Decision framework for selecting last mile delivery performance in Indian e-commerce companies

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Abstract: Last leg delivery plays a crucial role in improving logistics efficiency and customer acquisition through improved service quality and time. When implemented successfully, it becomes competitive advantage and ensures long-term success of the business. Last leg or last mile delivery is gaining importance in recent times in India, due to growing prominence of e-commerce. Major challenges in last mile delivery in India are: identification of best possible route to the destination, identification of best possible time window to reach and increasing efficiency of logistics through adoption of best possible delivery method to reduce delivery period. This paper first carries out a comprehensive literature review of last mile delivery practices adopted by e-commerce companies worldwide and the different factors affecting last mile delivery performance. The paper then describes a framework identifying necessary and sufficient conditions for selection of effective last mile delivery practices in India for specific product types.

Keywords: last mile delivery; decision parameters; electronic retail; India.


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This paper is a revised and expanded version of a paper entitled ‘Decision parameters affecting last mile delivery performance in Indian e-commerce companies’ presented at the 27th European Conference on Operational Research, Glasgow, 12–15 July 2015.
1 Introduction

When it comes to efficiency in logistics and customer acquisition, last leg delivery plays a crucial role. If it is implemented successfully, it can become a competitive advantage and ensure long-term success of the business. Last leg or last mile delivery is gaining importance in recent times, due to the growing prominence of e-commerce.

Whatever be the efficiency achieved by the companies in the pre-last leg delivery, it is always the ‘last mile delivery’ that impacts the customer satisfaction and loyalty as it is the only part of the delivery chain that is visible to the customer (Partridge, 2011). But, efficient last mile delivery is an expensive challenge that every major company is facing in last leg distribution in India (Mankotia, 2014; Rai, 2014; Wulfrat, 2013). According to reports, delivering the last mile of the chain comprises up to 28% of the total cost of moving goods in the supply chain (Gupta et al., 2014). Distribution in India is a lot more difficult and costly affair when compared to other countries. Some of the primary reasons for these increased hurdles for distribution, especially for last leg delivery in India are the following (https://c2xnitie.wordpress.com/):

- Poor infrastructure (road network): Surfaced roads constitute only 58% of total road network and only 40% of villages are connected by a road network usable in all weathers.
- Varied demographic factors: The variation in population density makes it extremely costly to reach out some of the low density areas. Language barriers add another constraint. Because of such factors, a lot of hardship and remote locations are not reached out by the companies.
- Geographical variation: India faces a huge variation in weather conditions across the country as well as across time. Some of the locations might be hard to reach in bad weather conditions making it difficult to provide delivery service during whole of the year.
- Expertise or talent pool: The demographics and geographical conditions of India are such that so far no courier company is close to reaching every nook and corner of the country. Only India Post has strong knowledge and expertise about last leg delivery by which they can reach any and every home for delivering mails (Kanekal, 2014). But being controlled by bureaucracy, it has its own challenges of inefficiency in operations (Kurmanath, 2014).

Because of the above key challenges in India, last mile delivery has not been very successful as in other countries. On a broader level, these challenges can be said to hamper optimisation in one or more of three aspects in last mile delivery:

1 Identification of the best possible route to the destination: This refers to traversing the distance from the last hub to the customer’s location in the best possible manner, in other words reaching the customer’s location in the minimum possible time while incurring the least possible cost.

2 Identification of the best possible time window to reach: This refers to delivering the product at customer’s location at a time when customer is present so that a re-attempt to delivery is not needed. Delivery re-attempts results in a huge cost to the service provider. In addition, this also includes the practices aimed at providing the customer
with flexible options of delivery on a time of his choice while keeping the cost structure at the same levels.

3 Increasing efficiency of logistics to reduce delivery period: This refers to the additional practices which are adopted so as to increase the efficiency and effectiveness of the last mile delivery by handling factors other than route and time so that the overall delivery cost incurred is reduced or the service levels are increased keeping the costs at the same level.

A key challenge which is faced by the last mile service providers, especially e-commerce companies, globally is the huge inventory costs that they need to incur unlike package carrier delivery providers. E-retailers need to have their warehousing network much closer to the customer location. Inventory costs are higher when the stock that needs to be managed has huge variety with varied shelf-life. At present, many e-commerce service providers such as Amazon and Flipkart are facing the same issue and trying to come up with methods to manage their inventories in optimal ways.

