

# Bottom of the Pyramid as a Source of Breakthrough Innovations\*

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*In this paper, I identify the bottom of the pyramid (BOP) markets as a new source of radical innovation. By focusing managerial attention on creating awareness, access, affordability, and availability (4As), managers can create an exciting environment for innovation. I suggest that external constraints can be utilized to build an innovation sandbox within which new products and business models can be created. Using a live example of such an innovation—the development of the biomass stove for the rural poor in India—I illustrate the process and the usefulness of the approach. Increasingly, global firms are recognizing the implications of innovations at the BOP for developed markets as well.*

A 2000-dollar car (Tata Nano); 50-dollar cataract surgery (Aravind Eye Care System); less than \$0.01 per minute of cell phone time (Airtel); a modern, well-appointed 20-dollar hotel room (Ginger); and a supercomputer (Eka) that costs less than \$40 million to develop: These are all part of an emerging phenomenon of innovations from the bottom of the pyramid (BOP). We will examine in this paper how and why these markets are becoming drivers of fundamental innovation—not just in products but also in the whole business system. To operate profitably in these settings, we have to transcend technology and product perspectives of innovation and focus on total delivery of value. As a result, we are forced to rethink the very *source, the focus, and the processes of innovation*.

## BOP Markets

It is important to start with a brief description of the characteristics of the BOP market. It consists of over four billion people who live on less than \$2/day. However, these four billion people who make up the BOP are not a monolith. They represent multiple cultures, ethnicity, literacy, capabilities, and needs. They can be segmented in multiple ways. This segmentation opportunity has allowed, since the publication of the book *The Fortune at the Bottom of the Pyramid* (Prahalad, 2004), a proliferation of books and articles such as *The Next Billion* (Bhan and Tait, 2008) and *The Bottom Billion* (Collier, 2007). The World Resources Institute and the International

Finance Corporation (IFC) did a detailed study of the BOP around the world and estimated that the market is about \$5 trillion in purchasing power parity (World Resources Institute, 2007). We can safely conclude that there is a large, untapped market. This market is currently served by the unorganized sector that is often inefficient and controlled by local monopolies, such as money lenders and middlemen. The challenge is to convert the *unorganized and fragmented markets to an organized, private sector market*.

Established global firms ignore this market at their own peril. Consider, for example, the wireless industry. Over four billion people around the world will be connected through wireless devices by 2010. India alone was adding over 10 million new subscribers per month during 2008 and early part of 2009. Three Indian firms (out of a dozen) in the wireless business have a market capitalization of about \$40 billion. No firm in the industry—Nokia, Motorola, Samsung, or LM Ericsson—can ignore this market. The story of growth of wireless in India is similar in other parts of the world—be it sub-Saharan Africa, Latin America, China, or Eastern Europe. The proliferation of cell phones and the rate of adoption is just the start of the process of BOP-led growth and innovation. Low-cost transportation is another (Tata Nano received over \$600 million in advances from consumers; most of it for delivery in 2010 and beyond). A similar pattern is unfolding in low-cost housing by Tata and others. Understanding and effectively participating in the BOP markets is essential to growth in most sectors. Firms have to, therefore, understand the dynamics of these markets and the process of innovation therein.

The poor live both in rural and urban settings. For example, 70% of the BOP in India lives in rural areas, and therefore access to that market is a major problem. However, most of the poor in Brazil live in favelas or

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urban slums. These distinct differences suggest that an undifferentiated approach to these markets will not work. While differences are real, converting the BOP into microconsumers, microproducers, microinvestors, and innovators requires that we focus on the 4As (as opposed to the traditional 4Ps of marketing). We need to focus on the following:

1. Creating an *awareness* of the product and service such that the BOP consumers and producers know what is available and on offer, and how to use it;
2. Enabling *access* such that even consumers in remote locations are able to get access to the products/service;
3. Ensuring that the product or service is *affordable*. Most often, this is the most difficult problem for firms from the developed markets to come to terms with. We need to provide world-class quality (not luxury) at prices that are 1/50 or better such as a \$50 cataract surgery (with world-class quality); and
4. Focusing on *availability*. To *build trust* and a loyal base at the BOP, we have to ensure an uninterrupted supply of products and services.

