DEMYSTIFYING DIGITIZATION AND ANALYTICS

JACK HONG, PH.D.

CO-FOUNDER

RESEARCH ROOM PTE LTD

AGENDA

- About Research Room

- Demystifying Digitization

- Demystifying Analytics

- Important Take-aways

A collection of creative talents with deep expertise in multiple business domains and artificial intelligence with full-stack development competencies

RESEARCH ROOM

WHAT DO WE DO?

We provide evidence-based business intelligence and insights, modelled using proprietary domain expertise, powered by artificial intelligence capabilities from big data.

Domain specializations:

- Bridging data science and business innovation in multiple fields to maximize long term firm value through new competencies

- Business and financial asset valuation and rating

- Profiling corporate leaders and firms through their performances, social and business networks, and unstructured data (e.g. natural language)

Deep technology (Deep Tech) specializations:

- Predictive and prescriptive modeling using AI and big data

- Full-stack analytics software development (focus on prototyping to fit unique business needs)

- Data science workshops and big data analytics training

OUR CORE CAPABILITIES

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Finance **PhDs**

The team is made up of 4 **Ph.Ds. in Financial Economics**.

Our expertise covers all conventional finance disciplines in **Asset Pricing** and **Corporate Finance** with innovative IP applications in Natural Language Programming and Social Network Analytics.

Full-Stack **Developers**

We have **full-stack** expertise in integrating analytics capabilities to existing IT infrastructure, using either **open-source** languages or **COTS** analytics software stack.

We are fluent in the creation and implantation of end-to-end of big data analytics solutions incorporating Internet-of-Things.

Analytics **Experts**

We are experts in theoretical and empirical aspects of **statistics**, **econometrics**, **machine learning** and **deep learning** algorithms.

We leverage on the latest AI technologies to develop predictive systems and prescriptive solutions.

FOUNDING MEMBERS

Dr. Jack Hong
Co-Founder

Dr. Jack Hong has a Ph.D. in Finance from the Singapore Management University. He has extensive experience in applying a wide range of advanced empirical techniques and research expertise to drive business, financial, and policy value chains.

He is an accomplished full-stack programmer in artificial intelligence (AI) and big data analytics, and concurrently an adjunct faculty with SMU.

Prior to his academic pursuits, Dr. Hong was the Corporate Planner for CapitaLand China and The Ascott Group (North Asia).

Dr. Jinghao Ke
Co-Founder

Dr. Jinghao Ke has a Ph.D. in Finance from the Singapore Management University. His research involves identifying firm value from corporate governance and executive compensation designs.

He is concurrently an adjunct faculty with SMU.

Prior to his academic pursuits, Dr. Ke served as a business consultant for several SMEs and worked on analytics projects for MNCs and government agencies.

Dr. Jonathan Khoo
Co-Founder

Dr. Jonathan Khoo has a Ph.D. in Finance from the Singapore Management University. His research involves extracting drivers of firm value from the social networks of Board and Management.

Dr. Khoo is currently a Certification Board Member of the Financial Planning Association of Singapore.

Prior to his academic pursuits, he was a PSC scholar with stints at MTI and A*STAR.

OUR BACKGROUND

- The team was formed in May 2015 by 3 Ph.D. buddies from the Singapore Management University
  - **Deep domain expertise** in economics, finance, strategy and business management
  - Research skillsets include **rigorous scientific techniques** with **big data capabilities**
  - Expertise augmented by working experiences in **coveted roles** in MNC and government entities
- Supported SMU institutions in industry and government research and outreach initiatives
- Extensive support to multiple SMEs with UOB-SMU Asian Enterprise Institute
- Formed Research Room Pte. Ltd. in Mar 2016 to formalize our support to the industry
- Provided full-service artificial intelligence and big data customization to government agencies and the industry

DEMYSTIFYING DIGITIZATION

THE AGE OF DIGITIZATION

- The age of industrialization created technology and machines that scale our **physical abilities**

- The age of digitization created technology and machines that scale our **mental and decision making abilities**

WHY DO WE CARE ABOUT DIGITIZATION?

- Disrupt or be disrupted
  - Replicative (Provide more of existing goods and services: Cheaper, better, faster)
  - Innovative (Reshape industries and add value to the economy)
    - Google, Facebook, Wechat, Alibaba and Taobao

- Cater to changing consumer expectations or lose your customers
  - Instant gratification
  - News, anytime, anywhere
  - One click setup
  - 24/7 immediate response
  - Automated administrative tasks – e.g. approvals, transfers, form filling
  - Personalized treatment with seamless transition across multiple business or lifestyle touchpoints
  - Community wisdom and reputation building

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WHY DO WE CARE ABOUT DIGITIZATION?

- Increase productivity

  - Reduce processes and increase accuracy (e.g. smart document identification, automated rules)

  - Identify anomalies accurately and instantaneously (e.g. fraudulent/erroneous entries)

  - Augment human decision-making with smart analytics to increase speed and accuracy (e.g. sentiment and topic identification for feedback)

- Increase job satisfaction

  - Reduce mundane tasks, increase engaging ones
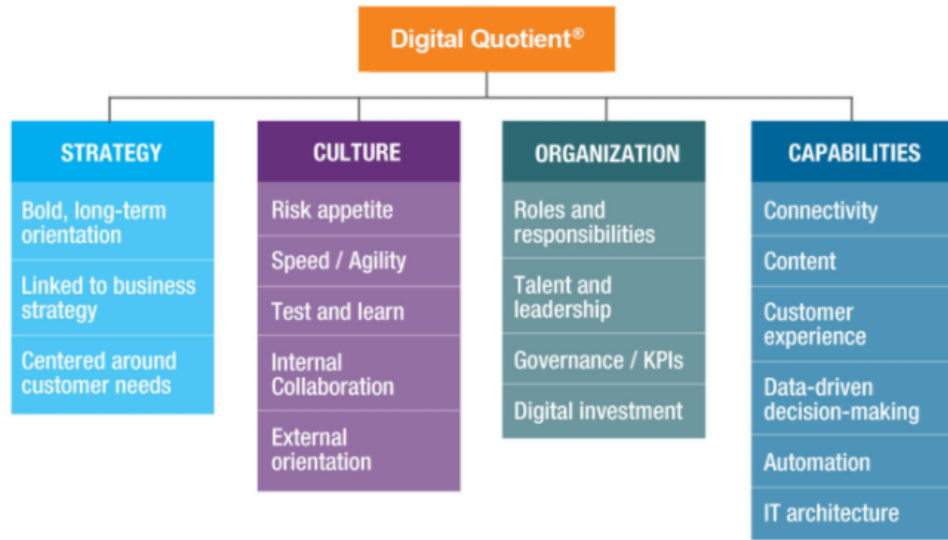
  - Cultivate and deepen skillsets of the future

THE CURRENT STATE OF DIGITIZATION

Digital Quotient® (DQ™) evaluates four major outcomes

The maturity score determined by a DQ™ assessment directly correlates with digital and financial performance

Digital Quotient®

STRATEGY	CULTURE	ORGANIZATION	CAPABILITIES
Bold, long-term orientation	Risk appetite	Roles and responsibilities	Connectivity
Linked to business strategy	Speed / Agility	Talent and leadership	Content
Centered around customer needs	Test and learn	Governance / KPIs	Customer experience
	Internal Collaboration	Digital investment	Data-driven decision-making
	External orientation		Automation
			IT architecture

The extent of digitization varies by company, with a large gap between digital leaders and the rest.

