



# Conversational AI is reshaping the human-machine interaction

November 2020



**MAKING AN  
IMPACT THAT  
MATTERS**  
*since 1845*

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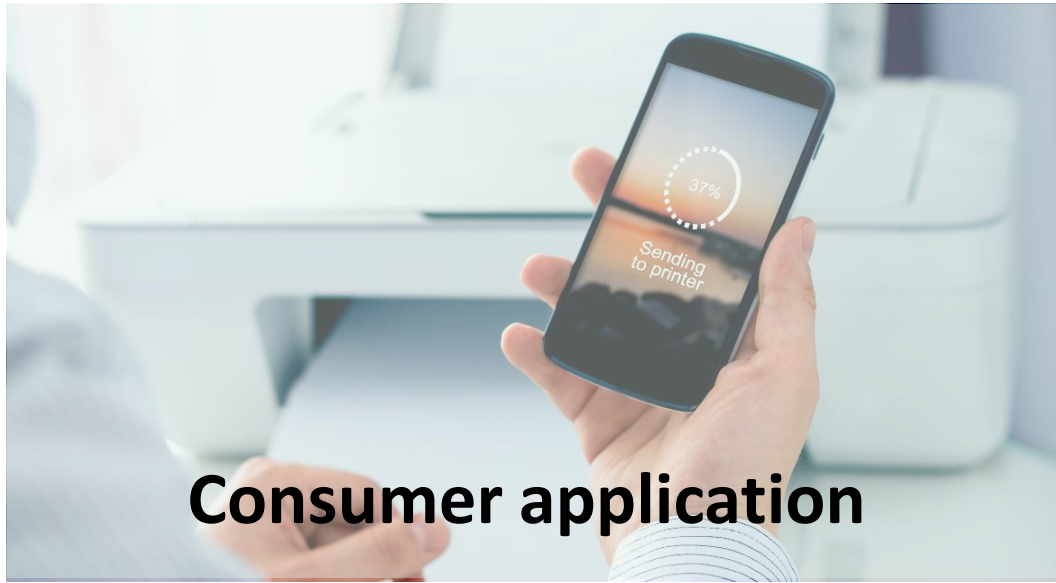
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# What is Conversational AI ?



**Conversational AI (CAI)** combines natural language processing , AI, and machine learning to understand and respond to free-form text or voice in an engaging and personalized manner.



**Consumer application**



**Business application**

**Typical scenarios**



**Intelligent vehicle**

Speech navigation  
Voice control



**Wearable device**

Smart watch  
Smart band



**Smart phone**

Voice assistant  
APP



**Smart home**

Intelligent lighting  
Intelligent kitchen



**Healthcare**

Voice diagnosis  
Hospital guidance



**Finance**

Call center  
Interactive voice response



**Education**

Speech teaching  
Speech assessment

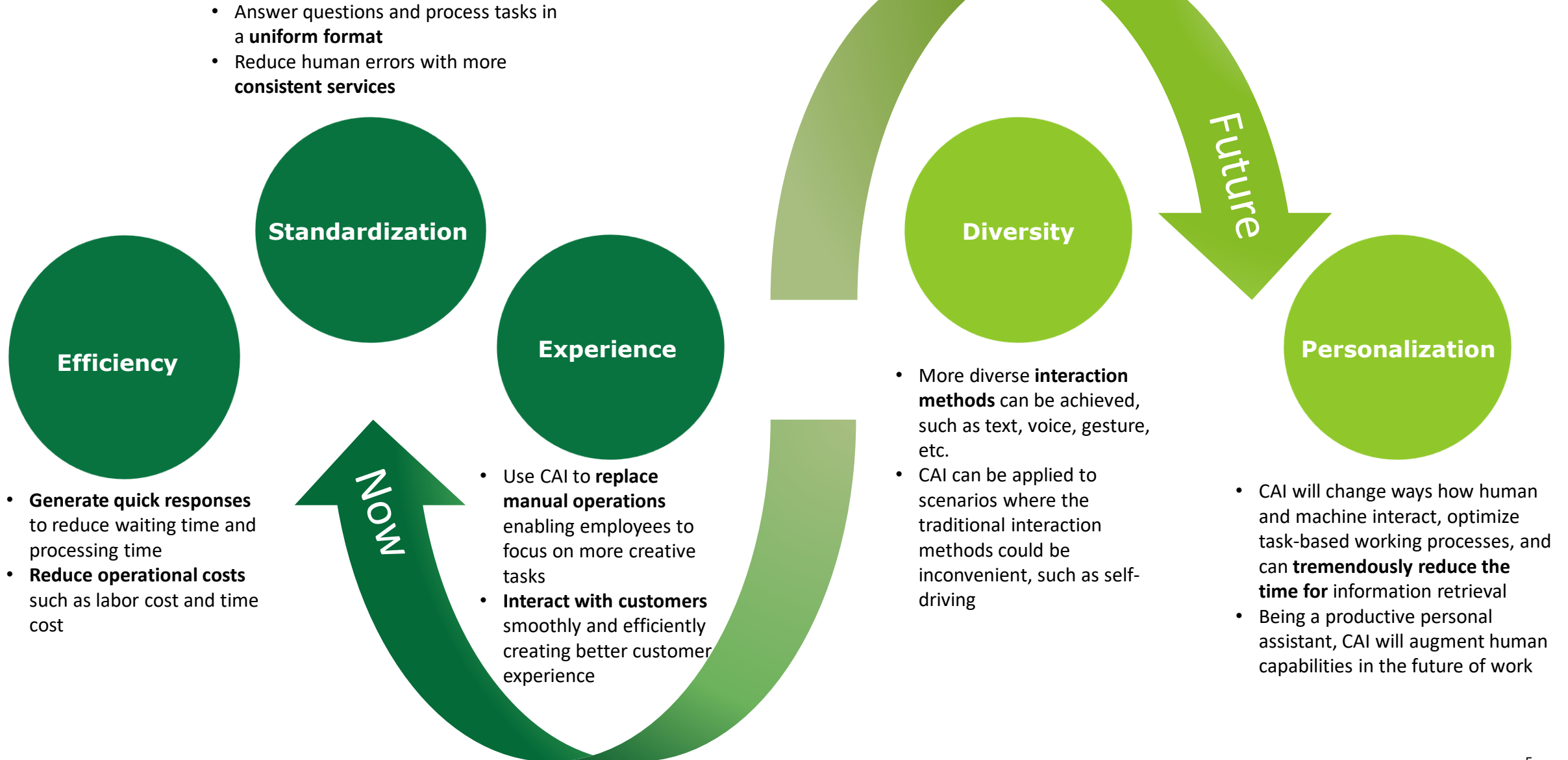


**Manufacturing**

Industrial robot

**Transform the ways we live and work**

# Benefits of CAI in organizations



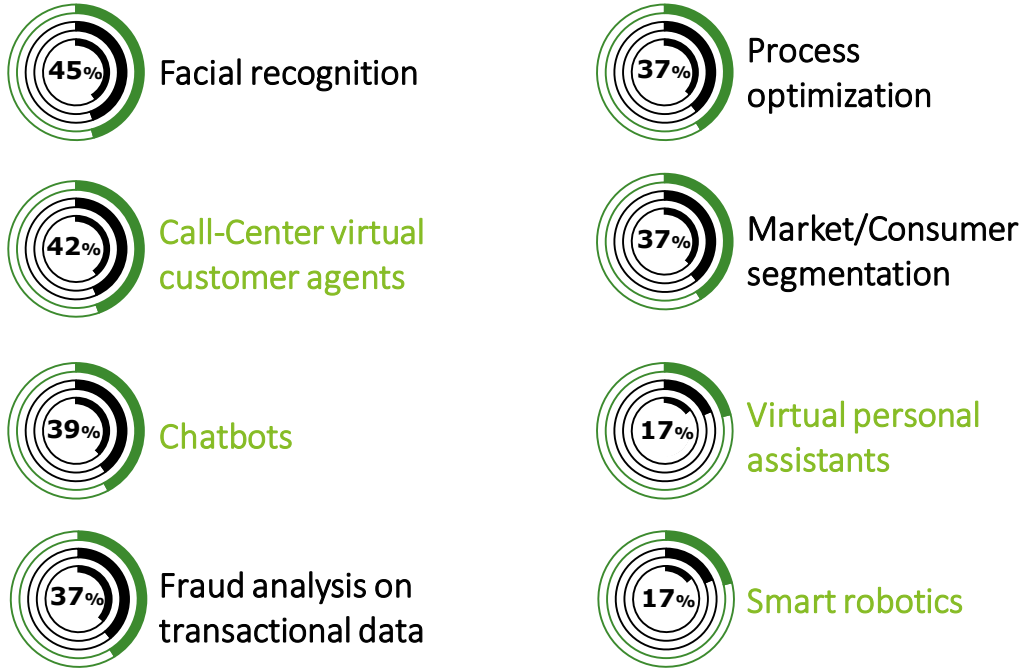
A hand in a light blue shirt sleeve reaches out from the left side of the frame towards a complex, glowing digital network structure. The network consists of numerous white nodes connected by thin, light blue lines, creating a dense, interconnected web. The background is dark, with a bright, glowing orange and yellow light source behind the network, creating a lens flare effect. The overall color palette is dominated by blues, whites, and oranges.

**CAI development**

# CAI growth in applications

## CAI plays a major role in the applications of Artificial Intelligence

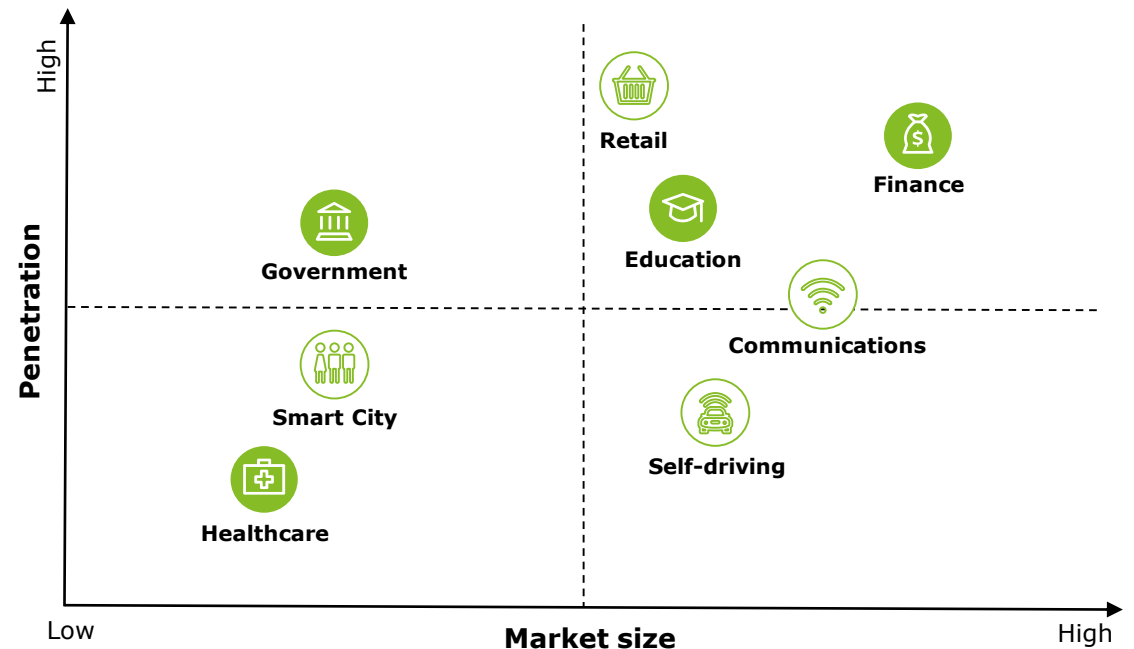
### Leading use cases for CAI in AI deployment <sup>1</sup>



(Percentage of China respondents)

- Speech-activated applications have been widely adopted in the field of AI, such as call-center virtual customer agents, chatbots, virtual personal assistants, and smart robotics.

