Forecasting the Future of (Retail) Forecasting

Stephan Kolassa, SAP
April 2019

PUBLIC

Run Simple

Digital Technologies are Disrupting Business Models

Digital Technologies are Here to Stay

Mobile

Hyper Connectivity

In-Memory Computing

Internet of Things

Big Data

Machine Learning

Social

Cloud

Digital business models are disruptive. The rules have changed.

***Under Armour** is entering healthcare space* with "Connected Fitness" apparel, accessories and apps

Novartis set prices for heart drug Entresto *based on health outcome;* payment is linked to reduction in patients who are admitted to hospital for heart failure.

Red Bull is not just a beverage company. It is a content media company spanning web, social, film, print, music and TV creating brand experiences of joy, excitement and adventure

***Uber** is not just another taxi company,* it is redefining transportation and logistics services by expanding its services beyond taxi rides to merchandise and food delivery

Technology trends enabling digital transformation

The Internet of Things (IoT)

Connecting the end-to-end consumer value chain for new levels of customer proximity and new retail offerings

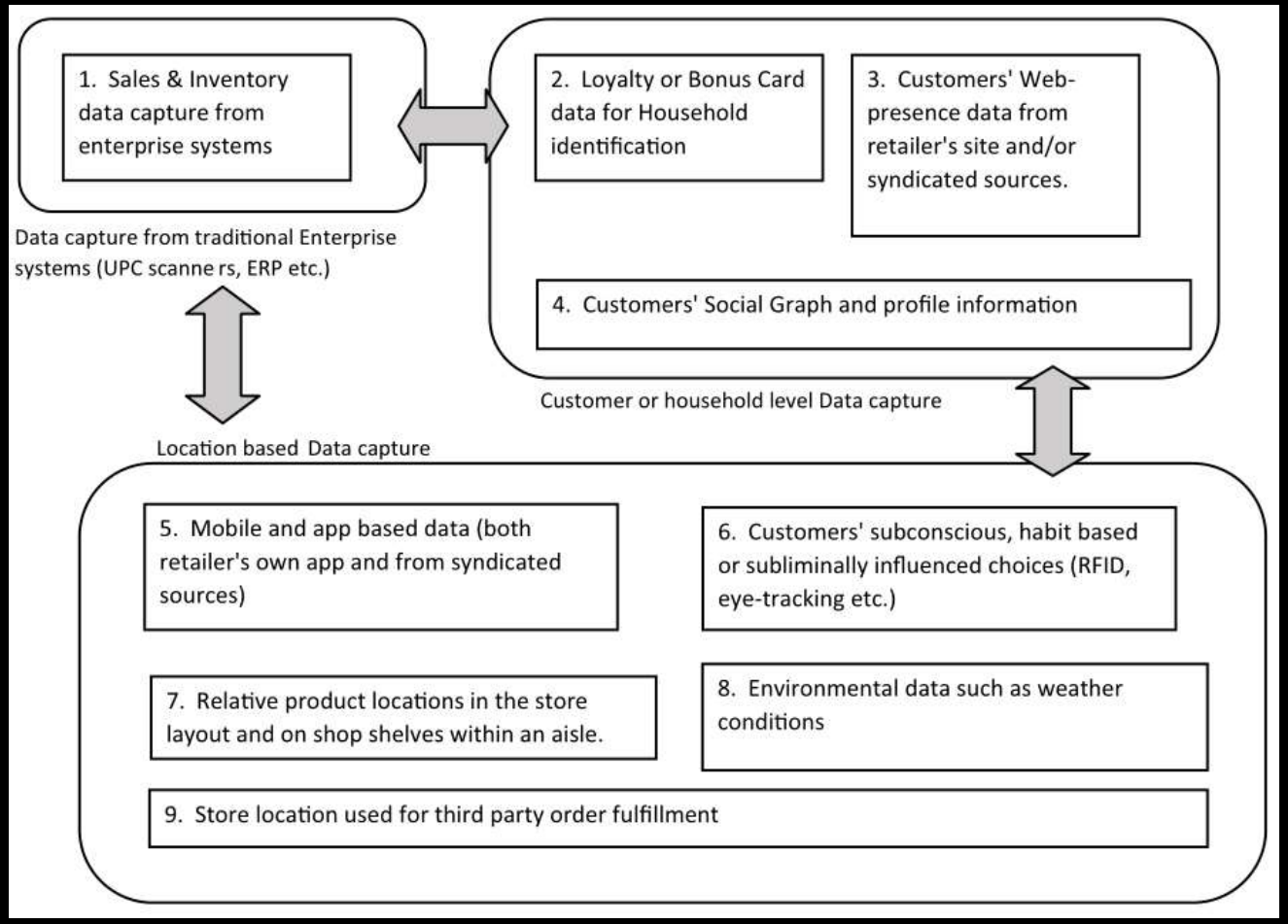
Artificial intelligence and machine learning

Optimized business processes and more impactful personalized and contextual consumer experiences

Virtual and augmented reality

Adds real-time digital information to shopping environment to drive next-generation consumer experiences

New sources of data – IoT, but also others



Bradlow, E. T.; Gangwar, M.; Kopalle, P. & Voleti, S. The Role of Big Data and Predictive Analytics in Retailing. *J of Retailing,* **2017***, 93*, 79-95

The Internet of Things is by no means new!

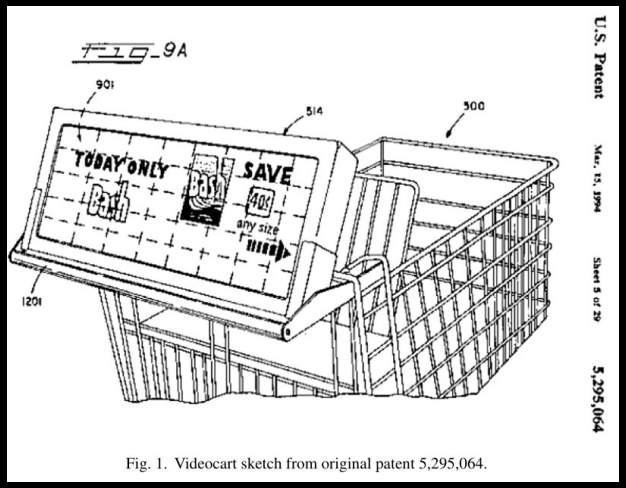


Fig. 1. Videocart sketch from original patent 5,295,064.

