



# Scope and Challenges in the Retail Industry : Application of Data Science

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**ABSTRACT:** The present paper discusses the biggest challenges faced in predictive analysis in consumer oriented industries and how data science comes to the rescue. It discusses the most important issues that need to address while creating a long term dialogue with the customers and enlists data mining techniques as suitable for different marketing scenarios. It also discusses the steps that must be followed to keep data challenges at bay.

**KEYWORDS:** Customer intelligence, cognitive modelling, customer segment analysis, price elasticity, customer loyalty, market basket analysis, recommendation engines.

## I. INTRODUCTION

The retail encounter has changed drastically as of late as there has been a paradigm shift over to buyers. Customers can without much of a stretch find and analyze items from a variety of gadgets, even while strolling through a store. They can impart their insights about retailers and items through online networking and impact other forthcoming clients. In order to contend in this new multi-channel environment retailers need to embrace new and innovative methodologies to pull in and hold clients. While this includes studying the trend of consumers it also includes the changing needs concerning the particular product being marketed.

A retail company's data about how it serves its customers and/or how the customer is reacting to its service reflects the company's role in nurturing its customer base. Historical data however is not only just an indicator of how bad or good the company is doing but can also give a very important insight about what can be done to maximize its profits depending on consumer behavior. The reports summarizing average behavior don't provide the useful insights needed to determine how individual customers are likely to behave because general behavior tendencies are simply too broad. So it is required to incorporate even more complex labelling methods to decide which group to cater to.



Figure 1: Three biggest challenges of marketing today [1]



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In order for retailers to create a meaningful dialogue with customers that honors the shopper's preferred level and mode of engagement, it takes more than summarized reports, which is why customer intelligence and predictive analytics provide the opportunity to significantly change the retail marketing industry. Customer intelligence modelling is thus a simulating discipline of cognitive science and data science and thus is a practice of determining and delivering data-driven insights into the past and thus predict consumer behavior for the aid of the concerned company. [1]

The most valuable customer intelligence focuses on how and why customers are likely to make decisions in the future and requires the integration of quantitative and qualitative information. The most complete and actionable picture of the customer comes from a combination of exchange driven data and human-derived insights, which can only come from being in rich dialogue with customers. Decision-makers who rely on quantitative data points alone may have a superficial view of the customers. But choice-makers who have a rich dialogue with their customers are better equipped to understand transactional data and make strategic decisions. Thus, customer intelligence must combine both raw transactional as well as behavioral data to generate the deviated measures from the company's existing insights. Thus, the process designed to provide an additional insight into the customer's intent is not just about a large amount of data that is collected but also the data that is created. [2]

## II. CONSUMER BEHAVIOUR MODELLING – A CROSS-DISCIPLINE

In a certifiable case, consider a retailer that might want to properly message high-esteemed, steadfast customers who give off an impression of being withdrawing from the brand. A prescient model worked from historical data could recognize which customers are liable to buy again with seven days, permitting the retailer to give them a chance to be the dedicated clients they really are. The prescient model can likewise appear if certain customers are unrealistic to buy inside seven days yet have a high normal request esteem.[3] [4] For these customers, the retailer could give a motivating force to take the customers back to the brand. In either case, foreseeing what customers are prone to do is basic to seeing how best to finish the discourse with them. Moving on, retailers should use advertising choices utilizing bits of knowledge picked up from client insight and prescient examination. Every retailer's information group must acquire components from all parts of the business, including retail specialists, information nerds and data scientists. These key components will set retailers up for accomplishment as we push ahead into the time of big data. Accordingly, a cooperation with domain experts is the key. This coordinated effort resemble a three-legged stool. Every leg is basic to the stool staying stable and satisfying its planned reason. With regards to producing client insight, the three legs of the stool are retail specialists, coders, and prescient modelers or data scientists. [4],[5]

### *The Retail Experts*

Retail specialists have sufficient domain knowledge and can best edge the issue client insight is intending to explain. They recommend determined traits that will give quality to both the brand and the organization's advertising effort.[5]

### *Coders*

Information nerds are expected to program these thoughts and store them in an appropriate database, which can regularly prompt extraordinarily expanded information stockpiling necessities for the retailer. Be that as it may, if the information must be utilized to make arrangements or settle on key promoting choices in the event that it's appropriately put away and got to. Out of reach information implies pointless information and a squandered opportunity.

