EASTASN - , EE - , EALC – 402A
Topics in International Technology Management
Week 1: September 23, 2021

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Where Is Asia Going?
Mobility as an Aspect of the Fourth Industrial Revolution

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Adjunct Professor, Stanford University

Welcome to everyone

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- **Stanford students may take the series for University credit**
  - Register for EASTASN-402A, EE-402A, or EALC-402A
  - One unit, S/NC
  - See Syllabus for requirement for credit (may differ from other seminars)
    - Weekly comment by email to me that provides evidence you watched the session
    - Each comment is due within two weeks of the date of that session
      - Due to my deadline for submitting grades, final comment will have shorter deadline
      - All work due to me by: Friday, December 10, at 5:00 pm, Pacific time.
- **Public is welcome**
  - Continuing long history of US-ATMC mixed audiences: Silicon Valley and Stanford
- **Please register** for the entire series at https://stanford.zoom.us/meeting/register/tJIldu6srDsjG9yX-9Mhl6v2VCtCcBUhSLYo
- **Time of official class**: 5:30 pm – 7:00 pm
  - The session is being recorded and will be posted to the Internet
- **Optional networking session** (not recorded): 7:00 pm – about 7:30 pm

Outline

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- **Understanding the current Industrial Revolutions**
- **Overview of Asia innovations in mobility**
  - Mobility 1: New ways of getting around
  - Mobility 2: New things to do with mobile devices
- **Teaser: subsequent sessions of this series**

We are in the middle of two overlapping Industrial Revolutions

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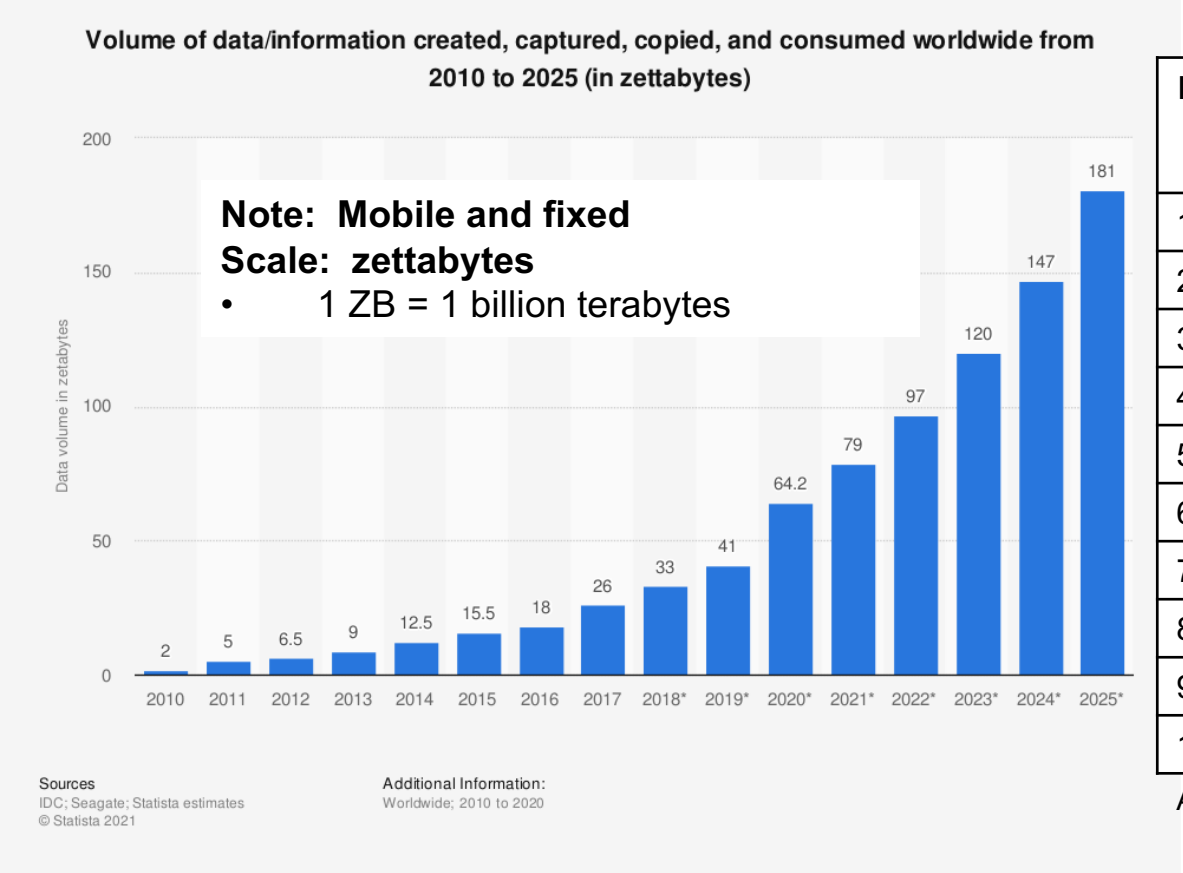
First Industrial Revolution (IR): Advent of machines (mechanization)		mid-late 1700's – mid-late 1800's	New tools, equipment, manufacturing processes (& lifestyles)
Second IR: New ways of using machines: mass manufacturing		mid 1800's – mid 1900's	Assembly lines, standardized parts > specialized salaried jobs > urbanization
Third IR: digital ICT becomes ubiquitous	**Mainframe-terminal**	1940's – c. 1980	Structured text > unstructured text > image/audio > IOT
	Client-server	c. 1980 – c. 2005	
	Cloud	c. 2005 - **present**	
Fourth IR: New ways of capturing value from data	**Industry 4.0 (transitional from 3-IR)**	c. 2010 - **present**	Artificial intelligence, blockchain, edge computing, quantum computing, ...
	More analytics and automation		

Scale of 3rd Industrial Revolution



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Rank	(Mobile) application category	% down	% up
1	Video streaming	48.9%	19.4%
2	Social networking	19.3	16.6
3	Web	13.1	23.1
4	Messaging	6.7	20.4
5	Gaming	4.3	1.9
6	Marketplace	4.1	1.2
7	File sharing	1.3	6.6
8	Cloud	1.1	6.7
9	VPN and security	0.9	3.9
10	Audio	0.2	0.2

Above: Sandvine. *Mobile Internet Phenomena Report*, May 2021.