Digital Quotient[1] score, sample of large corporations

Low — Medium — Emerging — Established

Average = 34
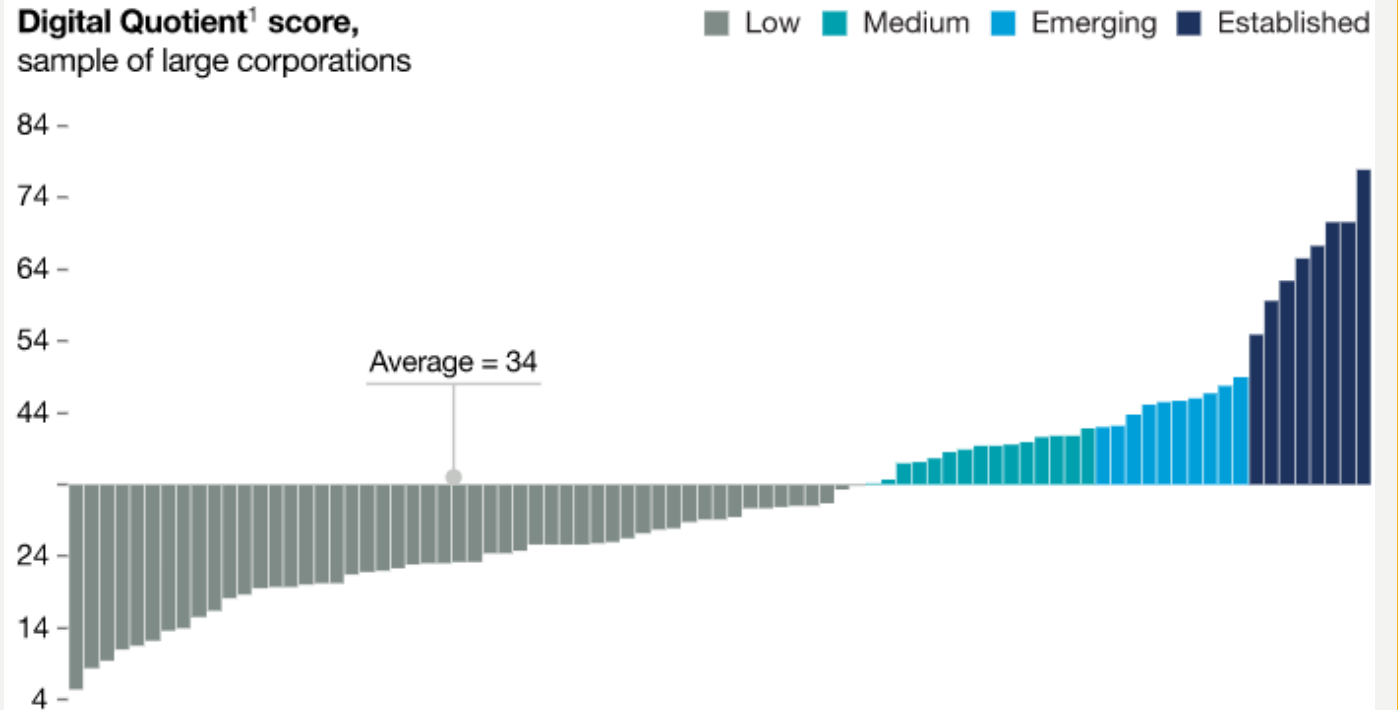
[1] By evaluating 18 practices related to digital strategy, capabilities, and culture, McKinsey has developed a single, simple metric for the digital maturity of a company.

Source: McKinsey Digital Quotient company survey, 2014–15; Tanguy Catlin, Jay Scanlan, and Paul Willmott, "Raising your Digital Quotient," *McKinsey Quarterly*, June 2015, McKinsey.com

Source: McKinsey Global Institute "What's now and next in analytics, AI, and automation." May 2017

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CORE COMPONENTS OF DIGITIZATION

- **Infrastructure and assets in technology**
  - Computing resources (machines, network etc.)
 - Data and the software to analyze them effectively
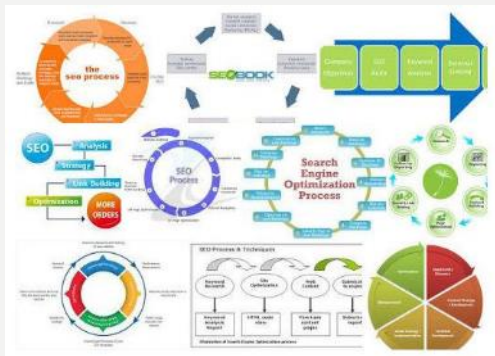
- **Business management with technology**
  - Workflow and processes
  - Operating, financing, investing activities
  - Upstream (supply chain) to downstream (customers) processes

- **Human capital in technology**
  - Skilled management and staff in technology
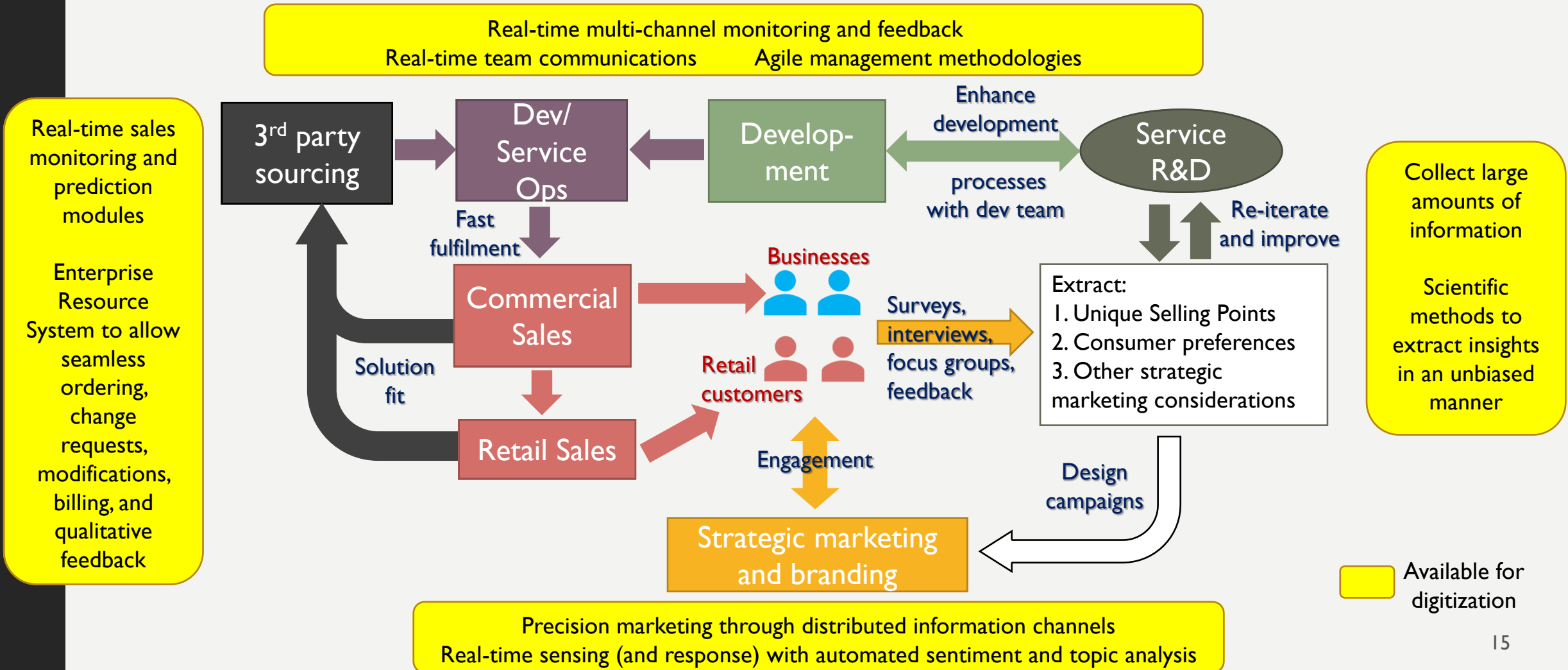 - Digital roles and responsibilities