### *The Data Scientists*

Prescient modelers and data scientists are then expected to utilize the stored information to manufacture models that accomplish those business goals initially set by the retail master. Prescient models discover connections between noteworthy information and consequent results so that close term and long haul client conduct can be anticipated. This leg of the stool intends to answer issues, for example, the probability of when a customer will make their next buy and what the estimation of that buy will be. Now and again, these connections are complex to the point that alone machine learning systems will discover them.

This paper deals with the role of data science in retail management.

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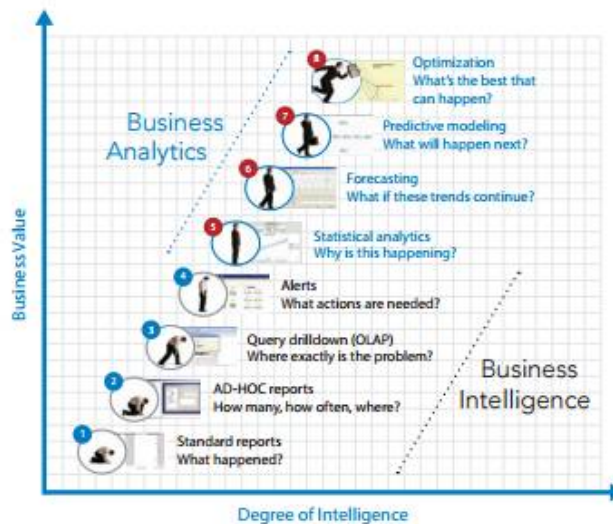


Figure 2: Business Value vs Degree of Intelligence [1]

- Data Science helps in enhancing customer experience. Cognitive modelling of consumer behavior trends help in sentiment analysis of social media streams, call center records, product reviews, etc. for customer feedback and market insights. It also helps in coming up with personalized recommendations for purchase references. These predictive analytics help to build a proactive system for the enhancement of the customer experience.
- Merchandizing-Data science helps to produce improved layouts, promotional displays and product placements using heat sensors and image analysis to identify behavioral patterns. Some of the other merchandizing techniques include identifying shopping trends, comparing trends and cross-selling prospects with the help of video data analysis. It also helps to collect higher daily profits through a combination of internal and external data (e.g. economic forecasts, weather and traffic reports, holiday and seasonal trends) and faster revenue growth through detailed market basket analysis.
- Marketing - Help in location-based and personalized offers on mobile devices, deploy real-time pricing using “second by second” metrics (e.g. supply chain and inventory data, competitor pricing, market and consumer behavior data). It is also possible to conduct directed promotions using analytics to segment consumers and find the most appropriate channels. This is often done by customer segment analysis. Online behavioral analysis and web analytics can help to create bespoke offers that are sure to attract a certain segment of people.
- Supply Chain Logistics- Data science can help to route optimization and more efficient transportation using GPS-enabled big data telematics. It can also help in more effective supplier negotiations based on in-store records. Demand –driven predictions can be made with the help of structured as well as unstructured data. [6]

The need to deal with and predict changing customer needs has mainly four goals as listed below. [6][7]

- The knowledge obtained helps to deepen customer insight and thus allows the company to flourish.
- It is very important to engage customers when they want to be engaged and note how they wish to be engaged.
- It is needed to ensure cross-channel consistency

Most of the consumer oriented companies need to work on real time responses. But it is quite likely that with a huge database and millions of customers’ big data analysis is required to accomplish this goals.[8] It is possible to transform the conversation from a one-way, one-time marketing campaign to a two-way, long-term dialogue with each and every customer.



