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China's Open-Source Tech Development

Insights into a growing ecosystem

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Understanding the rise of open source in China

An explanation of open-source code and why it matters for China's tech industry

Open source	At a glance	Details
What?	A practice of developing and distributing tech whereby all coding is done publicly and collaboratively, usually in a public repository	▪ The global open-source model is based on radical openness and transparency and was first used to develop software, but it can also be used for hardware development ▪ Since source code is freely shared, modified and distributed, open-source tech is a vendor-neutral alternative to proprietary tech
Where?	Open-source tech underpins a variety of digital programs, software applications and cloud-based platforms we use in our day-to-day lives	▪ **Operating systems (OS)**: Firefox, Android, HarmonyOS ▪ **Programming languages**: Python, JavaScript, MATLAB ▪ **Chip design software**: RISC-V ▪ **Deep learning & cloud computing frameworks**: TensorFlow, PyTorch, Apache CloudStack, PaddlePaddle
Why?	Collaboration on codes and programs leads to faster tech development, the cultivation of software skills and more robust and secure tech	▪ In China, open source allows companies to access and modify for their own use crucial codes and programs shared by international peers that would usually be proprietary ▪ Meanwhile, open-sourcing their own tech helps Chinese companies with brand recognition, platform expansion and talent cultivation
Covid-19 as a catalyst	The pandemic caused an uptick in open-source adoption as businesses sought to cut costs, save time and manage remote work	▪ In China, the all-hands-on-deck effort to fight the Coronavirus pandemic with data-driven tools caused many more tech companies to open-source their tools and frameworks ▪ E.g., Image recognition unicorn Megvii open-sourced its deep-learning framework **MegEngine (旷视天元)** which underpins its smart fever-screening tech) and Tencent made the code for its **Health COVID-19 module** and **COVID-19 self-triage assistant** available on GitHub

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China was late to embrace open source, but is now going full steam ahead

A timeline of China's open-source development (key milestones)

Late 1990s – 2011

Linux kickstarts China's open-source journey

- *Late 1990s:* First arrival of Linux in China
- *1999:* The Chinese Academy of Sciences launches government-funded Red Flag Linux (红旗Linux) project to replace MS Windows
- *2004:* The government supports launch of China's first multi-stakeholder organization devoted to open-source software (OSS)
- *Mid 2000s:* Chinese developers gradually start participating in international open-source projects
- *From 2008:* Traditional industries adopt open-source to cut IT costs while embracing the government's informatization push
- *2009:* China is among the founding members of the Asian Open Source Software Center (AOSSC) alliance
- *2011:* Android smartphones pave the way for the wider adoption of Linux

2012 – 2018

Open-source tech gains momentum thanks to government support and AI enthusiasm

- *2012-2015:* Large-scale adoption of OSS in the cloud computing sector and creation of China's first open-source cloud industry alliance
- *From 2012:* The government issues policy documents in support of open-source development and helps establish more open-source alliances and foundations
- *From 2015:* Broader adoption of artificial intelligence (AI) sparks a new wave of open-sourced projects
- *2017:* The New Generation Artificial Intelligence Development Plan emphasizes openness and open-source innovation
- *2018:* Construction of AI open-source platform Dubhe (天枢平台) starts in Zhejiang province to foster industrial ecosystems and applications of AI algorithms

2018 – present

US-China tech conflict and Covid-19 accelerate open-source development

- *Sept 2018:* China establishes a RISC-V Industry Consortium to promote the adoption of open-source chip design architecture amid tightening US export controls
- *May 2019:* Huawei loses its license to use Google's Android OS
- *July 2019:* The news that developers in US-sanctioned Iran have lost access to GitHub raises alarm in China's tech industry
- *From March 2020:* Several Chinese tech companies open-source tech solutions used in epidemic prevention and control
- *June 2020:* Students at Chinese universities blacklisted by the US for military ties lose access to MATLAB programming language
- *Aug 2020:* The Ministry of Industry and Information Technology handpicks Gitee as China's independent, open-source hosting platform (an alternative to GitHub)

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Beijing channels policy support towards the development of open-source tech

The government sees open source as a strategic industrial policy tool

The government wishes to *both* use open source to retain access to foreign tech *and* create a domestic open-source ecosystem to boost tech self-reliance