Scale of 4th Industrial Revolution

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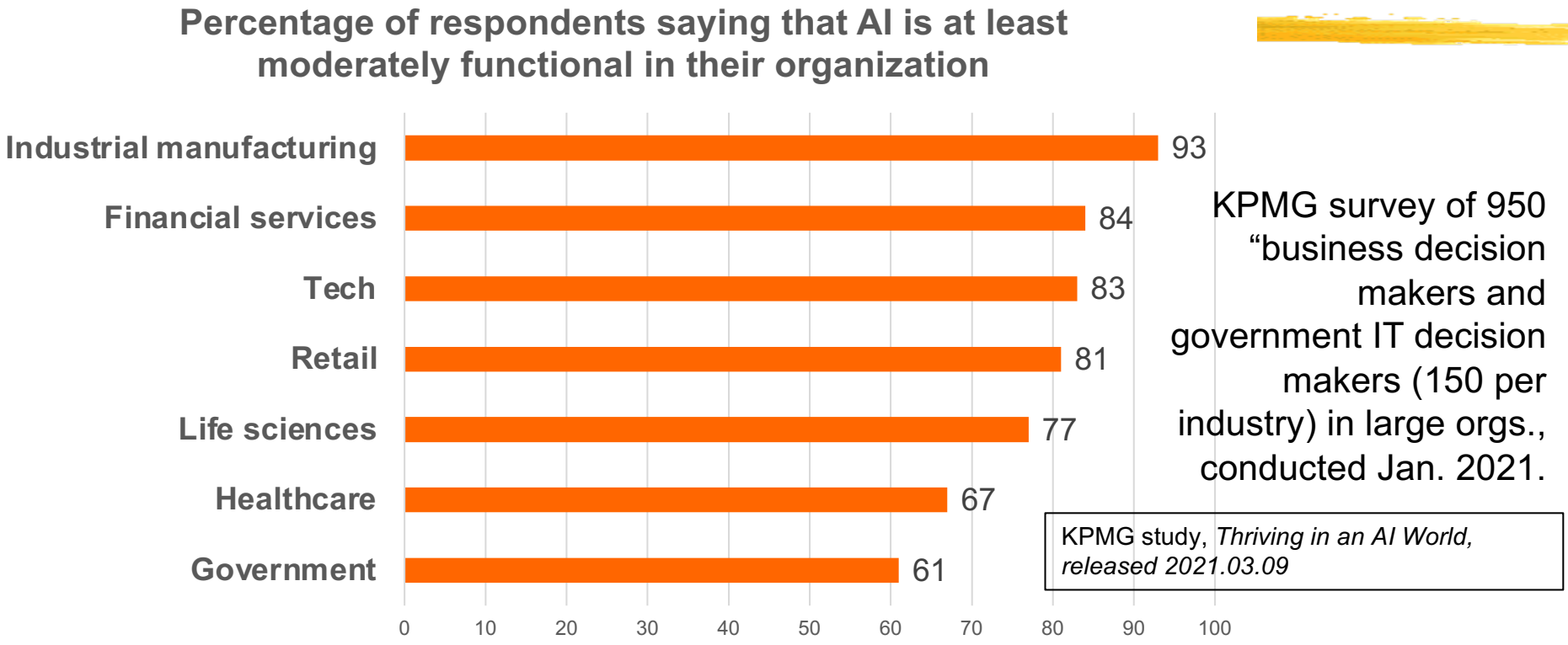
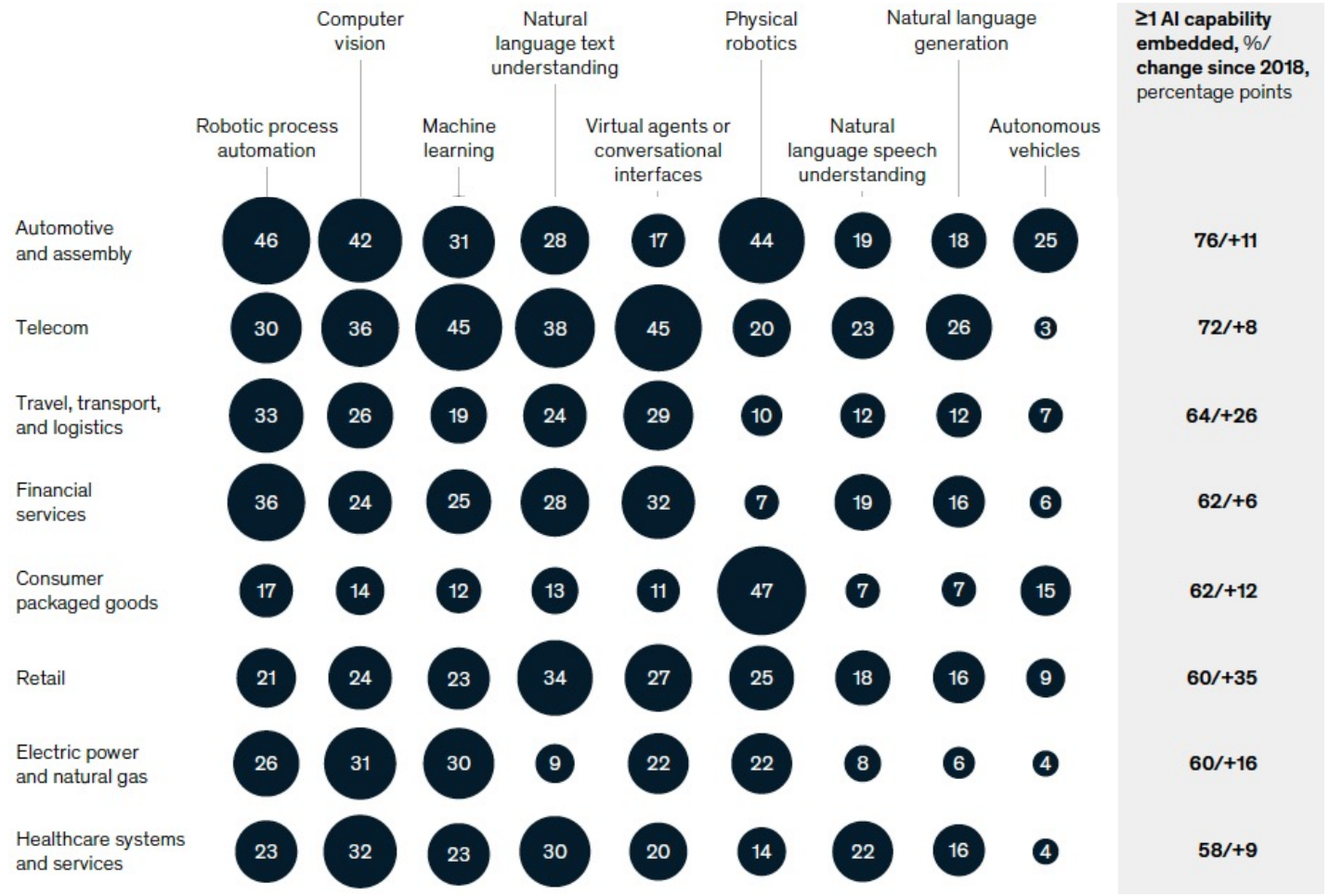


KPMG survey of 950 "business decision makers and government IT decision makers (150 per industry) in large orgs., conducted Jan. 2021.

