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Purpose of this report

Paper & research

Market

Association

Technology

Parson

What is singularity?

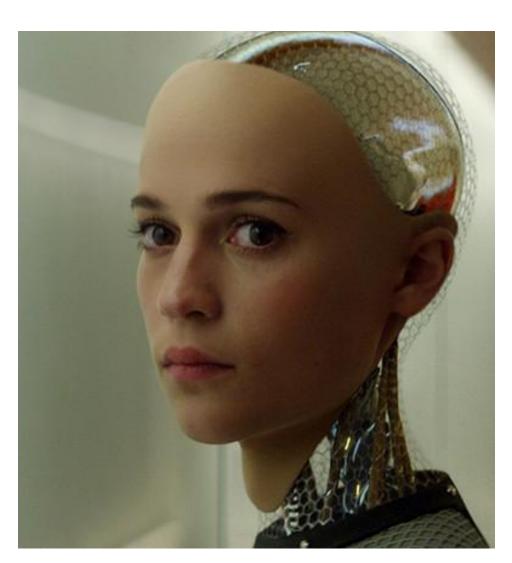
What is GNR?

Technology Giants Action

Investment in AI industry

Fund, VC, CVC

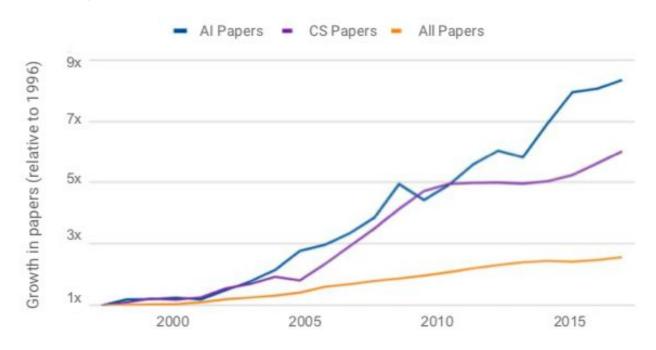
Who is supreme ruler in AI industry



Al paper is the most increase in published papers



Growth of annually published papers by topic (1996–2017) Source: Scopus



Note: This visual uses the Scopus query search term "Artificial Intelligence," not the Elsevier keyword approach. See more details in the appendix.

Al techniques categoriy

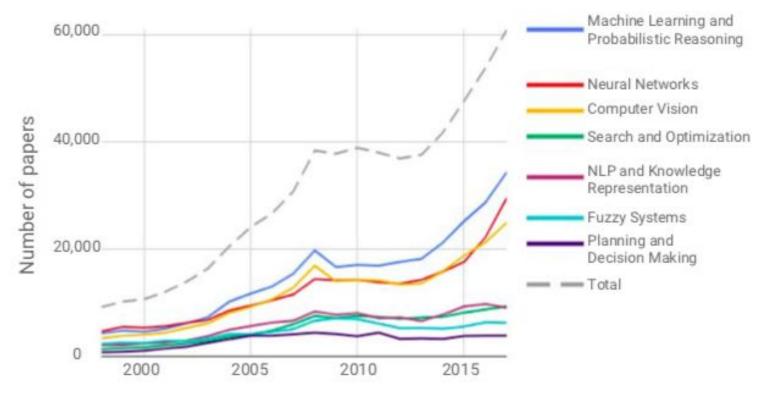




Number of AI paper by subcategory is large in order of machine learning, neural networks, computer vision



Number of Al papers on Scopus by subcategory (1998–2017) Source: Elsevier



Ref. artificial intelligence index 2018 annual report

Categories and subcategories of AI techniques



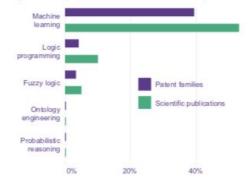
Figure 3.5. Patent families for AI technique categories and sub-categories

Machine learning is the dominant AI technique, representing 89 percent of patent families related to an AI technique



Figure 3.6. Patent families and scientific publications related to AI techniques as a share of the total for AI

The share of scientific publications is generally higher than patent families for AI techniques