### CAI penetration in leading AI industries <sup>2</sup>



(Penetration: industry application degree; Market size: marketing opportunity)

- CAI has a higher penetration rate in finance, education, government and healthcare among applications across industries.

# Four drivers of CAI growth

## Machine learning, deep learning and other technologies build solid foundation for CAI

- Deep learning has made great breakthroughs in speech recognition, natural language processing and speech synthesis.
- In the future, it is possible to realize barrier-free human-machine emotional communications.

## Development of chips and cloud technology has fueled the basic computing power to CAI

- The development of chips and cloud computing shows the trend of integrating with AI.
- With the development of edge AI chips, CAI will find its way into mobile devices.
- Cloud computing enables enterprises and governments to offer more personalized and intelligent services and products.

1 Algorithm

2 Computing power

3 Policy

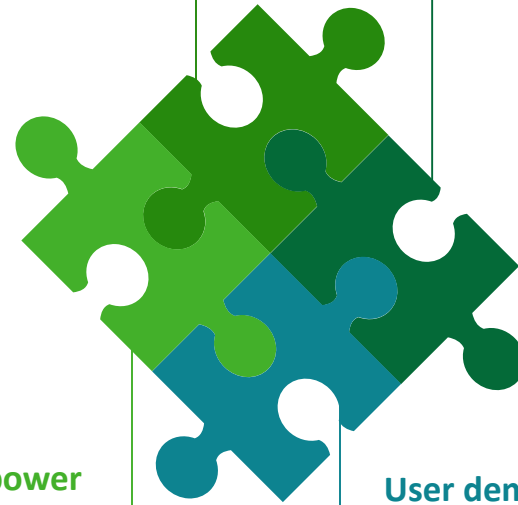
4 CAI is transforming the ways we live and work

## Policy is a catalyst for the future of AI growth

- Policy has gone through three phases, from single products to data-driven innovation platforms, from individual actions to national strategies, and most importantly, from AI technology development to the integration of AI and the real economy.

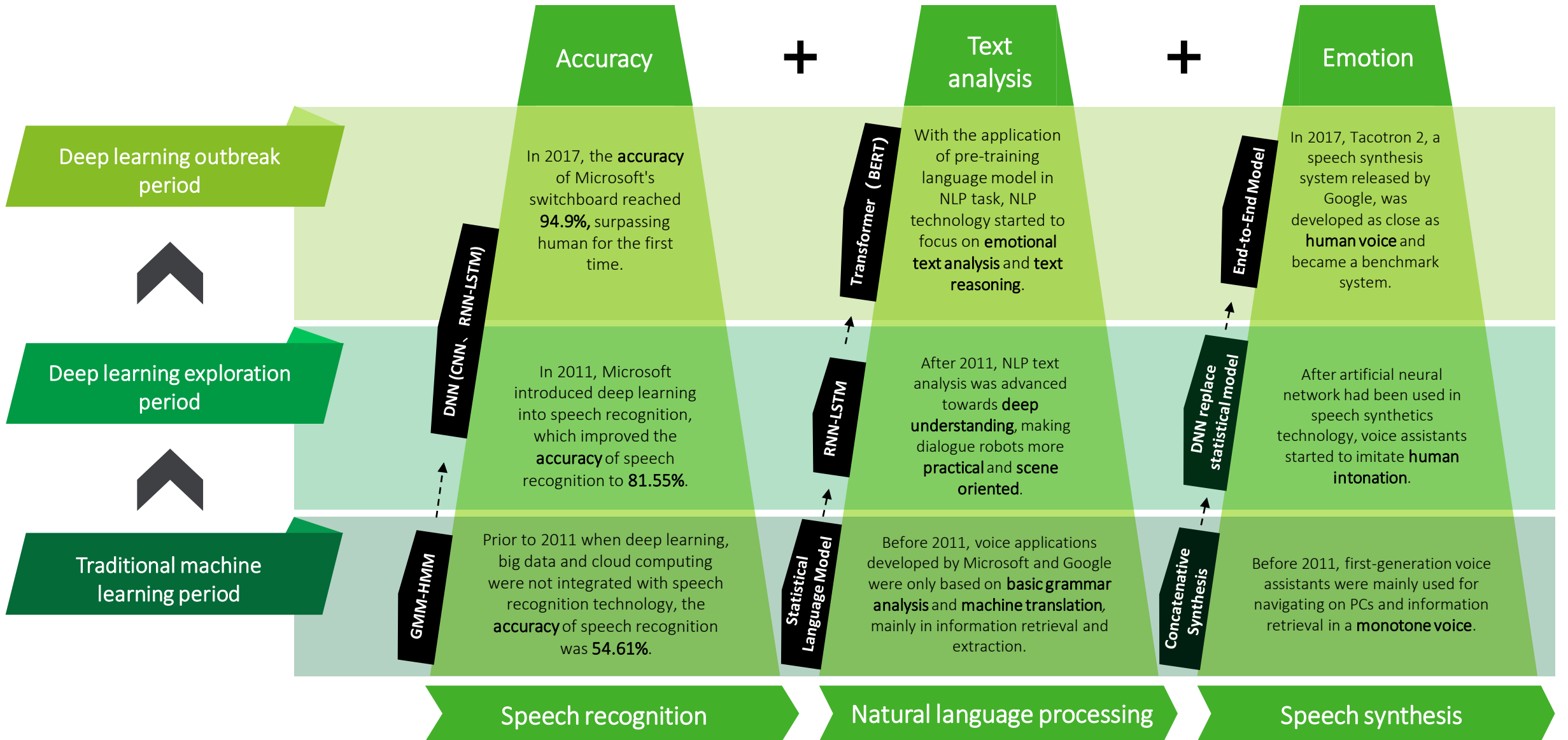
## CAI is transforming the ways we live and work

- Extensive applications of CAI have emerged in consumer market.
- CAI brings value enhancement to various industries.
- Users hold more positive attitudes toward CAI applications.





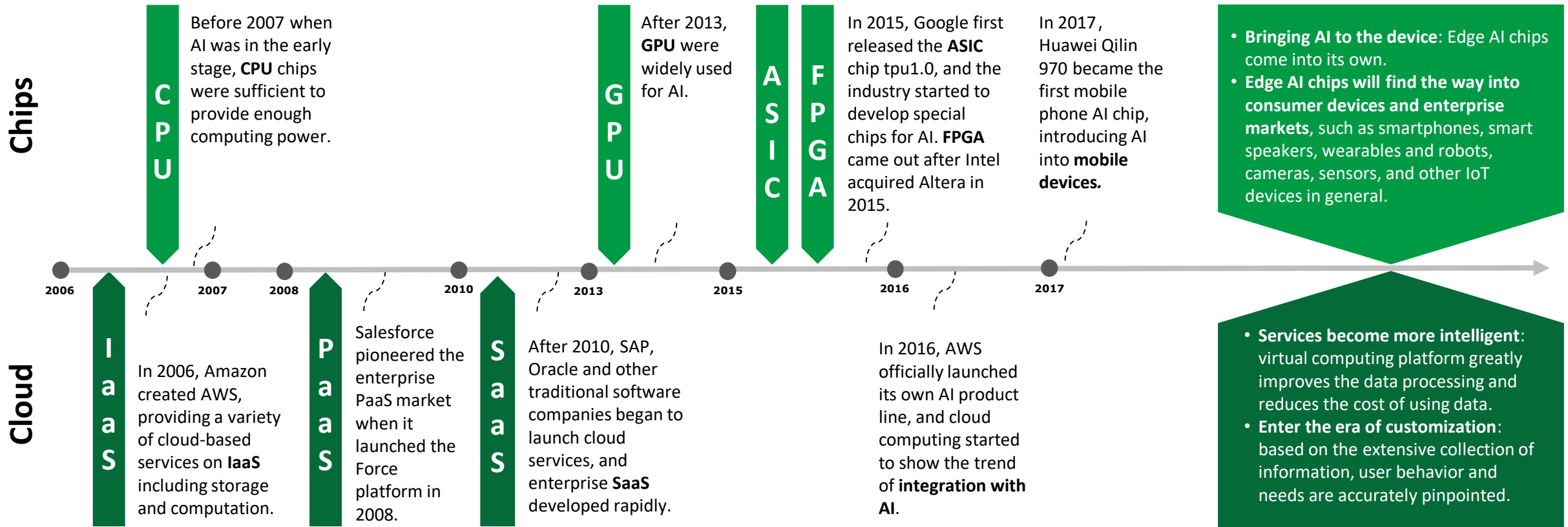
# Algorithm



# Computing power

The increasing computing power releases the potential of AI algorithms

The continuous chip evolution integrated with cloud computing



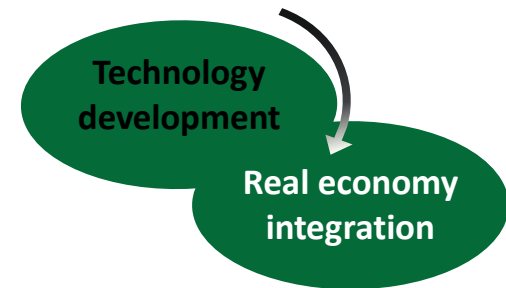
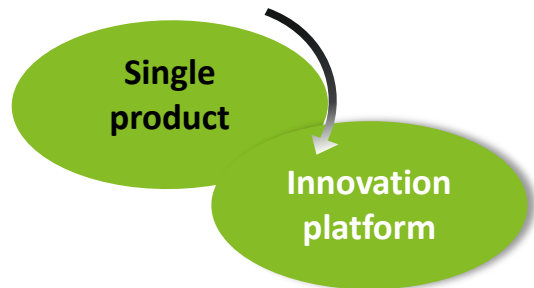
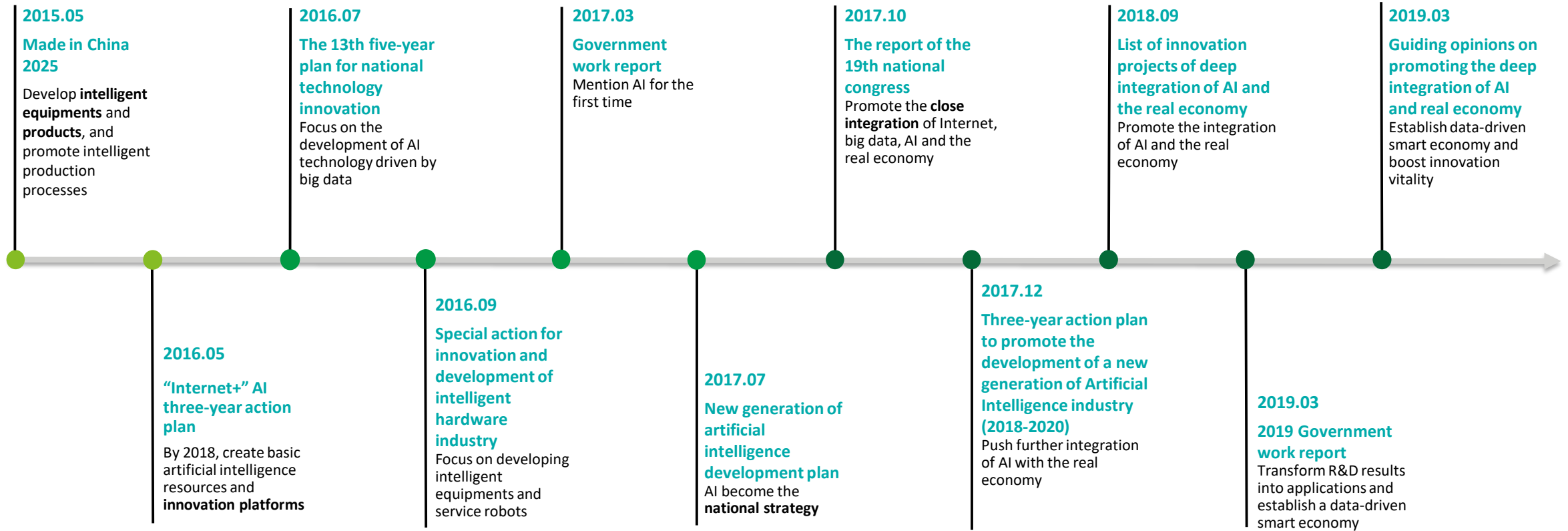
## AI + Edge Computing

- **Bringing AI to the device:** Edge AI chips come into its own.
- **Edge AI chips will find the way into consumer devices and enterprise markets,** such as smartphones, smart speakers, wearables and robots, cameras, sensors, and other IoT devices in general.