KPMG study, *Thriving in an AI World, released 2021.03.09*

4-IR: AI adoption in selected industries (2019)



Percentage of respondents, by selected industry, who reported 1-or-more AI programs in at least one product or business process for 1-or-more functions or business units

- Of 2,360 respondents in all industries, 1,872 work at companies that fit this category

McKinsey, Nov. 2019, *Global AI Survey*

Industrial revolutions and digital transformation

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- **What happens in an industrial revolution? Macro-scale change**
  - New ways of doing things in industry become mainstream
  - New lifestyles become the norm
  - Polarization of winners and losers
    - Companies and people “on the side of innovation” tend to increase in wealth
    - Economic gap widens to those left behind
      - Results in 19th-century: migrations to the New World, social unrest, reactionary politics
      - Results in 21st-century: national populism, anti-immigration sentiment, etc.
- **Digital transformation: Micro-economic response**
  - Individual companies undergo change at their core
    - Adopting the new standards is essential to stay ”alive” (competitive)

Mobility as aspect of 3rd, 4th Industrial Revolutions

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- **Key devices at focus of changes that merit the term "revolution"**
  - Smartphone
  - Automobile – rapid onboarding of more and more digital ICT
- **Digital technologies intrinsically involved in (all of) the changes**

Mobility Category 1: **Moving people and things around**

- Shift from gasoline power to electric vehicles (EVs) – *battery management*
- Connected car (> smart city) – *digital communications (mobile and WiFi used by mobile platforms)*
- Autonomous vehicles, drones – *AI-based control or remote control via digital comm.*
- New propulsion systems on horizon – *fuel cells, direct hydrogen power*
- Logistics management – *(often AI-enabled) cloud and edge computing*

Mobility Category 2: **Doing things with smart mobile devices**

Mobile access as aspect of 3rd IR

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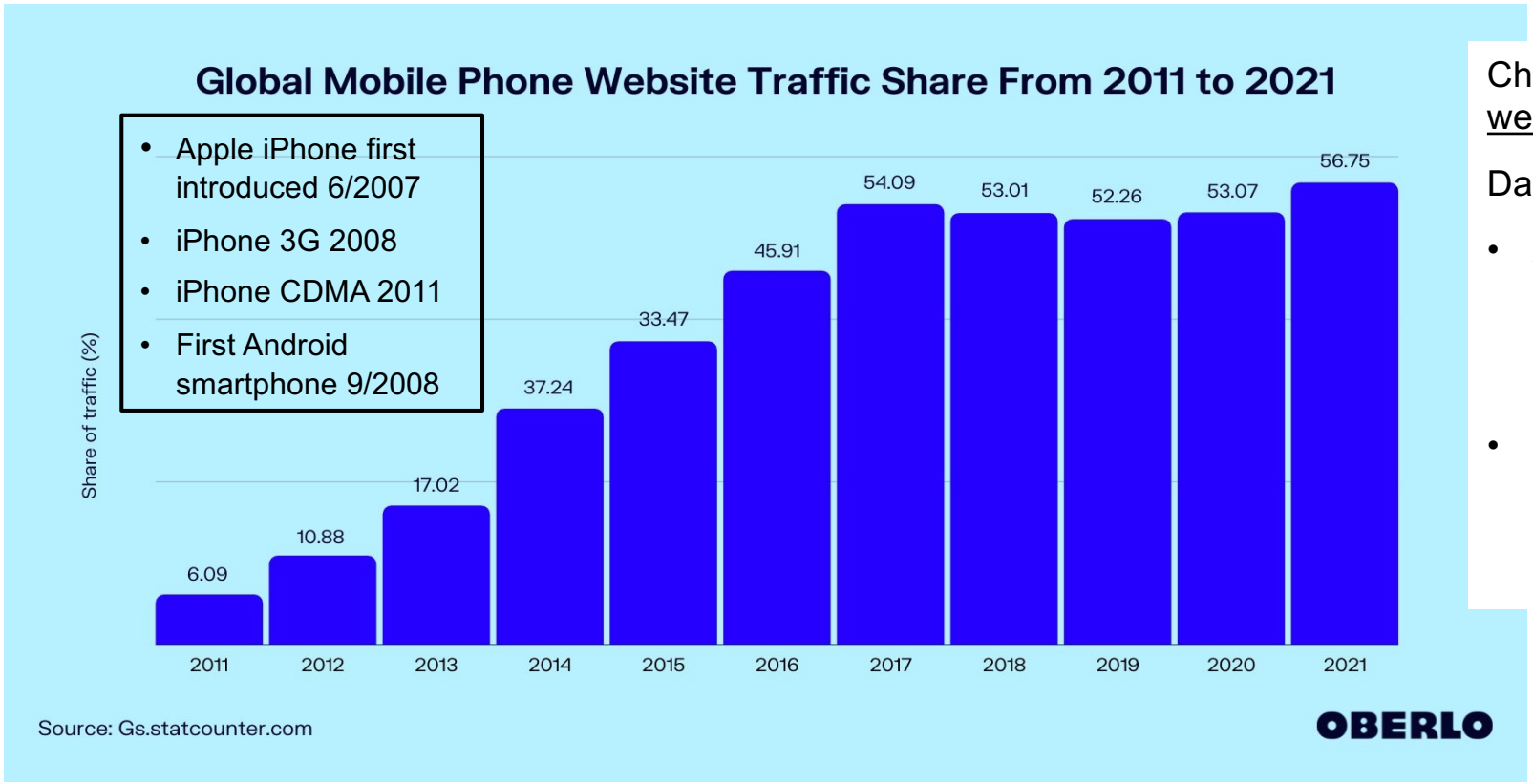

Chart shows % of all website traffic

Data as of July 2021

- Appears to show access both via apps and browsers
- 49.71% of all website visits are from mobile (50.29% desktop)

Mobile access as aspect of 3rd IR (Slide 2)

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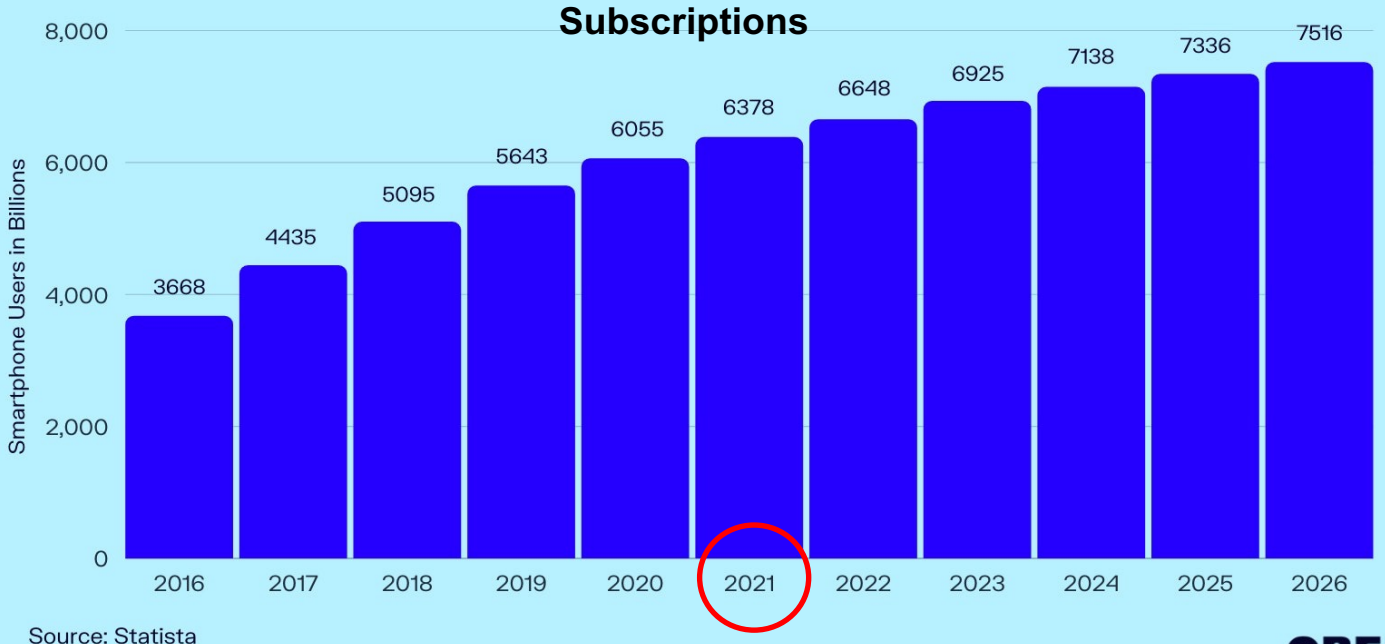

