Algorithmic Retailing

Machine Learning and Cognitive Platforms Create Winning Experiences by Making Retailing Contextual at Every Touchpoint

TATA CONSULTANCY SERVICES

Rajashree R

IN BRIEF

The new wave of "Algorithmic Retailing" is powered by Artificial Intelligence (AI) and Machine Learning (ML), which enable machines to acquire cognitive capabilities hitherto exclusive to humans. There are many ways in which the retail industry can apply intelligent algorithms to get customer centric. This article discusses space and price optimization as both of these are highly dynamic in the digital era, with a few hundred parameters impacting each of these. We also give a glimpse of how we improved image matching algorithms in use for planogram compliance. We believe retail will continue to leverage AI in the future to further improve several functions such as demand forecasting customer segmentation and decision support.

Intelligent algorithms are blazing the trail in retail, helping businesses become agile, proactive, and efficient. Several leading retailers are already using AI to manage core retail processes and are moving from insights to action at lightning speed.

This wave of "Algorithmic Retailing" is powered by Artificial intelligence (AI) and Machine learning (ML), which are enabling machines to acquire cognitive capabilities hitherto exclusive to humans: natural language processing, pattern recognition, and the ability to hypothesize and learn with experience. In contrast to conventional rule-driven automation, where decisions are made based on independent variables, algorithmic retailing leverages intelligent algorithms that take into account multiple variables and context, filter noise, and respond by choosing the best possible action. Most importantly, with every activity, the accuracy of the algorithm increases and future responses are prioritized based on the outcomes. What is more, it can do this any number of times with precision, and autonomously respond to circumstances such as competition, weather, and seasonal demand, as they unfold.

This article discusses emerging use cases for using intelligent algorithms to become customer-centric, namely:

- Detecting anomalies to predict and remediate breaks in omni-channel customer journeys

Fact File

TCS Research: Object Recognition based Estimation of Planogram Compliance (OREPLAC)

Outcomes: TCS Optumera™ Recognyze

Principal Investigator: Prof. Dipti Prasad Mukherjee (ISI), Avishek Kumar Shaw (TCS)

Academic Partners: Indian Statistical Institute, Kolkata (ISI-K)

Techniques used: Manufacturing modeling, design engineering, machine learning and knowledge engineering; model-driven Software Engineering

Industries benefited: Retail, CPG, Manufacturing, Airlines, Healthcare, Life Sciences, etc.

Patents: 10 filed

Papers: Research Paper in ECCV '18

With our AI powered approach of Macrospace Optimization, which leverages the power of AI and big data analytics, we considered 500+ data parameters from multiple sources.

- Contextual personalization
- Automating store tasks such as gap scanning and planogram compliance; selecting the optimal route for picking, etc.
- Enabling dynamic, multifactor, inventory optimization by node
- Enabling multivariate, source-to-customer flow path optimization
- Fulfilling the customer promise through last mile visibility, and dynamic rerouting and rescheduling

Space transformation for retailers with AI-based macro space optimization

With a surge in online sales, and stiff competition from specialty and discount retailers, physical stores are facing significant drop in space productivity. Small express format stores and mid-sized neighborhood stores were losing on market share due to limited choices in assortments and were in need of solutions that enabled hyper-localization, tailored to local preferences. Limited space and remoteness from distribution centers incurred additional costs for the retailers and led to lower on-shelf availability. For certain categories, such as electronics, toys, and home furnishings facing an online swell, the stores had to be transformed to become experience zones. With today's customers shifting loyalties, comparing everything, hungry for choices, and being channel agnostic, these experience centers needed to be aligned with how they shop—Persona- or Trip-based layout.

Retailers wanted to right-space their categories to improve usage of space and unlock the hidden potential within department spaces.

