

# Impact of Information Technology Deployment on Supply Chains at the Bottom of the Pyramid: A Separations Lens

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## ABSTRACT

*There has been recent interest of corporations (e.g. producers, marketers and distributors) in Bottom of the Pyramid (BOP) communities because of notions that - business enterprises can (profitably) provide price- and culture-sensitive products to them and economic benefits can accrue to BOP communities if business enterprises can source products from BOP producers. However, supply chains that connect into BOP communities are subject to several difficult conditions such as problems in building distribution channels into remote locations and lack of transportation and warehousing resources. Studies that examine supply chains in the context of under-developed populations do not provide theoretical understanding of particular conditions and problems in BOP supply chains. Similarly, while, the supply chain literature acknowledges the role of IT in supply chain integration and supplier development, it does not theoretically examine the potential role of IT in BOP supply chains. There is consequently, an absence of research frameworks for understanding specific characteristics of BOP supply chains. This research-in-progress paper reports on a larger study, the objective of which is to examine the following research question – How does the deployment of IT impact supply chains at the BOP. We adopt the idea of market and economic separations as our informing theoretical lens and address our question through two sub-questions – (1) What are the separations in supply chains at the BOP; and (2) How can IT*

*reduce these separations? In this paper we report on the first part, that is, on theorization that characterizes different separations that exist in supply chains at the BOP. Our continuing research aims to develop case studies to address the second part, that is, to understand how IT can reduce them. If selected we hope to present some of our findings at the workshop. With this study we hope to develop a theoretical basis to examine distinguishing characteristics of supply chains at the BOP, thus contributing to our understanding of problems plaguing supply chains at the BOP. Second, we hope to analyze the role of IT in mitigating these problems.*

**Keywords: Supply chain management, Bottom of the pyramid, Case study**

## **INTRODUCTION**

The bottom of the pyramid (BOP)<sup>1</sup> is typified by communities residing in geographically remote and rural areas that lack access to physical and technological infrastructure (Vachani and Smith, 2008, Babbar et al 2008). It is characterized by economic deprivation and illiteracy (Weidner et al 2010). There has been recent interest of corporations (e.g. producers, marketers and distributors) in BOP communities, primarily because of two reasons. One, that business enterprises can (profitably) provide price- and culture-sensitive products to them (Prahalad and Hart 2002). Two, that economic benefits can accrue to BOP communities if business enterprises can source products from BOP producers (Sesan 2012).

However, supply chains that connect into BOP communities are subject to several difficult conditions. First, it is difficult to build distribution channels to reach BOP consumers due to their remote and hard-to-access locations (Vachani and Smith, 2008). Second, BOP producers lack the transportation and warehousing resources to effectively reach non-local markets (Agnihotri 2013). Third, most organizations that are part of supply chains at the BOP, such as small scale and local enterprises, BOP producers, and local public/non-government entities, cannot afford implementations of traditional large-scale inter-organizations information systems (IS) such as supply chain management applications; supply chain partners therefore find it difficult to communicate necessary (e.g. demand and inventory) information with one another (Prahalad and Hammond, 2002, Vachani and Smith, 2008). These conditions suggest that different entities in the supply chain are separated from one another – in terms of distance and asymmetrical or

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<sup>1</sup> Refers to individuals whose per-capita income is USD 1,500/year or less (Prahalad and Hart, 2002; Vachani and Smith, 2008)

incomplete information. Recent practical examples suggest that application of Information Technology (IT) to processes in BOP supply chains can potentially address some of these problems. For instance, mobile phones can be used by corporations for establishing product-related communication (e.g. price and features) and distribution channels (e.g. cell phone minutes) with BOP consumers (Prahalad and Hammond, 2002, pg. 50, Anderson 2006).

Studies that examine supply chains in the context of under-developed populations have focused mainly on physical distribution (Karamchandani et al 2011, Vachani and Smith, 2008). They do not provide theoretical understanding of conditions and problems in BOP supply chains. Similarly, while, the supply chain literature acknowledges the role of IT in enabling material and information flows through IT-based integration of supply chain processes (Rai et al 2006) and IT-enabled supplier development and supplier relationships (Subramani 2004), it does not theoretically examine the potential role of IT in BOP supply chains. There is consequently, an absence of research frameworks for understanding specific characteristics of BOP supply chains. This research-in-progress paper reports on the conceptual part of a larger study, the objective of which is to examine the following research question – **How does the deployment of IT impact supply chains at the BOP?**