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## III. STEPS TO CREATE A LONG TERM DIALOGUE WITH CUSTOMERS

- Familiarizing with the data parameters and variables: It is possible to have a lot of data none of which can be utilized for proper predictive modelling. Most of the data that is obtained needs to be analyzed in such a way that it allows to determine what data variables are present and which ones are valuable to the business and will move us toward the goals listed above. For instance, to deepen customer insight, it might be required to find out of the predictive elements and patterns available for each customer, including variables derived from data of various departments, channels, and possibly even partners.
- Prioritizing relevant variables for predictions and formatting them to be used for business activities – As soon as the data necessary to achieve marketing impacts are identified it is possible to influence producer-consumer relationship. These signals can vary by function or by industry type. After identifying this predictive signals and managing them critically it is possible to respond very quickly to market conditions. If a certain competitor has a promotion, the process for extracting the signals are supposed to warn the system that the promotion needs to be repeatable and scalable to truly achieve a dialog that responds to the environmental changes that the current customers are experiencing.
- Establish normative behavior and leverage science to alert you to changes. – Ideally every organization needs to respond instantly to changes however it can be quite complex. So it is required to monitor changes in such a predictive fashion that the organization has time to prepare and respond. One of the challenges to 1:1 marketing is the lack of sophistication in the response that need to be provided based on a real time event. While these events are impactful in certain situations, many more start out as data anomalies before they develop into a trend that reaches statistical significance. Thus by monitoring changes over time it is possible to ensure that reactions are better aligned with the customers' needs.  
Thus proactive monitoring becomes a need before a need for a real-time response system becomes a necessity. For example, if complaints are trending up about a specific product over time, a good company would try to assess the situation and take corrective measures before the situation turns into a crisis. Also when the demand for similar products from other companies surpasses the company's records it might be required to study the changing consumer needs and adapt. Thus by establishing patterns in customers' normative behavior it is possible to be proactive in adjustments, stopping negative trends in their tracks and seizing opportunities precisely when the customer is prepared.
- Integrate the predictive system with existing customer management processes. While a predictive system in place it must be integrated with customer management processes. Expansion of the application of science into more of current platform tools, such as campaign management systems, customer relationship systems, and call center support systems, will drive innovation and build the foundation for an ongoing dialog with the customers empowering the staff and integrating the company as a whole proactive system. [8] ,[9] ,[10]

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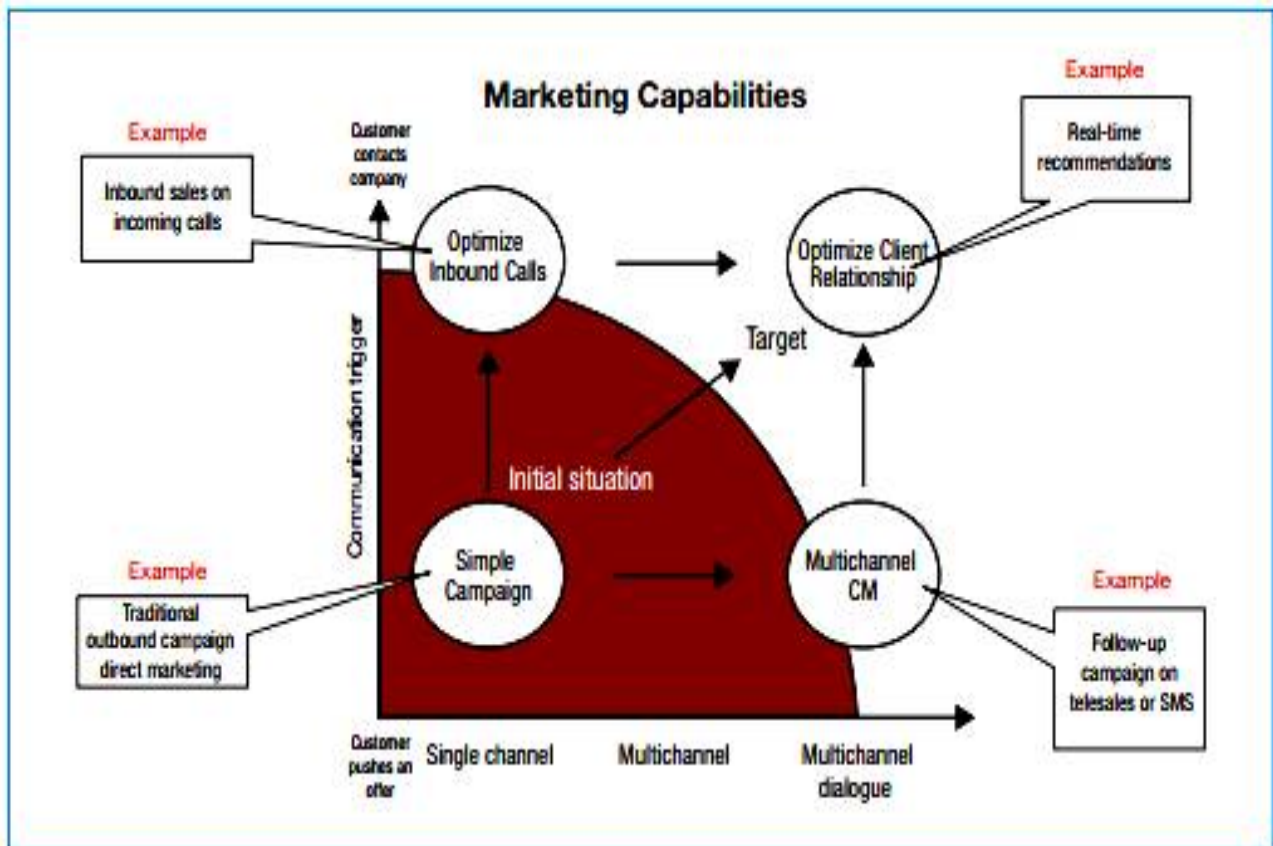


