# Data-Driven Analysis of Acceptability factors of B2B apps in Retail (Grocery stores) Industry: An Multi Criteria Decision Making Approach

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## ABSTRACT

Technology and digitalization is a very crucial factor of supply chain when the efficiency & responsiveness is considered. Delivering the correct product at the justified prices within the stipulated time at the right location is key factor in increasing the value of the supply chain. To aid that purpose, information technology & mobile apps shows a big role in the supply chain domain. In the modern retailing industry, lots of technological developments have happened with respect to the customer & retailer interaction. Mainly, these advancements could be seen in supermarkets or malls. But, there is very limited solutions provided in the market which connect the dots between the retailer and its suppliers.

This study focuses on the technological factors that a retailer should keep in mind while choosing the correct solution for their stores. The study mainly focuses on choosing the factors which retailer perceives to be important in making such decision. Then the factors are categorised into groups so that the factors can be correctly measured. Post the categorisation, the factors are weighed based on the inputs from the retailers. The study shows that in each group only one factor has the highest weight and that is most preferable to the retailers. Also, the study focuses on 5 apps (already present in the market) and rank them based on the inputs of the retailers. The study clearly identifies which apps is most convenient, modernised or technologically advanced.

**Keywords:**

AHP, TOPSIS, Supply Chain, Grocery, Indian Retail, Technology

*Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020*

## Introduction

Since long back, India started with the journey of retail stores. From ancient times, right from the period of Mughals & before, the concept of weekly market was existing in India. In these markets, people used to have barter system to trade goods & services. These systems of old markets came a long way to come into shape of modern retail system. Today we have supermarkets, malls, and many chains of retail shops. However, in between these two concepts (i.e. the ancient weekly markets & the modern supermarkets) there exists another type of retailing, which is the "Kirana Dukaan" or Pop Shops or "Baniya ki Dukaan". India, being a growing economy, still holds these type of Pop shops in large numbers. Predominantly, the retails sector is divided into two main parts namely, the Organised Retail and the Un-Organised Retail. Organised retails comprises of the big branded shops & malls that sell their products through the use of modern technologies & services. Unorganised retail comprises of the small & local pop shops that doesnot use modern technologies. Indian retail industry is still one of the most important pillar of the Indian economy and accounts for over 10% of the country's GDP & 8% of total employment. India is one of the fastest growing retail industry in the world.

The retailing industry in India is majorly owned and managed by small shop owners & few employees. Though the industry comprises of small shops, but the industry is huge. The Indian retails have experienced a steady growth over the last few years thus achieving a total market size of $800bn in 2017. It is expected to reach nearly about $1.75tn by 2026 growing at a CAGR of 9-11% driven by economic factors such as income growth, urbanization, rise in nuclear families & many more. India has majorly the unorganised retail market which contributes 88% to the total retail sector in India. The organised market hols about $60bn and the unorganised holds the rest. It is expected that the Organised market will rise by 11-15% in the next few years thus giving a challenging threat to the unorganised businesses. (Anon n.d.)

The retail sector in India is highly dis-organised and fragmented. Earlier, people used to buy grocery from pop shops & vegetables and fresh

products from the open kiosks or stalls called as mandis. But times are changing now and there is a wave of new concept of retailing in place. In this century, the infusion of western culture brought in new changes in the structure of retailing. With this new infusion, we see a lot of challenges in the supply chain with respect to the unorganised retail sector. It has become difficult for the small shop owners to manage their inventory and compete with the big retail chains. Let us now look into the supply chain terms involved in this industry.

***Supply Chain Management:***

The Supply chain management is the encapsulation of small processes that begins right from procurement of materials, movements, storage, and selling of products to the end customers. The supply chain comprises of chain of processes that helps to procure & supply the products & services right from suppliers to the manufacturers and further to the end customers through proper channels. This seamless flow of materials, finance & information with the help of mutual relationship of suppliers & customers is known as Supply chain management.

***Channels in Supply chain management***

In the retail industry, one can find different channels that a retailer may follow to procure goods from manufacturers & sell it to end customers.