It is found that, no study has addressed the challenges and the different factors affecting the choice of last mile delivery performance in Indian context. Few last mile delivery practices reported in literature are identified and a decision framework is provided for evaluating their suitability in Indian context based on the factors effecting last mile delivery practices. Next section highlights the literature on last mile delivery practices used in e-commerce and the methods of selecting them.

2 Literature on last mile delivery practices in e-commerce

Globally, different companies have tried different methods (Gevaers et al., 2009) to tackle last mile delivery, and investment in last mile delivery is a trade-off between risk and return. The stronger the last mile network, more visibility for company’s products (reach and penetration), which further boosts customer loyalty and gives company a competitive advantage.

Vanelslander et al. (2013) studied the logistics costs of online sale of grocery items. They mentioned the input and output factors of e-commerce. According to their research, there are three main determinants within the retailer’s control: the delivery method, the picking method and the return policy. Reasonable control is available on volumes and customer density. Partial control is possible on the properties of the goods and the wage levels. Out of there tailers’ span of control is legislation. On the output side, logistics costs are the main element preceding service levels. One of the most important determinants, both in terms of cost, as well as shopper service level, are the options the e-commerce company chooses to offer for the last mile delivery (Ogawara et al., 2003). Wang et al. (2014) studied three different last mile delivery options: attended home delivery or reception, reception or delivery box, and collection-and-delivery points in high population density areas in China. The researchers concluded, choosing the most appropriate practice reduces logistics cost effectively.

Attended reception is the traditional delivery mechanism where a delivery person visits the customer’s location to deliver the package within the specified delivery date. A delivery time window is specified either on the day of delivery or at the time of placing the order, during which the customer can expect the delivery person to visit them for
delivery (Punakivi and Tanskanen, 2002). Reception box (Kamarainen, 2001) is a type of unattended delivery where deliveries can be made without requiring the customer’s presence. In order to deliver the package securely, an insulated storage box with a locking mechanism is installed in the customer’s premises and deliveries are subsequently made into this box (e-locker or computerised personal lockers described by Ogawara et al. (2003). Delivery box (Punakivi et al., 2001; Tanskanen et al., 2002) is also a type reception box mechanism. Unlike reception box, deliveries are made by keeping packages inside secure insulated boxes, which can be left outside customer’s home securely using a locking mechanism. Customers can then take their packages and leave the boxes outside their home for the delivery person to collect on his next visit. Collection point delivery method (Gevaers et al., 2009) is another kind of unattended reception where the package is not delivered to the customer’s location. Instead the service provider drops off the package at a collection point, which can be a storage location with lockers or safety deposit boxes or a local agent like supermarket, service stations, general stores, etc. The customers can then go to the collection point and pick up the package at any time according to their convenience. Outsourcing is an extension of collection point delivery method with the delivery from collection point being made by a third party instead of customers travelling to the collection point for picking up the package (Vanelslander et al., 2013).

Different authors have compared the different options of last mile delivery based on few performance measures. Most of them have studied the methods with respect to their operational efficiency. According to Tanskanen et al. (2002), the most expensive service model is attended delivery on the following day in one-hour delivery windows. The key to efficient home delivery is unattended reception of goods (Punakivi and Saranen, 2001).

Wang et al. (2014) concluded, under normal circumstances, collection point delivery method’s operation efficiency is the highest, followed by reception box and attended reception. They also found, when orders are few, attended reception is the most suitable mode as larger amount of equipment investment in reception box and collection points makes them costlier. On the contrary, when there are plenty of orders in high population density areas with high reception box expense and low commission of third party partners, collection point method gives optimum cost of delivery. Moreover, when there are plenty of orders in sparse areas reception box has the optimal advantage.

In delivery boxes, the service provider needs to make only little investment in a fixed number of boxes which can be circulated and shared among all the customers (Punakivi et al., 2001). Collection point delivery method is mainly used to deliver in locations which present geographical challenges, areas with widespread population which makes it financially difficult to deliver to individual customer’s location. Yet, another reason is the high proportion of time that people spend outside their homes due to which it makes no sense to deliver it to their homes. This method achieves high service quality similar to that in attended reception but at a lower delivery cost. By outsourcing to local agencies, service provider lowers delivery cost by utilising the expertise of the agency in the local area and the economies of scale achieved by this agency. In addition to cost advantage, this delivery method also helps the service provider increase its coverage by reaching difficult locations and remote areas in a cost effective manner along with delivering a service quality which is equivalent to that of attended reception. Vanelslander et al. (2013) found that, when an order can be contained in a single parcel, the cost per order when using outsourced parcel delivery is less than half of the cost when using own van
decision framework for selecting last mile delivery performance

Greasley and Assi (2012) showed using simulation models how delivery time improves through collaborative design of hub and spoke delivery mechanism for a real world retailer-distributor network for last mile delivery.