Est. world pop. 2021 = 7.9 billion

- *Users* projected to reach 4.3 billion by 2023 (53.8% penetration rate)
- 2021:
  - -- 76% of adults in advanced economies have smartphone
  - -- 45% in emerging economies

Mobile Internet traffic in select (Asian) countries

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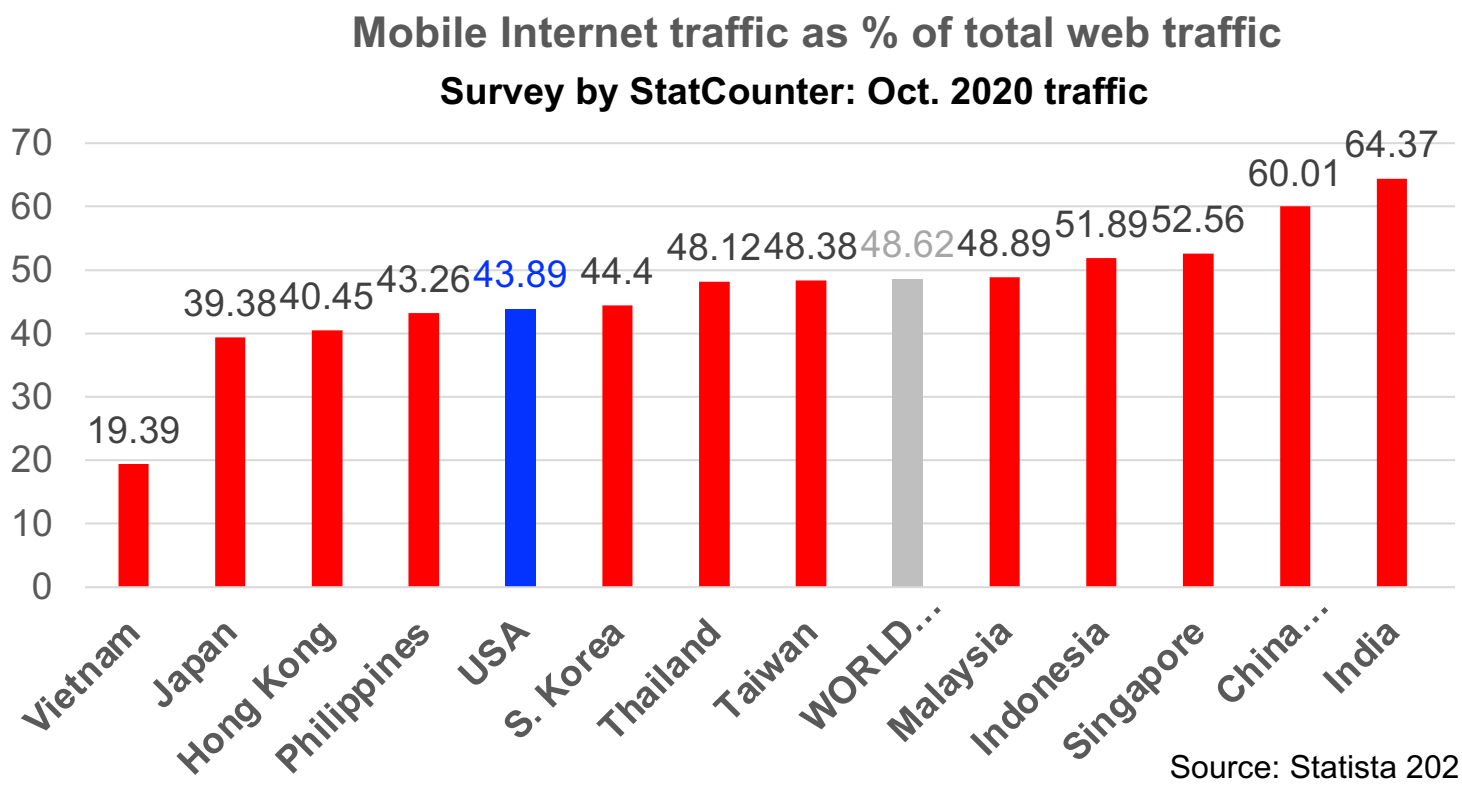

Source: Statista 2021

Survey excluded tablets

- USA, other advanced countries mobile rates low because of high desktop use rates
- So, very high use of mobile Internet in some Asian economies
- Vietnam – may still reflect popularity of Internet cafes
- HK: 2020 troubles?

Asia **mobile** Internet speeds (selected countries)

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World Rank	Economy	Down (Mbps)	Up (Mbps)	Latency (ms)
2	S. Korea	192.16	21.42	30
5	China (mainland)	163.45	30.34	29
17	**USA**	**96.31**	**12.99**	**41**
18	Singapore	91.75	19.78	21
22	Taiwan	81.32	16.30	24
25	Hong Kong	78.75	15.03	23
37	Japan	61.32	11.66	43
	WORLD AVG	**56.74**	**12.61**	**37**
50	Thailand	49.37	15.40	30
57	Vietnam	41.16	18.95	28
73	Philippines	33.77	8.63	30
82	Laos	32.04	13.88	31
89	Malaysia	29.14	10.87	33
112	Indonesia	21.96	12.44	33
120	Pakistan	19.79	11.08	37
126	India	17.96	5.11	47

Notes
- Relatively slow speeds in some heavy mobile Internet traffic countries (India)
- Probably excludes (fixed) WiFi

Survey August 2021 https://www.speedtest.net/global-index
- Average of test results by 300 unique users in each country