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A REAL LIFE EXAMPLE (PRODUCT)

- Digitization involves hardware, software, business process re-design and most importantly, human capital
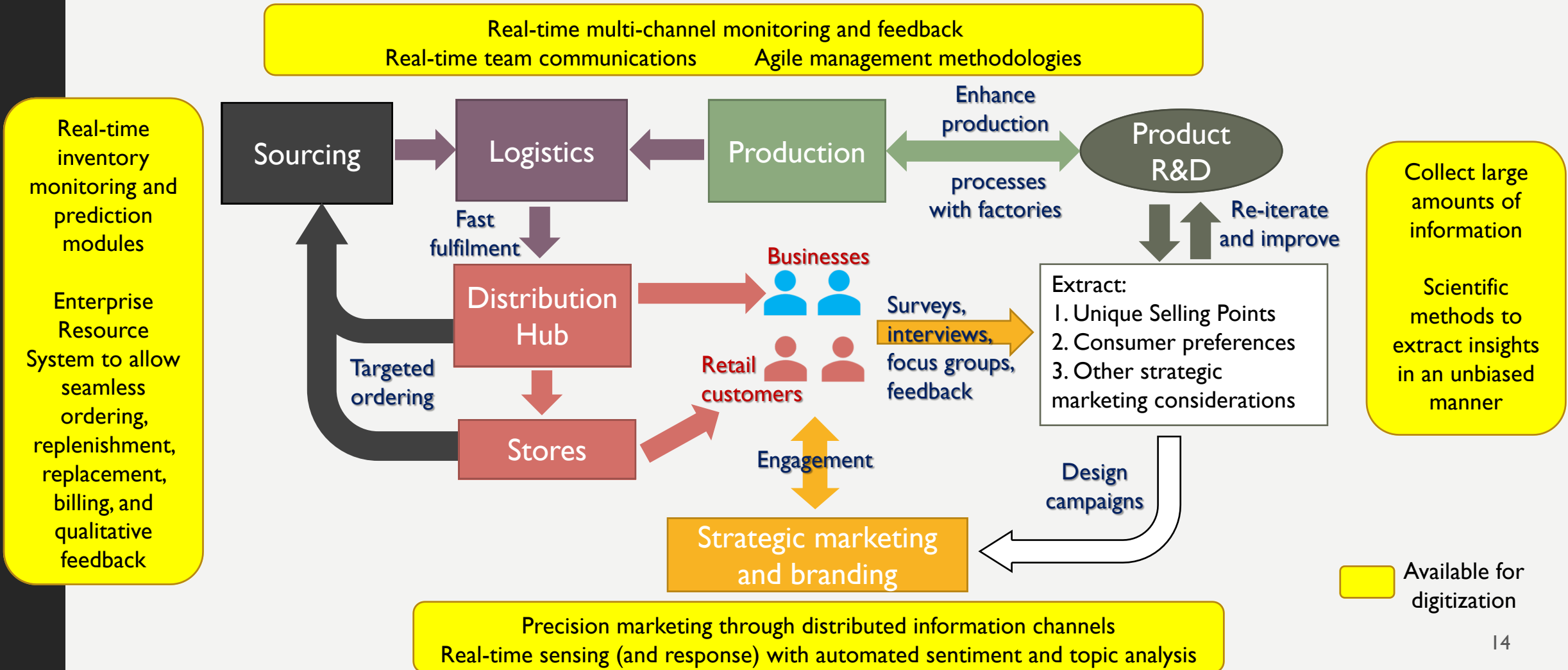
A REAL LIFE EXAMPLE (SERVICE)

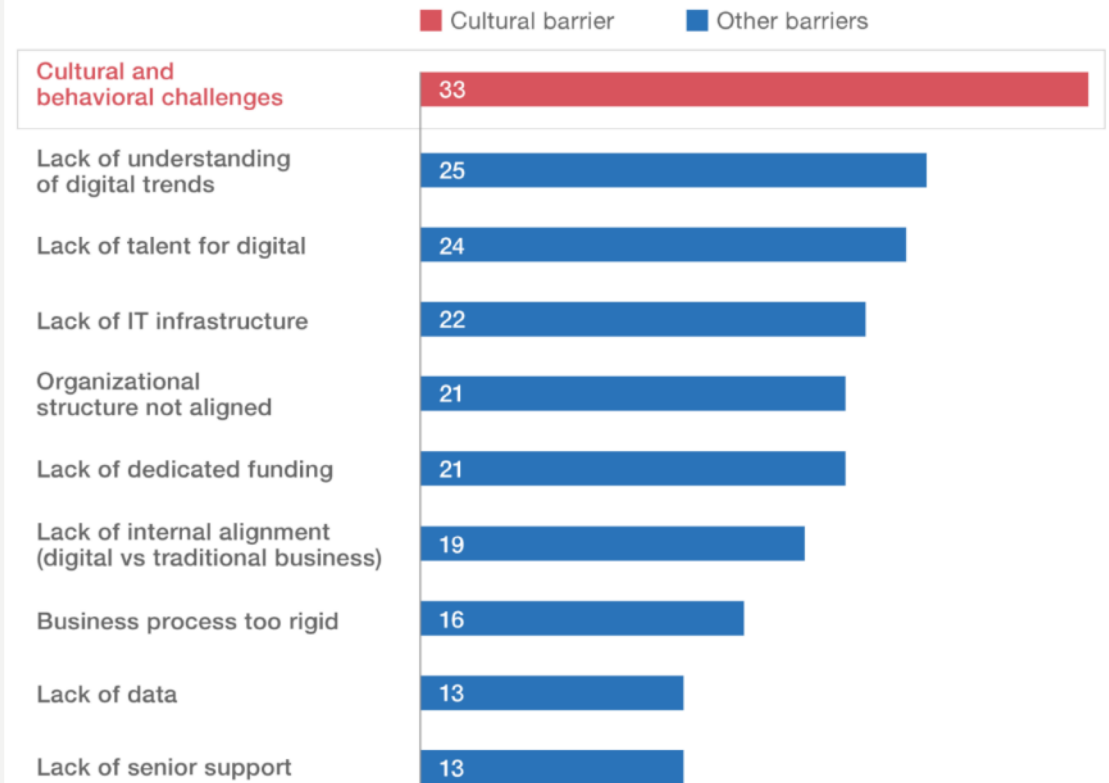- Digitization involves hardware, software, business process re-design and most importantly, human capital

