Towards Reducing BoP Penalty through Rural E-Commerce: Optimization of Product Delivery Mechanism

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Abstract— E-Commerce became popular among the affluent people in the world. However, a big portion of the population of the world cannot enjoy the advantages of e-commerce service because they do not have (1) access to online catalog (2) payment system to pay for online purchase (3) home delivery infrastructure in their community. This scenario ultimately increases the BoP penalty (people at Base of the Economic Pyramid pays more than the urban affluent people for the same product). This article introduces the existing e-commerce operation model and outline the barriers that limit its expansion to cover the underserved community. The recent penetration of 3G technologies and smart phones allow the villagers to access to internet based e-commerce services. Availability of mobile money transfer service made it easier for the villagers to make remote payments. A significant number of e-commerce start-ups opened new windows for people in the urban areas to enjoy e-commerce services. The remaining biggest hurdle for the villagers is now the delivery mechanism in the rural areas in a cost effective way. We take this challenge to reduce BoP penalty by delivering goods in a cost-effective way. In this article, we propose a model to deliver the ordered product to a nearby service point. The model studies the required products in the village and their demand frequencies. Our approaches are 1) Collecting group order and 2) Efficient delivery mechanism. We have two experimental sites (population more than 0.3 million people in each site) in Bangladesh. We have simulated our model with a social good and found that 112.5% BoP penalty can be reduced in an ideal situation.

Keywords—BoP Penalty; ICT; E-commerce; Last mile delivery; GramWeb

I. INTRODUCTION

Currently, there are 4 billion people at the BoP (Base of the Pyramid), comprising 69% [1][2] of the world population. Despite their low income and limited purchase capacity, they make frequent purchases within their limited spending power. The people at the BoP often pay higher prices for basic goods and services than do wealthier consumers [3]. Considering the definition of BoP penalty we can draw following equations:

$$\text{BoP penalty} = \text{Premium price} - \text{Original price} \quad \ldots\ldots\ldots(1)$$

$$\text{Poverty premium} = \frac{Premium\ price}{Original\ price}\ \text{times} \quad \ldots\ldots\ldots\ldots(2)$$

Original price of a product or service is the price determined by the seller of that product or service in a competitive marketplace. On the other hand Premium price is the increased price of the same product or service in a remote area due to extra delivery cost added with the original price of the product or service. From equation 1 we find BoP penalty is the difference between premium price and original price which is measured in monetary unit. In equation 2 poverty premium is the degree of price difference. For example, if a product's price in a competitive market place is 10 dollars and the price of that product in a remote area is 15 dollars then poverty premium would be 1.5 times and BoP penalty would be 5 dollars. Table 1 shows some practical examples of BoP penalty and poverty premium in Bangladesh perspectives.

Table 1: Examples of BoP Penalty

Item	Bheramara (Rural)	Dhaka (Urban)	Poverty Premium (times)
Mineral water (500 ml)	20 taka	15 taka	1.33
Blood glucose test	300 taka	150 taka	2.00
Rice (per kg)	60 taka	50 taka	1.20

Cost disparities between BoP consumers and the rich in the same economy can be explained only by the fact that the poverty penalty at the BoP is a result of inefficiencies in access to distribution and the role of the local intermediaries [4]. Table 1 shows three examples that describe how people in a rural area buy same products or services in higher prices than the people live in an urban area.

Rural E-commerce can be used as a tool to reduce BoP penalty. It will enable villagers to purchase products from a village at any time of the day and get the desired products delivered to their doors. It saves time, money and labor [5]. A product seller can upload the product information on the web and can breach the boundaries of the local market to reach the customers on a global scale. A customer, on the other hand, can search for the desired product in a much more extensive selection space, and find a suitable product. In this way, e-commerce brings benefits for both the buyers and sellers as indicated by the trend in e-sales.

In order to purchase a product through a web-based e-commerce service, a customer needs access to the internet and an online payment mechanism, typically a credit card. Presently 40% of world population has access to the internet [6]. Fig. 1 shows a big gap between the users of internet in developed world and developing world. Four billion people from developing countries remain offline, representing 2/3rd of the population residing in developing countries [7]. Out of 940 million people living in the least developed countries (LDCs), only 89 million use the internet, corresponding to a 9.5% penetration rate [7]. Similarly, most of the people of developing and least developing countries are unable to use credit cards due to the rules and regulation which are also designed targeting the rich people of our society. However, mobile money transfer is becoming popular to the local e-commerce companies which is replacing the need of credit card in the developing and least developing countries. Still, product delivery in a cost-effective way is the biggest challenge at the BoP community.