From the perspective of market and economic separations (Bartels, 1968), producers, consumers and intermediaries in a supply chain have the potential to be ‘removed’ from each other due to the presence of one or more of the following separations: (1) *financial separation*, that is, the inability of buyers to make purchases during times a purchase is necessary; (2) *information separation*, that is, when different organizations and entities in the supply chain have dissimilar information concerning products, demand and market characteristics; (3) *spatial separation*, whereby production and consumption take place in different physical locations; (4) *temporal separation* as represented by a significant time delay between the time a good is produced and consumed (Bartels, 1968). The reduction of these separations enables exchange of goods between different entities in the supply chain. Distinguishing conditions of BOP communities such as physical inaccessibility, lack of literacy and lack of financial resources, suggest that these separations are high in BOP supply chains. We thus adopt the idea of separations as our informing theoretical lens and address our question through two sub-questions as follows – (1)

## **What are the separations in supply chains at the BOP; and (2) How can IT reduce these separations?**

In this paper we report on the first part, that is, on theorization that identifies and characterizes different separations that exist in supply chains at the BOP. Our continuing research, using the theorized framework as a sensitizing focus for data collection, aims to develop four case studies to address the second part, that is, to illustrate these separations and understand how IT can reduce them. If selected we hope to present some of our findings at the workshop.

With this study we hope to make the following theoretical contributions to the literature on supply chains in emerging and under-developed economies. First, by identifying and describing different separations, we develop a theoretical basis to examine distinguishing characteristics of supply chains at the BOP, thus contributing to our understanding of problems plaguing supply chains at the BOP. Second, and from this basis, we then analyze the role of IT in mitigating these problems, thus focusing the attention of the IT-supply chain interface literature on the application of IT to supply chains that reach into communities separated from mainstream economic activity. In terms of findings that can impact practice and policy, we aim to show that supply chains that transport goods to and from BOP populations would need to be managed in a manner that acknowledges local situational contingencies and addresses the resulting structural issues in terms of reducing the separations.