Innovation at the BOP must start with the commitment to *awareness*, *access*, *affordability*, and *availability* as the organizing themes. Each of these prerequisites *creates* unique challenges. For example, how do we create awareness in areas that are “media dark”—without access to radio or TV signals? How do we get access to rural markets at low cost? What are the logistics challenges? How do we dramatically reduce costs such that goods and services are affordable to BOP consumers? How do we replenish products in remote locations on an ongoing basis without an established logistics infrastructure? It is the response to these questions that become the basis for breakthrough innovations. To succeed, we need to accept these constraints as real and work within them. Contrary to popular wisdom, innovation is not about working

without constraints, or adopting a “blue sky” approach. *In the BOP, successful innovation is about working within constraints.* I call this approach: “working within an *innovation sandbox*” (Prahalad, 2006). I will illustrate what I mean with a detailed example.

## The Innovation Sandbox

I will illustrate the development and use of the innovation sandbox using the example of building a biomass stove for the very poor in rural India, a project I was intimately involved in. (I led a team of two, Jeb Brugmann and Craig Cohen, and we worked with the BP team of about ten led by Roberto Bocca. For two years, this team did all the research, the conceptualization of the business, and the development of the ecosystem.) Traditionally, rural women collected sticks, shrub, grass, and other biomass materials, and sometimes cow dung to use as fuel. They spent anywhere between two and three hours per day collecting biomass. The biomass they used produced acrid smoke. The pollution was significantly higher inside the hut than outside. The resulting pollutants were a health hazard not just for mothers but also for young children. The pictures below, Figure 1, show the nature of the cooking system that is in use in a significant portion of rural India.

Women in rural India also make intelligent choices of fuel. The choice depended on availability of various types of fuel, the amount of money they had to spend (depending on the season, more after harvest and less during the non-agricultural season), and the type of cooking they did—from making a cup of tea to cooking a full meal for seven. Further, the food and cooking habits varied considerably across India. There was no single solution that could satisfy both the rice eaters and the wheat eaters (who make flat Indian bread called chappati). The solution, therefore, must have a capacity for personalization built-in.

The starting point of the process was a detailed and in-depth understanding of the consumer, and her varying requirements. We used video-ethnography to identify not just what people say they need and use but also to document visually how they really cook—the entire process from collecting biomass to delivering a finished meal. This was done with multiple families in different parts of the country—south, north, east, and west—and significant differences were identified. A content analysis and clustering of the results of this analysis led to a deep immersion into a consumer’s life as well as a deep dive into her decision processes. That was the starting point for developing broad specifications for the design and development of the project. The process is shown below in Figure 2.

### BIOGRAPHICAL SKETCH

Professor C. K. Prahalad (1941–2010) was the Paul and Ruth McCracken Distinguished University Professor at the Ross School of Business, The University of Michigan. He was the coauthor of four books on strategy: *The Multinational Mission*, *Competing for the Future*, *The Future of Competition*, and *The New Age of Innovation*. He was also the author of *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits*. He was a prolific author and won the McKinsey Prize four times for the best article in Harvard Business Review, as well as the best article in Strategic Management Journal. He was a fellow of the Strategic Management Society and the Academy of International Business, and a member of the Board of NCR Corporation, Pearson plc., Hindustan Unilever Limited, and the World Resources Institute.



Figure 1. Traditional Cooking System in Rural India

The constraints within which we had to operate—the innovation sandbox—became obvious. We had to:

1. Build a *modern*, smokeless, easy-to-use stove. We wanted to make the product *aspirational* such that the consumer would want to own one. Most of the market research is focused on identifying needs. The need in this case was easy to identify. It was harder to identify what people aspire to own. This is critical as most work in the BOP pays little explicit attention to the emotional needs of the poor. We wanted to actively incorporate their aspirations to own esthetic and “fashionable” products.
2. Build a product that meets *global safety standards*. This meant that safety must be built into the design.