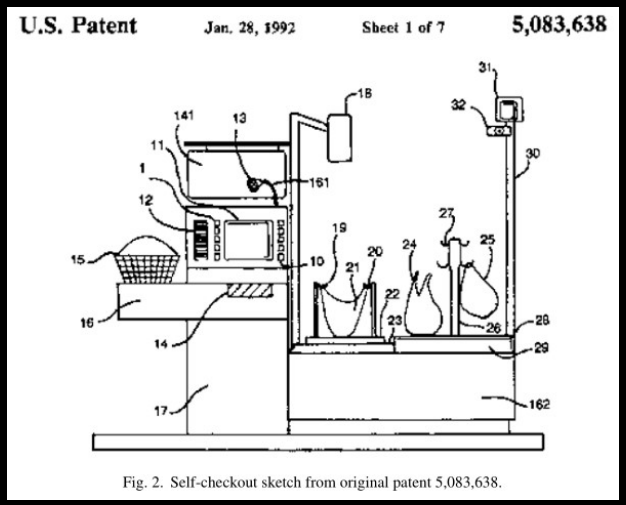


Fig. 2. Self-checkout sketch from original patent 5,083,638.

Videocart

- Screens on carts reacted to store IR emitters
- Ads were mostly reminder ads and did not offer a financial incentive for shoppers → effect on incremental sales difficult to measure
- Shoppers did not like the screen location
  - Blocked a view of the cart
  - Took up a large part of the cart's seat (used for valuables, fragile items, or a small child)
- Batteries ran down → shoppers were pushing a nonfunctioning cart
- Costs and installation of cart displays and store IR emitters
- Patent filed for in 1988, 46,000 carts in 1992, Videocart Inc. bankrupt 1993

Self-checkout

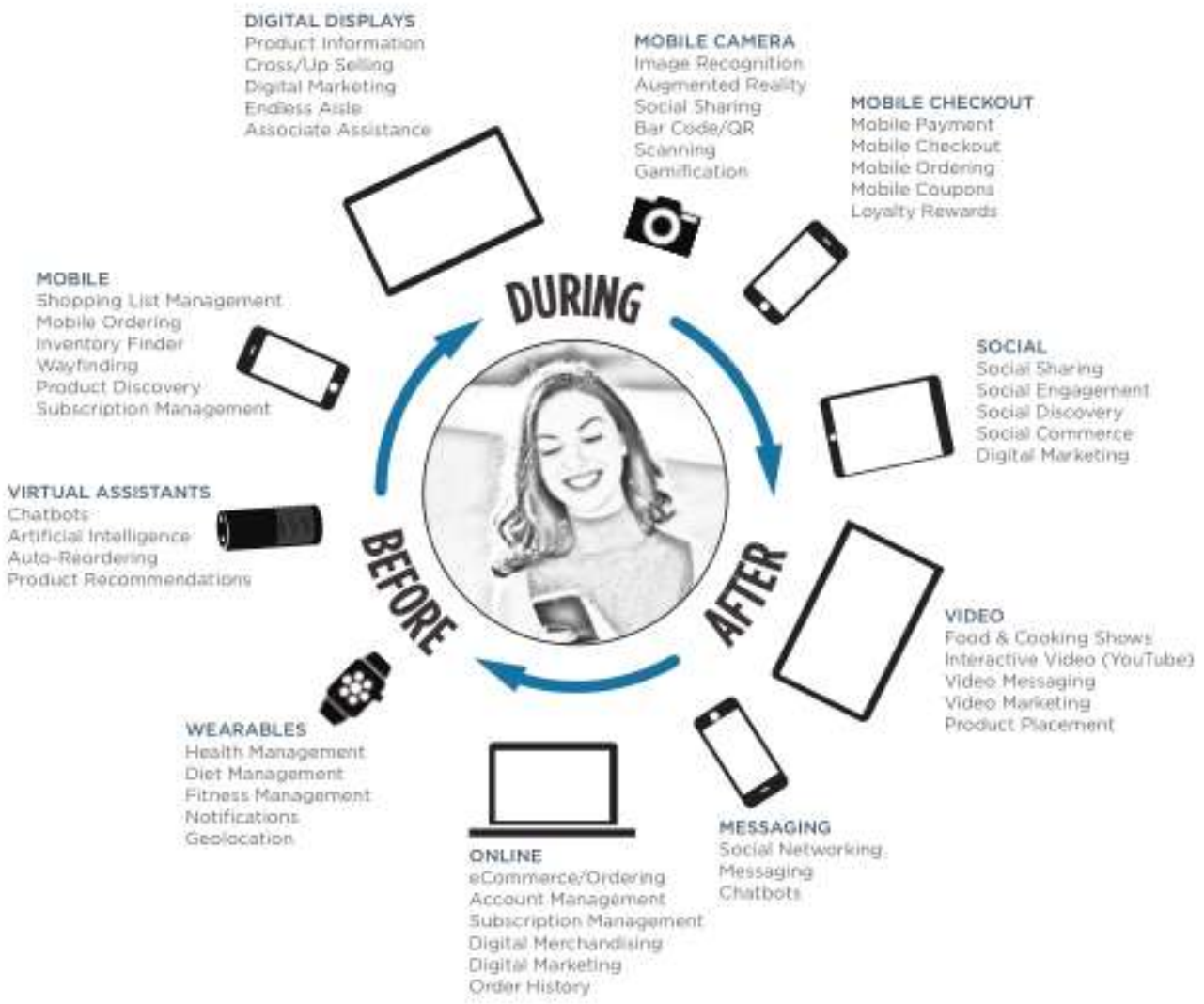
- Patent for "an automatic point-of-sale machine" granted 1992
- First system installed in 1992

Inman, J. J. & Nikolova, H. Shopper-Facing Retail Technology: A Retailer Adoption Decision Framework Incorporating Shopper Attitudes and Privacy Concerns. *J of Retailing,* **2017**, *93*, 7-28

Malec, John and Joseph P. Moser (1994). U.S. Patent No. 5,295,064. Washington, DC: U.S. Patent and Trademark Office.