Most of the studies in literature had a limited view in analysing the impact of delivery methods. They considered either logistics costs or delivery time as output factors. This research uses an analysis in a fully comprehensive way making a comparison of the outcomes of adopting different last mile delivery practices not only for costs but also for other output factors, like service quality and delivery time. Also, latest technology as unmanned aerial vehicles called drones for last mile delivery are not analysed in literature (Hern, 2014). This paper builds a comprehensive decision framework to choose the most appropriate delivery method for Indian market.

3 Factors affecting last mile delivery performance in India

In this section, a framework is designed to evaluate last mile delivery practices in any application in Indian context, after thoroughly studying three major factors in detail:

1 delivery time
2 delivery price
3 service quality.

3.1 Delivery time

Delivery time in a last mile network is the time taken to deliver package from the last hub in the delivery path to customers’ premises. The distance travelled in this last leg of the delivery varies depending on the geography of the recipient’s address (typically, a few kilometres).

In reality, the delivery time is impacted by a number of parameters, key parameters being the following:

a Time to identify delivery point: This refers to the time that the delivery mechanism takes to identify the best possible route to reach the customer’s exact location. In traditional delivery mechanism, this is influenced by the familiarity or expertise of the delivery person with the area around the delivery location. Nowadays, with the advent of GPS and detailed online maps, it has been made possible to identify the location and find optimal routes to the customer’s area. In Indian context, however, locating the exact delivery point has many challenges considering the geographic variation and congestion. Technology has immense potential to substitute the human expertise in this respect.

b Proximity of delivery locations: This refers to the distance that has to be traversed in order to fulfil the deliveries bundled around certain geography. If such geographies are in closer proximity to each other, delivery time reduces, as smaller proportion of time is spent in covering the additional distance to reach to the next delivery location.
Type of collection mechanism: Two broad types of collection mechanisms have been implemented globally in various applications – collection point and reception box (attended/unattended). Aggregate delivery time is a function of type of collection mechanism, for example, in case of collection point mechanism this is less on account of two factors:

1. reduced effort (distance, thus time) in reaching out to individual customers’ locations
2. eliminated effort in identifying the right time window to make the delivery (as opposed to attended reception).

In Indian context, with changing social, economic and demographic characteristics, people’s lifestyle is changing and hence, the collection mechanism also gets changed due to non-availability of customers while making deliveries.

External factors: Factors like geographical conditions, constraints due to road infrastructure, traffic conditions, etc., which cannot be controlled by the service providers, are big influencers to last mile delivery performance, especially in Indian context. Congested and poor road network greatly hampers the delivery time. External factors mentioned above can be bypassed with the use of technological solutions.

Fleet size and type: Fleet size and type respectively refer to the number and type of vehicles used for deliveries. In Indian context, certain type of vehicles is not allowed to travel intra-city roads during day time (when most of the deliveries happen). Therefore, fleet type becomes crucial in determining the delivery time for Indian context.

3.2 Delivery price

Delivery price refers to the price that the customers pay in order to get the package delivered to them. In Indian context, especially in e-retail, delivery prices are charged depending upon the value of the item and date within which it needs to be delivered. In some cases, delivery charges are waived-off to induce customers’ purchase of high value products. Higher delivery prices might be charged from customers on account of higher costs incurred by service provider due to inefficiencies in the delivery processes, resulting in lower delivery performance for the end-consumers.

Delivery price can be mainly broken into two broad heads:

Margin for the logistics provider: In Indian context, logistics arm of the e-commerce supply chain has already been commercialised, with majority of the service providers developing their own logistics arms which earn additional revenue by providing logistics services to other e-commerce service providers. Due to this commercialisation, logistics service providers keep their margins, thus impacting the delivery charges that the customer pays.

Cost of delivery: This refers to the overall cost that the logistic provider incurs in the process of delivering the package and is impacted by the following factors:
Order density: This refers to the number of orders received from a particular area, which can be measured in ‘number of orders/km²’. It has been seen in literature that higher order density leads to lower aggregate delivery costs on account of:

- economies of scale
- less incremental distance to be travelled in order to deliver additional packages (Boyer et al., 2009).