Real-time multi-channel monitoring and feedback
Real-time team communications   Agile management methodologies

Real-time sales monitoring and prediction modules

Enterprise Resource System to allow seamless ordering, change requests, modifications, billing, and qualitative feedback

3rd party sourcing

Dev/ Service Ops

Develop-ment

Enhance development

Service R&D

processes with dev team

Re-iterate and improve

Fast fulfilment

Businesses

Commercial Sales

Solution fit

Surveys, interviews, focus groups, feedback

Extract:
1. Unique Selling Points
2. Consumer preferences
3. Other strategic marketing considerations

Retail customers

Retail Sales

Engagement

Design campaigns

Strategic marketing and branding

Collect large amounts of information

Scientific methods to extract insights in an unbiased manner

Available for digitization

Precision marketing through distributed information channels
Real-time sensing (and response) with automated sentiment and topic analysis

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STARTING THE TRANSFORMATION JOURNEY

Principal Considerations

- People, people, people!
  - Culture
  - Skill sets and expertise
  - Right person for the job, right job for the person
- Start with the end state in mind
  - Don't jump into constraints immediately
- Don't bite off more than you can chew
  - Trying to do everything at the same time doesn't end well most of the time
  - Multiple small wins build morale
  - Re-pivot quickly and nimbly
- Results are driven by teamwork, not ideas or the "superman" CEO/Chairman/Champion
- Build new teams to achieve results for buy-in
  - Changing mindsets, behaviours, and habits is much harder

Which are the most significant challenges to meeting digital priorities?
% of respondents

■ Cultural barrier   ■ Other barriers

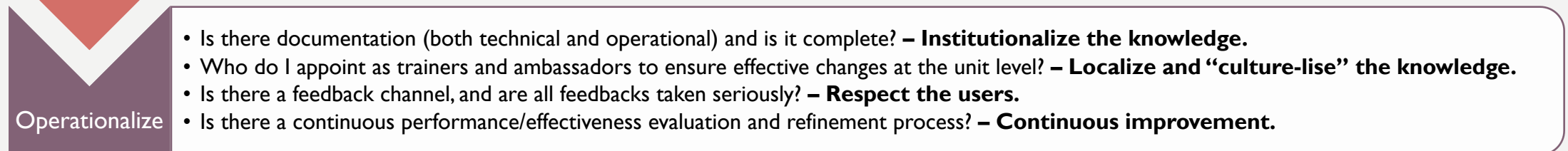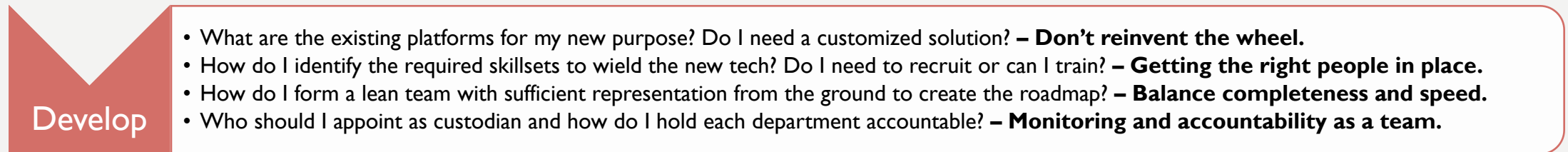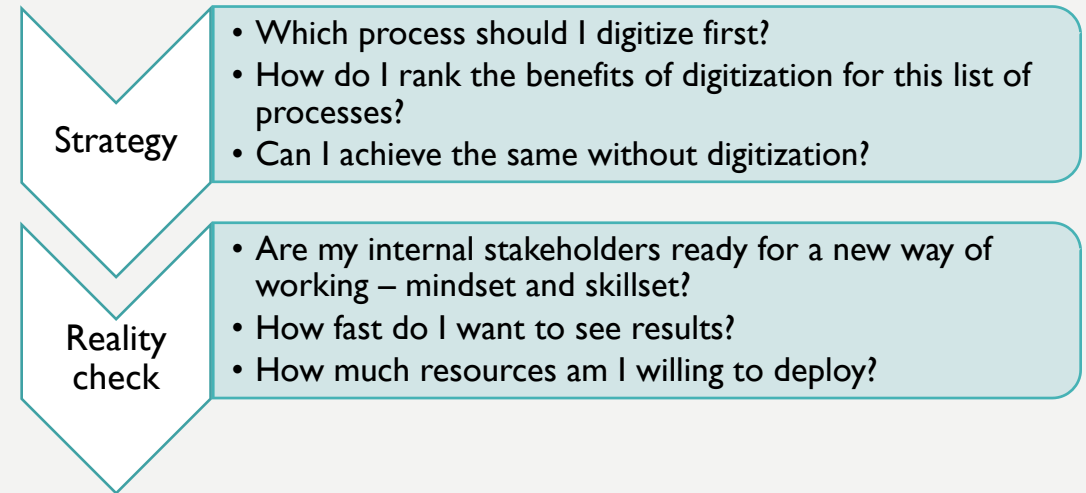|	
Cultural and behavioral challenges	33
Lack of understanding of digital trends	25
Lack of talent for digital	24
Lack of IT infrastructure	22
Organizational structure not aligned	21
Lack of dedicated funding	21
Lack of internal alignment (digital vs traditional business)	19
Business process too rigid	16
Lack of data	13
Lack of senior support	13

McKinsey&Company | Source: 2016 McKinsey Digital survey of 2,135 respondents

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GETTING IT DONE

Consumer facing – Product, Services, and Experience

Strategy
- Which products and services should I digitize first?
- Does digitization create sustained competencies and improve my long term profitability?
- Can I achieve the same without digitization?

Reality check
- Are my consumers ready for the new experience?
- Do they value the new experience?
- How fast do I want to see results?
- How much resources am I willing to deploy?