Mobility 1:
Moving people and things around in Asia

Advent of electric vehicles in select countries

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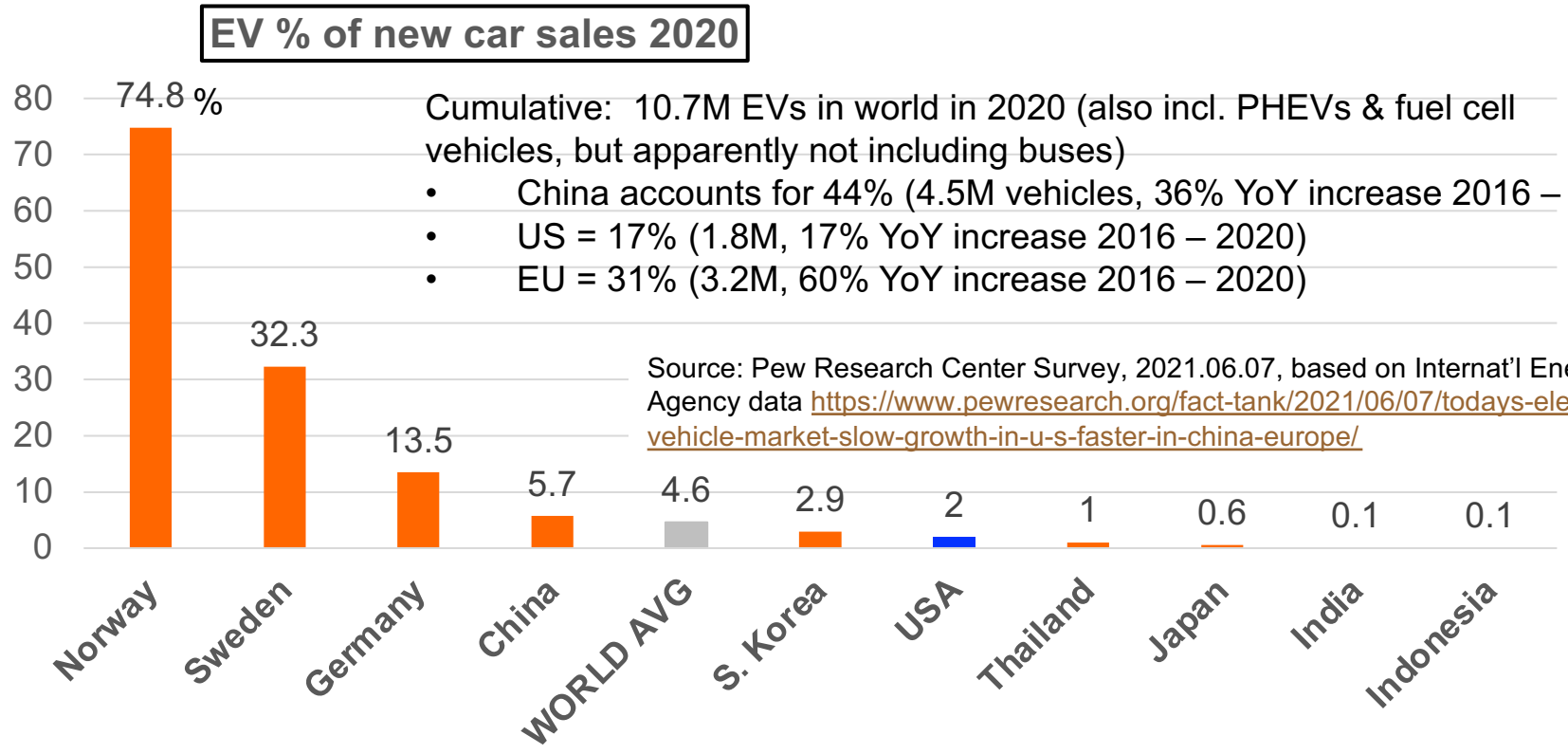

Cumulative: 10.7M EVs in world in 2020 (also incl. PHEVs & fuel cell vehicles, but apparently not including buses)

- China accounts for 44% (4.5M vehicles, 36% YoY increase 2016 – 20)
- US = 17% (1.8M, 17% YoY increase 2016 – 2020)
- EU = 31% (3.2M, 60% YoY increase 2016 – 2020)

Source: Pew Research Center Survey, 2021.06.07, based on Internat'l Energy Agency data https://www.pewresearch.org/fact-tank/2021/06/07/todays-electric-vehicle-market-slow-growth-in-u-s-faster-in-china-europe/

EV charging stations

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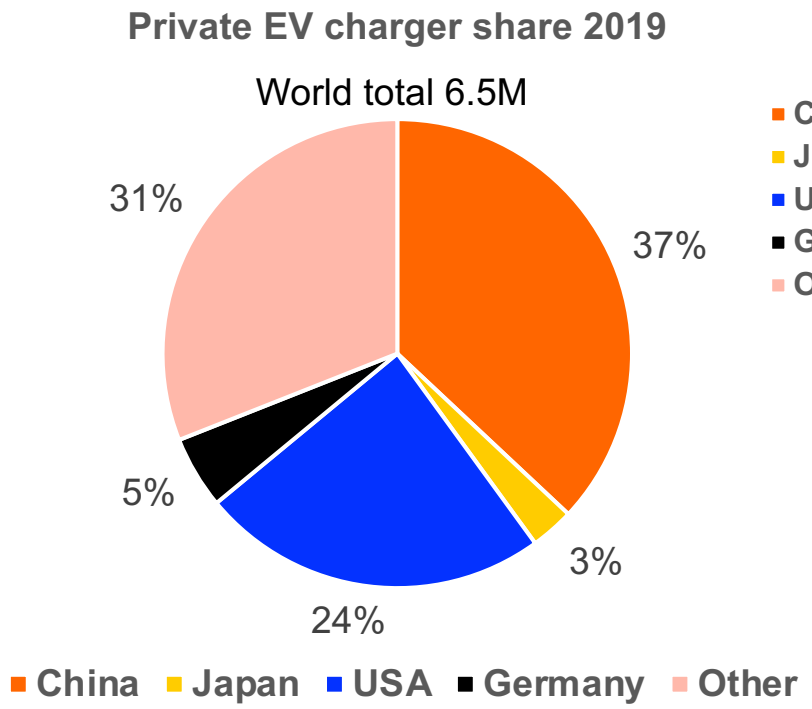
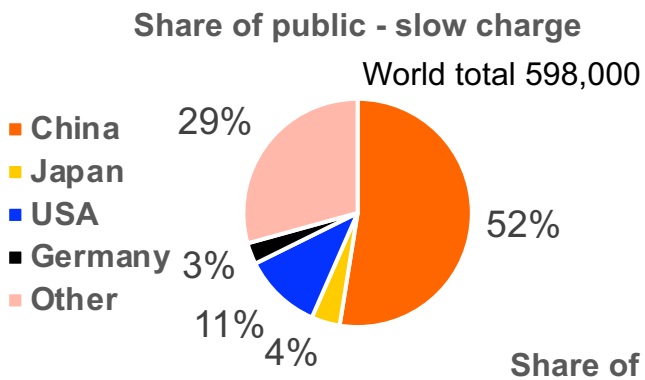
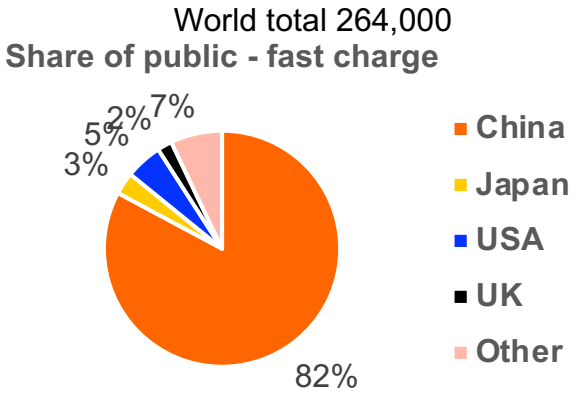




