchair Mission) have noble objectives that deserve support and respect. However, this respect should not prevent designers from consciously and critically criticizing the quality of their products and the products of many other organizations that do similar work and the numerous designers that are inspired by their work and thus design more similar products.

The individuals being served by these organizations typically live in extremely difficult situations but the last thing it means is they deserve horrible products. A bad or insulting product is worse than nothing at all. It also deters users from be open minded about other potential breakthroughs.
The Smithsonian later followed up with a second series in 2011 titled “Design With the Other 90%: Cities” (Smith, Design with the other 90%: cities). The key change is the use of the word “with” instead of “for” – a subtle change, but not in terms of inclusivity. It had a huge positive impact on mindset, therefore resulting in a very different and much more extensive project by the Smithsonian.

We don’t want to dismiss efforts of organizations such as the Smithsonian, Ellen Meadows Foundation, or the Free Wheelchair Mission; however, their products leave much to be desired. Something instead of nothing is good, but not at the risk of providing poor quality products. We must be active designers and not accept their mindsets or products without question. We need to consciously push ask whether or not we can do better (Donaldson).

### 3.3 NON-DISCRIMINATORY ACCIDENTS

Can you imagine a traditional western consumer who needs a prosthetic arm or a wheelchair using either the LN-4 arm or the Free Wheelchair?
Both of these products discriminate heavily against their users. They assume that since the potential users are beggars, that they don’t deserve to choose their products. Of course, that is not the intention, but that is the result of poor product design combined with a mindset of charity. This is stifling social design for the developing world.

By looking at three massive multinational companies, Coca Cola, BIC, and Nokia, it is possible to develop and distribute very equitable and non-discriminatory products in the pure pursuit of business success. The products of these three companies have become so widespread and successful, they are often considered ubiquitous.

Table 1 - A COMPARISON OF CHARITY VS CAPITALIST PRODUCTS

<table>
<thead>
<tr>
<th>CHARITY</th>
<th>CAPITALIST</th>
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<tbody>
<tr>
<td>- Requires donation</td>
<td>- Respects customers</td>
</tr>
<tr>
<td>- Can belittle the user</td>
<td>- Needs sales to survive</td>
</tr>
<tr>
<td>- Users tend not to value the product</td>
<td>- Users won’t buy if they don’t value the product</td>
</tr>
<tr>
<td>- No feedback loop to improve the product</td>
<td>- Direct feedback loop improves the product</td>
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3.3.1 COCA COLA – Fizzy Sugar Drink

*Ever wonder about how a homeless person on the side of the street and the leader of the free world consume the same fizzy sugar drink to quench a thirst?*

Coca Cola as a product treats every citizen on this planet with equity – and in that equity, is their building block to global business success. It is the most ubiquitous product in the world. Coca Cola shows the massive worldwide potential for products that embrace innate human needs & desires without discrimination. A simple Coca Cola drink exhibits far more equity than the majority of products in the world.
Was Coca Cola trying to achieve a social mission or to help the world with its fizzy sugar drink? No. However, despite an absent social mission, its product is in the hands of virtually every human being on this planet – the same product, without discrimination. Everyone, everywhere in the world, no matter how rich or how poor, can enjoy a Coca Cola. The President of the United States, despite all of his resources, does not have the ability to buy a better Coca Cola than a homeless man on the side of the street.

Yet, this equity was achieved largely by accident. Equity came in the pursuit of expanding market share and increasing profits – but it shows, that even if by accident, it is possible to create very
desirable products which satisfy human needs and desires without discriminating based on geographic, economic, or cultural status. Versatility in product must be a goal for all designers.

3.3.2 BIC – Ball Point Pen

BIC Cristal pens are not the best pens that exist in the world. Yet, there is no pen quite as great as a BIC pen. It is cheap, durable, sold everywhere, it doesn’t leak, it writes smoothly, the ink dries quickly, and clearly informs you how much ink you have left, all in a simple chic form factor. Over the years it has become an icon of design, reliability, and brilliant ideas.

![Figure 11 - A BIC advertisement featuring J.K. Rowling’s BIC Cristal pen and a timeline of her various novels. She is known to have written much of her novels using a pen and napkins.](image)

Unlike, a Coca Cola drink, numerous pens are considered better than a BIC pen. Even the BIC company sells pens that are more expensive than their Cristal pen being referred to here. However, the BIC Cristal pen is an extremely equitable product that offers tremendous value in return for its small cost. It does what it is supposed to do, and has a variety of applications.
This tool is widely used by wealthy artists, designers, students, taxi drivers, and shopkeepers alike.

Comparing BIC’s stock price to Coca Cola’s, we easily see that their stock is today valued at over twice the price of Coca Cola’s (Wolfram). It is interesting to see that the stock value for a pen company is double that of one of the biggest brands in the world (Interbrand).
3.3.3 NOKIA – Reliable Mobile Phone
The developing world skipped over landline phone systems. In the face of limited resources, they are expensive, difficult to access, limited in function, expensive to maintain, and ultimately have very poor value performance. Mobile phones today can make the difference between subsistence farming and having a few extra liters of milk to sell, just based off text messages that are sent to farmers that help increase their herd’s milk resources. Mobile phones in the 21st century are as crucial to human survival and development just like water, food, and shelter.

3.3.4 Conclusion
All three of these are great products that serve many of the same purposes between socio-economic groups. Imagine instead that a nonprofit or a social designer wanted to design a pen for the other
90%. This would be a worthless endeavor. There is no guarantee this design would be better than a BIC pen.

It is counter intuitive to think that a great way to make a product for the poor is to make a product for the rich. Yet, Coca Cola, BIC, & Nokia show that it can be an exceptional way to create valuable & accessible products for all—rich and poor. These products purely and efficiently satisfy human needs and desires.

Their purity makes the products understandable. Their efficiency makes the products affordable and reliable. The satisfaction of needs & desires is something that any human aspires to.

A truly great and successful global product design has no need per se to discriminate between one human being and the next.

Designers must stop producing cheap undesirable products and instead focus on intentionally mimicking the achievements and successes of products like Coke, BIC, and Nokia that have impacts on both the wealthiest and poorest people on this planet.
Chapter 4 – Design & the Changing World

“I like reminding people of all the things that we take for granted now: a life expectancy doubled that of a century ago; drinking water that didn’t kill us; the creation of new tools for collaboration and civic participation. I liked talking about progress not because I thought we could rest on our laurels, but because talking about progress was a particularly effective way to inspire people. Life on the whole, was getting better, and it had been for a while now—so why not gather together and dream up new way to keep those trends going? That was the progressive tradition I wanted to belong to: one that predicated on home and optimism, not because those were nice slogans for a political campaign, but because there was plenty of evidence out there that suggested optimism was warranted” (Johnson)

— STEVEN JOHNSON, FUTURE PERFECT

The world is changing and it will continue to change. We are transitioning from a pre-computer era to everyone having the ubiquitous computer in his or her pocket (Friedman). It is a very transformative period occurring more rapidly than the Industrial Revolution. Design has a role in this global change as laboratory technologies evolve into useful consumer products.

We are in a new age where information is instantly accessible and transmittable around the globe (Friedman). Facebook purchased an instant messaging phone app, Whatsapp, for $19 Billion USD because it has 450 million users primarily in emerging markets such as Latin America, Africa, and India. Companies want opportunities to engage with new users to be more profitable. (Chatterjee and Ahmed). What better way to be more profitable than including more consumers in your end user audience?
4.1 THE THREAT OF REVERSE INNOVATION

“GE has tremendous respect for traditional rivals like Siemens, Philips, and Rolls-Royce. But it knows how to compete with them; they will never destroy GE. By introducing products that create a new price-performance paradigm, however, the emerging giants very well could. Reverse innovation isn’t optional; it’s oxygen” 
(Immelt, Govindarajan and Trimble)

— JEFF IMMELT, GE CHAIRMAN

A 2006 Bloomberg Magazine article titled Emerging Giants discusses an increasing trend of successful companies rising from developing countries to become serious competitors in Western countries (Engardio, Arndt and Smith).

What makes these upstarts global contenders? Their key advantages are access to some of the world’s most dynamic growth markets and immense pools of low-cost resources, be they production workers, engineers, land, petroleum, or iron ore. But these aspiring giants are about much more than low cost. The best of the pack are proving as innovative and expertly run as any in the business, astutely absorbing global consumer trends and technologies and getting new products to market faster than their rivals. (Engardio, Arndt and Smith)

They name cell phone, pharmaceutical, tractor, and computer businesses emerging from countries like China, India, and Brazil to compete with incumbent companies in the US and Europe (Engardio, Arndt and Smith).

Techtronic, for example, was the first to sell heavy-duty cordless tools powered by lightweight lithium ion batteries. Jetmaker Embraer’s sleek EMB 190, which seats up to 118, has taken smaller commercial aircraft to a new level with a fuselage design that offers the legroom and overhead luggage space of much larger planes. (Engardio, Arndt and Smith)

As they point out, all of this is possible because of the new age of internet enabled globalization (Engardio, Arndt and Smith).
Globalization and the Internet are ushering in this "seismic change" to the competitive landscape, says management guru Ram Charan. Because they can tap the same managerial talent, information, and capital as Western companies, "anyone from anywhere who sets his mind to it can really restructure an industry," Charan says. "Make no mistake, this now is a global game." (Engardio, Arndt and Smith)

The quote below really drives home the point that companies cannot ignore what is going on in emerging markets, otherwise, they will be left behind by the competition, the Emerging Giants (Engardio, Arndt and Smith).

No matter how the big U.S. companies respond, gone is the era when they could afford to wait for an emerging market to ripen, then count on their ability to roll over the unsophisticated local players. "If you don't participate in these markets, you not only miss opportunities but also are cut out of all the innovation that comes from competing there," says University of Michigan management strategist C.K. Prahalad. "Then you won't be able to withstand the pressure when these companies come and hit you here." Whether one chooses to confront or collaborate, the new multinationals are set to change the rules in industry after industry. (Engardio, Arndt and Smith)

Big multinationals have to do adopt new methods of innovation in order to stay relevant. They need to compete in markets they would traditionally ignore and serves users that were previously ignored for being considered too poor. To this point, Andrew Stein argues that the biggest opportunity for disruptive innovation is to "Deliver Value to those in Poverty" (Stein):

A disruptive innovation is a breakthrough innovation that transforms a product or service that was so complicated and expensive in the past that only a few people could afford it. That disruptive innovation democratizes a new product or service, and enables significantly more people to gain access to an innovation that was previously unavailable. Disruptive innovation enables businesses to pursue completely new markets. (Stein)

He mentions several radical and recent business model innovations arising from the developing world that flipped traditional assumptions on their head:
Consider that others have already found ways to re-engineer traditional approaches that by western thinking alone left this portion of the world behind. Consider how Nobel Laureate, Muhammad Yunus of the Grameen Bank came up with the idea to invent the microcredit industry by thinking differently about credit-worthiness of borrowers living in poverty. Consider how Dr. Venkataswamy founded India’s Aravind Eye Hospitals through a new business model providing vision care to patients regardless of ability to pay – driven only by the notion that everyone deserves to see, and no one who can be helped should remain blind. (Stein)

The real question though is not necessarily even about per se helping the poor; it is about being a profitable and innovative company. This new age in the changing world is showing how globalization and capitalism can harmonize with social good.

This is the kind of creativity thinking of how to serve customers that your company should be thinking about. How should McDonalds Corporation serve this portion of the pyramid? I don’t know, but I’m fairly certain it’s not through expansion of the existing business in its same form. How should Procter and Gamble, Coca Cola, Boeing, Ford, and others provide products to this part of the global market? What are the possibilities? What trends and environmental factors change the game? (Stein)

By Designing toward the 100%, we can satisfy a growing desire for more equitable products, and in the process optimize the profits of companies competing on a global scale.

These articles in conjunction with the work of Hans Rosling display a compelling business incentive to cater to the economically poor that are rising in economic status (Rosling, 200 Countries, 200 Years). However, it needs to be kept in mind that people are people and people have desires. It cannot be assumed that just because people are economically lesser off that they desire anything less than what wealthier people desire, which is where Design for the 100% comes in.