- Open-source technologies offer greater **technical independence and controllability** compared to (foreign) proprietary products
- Amid escalating geopolitical tensions with the US, open source allows Chinese firms to access foreign technology, as it is **exempted from US export controls** (e.g., China hopes that the global RISC-V instruction set architecture may become a viable alternative to ARM and Intel chip design frameworks)
- But Beijing also wants to foster an **indigenous open-source community** that is shielded from geopolitics and provides China's tech industry with continuous access to key soft- and hardware, in case US export controls are tightened such that they affect open-source code
- Developing domestic open-source products and platforms is seen as a strategic lever for **boosting China's ICT industry and innovation capabilities**
- **Regulators have embraced open-source technologies**, which they see as the foundation for innovation in the software industry, as well as a tool for enabling the much-awaited digitalization of China's traditional industries
- The government has overseen the creation of several open-source **alliances and foundations,** which bring together government agencies, industry, research institutions and individual developers

Key elements of official policy support	Date
MIIT officials declare support for open-source cloud computing platform **OpenStack** and promote it among SOEs	Dec 2014
The State Council's **13th Five-Year National Informatization Plan (2016-2020)** encourages the establishment of R&D units dedicated to open source	Dec 2016
The MIIT issues a **Software and Information Technology Services Industry Development Plan (2016-2020)**, which calls for the construction of a collaborative open-source ecosystem	Jan 2017
The MIIT-affiliated China AI Open Source Software Development League issues a **White Paper on China's Development of AI Open Source Software**, calling for breakthroughs in AI OSS	July 2018
The National Development and Reform Commission (NDRC) and Cyberspace Affairs Commission (CAC) highlight the **importance of open-source communities for industrial digitalization** in an implementation plan for digital economy development	Apr 2020
The **14th Five-Year Plan (2021-2025)** encourages the development of open-source algorithms in the context of AI innovation	Mar 2021

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Multiple alliances and foundations drive forward breakthroughs in open source

These communities provide operational and technical support and act as incubators for projects

Name	Establishing agencies	Function	Key members	Est.
China Open Source Software Promotion Union (COPU) 中国开源软件推进联盟	MIIT (formerly Ministry of Information Industry)	China's first alliance devoted to OSS. Founded to promote the application of Linux and facilitate OSS cooperation between China, Japan and South Korea	Red Flag, Kingsoft, IBM, HP, etc.	Jul 2004
Open Source China (OSChina) 开源中国	Open Source China (Shenzhen-based company)	China's first and largest open-source software community; supported by MIIT to establish Gitee	Major tech firms	Aug 2008
China Open Source Cloud League (COSCL) 中国开源云联盟	MIIT department for software services	Designated national organization for the development of China's open-source cloud ecosystem	ZTE, Huawei, Intel, China Mobile, various software companies	Aug 2012
China AI Open Source Software Development League (AOSS) 中国人工智能开源软件发展联盟	China Electronics Standardization Institute (CESI, agency under MIIT)	Promotes independent breakthroughs, development, and applications of AI OSS	Baidu, Didi, Ping'An Technology, WeBank, Ant Financial, Didi, etc.	Jul 2018
China RISC-V Industry Consortium (CRVIC) 中国RISC-V产业联盟	Shanghai government, National IC Innovation Center and Shanghai IC Industry Association	Promotes the application of RISC-V to help establish it as the standard architecture for chip design, especially in processors for IoT applications	VeriSilicon, Ingenic Semic., Andes Techn., ZTE, Fudan Univ., etc.	Sept 2018
China RISC-V Alliance (CRVA) 中国开放指令生态(RISC-V) 联盟	Institute of Computing Technology at the Chinese Academy of Sciences	Convenes and integrates resources from enterprises and research institutes to promote the development of a RISC-V ecosystem for China	Baidu Netcom, Huawei, UNISOC, Tencent, etc.	Nov 2018
OpenAtom Foundation 开放原子开源基金会	Huawei (supervised by Ministry of Civil Affairs, MIIT)	China's first open-source foundation; provides "neutral IP custody," incubates projects, channels funding, and performs community governance functions	Huawei, Alibaba, Baidu, Tencent, Inspur, etc.	Jun 2020

Sources: Alliance and foundation websites, MERICS

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OSS adoption is growing across traditional industries

OSS helps companies with digital upgrading, but a lack of governance systems creates risks