Sourrce: Inernational Energy Association, *Global EV Outlook 2020*



On the horizon: Hydrogen fuel-cell vehicles

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China Pushes Ahead With Hydrogen, Defying Skeptics Like Elon Musk

An attendant fills a truck with compressed hydrogen at a filling station in Shanghai. (Qilai Shen/Bloomberg

Above: Ballard Systems providing fuel-cell hybrid buses to Foshan & Yungfu cities (Guangdong), China

- Planned deployment of 300 buses announced 2015
- Consortium with local manufacturer, design localization, local development of charging stations
- By 2018, 16 were already in use with passengers

Source (Ballard Systems website)

Japan and Korea automakers – push for FCEV as next generation EV

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- **Three fuel cell hybrid cars already available in U.S.**
  - Honda Clarity (actually the first) – leasing only, market figures unavailable
  - Toyota Mirai – in U.S. 2019 sales = 1509 cars, 2020 = 499
  - Hyundai Nexo (SUV) – to market from 2018
    - In Korea, over 10,000 units sold (cumulative) by Oct. 2020 (over 5,000 in 2020)
    - In U.S. 2019 sales = 320, iin 2020 = 208
- **Charging stations are still big limitation**
  - But, China plans to have 1 million FCEV on the road by 2030
- **Hyundai plans to build fuel cell factory in Guangzhou** (FT 2021.01.15)
  - Completion expected 2022 at cost of ~ $1 billion
  - At first, will make 6,500 units/year, planned capacity of 730,000/year
- **Hyundai: first production models of big FCEV truck "Xcient" del. 12/20**

Really far out on the horizon…

Toyota: racing car with hydrogen (combustion) engine

- Built on Corolla Sport body
- Completed 24-hour car race: (Round 3 NAPAC Fuji Super TEC 24 Hours Race at Fuji International Speedway, Japan) May 22, 2021

-- 358 laps, 35 pit stops, had to leave racetrack & go to paddock each stop

- The driver was … Toyota President Akio Toyoda (under racing name "Morizo")

Connected car – Asia approaches focus on "smart city" infrastructure development

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- **Early discussions of connected car (~ 10 years ago) focused on location-based services – business just has not taken off**
- **In contrast, smart city projects are active, especially in Asia**
  - Worldwide, over 443 smart city projects in 298 locations
  - Toyota has spun out "Woven Planet" – upcoming session in our series
  - 10 cities in ASEAN (inc. Jakarta, Hanoi, Phuket, New Clark City [Ph.], …)
  - Korean government has comprehensive "Smart City Korea" portal, as well as major project in Songdo (Incheon)
  - Typically: advanced communications (true 5G), IOT networks of sensors for vehicle-to-infrastructure communications, location systems, electronic payment, data analytics
    - Many will be autonomous vehicle testbeds – autos, shuttles, delivery robots, etc.

Companies with autonomous vehicle projects in China

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- **AutoX (Hong Kong)** – started robotaxi service in Shanghai 4/2021, has just received permission to start testing in San Jose, CA
  - Backed by Alibaba Group, MediaTek, Shanghai Auto, and Dongfeng Motor
- **Baidu** – started R&D 2013, branded "Apollo" from 2017, launced robotaxi service in Changsha (Hunan Prov.) Sept. 2019 with 45 AVs
  - Building testing grounds, including world's largest in Beijing's Yizhuang Economic Development Zone from May 2020
  - May provide operating system license to other developers
- **DiDi Chuxing** – AV robotaxi service in Shanghai (Jiading) from June 2020
- **Pony.ai** – has 50 AVs operating in Guangzhou – Toyota backing
- **TuSimple – autonomous long-haul trucks, HQ in San Diego**
- **WeRide** – robotaxi service in Guangzhou (JV with Baiyun Taxi)
  - Backed by Nissan/Renault group

Chinese AVs


Bai 百度 apollo
车库入口
车辆出入口
保持车距 谨防追尾


滴滴
滴滴


小马智行 pony.ai
pony


SELF-DRIVING TRUCK
tusimple
SELF-DRIVING TRUCK

Selected autonomous vehicle news in other Asia countries

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- **Japan**
  - Honda – brought to Japan market AV of *Legend* Mar. 2021
    - Claims to be Level 3, available for leasing only
  - Toyota – ePallette AV shuttle bus in operation at Tokyo Olympics
  - NEC – providing technology for AV testing in UK
  - Komatsu – commercial AV "Autonomous Haulage System" in use at mines in Australia from 2009
- **Singapore** – robotaxi project with nuTonomy (later bought by Delphi) from Oct. 2017
- **S. Korea** – 22 autonomous vehicle-related startups (as of July 2021)
- **India** – approx. 20 AV-related startups (as of Sept. 2021)

Mobility 2:

Doing new things with mobile devices in Asia

Despite challenges, mobile ecommerce is big

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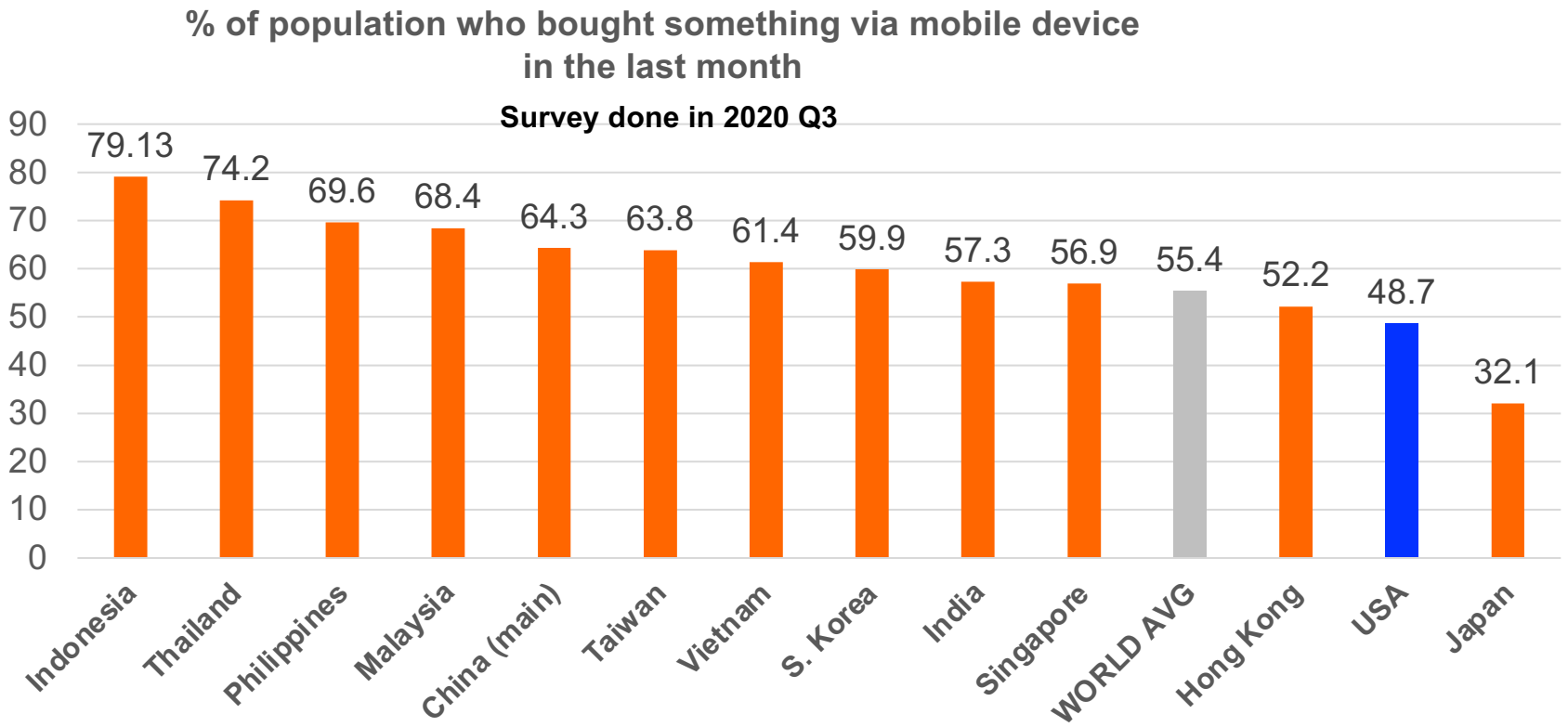