Rosling demonstrates how a product taken for granted in the West, the washing machine, has a huge impact on overall quality of life, education, and health (Rosling, Hand Rosling and the Magic
Washing machine). The washing machine is a product that has not been designed towards the 100%.

If a company managed to design and distribute a washing machine designed towards the 100% they would do a great service to help both lower and higher income individuals satisfy a crucial need while also earning enormous revenues. That is the inevitable win-win nature of future business and product design.

4.1.1 GE SUCCEEDING AT REVERSE INNOVATION, ACCIDENTALLY DESIGNING TOWARDS THE 100%

One of the most significant reverse innovations by a major company has been the development of a portable ultrasound device by GE. Traditional ultrasound devices cost over $100,000 and need an entire hospital room. Traditional devices work great for large hospitals in the US. But in China, hospitals are small and scattered making a large expensive device impossible. When GE localized their USA-developed device in China, it sold poorly. However, in 2002, a GE team in China developed a new device specifically for China – this device proved not only to do well in China but also in the United States finding new previously unforeseen applications (Immelt, Govindarajan and Trimble). GE succeeded in preventing disruption from emerging giants by attempting its own reverse innovation – the outcome is thus a new portable, handheld, and highly effective $7,900 ultrasound machine designed towards the 100% (Shah).

Figure 16 - A traditional non-portable ultrasound machine (left) next to the new portable $7,900 GE Vscan device (right)
4.2 GLOBALIZATION OF GLOBALIZATION: CHEESEBURGERS, GANGAM STYLE, AND PLASTIC CHAIRS

“I noticed that no two countries that both had McDonald’s had ever fought a war against each other since each got its McDonald’s...when a country reached the level of economic development where it has a middle class big enough to support a network of McDonald’s, it became a McDonald’s country. And the people of McDonald’s countries didn’t like to fight wars anymore. They preferred to wait in line for burgers...as countries got woven into the fabric of global trade and rising living standards, which having a network of McDonald’s franchises had come to symbolize, the cost of war for victor and vanquished became prohibitively high” (Friedman)

— THOMAS FREIDMAN, THE WORLD IS FLAT

In 2012, Gangam Style, a music video and song by Korean pop-star Psy, took the world by storm. It went around the globe several times over becoming the first YouTube video to have over one billion views. At the time of publication, the music video has continued to spread reaching over 1.9 trillion views on Youtube – overnight becoming a globalization phenomenon (officialpsy). It is without a
doubt a marker in history where there is now a means and interest to instantaneously distribute products, or in this case a digital product, globally to everyone without regard to social, economic, or cultural status (Lam).

The new era of globalization and the digital infrastructure that Friedman discusses extensively in *The World is Flat* has opened up the doors not only for burgers to go around the world, but music videos too. However, what is often overlooked are the most simple products that are taken for granted, such as a simple plastic patio chair. Ian Frazier brings attention to this in one of his pieces on the New Yorker:

“On a higher part of the beach, a single patio chair of molded white plastic commanded a wide view. Someone might have put it there to enjoy a beer in, or for winter sunbathing. Then again, it might have been flotsam. I have seen this identical type of plastic chair in photos of the Lagos, Nigeria, city dumps in the Times. A photo of a memorial gathering for a slain Al Qaeda leader in Jordan showed a row of these same chairs in a tent. I own six of these chairs myself. I believe this type of white molded-plastic chair belongs to the growing category of the world’s ubiquitous objects” (Frazier)

![Figure 18 - A typical plastic monobloc chair](image)

This chair is more formally known as the monobloc chair. Originating in the late 1960s in Italy, the design was copied by numerous companies around the world. Competition and an increased understanding of plastics processing quickly drove the price down from $60 a chair to $6 a chair (Freinkel). It is surely one of the most ubiquitous products in the world, as Ethan Zuckerman points out, it has been able to entirely shed itself of any specific context:
“Virtually every object suggests a time and place. The Monobloc is one of the few objects I can think of that is free of any specific context. Seeing a white plastic chair in a photograph offers you no clues about where or when you are. I have a hard time thinking of other objects that are equally independent of context. Asking friends to propose a similar object, most people suggest a Coke can... but I can tell you that Coke is presented very differently in different countries, in glass bottles as well as cans, with labels in local languages. The Monobloc offers no linguistic cues, no obvious signs that it’s been localized. Wherever you are, it’s at home... (Zuckerman)

Zuckerman does a good job of pointing out the easy to overlook significance of this unique context-free quality of the Monobloc chair.

The Monobloc is a reminder that the world is still filled with the local, the unique, the distinctive. Globalization may be homogenizing the world, but most objects still offer some context. The few objects that defy localization deserve some special form of lionization. They’ve achieved a level of design perfection where they don’t require adaptation to be as successful in Africa as they are in suburban America. Dismiss them at your peril – context-free objects like the Monobloc have achieved a sort of global celebrity that few humans could ever hope for” (Zuckerman)

In the 20th century what might have taken 20 years to spread around the world takes y a few months in the 21st.

4.3 VANITY OF THE POOR

“Poor people can’t afford cheap things” (Madsen and Cotter)

— TRADITIONAL FINNISH SAYING
VisionSpring is a social organization that works with the poorest people in the to provide equitable and affordable access to eye care (VisionSpring). They estimate that uncorrected vision results in a $202 billion loss to the global economy (VisionSpring). VisionSpring's glasses are typically sold for between $2 to $4, however, as Madsen and Cotter point out in the paper titled Quality Design for the Poor, “although customers may save for a month or two before they are able to purchase the glasses, only 5% choose the 'Ushas,' the least expensive and least attractive option” (Madsen and Cotter). Founder and CEO of VisionSpring, Jordan Kassalow, says, “Vanity isn't monopolized by the rich” (Madsen and Cotter).

This is a very subtle, yet immensely significant observation by Kassalow. Despite the extreme poverty of these individuals and having to work for a month or two to save up enough money to purchase the glasses, they see themselves above the “cheapest” option. The “Ushas” do not provide enough of a sense of dignity when they have an option for something better. Compare this to the mentality discussed earlier where nonprofits simply give away their product with no user input or choice.

In the same paper, Madsen and Cotter discuss the hesitancy of the poor to spend their money until they gain enough confidence in a product. Their anecdote gives profound meaning to the Finnish saying, “poor people cannot afford cheap things”:

“The discerning farmer

Farming is risky everywhere, and farmers in Myanmar, whose survival hangs in the balance, have learned to scrutinize every investment and to demand evidence of reliability. U Hla Thein, a farmer in Maubin township, had seen demonstrations of a water pump sold by the NGO, Proximity Designs, but it wasn’t until his son reported on seeing them in use in other villages that he felt confident that this was a “name brand” he could trust. While cost is the constraint, quality is often the top concern” (Madsen and Cotter)

Poor people lack disposable income to use on a product that they cannot rely on. They instead rely on an extensive vetting network of friends, family, and fellow villagers to research the quality of products rather than their price alone.
Poor people do not simply want cheap things; they want nice, high quality products. The few products poor people own must be reliable. They want to be able to take pride in their purchases, same as anyone.

4.4 LOOKING INTO HUMAN DESIRE

“We all need the services and help of teachers, doctors, dentists, and hospitals... no matter what our geographical or cultural location. We all need transportation, communication, products, tools, shelter, and clothing. We much have water and air that is clean” (V. J. Papanek)

— VICTOR PAPANEK, DESIGN FOR THE REAL WORLD

What do a pen, flip flop, cough drop, soda, cell phone, and chair all have in common? They are products that focus on satisfying our core human needs and desires.

Pens help us exchange information, but also retain it.
Flip flops Protect our feet, but also provide comfort.
Cough drops soothe us, but also help regain the ability to speak.
Soda quenches our thirst, but is also sweet.
Phones connect us, but faster than previous communication outlets.
Chairs let us rest so we can return or focus on other tasks.

These products all contain attributes that make us, or help us reach our maximum efficiency, and are deeply desirable by humans around the world because they focus on core issues. Ultimately, fundamental human needs do not vary across the world, rather, circumstances do. These are examples of products that perform their function well, satisfy core humanistic needs, and often satisfy higher levels of Maslow’s hierarchy, that they often transcend any financial, social, or cultural barriers.
Figure 19 – A figure of Maslow’s hierarchy of needs modified by the author to distinguish between core human needs and higher level needs which are considered by the author to be desires

For example, a Coca-Cola does not simply satisfy thirst, a core human need, it also provides happiness, a human desire. If Coca-Cola only satisfied thirst, it would not have become the ubiquitous global product it is today.

Renowned social designer Victor Papanek writes in his book Design for the Real World that:

“As we are taught to equate power, money, and possessions, we deny access to goods to those who are poor or in need. Low income means buying used appliances from Goodwill or the Salvation Army or doing without them entirely. Certainly nothing is designed for the low-income group. The philosophy behind this is that ‘if only these people had more money’, why then they could participate in the American Dream’” (V. J. Papanek)

Papanek brings up that it is just assumed that lower income people will just want “recycle” the unwanted goods of more wealthy people. However, as he suggests, what is needed is to change our mindset to directly accommodate and design for the “low-income group”.
Chapter 5 – A New Mindset for Product Design

“The ultimate job of design is to transform man's environment and tools and, by extension, man himself” (Papanek)

— VICTOR PAPANEK, DESIGN FOR THE REAL WORLD

Intentional or not, every design process begins with a mindset. If that mindset exclusively focuses on poverty (or wealth), it means that designers are focusing on and are biased by inequality. If designers instead focus on people first and their commonalities, what they share in common, then they can instead focus on and be biased by equality.

It is time for products and the design discipline to actively acknowledge that we are all human even when designing for the poorest of the poor. An irrefutable fact that is forgotten too easily, we let ourselves discriminate, we let greed and profit cloud our judgment and, despite good intentions we mistakenly amalgamate poverty and inferiority.

The new mindset presented advocates for a proactive approach to product innovation which can create desirable and accessible products for all cultures and classes of people without discrimination based on culture, geography or economic status; which up till now has often been left to accident rather than intention.

5.1 WHAT IS DESIGN TOWARDS THE 100%?

“I have a personal opposition to the term ‘design for the other 90 percent’. Yes, you can quantitatively differentiate, in economic terms, the divide between the wealthy 10 percent (whom designers usually serve) and the underserved 90 percent, but there are problems with this approach. In its construction, the argument to design for the underserved is then inherently defined by difference.
Also, the 90 percent has too often become synonymous with only impoverished residents of the developing world, when, in fact, the underserved is a much broader and more urgent category of people” (Pilloton)

— EMILY PILLOTON, DESIGN REVOLUTION (Fuller)

We live in a new age where globalization and capitalism must harmonize with social good. Rather than exclusive design for the top 10%, or guilt-driven design for the other 90%, let’s instead design towards the 100% without traditional discriminations. Designers can simultaneously embrace influences of design for the top 10% and the other 90% to intentionally create products like Coca-Cola, a BIC Cristal pen, or a Nokia phone which blur the lines, or the need, to actively differentiate between the top 10% and bottom 90%. Products focused on equality and dignity will dovetail and become extremely profitable products for their respective companies.

Design towards the 100% is simultaneously motivated by (1) selling lots of the same product to reduce costs & increase profits and (2) to create products that treat everyone with dignity and satisfy core human needs & desires. These intuitively opposing factors are two sides of the same coin. Traditional incentives of capitalism and humanitarian aid together create a more productive effort.

For a typical top 10% consumer, product inefficiencies and expenses are assumed to be ok because better solutions are not always obvious. For example, the top 10% can afford a gas-guzzling car, electricity sucking A.C., a $1000 computer, a $6000 prosthesis, a $500,000 medical machine, and even clean water. The 10% consumer is somewhat wasteful with our seemingly abundant resources and wealth. However, a bottom 90% consumer often cannot afford inefficiencies in their products. For them, the inefficiencies outweigh the gain, despite the possible improvement of their quality of life. The high maintenance and lack of sustainability of the products mentioned above put them out of reach of these consumers.
Figure 20 - Product accessibility slowly increasing over time for pens. In this example, we can imagine how over time a product that originally very few people had access to improved over time and slowly became accessible to and designed for the 100%. This is essentially the story of the BIC Cristal pen. However, the mindset and techniques discussed here are about intentionally reproducing this process in an accelerated fashion.