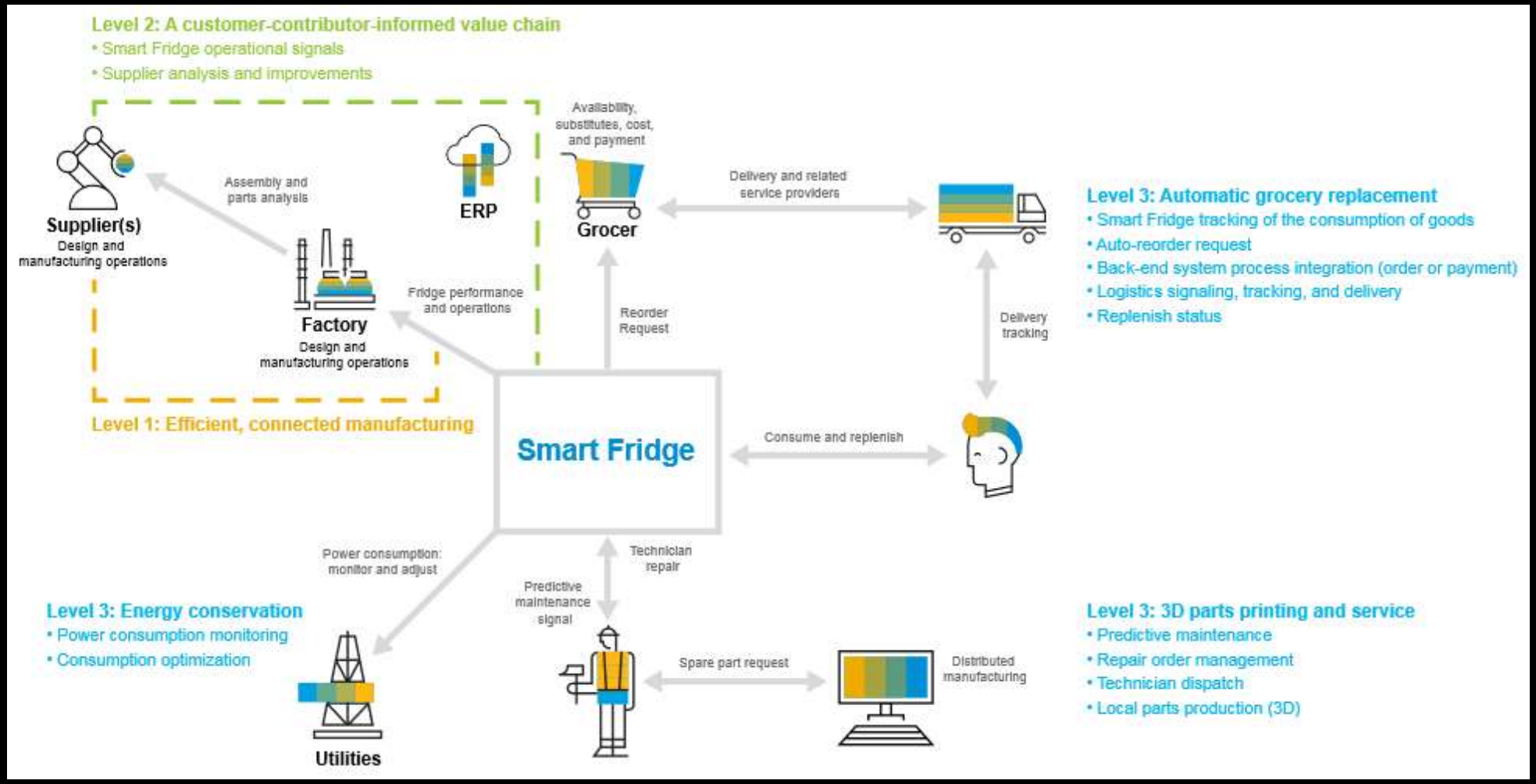
Schneider, Howard (1992). U.S. Patent No. US5083638 A. Washington, DC: U.S. Patent and Trademark Office.

THE CONNECTED FOOD SHOPPING EXPERIENCE



Source: Kurt Salmon

The Transformation of the Refrigeration Product Value Chain



Connected Products

- Distribute and optimize smart products
- Connect, monitor, and control products in the field
- Track, trace, and respond to changing conditions




SAP Connected Goods • SAP Track and Trace*

** Future release*

Connected Fleet

- Collect, map, store, and analyze moving assets data in real time
- Optimize supply chain and logistics processes
- Gain full visibility of component, spare part, and product stocks, and movements

