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Design and development of products and services at the Base of the Pyramid: a review of issues and solutions

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Abstract: The base of the world income pyramid, generally called the 'Base of the Pyramid' (BoP), consists of four billion people with average per day income of less than four dollars. Over the past several years, the design and development of products and services at the BoP (BoP people as producers and consumers as well) has been investigated by several authors from different disciplines. A literature review showed that the issues (i.e. constraints) in designing and developing products and services at the BoP and ingredients of solutions addressing these issues have not been synthesised. Furthermore, quantitative findings on these issues and solution-ingredients are lacking. This paper addresses these gaps by pulling together the issues and solution-ingredients in the BoP from the reviewed literature and comparing these with a large study found in this literature. In addition, through the analysis of the data available in this large study, we extracted some quantitative findings on these issues and solution-ingredients, and identified relationships between them. We have discussed the practical implications of these findings. This study adds to the growing body of literature on the sustainable development at the BoP.

Keywords: BoP; Base of the Pyramid; poverty; sustainable development; design and development; products and services; issues; solutions.

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Andreas Larsson is an Associate Professor at the Department of Design Sciences at Lund University, where he is heading the Innovation Engineering Group. His research agenda aims to create a rich blend of needs-motivated activities dealing, among other things, with cross-functional knowledge sharing, local and distributed teamwork, and participatory innovation. These interests can be summarised in the overarching aim to support product developing individuals, teams and organisations in effectively and efficiently co-creating and sharing ideas and knowledge across a wide range of boundaries (i.e. teams, organisations, cultures, languages, time zones, etc.) in the pursuit of innovation.

Prabhu Kandachar is a Professor of Industrial Design Engineering and Chairman of the Department of Design Engineering at the Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands. He has organised two conferences in the area of the BoP and has edited the book *Sustainability Challenges and Solutions at the Base of the Pyramid*.

1 Introduction

1.1 *Business strategy and sustainable development at the BoP*

The base of the world income pyramid, generally called the ‘Base of the Pyramid’ (BoP), consists of four billion people with average per day income of less than four dollars. Their income is irregular and unpredictable. Most of these people live in rural villages, urban slums or shanty towns. Usually, these people have little or no formal education, and they are hard to reach via the conventional means of communication and distribution channels. The World Bank conducted a study called ‘Voices of the Poor’ involving 20,000 poor women and men from 23 countries to explore their perspective regarding poverty, well-being and ill-being (Narayan et al., 2000). This study identified that the poor face different problems such as hunger, violation of dignity, state corruption, unemployment, poor health, gender inequality, etc. Karelis (2007) argues that the poor, in general, are not good at saving, borrowing and investing; and they prefer immediate consumption. This short-term approach of the poor can be attributed to their lack of assets (Sherraden, 1991). Furthermore, the poor have limited access to financial services (Ramady and Kantarelis, 2009).

The traditional development aid has not been effective in solving the problems of the world’s poor. New solutions involving business development combined with poverty alleviation are currently being explored. These solutions, consisting of business strategy, focus on the BoP people as producers and consumers of products and services. Henceforth, we use the term product(s) for products and services. According to Prahalad and Hart (2002), the most visible and prolific writers in the area of the BoP, this business strategy is important in “...lifting billions of people out of poverty and desperation, averting the social decay, political chaos, terrorism and environmental meltdown that is

certain to continue if the gap between rich and poor countries continues to widen.” This suggests that such a business strategy offers a potential approach to meet the challenges of social, economical and environmental sustainability at the BoP.

The International Finance Corporation together with the World Resources Institute measured the size of BoP markets (BBC, 2007). The potential purchasing power of the BoP is five trillion US dollars. At the BoP, businesses can achieve financial sustainability while improving the lives of the BoP people. The BoP people now have relatively increased access to television and information. This can help businesses to make them aware of their different products (Prahalad and Hart, 2002). Deregulation and gradual withdrawal of government and international aid make the BoP more hospitable for businesses by taking support from non-governmental organisations (NGOs).

There is a profound need to reduce adverse effects on the environment caused by human activities (Lempert and Nguyen, 2008; Sangle, 2008; Teo et al., 2010). Furthermore, environmental sustainability is crucial for holistic sustainable development of any society (Gorobets, 2011). The business strategy at the BoP therefore needs to be environmentally sustainable. There are links between poverty and environmental sustainability. For example, Bangladesh can lose more than the developed countries, physically and financially, from increased storms and a rising sea level (DEFRA, 2003). In addition, the poor can have negative influence on the environment due to the lack of appropriate products (e.g. pollution caused by the lack of smoke-less wood-burning stoves). Products designed and developed at the BoP (i.e. BoP people as producers and consumers as well) can promote human development and environmental sustainability simultaneously. This is illustrated with the following two examples drawn from the study carried out by the United Nations Development Programme (UNDP, 2008).

- 1 In Brazil, a company ‘Sadia’ has marketed biodigesters to the swine producers from the BoP. These biodigesters can convert pork breeding waste into resources such as renewable energy, biofertilisers and food for fish.
- 2 In Trinidad and Tobago, Mt Plaisir Estate Hotel has promoted the development of the poor from a rural village and has simultaneously protected the environment and natural biodiversity (e.g. an endangered leatherback turtle, which is a main tourist attraction). The hotel uses the biodegradable kitchen waste on its farm, which yields fruits, vegetables and livestock for the resort.

1.2 Products at the BoP: issues and solution-ingredients

In this paper, we focus on the BoP people as producers and consumers of products. The businesses at the BoP design and develop products to serve the BoP producers and to market the products to the BoP consumers. By focusing the poor as producers, their income can be raised. This can also help to generate employment opportunities for them and can alleviate poverty. There are two approaches to focus on the BoP people as consumers. First approach involves tapping BoP markets by selling products to the poor with the primary aim of earning profits. This approach may not be sustainable and may not help to alleviate poverty. Karnani (2007) has rigorously argued that this approach is flawed for alleviating poverty, and that it can exploit the poor. In the second approach, businesses aim at the development of the poor and accordingly market appropriate products to them. In this approach, innovative solutions are devised to seek financial sustainability combined with the development of the poor. This approach can help to

raise the income of the poor and can alleviate poverty. For example, in Ethiopia, Kenya, Nigeria and Uganda, private for-profit businesses provide healthcare services to more than 40% of people in the lowest economic segment (IFC, 2007). In this paper, we focus on the second approach where the BoP people are seen as consumers.

Designing and developing products at the BoP (i.e. BoP people as producers and consumers as well) require addressing specific issues in the BoP. These issues are constraints in the BoP (e.g. lack of physical infrastructure, BoP people's inaccessibility to financial services, etc.) that need to be overcome in the design and development of these products. These issues are significantly different from those in high-income markets. These differences can be attributed to the characteristics of the BoP (e.g. literacy level and income of the BoP people, available infrastructure in the BoP, etc.). Radical innovations are necessary to successfully address the issues in the BoP (Beiser, 2011).

