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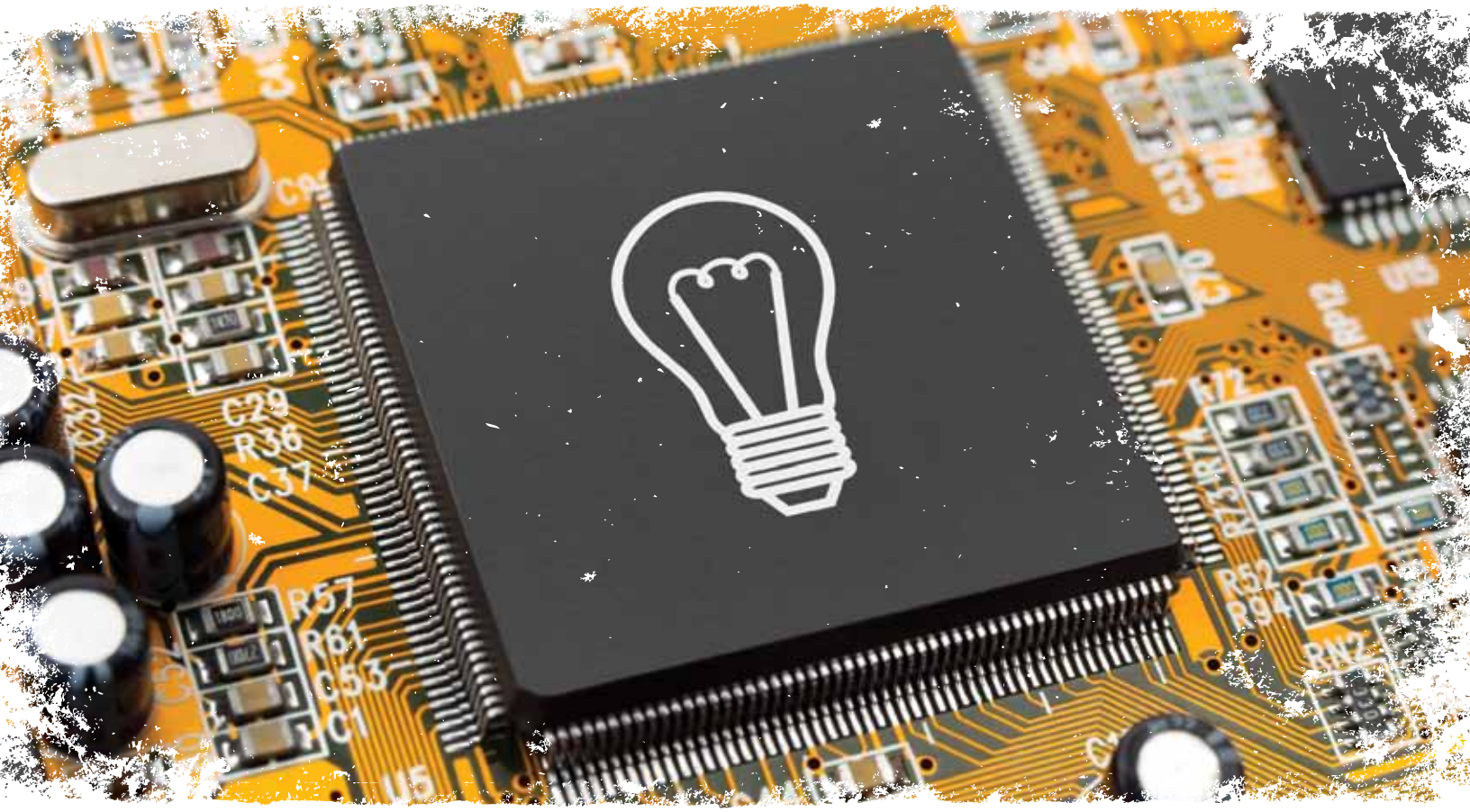
Who Invents It? Women's Participation in Information Technology Patenting, 2012 Update

Catherine Ashcraft
National Center for Women & Information Technology

Anthony Breitzman Sr.
Rowan University, breitzman@rowan.edu

national center for women & INFORMATION TECHNOLOGY



WHO INVENTS IT?

Women's Participation in Information Technology Patenting, *2012 Update*

Catherine Ashcraft, PhD, National Center for Women & Information Technology (NCWIT)

Anthony Breitzman, PhD, 1790 Analytics, LLC

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INTRODUCTION

While a number of studies have documented the underrepresentation of women in information technology (IT), few studies have investigated gendered patterns in IT patenting. Patenting, however, is an important measure of innovation and influence in IT and computing. As a result, examining women's participation in IT patenting is important for helping us understand women's involvement in the recognized and rewarded aspects of IT innovation, research, and development. Documenting these trends also helps us move beyond merely counting how many women are in computing professions and toward measuring their meaningful participation in the field. Identifying the current state of affairs in female patenting also can provide a benchmark against which to measure future efforts to increase women's patenting activities. In addition, examining differences in women's patenting across industry subcategories and across specific organizations is important for uncovering potential areas for future research — research into "what works" in those companies where women patent more frequently.

In 2007, the National Center for Women & Information Technology, in partnership with 1790 Analytics, published its first report on female IT patenting, analyzing records from the U.S. Patent and Trademark Office from 1980-2005. The original report examined female participation in IT patenting and how this participation evolved over the past 25 years. It also identified how female patenting differs across IT industry subcategories and across specific organizations.

This new edition updates those findings, examining U.S. patent data in the intervening five years from 2005-2010. It updates and addresses the following questions:

- What percentage of IT patents are invented by males, females, and mixed-sex teams?
- How have these percentages changed during the past five years? How do these changes compare to the findings from the previous report?
- Do female patenting patterns differ across IT industry subcategories (e.g. Communications and Telecommunications, Computer Hardware, Computer Software, Semiconductors). If so, how and to what extent? Do citation patterns differ for patents invented by male, female, and mixed-sex teams? If so, how and to what extent?
- Do female patenting patterns differ across specific companies, organizations, and sectors (e.g., government, academic, industry)? If so, how, and to what extent?

In addressing these questions, this report also looks at how some of the trends over the past five years are similar to or different from the previous study.

SUMMARY OF FINDINGS

- ***Percentage of patents with at least one female inventor.*** In the 31-year period covered by this study (1980-2010) approximately 13% of U.S.-invented IT patents have at least one female inventor. This reflects an increase from the previous report (1980-2005) when about 9% of U.S.-invented IT patents had at least one female inventor.
- ***Percentage of patents invented by women, when accounting for multiple inventors.*** Since many patents have multiple inventors, it is more accurate to count only a fraction of the patent as female (for example, a patent with two female inventors and one male inventor counts as 2/3 female and 1/3 male). Counting this way over the 31-year period, 6.1% of the U.S.-invented IT patents were produced by female inventors; 7.5% were produced by women in the last five years.

The chart below illustrates how the above updated findings compare to the original report findings.

	ORIGINAL REPORT YEARS (1980-2005)	UPDATED YEARS (2006-2010)	TOTAL YEARS STUDIED (1980-2010)
% of patents with at least one female inventor *(e.g., any patent with at least one female inventor is counted)*	9%	16%	13%
% of patents invented by women, when accounting for multiple inventors *(e.g., a patent with 2 male and 1 female inventor = counted as 2/3 male and 1/3 female)*	4.7%	7.5%	6.1%

- ***Long-term trends in female patenting.*** Although the overall level of female participation in IT patents is still relatively low, the trends are quite promising. While, females held only 2% of all IT patents in 1980, their share increased to approximately 6% in 2005 and 8% in 2010.

	1980	2005	2010
Long-term trends in female patenting	2%	6%	8%

- ***Long-term trends in actual numbers of female patenting (as compared to change in percentages).*** In general, IT patenting has grown substantially over the 31-year period. For female inventors to increase their share of patenting during this period means that female patenting had to grow even more substantially. For example, overall U.S. IT patenting grew from 26,725 patents in the period from 1980-84 to 203,484 patents in the period from 2006-10. This is a 7.5-fold increase. For the same periods, U.S. female IT patenting grew from 611 to 15,292 patents (a 25-fold increase). These growth multiples also are noteworthy because the percentage of women employed in IT remained relatively flat, declining slightly during the past 31-year time period.

	1980-84	2006-10
Number of IT Patents (total, male and female)	26,725	203,484 (7.5-fold increase)
Number of Female IT Patents	611	15,292 (25-fold increase)

- ***Citation patterns.*** Mixed-sex teams still produce the most highly cited patents, with citation patterns 30-40% higher than the norm for patents of similar age and type. Mixed-sex teams average more inventors than either male- or female-only teams, and controlling for size largely accounts for these increased citation numbers. Further research is needed to determine exactly why larger teams produce more highly cited patents. For now, a likely explanation is the fact that during development, inventors and organizations often have an idea of whether an invention is likely to be of significant importance, and that these projects attract more resources and inventors as organizations try to accelerate their development. In addition, it is also possible that originality and diverse thinking do, in fact, influence citation rates but that, at this time, we do not have sensitive enough measures to capture or fully understand these relationships.
- ***Female patenting patterns in individual companies.*** Female patenting patterns differ widely from one organization to another. For example, several companies were shown to have 20% to 30% of their patents naming at least one female inventor, while some companies have less than 5% of their patents naming a female inventor. This suggests that individual organizational environments do matter and can influence female patenting patterns. More research is needed to determine the conditions and practices that foster or inhibit female patenting.

