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# A FRAMEWORK FOR AGGREGATION IN COMPLEX SUPPLY CHAIN SCENARIO

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**ABSTRACT:** Different business models are being implemented in e-commerce for the delivery of products and services leveraging the latest advances in Internet technologies. These models are extremely useful for the provision of Quality of Service (QoS) matching between the supply and demand sides in multiple corporate sectors. Currently aggregation models are gaining in prominence compared to the traditional disintermediation models. Aggregation models bring together disaggregated providers or suppliers and customers on a common platform and intermediate between the two. However, most of the successful implementations of the aggregation model such as Uber and Airbnb involve a simple supply chain on the provider side often involving only a single link between the platform and the provider. This article discusses the concept of Aggregation model and its deployment in complex supply-chain scenarios. It analyzes the conditions where the Aggregation is most applicable, the players involved, complexity of the supply chain in context, and discusses approaches to implement aggregation in a scenario with a complex supply chain. The Indian Pharmaceutical retail business is used as a case study.

**Keywords: aggregation model; disaggregated; Quality of Service, supply chain complexity.**

## 1. Introduction

In recent years, the impact of technology has changed the way businesses operate. The domain of retailing and related activities has been disrupted by the emergence of E-Commerce. Over a period, E-Commerce has evolved based on a variety of business models to deliver online the different products and/or services. These models have been characterized by various terminologies, such as Storefront Model, Auction Model, Portal Model, Dynamic Pricing Models, Bartering Model, B2B Model, Online Trading Model, Online Lending Model, Online Travel Services, and E-Learning Model, *etc* Aithal, S. (2016).

From a structural perspective, two such models are the most significant– Disintermediation models and Aggregation model Nordin, F., Brozović, D and Holmlund, M (2013). Until recent times, the Disintermediation models have been the most frequently deployed models in E-Commerce applications. “Disintermediation is the displacement or elimination of market intermediaries, enabling direct trade with buyers and consumers without agents” Wigand, R. T. (1997).

In the case of these models, most organized retail businesses typically involve several layers of intermediaries between the supplier/producer and the end customer. These supply chain layers comprise of a range of services, such as local marketing, transportation, end-point servicing, and so on. Usually, the E-Commerce players disintermediate these layers by bringing together the producers and customers on a shared platform, thereby generating benefits, such as reduced costs, greater convenience, and rapid processing.

On the other hand, the Aggregation models have emerged in businesses where the customers and producers have direct but disorganized interface with each other, thereby leading to poor services, inefficiencies in the processes and so on. Therefore, the aggregators have developed an intermediation platform which provides an interactive system for both the customers and the providers to achieve better efficiencies, improved services, lower costs, and many other benefits. Traditionally, most markets have been unorganized (or dis-aggregated); however, and the advances in Communication and Information technologies have facilitated aggregation of these markets Pahwa, A. (2016, September)

The complexity levels in the aggregation process are low in those business scenarios where the supply chain is either shallow or it is uncomplicated due to only a few supply-chain links. Currently, the most successful examples of aggregation can be classified in this category. For example, in the case of UBER, the supply chain on the provider side is only one link deep. Further there is limited literature on research studies of Aggregation models, where the supply chain is complicated. This paper is an attempt to extend the concept of disaggregation to business scenarios where the supply chain is complex, thereby comprising multiple links. The Indian pharmaceutical retail business is used as a test case to study the problem of complex Aggregation models.

In the IT and related fields, the most common metric used to ensure quality of service is the Service Level Agreement (SLA). From Bouras, C.and others (2008) we see that QoS, and SLAs are interrelated. SLAs include the metrics that are relevant to the end users and thus are the metrics to be delivered by the providers to ensure the QoS. The term SLA will be used in the rest of the document as the tool to deliver the QoS metrics.

## 2. Aggregation model, theory, characteristics, simple and complex supply chain scenario

Pahwa (2016] states that the Aggregator Business Model usually organize an unorganized and populated sector like hotels, taxis, etc. and provides their service under their brand. Aggregators, just like a marketplace, are big brands which provide goods/services under their own name. The sellers are their partners but, unlike the marketplace, sellers don’t sell under their own name. Goods/services are sold under the name of the aggregator and hence the price/price band is determined by the aggregator. Examples of online aggregators are Uber, Ola, Munchery, etc.”