Length of delivery window: Delivery window refers to the time window that is indicated to the customer at the time of placing an order. Length of this window determines the duration for which the customer has to wait to receive the package. It has been observed that, shorter the delivery window, higher is the delivery cost because of resulting inefficiencies in routing (Boyer et al., 2009).

Distance: This refers to the distance between the last hub in the delivery path and the exact delivery location. As this distance increases, extra time and cost are incurred in reaching the customer’s premises.

Volume: This refers to the total number of orders received from an area. Higher volume results in lower delivery costs on account of economies of scale and better utilisation of resources. As use of better technology improves the service quality, volume achieved by the service provider will be increased on account of higher customer loyalty rate.

Customer interference: Reception can be categorised as attended and unattended reception. Unattended reception facilitates a mechanism for the service provider to deliver package to the customer’s premises, without need for customer’s presence. As a result, cost reduces with unattended reception by eliminating the need of re-visiting the customer’s premises, in case of their absence. Although unattended reception eliminates inefficiencies, it does require additional investment to ensure packages are delivered in secured and tamper-proof storages.

Type of collection mechanism: In case of collection point, mechanism costs are reduced as the need to reach the individual customer’s premises is eliminated. On the contrary, in case of reception, package needs to be delivered at each individual customer’s premises.

Fleet used: The number and type of vehicles used for deliveries affects the cost that the service provider has to bear for making the deliveries. In this respect, volume is a crucial factor for determining the profitability as it impacts the utilisation of the resources.

Geographical location: In Indian context, some of the locations are hard to reach owing to the geographic variation which makes it costly to reach out to these locations for making the last mile deliveries. Customers in such locations might incur an additional price for deliveries.
3.3 Service quality

Service quality in last mile delivery refers to the overall experience that the customer gets during the course of receiving the package. It is not only restricted to the interaction of the customer with the delivery mechanisms while receiving the package but also includes several touch points that influence the overall perception of service quality. Especially in the last mile, apart from the time taken to deliver the package, the flexibility given to the end customer and the return handling mechanisms employed also impact the customer’s perception.

Below are the major parameters that influence the service quality in last mile delivery:

a Tracking systems: Such systems are employed in order to ensure transparency and facilitate better communication to the end customer. Two parameters help in evaluating the performance of tracking mechanisms, both of which are greatly influenced by the technology employed:
   1 Accuracy of data: This refers to the correctness of the location of the package at any given point of time during delivery so that the customers can know the progress and estimate tentative time of delivery. A minimum level of accuracy is necessary so as to keep the customer informed but real-time information during last mile delivery can help make the deliveries really smooth.
   2 Level of detail: This refers to the amount of precision at which the package location data is captured and displayed to the customer.

b Delivery flexibility: This refers to the ability of the system to incorporate the customer’s convenience on a real-time basis and deliver the package at the appropriate time and location. Flexibility in the last mile delivery process can be ensured depending on two factors:
   1 Process intelligence: It is the ability of the system to capture and incorporate customer’s preferences and adopt quickly and optimally to ensure the same service quality. This is mainly dependent on the technology and the type of delivery mechanism employed.
   2 Geographical location: In Indian context, geographical variations and presence of hard to reach locations pose extreme challenges to make last mile delivery flexible in some cases even with the use of technology.

c Package condition: In e-commerce, package condition upon delivery acts as a proxy for the customer’s perception of quality and condition of the product inside. Also, the package condition at the time of delivery can be influenced by the following factors:
   1 Quality of packaging material: It is in the interest of service provider to ensure high quality of packaging material so as to reduce cost of returns occurring because of products damaged in transit.
   2 Control over delivery mechanisms: This refers to the amount of control that the service provider has over the logistics in case it is outsourcing it to a third party logistics provider. This includes tracking the condition and location of package across the delivery path. In addition to reducing damages, ensuring control also helps in determining the liable party and the amount of liabilities in case of any damages.
Fleet used: Type of fleet used often leads to product damages in case any particular vehicle is not right for shipping a particular product. In addition due to geographical constraints, extra care needs to be taken to ensure transport of packages in safe vehicles.

Handling returns: In last mile delivery, returns is a crucial element which impacts the purchase behaviour of customers and subsequently affects the customer loyalty. If smooth return handling is not ensured, the perception of service quality declines considerably, resulting in lost purchases. Return handling mechanisms are impacted by two factors:

1. Control over logistics: Deliveries in remote India are mostly handled by third party logistics providers as they have more expertise and volume to make efficient deliveries. However, sometimes it becomes difficult to convince these logistics providers to handle return mechanisms because of lower volume and higher costs for such processes.