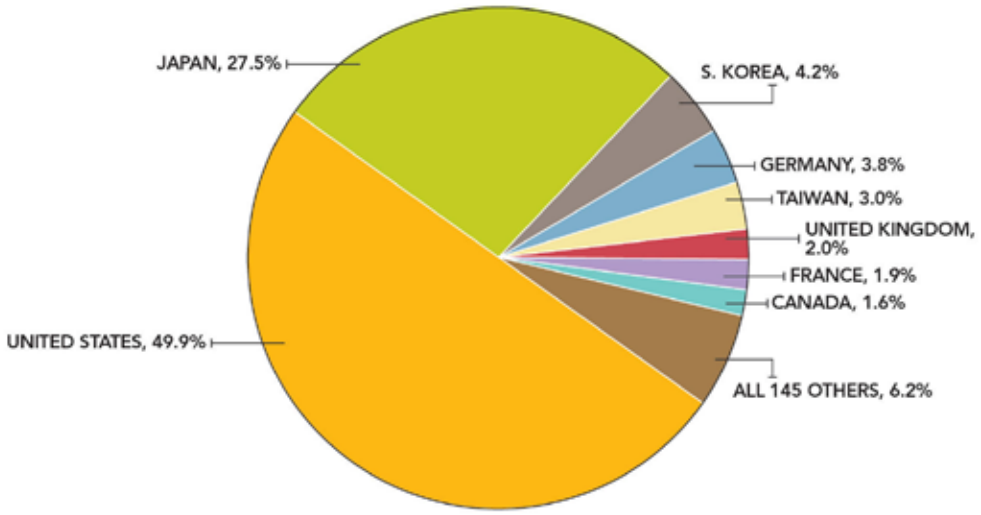
METHODOLOGY

To update the original report, NCWIT commissioned 1790 Analytics to analyze U.S. IT patents granted by the U.S. Patent and Trademark Office between 2006-2010, the years since the first report was published. For purposes of this and the previous study, IT patents were defined as any patent that fit into the following categories: Communications and Telecommunications, Computer Hardware, Computer Peripherals, Computer Software, Semiconductors/Solid-state Devices. To identify IT patents, 1790 Analytics used a well-defined set of patent filters consisting of patent classifications and keywords for identifying patents in these categories. This set of patent filters has been tested and refined by 1790 Analytics in previous work.

Included patents were limited to those granted by the U.S. Patent and Trademark Office because the U.S. is one of the largest consumers of IT products. As a result, any company wishing to sell these products in the United States would need to obtain a U.S. patent. Figure 1 shows the distribution of U.S. IT patents by inventor country. Roughly 80% of all U.S. IT patents are produced by U.S. and Japanese inventors. Given this distribution, the content of this report focuses on the findings for U.S.-invented IT patents. Summary findings for the Japanese-invented patents are reported in the Appendix.

FIGURE 1

Top Inventor Countries: Percentage of IT Patents by Inventor Country
(U.S. Information Technology Patents Granted 1980-2010)



PROCEDURE FOR PATENT GENDER-MATCHING

Unfortunately, the patent office does not record the gender of the inventors for each patent; therefore, 1790 Analytics used the names given on the patents as indicators of gender. Figure 2 lists the top 150 names that appear in U.S.-invented Information Technology patents. A majority of these names are gender-specific (e.g. John, Robert, Susan), so one could easily scan this list and assign gender to each name. However, a much more precise and automated process was needed for identifying thousands of names that rank lower than the 150 shown in Figure 2. To do so, 1790 Analytics used the Social Security Administration (SSA) database which maintains a list of the top 1000 most popular baby names each year from 1900-2009. This established a list of 4,000+ unique names that could be matched to the IT patent database.

Gender-ambiguous names (e.g. Terry, Lee, Chris, and Jan) required a number of other steps to determine gender. First, whenever possible, both the first name and the middle name were used. For example, if the name is Terry James Smith, the gender is assigned as male, while Terry Louise Smith would be assigned as female. This is not always possible, however, because often only a middle initial is listed on the patent. In this case, 1790 Analytics used the SSA database records for how many boys and girls are given a name. These percentages were used to decide what percentage of patents to count as "male" and "female." For example, the SSA database indicates that 82% of people named Terry are male and 18% are female; therefore, if Terry is listed as a first inventor 749 times, 82% of the 749 patents are assigned to the male count and 18% to the female count.

To augment the SSA list, a set of 200+ first names were identified via a web search for names that are prominent on several hundred patents but that are not typical American names For example, the name Sanjay can be found on 676 U.S.-invented IT patents but is not on the SSA list. To identify gender for these names 1790 Analytics identified websites of professors on the world wide web via a search such as ('Sanjay') and ('professor' or 'cv' or 'department' or 'resume') — since university professors often include a photograph on their resumes. When possible, a set of ten or more websites were identified in order to create a multiplier (as in Figure 2) for names that could go with either gender. Gender-matching for Japanese invented patents followed a similar process, starting with a database of Japanese baby names and augmenting that with a similar web search.

FIGURE 2

Top 150 First Names Appearing in U.S.-invented Information Technology Patents 1980-2010

RANK	#PATENTS	MATCH NAME	SEX	MULTIPLIER
1	51068	DAVID	M	
2	49984	JOHN	M	
3	46042	ROBERT	M	
4	43790	MICHAEL	M	
5	39593	JAMES	M	
6	31602	WILLIAM	M	
7	28279	RICHARD	M	
8	24716	THOMAS	M	
9	24341	MARK	M	
10	20015	PAUL	M	
11	17202	STEVEN	M	
12	15746	JOSEPH	M	
13	14818	CHARLES	M	
14	14806	DANIEL	M	
15	14243	PETER	M	
16	14107	STEPHEN	M	
17	13921	JEFFREY	M	
18	11724	DONALD	M	
19	11462	KENNETH	M	
20	11424	CHRISTOPHER	M	
21	11361	BRIAN	M	
22	11024	SCOTT	M	
23	10138	EDWARD	M	
24	10132	ERIC	M	
25	9765	GEORGE	M	
26	9434	KEVIN	M	
27	9348	GARY	M	
28	9174	ANDREW	M	
29	8966	RONALD	M	
30	8954	GREGORY	M	
31	8739	TIMOTHY	M	
32	7938	DOUGLAS	M	
33	7190	BRUCE	M	
34	6620	ALAN	M	
35	6337	MATTHEW	M	
36	6153	FRANK	M	
37	6000	ANTHONY	M	
38	5278	PATRICK	M	
39	5058	PHILIP	M	
40	5055	ROGER	M	
41	4951	LAWRENCE	M	
42	4768	LARRY	M	
43	4747	JONATHAN	M	
44	4712	DENNIS	M	
45	4469	KEITH	M	
46	4410	RAYMOND	M	
47	4387	CRAIG	M	
48	4328	CARL	M	
49	4023	MARTIN	M	
50	3934	ALEXANDER	M	
51	3809	GERALD	M	
52	3676	JACK	M	
53	3599	JASON	M	
54	3514	HOWARD	M	
55	3371	FREDERICK	M	
56	3355	WALTER	M	
57	3297	TODD	M	
58	3153	WAYNE	M	
59	3124	ARTHUR	M	
60	3086	LOUIS	M	
61	3079	HENRY	M	
61	3006	STEVE	M	
63	2915	DALE	M	
64	2885	JAY	M	
65	2826	JERRY	M	
66	2739	ALBERT	M	
67	2689	EUGENE	M	
68	2629	BARRY	M	
69	2605	LEONARD	M	
70	2584	VICTOR	M	
71	2577	GLENN	M	
72	2499	TERRY	M	(.82M; .18F)
73	2493	LEE	M	(.78M; .22F)
74	2471	RUSSELL	M	
75	2420	NICHOLAS	M	

RANK	#PATENTS	MATCH NAME	SEX	MULTIPLIER
76	2371	THEODORE	M	
77	2342	DAN	M	
78	2330	JOEL	M	
79	2314	BENJAMIN	M	
80	2310	JON	M	
81	2308	HAROLD	M	
82	2278	ROY	M	
83	2272	HARRY	M	
84	2266	MARC	M	
85	2266	CHRIS	M	(.86M; .14F)
86	2257	RALPH	M	
87	2233	KARL	M	
88	2227	DEAN	M	
89	2172	ALLEN	M	
90	2155	SAMUEL	M	
91	2126	BRADLEY	M	
92	2103	FRED	M	
93	2099	STANLEY	M	
94	2090	GORDON	M	
95	2064	RANDALL	M	
96	2003	VINCENT	M	
97	1997	WEI	M	
98	1972	NORMAN	M	
99	1959	WARREN	M	
100	1920	FRANCIS	M	
101	1918	MING	M	
102	1876	BRENT	M	
103	1871	KURT	M	
104	1841	BRYAN	M	
105	1841	RANDY	M	
106	1828	JEFF	M	
107	1799	ADAM	M	
108	1768	PHILLIP	M	
109	1711	STUART	M	
110	1711	BERNARD	M	
111	1703	GREG	M	
112	1697	JEAN	F	
113	1681	RAVI	M	
114	1592	GLEN	M	
115	1565	JEROME	M	
116	1559	NEIL	M	
117	1555	AARON	M	
118	1542	MIKE	M	
119	1533	GEOFFREY	M	
120	1519	ALFRED	M	
121	1492	TOM	M	
122	1465	VLADIMIR	M	
123	1452	SUSAN	F	
124	1444	SEAN	M	
125	1437	GUY	M	
126	1416	IAN	M	
127	1410	ALEX	M	
128	1403	RODNEY	M	
129	1362	EDWIN	M	
130	1359	CURTIS	M	
131	1348	JIM	M	
132	1297	KEN	M	
133	1295	DON	M	
134	1293	ALLAN	M	
135	1293	HERBERT	M	
136	1288	SIMON	M	
137	1288	ERIK	M	
138	1279	KENT	M	
139	1264	NATHAN	M	
140	1258	ALI	M	(.77M; .23F)
141	1254	JOSE	M	
142	1230	DEREK	M	
143	1216	SANJAY	M	
144	1205	CHUNG	M	
145	1205	JEREMY	M	
146	1203	BRETT	M	
147	1193	RYAN	M	
148	1171	MARY	F	
149	1132	CHRISTIAN	M	
150	1096	JOE	M	