In addition, Aggregation is also different from the Portal model, where the goods or services are sold. Kohlborn et al.( 2009) have defined the service aggregator as follows:

"A service aggregator acts as an intermediary between service consumers and providers. This role combines certain services based on their detailed domain knowledge to add additional value to the services and provide a solution to a customer specific need. Thus, they rebrand, re-purpose and refactor certain services for a specific or anticipated customer demand. The value proposition includes selection, organization, matching, price, convenience, and fulfillment."

It has been observed that the exponential growth of the internet in recent years has provided a platform to aggregate the business suppliers or providers and customers for dynamic matchmaking. In the article titled as "Organizing the Unorganized: Role of platform intermediaries in the Indian real estate market" Srinivasan, R. (2017)., has inferred that a disorganized customer base would be a prerequisite for Aggregation.

The Aggregation theory was first suggested by Thompson (2015) as "The value chain for any given consumer market is divided into three parts: suppliers, distributors, and consumers/users. The best way to make outsize profits in any of these markets is to either gain a horizontal monopoly in one of the three parts or to integrate two of the parts such that you have a competitive advantage in delivering a vertical solution. This has fundamentally changed the plane of competition: no longer do distributors compete based upon exclusive supplier relationships, with consumers/users an afterthought. Instead, suppliers can be aggregated at a scale leaving consumers/users as a first order priority. By extension, this means that the most important factor determining success is the user experience: the best distributors/aggregators/market-makers win by providing the best experience, which earns them the most consumers/users, which attracts the most suppliers, which enhances the user experience in a virtuous cycle."

From the above excerpt, it can be observed that the aggregators enhance the user experience by aggregating the suppliers and customers by offering them a single source (or point of contact) to fulfill their mutual requirements. In addition, they allow consistent user experience across multiple transactions for all the stakeholders by disengaging them to handle multiple suppliers for each transaction.

### 2.1 Aggregator model characteristics

Aggregation models are more common in the services sector. According to Kohlborn et al. (2009) "Service aggregators need to have superior governance frameworks in place to manage the multitude of different services within an ecosystem. In a typical multi organizational service delivery and exchange model, where each organization relies on services of partners within an ecosystem, governance issues become important due to the disappearing (economic, legal, technical, etc.) boundaries. Research into new governance models, risk management tools, service portfolio management approaches and service bundling techniques will be essential to understand core determinants of competitiveness and success of service aggregators in the future."

As mentioned earlier, most examples of successful aggregation involve simple or a single-link chain on the supply side. However, as the complexity of the aggregation grows due to customer demands resulting in an increase in the number of links on the supply side, the requirement for a well-defined and structured framework gains paramount importance. It is expected by all the stakeholders that the framework must handle all the required business rules and relations with well laid out terms in case of all scenarios.

In the article "***An introduction to Aggregation Theory,***" Abrol, A. (2017, has identified a few examples of aggregators, such as Uber, Ola, and Airbnb. The author comprehensively evaluates the dominance of aggregators, their horizontal monopoly to leverage the virtuous cycle, and their implications on public policy.

Perhaps the greatest challenge in successful aggregation is to ensure uniform quality in the delivery of products given the number of suppliers for the same service or product. In each of the above examples of aggregation, this is implemented and enforced by the Service Level Agreement (SLA), the key document that governs the relationship between the aggregation platform and the provider of the service. The SLA lays down the parameters of the service quality, compensation mechanism, cost sharing terms, terms of the agreement and dispute resolution mechanism, if applicable.

We see a very disaggregated and fragmented Indian Pharmaceutical Retail sector suitable for aggregation and with following details:

- The number of retail pharmacies is about 900,000 and growing, which provides a good volume of players.
- Number of stockists in India is around 65,000 which provides a second layer or link in the supply chain.
- There is further room for expansion as it is estimated that more than three-fifths of Indians still do not have access to modern medicines - rural market is largely unattended and untapped.
- There are no nationwide pharmacy chains yet and the emerging chains are often limited in size and/or restricted geographically. Given that customers are disaggregated and distributed, this is potentially very amenable to aggregation.
- Aggregation models for this business scenario will be different as a higher level of complexity is involved compared to single source models.

## 3. Analysis of the complexities

Technological advances in telecommunications and computing have enabled the creation of the infrastructure to implement Aggregation successfully. While most existing successful examples of aggregation involve simple supply chains (often involving only one link on the supply side), aggregation in complex supply chains, involving multiple links on the supply side, would also be of interest to bring the benefits of aggregation to such scenarios. However, the analysis of such an aggregation process and the operational and other parameters may be different.