- Limited Channel: This channel enables the retailers to be in direct contact with the producers and manufacturers without the inclusion of intermediaries like distributors & wholesalers. This helps in eliminating the margins put aside by intermediaries thus reducing price of the products.
- Direct Channel: This channel enables the producers to directly sell their products to the end customers without any retail system. Producers or manufacturers setup their own outlets where they sell their products to the end users by directly bringing from manufacturing site to the shops.
- Indirect Channel: This channel is the normal way of moving goods from producers to customers through a series of layers in between. The whole chain consists of intermediaries like manufacturers, Carry forward point, distributors, wholesalers and of course retailers. The traditional way of moving goods to mom & pop stores includes this channel of distribution.

***Impact of pricing on Indian Consumer***

Price of a product plays a huge role in the Indian retail industry. If the retailer increases or decreases the price of a product, the demand & supply of the product may change considerable. Indian consumers are very sensitive to price and gives emphasis on the pricing factor while choosing a product. Thus to maintain a healthy business, the retailer must charge the customer economically.

To reduce the overall price of the product, the supply chain needs to be cost effective. With changing market strategies and retail trends, companies have now started giving priorities to reduce the cost of the product and techniques that would enable efficiency in the supply chain.

***Technology in retail Industry***

Technology can bring in new challenges to the retail industry. The proper planning and strategizing the key management steps with the help of technology becomes very important for the supply chain to be effective, efficient and profitable at the same time. Technology has helped to bring cheaper & more accessible products across the whole industry. Though the consequences of technology development is clear but the implementation of the capabilities is quite complex & cumbersome. The size of business, its requirements, & impacts on customers could be a major factor in deciding the complexities of technology implementations. The implementation strategies brings new advantages to the Business Process Re-Engineering, Just in Time ordering, shelf labels, automated inventory, point of sales, order management and many more. These are of great help to increase the efficiency, effectiveness as well as has an advantage of cost reduction, quality improvements, etc.

The whole supply chain is highly benefitted from the use of technology and its subsidiaries. Both retailers & suppliers have felt great advantages by the use of technology in its supply chain. The technology has given great benefits from the perspective of Value chains and value systems. The information technology models has given positive output in affordable electronic banking system, payment systems, and has permeated every level of business.

Though there has been many advantages of usage of information technology, but still consumers are little wary of the associated threats like technology frauds, security, privacy & data management. With all these new technologies, there are security implications. The rise in different digital payment technologies like credit cards, debit cards, cash cards, payments apps, gateways, quick mobile transfers, etc. has given the opportunity to look into the security aspects of the systems. Businesses are more concerned with the risks associated with the crimes & frauds.

A hugely common under-rated factor of technology is the impact on the consumers. The quality of the technology is highly dependent on the acceptance by the end customers. If correctly used, technology along with marketing can do wonders to business. It can bring huge benefits to the retailing industry as a whole. It can be defended that investment in Information Technology solutions is required for both the survival & success of retail business. The future new innovations will offer many improvements in efficiency, profitability & effectiveness..

## Literature Review

(Saaty 1984) presented the The Analytic Hierarchy Process (AHP), which is a successful tool for organising complex & dynamic decision making criterias, and helps the manager to set objectives and then choose for the best option. By minimizing the complex options to a progression of pairwise matrix evaluation, and afterward ranking the options as the outcomes, this tool helps with holdng both abstract and target parts of a choice. Furthermore, the AHP combines a exclusive process for checking the consistency of the leader's assessments, along these lines reducing the inclination in the dynamic cycle.

According to (Prabhuram et al. 2020), “The rise of new & exclusive technologies and mobile platforms attracts customers to online channels. The Indian retail industries are facing a challenging task of managing the online demand along with traditional demand, which leads to the origin of the Omni channel.” With this said the need of new technology & mobile platforms in B2B sector is the need of the hour. Retailers can be connected with its upstream stakeholders in a seamless & efficient manner thus giving a competitive edge over others. The mobile device technologies has exceptionally innovated the retail industry by changing the way consumers buy their products, (Verhoef, Kannan, and Inman 2015) gave this perspective.

According to a study from (Nielsen 2015), 86.9% of mobile phone users use their devices as an integrated part of their shopping experiences and activities. Mobile devices commerce accounted for about 33% of the US Ecommerce sales in 2016 (Internet Retailer 2016 Mobile 500). These technologies have brought a competitive benefit to the supply chain.