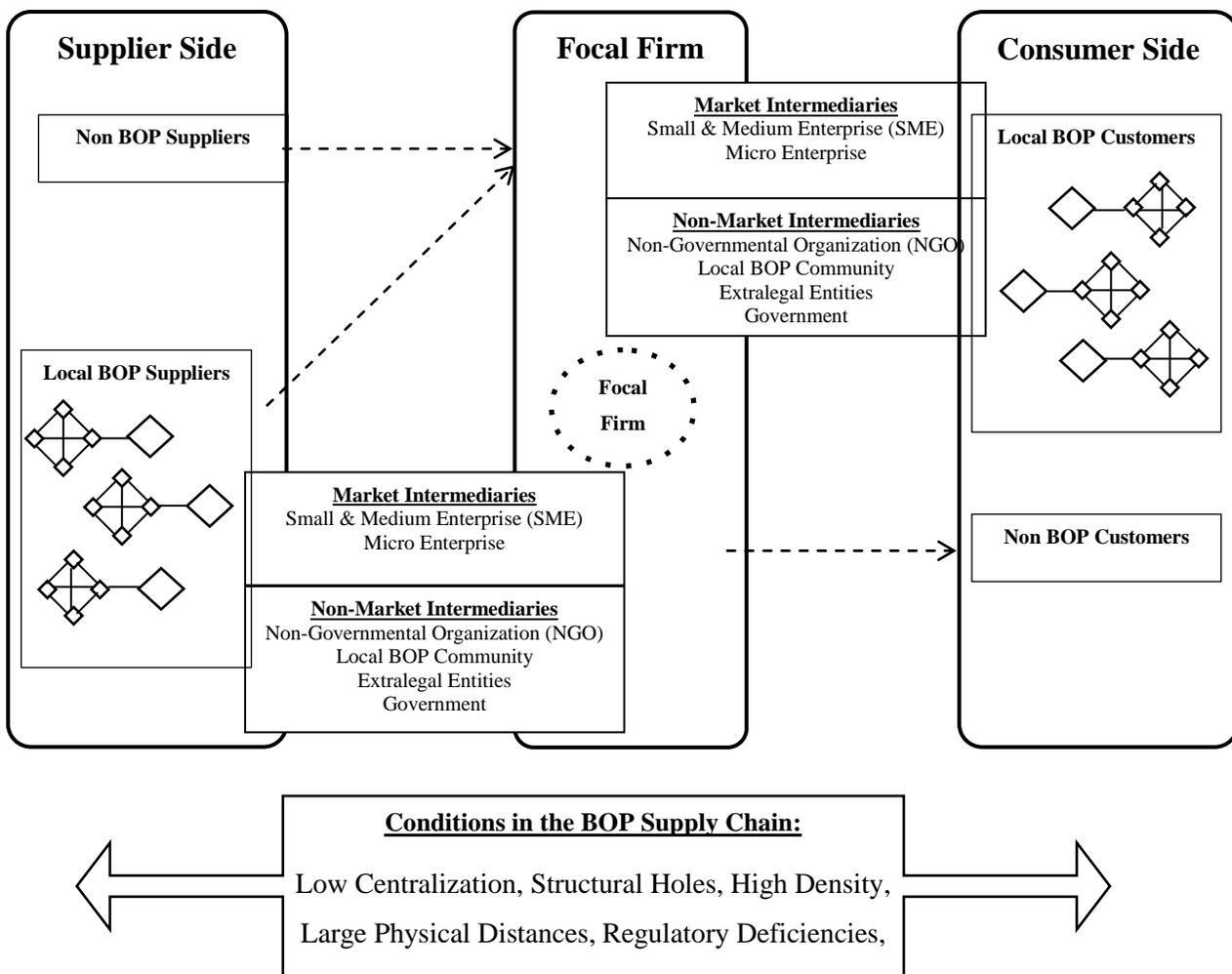
## **BACKGROUND LITERATURE**

### **Supply Chains at the BOP**

The BOP supply chain typically consists of private and public organizations (corporate producers/marketers/distributors/buyers, BOP producers, infrastructure providers and public/non-government facilitators) that generate economic activity in the context of BOP communities by selling products to and sourcing products from, them. It can be defined as a network comprised of these organizations that by working together, enable the flow of goods from upstream suppliers to downstream BOP end consumers and vice versa (Rivera-Santos and Rufin, 2012). The BOP supply chain has increasingly become an important component in the

global production and distribution of products, especially in commodities such as agriculture and handicrafts (London et al., 2010).

Figure 1 depicts a typical BOP supply chain. It consists of a focal firm that either sells to BOP customers, procuring from non-BOP or BOP suppliers (top part of Figure 1) or buys from BOP suppliers and sells to non-BOP customers (bottom part of Figure 1). In both cases, the focal firm needs to partner with various intermediaries in order to execute supply chain processes (Hahn and Gold, 2014). Market intermediaries include small-medium and micro enterprises, and non-market intermediaries include non-government, government, and local community organizations. Government organizations are responsible for regulatory oversight and local community organizations help to socially embed supply chain processes in the local BOP context.



### **Characteristics/Constraints in BOP Supply Chains**

There are seven major characteristics that distinguish BOP supply chains as follows. First, BOP producers and consumers usually reside in physically remote and far-flung locations (Prahalad & Hart, 2002), which means that supply chain entities are separated by large distances. Second, BOP regions are characterized by poor road, transport and IT infrastructure (Vachani and Smith 2008). Third, many BOP producers produce perishable goods such as dairy and grain products, which, if not sold and consumed within a given time, would spoil (Tarafdar et al 2012). Fourth, BOP markets suffer from regulatory deficiencies since many of their governing mechanisms are informal, and strongly influenced by local community-based trust, social networks and relationships (Sheth, 2011, Rivera et al 2012). Fifth, there is a wide range of supply chain partners that include small-scale rural enterprises, government departments and large private corporations. The diversity between supply chain partners is thus high, such that they face challenges in sharing expertise, information and knowledge. This gives rise to inefficient inter-organizational processes. Sixth, there are high levels of illiteracy in BOP producers and consumers due to low education levels (Vachhani and Smith 2008). Seventh, given the conditions of diverse supply chain partners, large physical distances and inadequate connectivity/infrastructure, any one supply chain entity seldom has control over the operations of the supply chain. That is, BOP supply chains are characterized by low centralization (Rivera-Santos et al. 2012).