If it is a goal to have a bottom 90% consumer to be able to enjoy and benefit from a car, A.C., computers, medical equipment, clean water, etc, it is first necessary to eliminate product inefficiencies, which prevent these solutions from becoming affordable and accessible to the majority of the world’s population.

In order to design a car towards the 100% we must reinvent the car because the car. Today, cars have inherent costs and inefficiencies are restrictively prohibitive. Maintenance, gas prices, miles per gallon, etc. Imagine, though, if we had a car that both a college student in the US and a shopkeeper in Bangladesh could both afford, and more importantly desire. If instead you design and engineer a car like the TATA Nano to be extremely affordable for the bottom 90%, there is a good chance that you are left, as TATA was, with very few customers that actually desire your product (Yohn). The TATA Nano addresses cost but it does so while assuming that the poor are willing to purchase a car no matter what just so long as it gets them from point A to point B with a low initial investment.

However, if in their design process TATA had simultaneously, for example, attempted to make their product desirable to an American college student while meeting the constraints of a Bangladeshi
shopkeeper, then it is possible that both shopkeepers would desire the car and it would be a great value for college students; effectively creating a product the greatly improved the quality of lives of very different people on opposite sides of the world through a single product; aka design towards the 100%.

Thus, if a product can satisfy the desires of a top 10% consumer, and satisfy the constraints of a bottom 90% consumer, then we have a product designed towards the 100%.

5.2 WHO IS THIS MINDSET FOR?

This mindset is be useful for anyone involved in a product development process including: designers, engineers, investors, educators, business, or nonprofits.

By using this mindset, social designers trying to help the poor potentially avoid negatively stereotyping and discriminating against the poor with their designs. Designers can embrace that we are all human and that anyone, no matter how poor, still has desires, vanity, and dignity as a human being.

If designers and nonprofits begin to think of the poor as their customers, instead of as helpless persons waiting to be saved, they will realize that the product has to be so good that their customers will value trading the few dollars they have for the product because they see the potential and see the sustainability of the product as a life enhancer.

On the other hand, of multinationals trying to increase their global market share adopt this mindset, they will grow and prosper in the new globalized era. Creating equitable products for everyone is not just about humanitarian purposes; it is also about creating new customers and massively growing the potential market size.

For many large multinational companies, their market penetration in the US & European countries has peaked. It is a puzzle to be solved on how to get widespread global market penetration. Facebook, for example, is aggressively pursuing this. One way to increase market penetration is to make great designs for everyone without the traditional discriminations that potentially hold back
and limit most products. Companies should not wait for another company to do it and buy them. Grow it organically as to associate the brand from the start with the innovation.

5.3 WHY CARE?

“To make the world work for 100% of humanity in the shortest possible time through spontaneous cooperation without ecological offense or disadvantage of anyone”

(Fuller)

— R. BUCKMINSTER FULLER, OPERATING MANUAL FOR SPACESHIP EARTH

Many reasons have been given to the significance and impact of adopting the mindset proposed. However, the two most significant reasons for why individuals and organizations should care about this mindset are the ability to simultaneously (1) increase sales & global market share (profit) and (2) to make massive positive impact (humanitarian aid).

1 TO 9 RATIO

![1 TO 9 RATIO](image)

*Figure 21 - By definition, the market size of the bottom 90% is 9x larger than the market size for the top 10%.*

Despite their wealth, the top 10% will never buy enough phones for a multinational company like Nokia not to bother trying to sell their product to the bottom 90%, which by definition is a market
9x larger than the top 10%. For every 1 phone sold to the top 10%, there is the opportunity to sell 9 phones to the bottom 90%.

Thus, it is possible to increase potential sales volume by up to 9x for a very successful phone designed towards the 100%, even with a reduced profit margin. This is a purely profit driven incentive. However, at the same time, the world’s poorest citizens were given access to mobile phone technology, which offers massive improvement in economic mobility, mobile banking, safety, and health.

### 5.4 WHEN IS THIS MINDSET USEFUL?

Design towards the 100% would not have necessarily been possible a decade ago. It has required an evolutionary process of product design and global commerce. This mindset is as much about product design as it is about capitalism and humanitarian aid. All three of these have been evolving at a rapid pace in the past decade, and we are now ready for a new age where globalization & capitalism must harmonize with social good.

Design towards the 100% has become relevant today and will become increasingly relevant in the future as more and more companies produce low-margin products, which require an enormous large number of users in order to become financially successful. For companies such as WhatsApp or Facebook, the market naturally forces them to adopt some aspects of this mindset in order to obtain the enormous number of users that their services require. However, if they intentionally adopted and utilized this mindset they could greatly accelerate their pace of meaningful innovation and user adoption, as well as doing their part to make the world a better place.

### 5.5 WHERE DOES IT APPLY?

Product solutions do not need to simply focus on developed world versus developing world consumers. While that might be the focus of large multinational corporations, we can also focus locally in single communities. It is not necessary to move beyond the borders of a single
neighborhood in the United States to attempt to create a solution which satisfies the needs and desires of what might be defined as top 10% and bottom 90% consumers.

5.6 METHODS OF DESIGN

“I think it’s important to reason from first principles... [With first principles] you boil things down to the most fundamental truths... and then reason up from there”

(Christensen)

— ELON MUSK – SPACEX, TESLA, PAYPAL

At the core of this thesis is the belief that every person on this planet is a human being; that there are fundamental human needs and desires that unite us all. It is the responsibility of the designer to discover what those needs are and to properly satisfy them through a great product. The first step in a more appropriate design process is ultimately to remember that every single person on this planet is a human being.

![Figure 22 - A Venn diagram of desire versus the typical top 10% and bottom 90% consumer.](image)
There are clearly exclusive desires that can be defined which differentiate the typical top 10% consumer from the bottom 90% consumer. However, there is no need to focus on what is exclusive. Let’s focus on mutually inclusive desires shared among human beings. These are core human desires for food, clothing, shelter, community, social interaction, prosperity, honor, pride, etc.

Likewise, this can be repeated for what the top 10% and bottom 90% can afford. Whatever, the bottom 90% can afford so can the top 10%. Instead of focusing on mutually exclusive qualities, we can and should focus on mutually inclusive qualities in order to create great designs for everyone.

*Figure 23 - A Venn diagram of affordability versus the typical top 10% and bottom 90% consumer.*

Great products can simultaneously be developed for rich and poor consumers. By simultaneously pursuing what appear to be competing interests between the Top 10% and Bottom 90% users, we can discover new needs, simplify the problem, and finally arrive at the core values that make everyone human. It can be a difficult process but, one with great utilitarian rewards.
The traditional perspective of product design is pursuing extremes. At one extreme, are pure desirous products such as luxury Gucci bags or a gold plated Mercedes Benz. On the other extreme, is pure constraint focused products such as the LN-4 Arm and Free Wheelchair discussed earlier.

Why can’t we pursue desires and constraints both? They must be pursued simultaneously rather than independently. This simultaneous pursuit and an embrace of both first world desires and third world constraints can result in products such as the BIC pen, Nokia phone, and Coca-Cola soda.
A great designer will also never assume that someone will automatically want his or her product. A great designer knows it is a combination of the right strategies and techniques in an iterative process that helps them arrive at a solution that will have a positive effect on people's lives. The methods and mindset described here will be used by a great designer in combination with their own traditional methods of product design in order to arrive at the best solution.

Follow four specific principles in order to intentionally create great designs for everyone. They are listed below:
4 PRINCIPLES OF GREAT DESIGN FOR EVERYONE

1. Simultaneously Embrace Desires & Constraints
   
   *Create a solution that simultaneously embraces and satisfies constraints & desires. Do not satisfy one and ignore the other.*

2. Minimize Resource Inefficiencies
   
   *Requires a systematic analysis of the product and often requires problematic aspects to be reinvented using first principles*

3. Optimize Value
   
   *Provide the maximum functional, social, and emotional value for the least amount of investment and maintenance cost*

4. Dignify Everyone
   
   *We are all human. Do not discriminate based on geography, culture, or economic status. Make a homeless person & the president feel equal.*

The first principle is explained extensively above. The second principle is to minimize resource inefficiencies using what Elon Musk calls first principles. This concept is explored extensively via a case study in Chapter 5.

The third principle relates to the value performance of products, how much value they offer for the associated cost of product ownership, and usage. Value performance can be defined as the functional, emotional, and social utility divided by the investment and maintenance cost of the product. The best examples of Design towards 100% products have very high value performances.

\[
\text{VALUE PERFORMANCE} = VP = \frac{\text{VALUE}}{\text{COST}}
\]

\[
VP = \frac{\text{FUNCTIONAL UTILITY + EMOTIONAL UTILITY + SOCIAL UTILITY}}{\text{INVESTMENT COST + MAINTENANCE COST}}
\]

*Figure 28 - The equation of product value performance.*
The last principle is a constant reminder to make sure we are not discriminating based on geography, culture, economic, or social status. An easy to check to identify if a product is dignified is to simply ask oneself whether or not a US consumer would purchase the product under consideration. Too often, nonprofit or social organizations create products which they think will change the world yet the products are not dignified enough where a US consumer would even consider purchasing it.

5.7 MEASURING HOW WELL A PRODUCT HAS BEEN DESIGNED TOWARDS THE 100%

Once a product exists and has been tested in the marketplace, continual assessment can be performed to determine how well the product has been designed and is distributed towards the 100%. A comparison can be made between various qualities of the product such as the products desirability versus its affordability. This has been done for several common products below.
It is noted that in the example above the lower left quadrant is empty as no products ideally should be both expensive and undesirable, the market should theoretically not allow products to exist in this category even though this is not always the case. The products in the upper left quadrant are items that are only accessible and affordable to consumers in the top 10%. Whereas the bottom right quadrant represents poorly designed products or products that are pushed onto users by nonprofit organizations.

This thesis is advocating for more and more products to be created that fit into the upper right quadrant – products that are both highly desirable and affordable. There are several metrics that can be assessed for products that exist in the marketplace to measure their performance and see how they can be improved or refined in new iterations.

1. Intrinsically Desirable
   - The product should tap into the natural human nature and pick at humanistic desires. This should be one of the earliest focuses in the design process and needs to be validated once the product exists.
2. Universally Accessible
   - Can the product be found in nearly any city, town, and village around the world? This often takes years to achieve for physical products and is an ideal that is sought after constantly.

3. Widely Affordable
   - The product must be affordable for both the top 10% and bottom 90% consumer

4. Profitable
   - The product must be profitable for the company producing and distributing the product otherwise it is not a sustainable venture that can ensure the products existence and availability.

5. Exceeds the Alternatives
   - The product has to exceed the alternatives. The alternatives can be other products or it can simply mean nothing. It should not be mistaken for example that any prosthetic arm adds more value than no prosthetic arm. A bad prosthetic arm can hinder the user's function, social confidence, and mobility.

The principles described in this chapter were used to curate 40 examples of great design for everyone. They are listed in alphabetical order in Chapter 4.
Chapter 6 – Examples of Great Design for Everyone

“The beauty of great design is that it’s both very complex and very simple” (Antonelli and Mosto)

— PAOLA ANTONELLI, MOMA HUMBLE MASTERPIECES

The examples of great design for everyone were curated based on the criteria discussed in Chapter 5. They are presented below in alphabetical order.

Most of the products in this list have been accessible and affordable to everyone for an extended period of time – these are things such as chopsticks, flip-flops, or match sticks. Other products listed have been “designed” for everyone in mind but have yet to prove themselves in the marketplace – such as the LifeStraw, the OpenSocket, or Facebook.