Figure 3: Making every customer interaction count across channels [8]

To realize these goals the top priorities for retailers include

- Customer segment analysis
- Customer loyalty analysis
- Market basket analysis
- Price Elasticity analysis
- Cannibalization analysis
- Predict Lift of Alternate Promotions Etc.

### Customer Segment Analysis

Customer segment analysis works best for industries where the demand changes depending on attributes such as age, gender, ethnicity etc. Light weight industries that are customer oriented in nature are the best examples of these kind of industries. [11] Customer segmentation is the practice of dividing a customer base into groups of individuals that are similar in specific ways relevant to marketing, such as age, gender, interests and spending habits. Customer segmentation, also called consumer segmentation or client segmentation, procedures include deciding what data is relevant to a particular label, how will it be collected and analyzed so that it can be worked with, integrating relevant data from several sources and also developing methods of data analysis for segmentation. It also includes establishing effective communication among relevant business units (such as marketing and customer service) about the segmentation. [12] It is important to implement applications to viably manage the data and react to the information it gives. Organizations utilizing client division work under the way that each client is distinctive and that their showcasing endeavors would be better off on the off chance that they target particular, more intimate gatherings with messages that those purchasers would discover pertinent and lead them to purchase something. Organizations likewise plan to pick up a more profound comprehension of their clients' inclinations and necessities with finding what every



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fragment finds most profitable to all the more precisely tailor showcasing materials toward that portion. Client division depends on recognizing key differentiators that partition clients into gatherings that can be focused on. Data, for example, a clients' demographics (age, race, religion, sex, family measure, ethnicity, salary, training level), geology (where they live and work), psychographic (social class, way of life and identity attributes) and behavioral (spending, utilization, use and wanted advantages) propensities are considered while deciding customer segregation methods. For example, luxury dress brands will frequently subdivide their clients into different classifications in light of how likely those clients are to purchase again later on. This is vital, in light of the fact that a few clients will be one-off buyers - they may purchase a costly bag as a present or for an uncommon event, however they won't be prone to be a normal or semi-consistent client. Knowing who the enormous spenders and rehash purchasers are permits the organization to develop associations with those clients. The retailer can offer advancements to them, hold private promotional events to showcase new items and make follow-up calls or send transcribed notes to them after their buys to keep them coming. The most common segmentation labels used in retail clothing market are gender related segments, age related segments, geographic segments, behavior related segments and lifestyle related segments. [13] A clothing brand called Zara used principles of demographic segmentation as part of its marketing policy. [14] Like many other consumer oriented companies this clothing brand is said to believe that responsiveness is more important than prediction as the consumer base is becoming more dynamic every day.[15]