For the complex scenarios, the aggregator design must involve an in-depth analysis of the commonalities and differences in each case. Moreover, the design should consider various supply chain factors to be incorporated in a comprehensive manner. Assuming an optimized supply chain, the most important effect of the complexity of the supply chain will be on the delivery commitments included in the SLA signed between the aggregator and the suppliers. The solutions developed will need to factor in this aspect in the proposed solutions.

In this article, some well-known aggregators such as Uber, OLA, and Airbnb have been considered as examples for simple supply-chain scenarios. On the other hand, the Indian Pharmaceutical Retail has been considered as the example for a complex supply-chain scenario.

### 3.1 Simple vs complex aggregation

In most scenarios, we usually observe a single level of Aggregation, where the customer requirements are matched to a single supply-side service provider such as a cab driver or a hotel. The aggregation platform intervenes in a disaggregated market and brings in the benefits of organized business such as a single point of contact (to both sides), economies of scale, larger customer pool, quality control and dispute resolution. In this scenario, some examples of supply side are the cab drivers in OLA or Uber and rental accommodations at Airbnb platforms; Ensuring uniform and predictable quality parameters is easier with a simple chain on the supplier side. Therefore, aggregators have designed and deployed solutions to address the key issues of these simple disaggregated models, such as Quality of Service (QoS), payments, dispute resolution, *etc*. By addressing these problems, aggregator models attempt to create a win-win condition for all three stakeholders, *i.e.*, suppliers, aggregators, and customers.

As a case study, we consider the example of Ola or Uber. A customer (*i.e.*, demand side) utilizes the Ola or Uber app to request a pickup and drop from point A to point B by opting for a particular vehicle type at a specific time. Subsequently, the aggregator discovers a suitable ride for the customer from the pool of cabs (*i.e.*, suppliers) and directs it to serve the customer. In this case the customer is served by a driver from a common pool of available cabs and no further links are required on the supply side. This scenario can be referred to as simple aggregation. Figure 1 depicts the schematic of a simple aggregation model.

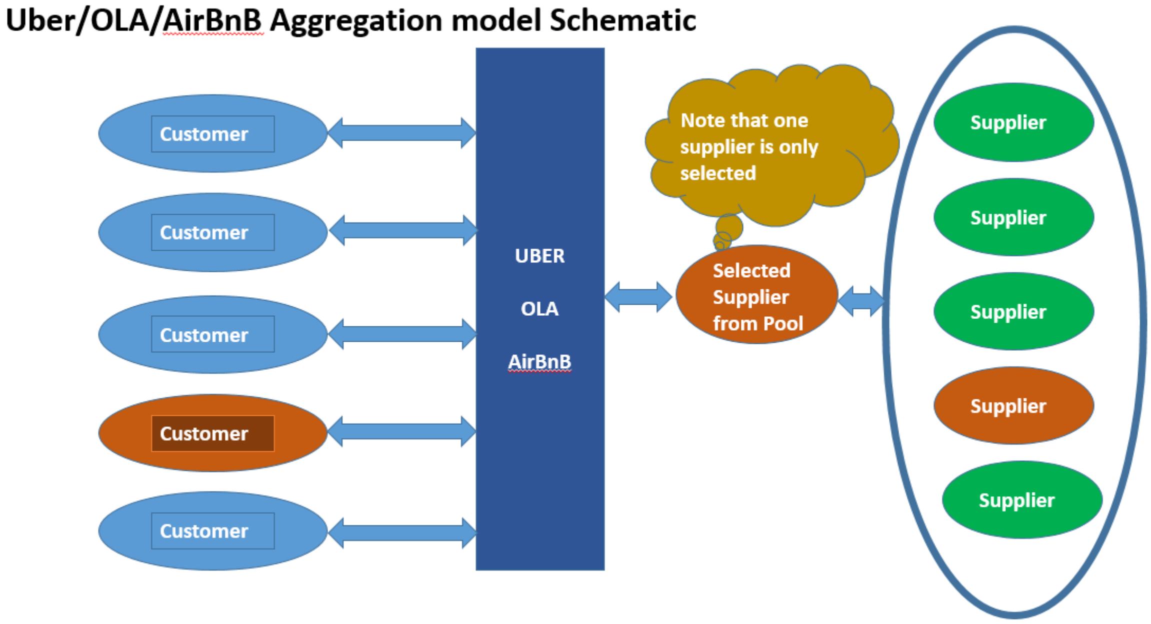
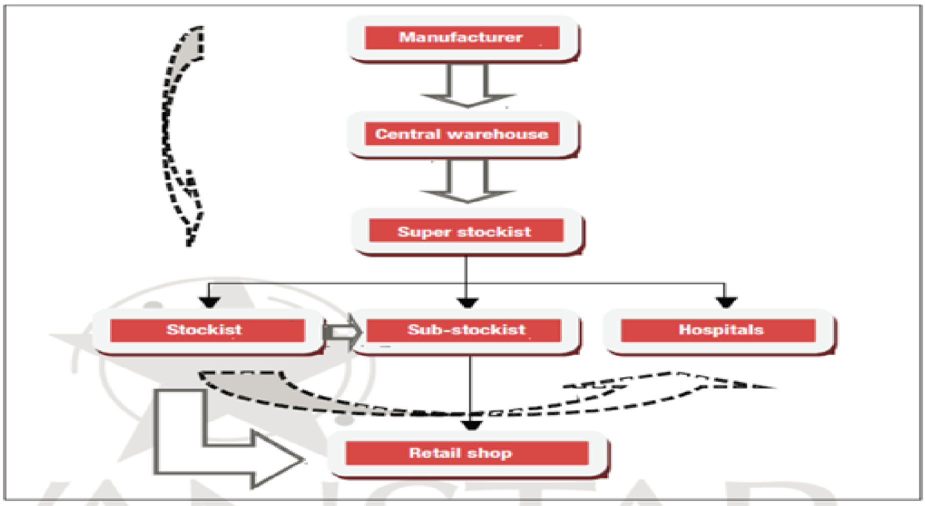