SAP Vehicle Insights • SAP Networked Logistics Hub
• SAP Global Track and Trace*

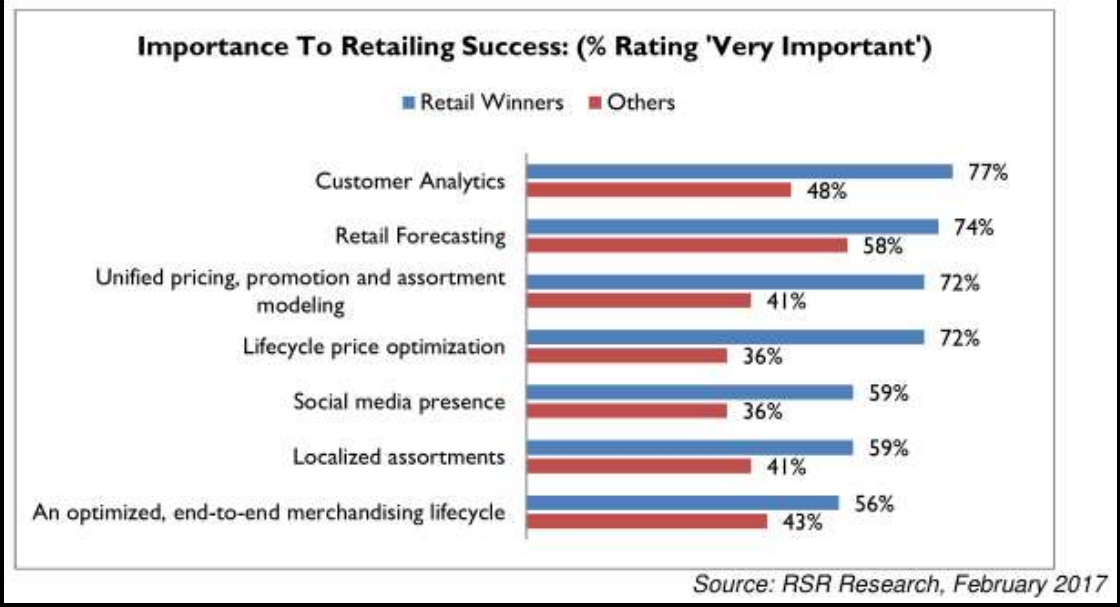
** Future release*

Connected People

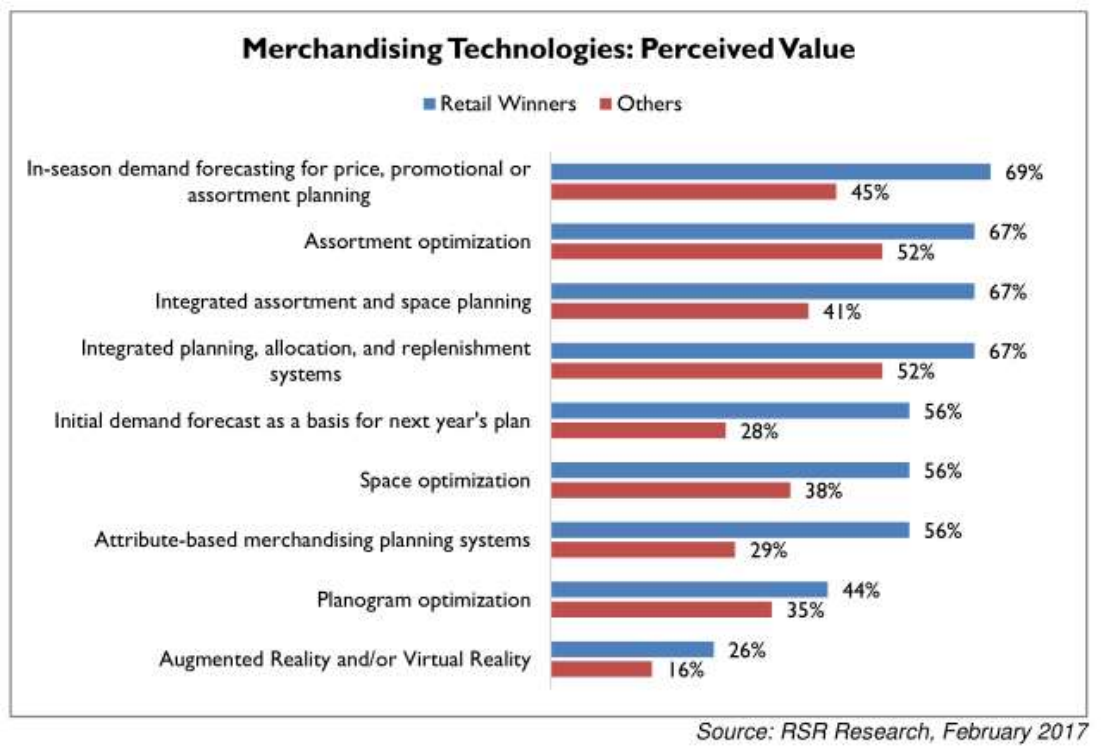
- Improve safety through real-time connectivity to environmental and safety practices
- Leverage a connected health network focused on patient outcomes with lower healthcare costs
- Make home life more comfortable, efficient, and secure with connected energy and security systems

SAP Connected Goods

Data & Understanding: Analytics, Artificial Intelligence, Machine Learning, …



Source: RSR Research, February 2017



Source: RSR Research, February 2017

Digital transformation priorities

Priority 1: Customer centricity

Putting the customers' point of view at the center of every decision

Priority 2: Service to the segment of one

Leverage customer insights to provide targeted personalized offerings

Priority 3: Digital consumer supply chain

Connect the real-time supply chain for greater efficiency and new levels of responsiveness

Priority 4: Smart retail technology

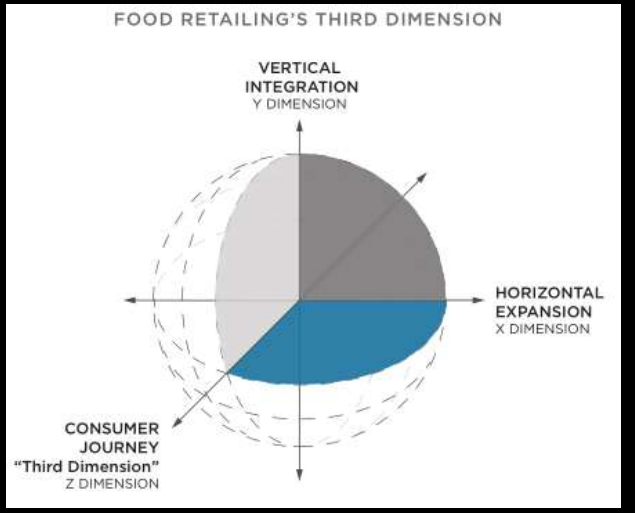
Differentiate your shopping experiences and drive new revenue opportunities

Priority 5: Monetizing new customer offers

Leverage understanding of customer needs for new revenue-generating offers

Reimagine Shopper Engagement
Reimagine Retail Processes
Reimagine Work
Reimagine Business Models

Reimagine Shopper Engagement



Source: Kurt Salmon

Customer Centricity

- Predict demand – not sales – with machine learning
- Influence customer navigation and decisions:
  - Advertisements personalized based on camera detections or location services
  - Reordered mobile shopping lists
  - Smart shopping carts
- Social and digital feedback mechanisms are replacing traditional marketing surveys. Closed-loop processes incorporating real-time customer feedback, reviews, and quality ratings will directly influence sourcing, assortments, and pricing

Service to the Segment of One

- "Millennials are more diverse than the generations that preceded them" - https://www.census.gov/newsroom/press-releases/2015/cb15-113.html
- Personalization is expected – but respect legal and cultural norms of privacy
- Proactive fulfillment & subscriptions/one-click service
- The Long Tail is expanding, driven by online retailers and make-to-order

Smart Retail Technology

- Digital households: expand your definition of "customer" to include smart refrigerators & Amazon Dash
- Cloud-based product information systems in omnichannel frameworks: exchange & enrich data and spot trends quickly