3. The business must be *scalable*. We had to build a business, not just the product. All aspects of the business—manufacturing and logistics, distribution, and fuel supply—had to scale.
4. It must be *affordable*. In this case, that meant that the product had to be sold for less than Rs 1000 (say \$20) and had to generate a profit when the appropriate volume levels were achieved.

These four criteria, based on consumer immersion and insights, became the boundaries of the innovation sandbox that could not be violated. All innovation had to be developed within these constraints as shown in Figure 3.

The implications of these constraints are important to recognize. The product design had to fulfill its functional characteristics—smoke-free and energy efficient. It also had to be esthetic and beautiful. *Functional and emotional appeal* was built into the design. The product had to be aspirational. Second, the safety standards had to be *global standards*, not local standards. Actually, India did not have government-imposed standard for biomass stoves. This was a critical constraint. So much of the work at BOP focuses not just on *local solutions* but *local standards*. We wanted to ensure that the poor get the best

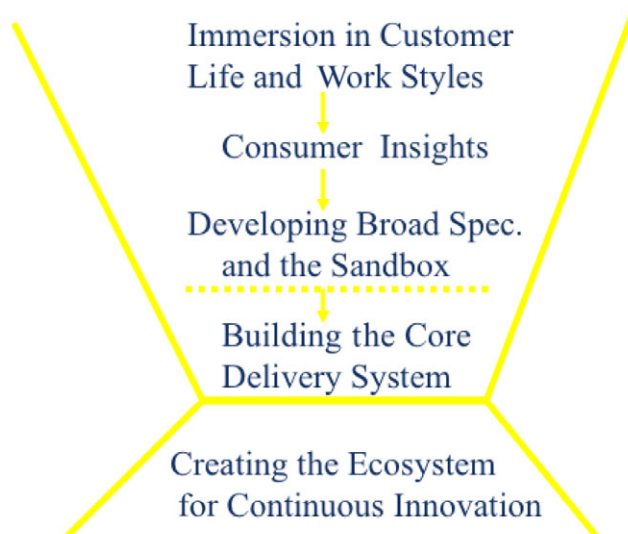


Figure 2. The Process for Developing Business Specifications



Figure 3. The “Innovation Sandbox” for Energy in India

quality that is possible within technical (manufacturing) constraints. Two considerations prevailed here. Because BP, a global firm, was involved, global standards became a necessary condition. Further, the project group was determined to show that global standards could be incorporated at an affordable price. Scalability meant that we aimed to produce and sell, say, one million units in a short time of two to three years. Most solutions at BOP, developed by nongovernmental organizations (NGOs), tend to be nonscalable solutions. We, therefore, set a goal of 20 million consumers around the world in 10–12 years. This meant that the solution must be not just *scalable in India but transportable across countries*. Finally, it must be affordable. This forced the logic of *Price – Profit = Cost* and not the more traditional *Cost + Profit = Price*. While this appears to be a small transition, when we start with price (focus on consumers and affordability) and recognize that profit is a requirement for the business to sustain itself and grow, the only lever that designers can focus and work on is cost. This challenged the design team, as it had to get the stove to be profitable at less than \$20 price. Mr. Roberto Bocca of BP signed up to lead the project called the Emerging Consumer Markets group in late 2004 with a global mandate. He was able to deliver on the basic innovation of product and ecosystem by early 2007—in little over two years. Mr. Mahesh Yagnaraman later joined the group as the general manager for India operations to scale the business.