Figure 1: Simple Aggregation model.

In contrast, considering the case of the Indian Pharmaceutical Retail space, we observe that the retailers and customers are both unorganized, and there is complexity involved on the supply side. In the following paragraphs, we discuss various factors associated with aggregation design in this case.

Evaluating the supply side and the corresponding complexity, we can explore multiple levels in the traditional supply chain in the Indian Pharma industry. Furthermore, it can be observed that each layer in this supply chain is unorganized, as shown in Figure 2 which provides a good case for application of aggregation.




Reference: Eric Langer, Abhijeet Kelkar; "Pharmaceutical Distribution in India"; September 2008

Figure 2: Application of Aggregation

Now the aggregation can be applied to the layer between the retailers only and the customers (Figure 3).

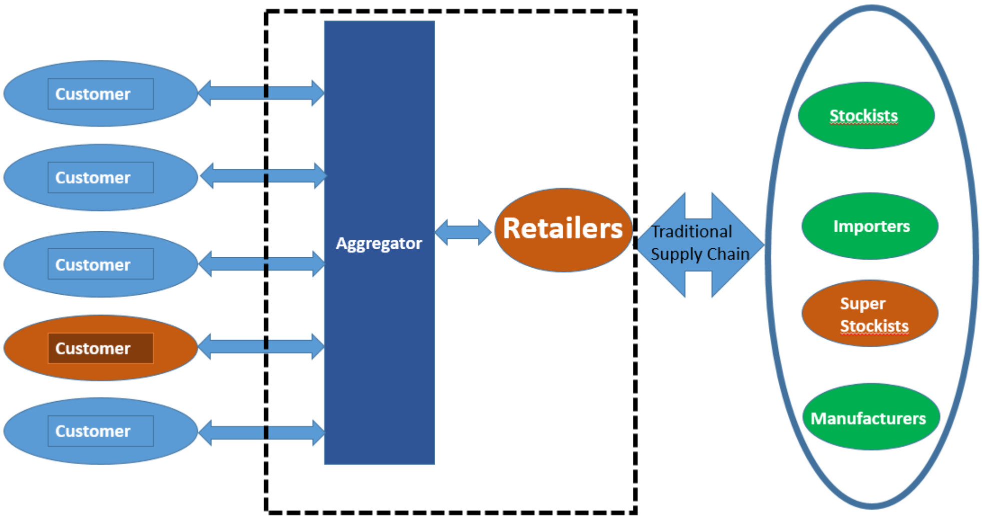



Figure 3: Pharmacy Retail Aggregation with Retailers.