Reimagine Retail Processes

Service to the Segment of One

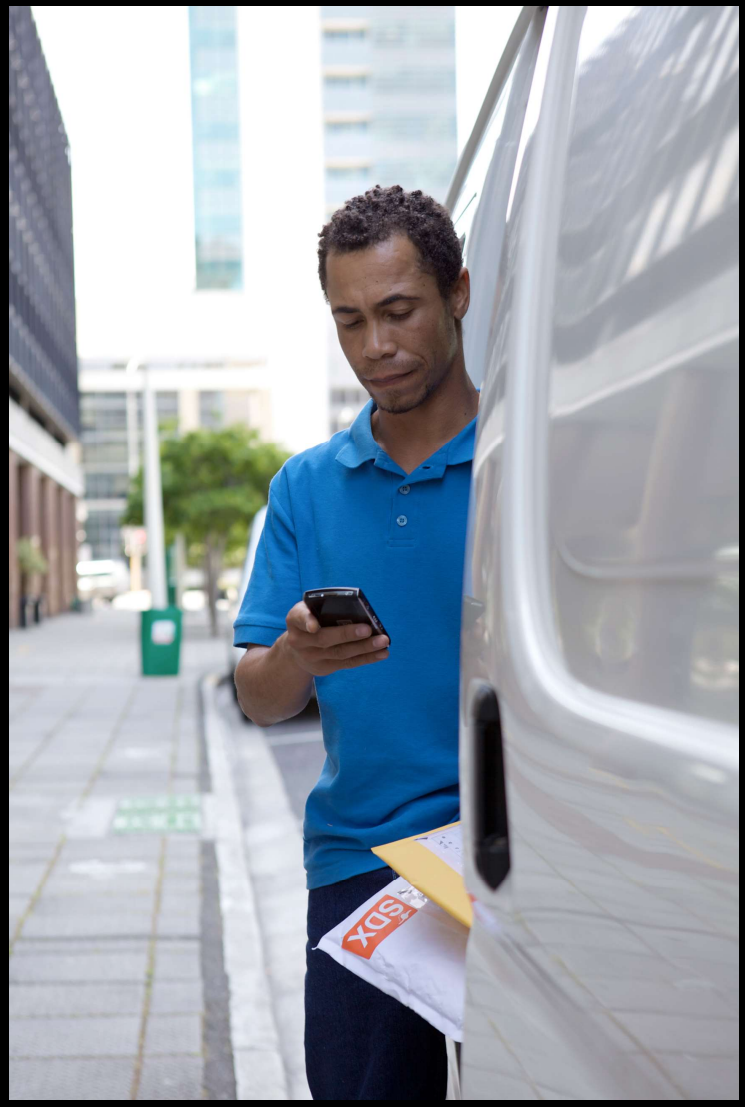
- Marketing:
  - Personalized
  - Location-based
  - Context-dependent

Smart Retail Technology

- Compliance of all store-related activities such as planogram execution
- Customer heat maps
- Smart shelves

Digital Consumer Supply Chain

- End-to-end tracking to improve on-shelf availability and replenishment
- Demand-driven operations in planning and replenishment
- Digitally engaged vendors allow faster reactions



Reimagine Work

Customer Centricity

- Real-time shopper and consumer insights from all channels
- Improve customer interaction through gamification

Service to the Segment of One

- Use real-time insights from social media to personalize store associates' interaction with customers

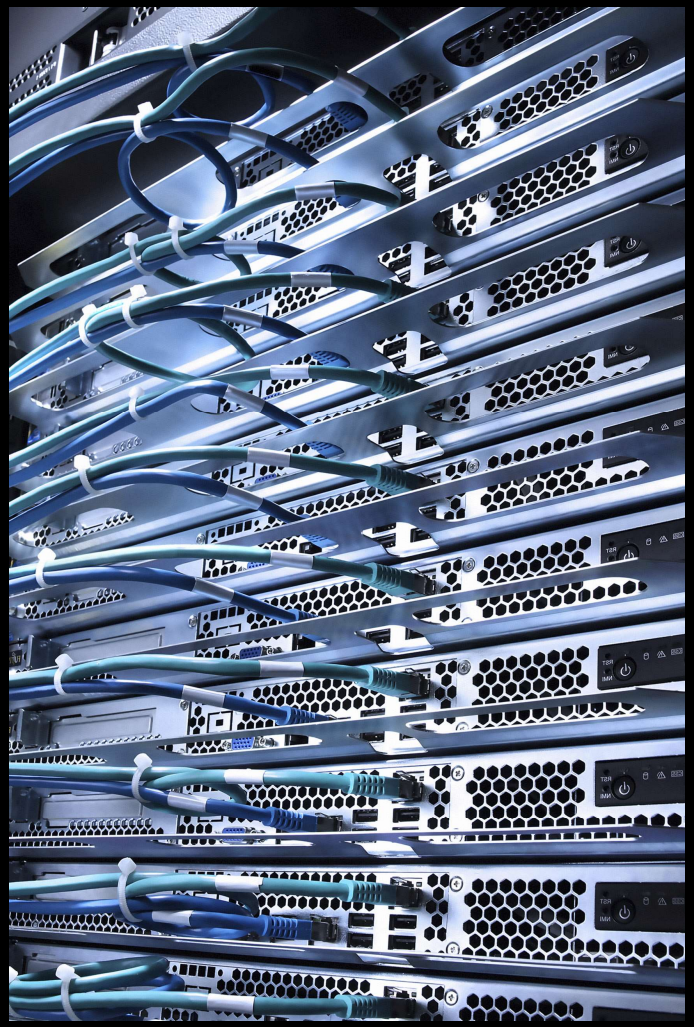
Smart Retail Technology

- Improve employee productivity
  - Turn scheduled tasks into on-demand activities – e.g., camera systems detect perishables' fresh status before employees
  - Target store associates towards high-value customers…
  - … or hand clienteling activities directly over to systems
- Digitize HR processes to replace manual paperwork through mobile apps and self-service functions
- Workforce planning and scheduling based on store traffic forecasts

Reimagine Business Models

Monetizing new consumer offers

- Move beyond selling products – to delivering on outcomes
  - Subscription services offering more than ingredients: HelloFresh.com
  - Predictive one-click shopping
- Build new digital businesses
  - Leverage massive customer data, cross-referenced to external sources
    - Social media data
    - Fitness tracker data
  - Create digital communities to build brand loyalty and generate even more data
- Digitize products and services
  - Ubiquitous connectivity
  - Smart personalization



What does this imply for forecasting?