In total, 95.5% of the U.S.-invented patents had at least one gender-matchable name and 92.9% of the Japanese-invented patents had at least one gender-matchable name. Most patents have more than one inventor, however. The typical U.S.-invented IT patent has 2.35 U.S. inventors of which 1.95 or 83% were matched. The typical Japanese-invented IT patent has 2.54 Japanese inventors of which 2.03 or 80% were matched.

The process for name matching is rather similar to the match we did for the 2005 report with two exceptions: First, we removed any names that are truly ambiguous. For example, we kept Terry since 82% of the time it is a male name. However, for any names in the 50%-75% male or female range (e.g. Avery or Taylor) we discarded the name as ambiguous. Second, we used the experimental Genderyzer website (http://jofish.com/cgi-bin/genderyze.py) to identify names that are not found in the Social Security database.[1]

Roughly 15% of patents could not be matched because these names are either missing, obscure, or because only initials are given. The unmatched portion consists of approximately 13,000 names, most of which appear on fewer than 10 patents, leaving roughly 62,000 patents unmatched. To put this in perspective, this is a smaller number of patents than the number invented by the top two inventor names alone — John and David. As such, adding ten, a hundred, or even thousands of names to the database would not significantly change the overall results.

PROCEDURE FOR ASSIGNING INVENTORSHIP ON MULTIPLE-INVENTOR PATENTS

When multiple inventors produce a patent, accurately crediting the inventorship of that patent becomes difficult. Sometimes companies list the primary inventor first; however, many companies list all inventors alphabetically. As a result, identifying the key researcher and the relative contributions of each author is impossible. Despite this difficulty, many analysts in the industry do assign the patent to the first inventor. Because of this precedent, this report also presents results by first inventor, where the gender of the first inventor determines whether the patent is counted as "male-invented" or "female-invented."

To enhance our understanding of female patenting, however, we also present results using two other counting methods: 1) counting as female all patents that have *at least* one female inventor and 2) "fractionally attributing" inventorship for each patent. In the first instance, if a patent has one female inventor, it is added to the female count. While this method helps identify patents that would have been overlooked when counting by first author only, it also tends to overestimate female patenting because, for example, a patent that is invented by one female and one male would be counted as female.

To account for this discrepancy, we also then present findings by "fractional attribution," a method that allows us to account for multiple inventors. For example, suppose a patent lists Susan, Lisa, and John as inventors. In this case 2/3 of the patent is assigned to the female count and 1/3 to the male count. If instead it is invented by Terry, John, and Lisa, the multiplier from Figure 2 for Terry is used. This, then, assigns (0.82*(1/3) + 1/3) = 0.61 to the male count and (0.18*(1/3) + 1/3) = 0.39 to the female count. The next section presents the results by first inventor and then by fractional attribution of inventorship.

[1] A brief analysis was undertaken of Genderyzer versus the Social Security Administration (SSA) database prior to completing the patent analysis. The results were largely similar in both cases. However, since the SSA database was used in the previous project, and since it is slightly more accurate with U.S. inventors we decided to use the SSA database as the primary matching source for U.S. inventors.

RESULTS

PERCENTAGES OF IT PATENTS HELD BY WOMEN INVENTORS

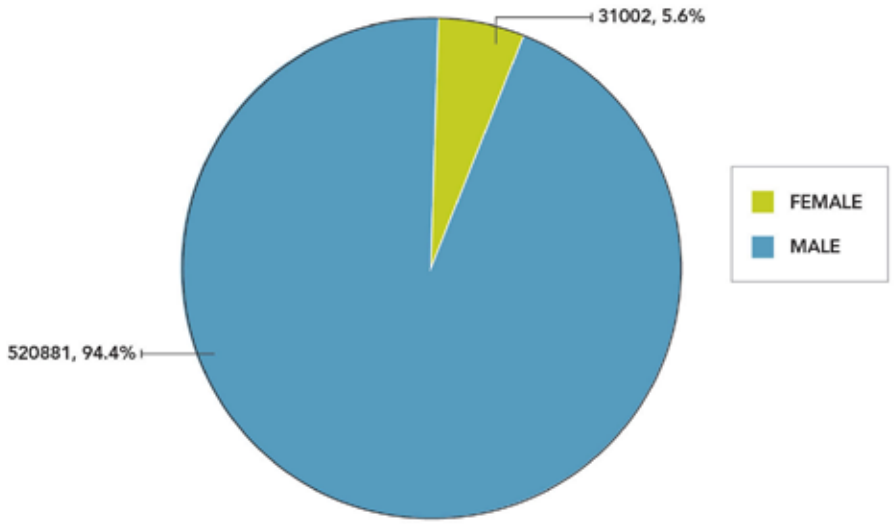
As discussed in the previous section, determining "inventorship" is more difficult than it may first appear, and different counting methods present slightly different pictures. To give the fullest picture, this section presents the percentage of patents invented by women in three different ways: 1) percentage of patents that have a woman listed as the first inventor, 2) percentage of patents with *at least* one woman inventor, and 3) percentage of patents invented by females when accounting for multiple inventors on one patent.

Percentage of Patents with at Least One Female Inventor. In the 31-year period covered by this study (1980-2010) approximately 13% of U.S.-invented IT patents have at least one female inventor. This reflects an increase from the previous report (1980-2005) when about 9% of U.S.-invented IT patents had at least one female inventor.

Percentage of Patents with Women as "First Inventors." When considering patents granted between 1980-2010, 94.4% of the matched first inventors on U.S.-invented patents are male and 5.6% of the matched first inventors are female (see Figure 3). Women fared slightly better between 2006-2010 with 7% of patents listing a female first inventor.

FIGURE 3

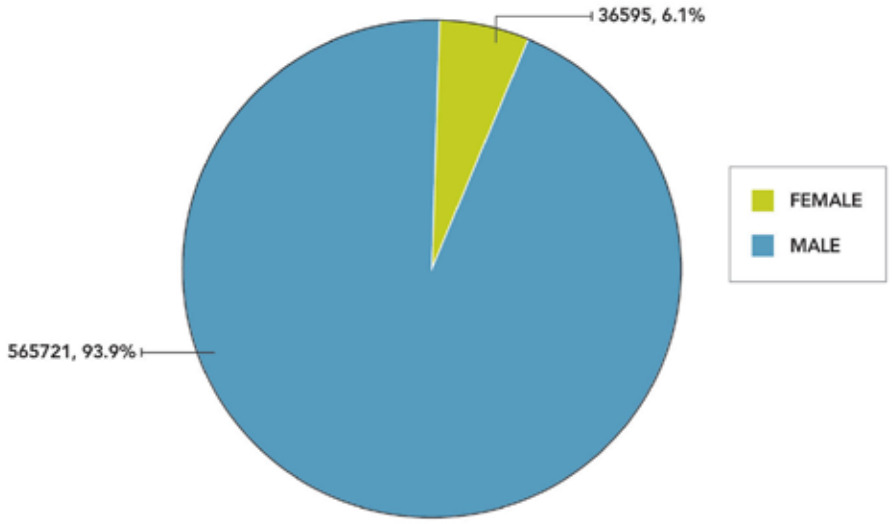
Number and Percent of First Inventors by Gender
U.S.-invented Information Technology Patents 1980-2010



Percentage of Female-invented Patents When Accounting for Multiple Inventors. When assigning authorship fractionally — where a patent with one female and two male inventors is counted 1/3 female and 2/3 male (see methods for more detail) — the numbers shift slightly, with 6.1% of U.S.-invented patents being female-invented and 93.9% male-invented (see Figure 4). This is up slightly from the first report when 4.7% of patents were female-invented.

FIGURE 4

Fractionally Attributed Inventors by Gender
U.S.-invented Information Technology Patents 1980-2010



To further illuminate the nature of gender and team collaboration over the 31-year period, it is helpful to consider how many U.S.-invented IT patents are produced by teams of multiple inventors and the gender makeup of these collaborative teams (see Figure 5). Roughly 40% of patents are produced by a single male inventor, while only 1.9% are produced by a single female inventor. The second most frequent team composition is two male inventors, accounting for 25% of patents; thus, 65% of all patents are produced by teams of one or two men. While approximately 13% of patents list at least one female, most of these are on teams with at least one male. Figure 6 shows a slight improvement in the last five years with almost 16% of patents having at least one female inventor.