2. Customer interference: It causes inconvenience and might negatively impact the perception of service quality. In case of unattended reception, it is easier to handle returns and ensure higher levels of service quality.

3. Geographical condition: In Indian context, it is a herculean task for the service provider to ensure smooth last mile delivery of packages for the first time. Employing another channel for handling returns becomes extremely difficult and costly in such areas. As an alternative, few service providers request the customers to ship back the product themselves.

4 Evaluation of last mile delivery practices based on three performance characteristics

In this section, the practices of last mile delivery as described in an earlier section are evaluated individually based on the three parameters designed to assess the delivery performance, as described in the previous section. Following the analysis of each practice over the three parameters, delivery time, price service quality, is a table summarising the observations. Actions to manage the issues associated with each practice are also mentioned below for successful implementation in Indian context.

4.1 Attended reception

- Delivery time: With attended reception or traditional delivery mechanism, delivery time is the highest, as the delivery location of each customer has to be identified and their presence is required in order to make the delivery. In addition, external constraints such as geographical variation and traffic have to be taken into account while finding the optimal route to reach the delivery locations.

- Delivery price: In traditional delivery mechanisms, delivery cost is high, as the delivery has to be attempted again in case of customer’s absence in first attempt. Length of delivery window and order density hugely impacts the aggregate delivery cost that the service provider incurs. Both the customer and service provider can be ensured of secure delivery. In addition, while handling returns, this method gives the
service provider the provision for product inspection, thus reducing the cost of errors
due to damaged or used products. Outsourcing deliveries to local agencies is another
solution to cost reduction by using higher expertise and economies of scale. This
method however results in loss of control for the service provider, which can be
tackled with the use of technology.

- **Service quality**: Attended reception provides for flexible delivery options to the
  customer, thus building a positive perception of service quality. This requires
  accurate tracking mechanisms to ensure high levels of service quality. Accurate
  communication plays a vital role in ensuring customers’ convenience and avoids
  futile delivery attempts. In addition, process intelligence is required to provide
  flexible delivery options to the customer. Both of these factors are greatly influenced
  by technological investments made by the service provider. Handling returns
  becomes difficult in traditional delivery mechanism, as it requires customers’
  interference, impacting the perceived service quality.

### 4.2 Reception box

- **Delivery time**: In case of reception-box mechanism, delivery location can be easily
  located as service provider’s database contains data pertaining to reception-boxes
  installed at customers’ premises. Thus, the time taken to deliver package in case of
  is less with reception-box mechanism compared to attended reception eliminating
  the waiting time of the customer as well as the need to track the package frequently.

- **Delivery price**: As this mechanism is unattended reception, it saves the cost by
  eliminating the need to find out the ‘right’ time-window to deliver package and any
  possible re-attempt of delivery in case of customer’s absence. Before getting these
  benefits, significant cost and effort has to be made in identifying the prospective
  customers and huge cost has to be incurred in installing reception boxes at their
  premises. This makes volume, a crucial factor in determining the profitability from
  this mechanism for the service provider. The issues of high installation cost can be
  handled by sharing the installation cost with the customers or sharing the reception
  boxes with other players along with cost sharing mechanisms. Sharing reception
  boxes among a number of e-commerce players also increases the customer’s options.

- **Service quality**: Since it is an unattended reception, it does not require customers’
  interference in delivery process, thus convenience is assured at all times. As
  reception box is installed at customers’ premises, it is convenient for them to receive
  packages without having to worry about damages. Handling returns with this
  mechanism is very easy, as customers can place packages in the box before the
  service provider picks it up. One of the major challenges with this mechanism is the
  absence of any mechanism to clearly define the liability of product condition
  between the customer and service provider while receiving the delivery or returns.
  This constraint can be removed by use of technology and installing cameras in the
  reception box.
4.3 Delivery box

- **Delivery time**: Delivery time is high, as each customer’s delivery location has to be identified in order to make the delivery. External constraints such as geographical variation and traffic have to be considered while finding the optimal route to reach the delivery locations.

- **Delivery price**: Because of unattended reception, this mechanism saves cost as there is no constraint of visiting the customer during a pre-defined delivery time window and no need of re-attempting the delivery. Moreover, compared to reception box mechanism, this method requires lesser investments in storage mechanisms as delivery boxes can be shared among different customers and need not be installed separately for each customer. However, volume still remains a determining factor for profitability of service provider.