Toyota Motor Corporation and Kyushu University in Japan are jointly carrying out a research to create values by

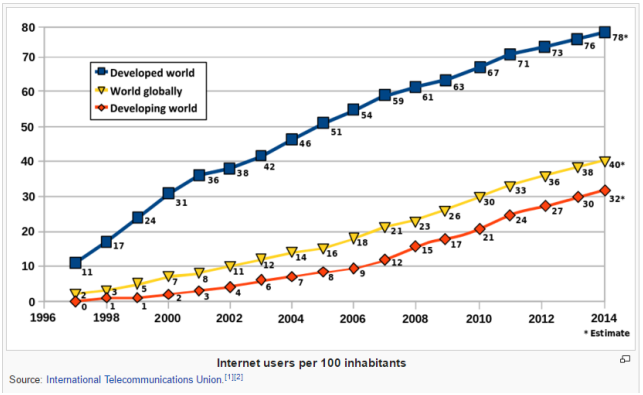

Figure 1: Internet Users Worldwide

introducing two community cars in two experimental sites. Grameen Communications in Bangladesh is supporting the experiment. A 10 seated Toyota Hiace vehicle carries 4 major services (healthcare, education, learning and purchase), we call it SSW (Social Services on Wheels) project [8]. In this research, we use this experimental platform to verify our rural e-commerce model. Our aim is to reduce BoP penalty. We design an ICT based product delivery mechanism and deliver social goods. By social goods, we mean the products that are required in the community, can solve a social problem and can create a big social impact. People may be unaware of the product or the purchase volume is not big enough to justify financial benefits to attract a local seller. Examples of these social products are: malaria preventive mosquito nets, energy efficient bulbs, sanitary napkins for females, medicines etc. These products are available in Dhaka city but not widely introduced or sold in local markets. In our proposed e-commerce system, we develop a villager-friendly online catalog to list the basic products and update the catalog based on villagers' needs.

Two experimental sites are in two districts in Bangladesh. One is in Kalhitari Upazila under Tangail district (105 km away from the capital Dhaka city) and the other one is in Bheramara Upazila under Kushtia district (235 km away from the capital Dhaka city).

Table 2: Demographic information of experimental sites

	Site-1 (Kalihati)	Site-2 (Bheramara)
Population (million)	0.41	0.2
Area (sq. km.)	295.6	153.7
Population Density (sq. km.)	1388	1302
Distance from Dhaka City (km.)	105	235
Courier delivery service point (km.)	8 to 18	2 to 14
Number of mobile phones (million)*	0.18	0.09
Percentage of people know about e-commerce	Under survey	Under survey
Availability of Smart Phones (million)*	0.0144	0.0072
Percentage of young (10-24 years) population (million)*	0.13	0.062

*Estimated

We have identified the following reasons for the increased BoP penalty- (1) poor distribution network (2) low frequency of demand (3) unnecessary intermediaries in the supply channel. We argue that the penalty can be reduced completely or partially if the following can be implemented- (1) group purchase (2) group delivery. Group purchase and group delivery will increase the delay but will reduce the total cost of the product.

Section II introduces the traditional e-commerce system wherein the participation of the local villagers are missing. Section III describes the obstacle of delivery model where the BoP penalty affects the most. Section IV explains our proposed model. We came up with a scheduling mechanism for group purchase, group distribution model in order to reduce the product cost i.e. BoP penalty. We summarize our findings in section V.

II. Traditional E-commerce System

We study traditional e-commerce system to understand most

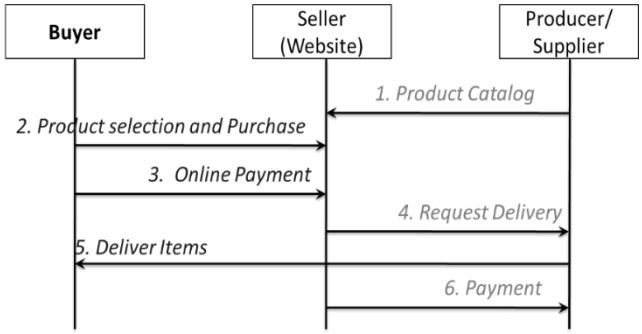

Figure 2: Traditional E-commerce System

important e-commerce components and major stakeholders of e-commerce. Fig. 2 shows a typical e-commerce model. There are three major stakeholders in the present e-commerce system:

Buyer: In a web-based e-commerce system, a buyer visits the product website, selects the product, and makes the payment by credit card, PayPal or other online transaction system.