SOURCE DISCLAIMER: All images and information in the table below are sourced under creative commons from Wikipedia, with permission from the respective owner(s), and/or based on the author’s own interpretation and primary research.
<table>
<thead>
<tr>
<th><strong>BIC Cristal</strong></th>
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<tbody>
<tr>
<td><strong>Pen</strong></td>
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<tr>
<td>The BIC Cristal pen is a tool of utility and creativity. It is highly reliable, stylish, and one of the most affordable ballpoint pens.</td>
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<tr>
<td><em>In massive global distribution.</em></td>
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<tr>
<th><strong>BIC Lighter</strong></th>
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<tr>
<td><strong>Tool</strong></td>
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<tr>
<td>The BIC lighter is a highly affordable and incredibly reliable child safe disposable lighter.</td>
</tr>
<tr>
<td><em>In massive global distribution.</em></td>
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<tr>
<th><strong>BIC Razor</strong></th>
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<tr>
<td><strong>Personal Hygiene</strong></td>
</tr>
<tr>
<td>The BIC Sensitive Shaver is a disposable single stainless steel blade shaver. It is a classic product that is still widely used today and available at an extremely affordable price.</td>
</tr>
<tr>
<td><em>In global distribution.</em></td>
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</table>
The bicycle is an invaluable transportation vehicle used for sport, leisure, and most importantly for daily commute. In rural parts of the world, bicycles are the primary form of transportation for many families. Ownership of a bicycle can almost serve as a metric of poverty.

The Flying Pigeon bike pictured here is an extremely useful and common single speed bike in use around the world.

A highly portable, electricity producing, and highly efficient wood burning cookstove for use in camping or developing world contexts. The BioLite cookstove weighs 2lbs, runs on twigs, and produces electricity to charge USB powered devices.

Has a 4.8/5 star rating on Amazon out of 56 customer reviews. Available for $130.

The bobby pin is a very simple hairpin used to keep hair in place. It has both functional and aesthetic utility.

In global distribution by numerous brands.
**Bouncy Ball**
*M*Toy

A bouncy ball is one of the most affordable mass produced toys in the world. It has an inherent playfulness that attracts youth of any demographic or culture.

*In global distribution by numerous brands.*

---

**Buses**
*Public Transportation*

Buses provide a highly affordable and practical way for numerous commuters of diverse economic and social background to travel great distances on a daily basis. Buses can be found all over the world.

*In global distribution by numerous brands.*

---

**Casio Watch**
*Wristwatch*

The quartz Casio brand F-91W digital wristwatch was introduced in 1991 and continues to be a popular product worldwide today. The watch is water-resistant, features a calendar, alarm, stopwatch, and has a battery that last over 7 years.

*Has a 4.5/5 star rating on Amazon out of 556 customer reviews. Available for $10.*
Chemex Coffee Maker

Gravity Powered Coffee Maker

The Chemex Coffee Maker was invented in 1941 and is still widely used today. It is a very simple and elegant manual coffee maker. It requires no electricity and lasts a lifetime.

The Chemex is very popular among coffee connoisseurs for brewing excellent coffee and has won multiple awards for being one of the best-designed products of modern times.

Has a 4.6/5 star rating on Amazon out of 736 customer reviews. Available for $42.

Chopsticks

Tool

Although many chopsticks can be a luxurious or decorative item, disposable chopsticks are a very affordable, useful, and equitable product.

In global distribution by numerous brands.

Coca Cola

Food

A carbonated soft drink sold in over 200 countries worldwide.

According to Interbrand, in 2011, Coca-Cola was the world’s most valuable brand.

In massive global distribution by the Coca-Cola Company.
| **Condom**   | Male condoms serve as an inexpensive, and easy to use, form of birth control.  
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<tbody>
<tr>
<td><strong>Contraception</strong></td>
<td>Distributed by various companies and brands around the world.</td>
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| **Facebook**   | Facebook is an online social networking website and mobile application.  
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<tbody>
<tr>
<td><strong>Social Network</strong></td>
<td>As of January 2014, Facebook had over 1.23 billion active users every month. That means that 17% of the world population visits the website every month. Facebook is constantly and aggressively looking for ways to grow its customer base through company acquisitions and global partnerships to increase internet access.</td>
</tr>
</tbody>
</table>

| **Flip Flop**   | Flip flops are one of the most minimal open-toed sandal designs in the world. They offer exceptional value return for the cost investment.  
|-----------------|----------------------------------------------------------------------------------------------------------------------------------|
| **Footwear**    | The oldest pair of this kind of sandal is assumed to have been used by the Egyptians and to be at least 1,500 years old.  
|                 | In massive global distribution by numerous brands.  


Table 2 (cont)

**Garden in a Sack**  
*Gardening Kit*

An effective way to setup a vertical garden for tight spaces in the slums of Kiberia, Nairobi or in the balcony of a New York apartment.

It allows people to save money and eat healthier food.

*In limited distribution.*

---

**GiraDora**  
*Washing Machine*

A highly affordable peddle powered washing machine and drying. It requires no electricity and is highly portable. This is a major improvement over manual washing methods.

This is a very practical solution for remote villagers, apartment dwellers, and campers.

*Concept design & functional prototype.*

---

**Glass Marbles**  
*Toy*

Glass marbles are a very simple and affordable toy that can be collected and used for various games.

*In massive global distribution by numerous brands.*
Table 2 (cont)

**Google Search Engine**

Google search is the most used web search engine processing more than three billion searches each day. Despite being a completely free tool for users, it makes exceptional profit for Google Inc. through the use of paid ads.

In massive global distribution, available in 123 languages, and the world's most visited website.

*Their mission statement: “Google’s mission is to organize the world’s information and make it universally accessible and useful”*

**Halls Cough Drop**

Halls is the brand name of the world’s most popular mentholated cough drop. In the US & Europe it is primarily seen as medicine, however, in Latin America is often used and advertised as a candy.

In massive global distribution by Cadbury, the second largest confectionary brand in the world.

**Heinz Ketchup**

Since being introduced in 1876, Heinz has become one of the best selling brand of ketchup worldwide. It is often provided for free in many restaurants as a condiment.

650 million bottles of Heinz Tomato Ketchup are sold every year worldwide.
### Ice Cream Cone

*Food*

An ice cream cone is a very simple pastry that allows users to eat ice cream on the go with their hands.

*In global distribution by numerous brands.*

### Inclusive Edge Canopy

*Canopy Kit*

A complete kit with materials and tools to setup a canopy to protect from the sun & rain. Useful for shopkeepers, farmers markets, small gatherings, parties, or camping.

*In limited distribution.*

### Kikkoman Soy Sauce

*Food*

Kikkoman brand soy sauce is a family run world leader, distributed to over 100 countries around the world. Their motto is "to promote the international exchange of food culture".

Their vision for 2020 is to (1) make Kikkoman Soy Sauce a truly global seasoning (2) be a company that supports a healthy lifestyle through food (3) be a company whose existence is meaningful to the global society.

*In global distribution and featured in the Museum of Modern Art.*
<table>
<thead>
<tr>
<th><strong>Learning Landscape</strong></th>
<th><strong>Educational Playground</strong></th>
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<tbody>
<tr>
<td>An educational and interactive playground constructed from a small field and recycled tires. It is used by students in Uganda to learn math and by executives in the United States to learn teamwork. <strong>In limited distribution</strong></td>
<td></td>
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<tr>
<th><strong>LifeStraw</strong></th>
<th><strong>Personal Water Filter</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A portable water filter straw. Instantly filters water using no electricity, UV power, chemicals, etc. Can be used effectively by rural communities or adventurers. <strong>Has a 4.6/5 star rating on Amazon out of 775 customer reviews. Available for $20.</strong></td>
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<tr>
<th><strong>M-Pesa</strong></th>
<th><strong>Mobile Money Transfer</strong></th>
</tr>
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<tbody>
<tr>
<td>A mobile phone-based service for saving, receiving, &amp; sending money. After launching in 2007, by 2012, M-Pesa already had 17 million accounts in Kenya alone. M-Pesa has made banking and electronic payments accessible to the masses without discrimination. <strong>It has also been used to track &amp; eliminate salary corruption in Afghanistan police.</strong></td>
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**Table 2 (cont)**

**Match Tool**

A match is an incredibly useful tool to quickly and reliably start a fire. Matchbooks are often given away for free with printed advertisements on the packaging.

*In massive global distribution by numerous brands.*

**Monobloc Chair**

*Most Common All-Weather, Stackable, Polypropylene Chair*

Numerous manufacturers worldwide produce the monobloc polypropylene chair. It is the world’s most common style of chair. The chairs are very affordable, need no maintenance, can be used in any weather, and are stackable.

*In massive global distribution by numerous brands.*

**One World Futbol**

*Indestructible Soccer Ball*

A new type of soccer ball developed in 2010 by Tim Jahnigen. The ball is self-inflating and consists of an extremely tough foam material.

*In limited distribution.*
OpenSocket
Prosthetic Arm

An off-the-shelf prosthetic arm that comes in small, medium, and large sizes. Reduces cost by up to 90% and fitting time by 30x in comparison to standard arms that are custom made.

Many amputees around the world and even the US end up without a prosthetic device due to the prohibitive cost and difficulty to access.

In limited distribution.

Paper Clip
Tool

A highly ubiquitous product often taken as granted. When needed, this product affords the flexibility to hold any two or more pieces of paper together.

In global distribution by numerous brands.

Safety Pin
Hygiene

A highly ubiquitous product often taken as granted. When needed, this product affords the flexibility to hold any two or more pieces of fabric securely together.

In global distribution by numerous brands.
**Sugar Cube**
*Food*

Sugar cubes are used all around the world as a simple way to sweeten a cup of hot tea.

*In massive global distribution by numerous brands.*

---

**Trains**
*Public Transportation*

Trains provide a highly affordable and practical way for numerous commuters of diverse economic and social background to travel great distances on a daily basis. Trains can be found all over the world.

“A developed country is not a place where the poor have cars. It’s where the rich use public transportation.”

*Enrique Penalosa, former Mayor of Bogotá, Colombia*

---

**Tweezers**
*Beauty Product*

Tweezers come in many different forms and are sold by many different brands and are most commonly used a beauty product. They greatly amplify human hands’ ability to manipulate small objects.

*In global distribution by numerous brands.*
### Table 2 (cont)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Description</th>
</tr>
</thead>
</table>
| **WhatsApp**      | *Mobile Messenger*  
WhatsApp is a mobile phone instant messenger application available on all major phone platforms. This versatility has allowed it to acquire up to 400 million active users each month.  
On February 19, 2014, Facebook Inc. purchased WhatsApp for $19 billion USD.  
*In global distribution.* |
| **Wikipedia**     | *Online Encyclopedia*  
Wikipedia is the world's largest and most popular free internet encyclopedia. It is collaboratively edited and available in 276 languages.  
*In massive global distribution and the sixth most visited website.* |
| **YouTube**       | *Video Entertainment*  
YouTube is the world's most popular video sharing website. All content is free to watch. The service is profits via advertisement revenue.  
*In massive global distribution, available in 61 languages, and the world's 3rd most visited website.* |
### Table 2 (cont)

<table>
<thead>
<tr>
<th><strong>Zipcar</strong></th>
<th><strong>Car as Service</strong></th>
</tr>
</thead>
</table>
| Zipcar offers car ownership as a communal service. Instead of owning your own car, members of their network have the ability to affordably use a car and pay by the hour.

This greatly reduces the barrier and financial burden of car usage. Zipcar or an equivalent service would be revolutionary to populations in India or China.

*Available in United States, Canada, United Kingdom, Spain, & Austria.* |
Chapter 7 – Case Study: Shoe Design

“We need to rethink shoes the way we rethought cigarettes” (Elmer)

— DANIEL HOWELL, PROFESSOR OF BIOLOGY LIBERTY UNIVERSITY

To explore, illustrate, and test the frameworks presented in Chapter 3 a shoe was designed following the principles of design towards the 100%, and documented here in Chapter 5 as an applied case study. The shoe was designed over the course of 6 months.

Figure 30 - The new shoe design developed by Ehsan Noursalehi is an applied case study of this thesis. The shoe comes in small, medium, and large sizes. The shoe is adjustable in width and length and uses a minimal amount of materials.