FIGURE 5

Collaboration Statistics for U.S.-invented Information Technology Patents 1980-2010
(Counts of Gender-matched U.S.-coinvented Patents)

# OF MALE COINVENTORS	# OF FEMALE COINVENTORS	# OF PATENTS	% OF TOTAL	% OF TOTAL
1	0	239192	39.65%	39.65%
2	0	150012	24.87%	64.52%
3+	0	137740	22.84%	87.36%
3+	1	20020	3.32%	90.68%
1	1	19113	3.17%	93.85%
2	1	15677	2.60%	96.45%
0	1	11589	1.92%	98.37%
3+	2	3299	0.55%	98.91%
1	2	1916	0.32%	99.23%
2	2	1730	0.29%	99.52%
0	2	1103	0.18%	99.70%
3+	3+	973	0.16%	99.86%
2	3+	371	0.06%	99.92%
1	3+	275	0.05%	99.97%
0	3+	182	0.03%	100.00%
		603192	**100.00%**	

FIGURE 6

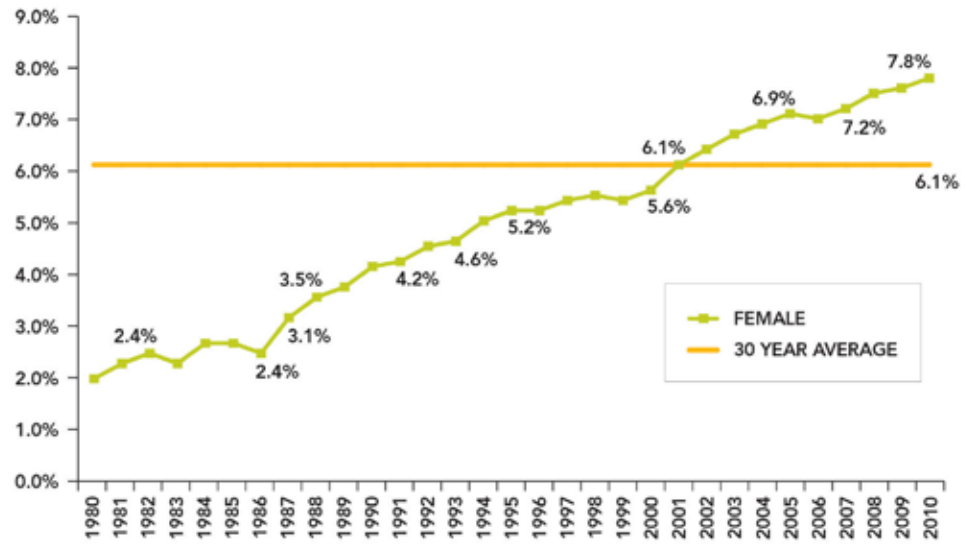
Collaboration Statistics for U.S.-invented Information Technology Patents 2006-2010
(Counts of Gender-matched U.S.-coinvented Patents)

# OF MALE COINVENTORS	# OF FEMALE COINVENTORS	# OF PATENTS	% OF TOTAL	% OF TOTAL
1	0	72902	35.14%	35.14%
3+	0	52163	25.14%	60.28%
2	0	49685	23.95%	84.23%
3+	1	8837	4.26%	88.49%
1	1	7810	3.76%	92.26%
2	1	6617	3.19%	95.44%
0	1	4735	2.28%	97.73%
3+	2	1634	0.79%	98.51%
1	2	886	0.43%	98.94%
2	2	832	0.40%	99.34%
0	2	496	0.24%	99.58%
3+	3+	442	0.21%	99.80%
2	3+	184	0.09%	99.88%
1	3+	155	0.07%	99.96%
0	3+	86	0.04%	100.00%
		207464	**100.00%**	

Trends in Female Patenting Patterns Over Time. Although women's participation in patenting has been and remains relatively low, the picture improves when we look at trends over time. While women account for only 6.1% of total U.S.- invented patents (when counting fractionally), that percentage has increased steadily from nearly 2% in 1980 to 6% in 2001 to 7.8% in 2010 — nearly a 4-fold increase (see Figure 7). This is particularly noteworthy because, during the past twenty years, the percentage of women employed in IT has remained relatively flat, even declining somewhat from 32% in 1983 to 25% in 2009 (with a high of 37% in 1990-1991).[2]

FIGURE 7

Percent of Female-invented Patents over Time
(U.S.-invented Information Technology Patents – Fractional Counting)



[2] Bureau of Labor Statistics *Current Population Survey, 1983-2005 Annual Averages*

This is perhaps even more promising when considering the growth in IT patenting overall. When looking at trends over the 31-year period, overall U.S.-invented IT patenting has increased approximately twelve-fold since 1980 and more than doubled since 2000. The combination of the 4-fold increase in the percentage of female-invented patents with the 6-fold increase in overall U.S.-invented IT patenting translates to a roughly 24-fold increase in U.S.-invented female IT patenting for the period. In raw numbers, this translates to an increase from 87 U.S.-invented female IT patents in 1980 to more than 2000 in 2005.

PERCENTAGES OF FEMALE IT PATENTS BY IT SUBCATEGORY

In this section, we explore how women's patenting trends vary across IT subcategories, which, for the most part, mirror the trends in IT patenting overall. In most subcategories, roughly 88% of the patents are produced by males, 2% by females, and about 11% by teams of males and females (see Figure 8). The exception is Computer Software, where approximately 82% of the patents are produced by only males, 3% by only females, and 15% by mixed-sex teams. Figure 9 displays the collaboration statistics in more detail, illustrating that very few teams of women patent without any male members. In contrast, 20-25% of the patents in each category are produced by teams of three or more men.

FIGURE 8

Male and Female Collaboration Statistics by Category
U.S.-invented U.S. Information Technology Patents

SUBCATEGORY	# MATCHABLE PATENTS	FEMALE-ONLY		MIXED-SEX TEAM		MALE-ONLY	
		COUNT	%	COUNT	%	COUNT	%
Communications	163,408	3,466	2.1%	13,813	8.5%	146,129	89.4%
Computer Hardware	132,486	2,291	1.7%	12,802	9.7%	117,393	88.6%
Computer Peripherals	45,732	871	1.9%	4,424	9.7%	40,437	88.4%
Computer Software	105,256	3,062	2.9%	15,915	15.1%	86,279	82.0%
Semiconductors/ Solid-state Devices	156,310	3,184	2.0%	16,420	10.5%	136,706	87.5%
All Information Technology	603,192	12,874	2.1%	63,374	10.5%	526,944	87.4%

FIGURE 9

Detailed Male and Female Collaboration Statistics by Category

SUBCATEGORY	# OF MALE COINVENTORS	# OF FEMALE COINVENTORS	# OF U.S.-INVENTED U.S. IT PATENTS	% OF TOTAL
Communications	1	0	70,885	43.38
	2	0	41,074	25.14
	3+	0	34,170	20.91
	1	1	4,685	2.87
	3+	1	4,073	2.49
	2	1	3,492	2.14
	0	1	3,200	1.96
	3+	2	590	0.36
	1	2	384	0.23
	2	2	301	0.18
	0	2	239	0.15
	3+	3+	171	0.10
	2	3+	67	0.04
	1	3+	50	0.03
	0	3+	27	0.02
Computer Hardware	1	0	50,343	38.00
	3+	0	33,764	25.48
	2	0	33,286	25.12
	3+	1	4,474	3.38
	1	1	3,666	2.77
	2	1	3,156	2.38
	0	1	2,034	1.54
	3+	2	667	0.50
	1	2	290	0.22
	2	2	286	0.22
	0	2	208	0.16
	3+	3+	177	0.13
	2	3+	54	0.04
	0	3+	49	0.04
	1	3+	32	0.02
Computer Peripherals	1	0	18,261	39.93
	2	0	11,389	24.90
	3+	0	10,787	23.59
	3+	1	1,497	3.27
	1	1	1,309	2.86
	2	1	1,099	2.40
	0	1	792	1.73
	3+	2	200	0.44
	1	2	122	0.27
	2	2	113	0.25
	0	2	67	0.15
	3+	3+	41	0.09
	2	3+	34	0.07
	0	3+	12	0.03
	1	3+	9	0.02
Computer Software	1	0	37,750	35.86
	2	0	24,582	23.35
	3+	0	23,947	22.75
	3+	1	4,854	4.61
	1	1	4,294	4.08
	2	1	3,798	3.61
	0	1	2,646	2.51
	3+	2	1,034	0.98
	1	2	651	0.62
	2	2	575	0.55
	3+	3+	417	0.40
	0	2	342	0.32
	2	3+	159	0.15
	1	3+	133	0.13
	0	3+	74	0.07
Semiconductors/ Solid-state Devices	1	0	61,953	39.63
	2	0	39,681	25.39
	3+	0	35,072	22.44
	1	1	5,159	3.30
	3+	1	5,122	3.28
	2	1	4,132	2.64
	0	1	2,917	1.87
	3+	2	808	0.52
	1	2	469	0.30
	2	2	455	0.29
	0	2	247	0.16
	3+	3+	167	0.11
	2	3+	57	0.04
	1	3+	51	0.03
	0	3+	20	0.01