Seller: A seller is a website that interfaces with buyers. Such a website offers a product catalog, an interactive interface to receive customers' preferences, a shopping cart system for the purchasing process and an online payment system. The website needs to ensure a secure system to handle customer information.

Supplier: A supplier receives purchase orders through the web, checks the payment process, and ensures the delivery of the product and post-sales services. A supplier can be a producer of the product, its representative, an agent or a distributor.

There are three components of e-commerce essential to operate its function by the stakeholders. They are:

a) Internet accessibility to explore online product catalog

b) A payment mechanism such as credit card, mobile money transfer etc.

c) Home delivery mechanism to transport the purchased product from supplier's point to buyer's point.

Therefore, the model can work only in places where the basic infrastructure of e-commerce is ready. Unfortunately, the remote locations and low income people are not included in the customer list of the current e-commerce system. However, recent internet penetration and popularity of mobile money transfer in developing countries are triggering its popularity in the rural areas. E-commerce service lies incomplete for the rural people of developing countries due to lack of proper home delivery mechanism. In the next section, we explain current product delivery scenario for rural e-commerce in Bangladesh.

III. The Big Obstacle

In Bangladesh, there is an established product distribution channel among city areas of different districts through

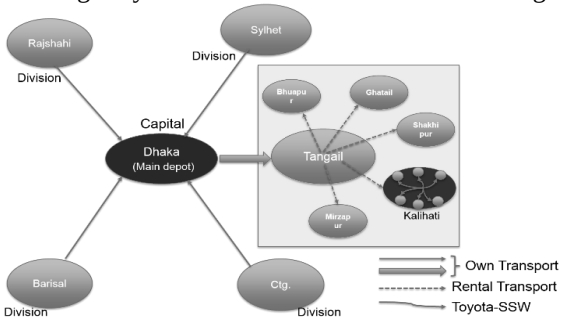

Figure 3: Existing Product Delivery Mechanism

different courier service companies. E-commerce service is also getting popular in those areas. From the city areas products are delivered to the sub-district branches using rental transport facility but still with the responsibility of the courier service companies. However, there is a big gap of delivering products from the sub-district office to the rural households. From Fig. 3 we find using the courier service channel, products are transporting to Dhaka (central depot.) from divisional level. From Dhaka, the products for Tangail district are sorted and transported. From Tangail, products are again sorted and transported to Kalihati, a subdistrict of Tangail. From Kalihati, social goods are delivered to the rural service points using the GramCar of Toyota-SSW project. In next chapter, we discuss in-detail about social goods, GramCar and Toyota-SSW project.

IV. Our Approach: Scheduling Operation Towards Maximum Utilization of Resources

In order to reduce the BoP penalty, we have identified the following items – (1) number of products to be ordered from the same area (2) distance from the existing courier service point.

For our pilot study, we used the research platform of GramCar, a joint research project of Kyushu University and Toyota with the help of Grameen Communications in Bangladesh. They are carrying out an experiment in Bangladesh to evaluate whether a vehicle can carry multiple services to the villagers' doorstep. The social services are healthcare service (e-health, virtual blood bank), mobility service (college bus, emergency transport, and demand responsive transport), education service (e-learning) and social goods delivery. At the rural sites the village car entrepreneur (VCE) operates the services with direct support of urban head office including doctors call center, database management, software development and maintenance, social goods collection and supply, training of rural staffs, promotional design and all other logistic support.

Under social goods delivery service a community car carries social good samples, Wi-Fi tablets and SSW ICT trainer to the service point. Social goods include, sanitary napkins and underwear garments, energy efficient bulbs, solar torches and charges, and mosquito nets and repellents. The social good samples allows the villager's to see the purchasable items. The villager and SSW ICT trainer use a catalog to access online purchasing opportunities. To overcome any illiteracy issue, a catalogue with pictures and prices are shown to the villagers. The customer selects which items he or she wishes to purchase and the ICT trainer makes the order online on the customer's behalf. The ordered products are delivered to the service point one week later by the community car.

A. Shared Resource, Shared Cost

In our model sites, the GramCar visits different service points in the community in a scheduled basis. The service points are scheduled in such a way as one service point serves the rural people once a week. Utilizing the empty space of the GramCar the social goods are delivered once a week in a specific service point without spending any extra money on last mile product delivery.