According to (Lim, Xie, and Haruvy 2018), a study shows that introduction of a mobile application may produce significant revenue gains for grocery retailers. This suggests that mobile applications & websites is a good way for the seamless communication between different players of the supply chain. This research focuses on the key differences between the digital channels and the mobile devices channel for the consumers who only prefers the old & traditional channel of physical stores. However, online channels are easily available but customers generally prefer the traditional channels. Once they are accustomed to the digital way, the consumers begin to realize & see the benefits associated with the technological interventions. Adding the electronic ways of shopping has increased the revenues though more frequent transactions without any change in the basket sizes. Managers of retail grocery stores should pivot on promoting tactics and managing the shopping trips through digital mobile applications. Retailers who are looking for adopting mobile applications should mainly pivot more on regular good that use the non online channels exclusively, in order to increase the effect of mobiles introduction. A mobile application can be a important tool for maximizing a retailer’s market share.

Next, comes the digitization of payments in the retail sector. As per RBI Ombudsmen Scheme, “Digital Transaction means of payment transaction in a seamless system effected without the need for cash at least in one of the two legs, if not in both. This includes transactions made through digital electronic modes wherein both the originator and the beneficiary use digital / electronic medium to send or receive money.” According to the study, (Khokhar, Dutta, and Narang 2019), “Digitalization is a mean of payment which is cashless on both the ends, at the end of the giver also and receiver also. A virtual

transit of cash backed by a software system i.e. Unified payment interface linked with the bank account which directly transfer the balance from the payer bank account to receiver bank account without the movement of hard cash through an electronic clearing system." According to the study, 94.3% of the retailers were aware about digital payment modes and 60% of them preferred cash transactions instead of digital modes. Also, based on the actual transactions, 71% of the respondents transacted only through case. The rest 29% used different other forms of digital payments. The key highlights as mentioned by the retailers, for adopting the online payments methods was the simplicity of managing the transactions, with easy accessibility of the transaction details. Also according to (Doan et al. 2021), economy in digital form is the key factor of the modern trade & society development. Value addition is created only through intellectual & technological innovations. Convenience and speed is one of the most important factors in the development of an organisation. Keeping in mind, the rate of change of digital technologies & business processes, the changing style of customers is also a key dynamic in choosing the retail grocery innovations. Through the study, the comparative analysis of digitalization levels in supply chain management was done.

According to the article from Times of India(Anon n.d.), "As the power of modern tools and technologies is in the hands of few large companies, these retailers are finding it difficult to grow their business more than ever before. Big players are chugging away at their business month-after-month, year-after-year. More retailers are gradually realizing the difference technology can bring to their business. These folks are looking for technology providers who can help them grow their business, and also help them with running it in a more efficient way. Swipe machines and accounting software are two good examples of these retailers adopting new technologies when convinced of the value they get from these technologies. They're even going online by partnering with non-conflicting software companies, so they can provide the same level of convenience their existing customers are getting from online aggregators."

According to (Fagerstrøm, Eriksson, and Sigurdsson 2021) the modern technology and mobile apps are very useful to create a smart grocery retail chain. The customised digital setup, the smooth information flow, the real time data transfers, and bi-directional interaction between the customers & retailers add to the shopping experience. This same kind of model could be applied between the retailers & its suppliers to enhance the supply chain value and reduce discrepancies in ordering of goods. The authors made a study about mobile apps in grocery store and the study showed that the digital information was most beneficial for the customers. The information provided by these apps indicated the customers of the trends in the market along with price, expiry dates, qualities, etc. The outcomes of the study clearly showed that managers should invest in mobile app technology that can improve the supply chain through digitalization.

According to (Alkan 2021), all the advancements arising from digital space & technology, they offer great value to the supply chain. The digital technologies provides increased scope & value for the manufactures, distributors & retailers. They get a productivity advantage in terms of process optimization & systems, better resource management & smart supply chain networks. Hence, digitalization in organizations enhance the adoption of sustainable practices in the supply chain. This brings the competitive advantage and a necessity for long-term sustainability.

(Hagberg, Sundstrom, and Egels-Zandén 2016), the paper focused on converging the revolution that has been implemented in by customer digital innovations. The research study inputs the retailing consumer design model that takes four factors in considerations. These four factors are participants, trade, settings & offers. Digitalization affected retail exchanges and the output of the study was to join the gap between the suppliers & retailers. This study aimed to know how effective digital factors are for the retailers.