- **Services become more intelligent:** virtual computing platform greatly improves the data processing and reduces the cost of using data.
- **Enter the era of customization:** based on the extensive collection of information, user behavior and needs are accurately pinpointed.

## AI + Cloud

# Policy



## User demand - consumer

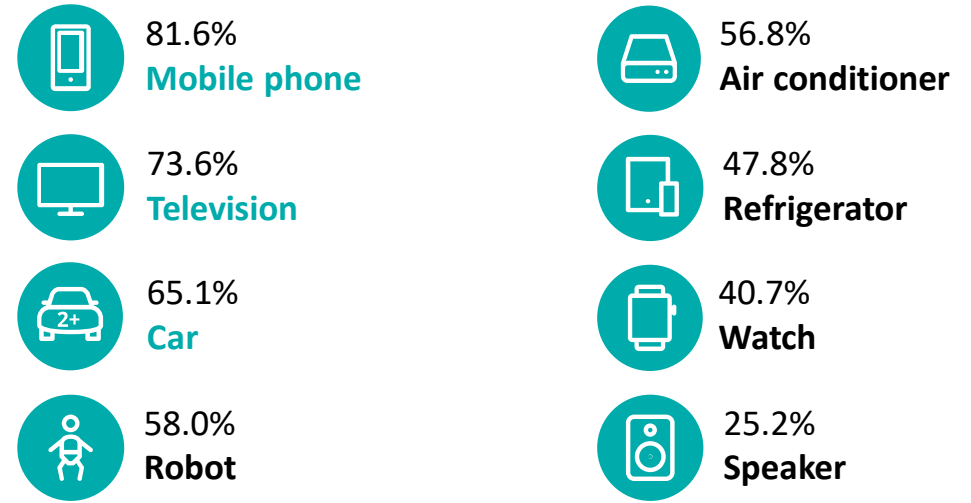


### Why Conversational AI in consumer market ?

- Hands-free
- Improve the quality of life
- Enhance human-machine interaction

### Users hold a more positive attitude toward CAI

User's expectation of CAI for equipment



- On smartphones, CAI related applications that users expect to see are information inquiry, weather broadcast, function setting and chatting.
- On televisions, voice control switch and timer setting are the top two desired CAI applications.
- In terms of intelligent vehicles, applications with conversational features expected by users are mainly voice navigation and control system.

# User demand - business

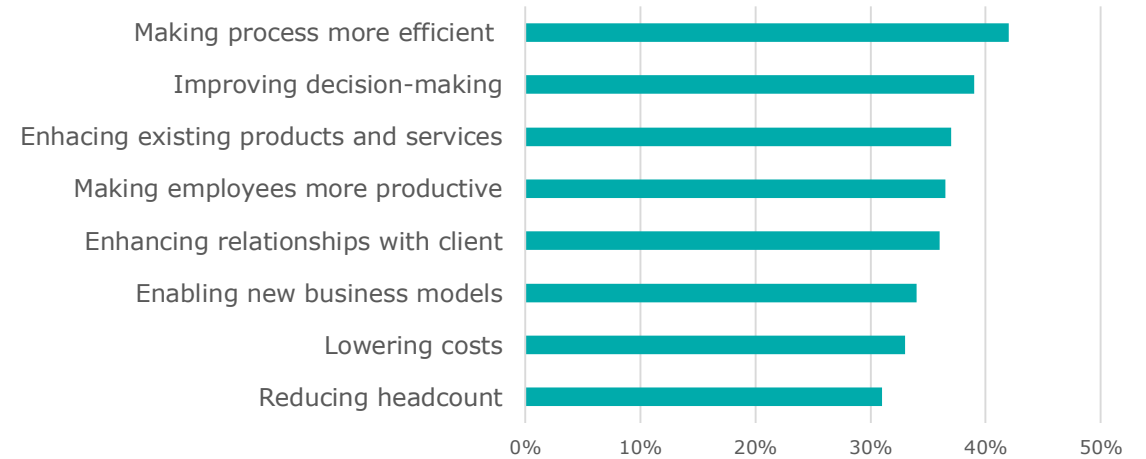


## Why Conversational AI in business market ?

- Improve operational efficiency
- Reduce labor cost
- Enhance quality of services
- Transform the ways we work

## CAI plays key role in AI benefits

Top AI benefits selected by organizations across the globe



- Making process more efficient: free up hands, change working paradigms and replace the tedious and high-cost operations with machines.
- Improving decision-making: find hot spots for the market and provide data support for follow-up planning.
- Enhancing existing products and services: transform human-machine interaction to provide customers with more personalized experience.

# Industry specific commercial applications



# Industry specific commercial application – financial services

## Applications of CAI in financial services focus on front-end customer services

Mostly adopted applications of CAI in financial service

<p><b>1</b></p> <p><b>Customer service</b></p> <ul style="list-style-type: none"> <li>• <b>Online virtual assistants</b> Online virtual assistants play a complementary role to human agents. These virtual assistants would chat with customers, understand customers' requirements and respond to their inquiries in an interactive way.</li> <li>• <b>Outbound call system</b> Outbound virtual agents would take the initiative to call customers, screening out most of the repetitive work for human assistant, such as tele-sales, customer feedback collection, and identity authentication.</li> </ul>	<p><b>2</b></p> <p><b>Speech navigation</b></p> <ul style="list-style-type: none"> <li>• <b>Speech navigation</b> This application replaces manual press-button function with navigation via speech, making it easier for customers to navigate on the phone when calling to service center.</li> </ul>	<p><b>3</b></p> <p><b>Extensive analysis</b></p> <ul style="list-style-type: none"> <li>• <b>Find hot spots in the market</b> With massive amount of speech information, identify most frequently used words and extract information valuable to potential commercial opportunities.</li> <li>• <b>Provide data support for machine learning</b> The corpus, generated from the speech information, greatly improves the machine learning database. Additionally, such database would provide reference for subsequent conversational interaction.</li> </ul>
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<p><b>Labor cost reduction</b></p>	<p><b>Instantaneity and mobility</b></p>	<p><b>Data accumulation for machine learning</b></p>
<p><b>Improvement of customer service efficiency</b></p>	<p><b>Multi-channel of service</b></p>	<p><b>Data support for subsequent marketing</b></p>

**Full penetration of CAI into customer relationship management in financial services**

Application scenarios embedded CAI in different fields of financial industry

<p><b>Banking</b></p> <p>Provide counter services inquiries such as deposit, transfer, loan and account settings</p>	<p><b>Insurance</b></p> <p>Recommend appropriate insurance products according to user profile and experience</p>	<p><b>Investment</b></p> <p>Provide the latest price information of stocks and funds, and speculate about the future</p>
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- In the financial industry, hundreds of banks, security companies and insurance companies have launched intelligent customer service systems since 2017.
- Due to huge total investment and fund size, Robo-advisor can be expected.

# Industry specific commercial application – healthcare

CAI has penetrated in every process of the hospital care system

## Diagnosis



### Formation of electronic medical record

Record the verbal consultation between doctors and patients, and generate the electronic medical records with CAI system processing voice information automatically.

Testing outcomes and radiology diagnosis reports can also be generated by physicians with voice narration.

## Operation



### Non-contact intelligent voice interaction

In the operating room, doctors can retrieve the medical records, images and other relevant data of patients through speech input.



### Medical robot

Compare the patient's disease description with the standard medical guide, and provide services such as guidance, medical consulting, self diagnosis, etc. At the same time, the intelligent robot can complete medical history collection work in advance through dialogue.

## Reporting



### Speech generation of diagnosis report

Integrate with each diagnosis report workstation to realize speech generation of diagnosis report, and transmit diagnosis results to patients and doctors in the form of voice output.

CAI applications have improved the healthcare services and alleviated the medical pressure caused by the shortage of medical resources with more efficient solutions



# Industry specific commercial application – automobile

Voice will become the primary interaction media between human and auto



## Voice navigation

The system can understand the travel requirements of customers through voice interaction and complete the navigation service, which helps the driver focus on driving and ensures the safety to the maximum extent.



## Control system

Instead of pressing buttons to control the car, drivers and passengers can directly control the car by talking to it, enjoying a more comfortable and convenient ride, improving the safety during driving and enriching the entertaining experience.



## Search engine

Replace the traditional search interface with voice interaction, including music search, weather and calendar query, stock search, restaurant recommendation and other functions. It makes the vehicle more intelligent and improves the in-car experience.



## Security

Based on the voice recognition and monitoring system, the on-board equipment can send out security alarm to the emergency contacts, so as to maintain the safety of vehicles and passengers and improve the lack of safety services in the vehicle system.

**In 2019, the penetration rate of CAI in intelligent vehicles has reached 40%, and shows a continuous growth trend**







# Industry specific commercial application – education

CAI enhanced education will be adaptive, customized and unlimited

	Learning	Practicing	Assessment
Language	<p>CAI can provide qualified and customized courses</p> <p>Voice enhanced AI could replace traditional manual teaching in fields of both language and specialty education by providing qualified courses.</p>	<p><b>Pronunciation, passage reading, oral expression and etc.</b></p> <p>Users can practice oral pronunciation and Q&amp;A in multiple languages with CAI education system which will provide assessment, feedback and correction.</p>	<p><b>Test and evaluate users' speech expression</b></p> <p>Assess the examinee's pronunciation and language ability without human bias.</p>
Specialty	<p>Intelligent adaptive course systems can use big data and algorithms to develop a set of effective and customized courses for all levels.</p>	<p><b>Structured musical practice</b></p> <p>By voice interaction and motion capture, students' proficiency and accuracy in vocal, musical instruments and other skills are evaluated.</p>	<p><b>Proficiency and accuracy</b></p> <p>Based on the speech recognition and motion capture technologies, the comprehensive ability of examinees is evaluated, including proficiency, accuracy and etc.</p>

- **Alleviate the problem of uneven distribution of education resources:** Intelligent education makes it possible to share educational resources.
- **Promote customized learning applications:** User demands drives educational products to be more diversified and personalized. The combination of online and offline courses makes it more adaptive to users at any level.