Businesses use a combination of strategies to address the issues in the BoP. We call this combination of strategies as 'solution'. Thus, a solution consists of one or more individual strategies. We call these individual strategies as 'solution-ingredients'. Thus, a solution consists of one or more solution-ingredients (e.g. engaging and training stakeholders in the BoP, engaging in policy dialogue with the local governments, leveraging the strengths of the poor, etc.) depending on the issues in the BoP that need to be tackled. Consider the following hypothetical example. Suppose that a product consisting of an irrigation system is designed and developed for a rural community with the aim of improving the agricultural productivity of that community. In the design and development of this product, two applicable issues (i.e. constraints) – lack of physical infrastructure and poor literacy level in the BoP – are addressed by using the strategies of engaging in policy dialogue with the local government and leveraging the strengths of the poor. In this case, the solution consists of a combination of two solution-ingredients, namely 'engaging in policy dialogue with the local government' and 'leveraging the strengths of the poor'.

An in-depth understanding of the issues and solution-ingredients can help in the design and development of products at the BoP. We have used the terms 'solutions-ingredient(s)' and 'ingredient(s)' interchangeably.

1.3 Research aims

The research in the BoP domain has been carried out by several authors from different disciplines (London et al., 2010; Nielsen and Samia, 2008; Prahalad, 2004; Rivera-Santos and Rufin, 2010; Subrahmanyam and Gomez-Arias, 2008; UNDP, 2008; Viswanathan et al., 2010; Whitney and Kelkar, 2004). Over the past several years, the design and development of products at the BoP has been investigated by several authors (Anderson and Billou, 2007; Hammond and Prahalad, 2004; Hammond et al., 2007; Kirchgeorg and Winn, 2006; Prahalad and Hart, 2002). However, the research in the field of BoP appears to be fragmented in relation to the issues (i.e. constraints) in the BoP that are tackled in the design and development of products at the BoP and solution-ingredients addressing these issues. No study in the reviewed literature on the BoP has synthesised and compared these issues and solution-ingredients. Furthermore, quantitative results on these issues and solution-ingredients are not available, and relationships between them have not been investigated. Addressing these gaps in the reviewed literature can be useful in

designing and developing products at the BoP and can contribute towards meeting the challenges of sustainable development at the BoP. Therefore, in this paper, we aimed at:

- synthesising and comparing issues (i.e. constraints) and solution-ingredients from different studies in the BoP
- gaining quantitative findings on these issues and solution-ingredients (e.g. frequently and less-frequently seen issues and solution-ingredients, which solution-ingredients are predominant in addressing a given issue, etc.).

To fulfil our aims, we pulled together issues and solution-ingredients in the BoP from the reviewed literature. We then compared these issues and solution-ingredients with those identified in the study conducted by the UNDP (2008). The details regarding this study are presented further in Section 2. We used this UNDP study as a reference because the sample size of cases analysed in this study is large, and these cases are drawn from different sectors (e.g. healthcare, energy, etc.) and countries. We analysed the data available in this UNDP study to gain quantitative findings on the issues and solution-ingredients in the BoP.

This paper is structured as follows. Section 2 presents the synthesis of issues and solution-ingredients in the BoP from the reviewed studies. The quantitative findings gained through the analysis of the UNDP data are presented in Section 3. Section 4 discusses the results of this research, practical implications of these results, the limitations of the UNDP study and the possible areas for further research. Finally, Section 5 sets out the conclusions.

2 Synthesis of issues and solution-ingredients at the BoP

2.1 Issues and solution-ingredients from the reviewed literature

Based on the literature reviewed, Table 1 summarises main issues in the design and development of products at the BoP. Table 1 also provides information on the data collection methods used by the authors and proposed or implemented solution-ingredients to tackle different issues in the BoP. The studies in Table 1 have used different data collection methods such as interviews, field visits, observations, etc. Excepting the UNDP study (UNDP, 2008), other studies listed in Table 1 have been explained in Appendix. The primary purpose of the cases described in the studies listed in Table 1 and the cases from the UNDP study is to promote the development of the poor while maintaining financial sustainability. This is achieved through innovations in the design and development of products such that the businesses have helped the BoP people in one or more of the following ways: satisfy their basic needs, increase their productivity, raise their income and empower them.

The UNDP led an initiative called growing inclusive markets. In this initiative, they analysed 50 case studies from 10 different sectors such as energy, healthcare, etc. and from different countries (UNDP, 2008). Some part of this UNDP study is reported by Gradl et al. (2008). For each of the 50 cases, the UNDP study identified relevant issues considered by the businesses and the solution-ingredients used to address those issues.

In the 50 cases, they identified five broader categories of issues and solution-ingredients. The five broader categories of issues are briefly explained as follows:

- *Market information*: This issue takes into account the knowledge of businesses regarding the BoP, e.g. what the poor need, what capabilities the poor can offer, etc.
- *Regulatory environment*: The regulatory frameworks are under or undeveloped in the BoP. In addition, enforcement of the existing rules is inadequate.
- *Physical infrastructure*: This issue considers the inadequate infrastructure (e.g. roads, electricity, water and sanitation, hospitals, etc.) in the BoP.
- *Knowledge and skills*: The poor, generally, are illiterate and do not possess knowledge and skills regarding availability of products, usage of products, etc. Furthermore, this lack of knowledge and skills inhibits them from starting their own businesses.
- *Access to financial services*: The poor lack access to credits, insurance products and banking services. This puts limits to the purchases made by them. In addition, they cannot protect their meagre assets from events such as illness, drought, etc.

Table 1 Issues and solution-ingredients in the BoP

<i>Author</i>	<i>Data collection method</i>	<i>Main issues considered or identified</i>	<i>Proposed, implemented or identified solution-ingredients</i>
Anderson and Markides (2006)	Field visits, observations and in-depth interviews	Affordability; availability; acceptability and awareness	–
Keating and Schmidt (2008)	Interviews with managers from multinational corporations (MNCs)	Affordability; market analysis; marketing, sales and distribution	Strengthening value chain activities with key partnerships; design of products and services; innovative changes to business models
Reza (2008)	Experience from implementation of a project in BoP markets	Affordability; availability; awareness; economic self-sustainability	Technology adaptation; stakeholder engagement
Richardson and Callegary (2008)	Experience from implementation of a project in BoP markets	Affordability; availability; accessibility; regulatory frameworks	Engaging and training stakeholders; collaborating with other partners; adapting technology
Skarp et al. (2008)	Experience from implementation of a project in BoP markets	Affordability; availability; usability; economic self-sustainability	Business management innovation; stakeholder engagement; technological innovation
Prahalad and Hart (2002)	Literature review	Affordability; accessibility	Stakeholder engagement; innovation in business models and management processes; empowerment of locals; creating employment opportunities

Table 1 Issues and solution-ingredients in the BoP (continued)

<i>Author</i>	<i>Data collection method</i>	<i>Main issues considered or identified</i>	<i>Proposed, implemented or identified solution-ingredients</i>
Karnani (2007)	Literature review	Affordability; marketing, sales and distribution; raising income of the poor	Job creation; creating efficient markets for the products of the poor
UNDP (2008)	Case studies	Market information; regulatory environment; physical infrastructure; knowledge and skills; access to financial services	Adapt products and processes; invest in removing market constraints; leverage the strengths of the poor; combine resources and capabilities; engage in policy dialogue with governments

Some of the above issues can be explained by using the concepts ‘ability to pay’ and ‘willingness to pay’ drawn from the demand theory. The term ‘demand’ indicates the ability and the willingness to buy a particular product (Sullivan and Sheffrin, 2003). The low income of the BoP people and their lack of access to financial services limit their ability to pay. Furthermore, their lack of knowledge and skills regarding availability of products, usage of products, etc. imposes constraints on their willingness to pay. Further, in this section, these concepts are explained with a case drawn from the UNDP study.