With our AI-powered approach of Macro Space Optimization, which leverages the power of AI and

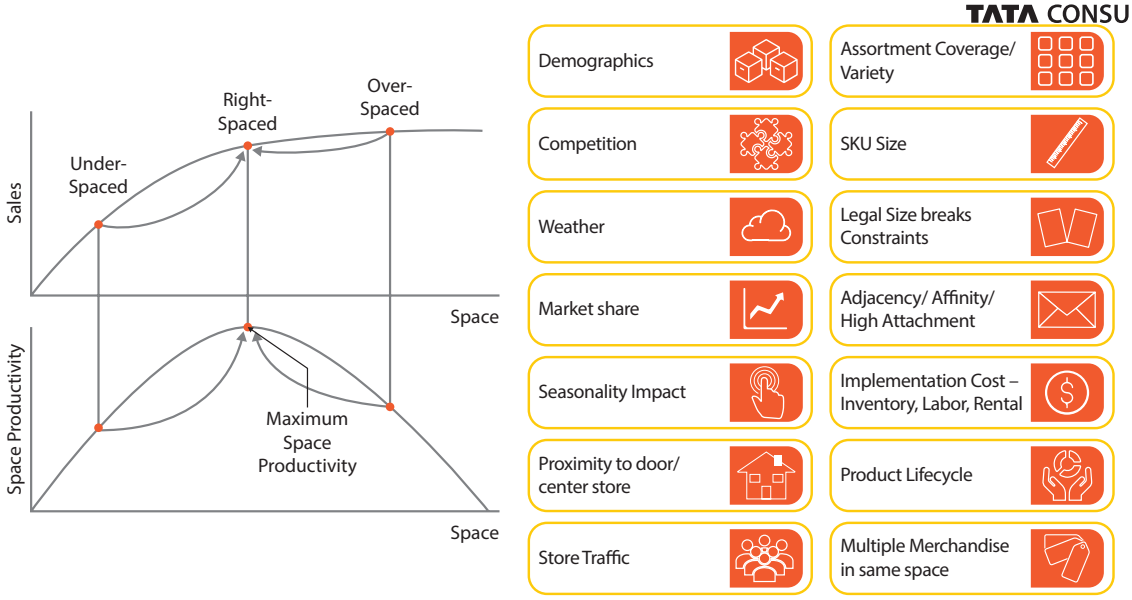

Figure 1: *Solving the space elasticity with real life considerations*

big data analytics, we considered 500-plus data parameters from multiple sources and enabled the retailer to, hyper-localize and right-size store spaces, tailored to local preferences, while including assortment considerations, so as to increase sales, profits, and simultaneously provide customers with the most relevant assortment. Powerful what-if simulations and why-of spacing helped the retailer to de-risk expensive investments and scientifically understand the impact of modifying category and department spaces.

With AI-based Macro Space Optimization, retailers are able to realize over 3–5% increase in sales and gross margin, witness drastic reduction in turnaround time required for store remodels scenarios (from weeks/months down to a day).

AI-based price optimization to propel dynamic pricing for enterprises

A staggering ~1.7+ billion price change happens across industries every day. Traditional price research can cost up to USD 300,000 and 6 weeks per item.

In retail, Amazon alone makes 2.5 million+ price changes in a day. Leading researchers/industry heads have not only called this trend fair, but also an inevitable paradigm shift, commanding market players to notch up their game and deploy price intelligence to stay afloat among stifling competition, thinning margins, and hard-to-please customers.

The onus is on the pricing managers to make myriad, meaningful, and profitable decisions every day, but they have seldom had tools that helped them handle the scale or provide scientific reasoning to make confident decisions. The existing solutions were rule-based and followed competitor prices leading to price spirals and reduced margins.

Conversations with retailers and analysts, and observing other market players, helped us identify gaps in the market. With exponential growth in price-change frequency and multiple

factors driving item performances, retailers needed systems with intelligence, automation, scale and dynamic strategy modelling capability to drive profitability and results accuracy, which led us to the conceptualization of an AI-powered approach to price optimization.

Optumera™ Price, TCS' price optimization offering, works on AI models and machine learning algorithms on a big data platform. It takes into consideration over 500 parameters while calculating the optimum price. Competitor's price preemption, item linkages determination, and granular and localized price optimization are some of the items factored in the algorithm to dynamically price millions of items in a matter of few minutes.

With AI-based Optumera™ Price, we enable retailers to preempt competitor prices, identify margin opportunities, decompose sales, and identify key sales drivers for item performance, sift through large magnitudes of data at superlative speed, and enable automated price execution for regular scenarios allowing business users to handle exceptions and spend more time in modelling strategies which is the paramount step in pricing.