Note: A patent or scientific publication may refer to more than one category

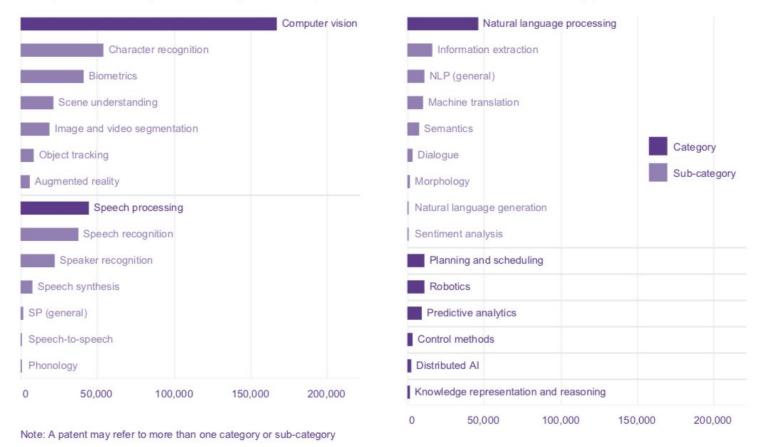
Ref. WIPO Technology Trends 2019 Artificial Intelligence https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf

Categories and subcategories of AI applications



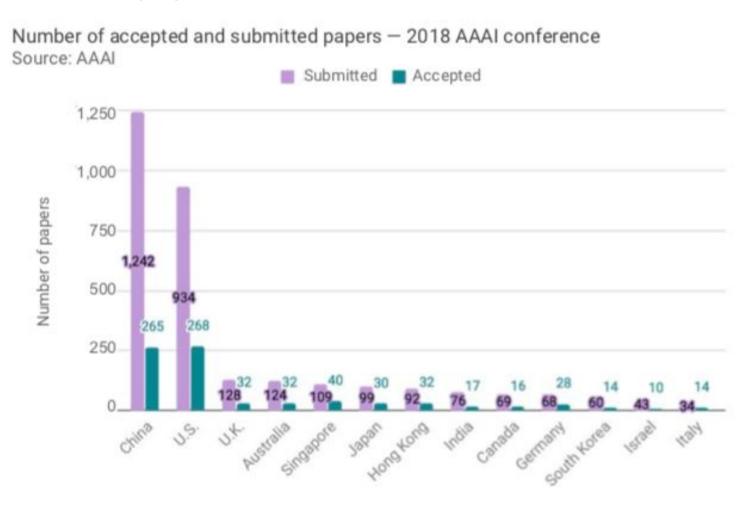
Figure 3.10. Patent families for functional application categories and sub-categories

Computer vision represents 49 percent of patent families related to a functional application



Top two of AAAI papers are China and U.S.





Ref. artificial intelligence index 2018 annual report http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf

Patent families by co-occurrence of application fields



Figure 3.20. Patent families by co-occurrence of application fields with machine learning and functional applications

Machine learning co-occurs most frequently with the life and medical sciences and telecommunications fields; computer vision with telecommunications and transportation

	Machine learning	Computer vision	Natural language processing	Speech processing	Control methods	Planning and scheduling	Robotics	Knowledge representation and reasoning	Predictive analytics	Distributed Al
Telecommunications	16,201	22,871	7,553	12,549	3,496	2,601	2,476	1,292	1,533	516
Transportation	13,741	21,744	2,330	3,997	14,030	3,614	5,080	761	866	533
Personal devices, computing and HCI	11,585	17,164	7,920	6,678	1,625	1,663	1,416	1,838	1,069	223
Life and medical sciences	18,772	17,098	3,818	2,504	1,494	1,617	1,988	1,698	1,694	428
Security	8,813	17,235	3,033	3,075	1,162	1,401	793	795	594	243
Document management and publishing	6,841	11,530	9,526	3,291	163	517	221	880	431	83
Business	9,709	7,968	5,850	2,422	271	1,381	350	1,820	2,585	189
Industry and manufacturing	9,569	5,573	3,031	798	1,262	2,404	1,073	1,213	1,086	382
Physical sciences and engineering	8,330	5,397	1,284	1,183	1,540	721	679	444	720	171
Networks	5,296	3,659	2,350	1,498	343	789	380	630	570	183
Arts and humanities	2,489	4,852	2,669	2,615	237	273	371	203	277	44
Education	3,914	3,767	1,642	1,951	284	365	372	532	247	56
Cartography	3,276	3,334	1,610	759	697	697	257	365	425	98
Energy management	3,766	1,056	397	309	734	944	336	187	299	335
Entertainment	1,822	2,890	737	1,087	309	199	528	189	133	41
Computing in government	2,583	2,587	938	444	149	380	135	243	213	71
Banking and finance	2,368	2,047	1,055	493	87	435	99	394	449	81
Agriculture	1,430	1,196	291	126	778	282	415	82	138	48
Military	1,300	1,343	370	269	443	241	255	110	111	73
Law, social and behavioral sciences	780	404	550	121	25	153	37	123	65	23