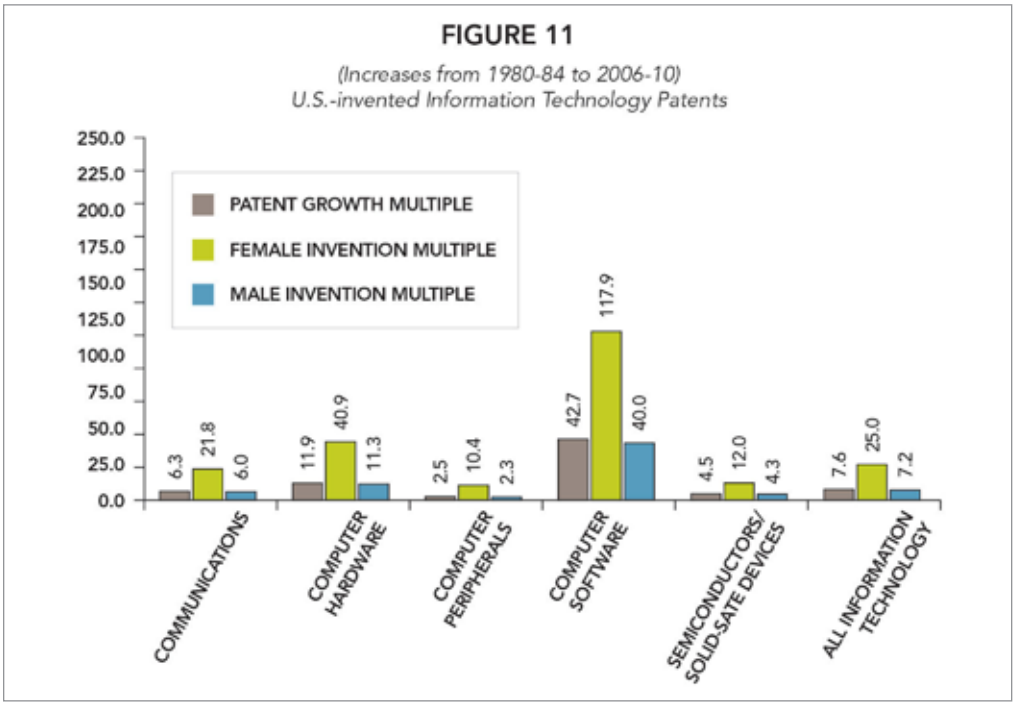
The above numbers, however, do not account for the varying numbers of males and females on different collaboration teams. As noted earlier, many of these teams have a mix of male and female members. To get a better understanding of the contribution of each gender, inventorship is again computed fractionally (where a patent with two males and one female is counted as 2/3 male and 1/3 female). From this perspective, we see that U.S. women are responsible for about 7.5% of the patents on average, up from 2.3% twenty years ago (See Figure 10). The changes for software patents are again notable, with a change from 3.4% in the first period to 9.3% in the latter period.

FIGURE 10

Percentage of Female U.S.-invented U.S. Information Technology Patents for Two Time Periods (Fractional Counts 1980-84 and 2006-10)

CATEGORY	1980-84					2006-10				
	# PATENTS	# FEMALE PATENTS (FRACTIONAL)	FEMALE % OF TOTAL	# MALE PATENTS (FRACTIONAL)	MALE % OF TOTAL	# PATENTS	# FEMALE PATENTS (FRACTIONAL)	FEMALE % OF TOTAL	# MALE PATENTS (FRACTIONAL)	MALE % OF TOTAL
Communications	8491	172	2.03%	8319	97.97%	53438	3743	7.00%	49696	93.00%
Computer Hardware	4169	76	1.81%	4093	98.19%	49428	3090	6.25%	46338	93.75%
Computer Peripherals	3820	69	1.80%	3751	98.20%	9460	719	7.60%	8741	92.40%
Computer Software	1175	40	3.38%	1135	96.62%	50113	4677	9.33%	45436	90.67%
Semiconductors/ Solid-state Devices	9071	255	2.81%	8816	97.19%	41045	3064	7.46%	37981	92.54%
All Information Technology	26725	611	2.29%	26114	97.71%	203484	15292	7.52%	188192	92.48%

As noted earlier regarding IT patenting in general, this is perhaps more promising than it first appears when considering the fact that while female patenting was increasing, overall patenting was also increasing in each IT subcategory. For example, 8,491 U.S.-invented Communications patents were granted from 1980-84, compared to 53,348 granted from 2006-10. This is a 6-fold increase (also called a growth multiple) in the total number of Communications patents. At the same time, the number of U.S. female-invented Communications patents showed an impressive 22-fold increase from 172 in 1980-84 to 3,743 in 2006-10. This is again particularly noteworthy when considering that, as mentioned earlier, the percentage of women employed in IT has remained relatively flat, declining slightly in the past twenty years. Figure 11 shows growth multiples (or "x" fold increases) for each category. In each case, the growth in female patenting has outpaced the growth in patenting overall, as well as the growth of male patenting.



CITATION ANALYSIS

Background on Citation Analysis. In this section we examine citation patterns for patents invented by female, male, and mixed-sex teams. Higher numbers of citations indicate that a patent is of particular importance. As a result, examining the citation of female-invented patents is one way of measuring their influence, importance, and potential return on investment. For example, companies with patents that have more citations have been shown to perform better in the stock market and have experienced increases in sales and profits.[3-5]

Comparing citation counts, however, involves more than simply counting the number of citations a particular patent has accrued. For example, older patents are likely to be more highly cited since they have had more time to accrue citations. Furthermore, average citation rates differ across technologies. A patent with 10 citations, therefore, may be very highly cited, or not very highly cited, depending on its age and technology category.

In order to account for these differences, citation counts were normalized by technology and year in order to determine the 'expected cite count' for patents from the same year and technology class. Dividing the citation count of a particular patent by the expected count results in a "citation index," a normalized measure of the impact of a particular patent. For example, a patent that has a citation index of 9.99 suggests the patent is cited about 10 times as often as typical patents of the same age and technology class.

[3] A. Breitzman and F. Narin, US 6175824: Method and apparatus for choosing a stock portfolio, based on patent indicators (Patent Application US1999/353613, 14 July 1999).

[4] P. Thomas, A relationship between research indicators and financial performance. In: 6th International Conference on Science and Technology Indicators, Leiden, The Netherlands, 24–27 May 2000.

[5] F. Narin, E. Noma, R. Perry, Patents as indicators of corporate technological strength, Research Policy, Volume 16, Issues 2–4, August 1987, Pages 143–155

The citation index can be extended beyond a single patent to a set of patents (i.e., all male-invented Communication patents, all female-invented Communications patents, or all mixed-sex team invented Communications patents — see Figure 12). In fact, applying the citation index to a set of patents tends to provide a more accurate picture since a larger patent set will dilute the effects of any outliers. The citation index for a set of patents is determined by taking the sum of the citations for that set (i.e., the sum of the citations for all male-invented Communications patents) and dividing by the sum of the expected citation counts for all Communications patents.[6] Applying the citation index to these patent sets allows us to compare patent sets of differing sizes with different age profiles (e.g., compare the averages for all of the male-invented Communications patents, all of the female-invented Communications patents, all of the mixed-sex team).

Differences in Citation Patterns for Male, Female, and Mixed-sex Teams. Among U.S-invented patents,[7] patents invented by mixed-sex teams — teams consisting of at least one female and at least one male — are cited 30-40% more often than patents invented by female-only or male-only teams. In the original study, we noted that both the diversity of thought and the fact that mixed-sex teams tend to be larger might be possible explanations that would lead to more innovative inventions. In this update, we investigated the relationship between mixed-sex teams and citation patterns further and found that controlling for size largely accounts for these increased citation counts.

So why exactly do larger teams produce more highly cited patents? We investigated a few possible explanations, but, to date, the answer remains unclear. First, as one can see from Figure 13, the originality index also rises with team size. This index measures the extent to which a patent draws on a wider range of prior art or different kinds of technologies. In other words, a relatively simple or incremental invention will have a lower index than complex inventions drawing from multiple areas of technical expertise. Initially, we thought perhaps the higher originality indexes of larger teams might explain their higher numbers of citations. A regression analysis, however, revealed that originality has very little explanatory power for higher numbers of citations once team size is factored in. In other words, team size seems to matter more than the originality index when predicting higher numbers of citations. This result, however, might be because the originality index is a rather insensitive measure — that is, it is primarily designed to distinguish highly original patents rather than to measure smaller differences in originality.

[6] Remember that Communications patents will have different expected counts depending on age of patents, so we add these different expected citation counts for different ages to get the average expected citation count for all Communications patents. We then divide the total number of citations for male-invented patents by this overall expected citation count. This process is repeated for female and mixed-sex invented patents.

[7] Citation indexes are based on the average of all U.S. patents in each technology class invented anywhere in the world (including the U.S., Japan, and all other countries filing patents).

In general, we see that U.S.-invented IT patents have a higher citation index than Japanese-invented IT patents. All of the U.S.-invented patent sets have citation indices exceeding 1.0, suggesting that the U.S.-invented IT patents are cited more often than average for all U.S. patents invented in other countries of the same age and technology class.