The new shoe is adjustable and comes in small, medium, and large sizes. These three sizes can comfortably fit adult males and females – traditional shoes would require at least 21 different sizes, and at most 84 sizes if multiple widths are available, to fit the same range of foot sizes as the new shoe.
Sections 5.1-5.5 further define why shoes were chosen for the case study and how the frameworks and mindset from Chapter 3 were used during the design process. Section 5.6 documents the details of the new shoe design in detail.

7.1 WHY SHOES MATTER FOR THE BOTTOM 90%

7.1.1 METRIC OF POVERTY
The poorest of the poor often is imagined as someone with no shoes or sandals. The ownership of a sandal or shoe is metric of poverty at the most extreme levels. This thesis uses lack of footwear as useful benchmark of the most extreme level of poverty. Although this is a qualitative assessment, it has quantitative bearing.

If this benchmark is no footwear, one step higher in the pyramid would be an individual who has fashioned scavenged materials into sandals. This person has the skills, intelligence, health, access to materials, and motivation to construct a sandal for their personal usage. Moving higher up the ladder of poverty, are people who have exchanged money or goods to purchase a sandal.

Even higher up the ladder, more variety is found, which most commonly embodies itself as more expensive materials or forms of sandals. Clearly, not all sandals are created equal and it is more difficult to measure the granularity in poverty through footwear alone.

However, the next clear level in the pyramid is the ownership of closed-toed shoes – something more protective and formal. These close-toed shoes are more difficult to access and afford for the poorest of the poor and there are three obvious methods to increase universal access to closed-toed shoes to those in extreme poverty:

1. Raise people out of extreme poverty so that they can afford shoes
2. Give shoes away for free to those that cannot afford them
3. Redesign shoes so that they are more affordable, accessible, and valuable
Option 1 is very hard and requires enormous financial resources. Option 2 already occurs regularly but often has the negative side effect of competing with local entrepreneurs through the distribution of free products, plus this is not a sustainable model for those who are still growing, as children go through a huge amount of shoe sizes in a relatively short period of time. For product designers, option 3 is the natural choice, but how can a more affordable shoe be created without sacrificing quality?

The only option sustainable, viable option is to entirely re-think and re-design shoes to minimize the inefficiencies that currently exist in traditional shoe design.

### 7.1.2 WHY SHOES ARE A GOOD CASE STUDY

Below are 10 reasons why shoes serve as a useful case study for this thesis:

1. **Everyone in the world can utilize and benefit from a close-toed shoe.** Shoes decrease foot-borne illness transmission (ringworm) and potential bacterial infections that can occur as a result of cuts to the bottoms of the feet.
2. **Flip flops/sandals are already designed towards 100% while a shoe is not.**
3. **An opportunity to respond to the iconic symbol of TOMS’ 1 for 1 model that sells shoes at a premium to the wealthy and gives pairs away for free to the extremely poor.**
4. **Each person needs many shoes throughout their lifetime as they naturally wear out.**
5. **Shoes are a functional tool for the poor and rich. Yet, shoes are also inherently desirable – there is also a phenomenon of extreme shoe-obsession in a subset of wealthy elites that have trouble satisfying their desire.**
6. **The ability to own a shoe is a measure of extreme poverty.**
7. **Shoes reach far into both extremes of both aspirations & constraints.** One of the most captivating childhood stories is the story of Cinderella and the magical shoe.
8. **Fundamental basic qualities of shoes make them relatively inefficient.** Shoes come in many different sizes and the materials wear out quickly.
9. **Huge potential to satisfy unmet aspiration at the “Bottom of the Pyramid” to own and utilize shoes.**
10. **Huge potential for global profit by selling shoes to a new previously untapped market.**
7.1.3 STRATEGIC OBJECTIVES

To satisfy the other 90%, a revolutionary new shoe is required—one that is more affordable and more accessible. This alone will not inherently make the product desirable to the top 10%. Thus, to satisfy the top 10%, additional objectives are necessary; in this case study the objectives are to create a more natural shoe for the human foot that is more adjustable and comfortable than the typical shoe. However, all of these objectives must be met while maintaining social and functional expectations of what a shoe should be, otherwise the final design will not be desirable by either the bottom 90% or the top 10%.

The strategy described above, in combination with the methods described in Chapter 3, will drive the goal to intentionally develop a shoe designed towards the 100% by creating a shoe that is attractive and useful for both the rich and the poor without traditional social, geographical, and economical discriminations that occur in product design while creating a great shoe for everyone.

7.2 WHY REDESIGN SHOES FROM THE PERSPECTIVE OF THE TOP 10%?

This section conceptually explores the nature of the human foot, its relationship with the modern shoe, shortcomings of the modern shoes, and further defines a strategy for shoe design innovation that would be useful for the top 10%.

7.2.1 FEET CAME FIRST, THEN SHOES

Before shoes ever existed, humans had feet. The first human foot came into existence about 200,000 years ago (Smithsonian National Museum of Natural History). Humans were not born with shoes on their feet, yet it took a very long time before anyone bothered to make one. The earliest known shoe has only been dated back to about 8000 BC, the same time humans started using agriculture (Connolly). That means that humans walked around Earth without any shoes for a very long time.

It is possible that humans had a very hard time walking around barefoot for those first few hundred thousand years but maybe they just weren’t smart enough to make shoes to protect their feet. Or maybe humans used to have big Neanderthal-esque feet that protected them from the dangers of walking around barefoot. If that were the case, why would the human feet evolve to become
weaker? What is known for sure is that, today, we can't even think about going past the front door without a pair of sneakers or sandals on our feet.

What changed was not feet. It was that the world around those feet. People started to grow crops, build cities, make pottery, and leave garbage lying around. Maybe some people stopped working as hard and didn't exercise their feet enough so that they could be strong and healthy. Maybe they started walking around on hard surfaces instead of grass and dirt. Maybe they started to create a dangerous unnatural world for their feet.

Needless to say, shoes eventually became the norm. Even if newborns are too young to wear shoes, they are given socks that look like shoes. We like shoes. No-- we love shoes! This is not a chicken and egg problem. Feet came first, and then came shoes. Yet how often is it questioned whether shoes are appropriate for feet? Are shoes doing what they should? Are shoes doing the right job?

7.2.2 DO SHOES FIT FEET?

Some people simply cannot comfortably fit into certain styles of shoes no matter what size they try on. Is it the fact that their foot doesn't fit the shoe? Or is it that the shoe doesn't fit their foot? The first option would suggest that there is something wrong with their foot instead of something wrong with the shoe.

Since the foot came first, there must be something wrong with the shoe.

A few hundred years ago shoes were built one by one based off of an individual foot size and shape by a shoe cobbler but, the Industrial Revolution and the invention of the assembly line brought us to the age of pre-sized shoes. People walk into a store, find a style they like, and then try them on. Pre-made shoes lets individuals own a new pair of shoes the same day they decide that they want to own a new pair; they don’t need to wait for their shoes to be made for them. It also means that everyone can have a variety of shoes that suit certain purposes-- fashion, running, dancing, tennis shoes, etc. Each subgroup has shoes designed specifically to suit those tasks.

Designing this way comes at a great sacrifice, or maybe it should be called a compromise: a compromise that shoes will only approximately be shaped and sized to feet. If someone's foot has a
weird bump on the side, it’s going to get a blister in those cool running shoes. If someone’s feet are very narrow, they are going to have tons of wiggle room in their dress shoes.

Most people are fine with this compromise because they don’t realize it can be better, but product designers know shoes can be designed better.

### 7.2.3 SHOE BASICS

**Selling shoes requires a large inventory.** Every individual shoe style that a store carries comes in at least 8 to 14 different sizes: 6, 6 1/2, 7, 7 1/2, 8, 8 1/2, 9, 9 1/2, 10, 10 1/2, 11, 11 1/2, 12, 13--more if you think about men's vs. women's shoes.

If a store wants to keep 5 pairs of each size in stock per gender, that's 140 pairs of shoes for just one style. Things can get out of hand pretty fast. Some shoes come in wide, most don't. If they do, the inventory was just doubled or tripled based on how many different widths are available.

**Selling shoes has low margins.** In comparison to clothing, shoes have much lower profit margins for stores. Shoes are heavier to ship, take up more storage space in a shop, and require a lot more unused inventory to be available. This all means that selling traditional shoes in stores is rather expensive and that maybe Zappos.com has a very viable business model as a result.

**Shoes are expensive.** Not only do shoes have low margins for shopkeepers, they are also very expensive for consumers. A lot of the new Nike Running shoes cost over $130 and the most basic TOMS shoes cost $60. On the other hand, an iPad Mini costs $329. Is it right that a portable touch screen computer costs the same as about 2.5 running shoes? *Something is wrong.*
Shoes have shoelaces but they don’t actually have much adjustability. The only thing shoe laces do well is adjusting how tight the shoe is around the ankle. Shoelaces cannot significantly change the width of the shoe very much because toe-boxes don’t let them. Toe-boxes, the front part of the shoe, provide protection for toes but their structure prevents the shoelaces from truly adjusting the width of the shoe by any considerable amount.

Shoes are based on lasts, not feet. Whether shoes are built in a factory or handmade, they are built on what are called lasts. The last is used to fill the shape of the shoe, almost like how a human foot would. Most companies use different kinds of lasts thus explaining why someone might be an 11 in one brand and a 10 in another brand. Lasts only loosely resemble the shape of the human foot and are designed to be more aesthetically appealing than they are anatomically correct.
7.2.4 WHAT IS KNOWN ABOUT FEET?

**Feet were meant to be freer.** For hundreds of thousands of years, humans walked around without shoes. The foot has lived most of its historical life without being confined in a shoe. Many shoes dramatically reduce the natural abilities of a foot to flex and behave how a natural foot should behave. Over a lifetime, the foot becomes dependent on a shoe as a crutch rather than using it as an effective tool.

**Feet are amazing.** The human foot has 26 bones and 36 joints. In comparison, the human hand has 29 bones and 29 joints; that’s 1 bone more and 7 joints less than feet. Yet, it is assumed by most people that feet are incapable and that they are better off being protected in a large rubber shoe all day instead of seeing the light of day. Shoes also change bone structure (see article linked above)

One of the common things overlooked about feet is that they come with five fingers – five individual fingers that have the capability to support an entire body weight on just their tips.

**Unlocking the potential of feet.** Bi-lateral amputees don’t have the luxury of having two hands and a lot of the ones that want to be independent often learn how to do a lot of complicated things with their feet. These people serve as a reminder that deep-down, hidden somewhere inside the human foot, is amazing capability.

**The Tarahumara run barefoot, and they run really well.** In the book Born to Run, McDougall explores how the Tarahumara Indians in an isolated region of Mexico can outrun some of the world's greatest super athletes in 100 mile runs in nothing more than basic hand-made sandals from repurposed tires (Parker-Pope).

**Feet have become weak.** Walking around in big protective shoes for a lifetime makes feet and ankles weak. The foot and ankle muscles are under utilized to the point that injuries become much more likely if barefoot. Hence, shoes are designed to be even more protective and feet, as a result, only get weaker (America's Podiatrist).
7.2.5 WHAT SHOULD NOT BE DONE

Custom shoes should not be made on demand. It is natural to get excited about the potentials of new technologies. Everyone in the technology and product industries is revved up about the possibilities of 3D printing. Often when discussing creating shoes that fit feet better, most people immediately start talking about scanning feet in 3D and 3D printing shoes on demand.

Yes, it is possible to scan feet and 3D print new shoes on demand! But that is not the right solution to increase access to well fitting shoes.

3D printing is a magnificent prototyping technology. It is very good at creating prototypes of parts that would otherwise have to be made by a machinist or a factory. It also allows for the printing structures that would otherwise be very difficult or even impossible to create otherwise. However, in all of its current forms and near-future forms, it will be best suited for prototypes, not products. Products are engineered to be of much higher quality than prototypes.

However, assume that feet could readily be scanned into accurate 3D computer models. What next? Several hours, if not days of working in CAD to adjust the shoe design to the shape of the 3D foot. With this increase in skilled labor required, the price of shoes would skyrocket even higher than an iPod.