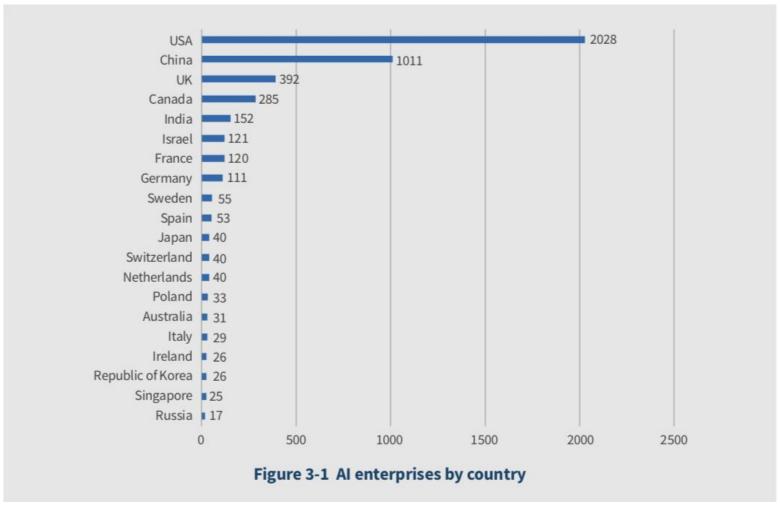
Computer vision x Telecommunications; 22,871 Computer vision x Transportation; 21,744 Machine learning x Life and medical science; 18,772 Computer vision x Security; 17,235 Computer vision x Personal devices etc; 17,164 Computer vision x Life and medical science; 17,098 Machine learning x Telecommunications; 16,201 Control methods x Transportation: 14,030 Machine learning x Transportation; 13,741 Speech processing x Telecommunications; 12,549

Machine learning x Personal devices etc; 11,585

Computer vision x Document management etc; 11,530

USA has 2028 AI enterprises, China has 1011



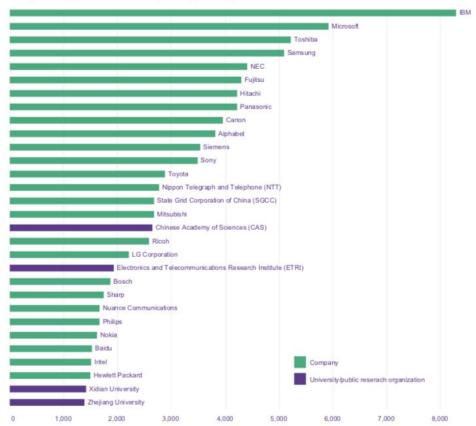


Ref. China Institute for Science and Technology Policy at Tsinghua University: China Al Development Report 2018 http://www.sppm.tsinghua.edu.cn/eWebEditor/UploadFile/China Al development report 2018.pdf

Top 30 patent applicants by number of patent families



Figure 4.1. Top 30 patent applicants by number of patent families Companies represent 26 of the top 30 Al patent applicants worldwide



Note: Fujitsu includes PFU; Panasonic includes Sanyo; Alphabet includes Google, Deepmind Technologies, Waymo and X Development Toyola includes Denso; and Nokia includes Alcatel

Ref. WIPO Technology Trends 2019 Artificial Intelligence https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf

Top 2 for AI technique category, AI functional category



Figure 4.5. Top two patent applicants for each AI technique category and sub-category by number of patent families