B. Product Selection

We select products based on the demand of rural community that adjusts with our delivery mechanism. Perishable products are excluded from the product list as the products are delivered one week after order placement. Products are also selected which have the attribute of solving rural problems. Locally unavailable products are included in the product list to save money, time, and effort of the rural people. Identifying community demand is an important task. We are analyzing different online/offline activities of rural people such as healthcare receiving, movement for family shopping, farming activities and so on. We are analyzing the data that we receive from ICT based social services as well as the data from different offline sources such as questionnaire survey and observation. Based on the analysis we carefully include new products in the product catalog. Fig. 4 shows a model of community specific online catalog. It will be prepared after the completion of community data analysis. The catalog will be displayed in GramWeb platform. GramWeb is an information platform for low-literate people that connects each and every villages of Bangladesh.

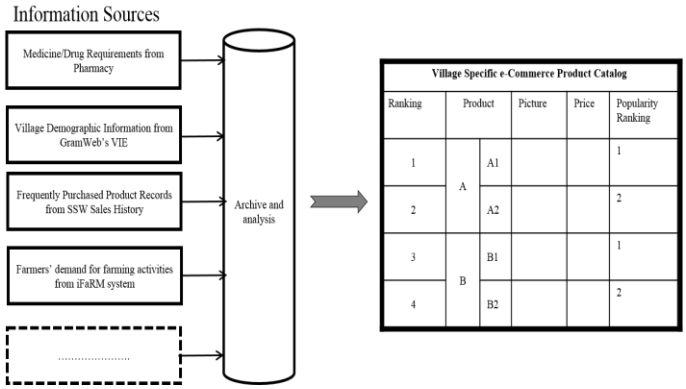

Figure 4: Model of a Community Specific Online Catalog

C. Service Point Optimization

We plan and implement different service point models to design an appropriate product delivery mechanism for the rural community. Fig. 5 shows the model of bi-weekly and weekly service points which are already applied in the experimental sites. In the bi-weekly model the vehicle visits 10 service points in the community per month. One service point deliver social services once in every two weeks.

On the other hand, under the weekly service point model the vehicle visits and deliver social services to 5 service points per month. One service point is repeated once a week. Findings from our experiment on the above mentioned weekly and bi-weekly service point models are the bi-weekly service point model serves more new people than weekly service point model while weekly service point model serves more repetitive customers.

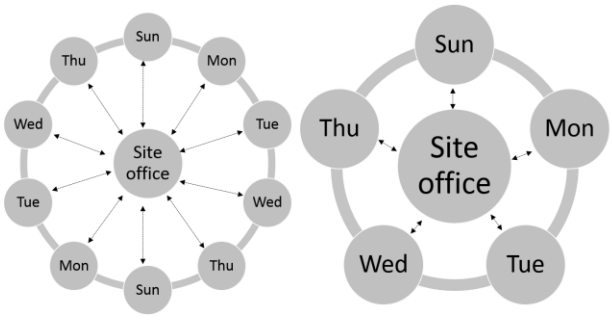

Figure 5: Service Point Design (Bi-Weekly and Weekly)

In order to increase service frequency in the rural community we are working on a new service point model (Model-3). Under this model the vehicle will touch 6 service points in one day. There will be total 30 service points and every service point will be repeated after one week.

Table-3 shows a comparison chart among different service point models.

Table 3: Different Social Goods Delivery Service Point Models

Measuring items	Model-1 (weekly)	Model-2 (bi-weekly)	Model-3 (proposed)
Visiting frequency (per month per service point)	4 times	2 times	4 times
Total service points in one site	5 service points	10 service points	30 service points
Total customer reach (per Month)	1000 households	2000 households	6000 households
Maximum product delivery time required	7 days	14 days	7 days

D. Social Goods Delivery Operation

Current social good delivery operation is shown in fig. 6. The process starts from customer order placement. The village car entrepreneur (VCE) transfers the order information to the head office. The supplier receives the product request from the head office. Product delivery is taken place in an opposite direction. The payment flow is similar to the order flow which means it starts from the customer and ends at the supplier. Mobile money transfer technology is currently using for the payment mechanism.