Subsequently, it can be extended to all the other stakeholders and the customers, as depicted in Figure 4

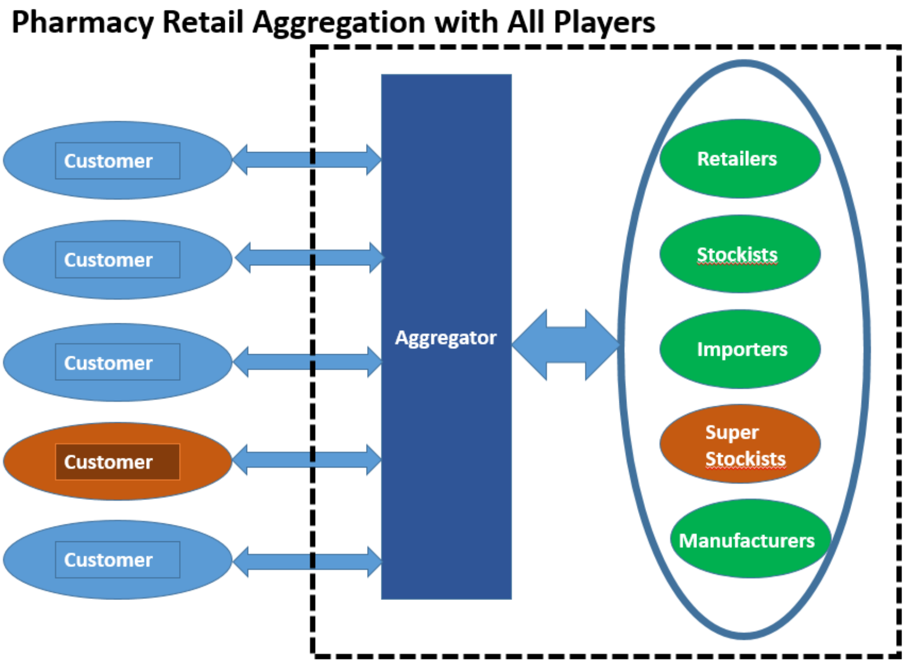



Figure 4: Pharmacy Retail Aggregation with all Players

From Figure 4, we can observe that there are multiple layers on the supply side, including retailers, super-stockists, stockists, importers, and manufacturers. Each of these stakeholders is a layer in its own echelon. What if multiple types of suppliers are at the same level (or different levels) in the supply chain need to be selected to cater for the customer requirement as opposed to the simple model? We can analyze this scenario as follows:

As was depicted in Figure 1, the simple aggregation models such as, Uber, Ola, and Airbnb perform a 1-step matchmaking among the vehicles(or the accommodation places) and customers. In this case, the aggregator selects one supplier from a pool of suppliers to fulfill the customer demands. Hence, the supply-demand association is simply one-to-one and at a single level.

On the other hand, a complex aggregation model will result in complicated matching scenarios. In this case, the aggregator must incorporate very complex and dynamic supplier selection and delivery mechanisms. Furthermore, the complexity increases if the aggregator considers the variability among the suppliers and levels to fulfill the Service Level Agreements (SLAs) with the customers. For example, an aggregator must deal with a request of branded drugs coming from a particular stockist. Based on the customer's demand, we may end up with one more than one supplier who can fulfill the customer's requirements. Then the aggregator will have to resolve this complexity to accomplish the task on time.

First, the selection of the supplier(s) can be generalized as follows:

***Single-level single source***

In this case, a single retailer has all items available, as required on the prescription. This is the best-case scenario, and it matches the simple aggregation scenario.

***Single level multi-Source***

In this case, a retailer has only some items available from the customer Rx list, and the aggregator must obtain them from other retailers based on geo-proximity or service level. ***Explicitly single-level single source but implicitly multi-level single-source***

The first level supplier (only one of the retailer, stockist, sub-stockist, super-stockist, or manufacturer) promises to source and deliver all the items as required on the prescription by the customer SLA but could further source from only one of the other suppliers. For instance, a retailer promises to source and deliver all the items based on the customer SLA from the Stockist only. Here, we can notice that the primary supplier can be anyone from the first level based on the SLA requirements.

***Explicitly single-level single source but implicitly multi-level multi-source***

The first level supplier (only one of the retailers, stockist, sub-stockist, super-stockist, manufacturer) promises to source and deliver all the items as needed on the prescription, according to the customer SLA. They can again source the items from multiple options among stockist, sub-stockist, super-stockist, and central warehouse.