IBM and Microsoft rank first and second in most AI techniques

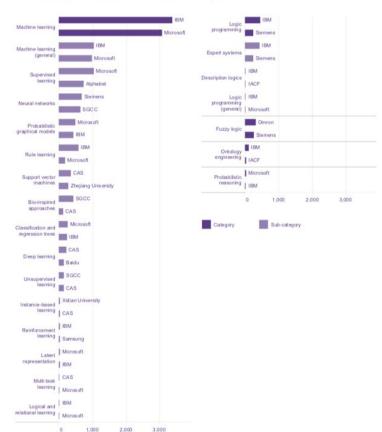
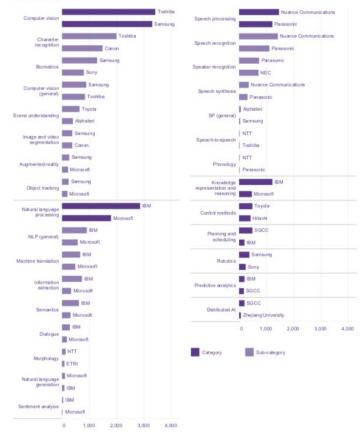


Figure 4.6. Top two patent applicants for each Al functional application category and sub-category by number of patent families

Different companies feature as top patent applicants across AI functional application categories and sub-categories



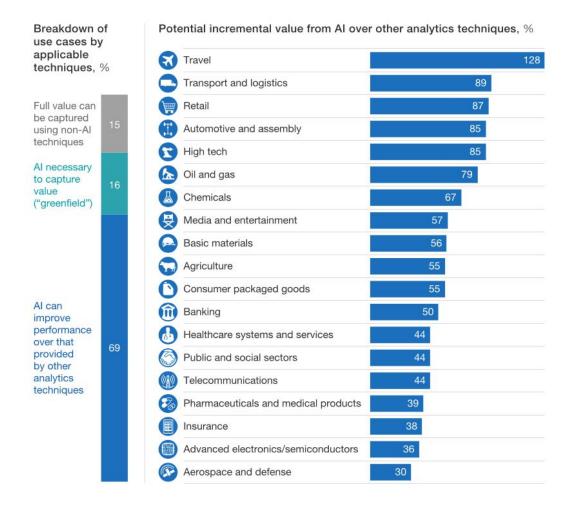
Note: A patent may refer to more than one category or sub-category

Note: A patent may refer to more than one category or sub-category

Ref. WIPO Technology Trends 2019 Artificial Intelligence https://www.wipo.int/edocs/pubdocs/en/wipo pub 1055.pdf

Potential incremental value from AI





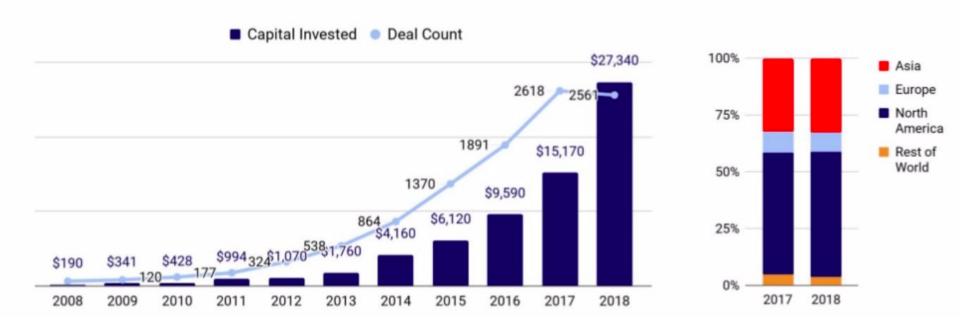
Ref. Mckinsey & company Note from the Al frontier: Applications and value of deep learning

Global venture capital investments in Al



Global venture capital investments in AI themes grow at a clip to reach >\$27B/year