# CAI business applications landscape

Industries	Value	Typical applications	Application cases
 <b>Finance</b>		<ul style="list-style-type: none"> <li>• Call center</li> <li>• Intelligent customer service</li> <li>• Intelligent office system</li> </ul>	<ul style="list-style-type: none"> <li>• Chat-bots replace agents and reduce their repetitive work</li> <li>• Virtual assistants recommend personalized products</li> </ul>
 <b>Healthcare</b>	<ul style="list-style-type: none"> <li>• Improving internal operations</li> <li>• Improving products and services</li> </ul>	<ul style="list-style-type: none"> <li>• Electronic medical record</li> <li>• Mobile medical care</li> <li>• Diagnosis report</li> </ul>	<ul style="list-style-type: none"> <li>• Record the consultation processes and generate the electronic medical records</li> <li>• Nurses can extract the patient's information by voice input</li> <li>• Transmit diagnosis to patients and doctors in the form of voice</li> </ul>
 <b>Retailing</b>	<ul style="list-style-type: none"> <li>• Enhancing existing products</li> <li>• Making processes more efficient</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligent logistics</li> <li>• Intelligent sales</li> <li>• Intelligent customer service</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time tracking of transportation path of goods</li> <li>• Chat robot recommends personalized products to consumer</li> <li>• Chatbot replaces manual customer service</li> </ul>
 <b>Manufacturing</b>	<ul style="list-style-type: none"> <li>• Optimizing decision-making</li> <li>• Enhancing relationship with customers</li> <li>• Enabling new business models</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligent interface</li> </ul>	<ul style="list-style-type: none"> <li>• Interact with users through voice, video and other modes</li> </ul>
 <b>Education</b>	<ul style="list-style-type: none"> <li>• Lowering costs</li> <li>• Making employees more productive</li> </ul>	<ul style="list-style-type: none"> <li>• Speech teaching</li> <li>• Speech evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Online intelligent teaching</li> <li>• Test and assess in the form of voice</li> </ul>
 <b>Government</b>		<ul style="list-style-type: none"> <li>• Intelligent government service</li> </ul>	<ul style="list-style-type: none"> <li>• Optimize the public hotline</li> </ul>

# Customer experience

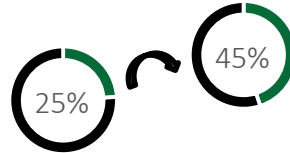


# CAI application status in customer service

## Virtual Customer Assistant (VCA) market

### VCA market growth

The Virtual Customer Assistant market will grow between **25% and 45%** annually over the next three years.



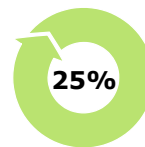
### Customer service interaction

By **2021**, nearly **one in six** customer service interactions globally will be handled by AI.



### Efficiency improvement

By **2025**, customer service organizations that embed AI in their multichannel customer engagement platform **will elevate operational efficiency by 25%**.



## Pioneering industries deploying VCAs



Financial Services



Technology, Media & Telecommunications



Health Care



Energy, Resources & Industrials



### The mutual characteristics of those industries



A large customer base frequently engaged



A limited set of less-complex frequently asked questions fit for robots



The continuous pursuit for reducing cost

## CAI challenges in customer service

What challenges will we encounter in customer services ?

Lack of operations process on how agents use AI to assist their work

**Lack of synergy between different channels**      Hard to deliver

Chatbots will not reduce headcount or interactions      Labor cost is still high

**Fail to deliver better customer experiences**

Limited functionality      Lack of standardization of operations process

Reporting and analytics focus too little on experience

**Lack of human and AI blending**      Employees may worry about their job prospects

Customers are reluctant to use chat-bots instead of agents when seeking service

**Long development period**      **Cannot satisfy users' diverse demands**

Fail to understand the user demand

**Efficiency has not been improved**

# Pain points of AI management in customer service

## Strategy and Planning



Most enterprises do not have a holistic **data science strategy** to systematically plan and organize datasets, models and applications.



Customers leave information in multiple channels such as text, voice interaction and operation records. However, there is no **integration to deliver synergy**.



Most enterprises highly rely on vendors' capabilities instead of **accumulating core AI competence** such as AI specialists, datasets, algorithm and etc.

## Procurement and Implementation



Lack of appropriate **procurement methodology** in selecting vendors in data science.



The degree of **vertical specialization** is low in most standard VCA products, which is hard to meet user requirements in different businesses.



Lack of **data science middleware** to centralize data, prepare datasets, and train and manage models.

## Operation



VCA **operation process** is not well designed. VCA only participates in basic work with high repetition. It still needs agents to participate in complex issues.

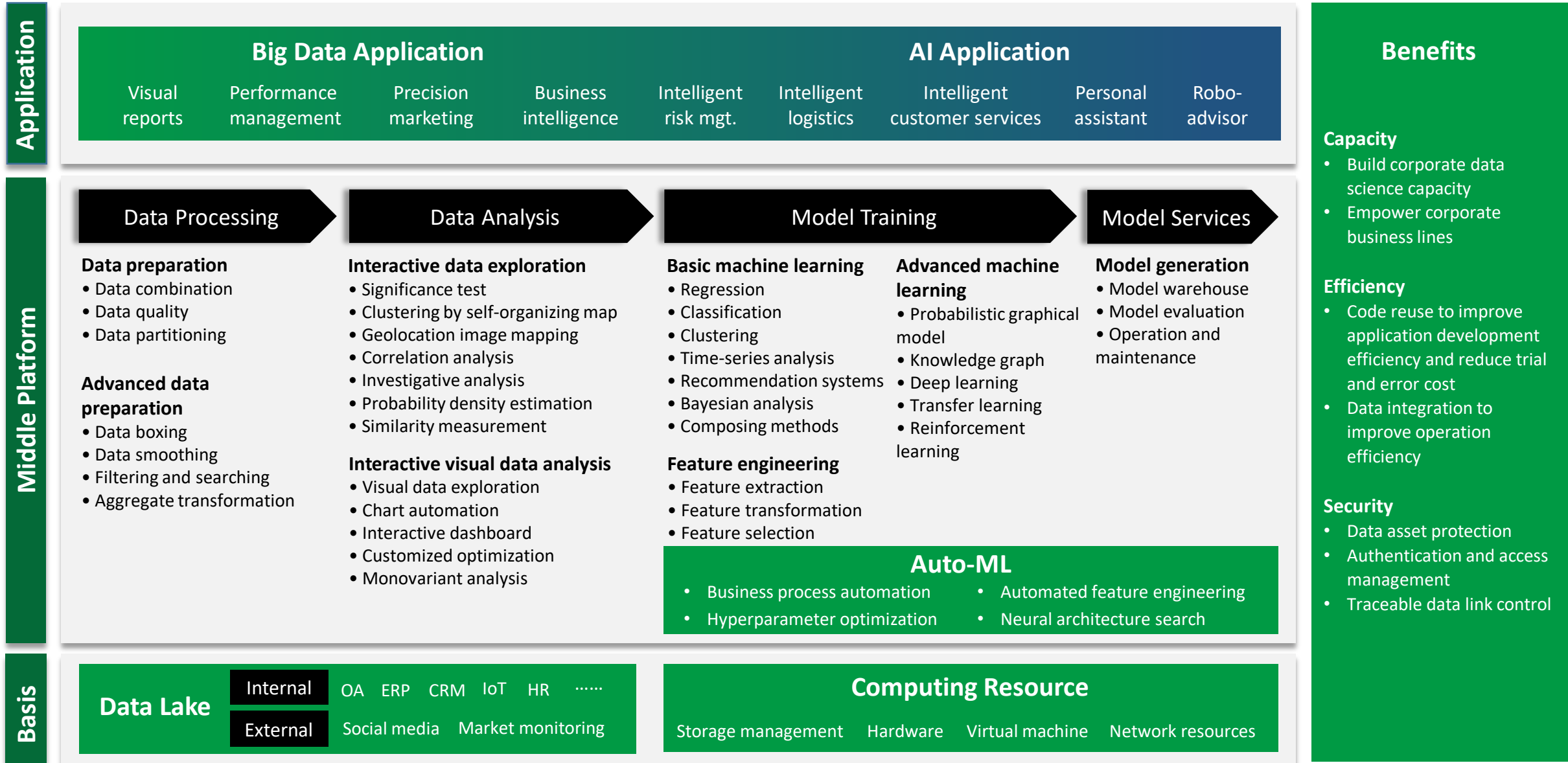


Lack of holistic **analytic functions** to monitor VCA performance.



Short of **maintenance and optimization of algorithms and models** after the deployment of VCA.

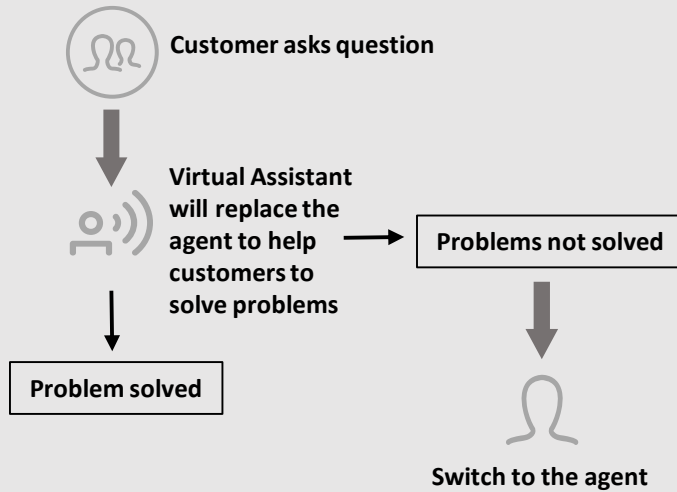
# Data science middle platform





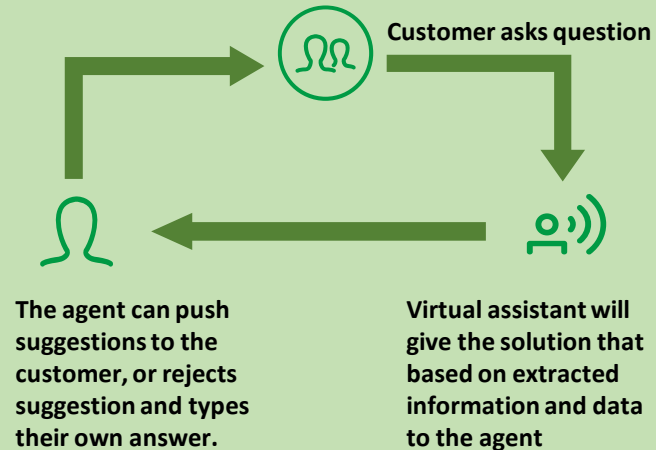
# Process design: new human-machine cooperation model

## Replace



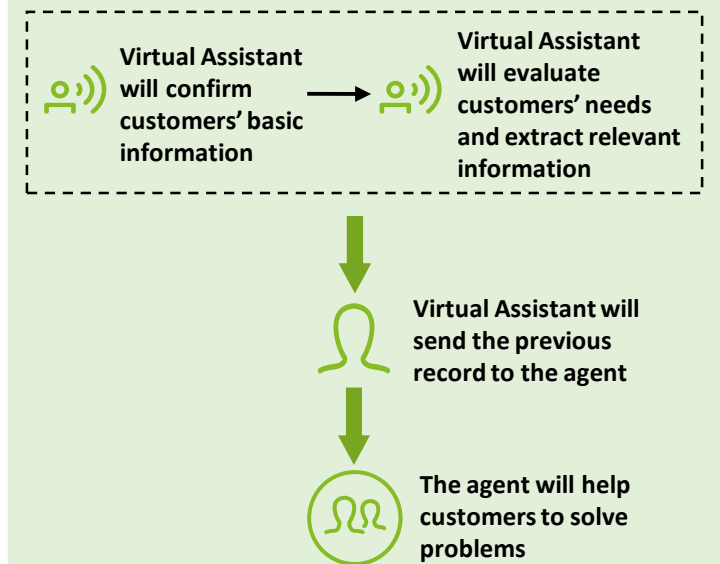
- This process will use **Virtual Assistant instead of the agent** to interact with customers directly to understand their needs and integrate relevant information to solve problems. Customer experiences will be directly affected by the voice technology.
- When Virtual Assistant and the agent have not reached a good connection and the problem can not be solved, customers need to switch to the agent and repeat their needs. This process will **not** only **decrease the efficiency** of customer service, but also cause **the negative customer experience**.