***Explicitly single-level multi-source but implicitly multi-level single-source***

The first level suppliers (only one of the retailer, stockist, sub-stockist, super-stockist, and manufacturer) promise to source and deliver all the items as required on the prescription according to the customer SLA. They can again source the items only from one of the stockist, sub-stockist, super-stockist, and central warehouse.

***Explicitly single-level multi-source but implicitly multi-level multi-source***

The first level suppliers (more than one of the retailer, stockist, sub-stockist, super-stockist, and manufacturer) promise to source and deliver all the items as needed on the prescription according to the customer SLA. In this case, they source from more than one stockist, sub-stockist, super-stockist, and central warehouse.

Based on the SLAs and customer expectations, one of the above-mentioned scenarios will be preferred. Subsequently, the delivery mechanism is also handled appropriately from the supplier side to manage the customer expectations. For appropriate delivery, multiple rules can be applied based on various factors according to the customer SLA. For example, a diabetic patient can easily organize his medication plan; and his SLA may require delivery in two weeks at a cost-effective manner. On the other hand, a patient requiring antibiotics may necessitate delivery within four hours at a reasonable price.

Based on the above discussion, if we treat all the players at the same level, we end up with multiple scenarios, some of which are listed below. It can be noted that the operational flows will differ in case of each combination.

Table 1: Sourcing Complexities in Pharma Retail (Subset)

| | Retailer | Sub-Stockist | Importer | Stockist | Manufacturer |
|---|---|---|---|---|---|
| Customer-1 | Single | | | | |
| Customer-2 | Multiple | | | | |
| Customer-3 | Single | | | | |
| Customer-4 | Single | Single | | | |
| Customer-5 | Single | Multiple | | | |
| Customer-6 | Multiple | Single | | | |
| Customer-7 | Multiple | Multiple | | | |
| Customer-8 | Single | Single | Single | | |
| Customer-9 | Single | | | Single | |
| Customer-10 | Single | | | | Single |
| Customer-11 | Multiple | Single | Single | | |
| Customer-12 | Multiple | | | Single | |
| Customer-13 | Single | | | Multiple | |

Kohlborn et al. (2009] states that ,"Service aggregators need to have superior governance frameworks in place to manage the multitude of different services within an ecosystem, we see that it is very critical that the contract agreements between the aggregator and the suppliers are well defined, and frameworks built to roll-in new supplier partners at all levels. When the supply side complexity is more, the rules of the game and the communication mechanisms between the aggregator and the suppliers need to be very quick and agile to cater to the customers' SLAs that keep shortening as time progresses."

Based on the customers' requirements and sourcing, the aggregator should be able to determine the lead and delivery times, and they must be communicated to the customers. For instance, if a prescription can be obtained from a single retailer, the delivery time may be very short (*e.g.*, a few hours only). Contrarily, if a prescription requires sourcing from multiple retailers or a super-stockist, then the delivery could be partial at one time with multiple delivery times. In that case, the overall delivery time of the prescription may be of a longer duration.

## 4. Solution approach

The solution approaches should be developed to result in a win-win scenario for both customers and providers factoring in issues of cost, effort, and potential benefits. Applying the pareto principle, it can be assumed that 20% of the above scenarios may fulfill 80% of user requirements. Based on this, two approaches can be considered in developing a solution.

Looking at the various scenarios, we can take one of the two paths to solution as below:

### *4.1 Develop a solution based on scenarios developed*

This approach can be used to develop an easy, low-cost solution suitable for most scenarios except the most complex ones. It can also be developed for POCs, pilot projects and other cases to demonstrate the concept.

- Develop a common list of SLAs between all levels.
- Develop a subset of all likely potential scenarios.
- Select a set of most likely scenarios that will cover 80% of customer cases.
- Build a solution framework for each of the potential scenarios.

- Identify the variables such as price, availability, delivery times etc. in real time. The data for these variables can be updated in a database on a regular basis from automated feeds or updated manually.
- Delivery time, costs and other details are estimated in real time by mapping the customer request with one of the scenarios and plugging the current values of the variables from the database.