Internal facing – Process, capabilities, mindset, and skills

Strategy
- Which process should I digitize first?
- How do I rank the benefits of digitization for this list of processes?
- Can I achieve the same without digitization?

Reality check
- Are my internal stakeholders ready for a new way of working – mindset and skillset?
- How fast do I want to see results?
- How much resources am I willing to deploy?

Develop
- What are the existing platforms for my new purpose? Do I need a customized solution? **– Don't reinvent the wheel.**
- How do I identify the required skillsets to wield the new tech? Do I need to recruit or can I train? **– Getting the right people in place.**
- How do I form a lean team with sufficient representation from the ground to create the roadmap? **– Balance completeness and speed.**
- Who should I appoint as custodian and how do I hold each department accountable? **– Monitoring and accountability as a team.**

Operationalize
- Is there documentation (both technical and operational) and is it complete? **– Institutionalize the knowledge.**
- Who do I appoint as trainers and ambassadors to ensure effective changes at the unit level? **– Localize and "culture-lise" the knowledge.**
- Is there a feedback channel, and are all feedbacks taken seriously? **– Respect the users.**
- Is there a continuous performance/effectiveness evaluation and refinement process? **– Continuous improvement.**

DEMYSTIFYING ANALYTICS

WHAT IS ANALYTICS?

- Relating to domain expertise
  - Asking the right questions (formulate hypotheses)
  - Extracting the right answers (interpreting results from analytical models)

- Relating to data technology
  - Translating business data into machine readable formats
  - Managing and linking data sources
  - Allowing large amounts of data to be stored and retrieved quickly

- Relating to analytical techniques
  - Aggregating and segmenting data (dice and slice)
  - Applying decision rules to data
  - Using statistics to represent and describe the data
  - Using machine learning and deep learning to extract patterns from data (without defining rules)

**Analytics help us discover new insights from data,
through rigorous scientific interpretations of the patterns in them**

ANALYTICS ALGORITHMS: WHAT DO THEY DO?

Supervised Learning

Is this A or B?
Classification

A / B

1 2 3

How many?
Regression

Unsupervised Learning

How is it organized?
Clustering / Segmentation

What matters?
Dimension Reduction / Addition

Others

Is this weird?
Anomaly Detection
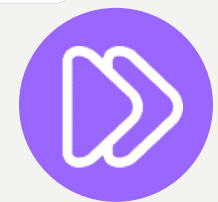
What should I do next?
Recommendation

ANALYTICS MUST BE GUIDED BY BUSINESS OBJECTIVES
- WHAT ARE YOU POINTING YOUR WEAPON AT?

Net Value
↓ cost / ↑ revenue

$

Satisfaction
~~Mundane~~

👍

Productivity
More with less, faster

⚙
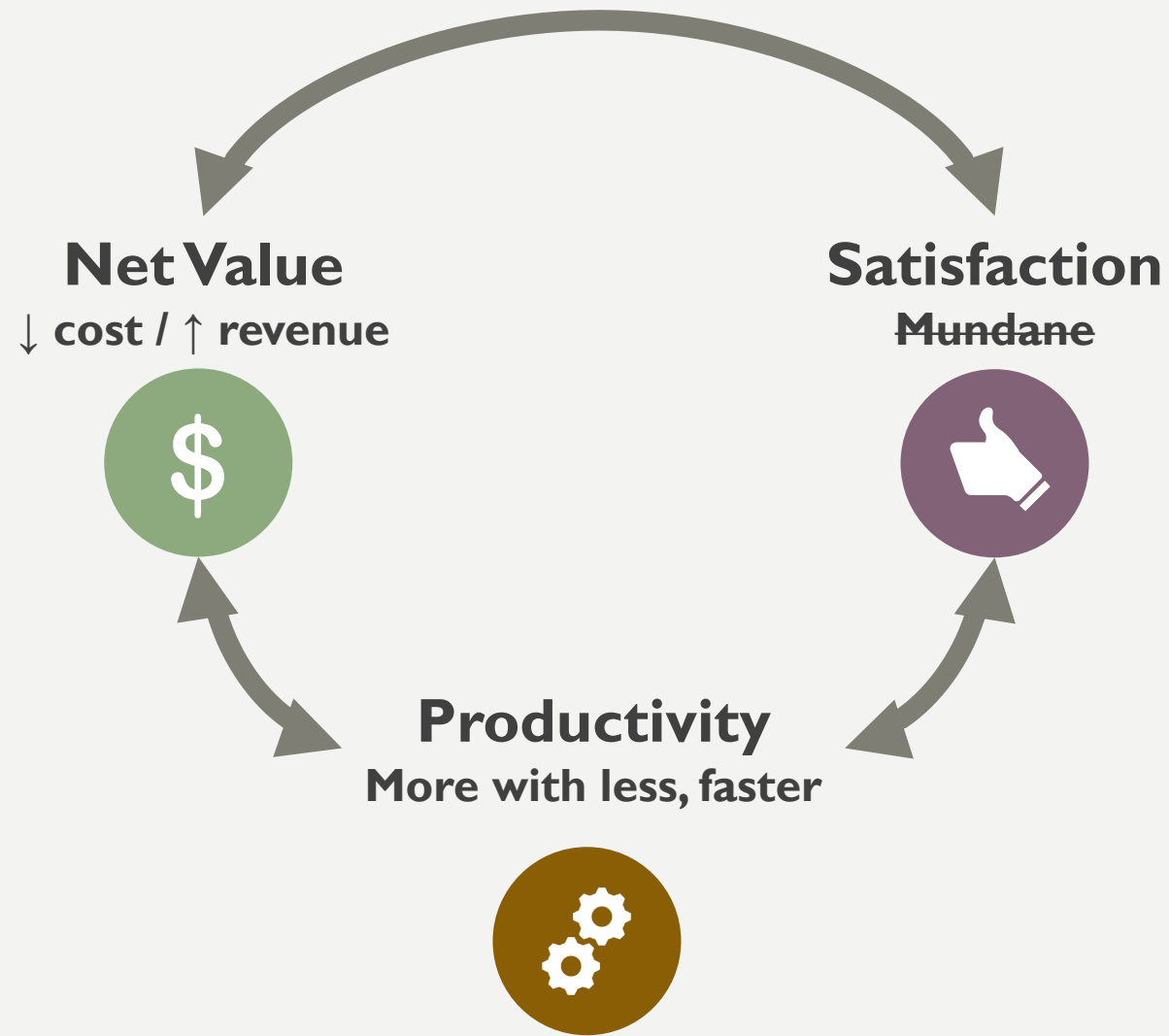
NETFLIX RECOMMENDATION

recommendation

- **Answering:**

segmentation

- **Business Objective:**

satisfaction

- 76,897 micro-genres

- Associating the type of viewers with what they like

- Inferring what new viewers may like

COMMUNITY ENGAGEMENT

- **Answering:**

  recommendation

  segmentation

- **Business Objective:**

  satisfaction

- Curated activity recommendation
  - Location
  - Profile (age, gender, interests)
  - Weather
  - Time / Day