- **Service quality**: Being unattended reception, this mechanism does not require customers’ interference in delivery process, thus ensuring convenience at all times. Moreover, as package is delivered in a delivery box, customers need not worry about damages, though proper security mechanism needs to be ensured. Few companies have implemented locking mechanisms with security codes being sent to customer’s mobile phone. Such mechanisms ensure security along with easy implementation. Handling returns is also easy in this mechanism as customers can place packages in the delivery box, lock it using the same security code and leave it for the service provider to pick it up without having to worry about anything. The major concern in this method is absence of any mechanism to clearly define liability of product condition on service provider and customer as it is unattended reception. Technology can be employed to overcome these by installing cameras or other image capturing devices which can help track the product condition. This becomes important even while taking returns as it reduces the cost incurred by service provider because of return of damaged or used products.

4.4 Collection point

- **Delivery time**: In collection point mechanism, time spent in identifying customers’ locations is saved as fixed collection point locations are already known to the service provider. Moreover, the number of locations where delivery has to be made is reduced in this mechanism, thus reducing the delivery time further. The time and effort that is spent by the customer in reaching to the collection point to collect the package is not considered as last mile delivery time in this case.

- **Delivery price**: Delivery cost with collection point mechanism is less compared to other methods such as reception box and delivery box, as the need to reach customer’s premise is eliminated. As it is unattended reception, additional cost and time are not incurred in making re-attempts of package delivery. In addition, delivery window need not be identified for making the delivery, as customers can collect package at any time from the collection point. One concern is cost of setting up and maintaining these collection points that the service provider incurs. This cost can be saved by outsourcing the same to third parties. Along with outsourcing, additional
investments in technology can be made to keep track and control of the process so that service quality to the customer is ensured.

- **Service quality**: Accurate tracking mechanisms are required to let the customers identify the collection point with higher level of detail. As customers can collect the packages at their convenience, flexibility is ensured in delivery. Handling returns is easier and cheaper, as a number of packages can be picked by the service provider in one go. Moreover, customers can handover the packages at the collection point according to their convenience, without having to wait for the service provider to pick up. Collection point delivery method can be very useful in delivering to locations which are hard to reach because of geographic variations or financial viability concerns. This mechanism combines all the benefits of convenient, flexible and hassle free delivery in case of unattended reception along with giving both the customer and the service provider, provisions for product inspection so that clear liabilities can be defined.

4.5 **Outsourcing to local agents**

- **Delivery time**: This mechanism is an extension to the collection point mechanism, where in the last leg delivery will be handled by local agents who are familiar with the delivery location. With this mechanism, time taken to identify best route to delivery location is reduced, as service provider can identify route till last hub and leave the rest to local agents. As this mechanism requires customers’ presence like attended reception method, delivery time remains unchanged and is more than that with reception box and delivery box.

- **Delivery price**: Delivery cost with outsourcing can be less, as outsourcing makes use of agents’ expertise and reduces overall cost to make last mile delivery. This mechanism inherently provides a hub in the form of the local agent who then makes deliveries in his vicinity, thereby ensuring economies of scale. Above benefits are achieved at a possible cost of lost control on the last mile delivery. This can be handled by employing technological investments which enable the service provider keep track of the progress of the delivery being made by the third party agents. In addition, identification of reliable local agencies is another concern which needs to be managed properly for successful delivery network. Overall, delivery costs can be minimised by outsourcing, which in most cases, will be less than that with attended reception.

- **Service quality**: Similar to attended reception, accurate tracking mechanisms are required to facilitate better communicate to end-customer and ensure high levels of service quality. This method requires process intelligence to accommodate flexible time-windows and delivery options. Handling returns becomes difficult, as it requires customers’ interference, impacting the perceived service quality.

4.6 **Delivery with drones**

- **Delivery time**: This mechanism solves many challenges that other last mile practices are facing – external factors such as geographical variation, routing, traffic, etc. Time to identify best possible route to customers’ location is reduced, as it has no specified
routes unlike road network and can be directly integrated to GPS. This mechanism is similar to delivery box in many ways, as it delivers package in tamper-proof box at customers’ premises. Overall, it is globally observed that delivery time is least with drones, as it by-passes external factors and routing issues associated with road network.

- **Delivery price:** Apart from initial investments required in technology, operating expenses can be low with drones, as they eliminate human labour in delivering the package. As this method does not require reception, customers’ interference and futile attempts made in delivering package are eliminated. Moreover, as no transit by vehicles is involved, it eliminates all chances of product damages during delivery and saves a huge amount of cost of errors incurred by the service provider because of damages, mishandling or miscommunication. However, any malfunctioning of drones might result in huge costs in terms of damage to property, product or even in extreme cases human lives.