## *Pitfalls Of Consumer Segment Analysis*

While consumer segmentation is a pervasive promoting technique, it is critical to know about its deficiencies. At the point when forgetting certain sections, an organization will be unable to boost potential. [16]Also, a brand may pick up a changeless relationship with a specific gathering, particularly while using social class, race, or way of life, which may deflect others from utilizing the item. Quantitative reviews deliver various measurably noteworthy fragments, yet making the portion (or sections) for which the organization ought to target is not a straightforward undertaking. Generally as each individual is exceptional somehow, shape or frame, it is difficult to characterize individuals into purchasing conduct fragments. [17] Promoting focused on a "fragment" may just take into account a bit of the people inside the portion, forgetting the others. There are such a large number of components that must be considered when dividing, for example, demographics, training level, pay level, psychographics (alludes to focusing on shopper fragments as per social class, way of life and identity), past acquiring conduct, that it is about difficult to gathering individuals into one segment. Another issue that can emerge amid the procedure of division is "cannibalization", in which one section surpasses another so nothing is picked up and in the most pessimistic scenario, deals or piece of the pie is lost. In addition, there is a danger of sending the wrong message or an event of brand "weakening" to excessively numerous fragments, or distinctive messages to various sections of the business sector. [16]

*Customer Loyalty Analysis* is a special type of customer segment analysis. For example, Companies such as Safelite, Philips, and Lenovo use Net Promoter to determine how likely customers are to recommend them to friends or associates. [18]

For example, GfK took a representative sample of the UK population, interviewing over 6,000 consumers, to find out how consumers shop, individual motivations and attitudes, highlighting differences by socio-economic background. The report segments consumers into 5 groups: [19]

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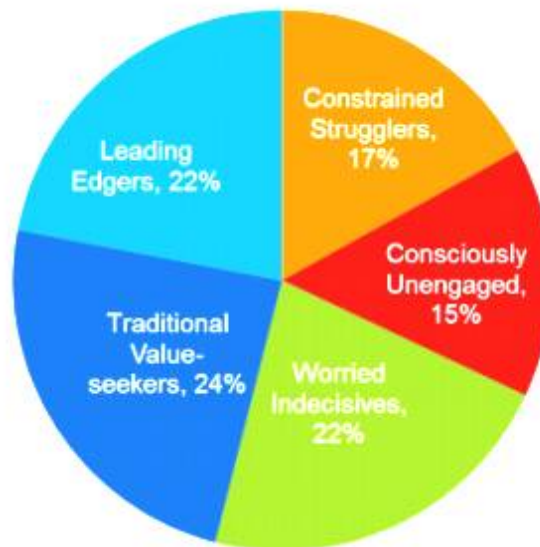


Figure 4: Customer Segmentation Example [19]

## Market Basket Analysis

Affinity analysis and affiliation principle learning incorporates a wide arrangement of analytical procedures aimed at revealing the affiliations and associations between particular objects: these may be guests to a particular site (clients or group of onlookers), items in your store, or things on your media site. Of these, market basket analysis maybe the most acclaimed case. In a business sector market basket analysis hopes to check whether there are mixes of items that frequently occur in transactions. For example, people who buy a pencil are more likely to buy an eraser. [20]

A retailer can utilize this data to typify the store design:

- Store design (put items that co-happen together near each other, to enhance the client's shopping experience)
- Promoting (e.g. target clients who purchase pencils with erasers and adopt ways to increase their shopping bill when they buy both together)

Online retailers and distributors can utilize this sort of examination to:

- Advise the position of substance things on their media destinations, or items in their index.
- Drive recommendation engines (In most online shopping facilities we see “people who bought this also liked”. This is done to target a like-minded customer base and make them shop more. )
- Deliver targeted marketing (e.g. messaging clients who purchased items particular items with different items and offers on those items that are likely to attract them.) [20] [21] [22]

## Price Elasticity Analysis

As retailers manage exceptional rivalry and changing client inclinations all inclusive, estimating remains a basic variable that can decide their prosperity. In today's unverifiable economy, the purchaser basic leadership cycle is intricate and cost is a key influencer of their purchasing choices.[23] Retailers are constrained to roll out value improvements much of the time because of rivalry, regularity, offers and advancements, et cetera. This obliges them to precisely gauge and figure the responsiveness of interest to these value changes. They should have the capacity to gage the cost elasticity, as an expansion in cost could prompt a decrease in deals. Additionally, a lessening in cost could prompt over the top interest prompting out of stock situations. Price elasticity is a typical measure of cost elasticity utilized by retailers to create fitting evaluating techniques and improve sales revenues. Anticipating deals or volumes because of value changes is especially difficult because of extensive retailers with a worldwide nearness and different stock keeping units (SKUs). Conventional investigation apparatuses are constrained in their abilities and not able to bolster the investigation of substantial information sets with deftness over different SKUs. Big Data is used to quantify value flexibility of things crosswise over a large number of exchanges. The point of this technique is to help retailers evaluate price elasticity with readiness and precision over all the SKUs in their collection. Price elasticity is a statistical procedure that can be joined into a product model to anticipate the deal amount contingent upon the rate of the adjustment in cost. The model is intended to anticipate the deal amounts relying upon the value change, advancement