## Augment



- This process changes the traditional form of using Virtual Assistant to replace the agent. **Virtual Assistant will support the agent without facing customers directly.**
- Virtual Assistant will generate the answer automatically by analyzing customers' needs and extracting information. Virtual Assistant can **provide solutions for reference** to the agent so as to **increase their working efficiency.**
- The agent can adopt the answer given by Virtual Assistant or reply independently. The solution will be more flexible and **improve the customer experience.**

## Intermingle



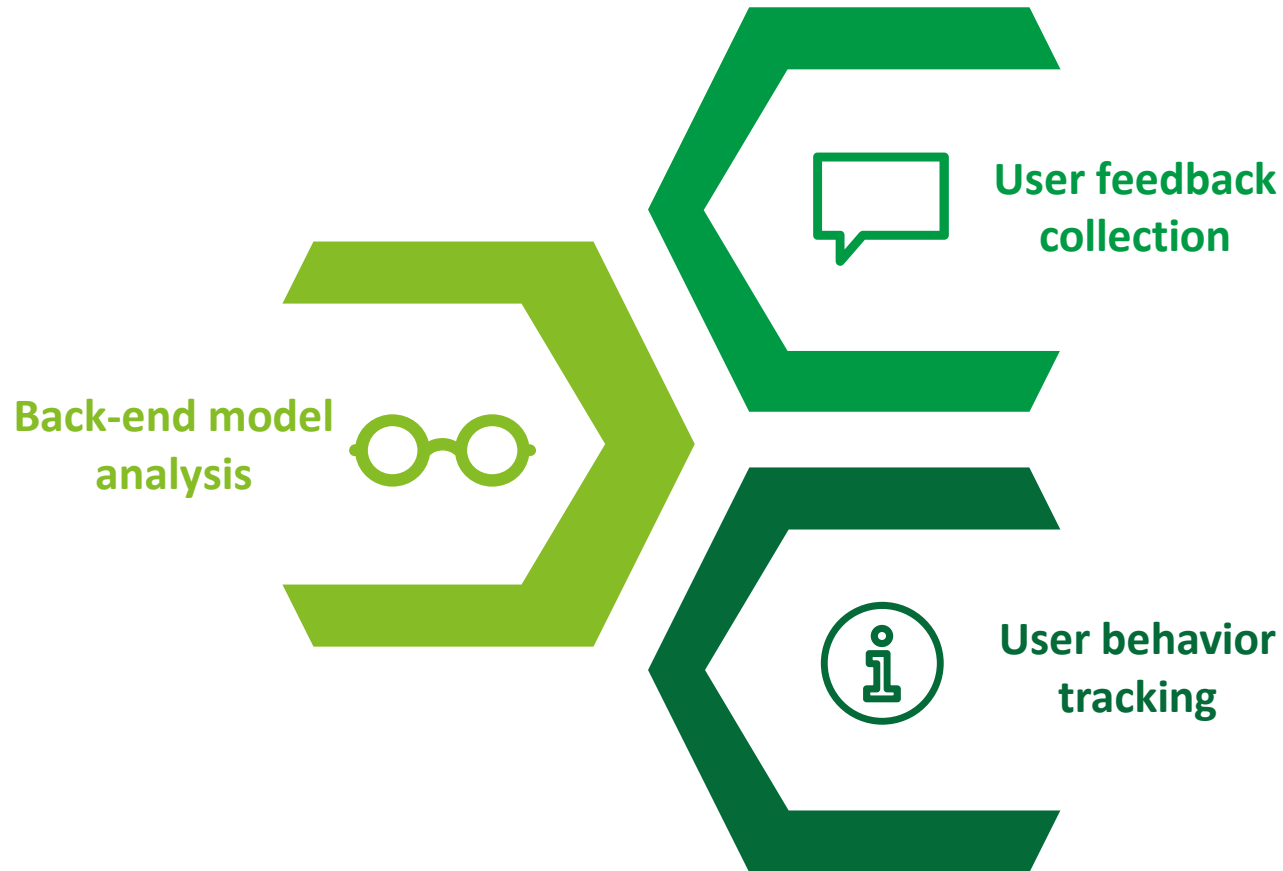
- This process will use **Virtual Assistant instead of the agent to finish basic tasks** with high repetition rates, which leads to the good combination between Virtual Assistant and agent.
- **Parts of labor can be liberated** by this process and the **efficiency of solving problems will be increased.**
- Because of the accurate human-machine interaction, the agent can communicate with customers directly by using the interaction records, which will make the **rapid improvement of customers' experience.**

Now

Future

# Experience optimization

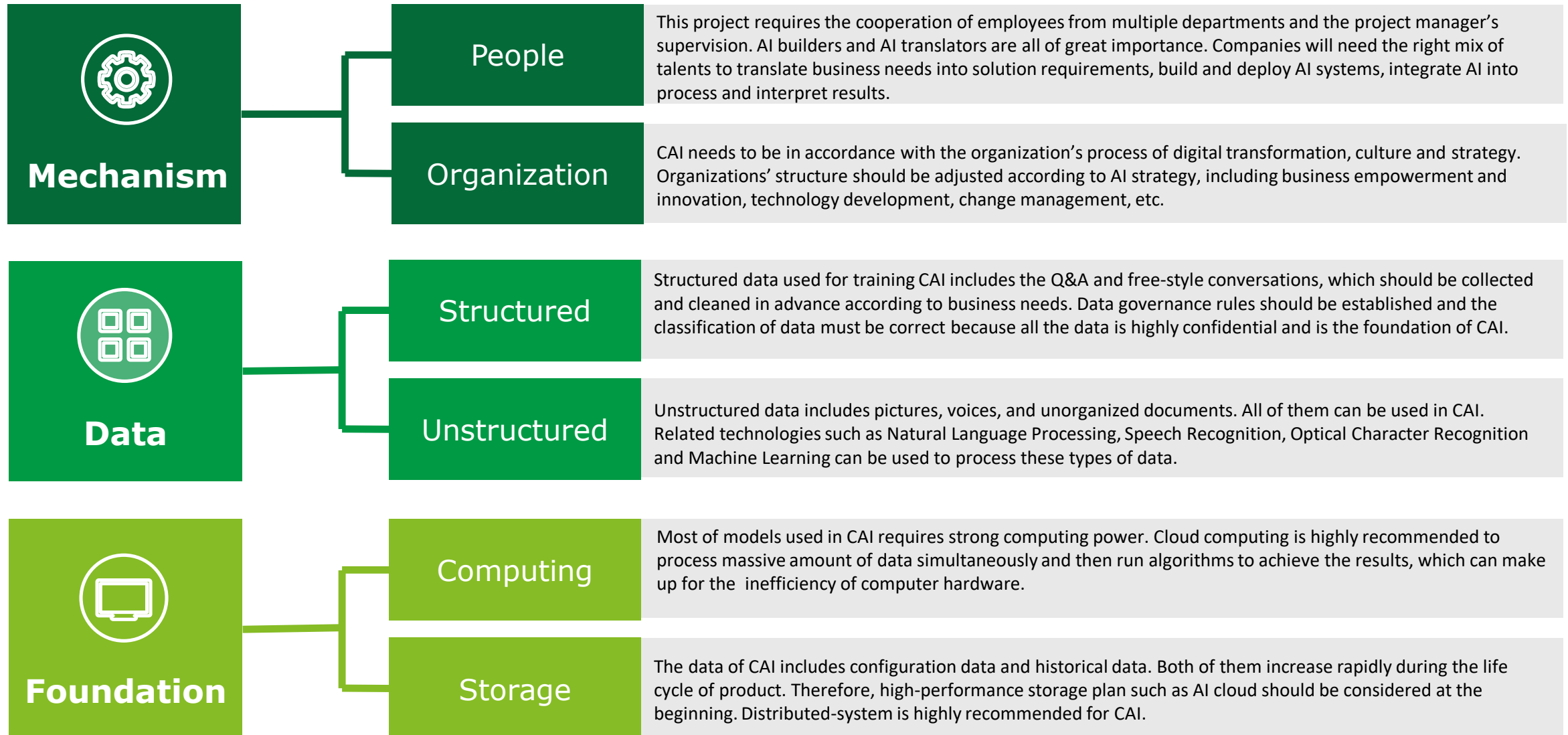
- The **confidence level** (relevance) of related answers for every question is recorded automatically
- For the questions with **low** confidence level answers, machines can send them to agents
- **Manually optimize** the answer contents and send them back to machine for further training



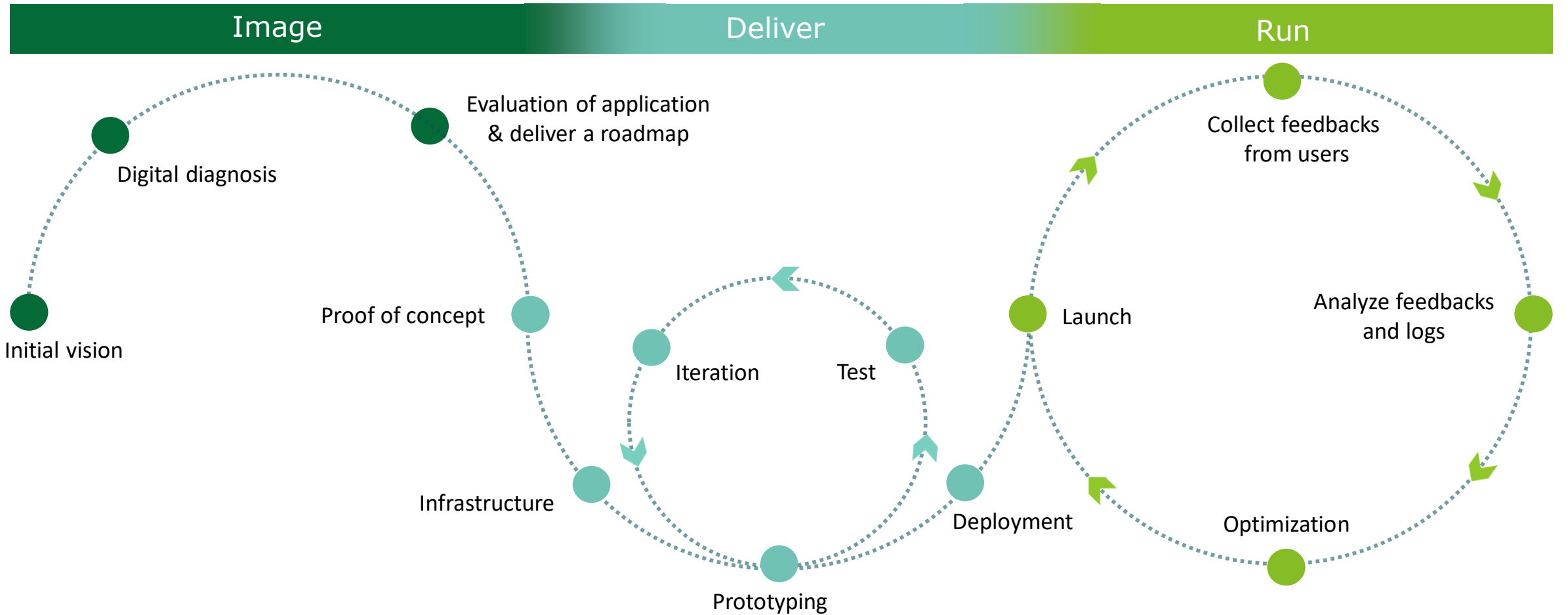
- Add **user evaluation and suggestion** functions in the interactive interface
- Hand over chat records with **low ratings**
- **Analyze** user suggestions and **optimize** accordingly
- Obtain the **dissatisfied dialogues** of users by analyzing the behavior data
- Such as the **records before the user switches to the manual customer service**
- The **chat records before user closes the conversation** for the problem is not resolved