Priority 1: Customer centricity

Putting the customers' point of view at the center of every decision

Priority 2: Service to the segment of one

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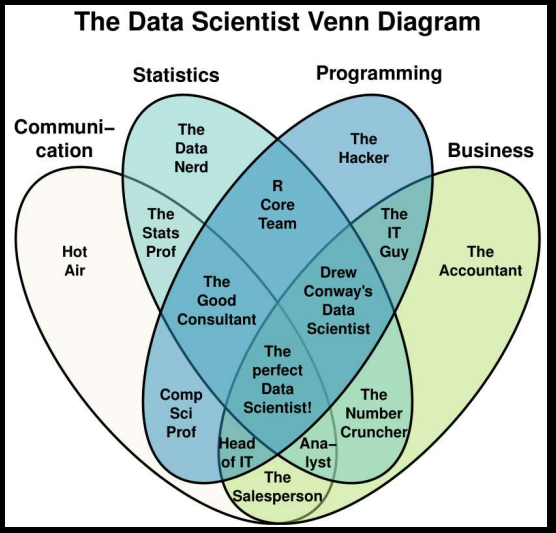
Reimagine Shopper Engagement
Reimagine Retail Processes
Reimagine Work
Reimagine Business Models

Retailers are getting more and more sophisticated in forecasting

- Retailer A
  - F&R customer
  - Use Bayesian neural networks to modify F&R forecasts and for workforce planning
- Retailer B
  - F&R customer
  - Is experimenting with Poisson regression, regression trees and similar tools
- Retailer C
  - F&R customer
  - Request predictive densities
- Retailer D
  - Has an entire Data Science team
- Retailer E
  - 30+ people in forecasting & replenishment
  - Statisticians, data scientists, computer scientists, …
- Walmart
  - Gave a keynote at the 2017 International Symposium on Forecasting (ISF)
  - Dynamic Linear Models (DLM) and ensemble forecasts
- Amazon
  - Gave a featured talk at the 2017 ISF
  - Leverage Innovation State Space Models (ISSMs) and Deep Learning
  - Publish academically

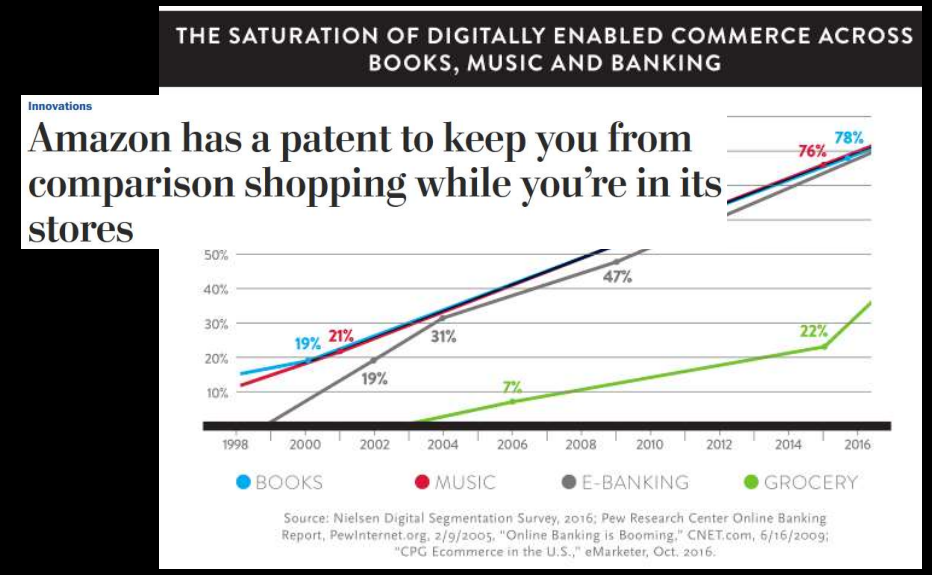
- Consequences for forecasting:
  - Retailers need to invest in forecasting and data science competence, or be left behind
  - Suppliers & wholesalers need to be able to hold their own in discussions with retailers
  - Software providers will see higher expectations and need to meet them – in all functions
  - Note that there are *two* aspects to this:
    - Understanding modern statistics, data science and machine learning
    - Understanding the retail business – domain knowledge

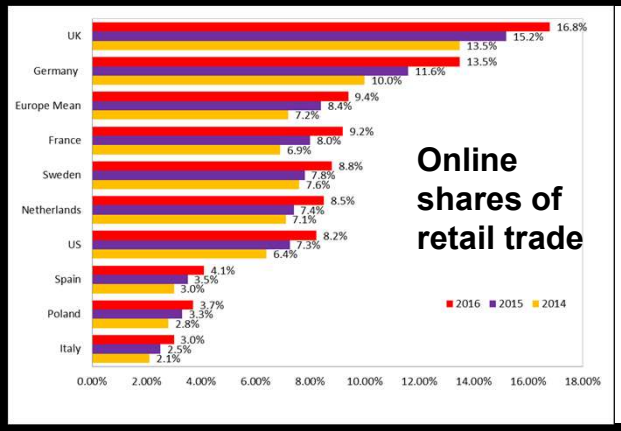


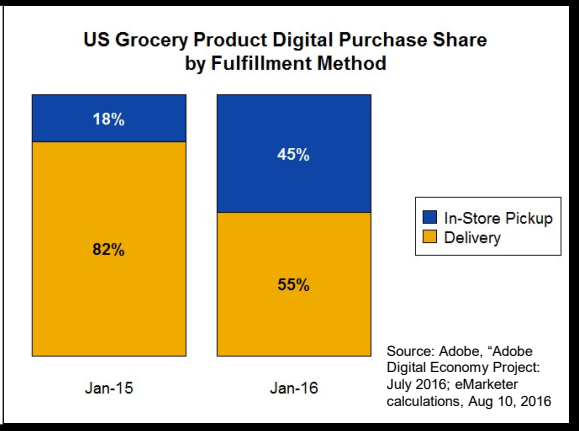
http://datascience.stackexchange.com/a/2406/2853

Times are changing, and nobody knows where they will end up

- Grocery is moving online, but speed differs between countries
- *Everyone* is experimenting
  - Home delivery by truck vs. by drone vs. click-and-collect in stores vs. click-and-collect in automated "dark distribution" centers vs. digital natives entering the market vs….
  - "Across all of these models there is no evidence that any are fulfilling ongoing digital transactions profitably." (Nielsen)
- Consequences for forecasting:
  - Take everything I'll say with a grain of salt
  - Flexibility is key
    - Collect all the data you can
    - It may be useful in five years