### Innovation as a Learning Process: The Evolution of Business System

Innovation in BOP markets is a continuous process of learning and refinement. For example, in the experiment with the stove, we started with a combination stove (or Chula in Hindi). Some of the critical milestones in our learning were the following:

1. The initial conception of the stove had a biomass and an LPG component to it. The goal was to give the consumer a choice. She could use either the biomass or the LPG component as she saw fit, based on what she was cooking and how much she wanted to spend. Very soon, we realized that BP, as a foreign firm, could not get access to LPG in India at subsidized rates that other Indian oil firms could get. So, we had to abandon the “two stoves in one formula” and move to a stand-alone biomass stove.
2. We started with the biomass stove, which required the consumer to use biomass broken into small bits that can fit into the sleeve of the stove. It was obvious that

this step was not easy on the consumer, and more importantly, did not give consistent quality.

3. We moved rapidly to a “biomass pellet” formulation where uniform pellets made out of biomass were offered as fuel. This required us to use a pelletizer to manufacture biomass pellets that can be sold to the consumer. This relieved the consumer from searching for biomass on her own. She could buy 1- or 5-kg bag of pellets from the local BP-supported vendor. The biomass stove–pellet combination became the preferred solution. It ensured convenience, ease of use, and consistent quality.
4. The design of the stove moved on to include a battery-operated fan that allowed the consumer to regulate the flame as required. This made the biomass pellet-based stove behave like an LPG stove where one could regulate the intensity of the flames. We also built a stainless steel sleeve with ceramic coating for burning biomass pellets that would withstand the intensity of the heat as well as render it easy to clean. The design of the biomass pellet–stove combination also evolved in its design and esthetics. The evolution of design over 24 months is shown in Figure 4.

In addition to significant changes to functionality, each version incorporated many easy-to-use capabilities. Further, each version improved on the esthetics of the design as well as the footprint of the stove.

### Building an Ecosystem

While the product innovation process was critical for the success of this project, the focus on *awareness*, *access*, *affordability*, and *availability* (4As) required that we incorporate in the innovation process methods to access the rural poor cost-effectively. It was obvious that BP could not cost-effectively access these markets, and even if it could, it would take an inordinate time to build the infrastructure. So, we decided to build an ecosystem that will be cost-effective, scalable, and provide much needed skills and knowledge. The elements of the ecosystem consisted of the following:

1. Collaboration with the Indian Institute of Science (IISc), a premier technology research and teaching powerhouse in India. The faculty of IISc helped develop the pellet-based, fan-assisted, top-down burning system and helped dramatically improve fuel efficiency.
2. Collaboration with several NGOs to identify and build village level entrepreneurs called JyotiAmmas. These were women in the village who were trained to advise



**First Version****Stabilized Version****Current Version****Figure 4. The Evolution of Product Concepts and Configurations**

potential buyers of the stoves as well as stock the stoves and fuel. They were an indispensable part of the logistics system for making stoves accessible and fuel available all the time. They were also the key to create an awareness of how the new stove worked. Collaboration with NGOs, and with their help in building a village-level entrepreneurial network, was critical (Brugmann and Prahalad, 2007).

- BP had to build a manufacturing capacity for stoves. They contracted with a third party with experience in manufacturing to build stoves. BP provided a ready market for it and technology assistance. Investment in the plant to manufacture the stove was made by their partner.

The entire ecosystem was an integral part of the innovation process. Without the ecosystem, BP could not have developed the stove and sold it at an affordable price. As of early 2009, more than 400,000 stoves were sold. No rural cooking solution using biomass, so far, has either reached the scale or the quality at an affordable price. The efficacy of the stove from a health point of view is equally impressive as shown in Table 1.

**Table 1. Comparison of the Traditional and the New Stove**

Item measured	Results
Energy efficiency	From 13% to 47–50%
Reduction in CO <sup>a</sup>	71%
Reduction in suspended particulates	75%
Reduction respirable particulate matter	34%
Level of smoke	Acrid smoke to smokeless

<sup>a</sup> Reductions measured from a typical cooking system found in villages.

So what are the generalizable lessons from this experiment?