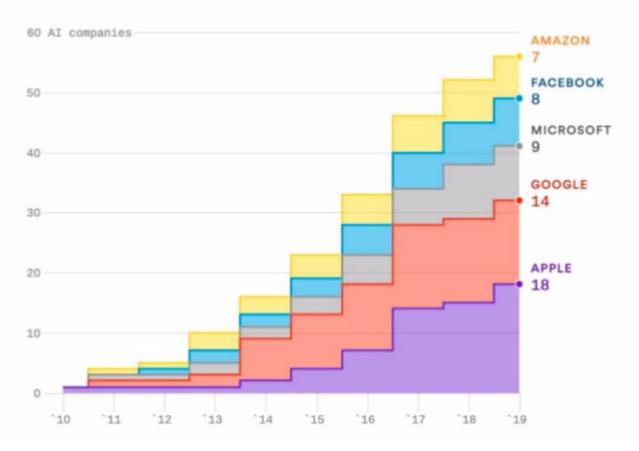
Almost 80% more capital invested in FY18 vs FY17 with North America leading the way at 55% market share.



Big tech companies gobble up Al-first startups



▶ GAFAM have completed a cumulative sum of 60 acquisitions of AI-first startups since 2010.





Ref. state of AI report 2019



Return on IBM stockholders' equity

(\$ in millions except per share amounts)					
For the year ended December 31:	2018	2017	2016	2015	2014
Revenue	\$ 79,591	\$ 79,139	\$ 79,919	\$ 81,741	\$ 92,793
Income from continuing operations	\$ 8,723	\$ 5,758	\$ 11,881	\$ 13,364	\$ 15,751
Income/(loss) from discontinued operations, net of tax	\$ 5	\$ (5)	\$ (9)	\$ (174)	\$ (3,729)
Net income	\$ 8,728	\$ 5,753	\$ 11,872	\$ 13,190	\$ 12,022
Operating (non-GAAP) earnings*	\$ 12,657	\$ 12,807**	\$ 12,880**	\$ 14,519**	\$ 16,534**
Earnings/(loss) per share of common stock:					
Assuming dilution:					
Continuing operations	\$ 9.51	\$ 6.14	\$ 12.39	\$ 13.60	\$ 15.59
Discontinued operations	\$ 0.01	\$ 0.00	\$ (0.01)	\$ (0.18)	\$ (3.69)
Total	\$ 9.52	\$ 6.14	\$ 12.38	\$ 13.42	\$ 11.90
Basic:					
Continuing operations	\$ 9.56	\$ 6.17	\$ 12.44	\$ 13.66	\$ 15.68
Discontinued operations	\$ 0.01	\$ 0.00	\$ (0.01)	\$ (0.18)	\$ (3.71)
Total	\$ 9.57	\$ 6.17	\$ 12.43	\$ 13.48	\$ 11.97
Diluted operating (non-GAAP)*	\$ 13.81	\$ 13.66**	\$ 13.44**	\$ 14.77**	\$ 16.37**
Cash dividends paid on common stock	\$ 5,666	\$ 5,506	\$ 5,256	\$ 4,897	\$ 4,265
Investment in property, plant and equipment	\$ 3,395	\$ 3,229	\$ 3,567	\$ 3,579	\$ 3,740
	N. 15 AT A 17 17 17 17 17	T SERVICE THE THE SERVICE THE	20.000.000.000.000.000.000	Contractor Contractor State Service	

At December 31:	2018	2017	2016	2015	2014
Total assets	\$123,382	\$125,356	\$117,470	\$110,495	\$117,271
Net investment in property, plant and equipment	\$ 10,792	\$ 11,116	\$ 10,830	\$ 10,727	\$ 10,771
Working capital	\$ 10,918	\$ 12,373	\$ 7,613	\$ 8,235	\$ 7,797
Total debt	\$ 45,812	\$ 46,824	\$ 42,169	\$ 39,890	\$ 40,722
Total equity	\$ 16,929	\$ 17,725	\$ 18,392	\$ 14,424	\$ 12,014

48.0%

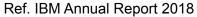
31.1%

74.0%

101.1%

72.5%

^{**}Recast to reflect adoption of the FASB guidance on presentation of net benefit cost.







^{*} Refer to the table below for the reconciliation of non-GAAP financial information for 2015 and 2014. Also see "GAAP Reconciliation," on pages 41 and 58 for the reconciliation of non-GAAP financial information for 2018, 2017 and 2016.