FIGURE 12

Citation Impact by Gender and Information Technology Category
U.S.-invented U.S. Information Technology Patents

	FEMALE-ONLY INVENTED		MALE-ONLY INVENTED		MIXED-GENDER TEAM	
	# PATENTS 1980-2010	CITATION INDEX	# PATENTS 1980-2010	CITATION INDEX	# PATENTS 1980-2010	CITATION INDEX
Communications	3466	1.11	146129	1.17	13813	1.37
Computer Hardware	2291	1.06	117393	1.24	12802	1.34
Computer Peripherals	871	1.09	40437	1.29	4424	1.41
Computer Software	3062	1.18	86279	1.32	15915	1.35
Semiconductors/ Solid-state Devices	3184	1.24	136706	1.28	16420	1.43

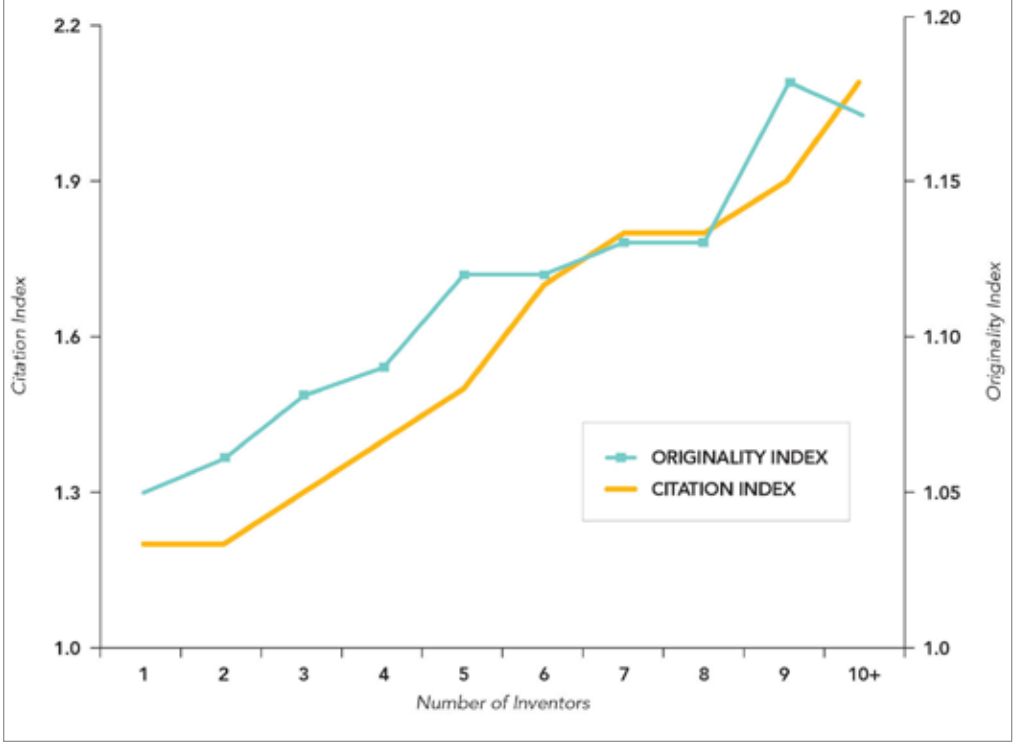
Japanese-invented U.S. Information Technology Patents

	FEMALE-ONLY INVENTED		MALE-ONLY INVENTED		MIXED-GENDER TEAM	
	# PATENTS 1980-2010	CITATION INDEX	# PATENTS 1980-2010	CITATION INDEX	# PATENTS 1980-2010	CITATION INDEX
Communications	913	0.63	64380	0.73	3550	0.79
Computer Hardware	702	0.61	50782	0.75	2805	0.72
Computer Peripherals	653	0.86	67680	0.89	4797	1.06
Computer Software	724	0.59	27480	0.69	2601	0.67
Semiconductors/ Solid-state Devices	1208	0.67	84450	0.88	5949	0.98

Highest Cited Patent Set Second Highest Cited Patent Set Third Highest Patent Set

FIGURE 13

(U.S. Information Technology Patents 1980-2010)



We also found no consistent significant relationship (using one-way ANOVAs) between the citation index and team characteristics such as self-citations, sector of organization (e.g., university, industry, non-profit) or country of organization. Further research is needed to determine exactly why larger teams produce more highly cited patents. For now, a likely explanation is the fact that during development, inventors and organizations often have an idea of whether an invention is likely to be of significant importance. Technologies that look particularly promising will attract more resources and inventors as organizations try to accelerate their development. In addition, inventors will happily join technical projects that look to be particularly promising. Similarly, it is also still possible that originality and diverse thinking do, in fact, influence citation rates but that, at this time, we do not have sensitive enough measures to capture or fully understand these relationships.

ORGANIZATIONAL DIFFERENCES IN PATENTING PATTERNS

This section explores female IT patenting patterns across different organizations by examining the patenting trends in all companies with more than 10 IT patents between 2000-2005. This analysis reveals that female patenting patterns differ widely from one organization to another. In both "small patenting entities" (those with less than 100 patents during 2006-2010) and "large patenting entities" (those with at least 350 patents during 2006-2010), male, female and mixed-sex team patenting varies widely.

Small-patenting Entities. Figure 14 identifies the top 10 "small patenting entities" with the lowest percent of male-only patents in each of the five industry subcategories. (Identifying the lowest percent of male-only patents is the easiest way to identify companies with the highest percentage of female only or mixed-sex team patents overall.) When considering all 50 of these "small-patenting entities," female patenting, for the most part, ranged from 0-22%, with two companies as exceptions at 31% and 52%. In these same 50 companies, patenting for mixed-sex teams ranged from 3% to nearly 67%, with most companies falling between 30-50%. In 37 companies, mixed-sex team patenting exceeded 20%. All of the top 50 small-patenting entities had at least some mixed-sex teams with patents (with 3.3% being the lowest percentage). Seventeen companies had no female-only-invented patents, but all of these companies had mixed-sex team patents, ranging from 27-67%.

When considering industry subcategories, Computer Hardware, Computer Software, and Semiconductors/Solid-state Devices have higher levels of mixed-sex team patenting, ranging from roughly 25% to 67% with almost two-thirds of these companies having levels above 35%. In contrast, Communications and Computer Peripherals have lower mixed-sex team patenting levels, with a range from 3.3% to 54%, with only two — or 10% — of these companies having levels above 35%.

Large-patenting Entities. In general, large-patenting companies (those with more than 350 patents during 2000-2005) experienced a narrower range of female patenting but still differed dramatically (see Figure 15). In these companies, female-only invented patenting typically ranged from 0.5–8%. Only one company had no female-only invented patents, but this company did have 21% of its patents invented by mixed-sex teams. Mixed-sex team patents ranged from approximately 11–28%, with 14 companies exceeding 20%.

FIGURE 14

Top 10 "Small-patenting Entities" with Female Inventorship 2006-10 (Organizations with 25 to 100 Patents 2006-10; Lowest % of Male-only Patents)

U.S.-invented U.S. Information Technology Patents

CATEGORY	ASSIGNEE	# PATENTS 2006-10	% MIXED GENDER TEAMS	% FEMALE ONLY	% MALE ONLY
COMMUNICATIONS					
1	Realtek Semiconductor Corp.	42	19.0%	52.4%	28.6%
2	Kineto Wireless Inc.	37	54.1%	0.0%	45.9%
3	Telecommunication Systems	39	51.3%	2.6%	46.2%
4	Huawei Technologies Company	35	17.1%	31.4%	51.4%
5	Yahoo Inc.	25	24.0%	16.0%	60.0%
6	Paratek Microwave Inc.	28	32.1%	7.1%	60.7%
7	Hill-Rom Holdings Inc.	28	32.1%	0.0%	67.9%
8	Kimberly-Clark Corp.	25	32.0%	0.0%	68.0%
9	NEC Corp.	49	24.5%	6.1%	69.4%
10	University of Washington	33	30.3%	0.0%	69.7%
COMPUTER HARDWARE					
1	Target Corp.	33	66.7%	0.0%	33.3%
2	Visa Inc.	27	29.6%	22.2%	48.1%
3	American Express Co.	96	32.3%	18.7%	49.0%
4	Walker Digital LLC	29	48.3%	0.0%	51.7%
5	Finisar Corp.	26	38.5%	3.8%	57.7%
6	First Data Corp.	67	34.3%	7.5%	58.2%
7	Cummins Inc.	39	35.9%	2.6%	61.5%
8	Cray Inc.	35	37.1%	0.0%	62.9%
9	Tokyo Electron Limited	65	20.0%	15.4%	64.6%
10	Promos Technologies Inc.	26	15.4%	15.4%	69.2%
COMPUTER PERIPHERALS					
1	General Electric Company	37	27.0%	0.0%	73.0%
2	Ricoh Co. Ltd.	74	16.2%	8.1%	75.7%
3	Nitto Denko Corp.	34	11.8%	11.8%	76.5%
4	Spectra Logic Corp.	25	20.0%	0.0%	80.0%
5	Canon Inc.	41	14.6%	2.4%	82.9%
6	Dell Inc.	30	13.3%	3.3%	83.3%
7	Toshiba Corp.	43	11.6%	4.7%	83.7%
8	LSI Corporation	69	13.0%	2.9%	84.1%
9	Electronics for Imaging Inc.	60	3.3%	11.7%	85.0%
10	Pitney Bowes Inc.	85	11.8%	1.2%	87.1%
COMPUTER SOFTWARE					
1	Fiserv Inc.	50	56.0%	0.0%	44.0%
2	CME Group Inc.	35	45.7%	2.9%	51.4%
3	Computer Sciences Corp.	50	46.0%	0.0%	54.0%
4	SAIC Inc.	27	33.3%	11.1%	55.6%
5	Walker Digital LLC	91	41.8%	0.0%	58.2%
6	Stanford University	46	37.0%	4.3%	58.7%
7	Fair Isaac Corp.	49	38.8%	2.0%	59.2%
8	Visa Inc.	65	33.8%	6.2%	60.0%
9	Comverse Technology Inc.	28	35.7%	3.6%	60.7%
10	Time Warner Inc.	31	32.3%	6.5%	61.3%
SEMICONDUCTORS/SOLID-STATE DEVICES					
1	Nanosys Inc.	51	52.9%	2.0%	45.1%
2	Maxwell Technologies Inc.	34	44.1%	8.8%	47.1%
3	Greatbatch Inc.	32	50.0%	0.0%	50.0%
4	Super Talent Technology Corp.	44	40.9%	6.8%	52.3%
5	PDF Solutions	29	41.4%	0.0%	58.6%
6	Air Products and Chemicals Inc.	39	38.5%	0.0%	61.5%
7	Stanford University	56	28.6%	7.1%	64.3%
8	Harvard University	33	30.3%	0.0%	69.7%
9	Mears Technologies Inc.	38	28.9%	0.0%	71.1%
10	Promos Technologies Inc.	65	24.6%	3.1%	72.3%