SOCIAL MEDIA ANALYTICS
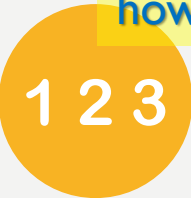
- **Answering:** **A / B**

  classification

- **Business Objective:**

  productivity

- **Past:** Copy & paste Facebook posts/comments and assigning:

  – Complaint or Compliment

  – One or many types of feedback (e.g. too slow, bunching)

- **Now:** Fully automated, consistent & high quality classification outcomes, with useful visualization for quick decision-making
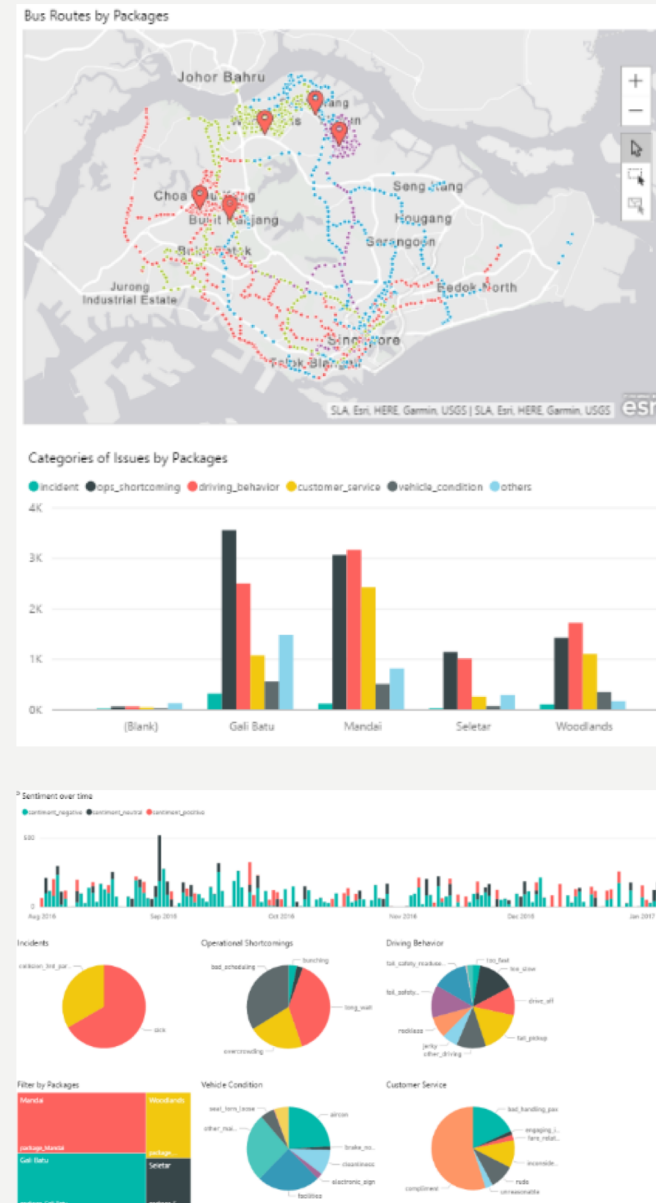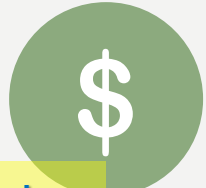
PREDICTIVE TAXI DISPATCHING

- **Answering:** 1 2 3 how many?

- **Business Objective:** productivity

- Estimate taxi waiting time
  - Weather
  - Time / Day (Holidays/Seasonal)
  - Flight load (no., origin)
  - Taxi queue count

- Basic model (using 3 publicly available environment variables) is accurate within 78.8 seconds, 95% of the time
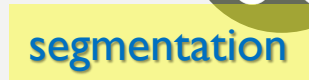
RESEARCH ROOM

TARGET CORP MARKET BASKET ANALYTICS

- **Answering:**

  classification

  A / B

  segmentation

- **Business Objective:**

  $
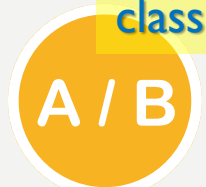
  net value

- Product placement:
  - Beer & Diapers

- Targeting:
  - Scent-free soap, extra-big bags of cotton balls

URBAN ZOOM – HOME AUTO VALUATION

RESEARCH ROOM

- **Answering:**

  classification

  A / B

  segmentation

- **Business Objective:**

  satisfaction

- Instant valuation for all homes in Singapore

- Uses advanced machine learning algorithms on a massive data set that has every unit-level transaction in Singapore since 1980

- Median error in value: 2.4%

D'LEEDON
7 Leedon Heights, #04-29, S267953
(1,216 sqft)

ZOOM PREDICTION

$1,833,137

($1,507 psf)

CONFIDENCE LEVEL: HIGH

What's this?

$2.0M
$1.9M
$1.9M
$1.9M
$1.8M
$1.8M
$1.7M
$1.7M

FEB 13 · JUN 13 · OCT 13 · FEB 14 · JUN 14 · OCT 14 · FEB 15 · JUN 15 · OCT 15 · FEB 16 · JUN 16 · OCT 16 · FEB 17 · JUN 17 · OCT 17

PREDICTION RANGE	LAST 30 DAYS CHANGE	LAST YEAR CHANGE
$1,793,788 - $1,872,485	+$5,351 (+0.3%)	+$34,441 (+1.9%)

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DESIGNING SET MENU

- **Answering:** segmentation
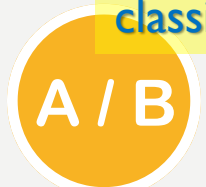
- **Business Objective:** $ net value

- What are the menu items that customers often order together?

- What should be included in a set menu?

CUSTOMIZED EDUCATION JOURNEY

R RESEARCH ROOM

- **Answering:**

  classification

  A / B

  segmentation

- **Business Objective:**

  satisfaction

- Content is mapped to a knowledge map based on a financial curriculum

- Advanced machine learning algorithms predict the optimal learning journey and recommend new content based on user interests (as revealed by their choice of content)

Stock-Picking: Skill or Luck?

INVEST ⏱ 3 min read

By Dr. Jack Hong
08 Mar 2018

COPY LINK

Before we explore the logic in the title, let's start with a simple experiment: a game of coin toss.