# Implementation journey

# Prerequisites



# CAI implementation journey

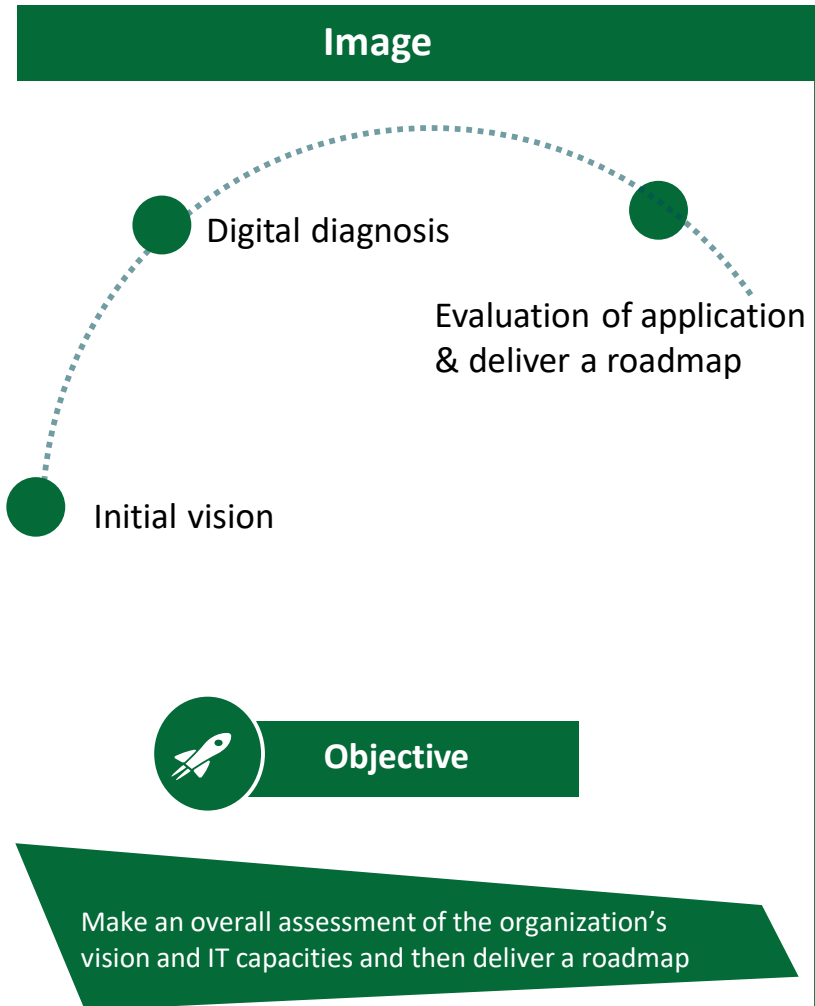


Goal	Deliver a roadmap	Iteration & update	Customized optimization
Time	2-4 Weeks	8–16 Weeks	Continuous

# Talents required during the lifecycle of AI adoption

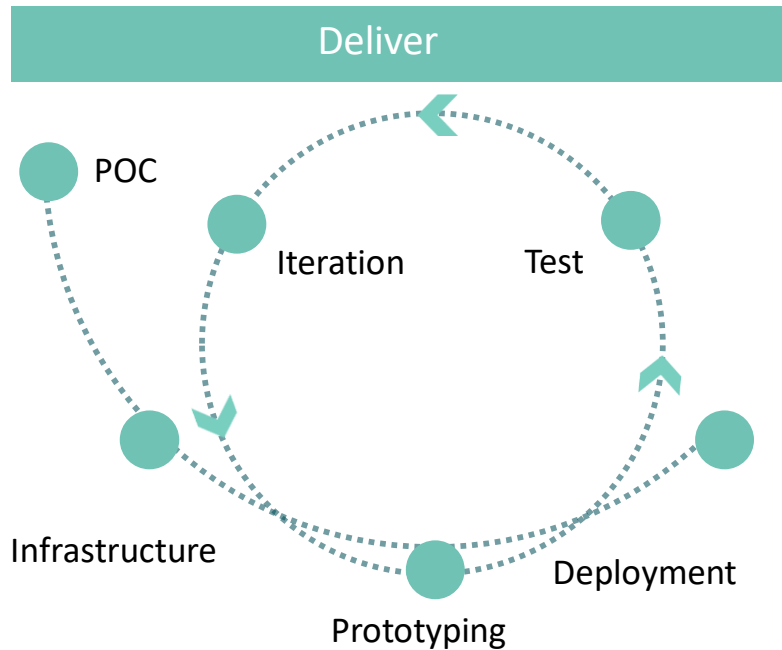
	Role	Responsibilities	Image	Deliver	Run
AI Builders	Program Leader	Govern the initiative and project, manage key issues and risks, approve project scope and timeline changes.	✓	✓	✓
	Product Manager	Schedule internal meetings, weekly status reports, manage risks/issue and escalations.	✓	✓	✓
	Architect	Define standards of architectures and technology stack and lead the architecture design of the framework.	✓	✓	
	DBA	Work with architect to design the data flow and manage the data used or generated by CAI.	✓	✓	✓
	Algorithm Specialist	Develop the key algorithms or evaluate the algorithms from the vendors.	✓	✓	✓
	Software Developer	Develop the CAI by integrating the algorithms to the CAI framework and optimize the product continuously.		✓	✓
	Data Analyst	Analyze the logs and users activities to support optimization and work with consumer behavior specialist to establish the analysis process.		✓	✓
	Test Analyst	Test the product including the logics, securities and data flow.		✓	
	DevOps	Build the test environment, help development team deploy the CAI and continuously monitor the operating status of the application.		✓	✓
AI Translators	Business Leaders	Translate business problems/needs into requirements that guide the building of solutions, and to interpret results from CAI system and make decisions.	✓	✓	✓
	UI Designer	Design the UI of the product and make AI systems easier to navigate.	✓	✓	
	Marketing Specialist	Design the schedule of the promotion and promote CAI in the organization or to the public.	✓		✓
	Consumer Behavior Specialist	Help the team establish the scope, design the interaction of the product and define the standard of the behavior analysis.	✓		✓
	Change Management Experts	Implement change strategies and help integrate AI into the organization's processes.	✓	✓	✓

# Methodology | Image



Step	Step name	Details	Key consideration
1	Initial vision	<ul style="list-style-type: none"> <li>Evaluate the <b>situation</b> of the organization to identify the challenges and opportunities</li> <li>Develop initial <b>high-level vision</b> of CAI, which is in line with the corporate value and strategy</li> <li>Define the list of <b>application scenarios</b> to find the suitable solutions</li> </ul>	<ul style="list-style-type: none"> <li>It is better to image the application of CAI from the <b>macro perspective</b>, such as corporate digital transformation strategy, corporate AI planning, etc.</li> </ul>
2	Digital diagnosis	<ul style="list-style-type: none"> <li>Understand the current status of IT foundation</li> <li>Understand the <b>data governance</b> status</li> <li>Evaluate <b>talents</b> required for each procedures of this project</li> </ul>	<ul style="list-style-type: none"> <li>Business leaders are required to <b>translate</b> business needs into solution requirements</li> </ul>
3	Evaluation of application & Deliver a roadmap	<ul style="list-style-type: none"> <li><b>Prioritize</b> application scenarios and evaluate IT foundation</li> <li>Integrate information and make a related <b>roadmap</b></li> </ul>	<ul style="list-style-type: none"> <li>Key factors: IT Foundation, Data readiness, value delivered, project cost, time scope and etc.</li> </ul>

# Methodology | Deliver



Objective

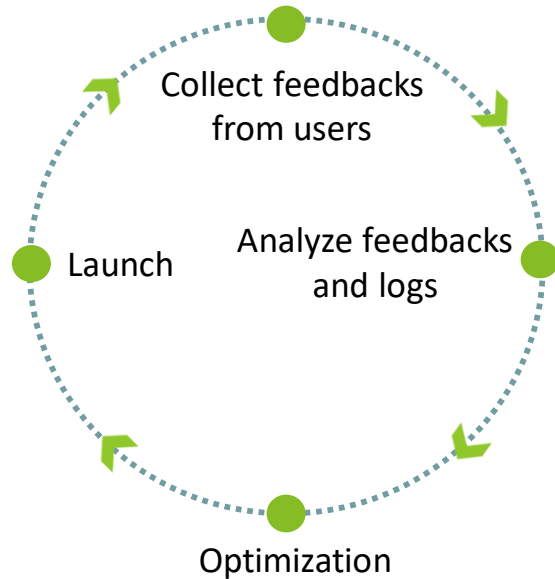
Test the module, update it iteratively and train the module repeatedly to make it better serve actual business needs

Step	Step name	Details	Key consideration
1	POC	<ul style="list-style-type: none"> <li>Establish the <b>baseline</b> of core models</li> <li>Evaluate the <b>performance</b> of the algorithm and key functions</li> </ul>	<ul style="list-style-type: none"> <li>POC is mainly to verify the <b>feasibility</b> of the algorithm</li> </ul>
2	Infrastructure	<ul style="list-style-type: none"> <li>Test the computing power and capacity of the storage</li> <li>Build a new database or integrated with existing data warehouse</li> </ul>	<ul style="list-style-type: none"> <li>Applicability of the architecture</li> <li><b>Integrate</b> with the organization's IT structure</li> <li><b>AI cloud</b> is recommended to operate and store data</li> </ul>
3	Prototyping	<ul style="list-style-type: none"> <li>Establish and improve <b>interactive interface</b></li> <li>Confirm the correctness of data flow</li> <li>Put core module into actual <b>business scenarios</b></li> </ul>	<ul style="list-style-type: none"> <li>Actual <b>business needs</b> should be evaluated</li> <li>AI translators are needed to bridge technology and business</li> </ul>
4	Test	<ul style="list-style-type: none"> <li>Test <b>logic</b> of the algorithms and <b>accuracy</b> of the results</li> <li>Application test such as <b>user friendliness</b></li> </ul>	<ul style="list-style-type: none"> <li>The algorithms need to be tested <b>repeatedly</b> to further optimize accuracy</li> <li>Less <b>running time</b> can bring better experience to users</li> </ul>
5	Iteration	<ul style="list-style-type: none"> <li>Update the models with the <b>feedback</b> from the step of test</li> <li><b>Optimize</b> the interaction according to users' activities</li> </ul>	<ul style="list-style-type: none"> <li>It is a <b>cyclic process</b></li> <li><b>Continuous</b> testing leads to continuous optimization</li> </ul>
6	Deployment	<ul style="list-style-type: none"> <li>Deploy CAI in production environment and connect it to production database</li> </ul>	<ul style="list-style-type: none"> <li>AI cloud can be used to collect and store massive data of all users which is useful for optimization</li> </ul>