As mentioned above, the UNDP’s (2008) study examined the 50 case studies to identify five main solution-ingredients in the BoP. A complete solution can consist of one or more of these five ingredients, which address one or more of the relevant issues in the BoP. These ingredients are briefly explained as follows:

- *Adapt products and processes*: This ingredient includes product redesign, business process innovation and technological adaptation.
- *Invest in removing market constraints*: This ingredient includes investing for educating consumers, enhancing or building capacities of the poor (e.g. supporting small producers who form a part of the supply chain) and building social marketing (e.g. health campaigns to increase demand of malaria nets).
- *Leverage the strengths of the poor*: This ingredient builds on the knowledge, networks and abilities of the poor and their communities (e.g. developing cooperatives of the poor, employing the poor to fulfil some tasks of a business and leveraging the knowledge of the poor to develop products).
- *Combine resources and capabilities*: Through collaborations and partnerships, this ingredient combines resources and capabilities of different organisations such as NGOs, financial institutions, local governments, etc.
- *Engage in policy dialogue with governments*: Businesses can overcome different issues in the BoP by engaging in dialogue with relevant governments, and this can help, e.g. to formulate appropriate regulations, reduce bureaucracy, etc.

The following case, drawn from the UNDP study, explains how the relevant issues in the BoP can be addressed by using the applicable solution-ingredients. This case also illustrates the concepts – ability to pay and willingness to pay. This case is about the healthcare intervention by Afrique Initiatives in Mali. A for-profit company, Afrique Initiatives, established Pésinet with the aim of monitoring health conditions of children from low-income families. Pésinet used information and communication technologies

(ICTs) to fulfil this aim. The weight of a child, transmitted to the doctor using SMS service of mobile phones, is used as an indicator of its health.

Pésinet implemented the project in Coura, a region near the capital city Bamako in Mali. In this region, the challenges faced by the people are: malaria, low income, poor or no literacy, poor sanitation and lack of adequate water supply infrastructure. In Mali, about 43% of children are underweight, and the infant mortality rate is 218 per 1000. There is limited access to modern care. Furthermore, 40% of the population live more than 15 km away from a health facility. However, in Mali, there are more mobiles phones than land lines, and this helps to contact remote areas.

To design and develop the healthcare service to monitor health conditions from the low-income families, the Pésinet partnered with:

- 1 two major French telecommunications companies, Alcatel-Lucent and Orange
- 2 two French schools, ESSEC Business School and Ecole Centrale Paris
- 3 a drug distributor, Medex
- 4 a local NGO, KafoYeredeme Ton.

A team of students from the ESSEC Business School and the Ecole Centrale Paris designed the business plan (e.g. subscription fee-structure to cover the operating costs and child sponsoring for low-income families). In Mali, the subscription fees are 500 Communauté Financière Africaine per month (US\$1.05) and include access to medicines. Alcatel-Lucent and Orange designed and developed the required technical systems, consisting of the use of mobile phones and specific applications for data transmission. The NGO, KafoYeredeme Ton, raised awareness by carrying out the marketing campaign together with the Pésinet, by going door-to-door for a couple of months. The involvement of women community leaders in the programme helped to raise the awareness.

Mothers subscribe to Pésinet's service by paying a nominal fee. This service consists of weighing her children once a week at her home (twice a week for children under one) plus advice and treatment (if required) by a doctor. Children are weighed by local women called Pésinet representatives. The weight readings are transmitted to the doctor using SMS service of mobile phones. The doctor makes a decision regarding the visit of the mother and child based on the pattern in the change of the child's weight. One doctor can cover about 2,000 children. When the doctor identifies an anomaly in the child's health, he/she sends an SMS to the Pésinet representative, who requests the mother and child to visit the doctor. The Pésinet's service helped mothers to get necessary advice and treatment for their children.

In the above case, as shown in Figure 1, the UNDP study identified the issues – 'physical infrastructure' (e.g. limited access to healthcare facilities) and 'knowledge and skills' (e.g. poor or no literacy). The study identified that the ingredients, namely 'adapt products and processes' (e.g. use of mobile phones to transmit weight reading of a child), 'leverage the strengths of the poor' (e.g. involvement of local women as Pésinet representatives), and 'combine resources and capabilities' (e.g. partnership with Alcatel-Lucent and Orange, two French schools, a drug distributor and a local NGO) addressed these issues. Therefore, in this case, the solution is a combination of these three ingredients. As shown in Figure 1, all these three ingredients collectively addressed the issue 'physical infrastructure'. The ingredients 'adapt products and processes' and 'leverage the strengths of the poor' addressed the issue 'knowledge and skills'.

Figure 1 Issues and solution-ingredients identified in the case of the healthcare intervention by Pésinet (the relevant cells are coloured) (see online version for colours)

		Solution-ingredients				
		Adapt Products and Processes	Invest in Removing Market Constraints	Leverage the Strengths of Poor	Combine Resources and Capabilities	Engage in Policy Dialogue with Governments
Issues	Market Information					
	Regulatory Environment					
	Physical Infrastructure					
	Knowledge and Skills					
	Access to Financial Services					

The low income of the people in the region Coura, where the Pésinet implemented the project, limited their ability to pay. The nominal fee, required to subscribe to the Pésinet's healthcare service, was within their ability to pay; and the company used the relevant solution-ingredients to achieve financial sustainability. Furthermore, the marketing campaign arranged by the NGO 'KafoYeredeme Ton' and the involvement of women community leaders enhanced the willingness to pay of the mothers in that region.

2.2 Comparison with the UNDP study

The sample size of the case studies, analysed in the UNDP study, is sufficiently large to be representative, and this study has identified main issues and solution-ingredients in the BoP. In addition, this study analysed cases from different sectors and from different countries. For these reasons, we have compared the issues and solution-ingredients identified in studies listed in Table 1 with those from the UNDP study. This comparison was difficult because different authors have used different terms for similar issues and solution-ingredients. Therefore, we qualitatively compared these issues and solution-ingredients.

The issue 'market information' of the UNDP study appears to be similar to the issue 'market analysis' identified by Keating and Schmidt (2008). The issue 'acceptability' of Anderson and Markides (2006) takes into account characteristics (e.g. cultural, socio-economic aspects) of different stakeholders including users in the BoP; and thus this issue is related to the knowledge of businesses regarding the BoP. Therefore, this issue appears to be similar to the 'market information' issue of the UNDP study. The issue 'regulatory environment' from the UNDP study is highlighted by Richardson and Callegary (2008). The issue 'physical infrastructure' of the UNDP study appears to include the issues: 'availability' of Anderson and Markides (2006), Reza (2008), Richardson and Callegary (2008), and Skarp et al. (2008); 'accessibility' of Richardson and Callegary (2008), and Prahalad and Hart (2002); and 'marketing, sales and distribution' of Keating and Schmidt (2008) and Karnani (2007). The issue 'knowledge and skills' of the UNDP study appears to include the issues: 'awareness' of Anderson and Markides (2006) and Reza (2008); and 'usability' of Skarp et al. (2008). The issue 'access to financial services' of the UNDP study appears to include the issues: 'affordability' of Anderson and Markides (2006), Keating and Schmidt (2008), Reza (2008), Richardson and Callegary (2008), Skarp et al. (2008), Prahalad and Hart (2002), and Karnani (2007). The issue regarding raising income of the poor highlighted by Karnani (2007) appears to be similar to the issue 'access to financial services' of the UNDP study. This suggests that different issues identified by different authors listed in Table 1 have been included in the issues identified by the UNDP study.