***Solution attributes***

- A feasible approach given that SLAs must be agreed to in advance – so limited number of most likely scenarios.
- Limited or minimal flexibility

  This can be acceptable as a starting solution for Quality Delivery of Service

***4.2 Develop a solution based on algorithmic approach***

A more flexible solution capable of covering all potential scenarios would require an algorithmic approach with flexibility built into it capable of handling not only regular and routine scenarios but also exceptions and outlier scenarios. Very likely this would involve much higher costs and development efforts but would be a long-term solution applicable to all scenarios.

- Develop a common SLA between all levels.
- Develop algorithms to build scenarios in real time.
- Layers are now variables too – the algorithm would be capable of handling a variable number of layers.
- Linkages between providers at different layers may be pre-defined.
- Developing a data structure to support the network of layers and suppliers at different layers is key. The variables identified can be populated dynamically as in the first approach.

***Solution attributes***

- Provides a flexible approach which can handle any scenario.
- Work required is much higher as generalization to cover all potential use scenarios will involve much higher programming and testing efforts. Economic feasibility needs to be analyzed.

**4.3 Technical approach**

From a technical perspective, the main challenge is to develop suitable data structure to support the implementation of either approach outlined in the previous section. Some of the key requirements that must be supported by the data structure include:

- A very wide range of products - with the same product sold under different names (paracetamol, to give one simple example), suppliers, delivery schedules, price, etc.
- A common set of data attributes across all products - attributes such as delivery time, availability (local or imported), price, amount of the active component and so on.

- A capability to aggregate an attribute across multiple links in the supply chain - for example, if a medicine involves two links in the supply chain, the overall delivery time will be an aggregation of the two delivery times

Given the range and variety of products, it would be useful to use and existing taxonomy or develop a new taxonomy to classify the products into a set of products based on common attributes or use an existing taxonomy. Two such existing taxonomies considered include the ABC-VED matrix Gupta, R., Gupta, K. K., Jain, B. R., and Garg, R. K. (2007)and the framework suggested for management of medicines in hospitals Iqbal, M. J., Geer, M. I., and Dar, P(2017). Both are aimed at managing the inventory and the supply of medicines to optimize availability, reduce costs and reduce wastage.

Both taxonomies do not explicitly include the key attributes required for retail aggregation such as delivery times and price. It may be possible to modify one of them for the purpose of aggregation. However, given the different needs, it may be preferable to develop a suitable taxonomy and the subsequent data structure to meet the needs of the aggregation model.

## 5. Conclusion

It has been observed that the Indian Pharmaceutical Retail space is very unorganized (or un-aggregated) and provides a good opportunity for the deployment of aggregation models. Moreover, there is complexity in the supply chain, as the supply side is layered. Consequently, many additional factors should be considered for the utilization of an aggregation model. These factors have been listed as follows:

(1) Nature of the suppliers
(2) Business rules involved among various stakeholders.
(3) Contract arrangements among stakeholders
(4) Pricing agreements and incentives across stakeholders and their combinations for the provision of better customer service
(5) The regulatory mechanisms and their complexity
(6) Maintenance of quality standards in the supply chain, and rating of the suppliers
(7) The liability issues and ownership are involved in the case of each combination.
(8) Expected impact on the end customer with the use of Aggregation.
(9) Social impact and supplier business continuance for the existing suppliers

Aggregation in a complex supply chain can resolve multiple issues on supply and demand sides, to provide benefits to the customers and retailers. For instance, we can consider the case of Indian Pharma Retail as follows:

- A scenario of a single visit not guaranteeing all medications is fulfilled by the aggregator using the following options:
- An aggregator can provide a single point of service to provide all medicines.
- An aggregator can look at multiple options to fill the complete list of prescriptions.
- An aggregator can inform and swap the legally equivalent medicines.

- An aggregator can use technology to cross check contra-indications in Rx.
- Quality is not guaranteed by the disaggregated pharmacy sector, which can be ensured by the aggregated sector.
- Aggregators can provide quality guarantee for medicine by ensuring the QoS guidelines.
- In the case of disaggregated pharma sector, the pricing is not consistent across various geographies, which can be ensured through aggregation models.
- Aggregator can provide standard pricing for all the products across multiple geographies.
- Due to uniform and documented retail pricing, the aggregators can ensure that the GST becomes a reality for the national economy.

Considering the various scenarios and multiple interdependent factors, two solution approaches have been described. Subsequently, our proposed aggregation model can be extended to various other retail sectors, where the supply chains and customer sides are unorganized, involving enormous complexity levels on the supply side.

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