(In millions, except per share amounts)

Year Ended June 30,	2019(a)	2018	2017(d)(e)	2016(d)	2015
Revenue	\$ 125,843	\$ 110,360	\$ 96,571	\$	91,154	\$ 93,580
Gross margin	82,933	72,007	62,310		58,374	60,542
Operating income	42,959	35,058	29,025 ^(f)		26,078 ^(g)	18,161 ^{(h}
Net income	39,240(b)	16,571(c)	25,489(f)		20,539(g)	12,193(h
Diluted earnings per share	5.06(b)	2.13(c)	3.25(f)		2.56(g)	1.48(h
Cash dividends declared per share	1.84	1.68	1.56		1.44	1.24
Cash, cash equivalents, and short-term investments	133,819	133,768	132,981		113,240	96,526
Total assets	286,556	258,848	250,312		202,897	174,303
Long-term obligations	114,806	117,642	106,856		66,705	44,574
Stockholders' equity	102,330	82,718	87,711		83,090	80,083

- (a) GitHub has been included in our consolidated results of operations starting on the October 25, 2018 acquisition date.
- (b) Includes a \$2.6 billion net income tax benefit related to intangible property transfers and a \$157 million net charge related to the enactment of the Tax Cuts and Jobs Act ("TCJA"), which together increased net income and diluted earnings per share ("EPS") by \$2.4 billion and \$0.31, respectively. Refer to Note 12 Income Taxes of the Notes to Financial Statements (Part II, Item 8 of this Form 10-K) for further discussion.
- (c) Includes a \$13.7 billion net charge related to the enactment of the TCJA, which decreased net income and diluted EPS by \$13.7 billion and \$1.75, respectively. Refer to Note 12 Income Taxes of the Notes to Financial Statements (Part II, Item 8 of this Form 10-K) for further discussion.
- (d) Reflects the impact of the adoption of new accounting standards in fiscal year 2018 related to revenue recognition and leases.
- (e) LinkedIn has been included in our consolidated results of operations starting on the December 8, 2016 acquisition date.
- (f) Includes \$306 million of employee severance expenses primarily related to our sales and marketing restructuring plan, which decreased operating income, net income, and diluted EPS by \$306 million, \$243 million, and \$0.04, respectively.
- (g) Includes \$630 million of asset impairment charges related to our Phone business and \$480 million of restructuring charges associated with our Phone business restructuring plans, which together decreased operating income, net income, and diluted EPS by \$1.1 billion, \$895 million, and \$0.11, respectively.
- (h) Includes \$7.5 billion of goodwill and asset impairment charges related to our Phone business and \$2.5 billion of integration and restructuring expenses, primarily associated with our Phone business restructuring plans, which together decreased operating income, net income, and diluted EPS by \$10.0 billion, \$9.5 billion, and \$1.15, respectively.



回次		第176期	第177期	第178期	第179期	第180期
決算年月		2015年3月	2016年3月	2017年3月	2018年3月	2019年3月
売上高	(百万円)	4, 851, 060	4, 346, 485	4, 043, 736	3, 947, 596	3, 693, 539
営業利益(△損失)	(百万円)	△72,496	△581, 376	96, 537	86, 184	35, 447
継続事業からの 税金等調整前当期純利益 (△損失)	(百万円)	△122, 333	△499, 439	44, 945	82, 378	10, 909
当社株主に帰属する 当期純利益(△損失)	(百万円)	△37,825	△460, 013	△965, 663	804, 011	1,013,256
当社株主に帰属する 包括利益(△損失)	(百万円)	90,638	△752, 518	△844, 585	819, 189	1,083,664
株主資本	(百万円)	1, 083, 996	328, 874	△552, 947	783, 135	1, 456, 659
純資産額	(百万円)	1, 565, 357	672, 258	△275, 704	1, 010, 734	1,699,045
総資産額	(百万円)	6, 334, 778	5, 433, 341	4, 269, 513	4, 458, 211	4, 297, 344
1株当たり株主資本	(円)	2, 560, 09	776, 74	△1, 306, 03	1, 201. 78	2, 691. 21
基本的1株当たり 当社株主に帰属する 当期純利益(△損失)	(円)	△89.33	△1, 086. 45	△2, 280. 76	1, 628. 88	1, 641, 85
希薄化後1株当たり 当社株主に帰属する 当期純利益	(円)	=	/ 	-	-	i —
株主資本比率	(%)	17. 1	6.1	△13.0	17.6	33.9
株主資本利益率	(%)	△3. 6	△65.1	-	698. 6	90.5
株価収益率	(倍)	_		-	1. 89	2. 15
営業活動による キャッシュ・フロー	(百万円)	330, 442	△1, 230	134, 163	37, 367	124, 855
投資活動による キャッシュ・フロー	(百万円)	△190, 130	653, 442	△178, 929	△146, 713	1, 305, 434
財務活動による キャッシュ・フロー	(百万円)	△125, 795	135, 747	△204, 220	△63, 613	△645, 018
現金、現金同等物及び 制限付き現金の期末残高	(百万円)	185, 721	975, 529	723, 231	548, 657	1, 335, 520
従業員数	(人)	198, 741	187, 809	153, 492	141, 256	128, 697