According to the study conducted by (Anita et al), "Convenience, Modernization & Advanced technology are the 3 key factor groups that affect the retailers choice of technology adaptation. It is of great importance of Tech Advocacy and found that comfort, modernization and virtual reality are three variables that will affect their store choice dramatically in the future. It is important for offline retailers to integrate technology within the store experience to ensure better customer connect and overcome the threat of online retailing."

According to study,(Prepletaný 2013), "The role of technology is discussed in these cases and also separately with an outlook to those future technologies that are poised to grab the attention of retailers. Examples of those technologies include, but are not limited to, location-based applications, targeted and customized mobile promotions, mobile point-of-sale, personal shopping assistants and radio frequency identification technology. The study describes how these technologies might affect customer behaviour and change the role performed by the store personnel. The combination of these examples sets the stage for a look into the near future of retailing."

## Objectives of the Study

This research study is conducted with the below objectives in the mind:

- To understand the key factor group that a retailer chooses while adopting a new technology solution
- To understand which factor is most considerable while choosing amongst the factor group. To rank the order of the factors.
- To understand the retailers perception of the available B2B apps in market and rank them on the basis of technology

## Methodology

The variables and factors considered in this study is taken from the literatures studied earlier. Based on the variables, the questionnaire was designed to collect information from the retailers. This information was to certainly identify the relationship of the variables and factors that are selected for this study. For this study, a total of 12 variables and 5 alternatives are considered. The questionnaire was taken to the local market and spoke with grocery owners to understand the consumer sentiments & perceptions. A total of 38 responses was obtained offline and 07 responses was obtained through selective networking through social media.

| Criteria Group | Criteria |
|---|---|
| Convenience | Receiving communication of promotional deals, coupons, invitations, etc |
| | Networking amongst other retailers, suppliers, stakeholders |
| | Receiving notifications of order delivery & pickup and other transportational aspects |
| | Website & apps User Interface, seamless connections |
| | Digitalised payments throught payments gateways |
| Modernisation | Right product at the right price through AI/ML |
| | Wishlist feature & sample product testing through Automation |
| | Prediction of sales of new products |
| Advanced Technology | Order management system |
| | Point of Sales |
| | Inventory control software |
| | Electronic data Interchange |

***Table 1: Criteria Groups & Criteria***

| Alternatives |
|---|
| Shopkirana |
| Retailers App |
| Metro Wholesale |
| GramFactory |
| Udaan |

***Table 2: Alternatives***

Relative Importance Score of any pair of Criteria

| | |
|---|---|
| 1 | Equally Important |
| 3 | Slightly More Important |
| 5 | More Important |
| 7 | Strongly More Important |
| 9 | Extremely important |
| 2,4,6,8 | Intermediate number |

***Table 3: Criteria Importance Scores***

| App Evaluation | |
|---|---|
| Highly Effective | 5 |
| Moderately Effective | 4 |
| Neutral | 3 |
| Moderately Ineffective | 2 |
| Highly Ineffective | 1 |

***Table 4: App Evaluation Scores***

After collecting the data, an analysis is done through MCDM technique, AHP (Analytical Hierarchy Programming) methodology. Multiple-Criteria Decision Making (MCDM) is a part of Operations research that helps in evaluating conflicting criteria in decision-making. AHP is a type of MCDM technique which helps in organising & analysing complex decisions based on mathematics & psychology.

The AHP can be implemented in three simple steps. *m* evaluation criteria & *n* options are to be considered.

1. Vector of Criteria weights are calculated using pairwise comparison matrix

a. Firstly, to compute the weights of various criteria, a pairwise comparison matrix (A) is created. The matrix A is of mxm order where m is the number of evaluation criteria that is taken from previous studies. Each entry of matrix A is judged on the importance of row to column.

$$a_{jk} \cdot a_{kj} = 1.$$

b. The relative importance between two criteria is measured in a numerical scale of 1 to 9. This is shown below.

| Interpretation | Value of ajk |
|---|---|
| j and k are equally important | 1 |
| j is slightly more important than k | 3 |
| j is more important than k | 5 |
| j is strongly more important than k | 7 |
| j is Extremely more important than k | 9 |