**BOP and Innovations:  
Generalizable Lessons**

It is clear from the experience of many multinational firms that taking the products, services, and business systems from the West will not work in the BOP markets. Firms have to learn to balance global standards and local responsiveness. The biomass stove is just one example of how to innovate effectively in and for BOP markets. We could add more such detailed examples. The development of a 20-dollar modern hotel room (Ginger) is another example. The book, *The Fortune at the Bottom of the Pyramid*, provides numerous examples in a wide variety of industries—from retail, finance, housing, health care, agribusiness, government, handicrafts (carpets), and telecommunications, and from across multiple countries. We can make the following generalizations:

1. We must recognize that the BOP markets are different from the developed country markets. BOP is not a monolith. Wide variations exist between BOP markets—India versus Mexico, or within India, Tamil Nadu versus Bihar. There is no universal BOP solution. Solutions must be specific to an industry and to a particular target within the BOP.
2. BOP challenges our thinking by focusing on the 4As. Affordability can challenge the existing product concept as well as “go to market” strategy. It forces us to start with a clean sheet of paper.
3. Innovation must start with a deep immersion into consumers’ lives to get unique insights. This allows us to

develop a system of constraints within which we have to innovate. The innovation sandbox is the result.

4. Finally, innovation is not about a product. It is about developing an appropriate ecosystem that enables a new business system to function.

These processes lead to a very different approach to *capital intensity of business*. The focus is on reducing capital intensity to a point where the capital requirements—fixed assets as well as working capital needs—are spread over the ecosystem and not borne by one firm. The ecosystem also allows for specialization. In the case of the biomass stove, the role of JyotiAmmas is distinct from the NGOs and from the IISC. Collectively, these *specialized groups* working in concert, and orchestrated by a nodal firm such as BP, create the business system. Affordable pricing focused attention on *volume and scale*. Profitability depends on large volume, low capital intensity, low margin per unit, and high return on capital employed. This logic is alien to “gross margin” thinking in most firms. Detailed understanding of the *workflow* is critical in building the innovative business system. Often, in established firms, workflow and business processes do not get senior management attention. They are taken for granted. In BOP markets, innovators have to pay special attention to workflow. Workflow is the basis for picking partners for collaboration and building the ecosystem.

The development of markets at the BOP is not just about serving an existing market more efficiently. It is often about *creating a new market*. Sometimes, it is a substitute for an existing approach to fulfilling well-recognized functionality as in the case of energy for cooking. But often, it is a new functionality as in providing weather and price information to subsistence farmers using a cell phone. This demands that we do not just create awareness but build ecosystems for *acquiring new customers*.

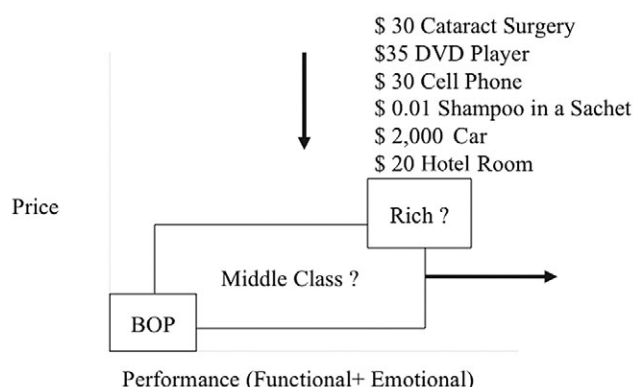
## The Innovation Flow

We have traditionally assumed that the focus of innovation is products and technologies for the developed markets. The BOP allows us to explore the possibilities of an untapped market of four billion new microconsumers and microproducers. This shift in emphasis forces us to move from a product-centric approach to a focus on business model innovation, of which the product is but a subset. Systems thinking is a prerequisite for success in BOP markets. Further, the BOP market requires a renewed emphasis on building an ecosystem as an integral part of innovation.