The solution-ingredient ‘adapt products and processes’ of the UNDP study is highlighted by Keating and Schmidt (2008), Richardson and Callegary (2008), Skarp et al. (2008), and Prahalad and Hart (2002). The UNDP study’s solution-ingredient ‘invest in removing market constraints’ is considered by Richardson and Callegary (2008). Some aspects of the solution-ingredient ‘leverage the strengths of the poor’ of the UNDP study consider the BoP stakeholders as business partners, and thereby this solution-ingredient considers creating jobs for the poor. Creating jobs helps to achieve economic self-sustainability. Therefore, we believe that the solution-ingredient ‘leverage the strengths of the poor’ of the UNDP study has been identified by Reza (2008), Skarp et al. (2008), Prahalad and Hart (2002), and Karnani (2007). The solution-ingredient ‘combine resources and capabilities’ of the UNDP study appears to consider engagement and partnership of different stakeholders. So, this solution-ingredient is seen in the studies of Keating and Schmidt (2008), Reza (2008), Richardson and Callegary (2008), Skarp et al. (2008), and Prahalad and Hart (2002). The solution-ingredient ‘engage in policy dialogue with governments’ is not seen in other studies listed in Table 1. Excepting this ingredient, all of the remaining ingredients of the UNDP study are identified by other authors listed in Table 1.

The above discussion shows that the issues and solution-ingredients of the UNDP study appear to be comprehensive. This can be attributed to the following facts: the sample size (i.e. 50 case studies) of the UNDP study is large; and the issues and solution-ingredients, identified in their study, are at broader level. However, their study has not identified the relationships between different issues and solution-ingredients. For example, their findings do not reveal answer to the question: What are the prominent solution-ingredients for different issues in the BoP? In addition, they have not used their data to extract findings such as frequently addressed issues in different case studies, frequently employed solution-ingredients, different combinations of issues and solution-ingredients, etc. We analysed the data available in the UNDP study to extract these quantitative findings. We could analyse the data on 48 cases from the UNDP study; the data regarding the remaining two cases was not available on their website (UNDP, 2008).

3 Quantitative findings

We analysed the data available in the UNDP study to extract some quantitative findings. These are described as follows.

3.1 Solution-ingredients and their relationships with different issues

Figure 2 shows the percentage of solution-ingredients for the 48 cases. A case can have one or more ingredients to address relevant issues in the BoP. Most of the cases include the ingredient ‘combine resources and capabilities’ with 65% of the cases followed by the ingredient ‘invest in removing market constraint’ with 60% of the cases. The major share of these two ingredients suggests their importance in addressing issues in the BoP.

The ingredient ‘combine resources and capabilities’ has addressed all of the five issues (see Figure 3). A single business wishing to work in the BoP may not have all the required capabilities and resources to tackle the problems in the BoP. The ingredient ‘combine resources and capabilities’ pulls together the capabilities and resources of different businesses including non-traditional partners (e.g. NGOs, public service

providers), and these combined capabilities and resources are effective in addressing different issues in the BoP. This ingredient is prominently seen in the case of the issues ‘knowledge and skills’ and ‘physical infrastructure’. With the issue ‘physical infrastructure’, the highest percentage (21%) of the cases has considered the ingredient ‘combine resources and capabilities’. This suggests a close relationship between the ingredient ‘combine resources and capabilities’ and the issues ‘physical infrastructure’ and ‘knowledge and skills’. Partnering with the relevant stakeholders such as BoP users, NGOs, etc. appears to be a rational way to address the problems emerging from inadequate infrastructure (e.g. roads, electricity, water, telecommunications network) in the BoP. Collaborations and engaging different stakeholders are effective, for instance, to distribute products and to make the different stakeholders aware of these products. The ingredient ‘combine resources and capabilities’ is thus closely associated with the issues ‘physical infrastructure’ and ‘knowledge and skills’.

Figure 2 Percentage of 48 cases using different solution-ingredients (see online version for colours)

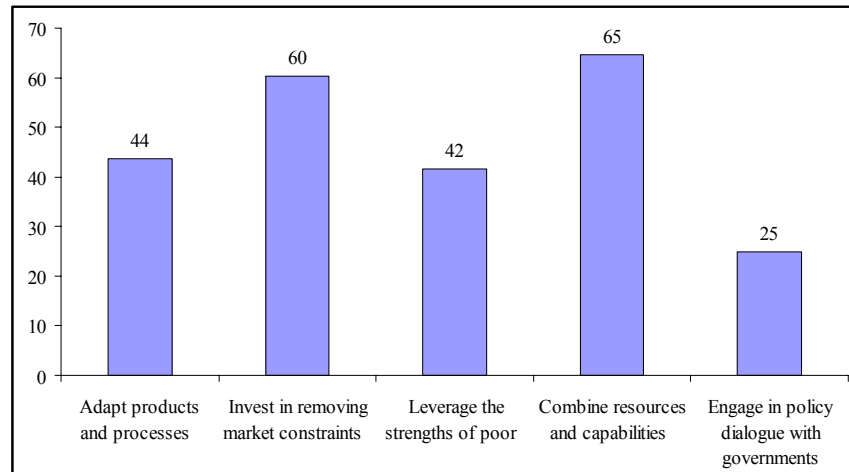
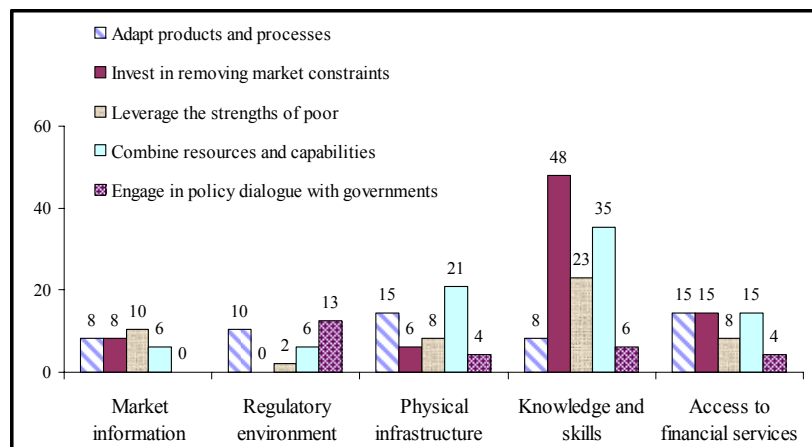


Figure 3 Issues vs. solution-ingredients (% of 48 cases) (see online version for colours)



As shown in Figure 3, the ingredient 'invest in removing market constraint' addresses four different issues excepting the issue 'regulatory environment'. The possible reasons for this can be: the functions of this ingredient are not associated with the issue 'regulatory environment'; and this issue is relatively and effectively addressed by one or more of other ingredients. The ingredient 'invest in removing market constraint' is prominently used to satisfy the issue 'knowledge and skills' (48% of the cases). This suggests that this ingredient is effective in addressing this issue. The issue 'knowledge and skills' takes into account the knowledge and skills of the BoP stakeholders including users, suppliers, distributors and retailers regarding their specific needs about products. Training these stakeholders appears to be an effective method to address the issue 'knowledge and skills', and investing to train them to overcome this issue seems to be a rational alternative.