ecommerce: Japan is moderately active but people still pay in traditional ways

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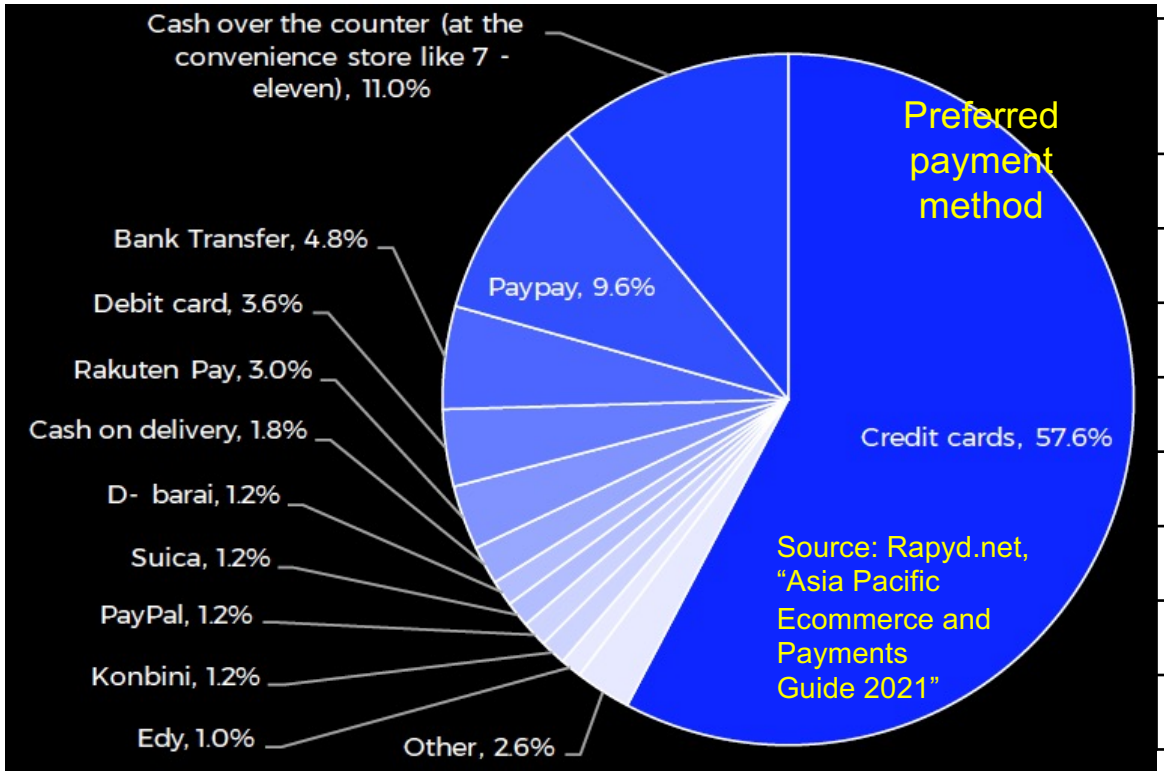

Year 2020	Ecommerce % of total retail sales	Total Retail Sales ($ bn)
China	41.2%	$ 5,071.9
South Korea	26.2%	396.7
Japan	**10.1%**	1,289.0
Indonesia	5.4%	289.1
India	4.2%	1,224.1
Malaysia	3.8%	161.2
Thailand	2.3%	254.9
Vietnam	1.9%	167.2

In contrast, India ecommerce small % of retail, but Paytm is most preferred payment method

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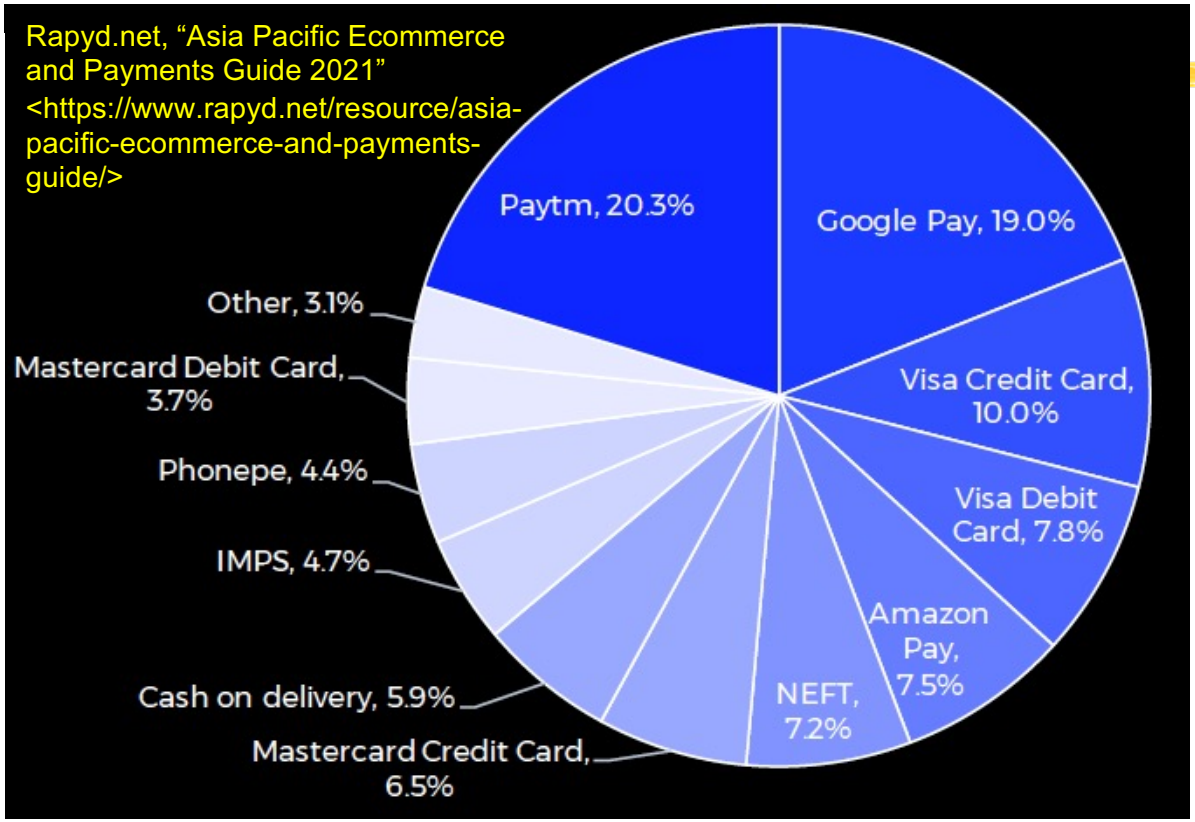
- Survey in March and April 2020 of approx. 500 people in India who do online shopping
- Right-hand chart shows preferred payment method
- Separate Q: "Which payments have you used (offline and online) in past month?"
  - -- 85% Paytm
  - -- 83% Visa credit card
  - -- 81% cash on delivery
  - -- 77% Google Pay
  - -- 66% Amazon Pay
  - -- 32% cash over counter