BOP markets by definition demand new services and applications. As a result, BOP can be a source of new developments. For example, paucity of banks and ATMs are forcing financial service institutions in BOP markets to look at cell phones as the basic access device to deliver financial products and services to the poor. It is possible to settle payments for small transactions with text messages, transfer money to a cell phone, check bank balances, and be notified of transactions (e.g., use of credit card or deposits and withdrawals) through instantaneous cell phone messages. Many of the applications are unlikely to have originated in developed markets where bank and ATM density is high, and consumers can be accessed through an existing infrastructure (Vaidyanathan, 2008). Because BOP does not have legacy systems, new infrastructures can be built at a lower cost and deliver better functionality. BOP markets do not have the burden of legacy systems and “legacy mindsets.” Both managers and consumers in the developed markets are socialized to accept services in a given format. They have a significant “forgetting curve” to overcome (Prahalad and Lieberthal, 1998).

Many global firms are increasingly using the BOP markets as a laboratory for innovation not only for the BOP markets but also for the established country markets. For example, GE Healthcare developed an electrocardiogram (ECG) machine for use in rural India. Given the poor infrastructure—no electricity, paucity of trained doctors, and pervasive poverty—the machine had to work on batteries, be operated by paramedics, be light (for being carried around) and robust, and be able to print ECG results on the spot for identifying problems, if any. More importantly, it had to be affordable. GE engineers in India started with a target of \$800 (compared with \$10,000 in the United States). The product that was created by GE India engineers at John F. Welch Technology Center at Bangalore weighs 1,100 g, and it is battery-operated with an inbuilt printer. The traditional ECG machine sold in the United States is about 50 lbs, stand-alone machine and occupies a much larger footprint. Now, the BOP version has been sold in India for \$1,000 and in various countries in Europe for about \$1,500 compared with the current U.S. models at \$10,000, a much better deal in both functionality and price. This breaks the price performance levels of established Western models. The same machine is also likely to be sold in the United States. A similar story is unfolding in ultrasound for GE.

We have gone through a journey of understanding the potential of the BOP markets. Recognizing the BOP—four billion underserved consumers—as a legitimate market consisting of microconsumers, microproducers,



**Figure 5. The Morphing of Value Equation in Global Market**

microinvestors, and innovators is the first step. The ability to accept constraints and build an innovation sandbox within which innovation will take place is the second step. The biomass stove provided an example of how this can be done in a systematic fashion. As BOP forces a new price performance envelope (value equation) and as it supports new applications, often first time in the world (as in mobile applications), a new innovation dynamic is evolving rapidly. These innovations, as shown below, are exerting pressure on the traditional definitions of markets of the “rich and poor.” If the 2,000-dollar car is compliant with European standards of emissions as is sold in India, why not in Europe? If it works well in India, can it be sold in Brazil, Mexico, Turkey, and Indonesia? Is there a global market? How will it impact the traditional car industry? These questions will be asked with increasing frequency in the years to come. It is important to recognize that the traditional cost structures of global firms serving the developed markets will be under significant pressure. The structure of market segments globally will also morph. The changing value equation forced by BOP markets is shown in Figure 5.

There will be a major move toward “middle class” orientation to businesses. This is not to say that some

luxuries will not exist as businesses, but the process of moving to the middle will prevail. It is estimated that over 60% of the world population in 2020 will describe themselves as middle class, and 60% of these 2.6 billion will live in emerging markets. What we are witnessing in BOP is just the early indicator of a systematic structural change.

## Conclusion

For global firms, active participation in BOP markets is not an option. Just as Nokia, Unilever, Nestle, and others have discovered, these markets are critical for their sustained and profitable growth. More important is the fact that breakthrough innovations that allow them to participate in BOP markets can often be leveraged in developed markets. The lessons that they learn in BOP markets, such as dramatic changes in price performance (value), use of hybrid technologies, lean management, market development, deskilling of work, collaboration with NGOs and the public sector, and distribution and logistics in hostile conditions, are the qualities that will serve them well in becoming globally competitive. In effect, the participation in BOP markets and innovation will set the global competitiveness agenda for the next decade.

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