The ingredient 'adapt products and processes' is employed to address all of the five issues and is prominent in the case of the issues 'physical infrastructure' and 'access to financial services'. The following reasons are proposed for this prominence. Technology helps to overcome the constraints arising from the poor physical infrastructure. For instance, wireless communication replaces physical transportation (e.g. mobile banking and telemedicine). Technology is associated with the adaptation of products, and therefore the ingredient 'adapt products and processes' is prominent in the case of the issue 'physical infrastructure'. In addition, technology (e.g. mobile banking) and business processes (e.g. small unit pricing, flexible payment, etc.) help to tackle the issues regarding the access to financial services.

The ingredient 'adapt products and processes' consists of one or both of the sub-ingredients, namely 'adapt products' and 'adapt processes'. We analysed the cases involving this ingredient with the aim to identify which of the sub-ingredients (i.e. 'adapt products' and 'adapt processes') are used in those cases. For example, some cases have not used the sub-ingredient 'adapt products'. Some cases have used both of these sub-ingredients. About 21% of the 48 cases have used the sub-ingredient 'adapt products', which is associated with technology (i.e. 79% cases have not used this sub-ingredient). About 35% of the 48 cases have employed the sub-ingredient 'adapt processes'. This suggests that creative use of different ingredients is imperative to address applicable issues in the BoP.

The ingredient 'leverage the strengths of the poor' is seen in 42% cases and is prominent in addressing the issues 'market information' and 'knowledge and skills'. This ingredient considers the BoP people as business partners. Businesses use the knowledge and skills of the BoP people to address different issues in the BoP. This ingredient has the highest number of cases in the case of the issue 'market information'. A possible reason for this is that businesses can easily obtain market information through the BoP people when they are business partners. Furthermore, businesses can use the BoP people as trainers, and thus satisfy the issue 'knowledge and skills'.

One-fourth of the cases have used the ingredient 'engage in policy dialogue with governments' (see Figure 2). As the share of this ingredient is small, it is interpreted that this ingredient is uncommon in the BoP. Note that this ingredient is not seen in the studies excepting the UNDP study listed in Table 1. This ingredient has addressed four issues excepting the issue 'market information' and is prominent in the case of the issue 'regulatory environment' (see Figure 3). This indicates a close relationship between the ingredient 'engage in policy dialogue with governments' and the issue 'regulatory environment'. That is, businesses prefer to discuss the relevant regulatory issues with the

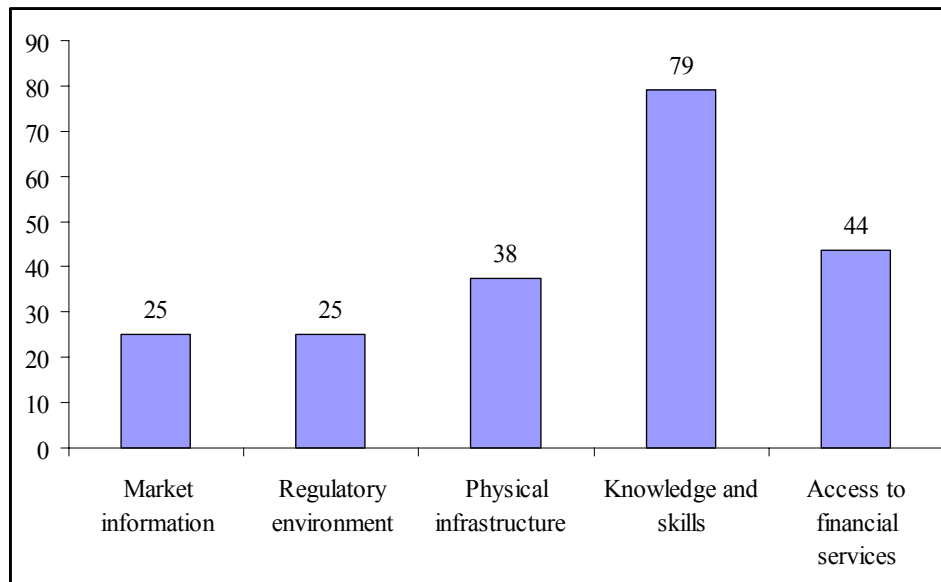
governments. The ingredient ‘engage in policy dialogue with governments’ has small number of cases addressing the issues – ‘physical infrastructure’, ‘knowledge and skills’ and ‘adapt products and processes’. This shows that businesses have least used policy dialogue with governments to address these issues. Some of the possible reasons can be: good effectiveness of other ingredients compared to the ingredient ‘engage in policy dialogue with governments’ in addressing these issues; and time delays involved in interacting with and convincing the governments.

3.2 Issues and their relationships with different sectors

Figure 4 shows the percentage of cases under the five issues. The issue ‘knowledge and skills’ has frequently been addressed (79% cases) followed by the issues ‘access to financial services’ (44% cases) and ‘physical infrastructure’ (38% cases). This clearly shows the issue ‘knowledge and skills’ is ubiquitous in the BoP. This can be attributed to the prevalent lack of education in the BoP. Although the field of education appears to be the responsibility of governments, the businesses have generally not used policy dialogue with governments to address the issues ‘knowledge and skills’ (see Figure 3). Instead, they have prominently used the ingredients ‘invest in removing market constraints’ and ‘combine resources and capabilities’ to address this issue. This can be attributed to the specific needs of businesses regarding the knowledge and skills of BoP stakeholders.

The issues ‘market information’ and ‘regulatory environment’ have been addressed by one-fourth of the cases. These issues appear to be uncommon in the BoP. These findings show that businesses ought to identify the issues, which are relevant to their products that are intended at the BoP. These identified issues can be fulfilled by creatively combining different solution-ingredients.

Figure 4 Percentage of 48 cases under different issues (see online version for colours)



The UNDP study categorised the 48 cases into 10 different sectors (e.g. ‘water and sanitation’, ‘health’, ‘energy’, etc.). We identified that the issue ‘knowledge and skills’ exists in all sectors, and therefore this increases our confidence in the above-mentioned interpretation that this issue is prevalent in the BoP.