Corporate adoption of OSS is now widespread

Levels of OSS adoption among companies in 2019
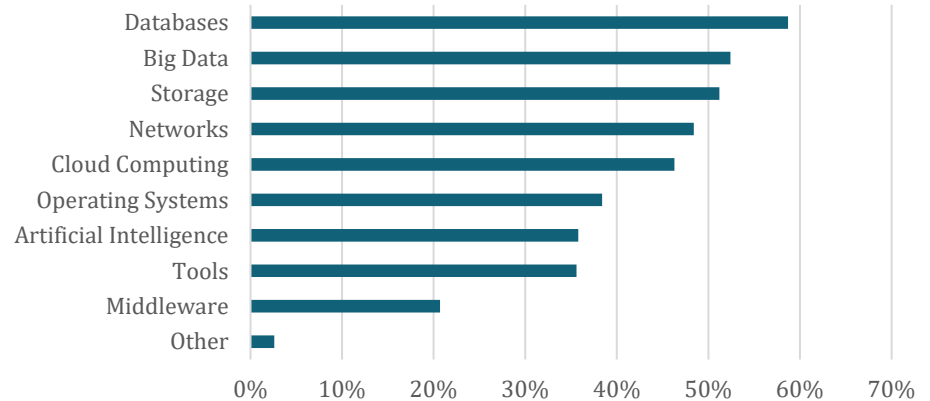

2.3%
10.3%
87.4%
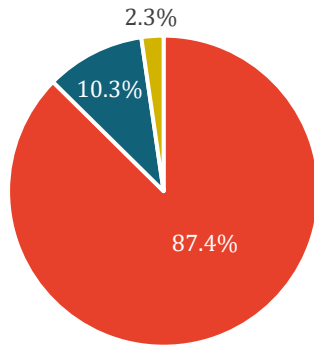
■ OSS in use ■ Plans to use OSS ■ No plans to use OSS

- According to a survey by MIIT-affiliated think tank China Academy for Information and Communications Technology (CAICT), 87.4% of Chinese firms used open-source technologies in 2019
- But Chinese companies lag in open-source governance: only 23.6% of companies having dedicated processes and teams to manage OSS
- Companies still struggle to manage the risks associated with the introduction of OSS, e.g., risks related to intellectual property and compliance, security, operation and maintenance and technical issues

OSS adoption is highest in the area of databases

Companies' OSS adoption rate by application

Databases
Big Data
Storage
Networks
Cloud Computing
Operating Systems
Artificial Intelligence
Tools
Middleware
Other

0%   10%   20%   30%   40%   50%   60%   70%

- Open-source database, big data and storage tools are the most widely adopted OSS among companies
- Traditional industries in China are gradually embracing OSS as open-source tech now dominates the market for basic software products and plays a strategic role in emerging tech development
- OSS is slowly making inroads into Industrial Internet, telecommunications, government procurement and the financial industry, among other sectors
- Internet (40.8%), software and ICT (32%) and finance (31.6%) firms are the top three customers for open-source service providers

Sources: CAICT Open-Source Ecosystem White Paper

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The private sector is embracing the use and development of open-source tech

Corporate innovations and investments have enabled China's open-source ecosystem to flourish

Tech giants	Startups	Venture capital (VC) firms
▪ Tech giants rely on open-source access to foreign soft- and hardware (e.g., operating systems, programming languages and chip architecture sets)	▪ Startups have been increasingly emerging that build, commercialize and facilitate open-source projects, e.g., in the areas of code hosting, database tools and big data analytics	▪ Chinese and foreign VC firms are investing in Chinese open-source projects and startups (e.g., Fosun, China Growth Capital, Sequoia, GGV Capital and Matrix Partners)
▪ Almost all major tech firms open-source their own tech or create openly shared projects to raise brand awareness, attract talent and incentivize developers to build apps	▪ With codes open-source, business models range from providing supporting and hosting services to making a small percentage of code proprietary	▪ Chinese tech giants' VC arms are also increasingly investing in emerging open-source platforms or related service providers

2,000+ projects

With a total of more than 2,000 projects, **Baidu**, **Alibaba**, **Tencent** and **Huawei** were the companies that open-sourced the most projects in 2019-2020

JD Chain

Many other tech giants like **JD.com, Bytedance** and **Xiaomi** also contribute open-source projects, e.g., in front-end development, AI, databases, middleware

gitee

Established in 2013, **Gitee** (码云) is a source code hosting platform with 5m+ registered members and ca. 10m projects (compared with GitHub's 56m+ users)

PingCAP

Founded in 2015, **PingCAP** supports 1,500 companies worldwide with its popular open-source NewSQL database project TiDB

BAI Bertelsmann Asia Investments

German conglomerate **Bertelsmann**'s Asia Investment arm is among the global investors in PingCAP

CODING CLOUD DEVELOPMENT

Huawei and **Baidu** are strategic investors in Gitee; **Tencent** invested in Chinese code hosting platform CODING