Assume even that it is possible to scan feet into 3D, adjust the shoe design, and print a custom shoe all in less than 1 hour. That still won't cut it. If people wanted to spend an hour buying something, they would all go to Best Buy to purchase their next gadget instead of going to Amazon.com. We live in a society of instant gratification. We want the most possible with the least amount of work involved. Amazon knows this and is even working on same day delivery (Popper). Amazon knows people would rather make a purchase online and have their purchase shipped to them rather than spend the time it takes to make a trip to the store. But most importantly, people want things at a good price. The best way to make things affordable is to mass-produce in large volumes; 3D printing is the antithesis of mass production.

Based on the theory above, shoe design should not move towards custom-made shoes on demand. It is not a solution to increasing the accessibility of better fitting shoes.
What about scrapping shoes all together? All natural is not the answer. Yes, it is possible to go entirely barefoot– and more and more people are trying it out (Elmer). Or if just basic protection is desired, it is possible to use minimal sandals. But that takes us back to an earlier point, we really love shoes, and it is unsanitary to go barefoot. Most restaurants have signs that say, “No shirt, no shoes, no service.” Shoes are fashionable; shoes enable humans to do new unnatural things such as play football or tennis, and protect the feet from diseases and injury, not to mention extreme weather conditions.

7.2.6 A STRATEGY FOR INNOVATION
Shoes have a tremendous amount of potential to be designed towards the 100%. One of the best ways to make things more affordable is to mass-produce them in a very large scale. Although that is done for shoes to a certain degree, all of the various sizes they require dramatically increase the cost of raw goods, production, logistics, and inventory. One of the reasons so many different sizes of shoes exist is that shoes are not adjustable enough to fit feet well; if shoes don’t achieve a good fit, designers compensate by providing a large number of different sizes and hope that one of them fits.

So here are a few things that can be done to simultaneously make shoes better for both the top 10% and bottom 90%:

• Increase adjustability, improve fit
• Reduce the # of sizes, improve fit
• Mass produce at larger scale, reduce price
• Reduce inventory, reduce price
• Increase accessibility, design towards the 100%

Strategy is the easy part, execution is what matters.

7.3 A STUDY OF EXISTING SHOES

Below is a form study of over 80 different Men’s shoes that Ehsan Noursalehi conducted to inform his design process. All images are property of Zappos.com.
The form study focused primarily on athletic shoes, as those exhibit the most variety in construction and form. The shoe brands in the study include: Merrel, Vivobarefoot, UnderArmour, Addidas, Nike, New Balance, Puma, Vibram, and Asics. Special attention was given to overall shoe form, sole & heel height, construction methods, toe-box structure, and lacing (or adjustment) method.

Observations from this study helped gain inspiration and overcome design challenges during the personal design process. Only a few of the newer more innovative “barefoot style” shoes by Merrel and Vivobarefoot resemble the general foot-shape that was discovered in the foot study that was part of this project. The Vivobarefoot shoes in particular have very wide toe-boxes in comparison to the other shoes – this shape much more closely resembles the natural shape of the human foot. The other shoes apply significant pressure on the sides of the foot – particularly in the front section of the foot near the toes. In addition, none of the shoes exhibited a significant capability to have width adjustment through the use of laces or other methods – adjustment is primarily only capable at the ankle.
Figure 33 – The side view of a collection of shoe designs
Figure 34 - The top view of a collection of shoe designs
Figure 35 - The bottom view of a collection of shoe designs
Figure 36 - The rear view of a collection of shoe designs
7.4 DISCOVERING THE “FIRST PRINCIPLES” OF FEET

Ehsan Noursalehi’s feet are a bit of a statistical outlier. The only shoes that fit well are ones that are flexible enough for his foot to reshape. He has more trouble finding comfortable shoes to wear.

Curious to see how different his foot is from the norm, or whether there even is such a thing as a "normal" foot, he documented and measured the shape of 62 people's feet.

In the small foot-shape-study, the left and right feet of 26 female and 36 male adults were outlined in two dimensions. The volunteers were within the ages of 19 to 60 with the majority of them between the ages of 19 and 30. All of the volunteers in this study are top 10% consumers, however, it is assumed that the findings of this study are applicable to the feet of bottom 90% consumers.
7.4.1 FOOT SHAPE STUDY PROCESS

Figure 38 - The left and right footprints of Ehsan Noursalehi traced onto 8.5”x11” paper

Ehsan Noursalehi started with his own feet. He typically wears a size 11.5 or 12 shoe based on the brand and fit. For someone who is 5 foot 8 inches tall and weighs 175 lbs, size 12 shoes are definitely larger than normal. But what is normal?

Each of the volunteers were given two sheets of blank computer paper and a pen, asked to take off their shoes, and to trace their own feet onto the paper. Most people tended to find it uncomfortable to take off their shoes but ended up doing it, often finding it interesting/embarrassing to see their foot on a sheet of paper.
Initially, the process involved creating a copy of these feet onto thick card stock paper that would then be cut out to create a stencil of each person's foot. This was only done for the first 6 volunteers. This small sample led to a very quick and interesting realization: it was possible to line up all of the feet stencils by the heel in order to compare the length and overall shape of these 6 feet. Despite the large variance in length and overall shape, there was very little variance observed in the size and shape of the heel.

As more and more feet were traced, working with card stock was simply too difficult. It took a very long time to manually cut out each foot with a pair of scissors.
To circumvent this issue, everyone’s feet were scanned into .PDF’s that were then opened up as layers in Adobe Illustrator. These scans were then traced to create digital tracings of everyone’s feet.

The digital align functions in Adobe Illustrator were used to center and align all of the feet by the heel. Each of the feet tracings were then made transparent so that it would be possible to overlay all of them on top of each other to see a composite of all of the feet tracings.

![Figure 41 - A foot being traced digitally in Adobe Illustrator](image)

These steps that were trivial within Adobe Illustrator software would have been otherwise extremely difficult, cumbersome, difficult to measure, and inaccurate to replicate manually with the original card stock tracings.

**7.4.2 62 FOOTPRINTS - A VISUAL ANALYSIS**

The final result is rather interesting to look at, but also visually communicates a significant amount of information. A comparison of thirty-six male feet and twenty-six female feet are illustrated below. Again, the heel exhibits little variance despite the relatively large variance in foot length.
Overlaying the transparent digital tracings and aligning all of them vertically and horizontally by the bottom edge of the heel created the images above. The male and female feet are shown separately. It is also possible to overlay the 62 feet to create the image below. There does not appear to be anything such as a "normal foot"; everyone's foot seems to have its own unique size and shape.
Figure 43 - A composite image constructed from all 62 footprints of the 26 female and 36 male footprints. The outlines are
transparent and darker regions represent areas with greater frequency.
As predicted, Ehsan Noursalehi’s foot is a clear outlier. The largest foot traced was a size 13 male. It is easy to spot because the toes extend the furthest from the other feet; as a reminder, because of the shape and width of Ehsan Noursalehi’s feet, he typically wears a size 12 shoe even though his feet are considerably shorter than the size 13; by simply measuring the length of his foot, he should actually be a size 10.5 according to most shoe sizing guides (Zappos).

![Figure 44 - Composite heat-map image showing all 62 footprints along with the author’s footprint outlined and labeled. His foot is one of the widest feet in the study.](image)

When all of the 62 left feet are superimposed on top of each other, it is readily observed:
- Heels line up very well
- Moderate amount of mid-foot width difference
• Extreme variance in regards to overall length

Below, the *largest male foot and smallest female foot* are superimposed on one another. It can be seen again that the variance in length is much greater than the variance in width. For comparison, it can be seen that the *largest female and smallest male* despite having very different shapes, have a very similar width and length.

![Footprint Diagram](image)

*Figure 45 - The smallest female and largest male footprints superimposed (left) compared with the largest female and smallest male footprints superimposed (right)*

It is also possible to compare the composite of all of the female footprints in the image in the left below to the *largest and smallest female feet* to the right. These two extremes vary dramatically in shape and size. However, in comparison to the composite, they do not appear to be extremes at all. Instead, they appear normal because nearly identical to the *largest foot*, there is a slightly smaller
foot; and next to the smallest foot, there is a slightly larger foot. Thus, showing that there is no normal foot, but rather a spectrum of variously sized and shaped feet.

Figure 46 - Twenty-six female footprints superimposed (left) in comparison to the largest female and smallest female footprints (right)

7.4.3 MATHEMATICAL ANALYSIS
Unfortunately, the sample is not large enough to draw significant statistical conclusions. However, this study visually documents very interesting and fundamental takeaways. Feet have unique shapes, but despite this variance, there are some major commonalities that they all share in terms of general shape and proportion.
For further comparison, the 62 left foot tracings can be compared in two additional ways. In the bottom left they are centered by both width and length on one another and in the bottom right they are aligned by width and the front tip of the toes.

*Figure 47 – Sixty-two superimposed footprints aligned by both width and length (left) in comparison with sixty-two footprints aligned by width and by toe tip (right)*

With these two visual alignments, the commonalities that are shared in terms of general shape and proportion become more obvious, however, basic measurements can also be taken to quantify the visual observations.
Length & Width Measurements

- Largest Male Foot - 11.8" x 4.7"
- Smallest Female Foot - 8.6" x 3.3"

Shoes Sizes

- Largest Male foot - **Size 13 Male**
- Smallest Female foot - **Size 5.5 Female**

Total Variance

- *Length* varied from 8.6"-11.8" for a total difference of 3.2"
- *Width* varied form 3.3"-4.7" for a total difference of 1.4"
- This range of *length* and *width* is accommodated by **20 different shoe sizes**

In order to accommodate a size difference of **3.2" in length** and **1.4" in width**, the following **20 unique shoe sizes** for a gender neutral shoe are required: Women’s 5.5, Women’s 6, Women’s 6.5, Women’s 7/Men’s 6, Women’s 7.5, Women’s 8/Men’s 6.5, Women’s 8.5/Men’s 7, Men’s 7.5, Women’s 9/Men’s 8, Women’s 9.5/Men’s 8.5, Women’s 10/Men’s 9, Men’s 9.5, Women’s 10.5, Women’s 11/Men’s 10, Men’s 10.5, Women’s 11.5, Women’s 12/Men’s 11, Men’s 11.5, Men’s 12, Men’s 13.

This comes out to an average difference of **0.16" in length** and **0.07" in width** in between each of the 20 shoe sizes. For comparison, a United States penny is **0.75" in diameter and 0.06" in thickness** (US Mint).

*That means that every single shoe gets wider by about the thickness of a single penny.*

Looking only at the 32 male feet, the total difference is found to decrease from **3.2" in length** and **1.4" in width** to **2.5" in length** (0.7" less) and **0.8" in width** (0.6" less). This reduced range, however, is still associated with a surprising **14 unique shoe sizes**.
7.4.4 SIGNIFICANT OBSERVATIONS

There is no such thing as normal. Foot shape cannot and should not be standardized. Almost everyone's foot has a unique shape and size. There doesn't seem to be anything that can be called a "normal" foot shape based on the 62 feet in this study.

Feet are not in a locked ratio. Some feet are long and narrow, others are short and wide. Feet don't stick to a rigid ratio between length and width. However, shoes tend to ignore this basic fact.

The difference in length is much greater than the difference in width. Out of the batch of 62 feet, the difference of feet width is about 60% less than the difference in feet length. This means that shoes need to adjust more for length than for width.

Women's feet overlap with Men's. There is a significant range where the men's smallest feet overlap with the women's largest feet. However, in general, women's feet are much smaller than men's.

If shoes had more adjustability in shape instead of the rigid shape of most shoes, there would be a dramatic improvement the quality of fit of shoes to feet. After conducting this study, it appears that shoes as they are currently designed and made are ignoring the diversely unique shapes and sizes of feet.

7.5 VALIDATION OF PRIMARY RESEARCH

Sections 5.2 and 5.3 highlight significant and useful takeaways to design a more natural and adjustable shoe for the human foot that will benefit both the top 10% and bottom 90% consumers in a singular, highly functional, and desirable product. However, the process of applying the research to a functional design outcome is a hurdle.