3.3 Sets of issues and combinations of solution-ingredients

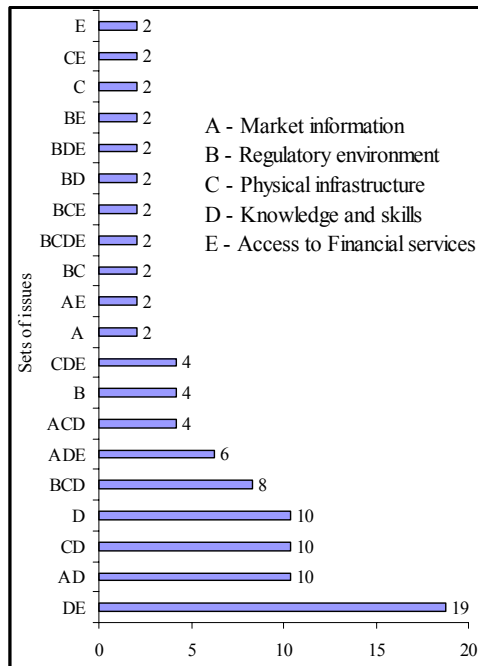
A solution satisfies a *set of issues*. In total, 20 *sets of issues* are seen (see Figure 5(a)). For example, 19% cases have satisfied the set of two issues, namely ‘knowledge and skills’ plus ‘access to financial services’ (i.e. the set DE). The issue ‘knowledge and skills’ is frequently seen (see Figure 4) and has been addressed in all sectors. That is, this issue is prevalent in the BoP. This issue is followed by the issue ‘access to financial services’, which is seen in eight out of the ten sectors. This issue is not seen in the sectors ‘energy’ and ‘textiles’, and the total number of cases under these two sectors is small. It is therefore likely that the set of these two issues has the highest percentage of cases. This also implies that the BoP is mainly characterised by the lack of knowledge and skills (i.e. illiteracy) of its people, their low income and their inaccessibility to financial services.

Half of the 48 cases have addressed sets of two issues (see Figure 5(b)). In addition, cases addressing only one issue are also seen (21% cases). No case has addressed all of the five issues. From these findings, it is clear that identifying the applicable issues, relevant to the products a business is designing and developing at the BoP, is important.

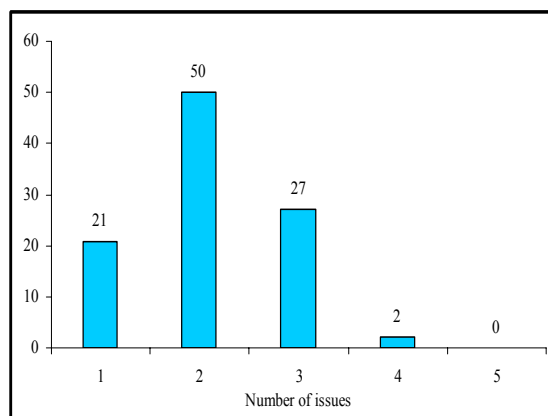
A solution consists of one or more ingredients, i.e. a solution is a *combination of ingredients*. This *combination of ingredients* addresses a set of issues. In total, 20 types of solutions (i.e. combinations of ingredients) are seen (see Figure 6(a)). For example, 15% cases have used the combination of two ingredients, namely ‘invest in removing market constraints’ plus ‘leverage the strengths of the poor’ (i.e. the combination bc). This is followed by the combination ‘invest in removing market constraints’ plus ‘combine resources and capabilities’ (i.e. the combination bd). As shown in Figure 2, the ingredients ‘invest in removing market constraints’ and ‘combine resources and capabilities’ are predominantly used. Therefore, intuitively one may think that the number of cases using their combination bd (‘invest in removing market constraints’ plus ‘combine resources and capabilities’) would be highest. However, the findings show that the number of cases using the combination bc (‘invest in removing market constraints’ plus ‘leverage the strengths of poor’) is highest. To explain why the combination bc is frequently used, we hypothesised that this combination is effective in addressing the predominantly seen set of issues, which is DE (‘knowledge and skills’ plus ‘access to financial services’). We examined the cases using the combination bc and found that 42% of the cases using this combination have addressed the set DE. In contrary, the combination bd (‘invest in removing market constraints’ plus ‘combine resources and capabilities’) has not addressed the set DE (‘knowledge and skills’ plus ‘access to financial services’). The highest frequency of the combination bc (‘invest in removing market constraints’ plus ‘leverage the strengths of poor’) can also be attributed to the relationships between its ingredients and the way these ingredients are combined. This suggests that when businesses address the set DE (‘knowledge and skills’ plus ‘access to financial services’), it can be worth examining the combination bc (‘invest in removing market constraints’ plus ‘leverage the strengths of poor’), first to check if this combination can address the set DE. However, businesses need to explore other

ingredients as well, so that they can select an appropriate combination of ingredients depending on the type of products they are designing and developing at the BoP.

Figure 5 (a) Sets of issues (% of 48 cases) and (b) number of issues addressed (% of 48 cases) (see online version for colours)

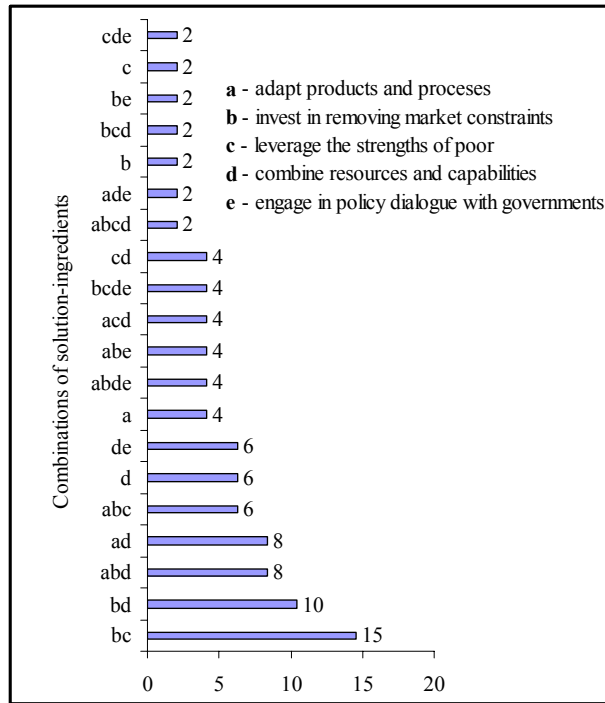


(a)

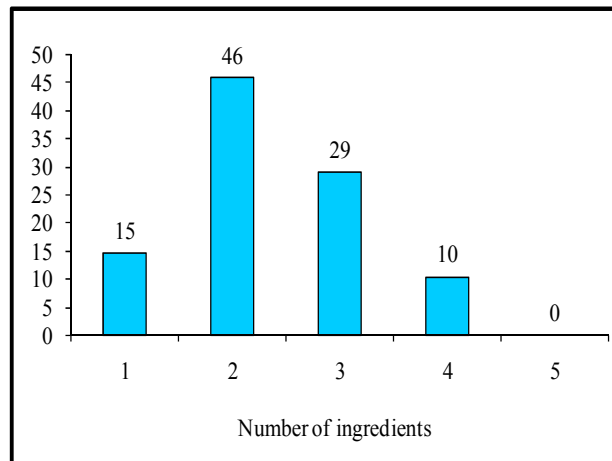


(b)

Figure 6 (a) Combinations of solution-ingredients (% of 48 cases) and (b) number of ingredients used (% of 48 cases) (see online version for colours)



(a)



(b)

Figure 6(b) demonstrates the prominence of combinations using two ingredients (46% cases). This is followed by 29% cases with the combination of three ingredients. Furthermore, there are some cases (15%), which have used only one ingredient. No case has used all of the five ingredients. This suggests that selecting and combining appropriate ingredients is important. A single ingredient can address many issues.