Mobile payments apps – millions of users

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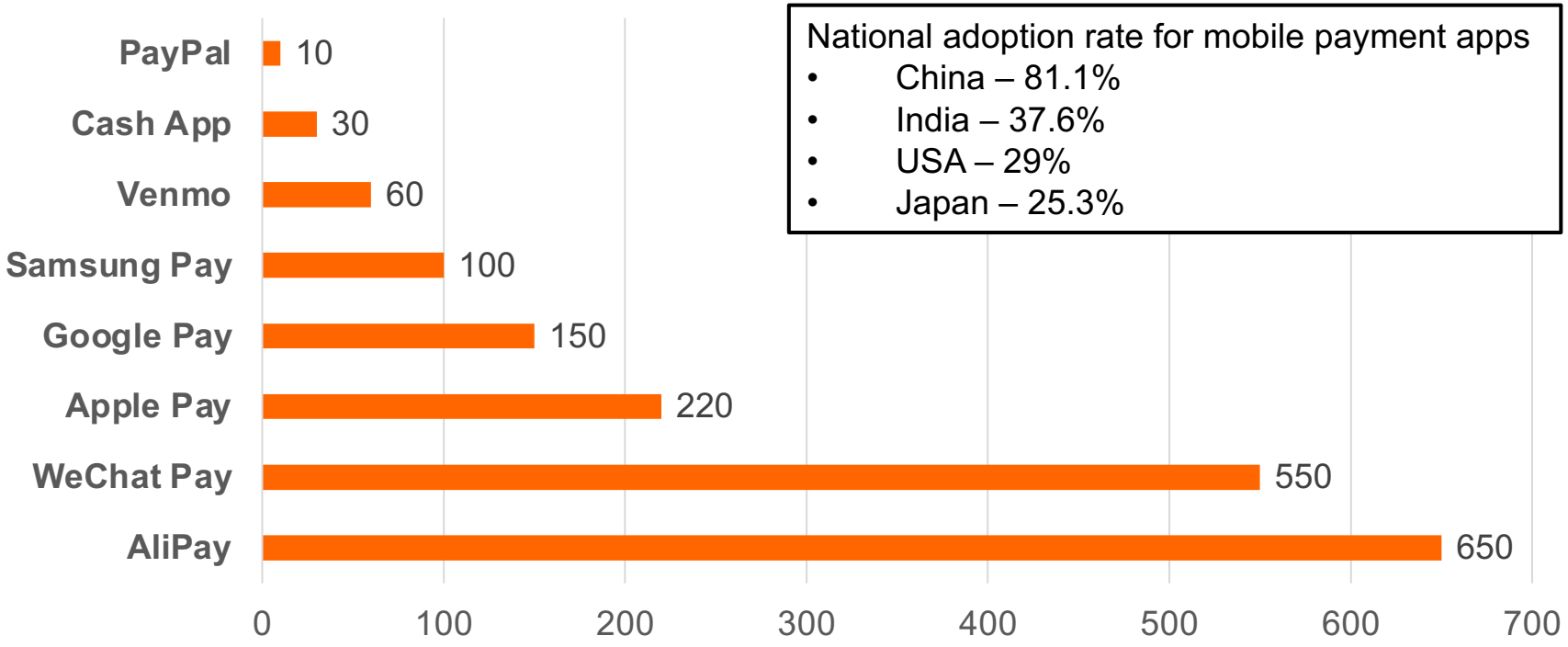

National adoption rate for mobile payment apps

- China – 81.1%
- India – 37.6%
- USA – 29%
- Japan – 25.3%

Dynamics behind growth in Asia of doing things online via mobile devices

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- **In some countries, mobile was the first means of access to Internet**
- **Business models may differ greatly from country to country**
  - Many SEA users still use pre-paid minutes, rather than having a set subscription
- **Telehealth may be focused more on reaching new markets than on improving quality of care**
  - If so, tendency will still be to prefer in-person care
- **EdTech is targeting adult markets**
  - Crackdown on after-school education services in China
  - Japanese “juku” still seem to follow traditional patterns (after school in-person)
  - Professional skills, English for business people, etc. are areas of growth

Some points about today (and this series)

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- **Mobility is a major aspect of the (overlapping) 3rd and 4th Industrial Revolutions**
  - Increasing mobility will probably be one of the biggest changes in business and lifestyles 1980 – 2050
- **Asia is particularly active in exploiting opportunities in mobility**
  - Disclaimer: diverse countries, not much Asia-wide coordination (but active globalization by some private companies: Grab, Paytm, …)
  - Although U.S. – China tension is making bilateral exchanges more difficult, much information is available about what is going on in Asia
    - But, one has to look
- **Many Asian directions of mobility innovation: driven by local conditions**
  - Solutions that may not yet have been developed in U.S.

Some upcoming sessions in this series

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- **See https://asia.Stanford.edu**
- **Sept. 30** **Deepak Garg**, Founder & CEO, Rivigo
  A new approach to long-distance trucking in India
- **Oct. 7** **Akimichi Degawa**, CoFounder & CEO, Tier IV
  Daisuke Tanaka, COO, Tier IV and Exec. Officer, Autoware Foundation
  Open source strategy in the automotive industry
- **Oct. 14** **Dr. John Chan**, Founder & CEO, Mapxus (Hong Kong)
  Indoor mapping and navigation for visually impaired persons
- **Oct. 21** **Madhu Shalini Iyer**, Partner, Rocketship.vc
  Massive adoption: VC perspectives into Asia opportunities in mobility applications

Thank you for participating!!

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