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China is no longer just an open-source consumer but also a global contributor

Chinese developers play an increasingly influential role in global open-source communities

## China's role in developing open-source software continues to grow

Share of open-source contributions to GitHub by region, 2020

Top-ranked nations
1st: US (22.7%)
2nd: China (9.67%)
3rd: India (5.2%)
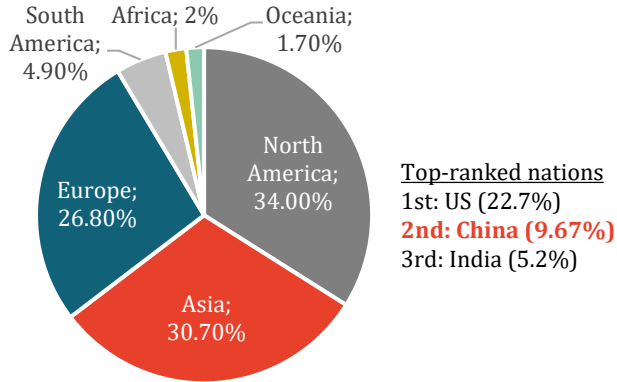
- In 2020, Chinese developers were the second most prolific group of contributors on GitHub
- Two out of the top five GitHub accounts with the most followers are Chinese and 26 Chinese projects are listed in GitHub's Top 500 list

Chinese companies' involvement in international open-source communities has grown considerably

Percentage of Chinese members/sponsors in major global open-source foundations

Membership/sponsorship levels:
■ Platinum ■ Gold ■ Silver
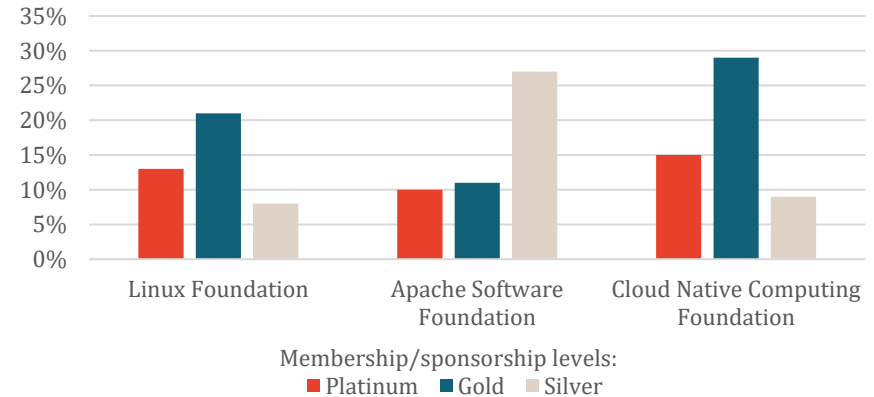
- As members or sponsors, Chinese companies (e.g., Tencent, Alibaba Cloud, JD.com, but also various telcos and banks) financially support *and* benefit from all three major global open-source tech foundations
- Consequently, Chinese open-source contributions to these communities have grown, e.g., Chinese companies make the third most contributions to projects hosted by the Cloud Native Computing Foundation

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A major goal is to create alternatives to US-developed open-source tech ...

Chinese tech giants are building homegrown open-source tech to support indigenous tech development

Example 1: Artificial Intelligence

- Tech giants such as Baidu, Alibaba or Huawei have open-sourced **deep-learning frameworks** that underpin their AI products and services
- The goal is to create **competitive Chinese alternatives to the dominant US-developed open-source deep-learning frameworks** (Google's TensorFlow and Facebook's PyTorch)
- These frameworks are **crucial for the development of AI applications** since they provide software developers with the tools and resources to rapidly adopt and implement deep learning at scale

PaddlePaddle (飞桨) *Baidu*	**X-DeepLearning (XDL)** *Alibaba*	**Mindspore** *Huawei*
The parallel distributed deep-learning framework behind Baidu's tech for search ranking, large-scale image classification, advertising, machine translation etc. It is said to be used by 1.9m+ developers and 84,000 companies worldwide	The industrial-scale deep-learning framework behind Alibaba's marketing tech and big data platform Alimama. It has gained recognition for its training scale, performance and horizontal expansion capabilities	A deep-learning framework used for AI app development that scales across devices, edge and cloud environments. Developed with Peking University, Imperial College, the University of Edinburgh and robotics startup Milvus

Example 2: Operating System (OS)