We also identified combinations of *solution plus issues*. This is illustrated in Figure 7. In the combination (a), the ingredient b has addressed the two issues D and E, and the ingredient c has addressed the issue D. Note that the combinations (a) and (b) in Figure 7 have the same set of issues (i.e. DE) and the same combination of solution-ingredients (i.e. bc). However, (a) and (b) are two distinct combinations of *solution plus issues*.

In the 48 cases, we identified 47 different types of combinations of solutions plus issues. Possible reasons for this big number of combinations can be: the large number of arrangements available for the combinations of solution plus issues, different types of relationships between issues, the way the ingredients are combined and different priorities of the addressed issues.

Figure 7 Combinations of solution plus issues (see online version for colours)

		Solution-ingredients				
		a	b	c	d	e
Issues	A					
	B					
	C					
	D					
	E					

		Solution-ingredients				
		a	b	c	d	e
Issues	A					
	B					
	C					
	D					
	E					

4 Discussion and future work

The reviewed literature on the BoP does not include studies synthesising the issues and solution-ingredients in the BoP. Furthermore, quantitative results on these issues and solution-ingredients are not available. In this paper, we synthesised and compared these issues and solution-ingredients from different studies in the BoP and carried out analysis of the data available in the UNDP study to gain quantitative findings. This study identified that the issues and solution-ingredients of the UNDP study are comprehensive and include those identified in the reviewed literature. This finding is irrespective of the different data collection methods used in the UNDP study and the studies in the reviewed literature (see Table 1). Two reasons why these issues and solution-ingredients of the UNDP study are comprehensive are proposed. The first is that the sample size (i.e. 50 case studies) of the UNDP study is large. The second reason is that the issues and solution-ingredients identified in this study are at a broader level.

The quantitative findings of the analysis of the UNDP data are presented and discussed in Section 3. This analysis identified predominant issues and solution-ingredients, and links between them. For example, the ingredients ‘combine resources and capabilities’ and ‘invest in removing market constraint’ are predominant. The issue ‘knowledge and skills’ is frequently addressed and is seen in all sectors. This issue appears to be prevalent in the BoP. The ingredient ‘invest in removing market constraint’ is prominently used to satisfy this issue. Furthermore, we identified different combinations of solution-ingredients and sets of issues. Some combinations of ingredients and sets of issues are predominant. The predominance of these combinations of ingredients can be attributed to the relationships between the ingredients in that combination and the way these ingredients are used to address the applicable issues.

Further research is required to gain an in-depth understanding of the interactions between different issues, relationships between various solution-ingredients, and the way these ingredients are used to address the applicable issues.

The findings of this research also have important practical implications. This research identified that most of the cases (65% of the 48 cases) have used the ingredient ‘combine resources and capabilities’. This ingredient pulls together the capabilities and resources of different businesses including non-traditional partners (e.g. NGOs and public service providers), and these combined capabilities and resources are effective in addressing different issues in the BoP. Governments can act as ‘facilitator’ to bring together different partners such as businesses, NGOs and the BoP people, and thus can assist businesses in using the ingredient ‘combine resources and capabilities’. The knowledge of governments regarding local BoP communities and NGOs can help in creating these partnerships. Furthermore, governments ought to facilitate the access of the poor to financial services, as the issue ‘access to financial services’ is one of the prominent issues in the BoP. The issue ‘knowledge and skills’ is ubiquitous in the BoP (79% of the 48 cases), and governments need to develop long-term plans by involving appropriate partners (e.g. businesses and NGOs) to address this issue. These long-term plans can involve training and educating the BoP people to start their own businesses (i.e. BoP people as producers). In addition, these plans need to consider the aspect of creating efficient markets for the products produced by the BoP people.

The ingredient ‘leverage the strengths of the poor’ (used in 42% of the 48 cases) considers the BoP people as business partners and has addressed all of the five issues. This ingredient can create jobs for the poor, and thereby can increase their income. As the use of this ingredient can increase the income of the BoP people, it can lay the foundation for long-term growth by developing new markets at the BoP. We therefore believe that businesses ought to use this ingredient in the design and development of products at the BoP.

The ingredient ‘engage in policy dialogue with governments’ is least used (one-fourth of the 48 cases). Governments need to identify the reasons behind the small share of this ingredient. Governments ought to develop efficient and effective processes so that businesses can easily engage in policy dialogue with them to address different issues in the BoP. As the businesses at the BoP help in tackling the wicked problem of poverty, the motivation for governments to help these businesses in addressing issues in the BoP is high.

It is important to overcome the limitations of the UNDP study. The limitations of the UNDP study are as follows:

- The 50 cases in this study have been analysed by 18 different researchers. Maintaining consistency in the analysis can be difficult when the data is analysed by many researchers.
- This study has not examined the relationships between different ingredients. For example, partnering with different stakeholders may be required to develop some technologies. This means that, there may be a relationship between the ingredient ‘combine resources and capabilities’, which is about partnering with different stakeholders and the ingredient ‘adapt products and processes’ related to the development of technologies. However, such relationships are not investigated in the UNDP study.

- This study identified general issues and solution-ingredients at a broader level and has not identified issues and solution-ingredients at a detailed level. In addition, this study has not examined issues and solution-ingredients that are specific to a given case.
- Nidamarthi (1999) identified two types of issues, namely solution-specific and solution-neutral. The UNDP study has not investigated solution-specific issues. For example, this study has not investigated the issues associated with adapting products at the BoP.
- The UNDP study has not considered different contextual parameters such as aims of a business, needs of BoP people satisfied through the developed products, some specific characteristics of BoP people that were considered, etc.

An analysis that can overcome these limitations can help to understand: the reasons why some combinations of ingredients are predominant, the way businesses combine different solution-ingredients, the relationships between different solution-ingredients and the reasons why businesses have frequently addressed some sets of issues. This understanding would be useful for practitioners to tackle different issues in the BoP. Furthermore, analysing successful and unsuccessful businesses at the BoP and their impact on the lives of the BoP people in an attempt to identify the most effective solution-ingredients for addressing the issues at the BoP may be a fruitful area for further research.

A possible way to overcome the limitations of the UNDP study is to analyse the cases using a systems approach combined with detailed analysis of different issues and solution-ingredients. A systems approach is useful to understand different aspects at a macro- or system-wide level and interactions between them. Furthermore, it is important to examine the design and development process of a product, because sometimes it is necessary to modify a BoP system prior to the deployment of a product in the BoP (Jagtap and Kandachar, 2010a,b). The examination of this design and development process can also provide information on design rationale (i.e. different issues considered, different alternative solutions generated, pros and cons of these solutions, etc.). Regarding a BoP case, this above-mentioned type of analysis can require detailed information on: aims of different stakeholders, resources available to them, BoP-people's needs satisfied, details of different issues considered, case-specific issues tackled, solution-specific issues considered and design rationale. Real-time data collection methods such as observations, diary studies, etc. can help to collect such detailed information.