FIGURE 15

Top 10 "Large-patenting Entities" with Female Inventorship 2006-10 (Organizations with 350+ Patents 2006-10; Lowest % of Male-only Patents)

U.S.-invented U.S. Information Technology Patents

CATEGORY	ASSIGNEE	# PATENTS 2006-10	% MIXED GENDER TEAMS	% FEMALE ONLY	% MALE ONLY
COMMUNICATIONS					
1	Yokogawa Electric Corp.	2178	23.8%	5.3%	70.9%
2	Furuno Electric Co. Ltd.	1722	14.9%	7.9%	77.2%
3	Japan Aviation Electronics Industry	1856	19.9%	1.6%	78.5%
4	Matsushita Electric Works Ltd.	638	15.8%	5.6%	78.5%
5	Samsung Electronics Co Ltd.	1507	16.0%	5.2%	78.8%
6	Nissan Motor Co. Ltd.	375	21.1%	0.0%	78.9%
7	Semiconductor Energy Laboratory Co. Ltd.	572	18.5%	2.4%	79.0%
8	Aisin Seiki Co. Ltd.	1036	13.8%	1.8%	84.4%
9	Omron Corp.	1723	11.4%	4.1%	84.6%
10	Citizen Holdings Co. Ltd.	953	11.6%	2.3%	86.0%
COMPUTER HARDWARE					
1	Yokogawa Electric Corp.	655	25.2%	2.9%	71.9%
2	Konica Minolta Holdings	5190	20.3%	1.3%	78.4%
3	Yazaki Corporation	720	18.6%	1.7%	79.7%
4	Lenovo Group Ltd.	1329	15.2%	3.8%	81.0%
5	Komatsu Ltd.	491	13.6%	2.0%	84.3%
6	Tokyo Electron Limited	2671	13.5%	1.9%	84.6%
7	Mitutoyo Corporation	2483	13.0%	2.3%	84.7%
8	Omron Corp.	518	11.4%	3.7%	84.9%
9	Funai Electric Co. Ltd.	530	13.2%	1.5%	85.3%
10	Olympus Corp.	354	13.3%	1.1%	85.6%
COMPUTER PERIPHERALS					
1	Western Digital Corp.	359	18.4%	4.7%	76.9%
2	Eastman Kodak Company	435	18.9%	1.4%	79.8%
3	Hewlett-Packard Co.	1105	16.5%	3.2%	80.4%
4	Seagate Technology	775	16.3%	2.2%	81.5%
5	Lexmark International Inc.	364	17.6%	0.5%	81.9%
6	Xerox Corp.	783	15.1%	2.6%	82.4%
7	Hitachi Ltd	834	15.6%	1.8%	82.6%
8	International Business Machines	410	13.7%	1.7%	84.6%
9					
10					
COMPUTER SOFTWARE					
1	Xerox Corp.	633	28.1%	5.8%	66.0%
2	AT&T Inc	964	24.4%	3.9%	71.7%
3	International Business Machines	5326	25.6%	2.6%	71.8%
4	General Electric Company	494	25.5%	1.4%	73.1%
5	Siemens Aktiengesellschaft	562	20.3%	6.0%	73.7%
6	Yahoo Inc	396	20.7%	3.3%	76.0%
7	Google Inc.	390	19.5%	3.8%	76.7%
8	Microsoft Corporation	6279	19.6%	1.3%	79.1%
9	Hewlett-Packard Co.	1403	16.5%	4.1%	79.3%
10	EMC Corp.	421	19.2%	1.4%	79.3%
SEMICONDUCTORS/SOLID-STATE DEVICES					
1	Applied Materials Inc.	804	25.2%	2.6%	72.1%
2	Freescale Semiconductor Inc.	798	20.8%	4.8%	74.4%
3	Advanced Micro Devices Inc	488	22.3%	1.2%	76.4%
4	General Electric Company	397	21.9%	1.0%	77.1%
5	International Business Machines	4564	19.7%	1.0%	79.3%
6	Intel Corporation	2035	15.7%	3.2%	81.0%
7	Altera Corp.	579	13.1%	3.3%	83.6%
8	Cadence Design Systems Inc	367	13.1%	2.2%	84.7%
9	Texas Instruments Inc	1175	12.1%	3.0%	84.9%
10	Micron Technology Inc.	3320	11.4%	3.6%	85.0%

A number of companies have also produced large increases in female patenting in the past five years, with 20 companies posting more than a 20% increase in their mixed-sex or female-invented patenting. At the same time, the percentage of female inventorship in some companies actually decreased, with 22 companies posting more than a 20% decline in mixed-sex or female-invented patents.

These patenting data alone tell us little about the reasons for the dramatic differences across organizations. As a result, future research would do well to explore how the demographic makeup and size of a company influences higher levels of female patenting. For example, do companies with higher levels of female patenting also employ larger numbers of women from the start? How is women's participation in patenting distributed in these companies? (e.g., are higher female patenting percentages due to large numbers of women patenting in these companies or to a few prolific women filing patents?) How does overall company size affect patterns in female patenting? What other characteristics, if any, do higher female-patenting companies share? Do specific organizational practices and conditions increase female patenting and if so, in what ways? This additional research is necessary to understand the reasons for the existing variance across companies. The fact that these differences exist, however, does suggest that specific contexts do make a difference and that there is no industry-wide systemic reason for the low level of female patenting overall.

SECTOR DIFFERENCES IN PATENTING PATTERNS

In this section, we examine sector differences in female IT patenting. Approximately 78% of U.S.-invented IT patents are assigned to U.S. companies while another 12% of IT patents are invented by U.S.-based inventors of foreign firms such as Alcatel-Lucent, Siemens, or Philips. Only about 7% of U.S. IT patents are held by individual inventors and only 2% of U.S.-invented IT patents come from universities, with even fewer from government agencies or non-profits.

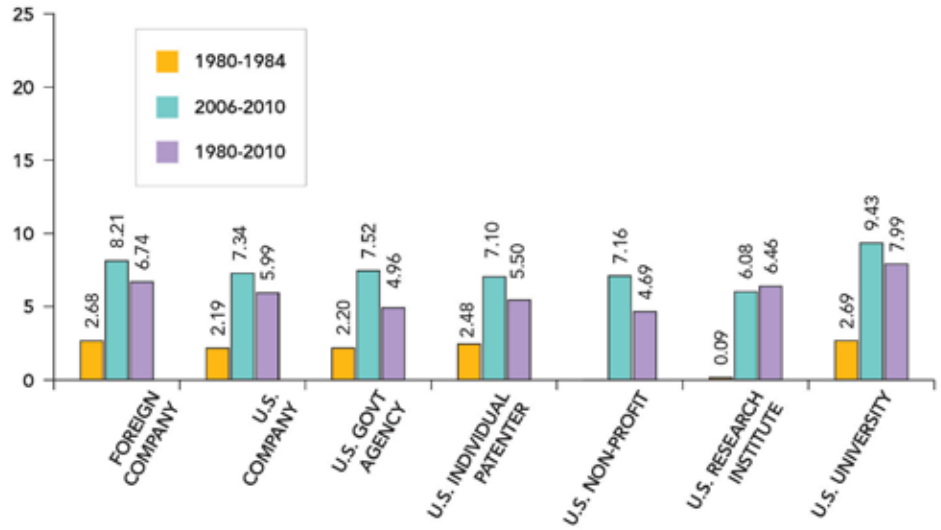
If we look at the overall combined category of IT patents (Figure 16), we see that U.S. universities have the highest percentage of female inventorship in each time period. From 2006-10, 9.43% of U.S.-invented IT patents from universities were invented by women, compared to 8.21% for women in foreign-owned firms with U.S. operations, and 7.34% for women in U.S. firms. It is unclear why foreign firms with labs in the U.S. like Alcatel-Lucent or Philips or Sony would have a higher percentage of patents invented by women, but that seems to be the case in each category except for Computer Peripherals and Computer Hardware. Interestingly, in the last five years, the highest percentage of female inventorship occurred in the U.S. labs of foreign corporations (11.11%), followed by U.S. government labs (10.61%). U.S. universities and U.S. corporations followed with 10.12% and 9.05%, respectively.