***Table 5: Interpretation of Pairwise scores***

c. After the matrix A is built, the same is normalised to get the Anorm matrix, which represents the normalised pairwise comparison matrix. This is achieved by computing the total value of each column to 1.

$$\overline{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^{m} a_{lk}}.$$

d. Finally, the criteria weight vector w is built by averaging the entries of each row of Anorm.

$$w_j = \frac{\sum_{l=1}^{m} \overline{a}_{jl}}{m}.$$

2. Computing the matrix of Option Scores
3. Ranking the options

**Data Analysis**

In this study, 45 responses from the local market was collected through a questionnaire. The data was fed into excel for the data cleaning and performing AHP & TOPSIS analysis.

For each of the major groups – Convenience, Modernization and Advance Technology, the data was subdivided into the respective categories.

Convenience group has 5 factors that was analysed. 10 data points was collected with respect to these factors. On each data point simple average was done and rounded off to the nearest integer value.

Modernization group has 3 factors to be analysed. To get the matrix values, 3 data points was collected on these factors. On each data point simple average was done and rounded off to the nearest integer value.

Advanced technology group has 4 factors to be analysed. To build the pairwise matrix, 6 data points was collected on these factors. On each data point simple average was done and rounded off to the nearest integer value.

After the cleaning of data of these groups, the rounded off values were fed into the group-wise pairwise comparison matrix.

**Convenience:**

| | **Receiving communication of promotional deals, coupons, invitations, etc** | **Networking amongst other retailers, suppliers, stakeholders** | **Receiving notifications of order delivery & pickup and other transportational aspects** | **Website & apps User Interface, seamless connections** | **Digitalised payments throught payments gateways** |
|---|---|---|---|---|---|
| **Receiving communication of promotional deals, coupons, invitations, etc** | 1 | 2 | 3 | 5 | 9 |
| **Networking amongst other retailers, suppliers, stakeholders** | 0.5 | 1 | 2 | 4 | 7 |
| **Receiving notifications of order delivery & pickup and other transportational aspects** | 0.333333333 | 0.5 | 1 | 5 | 6 |
| **Website & apps User Interface, seamless connections** | 0.2 | 0.25 | 0.2 | 1 | 4 |
| **Digitalised payments throught payments gateways** | 0.111111111 | 0.142857143 | 0.166666667 | 0.25 | 1 |

***Table 6: Convenience Group Pairwise Matrix***

**Modernization:**

| | Right product at the right price through AI/ML | Wishlist feature & sample product testing through Automation | Prediction of sales of new products |
|---|---|---|---|
| **Right product at the right price through AI/ML** | 1 | 4 | 7 |
| **Wishlist feature & sample product testing through Automation** | 0.25 | 1 | 3 |
| **Prediction of sales of new products** | 0.142857143 | 0.333333333 | 1 |

*Table 7: Modernization Pairwise Matrix*

**Advanced Technology:**

| | Order management system | Point of Sales | Inventory control software | Electronic data Interchange |
|---|---|---|---|---|
| **Order management system** | 1 | 4 | 7 | 9 |
| **Point of Sales** | 0.25 | 1 | 2 | 5 |
| **Inventory control software** | 0.142857143 | 0.5 | 1 | 3 |
| **Electronic data Interchange** | 0.111111111 | 0.2 | 0.333333333 | 1 |

*Table 8: Advanced Technology Pairwise Matrix*

After the pairwise matrix is built, the normalised pairwise matrix is calculated. The criterion weights are derived from the matrix for individual factors.

The criterion weights are multiplied with the pairwise comparison matrix to find the X(Weigted sum / Criterion Weight). With this value the Consistency Ratio is calculated to find out the consistency of the data. This is performed for each of the groups.