- **Service quality:** Similar to delivery box mechanism, locking mechanisms with security codes are provided to end customers. Perceived service quality can be very high, as it does not require customers’ interference and leaves little room for errors such as product damages. Handling returns can be cumbersome as it requires customers’ interference and ability to attach to the drone, thereby making handling returns difficult when compared to reception box and collection point mechanisms. Hence, it requires the customers to be familiar with drone technology and be able to fit in the package inside the drone properly without any errors, which cannot be ensured by the service provider. So, a supplementary return channel is required to be built along with drone deliveries or only limited portfolio of products should be delivered by this method.

### 4.7 Summary

To summarise the above observations with respect to delivery time, price and service quality for all the six global practices as described above, Tables 1 and 2 are constructed. In a nutshell, the two tables depict summary of evaluation of all the last mile delivery practices discussed in this paper. These tables allow service provider to choose last mile delivery practice, depending on the market conditions, internal ability, and value proposition offered to the customers.

#### Table 1 Evaluation of last mile delivery practices (see online version for colours)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Attended reception</th>
<th>Reception box</th>
<th>Delivery box</th>
<th>Collection point</th>
<th>Outsourcing to local agents</th>
<th>Delivery with drones</th>
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<tbody>
<tr>
<td>Delivery time</td>
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<td>Delivery price</td>
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<td>Service quality</td>
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Notes: Very bad | Bad | Not bad | Decent | Good | Very good
Table 2  Comparison of performance of different last mile delivery practices

<table>
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<tr>
<th>Delivery mechanism</th>
<th>Delivery time</th>
<th>Delivery price</th>
<th>Service quality</th>
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</thead>
<tbody>
<tr>
<td>Attended reception</td>
<td>• Identification of customer’s location</td>
<td>• Delivery re-attempt required</td>
<td>• Accurate tracking systems required</td>
</tr>
<tr>
<td></td>
<td>• Customer presence required</td>
<td>• Length of delivery window and order density have huge impact</td>
<td>• Process intelligence required for flexible delivery</td>
</tr>
<tr>
<td></td>
<td>• External constraints to be handled</td>
<td></td>
<td>• Returns need customer presence</td>
</tr>
<tr>
<td>Reception box</td>
<td>• Customer’s location already stored in database</td>
<td>• No delivery re-attempt and delivery time window required</td>
<td>• Convenient and flexible reception without customer presence</td>
</tr>
<tr>
<td></td>
<td>• External constraints</td>
<td>• Identification of customers and installation is costly</td>
<td>• Easier returns by placing package in box</td>
</tr>
<tr>
<td></td>
<td>• No customer interference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery box</td>
<td>• Identification of customer’s location required</td>
<td>• No delivery re-attempt and delivery time window required</td>
<td>• Convenient and flexible reception</td>
</tr>
<tr>
<td></td>
<td>• External constraints</td>
<td>• Lesser investment in ‘shared’ boxes</td>
<td>• Security mechanism to be implemented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Handling returns has security issues</td>
</tr>
<tr>
<td>Collection point</td>
<td>• Collection point locations fixed and known</td>
<td>• No need to visit customer’s location</td>
<td>• Tracking systems need higher level of detail</td>
</tr>
<tr>
<td></td>
<td>• Lesser delivery locations to be visited</td>
<td>• No delivery time window constraint</td>
<td>• Flexibility ensured in package delivery and return</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Can eliminate need for delivery re-attempts</td>
<td>• Cheaper return handling for service provider</td>
</tr>
<tr>
<td>Outsourcing to local agents</td>
<td>• Identification of customer’s location made easy with familiarity of local agents</td>
<td>• Economies of scale and expertise of local agents results in cost reduction</td>
<td>• Accurate tracking systems required</td>
</tr>
<tr>
<td></td>
<td>• Customer presence required</td>
<td>• Service provider loses control over delivery process</td>
<td>• Process intelligence needed for flexible delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Customer presence essential for return mechanisms</td>
</tr>
<tr>
<td>Delivery with drones</td>
<td>• Optimal routing achieved by integration with GPS</td>
<td>• Initial investment in technology</td>
<td>• Locking mechanisms with security codes required</td>
</tr>
<tr>
<td></td>
<td>• External constraints of geography and traffic overcome</td>
<td>• Low operating costs</td>
<td>• No room for product damages and human errors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Human labour reduced</td>
<td>• Handling returns cumbersome as customer interference is required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No customer interference and delivery re-attempts required</td>
<td></td>
</tr>
</tbody>
</table>
5 Conclusions: implications for last mile delivery in Indian e-commerce companies

Here, a decision tool is created for selecting the right last mile delivery method for right product type in Indian market.