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offers, regularity, and changes in contenders' SKU costs. With numerous SKUs in their portfolio, retailers are managing vast data sets. Retail locations, especially those spread over nations, have a huge number of exchanges each day with information sizes going in hundreds of terabytes. To process this huge volume of ever growing pile of data, conventional factual programming or software systems would need to run for a considerable length of time, and much of the time, would come up short on memory while dissecting them. Customarily, along these lines, retailers use models manufactured just to handle a couple sets of SKUs. Then again, store supervisors depend on their instinct and experience to foresee deals volumes. Presently retailers can understand better results and precisely assess price elasticity of items by utilizing a measurable model and structure that employments appropriated processing or Big Data. [24] [25]

The accompanying equation is by and large used to discover if the item is price elastic, inelastic or unbiased:

Price elasticity of demand = Percentage change in amount request/Percentage change in cost Price Elasticity of demand

$$\frac{(Q_2 - Q_1)}{[(Q_2 + Q_1)]}$$

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$$\frac{(P_2 - P_1)}{[(P_2 + P_1)]} Eq: (1)$$

Where  $Q_2$  is the current sold amount after the value change,  $Q_1$  is the past sold amount before the value change,  $P_2$  is the present cost after the value change,  $P_1$  is the cost before the value change. A distributed computing model utilizing MapReduce structure can be utilized to gauge price elasticity of things crosswise over stores and a large number of exchanges. Since utilizing customary strategies and software (like SAS, R, MATLAB) would be hard to handle huge information sets, Hadoop Distributed File System (HDFS) alongside MapReduce can be used to handle large data sets. Hadoop can scale on a level plane, empowering retailers to utilize a group of systems to assemble models for each SKU in the store. These prescient models can then be utilized to predict the business amount at a cost change, and in this manner, store administrators guarantee stock accessibility before the value change happens. [26]

## IV. CONCLUSION

As retailers try to improve the sales and introduce even more efficiency in their existing marketing strategies all-inclusive data management solutions are indispensable.



Figure 5: The most important objectives of data-driven marketing [27]



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The adoption strategy for big data consists of the following steps.

- Strategy - As the capabilities of big data are blooming many retailers feel the need to test their scalability with relation to their own information scenario. Thus a clear strategy that defines a road map for big data adoption in the enterprise is required. This would help in measuring the complexities and building a business case.
- Pilot- Retail enterprises should be made to identify small business units or departments that can be utilized to do a pilot run. The team in charge should identify solution, objectives, find out Key Performance Indicators (KPIs) that are easily measurable with relation to the business and can give clear understandable propositions.
- Large Scale adoption- Once the pilot test gives satisfactory results the enterprise can take decisions to use big data analytics across the different avenues of its company. It is more useful to use a top-down approach to create awareness of the value obtained by big data analytics so as to drive the business policies.
- Managing Growth- It is important to keep a good check that the solution implementation is being managed properly so that the benefits can be extend across all business departments.
- Data driven enterprise -Big data roadmap and adoption are initially driven by cost savings but it helps to take a more holistic approach that aims to deliver value to the business topline.
- Managing huge volume of data coming from heterogeneous sources.