5 Conclusions

We add to the growing body of literature on sustainable development at the BoP by pulling together the reviewed literature on issues (i.e. constraints) and solution-ingredients at the BoP and by extracting quantitative findings from the data available in the UNDP study. The issues and solution-ingredients identified in the UNDP study are at

a broader level and include those in the reviewed literature. Some of the findings of the quantitative analysis of the UNDP data are as follows:

- The ingredients ‘combine resources and capabilities’ and ‘invest in removing market constraint’ are frequently used.
- The ingredient ‘combine resources and capabilities’ is frequently used to address the issues ‘knowledge and skills’ and ‘physical infrastructure’.
- The ingredient ‘invest in removing market constraint’ is prominently used to satisfy the issue ‘knowledge and skills’.
- Most of the cases (79%) have not used the sub-ingredient ‘adapt products’, which is associated with the technology.
- The issues ‘knowledge and skills’ and ‘access to financial services’ have been frequently addressed.
- The issue ‘knowledge and skills’ is seen in all sectors and appears to be prevalent in the BoP.
- The set of two issues ‘knowledge and skills’ and ‘access to financial services’ has been frequently seen.
- The combination of the two ingredients ‘invest in removing market constraints’ and ‘leverage the strengths of the poor’ has been prominently used.

The quantitative findings, identified in this paper, can be useful for businesses interested in knowing (in)frequently addressed issues (i.e. constraints) and solution-ingredients used to address these issues. These findings have important practical implications such as:

- governments can assist businesses in using the ingredient ‘combine resources and capabilities’ by facilitating the collaboration between different partners such as businesses, NGOs and the BoP people
- governments need to develop long-term plans by involving appropriate partners (e.g. businesses, NGOs) to address the ubiquitous issue ‘knowledge and skills’ in the BoP
- as the use of the ingredient ‘leverage the strengths of the poor’ can increase the income of the BoP people, businesses ought to use this ingredient in the design and development of products at the BoP
- governments need to develop efficient and effective processes so that businesses can easily engage in policy dialogue with them to address different issues in the BoP.

While we have presented a review of issues and solution-ingredients in the design and development of products at the BoP, additional extensive research in this emerging and growing area of research is clearly warranted.

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Appendix

Details of the studies listed in Table 1

Excepting the UNDP study, studies listed in Table 1 are explained as follows:

1 *Anderson and Markides (2006)*

The work carried out by Anderson and Markides (2006) aims at identifying the reasons behind the success of strategic innovators who targeted their products for BoP customers. They collected data through observations and in-depth interviews with the companies (e.g. Smart Communications Inc., Hindustan Lever Limited, Indian conglomerate TATA, CavinKare and Haier Group), which produce and distribute products in BoP markets. The successful companies in BoP markets focus their attention on the '4As', namely affordability, acceptability, availability and awareness. These four 'A's are as follows:

'*Affordability* relates to the degree to which a firm's goods or services are affordable to BoP consumers'. The low income of BoP consumers (e.g. more than two-thirds of the income of Indian villagers' is spent on food) creates a significant problem in designing and distributing products to these customers.

'The extent to which consumers and others in the value chain are willing to consume, distribute or sell a product or service relates to *acceptability*'. The particular characteristics (e.g. cultural, socio-economic characteristics) of BoP customers and distributors are important to successfully tap BoP markets.

'*Availability* is the extent to which customers are able to readily acquire and use a product or service'. Usually, the infrastructure in BoP markets is poor (e.g. lack of or inadequate distribution channels).

'*Awareness* relates to 'the degree to which customers are knowledgeable about product or services'. Many BoP customers do not have access to the conventional advertising media (e.g. only 41% of poor rural households in India have access to TV).

2 *Keating and Schmidt (2008)*

Keating and Schmidt (2008) collected data through interviews with managers from MNCs. The factors contributing to MNCs' success in BoP markets are: 'offering products/services that leverage their core capabilities, strengthening value chain activities with key partnerships and making innovative changes to the business operating model where required'. MNCs must be radically innovative in relation to address issues regarding marketing, sales and distribution.

3 *Reza (2008)*

The Community Information Centres established by Grameen Phone provide different services such as access to internet, government information, telemedicine, information on rural trade and business, etc. (Reza, 2008). Reza's project aimed at supporting local communities in accessing ICTs, creating entrepreneur-centred local ownership and establishing economically self-sustaining business model. Regarding the sustainability of

the telecentres, the author states, 'to achieve the goals of community development and financial sustainability, telecentres have to integrate social, political, cultural and technical sustainability as vital elements into their planning and operation'. He highlights the challenges and threats to the successful operation of telecentres. Lack of computer awareness in rural communities pose a significant challenge, and the likelihood of transformation of telecentres for human development and democratisation of technologies into 'cyber-cafes' for entertainment is a threat.

4 *Richardson and Callegary (2008)*

Around 50% of the adult population in South Africa is unbanked. This has given rise to crimes such as cash-in-transit thefts, armed robbery, etc. (Richardson and Callegary, 2008). The authors' system, called WIZZIT, provides a mobile-phone-based banking facility and is independent of network, SIM card and the age of a mobile phone. In the development of the WIZZIT, the authors addressed the issues, namely affordability, accessibility and availability, through: technology (e.g. use of mobile phones tackles the need of brick and mortar banks and helps to achieve affordability); engaging and training stakeholders (e.g. trained agents help the clients to open their bank accounts, 18-hr call centre answers the queries of clients in 11 different official languages); appropriate use of regulations (e.g. low-income clients can open their bank account by providing only their identification document – salary slips and residence proof are not required) and collaborating with other partners (e.g. WIZZIT has collaborated with four major banks of South Africa – this helps to improve accessibility for clients).

5 *Skarp et al. (2008)*

Designing and developing products for BoP markets requires considering a variety of issues in parallel. Regarding the design, development and implementation of a product aimed at providing affordable mobile connectivity to the inhabitants of rural areas, Skarp et al. (2008) state, 'The project team focused simultaneously on three dimensions that it believes must proceed in parallel: technological innovation for low-cost communication solutions, business management innovation for the emerging markets, synthesis of the value network to make the solution feasible'.

6 *Prahalad and Hart (2002)*

BoP markets pose a new challenge to MNCs regarding how they can produce products for this market by combining low cost, good quality, sustainability and profitability (Prahalad and Hart, 2002). BoP markets are unorganised. The authors state, 'It takes tremendous imagination and creativity to engineer a market infrastructure out of a completely unorganised sector'. The authors describe four elements, namely crating buying power, shaping aspirations, improving access and tailoring local solutions to harness BoP markets. These elements require innovations in technology, business models and management processes, and businesses need to experiment, collaborate and empower locals.

7 Karnani (2007)

As BoP markets are geographically distributed and culturally heterogeneous, the costs of selling products in these markets are very high (Karnani, 2007). These high costs can be attributed to high distribution and marketing costs. Furthermore, weak infrastructure (e.g. communication, transportation, etc.) increases the cost of selling products in BoP markets. Karnani argues that companies have less scope to sell luxury products in BoP markets because BoP customers spend about 80% of their income on food, clothing and fuel. He suggests private sector can help to reduce poverty by focusing the poor as producers rather than as consumers. Raising income of the poor by crating efficient markets for their products, creating employment opportunities for them are suggested alternatives by the author to help alleviate poverty. He argues it is very difficult to reduce price of a product without lowering its quality. Cost-quality trade-offs play an important role in selling products in BoP markets.