# Methodology | Run

## Run



Objective

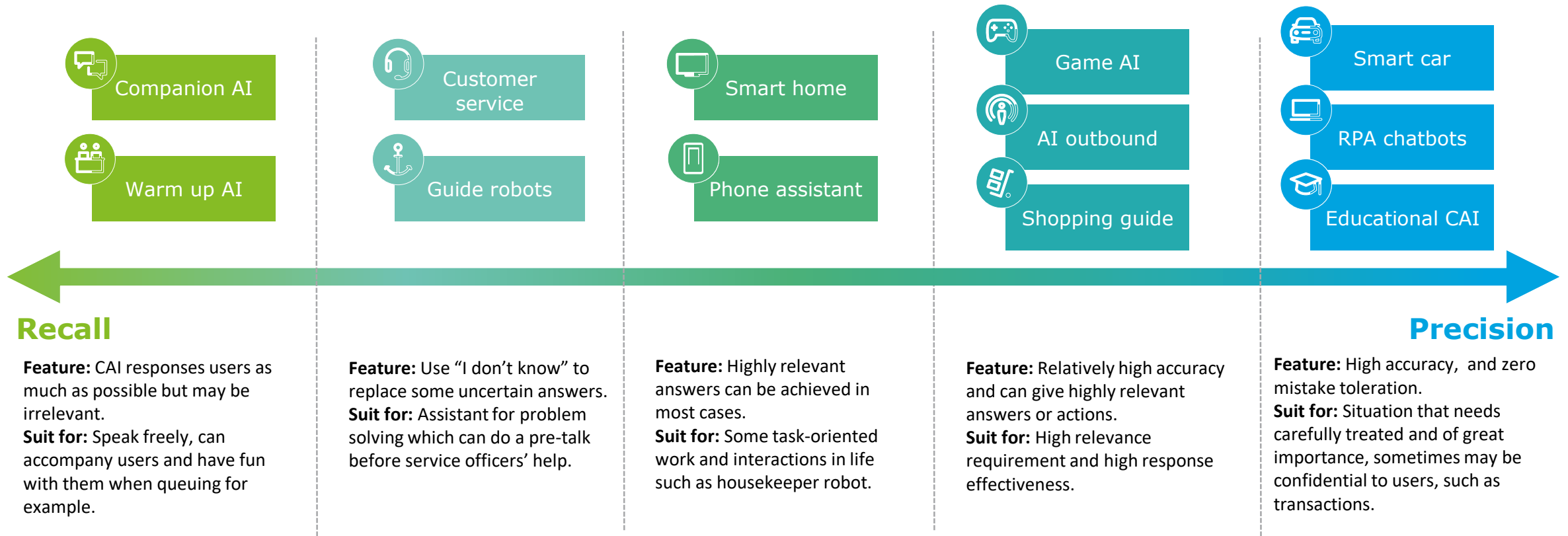
Formally put CAI into use and optimize models continuously to make it better fulfill its original vision

Step	Step name	Details	Key consideration
1	Launch	<ul style="list-style-type: none"> <li>Officially open for use</li> <li>Training</li> <li>Promotion</li> <li>Feedback collection</li> </ul>	<ul style="list-style-type: none"> <li>Change management experts should improve employee's <b>acceptance</b> of CAI, align employee's goal with the organization's vision</li> <li>Organization <b>reconstruction</b> and process optimization</li> </ul>
2	Collect feedbacks from users	<ul style="list-style-type: none"> <li>Use event tracking to record the users' <b>activities</b></li> <li>Collect the users' <b>reviews</b> with the help of user feedback mechanism</li> </ul>	<ul style="list-style-type: none"> <li>Event tracking should be automated. <b>Machine learning</b> based classification is recommended to reduce labor cost</li> <li>Users' activities and reviews should be <b>combined</b> to analysis comprehensively</li> </ul>
3	Analyze feedbacks and logs	<ul style="list-style-type: none"> <li>Determine the <b>popularity</b> of each function by analyzing the users' activities</li> <li>According to the users' suggestions to find the <b>directions</b> for improvement</li> <li>Evaluate <b>metrics</b> of core functions</li> </ul>	<ul style="list-style-type: none"> <li>The <b>real needs</b> can be better understood through analyzing user activity logs</li> <li>Additional workshops and questionnaires to address <b>users' requirements</b></li> </ul>
4	Optimization	<ul style="list-style-type: none"> <li>Optimize the <b>core models</b> and related <b>configurations</b> to improve the accuracy of the module and make it better serve real life</li> </ul>	<ul style="list-style-type: none"> <li>Optimization is a <b>continues</b> work at the life cycle of CAI and it is the <b>key step</b> to make a smarter CAI</li> </ul>

# CAI configuration approach -- trade-off between precision and recall

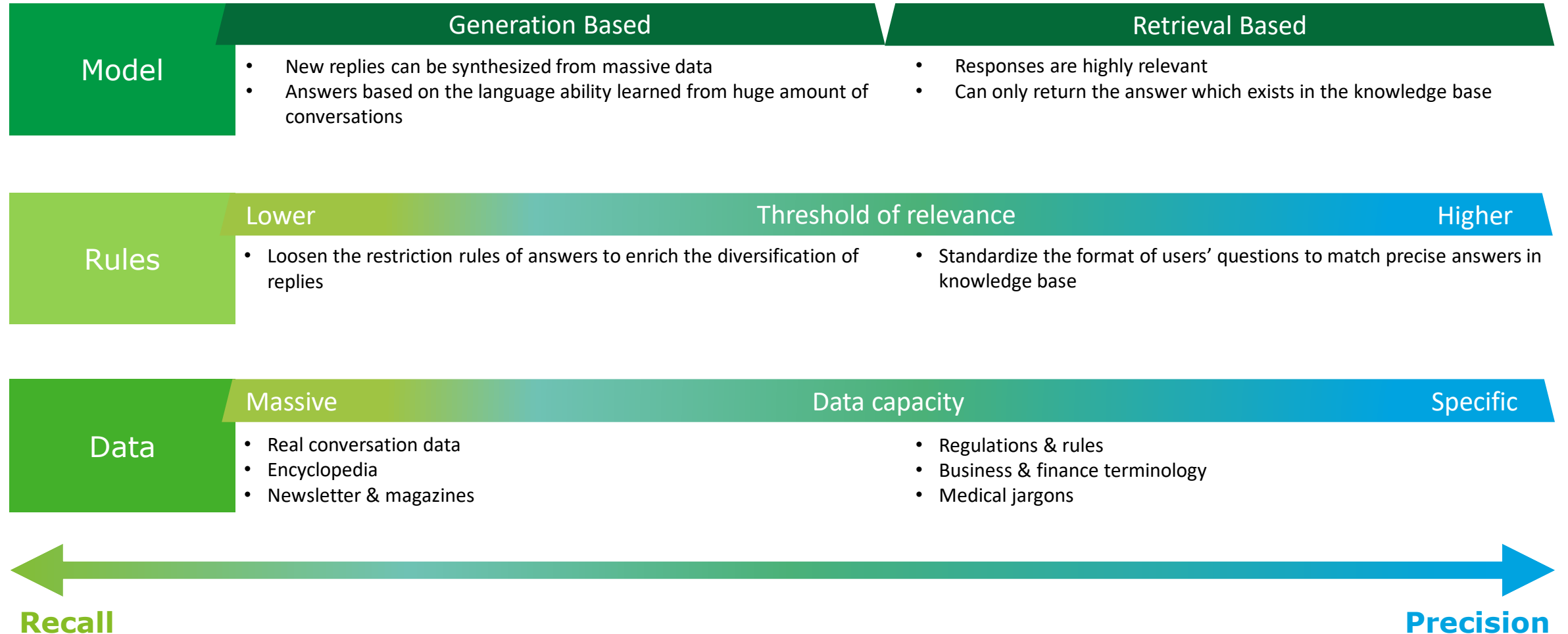
The trade-off between precision and recall is an important topic of CAI. According to different requirements and scenarios, clients have specific restriction of CAI. Some scenarios require CAI to be as precise as possible, while others require CAI to maintain the dialogue as much as possible, constantly attracting users to engage.

## Deloitte CAI five quadrants



# Technology of precision and recall

In order to achieve the five quadrants, related mechanisms are recommended to make it more suitable for use, which are broken down into three aspects: algorithm models, rules and training data.



# D.Bot introduction



# D.Bot | Intro

## Why we design D.Bot?

- After providing professional services and solutions to clients for many years, Deloitte has found how to minimize repetitive human tasks, improve user experience and prepare for the future of work, which are some of the pain points clients are facing today. Many clients wish to have interactive methods to realize their digital transformation and keep their competitive edges.
- D.Bot is born from these pain points and incorporates common requirements from different clients. At present, D.Bot has become a representative product of CAI designed by Deloitte.

## What can D.Bot bring?

### Efficiency improvement

- Reduce communication cost
- Reduce labor effort
- Reduce language complexity
- Increase productivity
- Increase operational efficiency
- Increase interactive friendliness

### User-centric

- D.Bot aims to provide a user-friendly engine, helping clients deploy customized chatbots quickly

### Promote future work

- As a CAI engine to assist employees efficiently
- As an AI robot to respond timely
- As an interpreter to change the method of interaction

## What is behind D.Bot?

### A combined CAI technology



Machine learning



NLP



Voice processing

...

### Key functions



FAQ



Task-oriented



Machine comprehension

blockchain

advanced analytics

Cloud

Deloitte Analytics Institute

RPA




data

artificial intelligence

algorithm

# D.Bot | Function

D.Bot incorporates the most common functions of CAI. All the models of these functions are designed with new architecture and algorithms and trained with massive dialogue data.