Through the foot and shoe studies, it is very clear that the vast majority of existing shoes overly constrain and manipulate the human foot into unnatural shapes. This was also the conclusion of a 1912 study by Dr. Edward Lyman Munson A.M., M.D of “The Soldiers Foot and the Military Shoe”
(Munson). The discovery of this extensive report was very significant to help validate and reaffirm the findings of this study. A brief summary of the 160 page report in Dr. Munson's own words is provided below:

_In the investigation of the Army Shoe Board, which extended over four years and included the critical study of the feet of some two thousand soldiers, the fitting of many thousands of pairs of shoes, and many months of direct inquiry into the causes affecting the shoeing of the United States soldier, it became evident that in very many instances the faulty conditions found were due to lack of information on this important subject on the part of the officers and noncommissioned officers of the line concerned._ (Munson)

Dr. Munson discusses many of the misconceptions about the relationship between feet and shoes from 1912 and it is interesting and disappointing to find that little has changed in 2014

_The human foot is not to be regarded, as seems almost to be the idea with many, as an in-coordinating mass of flesh, bone and gristle which may with impunity be crowded into almost any sort of protective covering to form a fleshy peg, more or less similar to a horse’s hoof, on which to walk. It is, on the contrary, one of the most intricate anatomical structures of the human body. Every one of its parts has a definite function, and interference with its normal anatomical relations and development produces a corresponding structural defect or weakness which will always to some extent diminish and not rarely is completely destructive of the capacity to accomplish military marching._ (Munson)

The military commissioned this study because of the critical importance of marching on foot at the time. Any defect on footwear would be greatly amplified during the extended amount of marching normally conducted during that era of war.

_Good marching depends in its first cause upon a good shoe, so shaped and adapted to the foot as not to compress it, nor to unduly interfere with muscular action, nor to cause corns, bunions, ingrowing nails and other defects. No amount of liberality in the matter of supply, or the most scrupulous care in endeavoring to secure a fitting, can compensate for structural defect in a shoe supplied to troops._
Given an inelastic container of bad shape, and the yielding tissues enclosed therein will be forced by pressure to assume a new, improper, and weaker foot form. (Munson)

Dr. Munson and the Army Shoe Board ultimately concluded that no existing shoe would satisfy the needs of the military and thus, they designed their own boot.

To meet the needs of the military service a special military shoe is required. No civilian shoe is adapted to the purpose. Civilian lasts as a whole are necessarily based in a general way upon the average civilian physical type engaged in various vocations of the average degree of civilian strenuosity. And in civil life, as already mentioned, average conditions tend materially to be against, rather than for, foot development. (Munson)

Figure 48 – From Munson’s report, an x-ray image of a foot of an officer bearing his weight on his naked foot (left) in comparison to the same foot shown and under same body pressure, but in the civilian shoe which the officer wore on dress occasions. The foot is compressed over three quarters of an inch across the ball (right).
Through their 4-year study and design process, the Shoe Board found that **90 different sizes** were required in order to properly fit their male military body. A detailed description of this is seen in the passage below from page 48 of the report:

*By reason of the relations which must exist between the different sizes and widths of the general military type of foot which it is intended to cover, a sufficient number of sizes as to length, and letters as to width, must be provided in order that the foot of every soldier may find a shoe of dimensions to properly cover it. This point is taken up in some detail under the subject of fitting of the shoe. It is sufficient here to say that the Shoe Board has recommended that shoes be made in fifteen sizes and half sizes, and that each of these be made in six widths, giving a total of ninety varieties of shoes from which to make selection. (Munson)*
Their dedication for offering a good fit is admirable but 90 different sizes is a mind-boggling number – this would require an inventory that only the military would be able to effectively and affordably maintain. This study discovered and documented many shortcomings of the relationship between shoe design and the human foot. Their resulting shoe design, however, had very limited adjustability and thus required a rather complicated and rigorous fitting process with trained staff.

![Figure 50 - A modern reproduction of the 1912 US Munson Military Boot](image)

### 7.5.1 SIGNIFICANT DESIGN LEARNINGS

A very useful validation from the Munson report, was regarding arch support in shoes – it is interesting to note that the myth of arch support existed over 100 years ago and persists today. Dr. Munson discusses this on page 50 of the report:

*The shoe should not support the arch of the foot in the sense of lifting it up or buttressing it from below. This fact is opposed to common belief, but the latter is based on lack of knowledge of the anatomy of the foot and misconception as to its function. Rigid support of this region weakens its intrinsic muscles by favoring their non-use, and thus tends to directly cause the condition of flat-footedness which it is attempted to avoid. Barefoot peoples have no such arch support and flat feet are practically unknown among them. (Munson)*
The ability to remove arch support has major implications in the potential adjustability of shoe design. In a traditional shoe, the arch support has to be in a very particular spot to be properly positioned under the foot’s arch. Without arch support the insole of the shoe can be flat and the necessary accuracy of design features is greatly reduced.

Additional key observations of the Munson boot are that it has a tight heel radius and much wider toe-box. The front of the shoe is much more rounded and less pointy than most shoes. Ultimately, the overall appearance of the shoe structure much more closely resembles the appearance and structure of a naked human foot than most shoes.

The idea persists that if a more natural shoe shape can be achieved that has significant dimensional adjustability in length and width, far fewer shoe sizes are required to achieve an even better fit to the human foot than is currently possible with existing shoe designs.

### 7.6 A GREAT SHOE FOR EVERYONE

#### 7.6.1 APPLYING RESEARCH & MINDSET TO DESIGN

A shoe is one essential piece of clothing that is ubiquitous. However, as discussed earlier, shoes are not easily accessible to the lower levels of the other 90% because of current shortcomings of shoe design. Thus, the intrinsic human need and desire to own shoes combined with the current barrier to access them, presents a major opportunity to intervene and create a new product designed towards the 100% that has quality and value performance interwoven into its design mindset.
Flips flops are a very functional, affordable, and desirable product. In recent years, the relatively new Croc-style sandal/shoe hybrids have evolved to become a new alternative to flip-flops. They provide much more protection to the foot and greater durability albeit, at a slight increase in price.

The graph below compares the value performance of several pieces of footwear to their quality. Flip flops have relatively poor quality, however, with a very low cost it is able to provide significant functional, social, and emotional utility which translates to a high level of value performance. TOMS shoes provide very high levels of emotional and social utility among a small percentage of top 10% consumers, yet their very high cost and poor durability give them a relatively poor value performance. Croc shoes provide the highest durability and quality but Croc knockoffs provide greater value performance, despite a lower quality, because of the huge disparity in price.
This analysis provides some information as to why certain shoes are more common than others and why wider ranges of the economic spectrum of consumers have adopted these various designs. Ultimately, the higher the quality of a shoe and the higher the value performance of a shoe, the more likely that shoe will be purchased and used by a massive number of people worldwide. This is a generic conclusion that can be applied to any product or product category.

The shoe industry is worth roughly $185 billion worldwide and $40 billion alone in the USA (Benasra). It is a huge profit market. It is useful to consider the specific industry stakeholders that can affect the design, accessibility, and cost of a shoe. The major stakeholders in a simplified system include the Brand, the Manufacturer, the Vendor, and the Consumer. Each of these stakeholders has their own concerns and constraints. The figure below briefly compares these four stakeholders.
The humanitarian goal in this case study is to design a new shoe that is accessible, affordable, desirable, and useful for an extremely poor consumer that would otherwise not be able to or choose to purchase/consume traditional shoes. The goal again is not to do this by creating a shoe that is designed purely for extreme affordability – according to the models, this will create an undesirable shoe. The goal is to simultaneously create a new shoe that benefits both the bottom 90% and the top 10%. However, this is not sustainable or possible if there is no incentive or benefit to the brand, manufacturer and vendor. The best solution provides benefits to each of the various stakeholders.

Some of the other various considerations that went into the design process are highlighted in the figure below.
Accordingly, the key design idea became to design a **highly adjustable shoe that contours to the specific shape of the user’s foot while coming in far fewer sizes.** If it is possible to have such an adjustable shoe, it will ideally be (1) more natural for the human foot, (2) more comfortable for the human foot, (3) come in fewer sizes and cost less money for the brand and manufacturer to produce and costs far less money for the vendor to keep in inventory, ultimately making it (4) more accessible to the poorest of the poor. The largest challenge is to design an adjustable shoe that can (5) maintain or exceed the high social and functional expectations for shoes while allowing for the necessary amount of adjustability.

### 7.6.2 DESIGN PROCESS

Transitioning from the research to the design process was a very daunting step in the overall process. At this point, the research lent a very strong background in the needs of the human foot and typical considerations in shoe design. However, transferring that knowledge to a functional design was not a trivial task. The first objective was to create a more adjustable shoe. Various concepts were explored and tested.
The first concept in the diagram above involved a combined tongue-sole design that would allow the tongue to slide downward to increase the length of the shoe. The second concept involved two halves of shoes that slid inside of each other to adjust width and length. The third concept involved a shoe sole that wrapped up the sides of the foot as fingers – the fingers would be able to adjust the overall shape of the shoe using shoelaces. The fourth concept was a hybrid between a sock and a shoe. The last concept was an idea for a ridged shoe sole that could roll up around the toe to decrease the length of the shoe. The various concepts were explored using rough prototypes to test for feasibility and functionality.

A plastic shoe last was used to mark up a pattern that could be used to create two halves of an interlocking shoe design. One half of the last was marked with duct tape, the pattern was transferred to paper and the reciprocal design was created to match it. The design was tested on a large male foot and a small female foot.
Figure 58 - Testing the design on a smaller female foot (left) and in a canvas material on a male (right)

Figure 59 - Prototype of a sock-shoe concept shown on Ehsan Noursalehi’s foot. Prototype is made from an athletic sock, foam insole, and leather outsole.

A thick piece of leather was attached to the bottom of a male athletic sock and foam was inserted inside the sock for padding. The sock shoe hybrid performed well on a large male foot and small female foot – adjusting seamlessly between the two dramatically different sizes. This was seen as a promising design.

Figure 60 – Successfully testing the same sock-shoe prototype on a much smaller female foot
Figure 61 - Illustration of combined tongue-and-sole concept that would allow the length of the shoe to increase by decreasing the size of the tongue

The combined tongue-and-sole concept initially seemed to be the most promising idea to create a highly adjustable design without dramatically altering the visual appearance of the shoe. The concept was elaborated to allow for significant adjustment around the ankle and width of the foot.

Figure 62 - Illustration of combined tongue-and-sole concept showing three modes of three-dimensional adjustment. The illustration on the left shows how to adjust length, the image in the middle shows how to adjust for width, and the image on the right shows how to adjust around the ankle.

A simple prototype of this concept revealed a major flaw in the design. The combined tongue-and-sole prevents the typical geometry that exists in toe box and also introduces two large holes on the left and right side of the shoe with no obvious way method for how to allow for length adjustment without leaving these holes exposed.
This flawed concept evolved into a shoe wrap idea with the help of fellow designer Sebastian Frith. Ehsan Noursalehi and Frith worked together to create a multi-piece shoe wrap concept that had multiple pieces extending from the shoe sole that would wrap around the foot to form a perfect fitting shoe.
The concept worked well and created a visually attractive shoe concept. However, it was not clear how the various pieces could be adjusted and held in place. A second version of the shoe wrap concept was developed based on a male athletic shoe that intended to use shoelaces to connect the multiple pieces of the shoe wrap. A simple prototype of this concept revealed that this design would also introduce major exposed holes when adjusted to feet of various sizes.

A very pivotal point in the design process occurred after defeat by numerous failed attempts to develop or discover a promising adjustment method. At this point, the prototyping moved back to the foot study and focused on simplifying down to their most basic first principles. After countless hours of staring at the composite of the feet tracings, Ehsan Noursalehi decided to use a sharpie pen
to trace the darkest regions, or the statistically most common regions, of the foot and discovered a very interesting shape.

Figure 67 - A dark tracing along the most common foot shape of the 62 feet in Ehsan Noursalehi’s foot study

This newly discovered shape shown above was close to the mathematical average of the 62 feet. Although there is no capability to accurately calculate this average shape using a computer, it was possible to simply trace onto a piece of paper. This realization was a major breakthrough in the design process.
It became clear that there are two nearly parallel lines between the heel and mid-foot. This section would allow for the shoe to be extended or shortened in this parallel region without dramatically altering the overall aesthetic of a traditional shoe. These realizations gave rise to a new round of experimental prototypes that performed much better than earlier tests.