**Convenience:**

| Lmax(Average of X) | CI(Lmax-n/n-1) | CR(CI/RI) |
|---|---|---|
| 5.258705436 | 0.064676359 | 0.057746749 |
| | | Consistent |

*Table 9: Convenience Consistency*

**Modernization:**

| Lmax(Average of X) | CI(Lmax-n/n-1) | CR(CI/RI) |
|---|---|---|
| 3.032576371 | 0.016288186 | 0.028083078 |
| | | Consistent |

*Table 10: Modernization Consistency*

**Advanced Technology:**

| Lmax(Average of X) | CI(Lmax-n/n-1) | CR(CI/RI) |
|---|---|---|
| 4.089880607 | 0.029960202 | 0.033289114 |

Consistent

*Table 11: Advanced Technology Consistency*

After the consistency check, the data for the Apps (available in market) was considered for analysis. The data was taken on the basis of features available on the APPs. There was 5 apps considered for this study, each having 12 factors. So a total of 60 data points was collected and 45 responses were taken for this study. These data points are subdivided into each of the groups mentioned above.

**Convenience:**

| | Receiving communication of promotional deals, coupons, invitations, etc | Networking amongst other retailers, suppliers, stakeholders | Receiving notifications of order delivery & pickup and other transportational aspects | Website & apps User Interface, seamless connections | Digitalised payments throught payments gateways |
|---|---|---|---|---|---|
| **Shopkirana** | 3 | 4 | 2 | 3 | 3 |
| **Retailers App** | 3 | 3 | 3 | 3 | 4 |
| **Metro Wholesale** | 5 | 1 | 3 | 2 | 3 |
| **GramFactory** | 3 | 5 | 3 | 4 | 3 |
| **Udaan** | 4 | 3 | 3 | 3 | 3 |

*Table 12: Convenience App Scores*

**Modernization:**

| | Right product at the right price through AI/ML | Wishlist feature & sample product testing through Automation | Prediction of sales of new products |
|---|---|---|---|
| **Shopkirana** | 3 | 5 | 2 |
| **Retailers App** | 4 | 3 | 3 |
| **Metro Wholesale** | 4 | 3 | 5 |
| **GramFactory** | 3 | 4 | 4 |
| **Udaan** | 2 | 5 | 5 |

*Table 13: Modernization App Scores*

**Advanced Technology:**

| | Order management system | Point of Sales | Inventory control software | Electronic data Interchange |
|---|---|---|---|---|
| **Shopkirana** | 2 | 1 | 3 | 2 |
| **Retailers App** | 4 | 2 | 3 | 1 |
| **Metro Wholesale** | 3 | 4 | 4 | 2 |
| **GramFactory** | 1 | 3 | 4 | 4 |
| **Udaan** | 4 | 4 | 3 | 3 |

*Table 14: Advanced Technology App Scores*

From these matrices, the normalised matrix is built followed by the weighted matrix. Weight matrix is found by multiplying the criterion weights with the above matrix. Then from the

weighted matrix, the Euclidean distances are measured. With the help of this Euclidean distance, the performance matrix is built with respect to each of the groups.

**Convenience:**

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.113198192 | 0.103360288 | 0.477285802 | 3 |
| **Retailers App** | 0.123794421 | 0.076345931 | 0.381461961 | 5 |
| **Metro** | 0.138999783 | 0.107156051 | 0.435317942 | 4 |
| **Wholesale GramFactory** | 0.102576804 | 0.142412633 | 0.581301116 | 1 |
| **Udaan** | 0.086438451 | 0.091826055 | 0.515111263 | 2 |

*Table 15: Convenience App Ranks*

**Modernization:**

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.099703438 | 0.106191534 | 0.51575584 | 3 |
| **Retailers App** | 0.050337687 | 0.191148302 | 0.79155028 | 2 |
| **Metro** | 0.046532379 | 0.193067124 | 0.805791002 | 1 |
| **Wholesale GramFactory** | 0.098716008 | 0.100106521 | 0.50349687 | 4 |
| **Udaan** | 0.190907094 | 0.054723471 | 0.222787709 | 5 |

*Table 16: Modernization App Ranks*

**Advanced Technology:**

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.209173923 | 0.094154845 | 0.310405259 | 4 |
| **Retailers App** | 0.066660569 | 0.282919818 | 0.809312617 | 2 |
| **Metro** | 0.095282093 | 0.208662856 | 0.686515295 | 3 |
| **Wholesale GramFactory** | 0.282919818 | 0.066660569 | 0.190687383 | 5 |
| **Udaan** | 0.016793921 | 0.295825362 | 0.946279957 | 1 |

*Table 17: Advanced Technology App Ranks*

**Results**

Based on the data analysis, we have reached on some key observations with respect to the factors & apps.