Attended reception is most suited for high value products where the security and product condition is of a higher priority for both the service provider and customer than the delivery time and cost. Products which are bought based on a subscription based model are most suited for delivering using reception boxes. Low value items such as groceries, out of counter medicines which are frequently purchased from only one service provider and do not require inspection while receiving delivery or returns can also be handled using this method. In delivery box mechanism, like reception box, volume plays a big role to achieve profitability. Hence, low value items like groceries, medicines, etc. which are frequently purchased are most suited for this mechanism. In addition, medium value items can also be delivered in case service provider is able to achieve high customer loyalty. As collection point method needs involvement of a collection point, this is mostly suitable for delivering medium value goods unless it is a hard to reach location, in which case all kinds of products should be delivered using collection point mechanism. High value goods can result in high inventory storage costs in case customers do not pick up deliveries within certain time windows. Moreover, low value goods can be procured by customers by other mechanisms like traditional retail rather than picking up from collection point after a few days post order placing. As this mechanism requires customers to travel till collection point to pick up deliveries, it faces competition from traditional retail/convenience stores in Indian market. Hence, a wide coverage of areas is required through a number of collection points which are close to customer’s premises. Outsourcing to local agencies mechanism combines the benefits of high service quality to customers as in attended reception and lower delivery cost incurred by service providers as in collection point mechanism. In addition, this is very useful in delivering in hard to reach locations as it makes use of the expertise of the local agencies which greatly reduces the delivery cost and time. As this mechanism relies on third parties for delivering the products, it is suitable for all products except high value items where huge cost can be incurred by the service provider in case of any errors made in delivering the product. In last mile delivery method using drones, a key constraint is the size of the items that can be delivered. Heavyweight and bulky items cannot be delivered using drones. In addition, this method is mainly effective for delivering items where chances of return are negligible, for example, pizzas and other food items, etc. Thus, although, delivery with drones as observed in Table 1 is given good ratings in terms of the three parameters, considering customer participation and return difficulties will find difficulty in widespread usage in Indian market. Table 3 shows the decision framework with the reasons for selection of particular last mile delivery method based on its benefits in a particular market and for particular type of products.

This paper provides a comprehensive review of different best practices for last mile delivery adopted by e-commerce companies around the world. The practices are then compared with respect to different performance parameters and Indian context for their suitability. The contribution of this study is in identifying the suitable delivery mechanisms based on product, technology, geographical location (particularly customer density in Indian context), and possibility of returns, customer interference which
eventually affect the service quality, time and price. Future studies can be conducted either in the form of case study research or numerical simulation to properly understand the delivery performance of each last mile delivery practice performance.

Table 3 Decision tool to select the right delivery method for right product and market

<table>
<thead>
<tr>
<th>Delivery mechanism</th>
<th>Why to choose?</th>
<th>How to overcome limitations?</th>
<th>For what type of products?</th>
</tr>
</thead>
</table>
| Attended reception | • Flexible and secure delivery  
• Provision for product inspection  
• Reduced cost of errors | • Market development → Volume  
• Improve communication using technology  
• Outsourcing to local agencies | • High value products: Security & product condition high priority |
| Reception box      | • Hassle-free, convenient method  
• No waiting time and tracking  
• Easy handling of returns | • Employ technology to clearly define liability in case of error  
• Share installation cost with customer and other service providers | • Subscription based product  
• Frequently purchased low value products – groceries and medicines |
| Delivery box       | • Same benefits as Reception box  
• No installation cost and space constraints | • Employ technology to clearly define liability in case of error  
• Lock-in customers to purchase frequently | • Frequently purchased and low value  
• Medium value items (customer lock-in) |
| Collection point   | • Useful in reaching hardship locations  
• Combines benefits of attended and unattended reception | • Wide coverage of areas and collection point should be close to customers  
• Partner with existing (familiar) locations to reduce costs | • Medium value goods – fashion |
| Outsourcing to local agents | • Combined benefits of attended and collection point methods | • Employ technology to gain control  
• Identify reliable partners | • All, except high-value items |
| Delivery with drones | • Eliminates human interference  
• No external constraints, low running cost | • Build supplementary return channel | • Items with negligible chances of return  
• Light and non-bulky items |
References