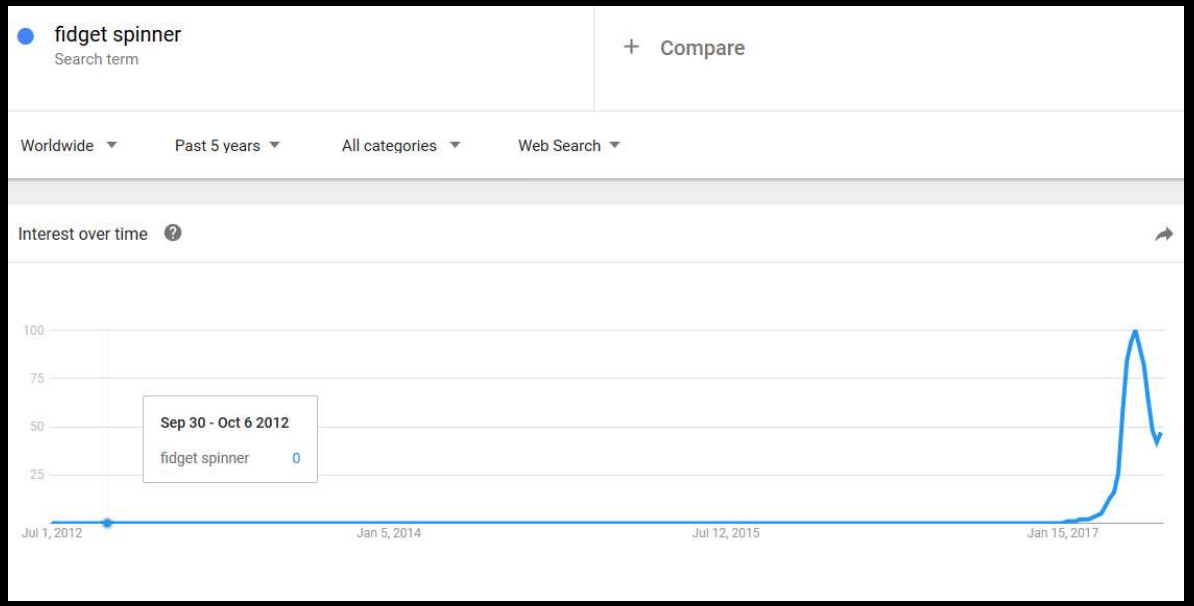




The (mobile) web and social media amplify feedback loops

- Higher variance
- Shorter lifecycles
- Incredibly fast dynamics

- Consequences for forecasting:
  - Forecasts may (!) need to be more adaptive
  - However, beware of picking up and extrapolating spurious signals!



On the output side, new data need to be forecasted

- Channel proliferation, Omnichannel
- Shorter lifecycles
- Proliferating variants
- Responses to personalized offers
- Responses to recommendations
- My own refrigerator stock, and when I need to refill it
- Footfalls
- Demand for services

- Consequences for forecasting:
  - We need to understand the drivers for each time series
  - The difference between numerical prediction and categorical classification is blurring
  - We need new tools in our forecasting toolbox

Data to be forecasted have lower and lower volumes on more and more granular levels

- So-called “count data”

- This is a consequence of:
  – DB capabilities – 20 years ago, we simply couldn’t store data on daily level
  – Product & variant proliferation – yoghurt demand now spreads over 20 instead of 5 flavors
  – Channel proliferation, Omnichannel
  – Personalization (requires “what-if” forecasts on customer/household level), Long Tail effects, make-to-order
  – Connected homes, smart refrigerators
  – And: increased expectations, partly driven by hype

- Consequences for forecasting:
  – The standard normal distribution assumption becomes more and more questionable
  – Forecast accuracy measures become misleading (Kolassa, 2016)

Kolassa, S. Evaluating Predictive Count Data Distributions in Retail Sales Forecasting. *International Journal of Forecasting,* **2016**, *32*, 788-803

Januschowski, T.; Kolassa, S.; Lorenz, M. & Schwarz, C. Forecasting with In-Memory Technology. *Foresight,* **2013**, *31*, 14-20

Inputs proliferate…

- More and more different promotions
- Personalization dimensions
- Social media, fitness tracker and other external personal data
- Weather, social media and other external non-personal data

- Consequences for forecasting:
  – These inputs can in theory be used to improve forecasts
  – However: beware of overfitting!
  – Regularization becomes more important