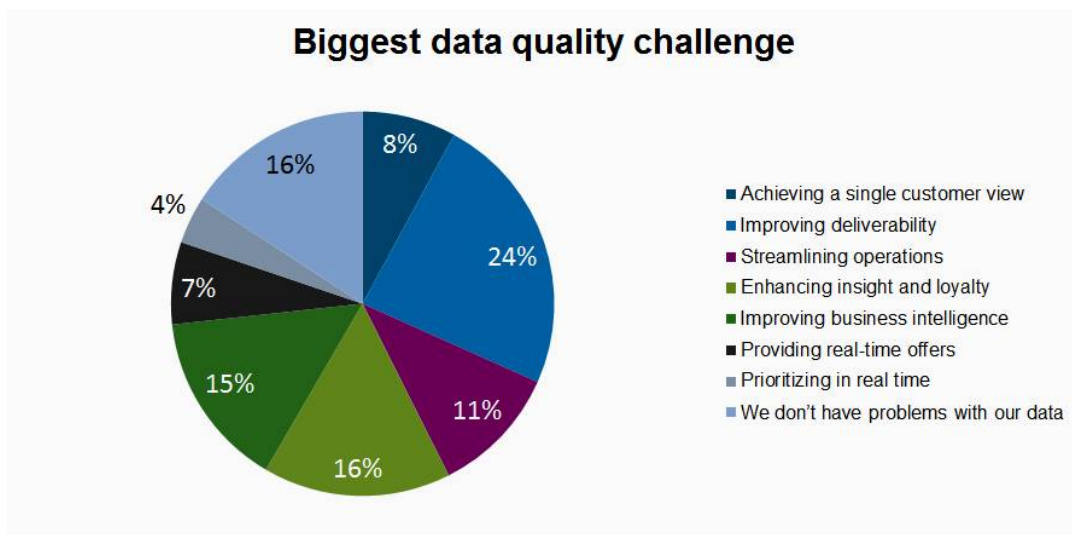


Figure 6: Data Quality Challenges [28]

Poor information quality effects each of these ranges in an unexpected way.

## 1. Deliverability

Advertisers work to enhance deliverability to build email showcasing change rates. By and large, organizations quality 32 percent of income to the email channel. Be that as it may, 66 percent of advertisers have encountered email deliverability issues in the most recent 12 months, fundamentally because of off base information. Without exact data, advertisers basically can't convey their painstakingly made messages to buyers. [28]

## 2. Single client perspective

Keeping up a solitary client perspective was more essential to advertisers than some other division in the study. Consolidating heterogeneous data into a solitary client perspective is an essential stride in keeping up open data that can be used for information driven understanding. As indicated by the study, a solitary client perspective is essentially used to produce business insight and make focused on showcasing offers, something numerous advertisers are hoping to influence with an inexorably digital environment.

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### 3. Upgrading understanding and dedication

Advertisers work to upgrade knowledge or understanding with a specific end goal to enhance client engagement and expansion income. As employments of information extend and advertisers turn out to be more modern with information control, it is normal that this zone will keep on growing more pervasive.

- Educating the senior leaders and ensuring that intelligence activities are driven by well-defined business needs and integrate the quantitative and qualitative approaches in the best way possible.

The retail industry is facing a large opportunity to understand and serve its customers. They need to organize the huge variety and volume of unstructured customer-oriented data to enable effective targeted marketing policies, product creation and supply chain planning. Big data uses intelligent analytics to uncover customer needs and track trends in a cost effective manner.



Figure 5: Most challenging obstacles in data-driven marketing [27]

““If you have more money than brains, you should focus on outbound marketing. If you have more brains than money, you should focus on inbound marketing.” ~Guy Kawasaki [29] A developing number of retailers are spending significant time in giving Big Data "as a service" framework. This allows the smaller organizations and free administrators to exploit large portions of the same information driven ways to deal with deals and promoting, without the requirement for executing costly equipment arrangements and procuring in \$100k-in addition to every year data scientists. Focused on publicizing stages of the sort pushed by Google and Facebook offer organizations of all sizes the opportunity to profit by Big Data-driven sectioned promoting methodologies. What's more, a developing number of new companies are putting forth social investigation to help anybody work out where their clients are sitting tight for them on online networking. Retailers irrespective of their operational magnanimity have been profiting from breaking down organized information for a considerable length of time, however are just barely beginning to get to grasps with unstructured information. There is without a doubt still a lot of undiscovered potential in online networking, client criticism remarks, video footage, recorded phone discussions and locational GPS information. Incredible advantages will go to the individuals who put it to best work, and the best arrangements will originate from inventive thinking and ways to deal with investigation, as opposed to the individuals who basically attempt to gather how much information as could be expected and then speculate its importance.[30]



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