The solution considers over 500-plus factors leveraging a combination of AI models and machine learning algorithms on a big data platform, and 1000-plus features were built based on these factors. It decomposed sales and explained performance at a granular item level and provided localized optimal price recommendations to dynamically price millions of items in a matter of just a few minutes.

Advanced image-matching techniques for planogram compliance

As smart retailers worldwide move away from designing one-size-fits-all planograms to creating store-specific localized versions, they are confronted with an exponential surge in the number of planograms.

To overcome the limitations of manual processes, that are not only time consuming but also error

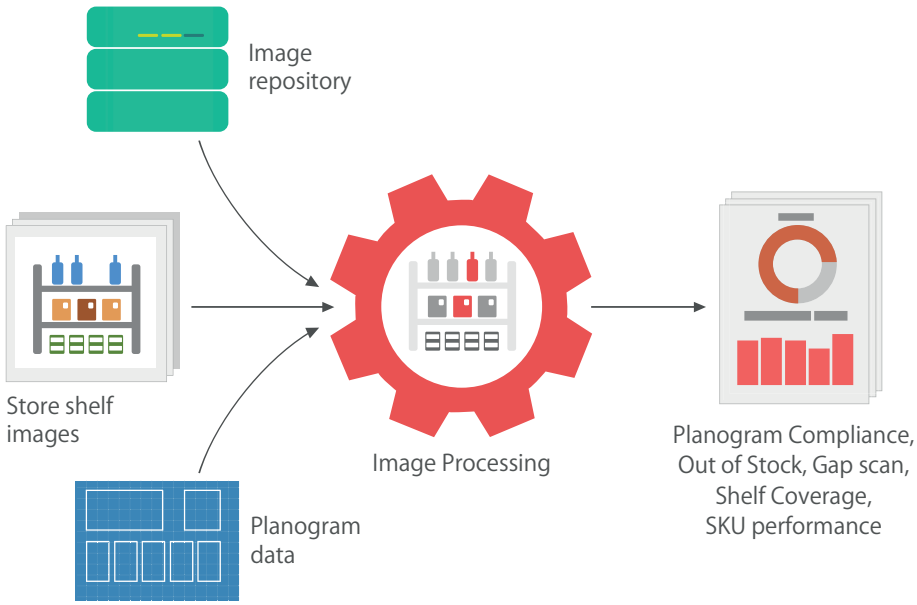

Figure 2: *Planogram compliance application*

Boundless competition	Consumers gravitate towards retailer & channel offering most value and convenience
Agile competition	An online retailer implements more than 2.5mn price changes every day
Comparison at fingertips	Digital platforms influence 36%* of dollars spent across in-store retail sales
Round the year price match	Price match guarantee permanent and not just for holiday season
Everything compared… Even Private Labels	Not just KVIs and promoted items, Private Labels are also compared now

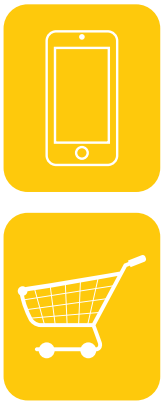

Figure 3: *What has changed in Retail Pricing?*

prone, several retailers are turning to image-processing techniques that leverage the digital and mobile technologies.

However, we observed that these technologies are constrained by challenges specific to the retail industry, such as varying in-store illumination levels, product packaging patterns, surface and styles; frequently changing product packaging; multiple product orientations on shelves; constraining in-store spaces; with varying camera resolutions and height of store associates. These factors not only affect the image quality but also cause distortions.

There was a dire need for new algorithms that are intelligent enough to scan any type of retail product—small or large, same stock keeping unit (SKU) but different packaging, dull versus glossy packaging, regular versus irregular shapes, and so on. Such algorithms had to be capable of working with non-standard conditions of SKU image capture.

When we integrated image-processing algorithms with computer vision and machine learning techniques, it ensured that with every matching activity, the image-processing accuracy of the algorithm increased.