While overall female patenting is highest in Computer Software, software is one of the few categories where universities do not lead in the percentage of patents held by women.

Another interesting finding occurs in the Computer Peripheral category where the sector with the highest percentage of female-invented patents is the individual inventor sector where women hold 11.28% in 2006-10. Evidently, there are a number of women tinkering on their own in order to come up with the next great printer or storage device. This finding also raises interesting questions about the kinds of environments that foster female patenting.

FIGURE 16

Percentage of Female U.S.-invented Patents by Sector and Technology Category
(Patents 1980-2010 – Sectors with Fewer than 50 Patents Omitted)



CONCLUSION

The National Center for Women & Information Technology, with funding from its Workforce Alliance, commissioned this study to provide insight into the current state of affairs regarding female patenting. The bad news is that patenting by females in IT is relatively low in the U.S. The good news is that the trends are positive with a growing share of female inventorship in a fast-growing field. The news is even better in some subcategories of IT such as Software, and to a lesser extent in Hardware.

Likewise, the finding that mixed-sex teams are more frequently cited than either male-only or female-only teams is still an interesting finding. While this advantage seems primarily related to size of team, future research would do well to explore the relationship between size, gender, and citation patterns.

Additional good news emerges in the finding that the level of female inventorship in IT is quite high at some companies. This suggests that systemic factors, such as company environment, can make a difference. As such, women could continue to gain greater shares of IT invention, especially if we identify and replicate the conditions and practices that foster women's increased patenting efforts. This report then serves as a call for future research to identify the conditions and practices that would make this possible.

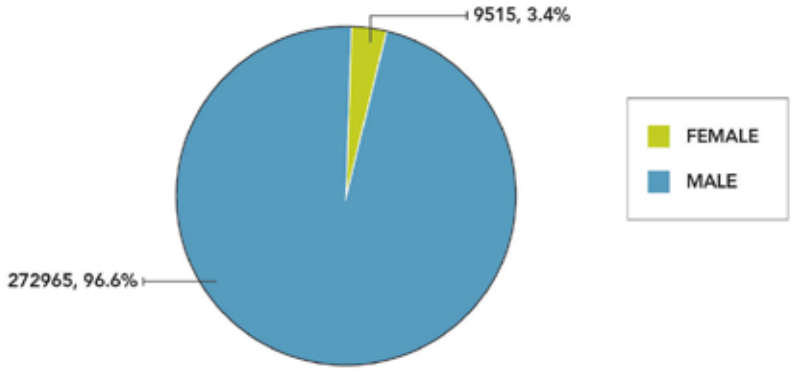
APPENDIX: SUMMARY OF FINDINGS FOR JAPANESE-INVENTED U.S. IT PATENTS

PERCENTAGES OF IT PATENTS HELD BY WOMEN INVENTORS

- From 1980-2010, 7.5% of Japanese-invented U.S. IT patents had at least one female; this is a slight increase from 6.5% in the previous study. This is a bit lower than the U.S.-invented percentage of 13%, which had increased from 9% in the previous study.
- When assigning inventorship by first inventor, 96.6% of the matched first inventors on Japanese-invented U.S. IT patents are male and 3.4% of the matched first inventors are female (see Figure 17). This is a bit lower than the U.S. percentage of 5.6%.

FIGURE 17

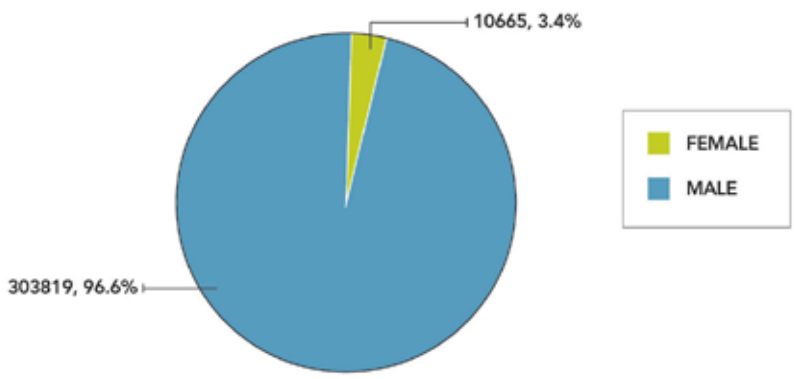
Number and Percent of First Inventors by Gender
Japanese-invented Information Technology Patents 2006-2010



- When counting fractionally, 3.4% of Japanese-invented U.S. IT patents were produced by women during the 31-year period, with 3.9% of Japanese-invented patents being produced by women in the past five years. This is also slightly lower than the U.S. percentage of 6.1% for the 31-year period and 7.5% for the past five years.

FIGURE 18

Fractionally Attributed Inventors by Gender
Japanese-invented Information Technology Patents 1980-2010

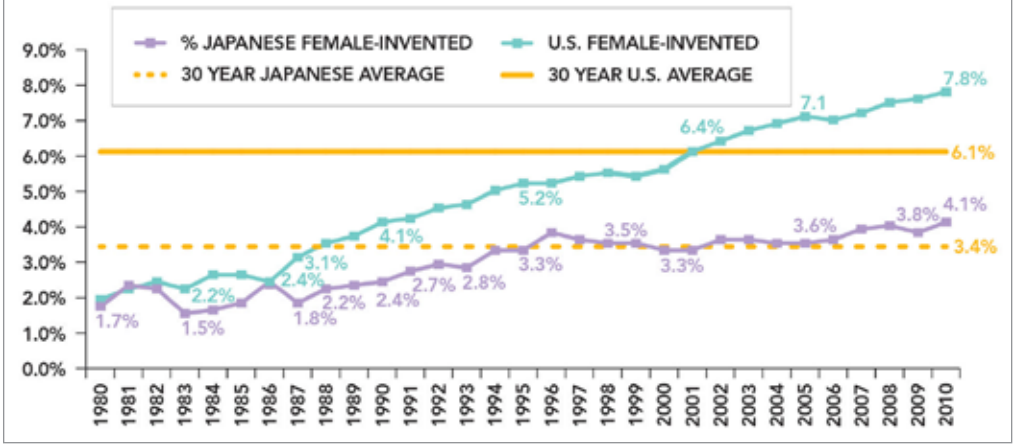


TRENDS OVER TIME

During the 31-year period, Japanese-invented U.S. IT patents experienced a different pattern in female patenting than did U.S.-invented U.S. IT patents. Among the U.S.-invented patents, female patenting steadily increased from 1.9% in 1980 to 7.8% in 2010. Among Japanese-invented patents, however, female patenting increased from 1.7% in 1980 to 3.8% in 1996 but then dipped below 3.8% for more than a decade. Female patenting did not reach 3.8% again until 2009 and then rose to 4.1% in 2010.

FIGURE 19

(U.S.-invented Information Technology Patents – Fractional Counting)



PERCENTAGES OF FEMALE IT PATENTS BY IT SUBCATEGORY

When it comes to IT subcategories, the Japanese-invented IT patents follow a pattern similar to the U.S.-invented IT patents but with slightly lower numbers, with women participating in 7% to 9% of the patents in most categories, but approximately 11% of the Computer Software patents (compared to 13% in most categories and 18% in Software for U.S.-invented patents). When counting fractionally, Japanese women produce 3.5% of the patents in most categories, but 5.6% of the Japanese-invented Computer Software patents (compared to 7.5% in most categories and 9% in Computer Software for U.S.-invented patents).

FIGURE 20

Male and Female Collaboration Statistics by Category
Japanese-invented U.S. Information Technology Patents

SUB-CATEGORY	# MATCHABLE PATENTS	FEMALE-ONLY		MIXED-GENDER TEAM		MALE-ONLY	
		COUNT	%	COUNT	%	COUNT	%
Communications	68,843	913	1.3%	3,550	5.2%	64,380	93.5%
Computer Hardware	54,289	702	1.3%	2,805	5.2%	50,782	93.5%
Computer Peripherals	73,130	653	0.9%	4,797	6.6%	67,680	92.5%
Computer Software	30,805	724	2.4%	2,601	8.4%	27,480	89.2%
Semiconductors/ Solid-state Devices	91,607	1,208	1.3%	5,949	6.5%	84,450	92.2%
All Information Technology	318,764	4,200	1.3%	19,702	6.2%	294,772	92.5%

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Editor: Stephanie Hamilton | Designer: Adriane Bradberry

National Center for Women & Information Technology (NCWIT)
www.ncwit.org | 303.735.6671 | info@ncwit.org