E. Group Delivery to Reduce BoP Penalty

Aschorjo moshari, a long lasting insecticide-treated mosquito net, is now available in Bangladesh to protect from a mosquito borne disease malaria. The customers can buy one mosquito net from the urban market at 850 Bangladeshi

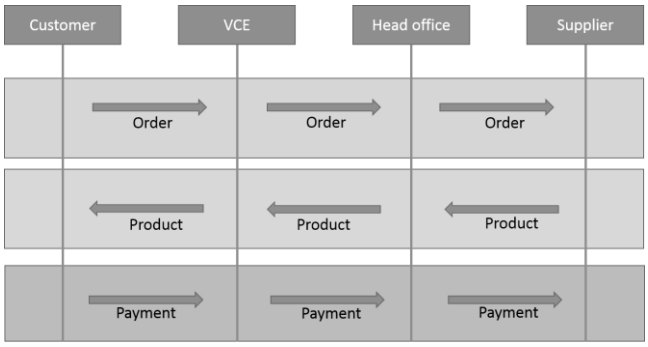

Figure 6: Social Goods Delivery Operation

Taka. If the product is ordered from the remote area of rural Bangladesh through e-commerce site it will add additional 100 Taka and will be delivered until the sub-district level. They have to travel all the way through uncomfortable transport which will add additional money, time and labor. We have selected this product to deliver at the remote area of rural Bangladesh. We receive a group order from the rural entrepreneur. We collect the product from the supplier at Dhaka with a wholesale price 625 Taka. We send through existing courier service. The courier company delivers the package up to the sub-district point and charge 200 Taka for 10 mosquito nets. SSW-GramCar collects the mosquito nets and distribute it at the rural service points. The rural consumers who ordered the product previously collect it from their nearest service point.

By analyzing customer demand and collecting group order we can buy the mosquito net from the supplier at wholesale price and can send them in reduced delivery cost by distributing the cost among multiple products. Fig. 7 shows total delivery cost for 1 mosquito net from supplier to the service point is 38 Taka only. We sell one mosquito net at 750 Taka. From this experiment we find the rural consumers are able to buy the mosquito net by reducing the BoP penalty more than 200 Taka with reduced time and effort as well.

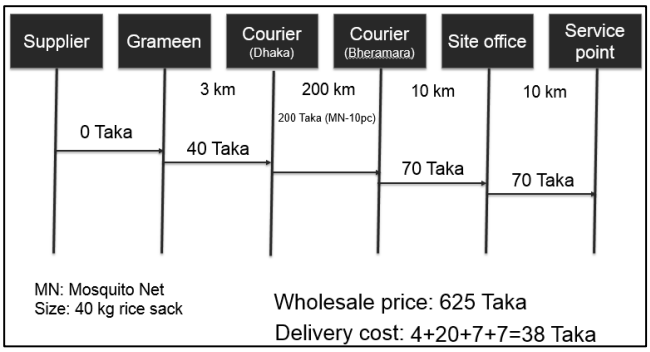

Figure 7: Financial Projection of Product Delivery

V. Summary and Challenges

The article focused on the issue of BoP penalty. This article showed a way to reduce the BoP penalty by improving the prodoct delivery mechanism. We focused on the efficient product delivery mechanism and last mile delivery problem and came up with group delivery methotd after analyzing community demand. We simulated the model in two rural areas in Bangladesh to verify our model. Considering equation 1 of measuring BoP penalty and we found that BoP penalty for mosquito net is -100 taka which means neither the BoP penalty is reduced partially nor fully, rather we could deliver the mosquito net at a lower price than the urban marketplace price. The BoP penalty was reduced by 112.5%.

The challenges we faced in delivering social goods outlined below:

- Individual purchase is more popular than group purchase. Due to lack of promotion and/or source of information people are less aware about the benefit of group purchase.
- Many people do not know about the advantages and the risks of e-commerce system. In the country, there are lot of fake items on e-commerce sites and there is no good platform to take care of post sales claims.
- Not all the products can be sold through e-commerce systems. Perishable products will not be popular until we have a safe and secure delivery and storage mechanism.
- Mobile money transfer is not secure yet. Technology needs to be improved to gain the trust of the people for mobile money transfer.
- Traditionally people are not accustomed with the culture of pre-paid system for unseen products.
- The online catalog needs to be villager friendly. Consumers trust on buying certain goods that they can't touch previously. Rural people checks the quality of the product by touching, tasting or taking closer look. The online catalog does not have a product before making a purchase decision. But in e-commerce shopping such kind of option is absent.

Our next step will concentrate on the following items.

- Prepare a community specific online catalog based on community demand.
- Evaluate the new model with increased service points.
- Outline the requirements to establish strategic alliance with new suppliers based on the demand of rural people.
- Estimate the reduced BoP penalty for newly added products.

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