Let's assume you start with a wealth of $100 and perform a sequence of coin tosses. When the coin lands on heads, you get a 3% increment to your wealth, and when it lands on tails, you lose 3% of your

HR AND TALENT MANAGEMENT

RESEARCH ROOM

Objective: Recommend 1 out of 3 roles with best job fit for staff on posting list

satisfaction

Research Strategy:
1. Identify variable that measures desired outcome: **appraisal score**
2. Identify characteristics/features that may predict outcome:
   - **Individual characteristics** (e.g. age, education, rank and grade, department, past performances, mentors)
   - **Qualitative/unstructured sources** (e.g. supervisor's remarks on strengths and weaknesses)
3. Combine characteristics and qualities (topic extraction from remarks) in a model to predict appraisal scores

Goals:
1. Identify predictive features through scientific methods
2. Use these features to predict how each staff may perform in each of the 3 potential roles
3. Recommend the role with the highest predicted appraisal score for each staff
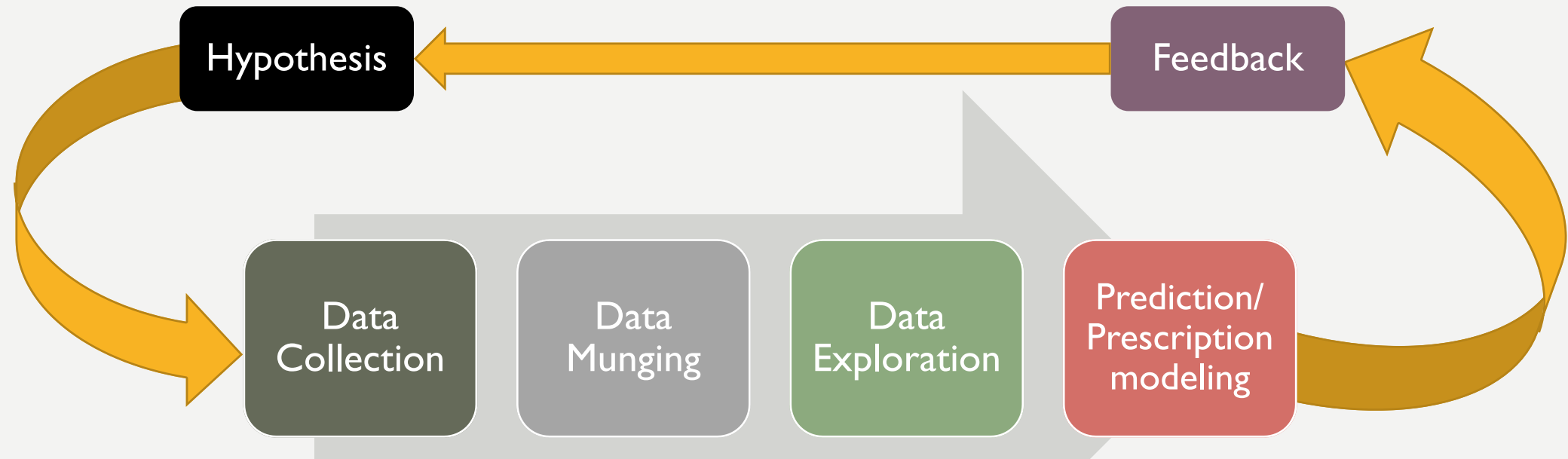
INTEGRATING ANALYTICS WITH BUSINESS MANAGEMENT

THE DATA SCIENCE VALUE CHAIN

RESEARCH ROOM

Hypothesis → **Data Collection** → **Data Munging** → **Data Exploration** → **Prediction/Prescription modeling** → **Feedback** → (back to Hypothesis)

Data Collection
- Identify data sources
- Collect data (APIs, crawlers, human labor etc.)
- Identify and implement the best data structures for storage and retrieval

Data Munging
- Identify and access datasets
- Append/merge datasets into views
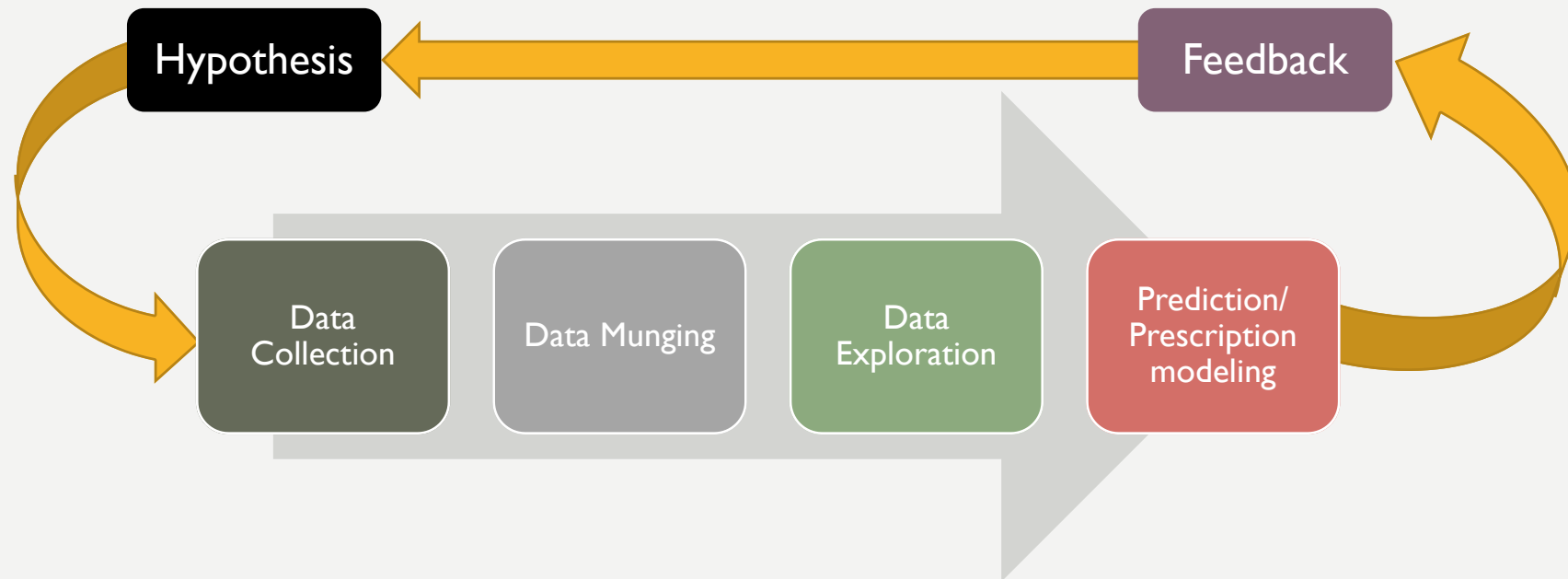- Preliminary data investigation
- Clean, transform and replace data

Data Exploration
- Apply multiple statistical and machine learning models
- Model selection
- Model comparison

Prediction/Prescription modeling
- Analyze useful features
- Does it fit the research questions?
- Predict the future using the best model
- Consider budget and other constraints

WHAT IS MORE IMPORTANT THAN THE VALUE CHAIN?

Your Story Board
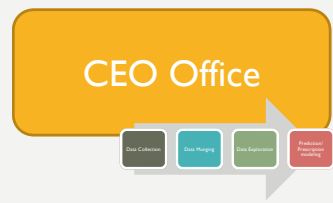- Why is your idea worth our attention?
- What questions are you trying to answer?
- Do you need data analytics to solve it?

Hypothesis → Feedback

Data Collection → Data Munging → Data Exploration → Prediction/ Prescription modeling

THE BUSINESS VALUE CHAIN
- CAN DATA ANALYTICS HELP?