(In millions of Korean won, in thousands of US dollars (Note 2.28))

			For the year ended	December 31,	
	Notes	2018	2017	2018	2017
		KRW	KRW	USD	USD
Revenue	32	243,771,415	239,575,376	221,568,382	217,754,524
Cost of sales	24	132,394,411	129,290,661	120,335,747	117,514,691
Gross profit		111,377,004	110,284,715	101,232,635	100,239,833
Selling and administrative expenses	24, 25	52,490,335	56,639,677	47,709,444	51,480,858
Operating profit		58,886,669	53,645,038	53,523,191	48,758,975
Other non-operating income	26	1,485,037	3,010,657	1,349,778	2,736,442
Other non-operating expense	26	1,142,018	1,419,648	1,038,001	1,290,345
Share of profit of associates and joint ventures	12	539,845	201,442	490,675	183,094
Financial income	27	9,999,321	9,737,391	9,088,569	8,850,496
Financial expense	27	8,608,896	8,978,913	7,824,786	8,161,100
Profit before income tax		61,159,958	56,195,967	55,589,426	51,077,562
Income tax expense	28	16,815,101	14,009,220	15,283,559	12,733,241
Profit for the period		44,344,857	42,186,747	40,305,867	38,344,321
Profit attributable to owners of the parent		43,890,877	41,344,569	39,893,236	37,578,849
Profit attributable to non-controlling interests		453,980	842,178	412,631	765,472
Earnings per share (in Korean Won, in US dollars)	29				
- Basic		6,461	5,997	5.87	5.45
- Diluted		6,461	5,997	5.87	5.45

Ref. SAMSUNG 2018 income statement



Consolidated Statements of Income Data:

Net income from continuing operations

Continuing operations

Continuing operations

Continuing operations

Continuing operations

Discontinued operations

Consolidated Balance Sheet Data:

Total assets

Total long-term liabilities

Total stockholders' equity

Discontinued operations

Discontinued operations

Discontinued operations

Net income from discontinued operations

Basic net income per share of Class A and B common stock:

Basic net income per share of Class A and B common stock

Diluted net income per share of Class A and B common stock:

Diluted net income per share of Class A and B common stock

Diluted net income per share of Class C capital stock:

Diluted net income per share of Class C capital stock

Cash, cash equivalents, and marketable securities

Basic net income per share of Class C capital stock:

Basic net income per share of Class C capital stock

Revenues

Net income

Income from operations



\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

2017

110,855

26,146

12,662

12,662

18.27

0.00

18.27

18.27

0.00

18.27

18.00

0.00

18.00

18.00

0.00

18.00

101.871

197,295

20,610

152,502

2017

0

2018

136,819

26,321

30,736

30,736

44.22

0.00

44.22

44.22

0.00

44.22

43.70

0.00

43.70

43.70

0.00

43.70

109,140

232,792

20,544

177,628

2018

2016

(in millions, except per share amounts)

90,272

23,716

19,478

19,478

28.32

0.00

28.32

28.32

0.00

28.32

27.85

0.00

27.85

27.85

0.00

27.85

86,333

167,497

11,705

139,036

As of December 31,

2016

(in millions)

0

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

\$

	HATASE
(zoogle	L HOLDINGS

\$

\$

\$

\$

\$

\$

Ref. Alphabet 2018 10-K https://www.sec.gov/Archives/edgar/data/1652044/000165204419000004/goog10-kg42018.htm#s2C90234435305497B8545742542AABBD