We worked with respective account teams to collect data, and generate and maintain an image repository that contains high-quality images of individual SKUs in different orientations. Over time, the repository will bring in synergies in product identification of the same product across planograms of different stores of different retailers.

When we integrate this intelligent image matching algorithm with the retailer's enterprise mobility platforms, it enables store associates and auditors to instantly generate several configurable reports on planogram compliance, gap compliance, and SKU performance.

Beyond track and trace: data-driven intelligence

The increasing application of IoT across various touch points of the product journey and associated supply chain operations results in continuous real-time streaming of a high volume of data. The resultant big data is a complex mix ranging from location information to environmental information; inventory/consumable consumption to service needs; and operational interactions to product movement status from connected resources.

This massive data lake of IoT information can be a goldmine,

The ability to build intelligent supply chain processes is amplified by a combination of real-time enterprise supply chain data and external repositories of connected device data, social media, news, events, and weather updates.

A survey of emerging applications shows the use of predictive modeling for demand forecasting, unsupervised learning for customer segmentation, reinforcement learning for decision support, and deep learning for image and speech recognition

enabling retailers to leverage analytics and learn from historical data to derive patterns. In addition, the ability to build intelligent supply chain processes is amplified by a combination of real-time enterprise supply chain data and external repositories of connected device data, social media, news, events, and weather updates.

Examples of how data-driven intelligence will enhance IoT applications in future supply chains include:

- **Automatic Reordering:** Improved visibility into the customers' inventory (level and conditions) and buying patterns can help predict future orders. Based on this, replenishment systems will be able to initiate pre-picking and shipping to the closest aggregation point. These anticipatory shipments will eventually be consumed by the actual customer orders created through IoT-Order Management System (OMS) interaction.
- **Maximizing Home Life:** Tracking of conditions and location in real time can ensure tight control of the product environment and reduce the supply chain lead time. Thus, the products will be available for a longer time "to sell by retailer" and "to consume by customer." Since sensor data can be leveraged to maintain integrity through freshness monitoring, the life of the products available for use by the customers will be longer. The data can be further leveraged by deploying machine learning to predict the home-life of a product and continuously improve it.
- **Logistics: From "In-Transit Blind Spot" to "Always In-Control":** A connected last mile goes a long way in dynamic fleet and fulfillment management through real-time assistance to drivers and centralized monitoring of delivery progress, trailer environment, and vehicle health. Making decisions on

Figure 4: *Questions retailers are pondering*

the fly is more challenging in the context of "assets in motion" because of the dependency on systems at the corporate center; it can prove to be costly too. When the response time is crucial, localized analysis at the edge can help in reducing latency. Drivers will receive critical alerts even if there is no connectivity with the central cloud; also the reduced amount of data saves the bandwidth and energy used by remote IoT devices. This can be enabled by edge computing applications powered by self-learning algorithms that run directly on IoT devices and only interact with the cloud occasionally.

- **Next Gen Logistics:** Next generation delivery enabled by self-driving cars, robots, and drones will leverage AI-embedded IoT devices to navigate congested residential areas. To enable this, computations and processing will need to be done in real time, using edge computing, as any latency could be extremely dangerous or even fatal.

The future: AI ahead!

A survey of emerging applications shows the use of predictive modeling for demand forecasting, unsupervised learning for customer segmentation, reinforcement learning for decision support, and deep learning for image and speech recognition. These technologies have permeated into actual application domains already. The future move towards better, more holistic artificial intelligence will lead us into a new era of the retail industry.

Judicious investment with a rigorous understanding of underlying techniques, and an emphasis on robust returns, will enable the industry to improve its agility and efficiency, despite the growing challenges.

Rajashree R

Rajashree R is the Global Head of Retail Strategic initiatives, Products, and Innovation at TCS. In her current role, Rajashree has been instrumental in conceptualizing TCS Algo Retail, which is a paradigm shift in the way retailers do business. She has created cutting edge products such as TCS Optumera - AI based merchandising optimization platform and TCS Omnistore - a microservices platform for unified commerce. She has been leading Transformation and Innovation programs for leading retailers worldwide for over 17 years. She also conceptualized the Retail Innovation Lab, which researches and experiments with new technologies in retail. Over 100 solutions have been incubated in this lab.