This method of adjustment also allowed the new shoe to have significant adjustability while maintaining a relatively traditional shoe structure and form.
The generalized foot pattern was broken into two parts that slid over each other to adjust for length. The smaller heel section would slide over the larger toe section. The early prototypes of this design shown in the images below performed far better and had much greater potential than earlier designs.

The patterns were iterated repeatedly in order to improve the overall fit of the shoe to the human foot in 3 dimensional space. These iterations in design were done using paper prototypes which were quick and affordable to construct.

A master pattern of each part would be kept on file and kept unaltered. Pattern modifications would be traced onto new sheets of paper. The new pattern would then be traced again in order to
keep a record of the modification. One of the new pattern duplicates would be cut and taped into a new prototype for testing. This process allowed for rapid pattern modification and iteration.

![Testing the paper prototype on a medium male foot]

Figure 72 - Testing the paper prototype on a medium male foot

![After many more iterations, the paper patterns for the shoe design]

Figure 73 - After many more iterations, the paper patterns for the shoe design

All of the pattern testing was initially conducted exclusively on the researcher. To gain an understanding of how the design would perform on other individuals’ feet and to gain an understanding of how to develop smaller versions of the shoe, copies of the shoe pattern at 90%
and 80% size were created. These patterns were then used to develop 3 sizes of the shoe in small, medium, and the original large shoe.

These three sizes were tested with 25 people at random and it was found that 5 people best fit the large, 5 people fit the medium, and 5 people fit the small. These tests gave insight into necessary adjustments to the master pattern. Certain areas needed to be more adjustable and other parts contoured poorly to the shape of the human foot. These edits were made to the large pattern which were then scaled down again to the 90% and 80% scale to produce the new medium and small shoes.

Figure 74 - The paper patterns for the large male shoe were scaled to 90% and 80% to create the medium (middle) and small (right) versions of the shoe which were then tested with 25 people
Figure 75 - Testing the large paper prototype with a male

Figure 76 - Some fit issues are noted from above. It is believe that the use of shoe laces can resolve the observed problem
Figure 77 - Testing the medium and small paper shoes with a female

Figure 78 - The medium prototype (left) was found to be a poor fit in comparison to the small prototype (right)
7.6.3 DESIGN OUTCOME

The refined paper prototypes were then modified for fabric pattern design. Allotments were given for seams and assembly by stitching. These final patterns were created digitally using Adobe Illustrator and printed onto paper to be used as stencils for the fabric components.

Several rough prototypes were created using the new fabric patterns and a stapler to simulate the stitching. It was found that without inserting a foam layer in between the fabric layers the shoe would have no structure resembling a shoe. Images of the shoe design with and without foam can be seen below.
The final prototype was constructed in all 3 sizes with the help of fellow designer Adam Booher. Adam was able to offer advice on refining the fabric patterns and to masterfully stitch the necessary components together.
The resulting shoe design is based off of the human footprint. The shape of the shoe is slightly different than traditional designs. This new shape makes the shoe much more comfortable and natural for the human foot. Ehsan Noursalehi also found that using this innovative adjustment method along with the new shape allowed for the 3 sizes to adequately and comfortably fit male and female adults.

This is a dramatic improvement to the current shoe sizing system which needs at least 14 different sizes to fit adult males, and at least another 14 sizes to fit adult females. The adjustability and comfort that can result from these shoes makes them theoretically desirable for top 10% consumers looking for a more natural shoe choice. However, reducing the 28 different sizes down to 3 sizes also makes the shoes much more affordable than traditional shoes, assuming that they are mass-produced at similar volumes.
The shoe easily adjusts for length by sliding the heel forward or back. The heel is secured in place using a 3 bar buckle and a Dacron strap. The length is only necessary to be adjusted the first time the user tries on the shoe. Once the length is set, the user can simply adjust the shoelaces like a traditional shoe.
Figure 85 - An overhead view of the shoe showing how the toe box is not sewn into the uppers, allowing for width adjustment

Nearly all shoe designs connect the toe box rigidly to the shoe uppers. This prevents the shoe from having the ability for noticeable width adjustment. However, this design does not stitch the toe box to the uppers. This allows for the uppers to tighten or loosen with the shoelaces effectively altering the width of the shoe to accommodate different widths and shapes of feet.
Simple materials are used in the design of the shoe including Dacron nylon webbing, canvas fabric, foam inserts, cork for the shoe sole, and neoprene rubber for grip.

The overall height of the shoe sole is intentionally kept to a minimum. This minimum height along with the flexible and spongy cork material offers protection to the human foot without over constraining it and limiting its natural mobility.
Figure 87 - Two females are seen wearing the small (top) and medium shoes (bottom)
The major design shortcoming in the current design is present in the connection between the heel and front half of the shoe. Currently, the two halves simply slide on top of each other to adjust for length. There is not robust mechanism in place to keep the connected and aligned. This is easily solvable and should be refined in future iterations.
Chapter 8 – Case Study: the OpenSocket

The design of an affordable prosthetic arm from 2009 to 2012 with a group of colleagues that eventually formed the 501(c)(3) nonprofit organization called Bump was a large source of lessons learned from the design process and helped inspire and inform the development of this thesis paper and the described mindset.

![Figure 89 - Ehsan Noursalehi in a brainstorming session circa 2009](image)

The design started as a project to develop the most affordable prosthetic arm possible for amputees in developing countries. Initial design concepts included recycling scrap materials to create a highly affordable arm. That initially seemed as a promising route, however, research revealed two affordable prosthetic arm designs distributed by nonprofit organizations that made the group question their original goals.
One of the discovered solutions was the Chaz Holder arm shown above. Very little information is available about the design online. However, a Prosthetics researcher shared two photos of the design with the team and shared some anecdotal knowledge. What is known is that distribution of the device ended with the death of Dr. Chaz Holder in 2002 (Martin). It is also rumored that many amputees would disassemble the arm and sell the metal components in local markets.

The design group noticed several additional problems with the design. The Chaz Holder arm certainly appears affordable, however, it is an underdeveloped product – one that does not offer enough value to its potential users. Learning that an amputee would be willing to sell their prosthetic arm in the local market instead of utilize it was very concerning for the team. It helped the team realize not any design will necessarily add value to a user’s life – low cost is clearly not the most important factor.

The team’s goal slowly shifted to instead create the most appropriate prosthetic arm for amputees in developing countries. However, the discovery of the second design called the LN-4 mentioned in Section 1.2 changed the goal once again.
This prompted the group to not only satisfy the needs of poor amputees in developing countries, but to also seek the opinion and satisfy the desires of US based amputees. In parallel, the team began co-designing their solution for a prosthetic arm with both amputees in Zacapa, Guatemala and Illinois, USA.

Figure 91 - The LN-4 prosthetic arm designed and distributed by the Ellen Meadows Foundation.

Figure 92 - Co-designing and testing two arm designs with a user in Zacapa, Guatemala
The group believed that this parallel approach would ensure that not only an affordable design would be developed, but that also a functional and desirable solution would be developed. This parallel process led to the final design through numerous iterations.
The final design solution is an off-the-shelf adjustable prosthetic arm called the OpenSocket that comes in small, medium, and large sizes. It can be fit by anyone in 30 minutes using only a few hand tools and costs 90% less than traditional devices that are custom made. The arms are sold to nonprofit partners that work to provide medical care in various regions of the world. These organizations purchase each arm from Bump for $500 and typically provide the arms to their patients for free. The solution created by Bump allows for an entire prosthetic clinic to exist within an easily shippable box.
The final solution developed by the team costs 90% less than traditional custom made arms but 900% more than the LN-4 arm. The reality is that traditional solutions are inaccessible to the bottom 90% amputees and while the LN-4 is highly accessible, it is undesirable.

Thus, the OpenSocket strives for functionality, desirability, and accessibility. It does well in functionality, and desirability, but needs a major reduction in cost in order to increase accessibility.
Chapter 9 – The Future

“We are tied together in a single garment of destiny, caught in an inescapable network of mutuality. And whatever affects one directly affects us all indirectly”

— MARTIN LUTHER KING JR.

There is an inherent desire among many to help those less fortunate than themselves. Corporations also will not object to social good if it can provide them with financial gain. This thesis attempts to be guide, or rather an inspiration, on how goals for capitalism and humanitarian aid can be combined through the strategic development of innovative, ubiquitous, and useful products.

One thing for certain, there is no need in this world for useless products and at minimum; nonprofits and social designers must raise their standards of what constitutes an appropriate solution for the base of the bottom 90%.

Figure 97 - After 30 years, all of these technologies can fit into a jean pocket
Thirty years ago, the world was a very different place. A large economic and technological gap created distance between Western countries and the developing world. Hans Rosling has shown with statistical data that the gap has dramatically decreased over time (Rosling, Hand Rosling and the Magic Washing machine). Thirty years ago, many individuals in the world did not have direct access to telephone technology. Today, not only do the vast majority of the individuals in the world own mobile phones, but many of the technologies that 30 years ago were stand-alone devices have been affordably and efficiently been added to the most affordable feature phones.

The changes in the global economy and dispersion of affordable technology changed the nature of the world in a way that can positively influence the equity shared among its citizens. The access to certain quality of life products can be ensured to citizens of any economic level.

9.1 URGENT NEEDS

“All of humanity now has the option to ‘make it’ successfully and sustainably, by virtue of our having minds, discovering principles and being able to employ these principles to more with less” (Fuller)

— R. BUCKMINSTER FULLER

Forty-one products were identified in Chapter 4 as examples of great design for everyone. However, there is a significant need for numerous additional products to ensure an improved quality of life for those that cannot afford the current financial burden of existing products.

Examples of products that urgently need to be reevaluated and redesigned for everyone are items such as washing machines, automobiles, computers, smart phones, air conditioning, clean water, electricity access, Internet access, and an extensive assortment of medical equipment. Some of these areas are being worked on extensively and others are not actively being pursued.

For example, there are countless examples of solar powered LED lights used by villagers in developing countries. Some of these might work well, however, the argument is that they are not good enough until those solutions for the poor are desirable enough and useful enough for the rich that it creates an innovative disruption in the traditional top 10% market. A truly useful, desirable,
efficient, and reliable solar powered lighting system should not just be good enough for the poor, it should entirely disrupt the traditional Western utility system. Until that point is reached and exceeded, there is continuous room for improvement in the technology and design of existing solutions. The 20th century brought us such technology as the incandescent light bulb and electricity. The 21st century will contain such dramatic advancements in technology at an even greater rate of speed. The driving force behind these innovations, however, cannot be the same as those in the preceding century. Innovation must consciously designed by be globalized, equity driven goals.

9.2 THE PATH FORWARD

“Something hit me very hard once, thinking about what one little man could do. Think of the Queen Mary—the whole ship goes by and then comes the rudder. And there's a tiny thing at the edge of the rudder called a trim tab.

It's a miniature rudder. Just moving the little trim tab builds a low pressure that pulls the rudder around. Takes almost no effort at all. So I said that the little individual can be a trim tab. Society thinks it's going right by you, that it's left you altogether. But if you're doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole big ship of state is going to go.

So I said, call me Trim Tab.” (Fuller)

— R. BUCKMINSTER FULLER

This project began with a simple observation of how the global market is undulating and behaving. There is an irrefutable gap in current product design mentalities. By not accepting mindlessly celebrated products with social missions, the mindset driven method exemplifies the necessity of focusing design on end users needs and desires. The examples of equitable products, and two case studies of how the mindset that everyone deserves great design show how to apply the design strategies discussed and develop innovative products and solutions.
Hope is not a design strategy. We cannot passively sit back and hope for the best. Embodying design as a catalyst for social change for good creates a new opportunity for capitalist, market driven structures to create a better, more sustainable future that empowers all consumers. The world will not stop changing. It is our design strategies that must change. Challenge your mindset. Think critically about the motivations and desires of your end users. Design for the 100%.
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