Weights of the Factors is calculated in each groups and the most influential factor is found out.

**Convenience:** Receiving communication of promotional deals, coupons, invitations, etc.

| | Criterion Weight |
|---|---|
| **Receiving communication of promotional deals, coupons, invitations, etc** | 0.42249782 |
| **Networking amongst other retailers, suppliers, stakeholders** | 0.26514636 |
| **Receiving notifications of order delivery & pickup and other transportational aspects** | 0.19820798 |
| **Website & apps User Interface, seamless connections** | 0.08052399 |
| **Digitalised payments throught payments gateways** | 0.03362384 |

*Table 18: Convenience Factors Criteria Weights*

**Modernization:** Right product at the right price through AI/ML

| | Criterion Weight |
|---|---|
| **Right product at the right price through AI/ML** | 0.701437451 |
| **Wishlist feature & sample product testing through Automation** | 0.213238151 |
| **Prediction of sales of new products** | 0.085324398 |

***Table 19: Modernization Factors Criteria Weights***

**Advanced Technology:** Order management system

| | Criterion Weight |
|---|---|
| **Order management system** | 0.636020348 |
| **Point of Sales** | 0.203247919 |
| **Inventory control software** | 0.111536741 |
| **Electronic data Interchange** | 0.049194992 |

***Table 20: Advanced Technology Factors Criteria Weights***

Based on these factors the apps are rated differently for each groups. Most desirable app is found out based the ranking.

**Convenience:** GramFactory

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.113198192 | 0.103360288 | 0.477285802 | 3 |
| **Retailers App** | 0.123794421 | 0.076345931 | 0.381461961 | 5 |
| **Metro Wholesale** | 0.138999783 | 0.107156051 | 0.435317942 | 4 |
| **GramFactory** | 0.102576804 | 0.142412633 | 0.581301116 | 1 |
| **Udaan** | 0.086438451 | 0.091826055 | 0.515111263 | 2 |

***Table 21: Ranking of Apps in Convenience***

**Modernization:** Metro Wholesale

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.099703438 | 0.106191534 | 0.51575584 | 3 |
| **Retailers App** | 0.050337687 | 0.191148302 | 0.79155028 | 2 |
| **Metro Wholesale** | 0.046532379 | 0.193067124 | 0.805791002 | 1 |
| **GramFactory** | 0.098716008 | 0.100106521 | 0.50349687 | 4 |
| **Udaan** | 0.190907094 | 0.054723471 | 0.222787709 | 5 |

***Table 22: Ranking of Apps in Modernization***

**Advanced Technology:** Udaan

| | Euclidean distance from ideal best (Spos) | Euclidean distance from ideal worst(Sneg) | Performance Score = Sneg / (Spos + Sneg) | Rank |
|---|---|---|---|---|
| **Shopkirana** | 0.209173923 | 0.094154845 | 0.310405259 | 4 |
| **Retailers App** | 0.066660569 | 0.282919818 | 0.809312617 | 2 |
| **Metro Wholesale** | 0.095282093 | 0.208662856 | 0.686515295 | 3 |
| **GramFactory** | 0.282919818 | 0.066660569 | 0.190687383 | 5 |
| **Udaan** | 0.016793921 | 0.295825362 | 0.946279957 | 1 |

***Table 23: Ranking of Apps in Advanced Technology***

## Conclusion

The study conducted above included 3 major groups – Convenience, Modernization & Advanced Technology. These were further subdivided into 12 factors. The 12 factors are studied for the AHP analysis where the weights of each factor was measured and most desirable factor in each category was identified.

Based on the study of factors, we also identified five apps which have considerable application of the factors. We have tried to rank the apps based on the category through data-driven approach and found the most desirable app for the retailers.

Through this study, retailers will be able to find out the most desirable app and the most desirable factor to look for during selection of new apps. This study smoothly connects the retailers to suppliers through digital innovation & technology.

## Scope of Further Research

The study could be further extended to in depth analysis of each feature of the apps. This will help to pin point the requirements of the retail un-organised grocery sector that would encourage for digital breakthrough. Also, the study could be done on a wider geography so that the overall sentiment of all regions could be considered. Currently this study is limited only to the region of Kolkata. But if extended to all states & cities, the analysis could fetch an outstanding result in terms of expectations from the retailers.

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