### **THEORETICAL DEVELOPMENT**

The conditions imply that different entities in the BOP supply chain are “separated” from one another in various ways. Remote locations and poor transport facilities, for instance, leads to physical separation. Inadequate IT infrastructure and diversity in supply chain partners cause information asymmetry between different entities in the supply chain. Illiteracy might lead to lack of ability on part of BOP consumers and producers to engage in financial transactions, thus creating economic asymmetry between them and other supply chain entities. We thus examine our research question through a conceptual lens that draws from the theory of market and economic separations (Bartels, 1968, Castells 1998). This perspective describes barriers in the flow of goods, information and money that hinder market exchanges between producers and consumers through four kinds of “dis-connections” or severances between them - Spatial,

Temporal, Informational and Financial. BOP communities differ from the larger society in various ways. Castells (1998) describes them as 'excluded nodes' in a networked society, primarily due to social exclusion, lack of access to information, and polarized distribution of wealth. Bartels (1968) describes four kinds of separations between producers and consumers. Spatial separation signifies geographical distances between producers and consumers. Temporal separation characterizes time difference between production and consumption. Informational separation describes informational asymmetry between producers and consumers relating to products, demand and other market conditions, whereby one side has more information than does the other. Financial separation is lack of consumers' financial ability to purchase, when they have a willingness to purchase and fulfill their consumption needs. These four separations tend to be high in BOP markets.

We apply these perspectives to supply chains at the BOP to theoretically analyze their distinctive characteristics and problems. Specifically we theoretically develop below, the concepts of Information, Spatial, Temporal and Financial separations in BOP supply chains by explaining why they occur and what their manifestations might be.

### **Information Separation**

Informational capitalism (Castells, 1998) describes the transition from emphasis placed on greater utilization of physical/material factors of production to that on use of information and knowledge as primary inputs to economic enterprise. Given the inadequacy of IT infrastructure at the BOP and the contrasting abilities in development, manufacturing and utilization of information technology of the more industrialized regions (Walsham 2002, Cecchini and Scott, 2003), BOP regions live in 'information poverty' (Ahmed, 2007) and are 'information deprived' (Banerjee, 2005). Information separation exists when participants within an economic system have different information and knowledge concerning products, prices, supply/demand conditions and market dynamics.

BOP supply chains are vulnerable to information separation for three reasons. One, relative lack of regulation and diversity of supply chain partners makes inter-organizational communication ad-hoc and inefficient. Second due to unavailability and unaffordability of IT infrastructure,

inter-organizational systems for process integration between supply chain members are not usually deployed. Three, due to high levels of illiteracy, BOP consumers and producers do not have access to proper counsel, guidance and support services usually available to those in industrialized economies (Prahalad and Hart, 2002). These factors cause organizations and entities in BOP supply chains to be ‘information – separated’ from one another.

Potential problems due to high supply chain information separation include lack of product related information for BOP consumers and producers. BOP consumers lack accurate information regarding products, prices, functionalities and uses, making them vulnerable to marketing and advertising messages about products they do not need (Karnani (2007). BOP producers lack information on product demand and appropriate price-points. Similarly, corporate sellers lack demand and need information. Traditional market survey methods are not effective because of lack of literacy and strong local social interdependencies/networks (Weidner et al 2010). Finally, there is lack of collaboration and coordination between firms in the supply chain (Babbar et al 2008, Vachhani and Smith 2008). Formal/institutional relationships and contracts often do not exist between corporate entities and local organizations (Sheth 2011). Taken together, these conditions result in inefficient flow of information between partners, making supply chain coordination and integration difficult to realize.

### **Spatial Separation**

Spatial separation can be defined as the physical distance between production (i.e. suppliers) and consumption (i.e. customers) of a product and or service (Bartels, 1968). BOP supply chains have high spatial separation due to the remote locations, poor transport infrastructure and limited and/or unpredictable utility provision (electricity and water) (Weidner et al 2010). BOP supply chains broadly face three problems as a result of spatial separation. First, organizations selling into or buying from BOP communities face limited physical mobility, resulting in costly distribution and uncertain lead times (Prahalad and Hammond 2002, MacCarthy and Atthirawong, 2003). Second BOP consumers have limited access to products, since it is not easy for them to travel to purchase them. Third, BOP producers lack access to non-BOP consumers and often have to travel large physical distances to sell their products

### **Temporal Separation**

Temporal separation is defined as the time lapse between production and consumption of a product or service (Bartels 1968). Temporal separation is high in BOP supply chains. Producers produce primarily agriculture and dairy related goods that are perishable and time-specific, and their utility/value is highly dependent on them reaching the user within a specified and relatively limited period of time. Further, unlike in the more developed economies, BOP regions have not had access to technological modernization (Castells, 1998). Transport infrastructure is also poor. Therefore supply chains face two problems due to temporal separation. One, the operations associated with production and storage of goods lack the specialized technologies and infrastructure that perishable products require (Agnihotri 2013), leading to problems in storage and preservation. Secondly, and consequently, there is spillage and spoilage associated with the flow of such products through the supply chain, resulting in product wastage; in general therefore transportation and logistics processes are inefficient.