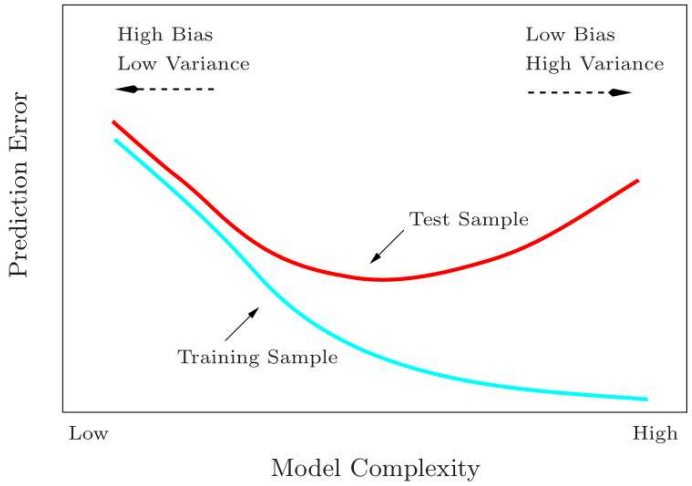


FIGURE 2.11. *Test and training error as a function of model complexity.*

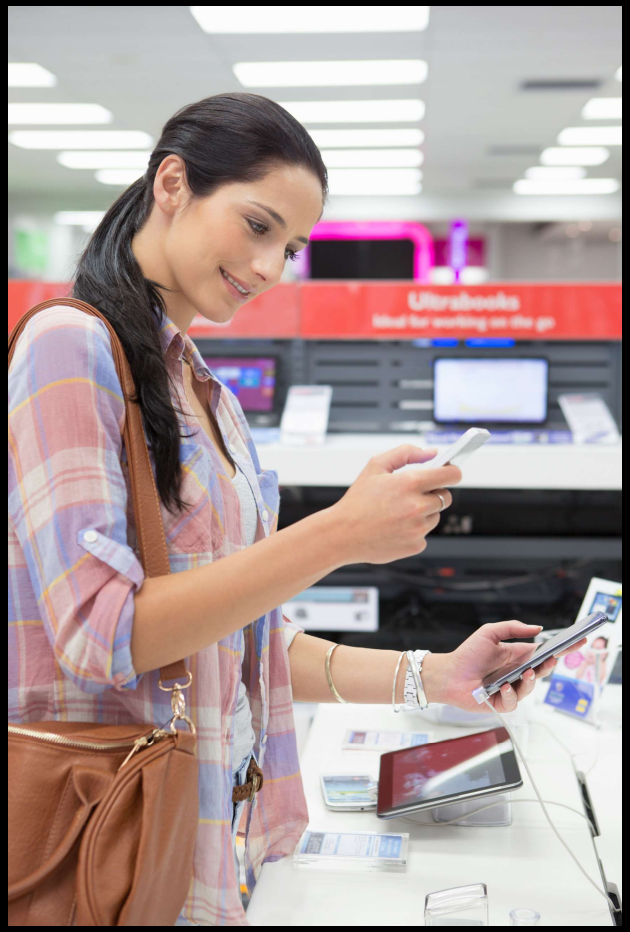
Hastie, T.; Tibshirani, R. & Friedman, J. The Elements of Statistical Learning. Data Mining, Inference, and Prediction. *Springer,* **2008**

Kolassa, S. Sometimes It's Better to be Simple Than Correct. *Foresight,* **2016***, 40*, 20-26

… and can be fed back into instantaneous decision tools

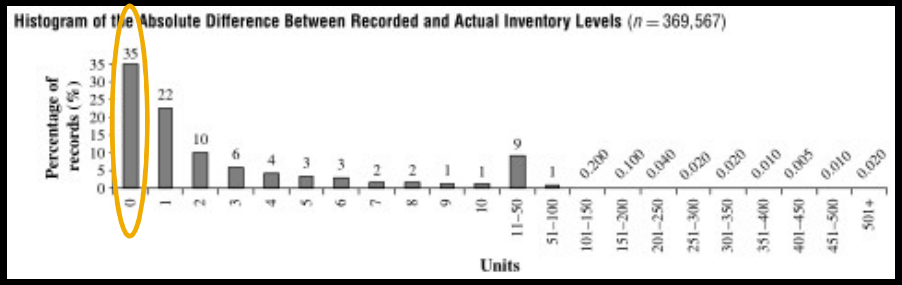
- Personalized offers and pricing based on:
  - Location (e.g., a competitor's store)
  - Context (e.g., your cart's contents)
  - Situation (e.g., an overstock on fish)
  - Emphasis (e.g., a supplier is paying to have his products recommended more prominently)

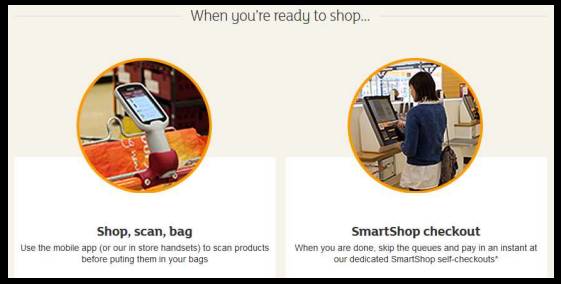
- Consequences for forecasting:
  - Can we leverage these at all in forecasting? How?
  - Do we need to forecast which customers enter the store, and what they put in their cart?

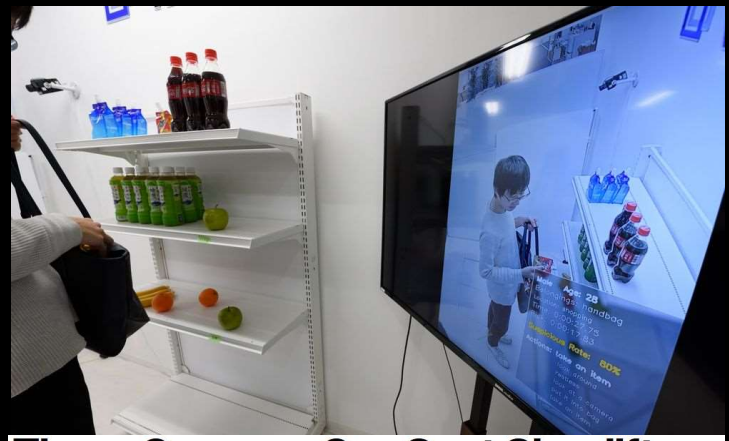


Data quality may improve – or not

- Does data quality improve faster through ML, IoT, connected stores etc. – or does proliferating data rot faster than we can clean it?
- Consequences for forecasting:
  – Data quality will remain a key issue
  – Developments in retail may both *improve* and *degrade* it







These Cameras Can Spot Shoplifters Even Before They Steal

By Lisa Du and Ayaka Maki
March 4, 2019, 4:00 PM GMT+1 *Updated on March 5, 2019, 12:38 AM GMT+1*

DeHoratius, N. & Raman, A. Inventory Record Inaccuracy: An Empirical Analysis. *Management Science*, **2008**, *54*, 627-641
Beck, A. & Hopkins, M. Developments in Retail Mobile Scanning Technologies: Understanding the Potential Impact on Shrinkage & Loss Prevention. University of Leicester, **2015**
Taylor, E. Supermarket self-checkouts and retail theft: The curious case of the SWIPERS. *Criminology & Criminal Justice*, **2016**, 16, 552-567
http://www.dailymail.co.uk/news/article-2135284/How-cheating-checkouts-turning-nation-self-service-shoplifters.html
https://www.bloomberg.com/news/articles/2019-03-04/the-ai-cameras-that-can-spot-shoplifters-even-before-they-steal
https://www.zerohedge.com/news/2019-01-15/automating-retail-googly-eyed-robots-are-coming-nearly-500-grocery-stores

Conclusions

- Yes, we *are* living in interesting times (IoT, ML, …)
- However, there is an enormous amount of hype
- Modern technologies will not solve all our (forecasting) problems
- Data quality in particular will remain a problem
- We will need to push back on hype-driven unrealistic forecast accuracy expectations
- For this – and to understand the strengths and limitations of new forecasting methods – we will continue to need forecasting expertise

Reminder

- Retailers are getting more and more sophisticated in forecasting
- Times are changing, and nobody knows where they will end up
- The (mobile) web and social media amplify feedback loops
- On the output side, new data need to be forecasted
- Data to be forecasted have lower and lower volumes on more and more granular levels
- Inputs proliferate…
- … and can be fed back into instantaneous decision tools
- Data quality may improve – or not

Thank you.

Contact information:

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