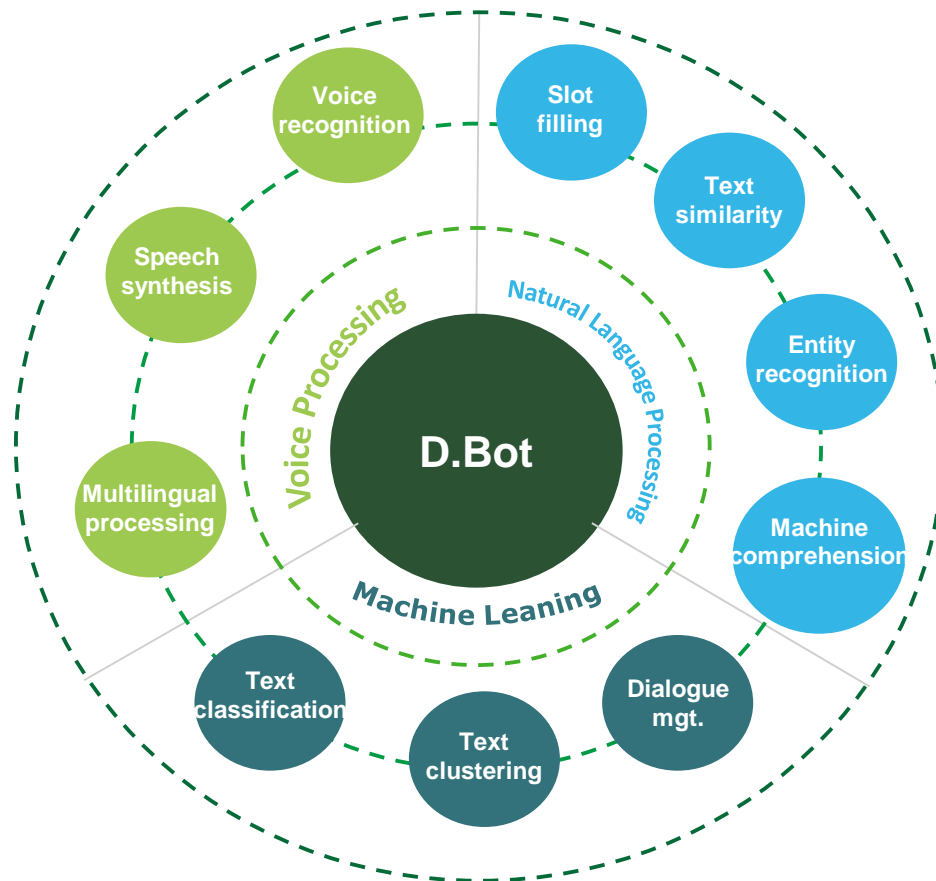
	Description	Technology	Scenario
 <p><b>FAQ</b></p>	<ul style="list-style-type: none"> <li>• <b>What it is:</b> FAQ module builds dialogue capabilities through Q&amp;A pair. It mainly supports a single round of knowledge-based dialogue.</li> <li>• <b>How it works:</b> FAQ module needs users to prepare question and answer pairs in advance and it will generate answers from these pairs.</li> <li>• <b>Pros and cons:</b> High accuracy, Low interactivity.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Text semantic matching:</b> SimNet is used in FAQ module. It is a point-wise model which applies the method of representation-based match.</li> <li>• <b>Special training:</b> It is based on millions of different domain corpus training, which is specially trained and optimized for similarity calculation task.</li> </ul>	<ul style="list-style-type: none"> <li>• Q&amp;A Robots</li> <li>• Intelligent Customer Service</li> <li>• Tourist guide</li> <li>• Companion Robots</li> </ul>
 <p><b>Task-oriented</b></p>	<ul style="list-style-type: none"> <li>• <b>What it is:</b> The task-oriented module is a multi-round dialogue system.</li> <li>• <b>How it works:</b> It supports the task which is users come with a clear purpose hoping to get information or services that meet certain restrictions. As the users' purpose can be complicated, it may need to be presented in multiple rounds and users may modify or perfect his purpose during the dialogue. In addition, it also requires the module help users get good response by asking, clarifying or confirming.</li> <li>• <b>Pros and cons:</b> High accuracy, high interactivity</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Conversational deep learning:</b> This module uses deep neural network and rules to complete tasks.</li> <li>• <b>Attention mechanism:</b> It is a joint model based on attention mechanism, using different outputs of the model to complete task classification and slot labeling prediction in the same model.</li> </ul>	<ul style="list-style-type: none"> <li>• Task management               <ul style="list-style-type: none"> <li>• Work distribution</li> <li>• Task tracking</li> <li>• Task notification</li> </ul> </li> <li>• Information searching</li> <li>• Connected to RPA</li> <li>• Navigation robot</li> <li>• Internet of Vehicles</li> </ul>
 <p><b>Machine comprehension</b></p>	<ul style="list-style-type: none"> <li>• <b>What it is:</b> The machine comprehension module is an search robot which can find answers in large documents according to the multiple questions.</li> <li>• <b>How it works:</b> Machine comprehension module is applicable to the scenario where the client has multiple knowledge documents and the answer can be generated by directly intercepting the content of the documents.</li> <li>• <b>Pros and cons:</b> The advantage of the module is that it does not require clients to maintain Q&amp;A pair which solves the last mile problem. The disadvantage is that the accuracy is lower than FAQ module and the response speed is relatively slower.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Dual module:</b> The module has two core models which are paragraph extraction model and machine comprehension model.</li> <li>• <b>Coordinated mechanism:</b> The first model helps the module extracts the candidate paragraphs which may have potential answers. The second model extracts answer fragments from the candidates.</li> <li>• <b>Massive training:</b> Both models are pre-trained with tens of thousands of documents.</li> </ul>	<ul style="list-style-type: none"> <li>• Q&amp;A related to laws and legal requirements</li> <li>• Q&amp;A related to contracts</li> <li>• Encyclopedia question and answer</li> </ul>

# D.Bot | Cognitive technology

D.Bot involves combination of traditional machine-learning algorithms and deep neural network.

- Traditional machine-learning algorithms are used to accelerate inferencing and get interpretable results.
- Deep neural network is used to build a generalized model and obtain more accurate results.

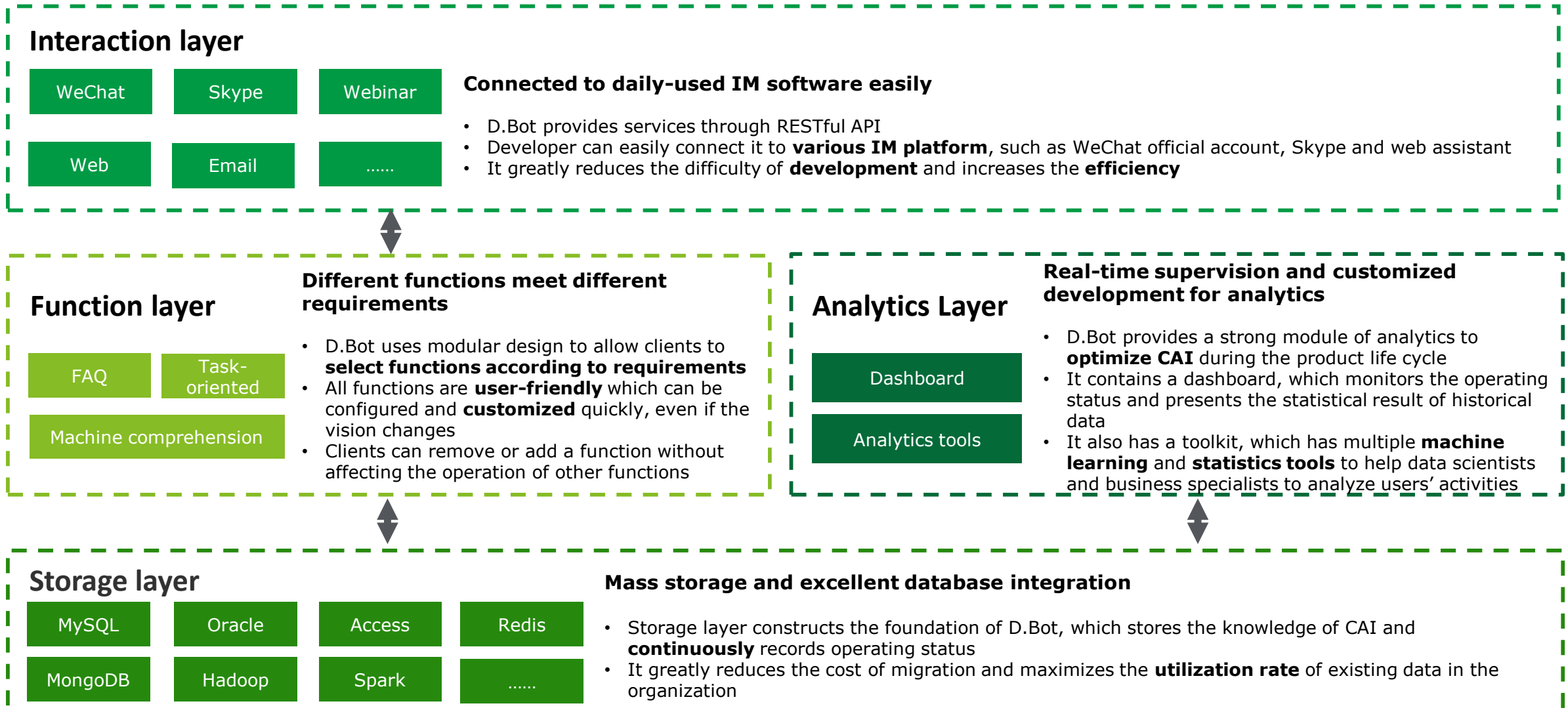
## Cognitive solutions: main capabilities



## Cognitive enabler

Natural Language Processing	Word to vector
	Support vector machine
	Dialogue state tracking
	Finite state machine
	Linear discriminant analysis
Voice Processing	Inverse document frequency
	Recurrent neural network
	Latent semantic indexing
	BERT
	Memory network
Machine Learning	DSSM-LSTM
	Conditional random field
	Voice Activity Detection
	Sequence to Sequence
	WaveNet / Tacotron
	Hidden Markov Model

# D.Bot | Architecture





# D.Bot | Industries

The vision of D.Bot is to create the CAI engine that will be applied across industries. Therefore, when Deloitte designed D.Bot, the demands in various industries were taken into consideration.

**Scenario:** D.Bot can be used as customer service assistant online. D.Bot can recommend products to consumers by capturing user's requirements during the dialogue.

**Benefit:** D.Bot is a good tool to increase consumer satisfaction with customer service and reduce the labor cost in post-sales and pre-sales period.

Consumer

Government  
& Public  
Services

**Scenario:** D.Bot enhances e-government and smart cities. It has advantages in communicating with citizens.

**Benefit:** D.Bot's analytics module can help governments understand requirements of residents more clearly and quantitatively evaluate the level of governance.

**Scenario:** D.Bot is a good assistant in logistics tracking. It is a supplementary toolset to improve internal management.

**Benefit:** CAI application plays an important role in digital transformation, helping clients manage their digital assets efficiently.

Energy,  
Resource &  
Industrial

Life Science  
& Health  
Care

**Scenario:** Smart healthcare is a developing direction of life science. D.Bot can be used in the process of diagnosis, guidance, management of digital medical records.

**Benefit:** It improves the satisfaction of patients and liberate doctors and nurses to focus on high-level work, which alleviates the shortage of medical resources to a certain extent.

**Scenario:** Smart customer services and smart sales are two main scenarios in financial services.

**Benefit:** The main benefit of the application is greatly reducing the labor cost of repetitive work.

Financial  
Services

Technology,  
Media &  
Telecommuni-  
cations

**Scenario:** D.Bot can be connected to various IM software, it can be used on different media as an assistant.

**Benefit:** D.Bot can reduce the entry cost of CAI, including labor costs and time costs.

## Deloitte's CAI vision and aspiration

Design  
the future  
of work

Break  
the barrier  
of language



Reshape  
the future  
of life

Connect  
human and  
machine

# Deloitte AI & Cognitive Service Team



**Chief Digital Officer  
Deloitte China**

Joseph Chu is the Chief Digital Officer (CDO) of Deloitte China. He has more than 25 years of experience in digital transformation, technology advisory, big data and artificial intelligence. As Deloitte AI Institute leader in China, he is focusing on leveraging artificial intelligence technologies such as facial recognition, natural language processing, robotics, etc. to drive business value. He is leading a digitization task force that is comprised of senior business leaders and AI experts to develop our digital and cognitive strategy and deliver our AI enabled services to the clients.

<b>Deloitte AI Institute</b>	Deloitte AI Institute (DAI) is Deloitte China’s digital technology research team. It has nearly 30 AI experts and is responsible for applying AI and cognitive technology to Deloitte client solutions and services
<b>Innovation &amp; Digital Development Center</b>	Innovation & Digital Development Center (IDDC) is responsible for building Deloitte’s digital assets and most of the assets will be enabled by AI and cognitive technologies.

 <p><b>Audit &amp; Assurance</b></p> <ul style="list-style-type: none"> <li>• Audit Innovation Team</li> <li>• Assurance Digital Team</li> <li>• Robotics &amp; Cognitive Automation Team</li> </ul>	 <p><b>Consulting</b></p> <ul style="list-style-type: none"> <li>• Analytics &amp; Information Management Team</li> <li>• Digital Team</li> </ul>	 <p><b>Risk Advisory</b></p> <ul style="list-style-type: none"> <li>• RA Assurance Team</li> <li>• RA Analytics Team</li> </ul>	 <p><b>Financial Advisory</b></p> <ul style="list-style-type: none"> <li>• Analytics &amp; Digital Innovation Team</li> <li>• FA Innovation Team</li> </ul>	 <p><b>Tax &amp; Legal</b></p> <ul style="list-style-type: none"> <li>• Robotics &amp; Cognitive Automation Team</li> </ul>
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<p><b>30+</b> AI enabled Assets</p>	<p><b>2300+</b> AI professionals</p>	<p><b>30%</b> Revenue enabled by AI / Cognitive</p>
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