2015

74,989

19,360

16,348

16,348

23.11

0.00

23.11

24.63

0.00

24.63

22.84

0.00

22.84

24.34

0.00

24.34

73.066

147,461

120,331

7,820

2015

\$

\$

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\$

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\$

\$

\$

\$

\$

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\$

Google	
70000	
	Year Ended December 31,

\$

\$

\$

\$

\$

2014

66,001

16,496

13,620

14,136

20.15

0.76

20.91

20.15

0.76

20.91

19.82

0.75

20.57

19.82

0.75

20.57

64.395

8,548

129,187

103,860

2014

516



2014

3,198,356

1,072,907

5,830,667

881,671

2015

4,046,025

923,503

(29.029) \$

8.067.939

Year Ended December 31,

2016(1)

7,000,132

1,599,257

432,791

22,664,076

TESLA	(+
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Consolidated Statements of Operations Data:

Consolidated Balance Sheet Data: Working (deficit) capital

Total revenues

Gross profit

Total assets

Loss from operations	\$	(388,073)	\$	(1,632,086)	\$	(667,340)	\$	(716,629)	\$	(186,689)
Net loss attributable to common stockholders	\$	(976,091)	\$	(1,961,400)	\$	(674,914)	\$	(888,663)	\$	(294,040)
Net loss per share of common stock attributable to common stockholders, basic and diluted	\$	(5.72)	\$	(11.83)	\$	(4.68)	\$	(6.93)	\$	(2.36)
Weighted average shares used in computing net loss per share of common stock, basic and diluted		170,525		165,758		144,212		128,202		124,539
	As of December 31,									
		2018 (2)		2017		2016 (1)	_	2015		2014

2018 (2)

\$ 21,461,268

\$ 4,042,021

2017

\$ 11,758,751

2,222,487

29,739,614

\$ (1,685,828) \$ (1,104,150) \$

28,655,372

information regarding this transaction.

(2) Includes the impact of the adoption of the new revenue recognition accounting standard in 2018. Prior periods have not been revised. See Note 2, Summary of Significant Accounting Policies, of the notes to the consolidated financial statements for further details.

Total long-term obligations 13,433,874 15,348,310 10,923,162 4,125,915 2,753,595

(1) We acquired SolarCity Corporation ("SolarCity") on November 21, 2016. SolarCity's financial positions have been included in our financial positions from the acquisition date. See Note 3, Business Combinations, of the notes to the consolidated financial statements for additional

Spotlight on companies

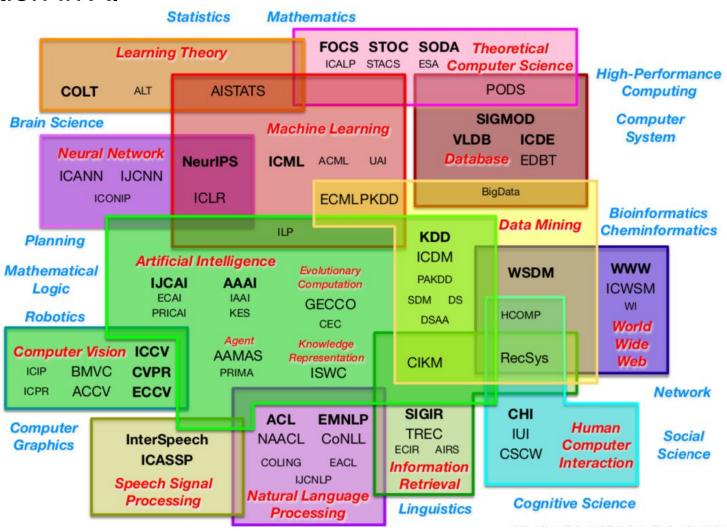


Spotlight on companies we featured in last year's State of AI:



Association in Al





http://www.kamishima.net/archive/MLDMAImap.pdf

Refarence



artificial intelligence index 2018 annual report

http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf

WIPO Technology Trends 2019 Artificial Intelligence

https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf

state of AI 2019

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Mckinsey & company Note from the Al frontier: Applications and value of deep learning

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