RESEARCH ROOM

Corporate

CEO Office
1. Strategy and innovation

Finance and Investments
1. Anomaly detection
2. Predicting and hedging risks
3. Budget forecasting

Marketing
1. Consumer profiling
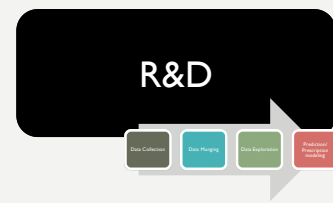2. Product/Service-mix and promo optimization

Human Resource
1. Job fit
2. Training and development
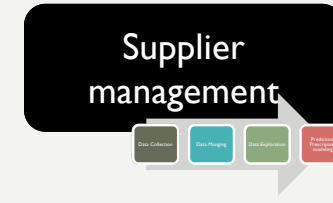3. Incentive design

Frontline

Sales
1. Sales prediction
2. Product preference
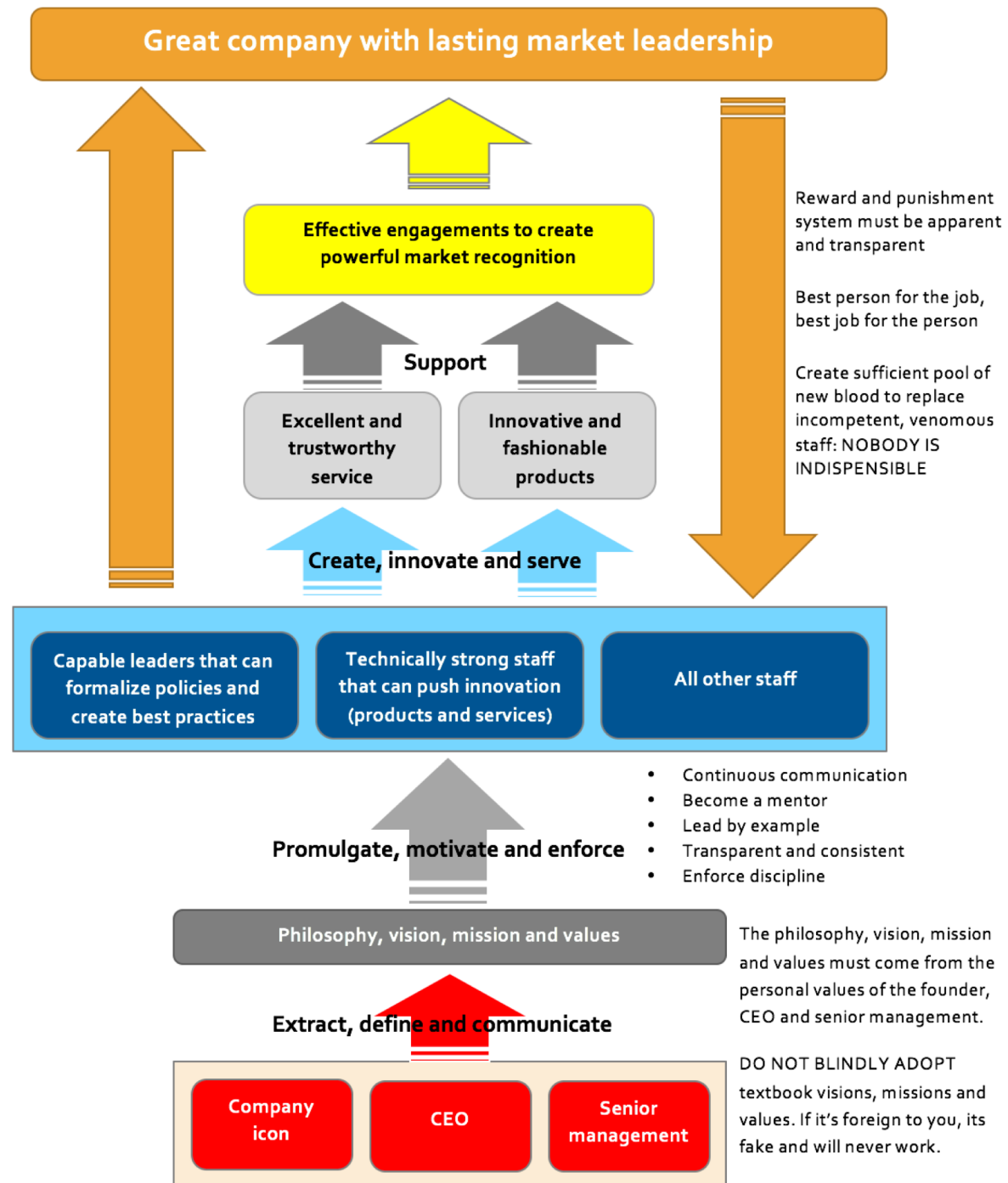3. Service recovery
4. Customer engagement

Production

R&D
1. Design-production cost optimization

Supplier management
1. Evaluating and predicting QC and fulfilment issues

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THE MANAGEMENT VALUE CHAIN
- CAN DATA ANALYTICS HELP?

Great company with lasting market leadership

Effective engagements to create powerful market recognition

Support

Excellent and trustworthy service

Innovative and fashionable products

Create, innovate and serve

Capable leaders that can formalize policies and create best practices

Technically strong staff that can push innovation (products and services)

All other staff

Promulgate, motivate and enforce

Philosophy, vision, mission and values

Extract, define and communicate

Company icon

CEO

Senior management

Reward and punishment system must be apparent and transparent

Best person for the job, best job for the person

Create sufficient pool of new blood to replace incompetent, venomous staff: NOBODY IS INDISPENSIBLE

- Continuous communication
- Become a mentor
- Lead by example
- Transparent and consistent
- Enforce discipline

The philosophy, vision, mission and values must come from the personal values of the founder, CEO and senior management.

DO NOT BLINDLY ADOPT textbook visions, missions and values. If it's foreign to you, its fake and will never work.

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IMPORTANT TAKE-AWAYS

- **Analytics is a human talent enhancer, not a business outcome**
  - The solutions to business needs must be designed and guided by business experts and specialists (domain experts), not technology
  - Nurturing technology-savvy domain experts is the right direction, buying technology is not

- **Analytics is not the panacea to all business problems**
  - Business models and solutions determine the success of your business, not analytics
  - Deploying analytics with precision strikes is the right direction, using analytics to carpet-bomb a battlefield is not

- **Analytics is not new, deep learning first appeared in the 1950s**
  - Don't get too excited by 'new' technologies
  - Most balanced algorithms (resource intensity, accuracy and prescriptive value) are amongst the more matured techniques

- **Communication strategy is more important than algorithms**
  - The purpose and deliverables are more important than fanciful black box equations
  - Deriving and communicating insights that can help management make better decisions, help frontlines improve operational performance, help corporate office increase productivity
  - Convincing people to change their mindsets is way harder than writing algorithms

QUESTIONS?