- Huawei is in the process of switching to its own, proprietary OS, **HarmonyOS (鸿蒙),** for all its smartphones
- Having had its Google Android license revoked due to US government restrictions in May 2019, HarmonyOS is Huawei's urgently needed **alternative to the Android app ecosystem**
- By open-sourcing it, Huawei aims to attract apps into its ecosystem and turn it into the world's **most advanced OS for 5G and IoT applications**
- Already, HarmonyOS is powering newly launched products by **home appliance manufacturers** (e.g., Joyoung) and **carmakers** (e.g., BAIC)

Example 3: Code Hosting Platform

- Several Chinese open-source code hosting platforms have been created in recent years **to rival GitHub**, the world's largest and most widely used code hosting platform
- Among them, **Gitee** has established itself as China's most promising alternative, having been endorsed by the MIIT in July 2020
- Amid fears that US regulations could in the future bar Chinese developers from accessing GitHub, these homegrown platforms are seen as **essential to ensuring developers can continue to share and collaborate** on important code needed for software

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... but several obstacles stand in the way of an 'indigenous' open-source ecosystem

Chinese open-source platforms are growing and gaining popularity, but weaknesses remain

Replacing US-led open-source tech is easier said than done

- Developing alternatives to widely adopted and highly specialized technical soft- and hardware takes **considerable resources and time**
- It also requires large communities of developers to be willing to **switch from often well-established platforms and frameworks** to Chinese alternatives, which can come at a cost
- **Examples:**
    - To become developers' top pick at home, Chinese platforms like Gitee will have to grow their communities by **attracting top-notch projects and developers** that give as much as they take
    - Similarly, PaddlePaddle will need to find ways to attract developers that have long settled on using US frameworks such as TensorFlow

A protectionist approach to open-source could hamper innovation

- The government's vision of creating a Chinese open-source ecosystem independent from international communities goes against the **core value proposition of open source**, which is open collaboration and exchange
- Prioritizing the **"nationality" of open-source frameworks** over their potential value for individual developers and companies could hinder innovation
- **Example:**
    - If the government were to introduce protectionist regulations that force Chinese developers to use national open-source platforms as opposed to foreign ones (e.g., Gitee vs. GitHub)Chinese developers would **lose valuable exchanges** they have in global platforms and communities and talent may be driven away

China's open-source communities face cultural & political barriers

- Overcoming the free-riding mindset of China's early open-source development days and embracing a **truly collaborative culture** is still a work in progress
- The government's **obsession with information control remains** at odds with its open-source ambitions as communities struggle to navigate a closed and censored Internet
- **Examples:**
    - The government's **temporary ban on GitHub in 2013** (over a plug-in software that allowed train ticket purchases discouraged by the government) led to outrage in China's tech community
    - **Censors remain wary of GitHub** repositories that have allowed people to archive dissenting opinions (e.g., related to COVID-19)

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Europe should closely watch China's open-source tech development

European businesses can learn from China's growing open-source ecosystem, but there are risks, too

Chinese advances in open source affect the EU as its own open-source movement gains momentum

- Europe is home to **successful open-source startups and scaleups**, like the conversational AI platform Rasa and database tool provider Prisma
- The **Eclipse Foundation**, a leading open-source non-profit, has moved its headquarters to Brussels
- A European Commission study estimates that the 10% increase in the number of individual contributions to software projects (2017-2018) translated into **a 0.4% growth of the EU's GDP**
- In October 2020, the European Commission approved an **Open Source Software Strategy 2020-2023**, aiming to boost the EU's progress towards digital autonomy and the implementation of its overall digital strategy

EUR 100 bn

Potential annual increase of the EU's GDP if the number of open-source contributors increases by 10%

Challenges for Europe

- When shared openly, European developers' source code can be freely accessed and used by individuals/governments in ways that **go against European values**
- E.g., Collaboration on open-source machine learning software could end up supporting Chinese military or state surveillance projects
- EU decision-makers must **be aware of these risks** in the context of broader open research and innovation cooperation with China
- Chinese companies could use open-source cooperation projects to **circumvent export controls**, as they are aiming to do through the RISC-V open-source chip design architecture

Opportunities for Europe

- European businesses in China could benefit from **the country's open-source community**, for example in terms of access to talent
- The open-source model is **at the heart of innovation in emerging industries**, such as autonomous driving
- Platforms like Baidu's Apollo open-source autonomous driving platform help European businesses **bring value to their customers** and improve their technologies
- Open-source communities enable **valuable exchanges** that benefit European innovation
- European and Chinese tech companies are **partnering on open source**, e.g., Alibaba acquired German data analysis startup Data Artisans to build a new Big Data open-source initiative

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