### **Financial Separation**

Populations in BOP regions are highly susceptible to financial exclusion due to poverty (Castells, 1998). From the point of view of market and economic separations, such financial exclusion can be termed as financial separation, defined as “buyers not possessing purchasing power at the time they have willingness or need to buy” (Bartels, 1968, p. 32). In terms of the BOP supply chain this implies that all supply chain partners do not have uniform abilities to pay for exchange of goods. Also, although local organizations play a significant role in the economic activity at the BOP (Rivera-Santos and Rufin, 2012), but they do not have the financial wherewithal and expertise necessary to efficiently intertwine their logistics processes with those of the more affluent supply chain partners (Webb et al., 2010).

There are a number of potential supply chain problems due to financial separation. One, supplier relationships are uncertain since payment terms and contracts are often not adhered to. For instance, BOP buyers, such as rural farmers, although highly dependent on suppliers for agricultural materials (Heide and John 1988), are not regular with their payments, resulting in terminated relationships. A second problem is lack of economies of scale in production and distribution (Pralhad 2005) and consequent higher product costs (e.g. Rivera-Santos and Rufin,

2012, Agnihotri 2013). BOP supply chains are encumbered by lower volumes due to lack of demand brought about by inability to afford products and services. This raises the cost of products and services. For instance, although there are a number of instances of microfinance companies lending to BOP entrepreneurs at rates lower than local money-lenders (e.g. Rivera-Santos and Rufin, 2012, Mohan et al 2013), they charge rates higher than comparable bank rates, due to the fact they have a smaller base of money to work with (Agnihotri 2013, Prahalad, 2005). Similarly, in the Dharavi region of Mumbai (India), a poor person pays many times more credit interest than the average borrower. Similarly, the premium for diarrhea medication is 10% more expensive and water is 15% more expensive (Prahalad, 2005).

### **Potential role of IT in BOP supply chains**

Studies focused on the BOP have alluded to potential impact of IT in providing distribution channels and driving down transaction costs (Prahalad, 2005, Prahalad and Hammond, 200, Prahalad and Hart, 2000, Vachani and Smith, 2008) through IT-enabled processes that connect different entities. From the supply chain literature, we know that IT infrastructure facilitates information flow required for effective flow of products and services in the supply chain (e.g. Rai et al., 2006), enables buyer-supplier coordination (Gunasekaran et al. 2008), and leads to shortened lead times (Hult et al., 2004). However these findings are reported in the context of deployment of formal inter-organizational systems for sharing information between supply chain partners in developed economies (Malhotra et al. 2005). The technological, skill and resource barriers associated with BOP communities and supply chain partners make development, implementation and maintenance of such systems difficult. In a similar way, literature addressing the deployment and use of IT innovations in under- or less- developed regions has focused on specific applications applied to contexts such as healthcare delivery (Braa et al 2004), administration of government departments for processes such as development, crop planning and land treatment methods (Walsham and Sahay 1999, Barrett et al 2001) and development of country level technological infrastructures (Al-Jaghoub and Westrup, 2003). Developmental impacts of relevant information-provision through Internet-based facilities such as health-related information to pregnant women and employment-related information to local people (Peterson et al., 2001) have also been reported.

Following from the above, neither of these literatures provides a specific focus on opportunities and problems in the deployment of IT in supply chains at the BOP, taking into account the particular contextual conditions. Consequently, there is lack of conceptual analysis of if and how IT can affect supply chains at the BOP, presenting an opportunity for a theoretical contribution to the IT-supply chain management interface literature. Drawing from the theory development described above, our ongoing research addresses this gap by examining how the deployment of IT in BOP supply chain processes reduces each of the above separations.

## **RESEARCH DESIGN**

We adopt a qualitative research design to address our research question. Such an approach is appropriate given that we want to understand why and how, these separations exist and IT deployment can reduce them (Yin, 2009). Further, the BOP context is characterized by a broad range of social, cultural, economic, technical and infrastructural factors that are inter-dependent and that impact supply chain processes (e.g. Vacchani and Smith 2008). Qualitative research design approaches can provide the detail and richness required to reveal these factors and explain the relationships between them. Using the separations perspective as the sensitizing theoretical lens, our objective is to investigate (1) problems due to the four separations in BOP supply chains and (2) how use of IT can potentially reduce or mitigate them. We will adopt a multiple case-study research design and develop four case studies of the supply chains of four different focal organizations. Each case study will illustrate one separation. If selected, we will present some of our case study findings at the workshop.

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