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The Recent Patent Analysis and Industrial Trend of 3D Printing

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Abstract

This study analyzed the trend of 3D printing-related patents for the last 10 years to investigate patent application trends by country, by year, by assignee and by technology. Furthermore, it analyzed the patent trend on 3D printers and materials used to secure original technologies and a portfolio of application technologies in medium and long terms.

Keywords: Additive Manufacturing, 3d Printing, Patent, Rapid Prototype

1. Introduction

As of 2013, the elderly population of Korea, aged 65 or older account for 12.2% of the population and the National Statistical Office forecasts that the share of this age group.

What could be some of the variables that affect SRH? Among the general characteristics are age and gender[6,9,16] whether they live alone[9] and level of education and income[6],[17,18].

2. Methodology

2.1 Study Subjects and Ethical Consideration

We searched 3D printing patents of America, Japan, Korea, Europe and China using KIPRIS (www.kipris.or.kr) patent database from year 1984 to 2013. We used keywords 3D printing, rapid prototype and additive manufacturing.

2.1 Research Variables

For the question of 'who and when 3D printing is playing in the market?' to which the answer choices were the number of patent application by year, nation, company.

2.3 Method of Data Analysis

The data used in the study is the patents by yearly application trend, technology trend, major player status and litigation status.

3. Findings

3.1 Industry Trend

Table 1 shows the original patents of 3D printing. As shown Table 1, patents of major technology are all US patents and obsolete before year 2014 passed. This patent situation and cheaper production cost are accelerating 3D printing industry. FDM patent expiration accelerate personal printing by open source Rap Rap project since year 2009. SLS patent expiration will accelerate personal mass production after year 2014.By Google trend search (www.google.com/trends), we find that from year 2013 the interest of '3D printing' is abruptly increase to 4~5 times than before. 9,370 news are announced before May 22nd 2014, and among them 3,667 news are announced in year 2013, and 5,320 news are announced in the five months of 2014 in Korea by Naver (www.naver.com) news using keyword 3D printer. By Naver news, we find 4,717 for 3D printing. This means 3D printing is near to Gold Rush.

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Table 1. Original patents of 3D printing

Tech.	Patent Number	Application/Obsolete Date
SLA	US 4,575,330	1984.08.08 ~2004.08.08
SLS	US 4,863,538	1986.10.17~2006.10.17
	US 5,597,589	1994.05.31(CIP)~2014.01.28
FDM	US 5,121,329	1989.10.30~2009.10.30
DMLS	US 5,658,412	1993.12.30~2014.08.19

3.2 Patent Trend

Table 2 shows Regional patent application trend. As shown Table 2, patent application is continuously increasing from year 1993 to 2010, especially jump double at year 2001. USA occupies 33%, international and Europe do 18%, Japan and China do 11%, Korea 9% respectively. Recent patent are focusing new material composition and improving apparatus.

Table 2. Regional patent application trend

Year	USA	PCT	EP	JP	CN	KR	Sum
1993	14	2	12	10	2	1	41
2000	45	44	77	41	8	23	238
2001	106	38	43	22	11	15	235
2002	108	43	45	40	7	11	254
2003	115	57	84	60	38	18	372
2004	155	50	58	38	41	18	360
2005	147	80	66	51	45	31	420
2006	119	76	83	65	52	28	423
2007	183	87	70	34	68	61	503
2008	139	85	91	42	69	81	507
2009	151	89	64	34	83	77	498
2010	165	80	75	28	82	66	496
2011	138	115	36	27	40	39	395
2012	95	90	12	6	37	6	246
Sum	1864	1032	987	619	601	507	5610
Portion	33%	18%	18%	11%	11%	9%	100%

Table 3 shows Top 10 patent applicant landscape. As shown Table 3, eight of top ten companies are focusing USA as target market. Most companies are focusing SLA technology, and 3D Systems merge Z Corp to expand market share. Stratasys which have focused in FDM technology added recently SLA technology by merging Object Geometries. Specilay Nederlandese Organisatie voor Toegepast focus only Europe market and DWS SRL focus USA and Korea market. Korea top applicants are KIMM, Z Corp, Postech, KAIST, VANTICO, Mr. Son, KIWA chemical, 3D systems, HP, this means 3D Systems SLA technology will be issued in Korea in near future. As an early stage, top patent applicants are more in 3D printer device than 3D printing application services.

Although original patents are expired, additional improved patents are continually applied in the world leading companies. This means patent litigation will be still hot issue in the 3D printing industry. Main patent litigation will be in the category of material and apparatus. Recently Games Workshop used Makerbot by copyright litigation that defendants used the design in printing 'war hammer' in game character's accessory. 3D System used Form labs and Kick starter crowd funder by patent litigation that defendants used the SLA technology in making product by social funding.Table 4 shows Major players by nation. Eight of top ten companies are focusing USA as target market. Most companies are focusing SLA technology and 3D Systems merge Z Corp to expand market share. Stratasys which have focused in FDM technology added recently SLA technology by merging Object Geometries. Especially NedernadeseOrganisatievoorToegepest focus only Europe market and DWS SRL focus USA and Korea market. Korea top applicants are KIMM, Z Corp, Postech, KAIST, VANTICO, Mr. Son, KIWA chemical, 3D systems, HP, this means 3D Systems SLA technology will be issued in Korea in near future. As an early stage, top patent applicants are more in 3D printer device than 3D printing application services.

Table 5 shows patent status by technology. For SLS technology, 3D systems is the top applicant as of 93 patent applications. 3D Systems focuses on the Plastic and Metal materials and MIT focuses on the Ceramic and Bio materials. For FDM technology, 3D systems is the top applicant as of 93 patent applications. 3D Systems focuses on the Plastic and Metal materials and MIT focuses on the Ceramic and Bio materials. For DMLS technology,

Table 3. Top 10 patent applicant landscape

Company	Nation	Total	KR	US	JP	EP	Target	Tech
3D Systems(& Z Corp)	US	318	27	198	33	60	US(62%)	SLA
Stratasys (& Object Geometries)	US	59	0	42	2	15	US(71%)	FDM SLA
Univ. of Teasas Systems	Israel	18	1	13	2	2	US(72%)	SLA
Huntsman Advanced Materials	US	18	4	2	9	3	JP(50%)	SLA
MIT	US	18	0	13	2	3	US(72%)	SLA
Vantico	US	16	3	8	1	4	US(50%)	SLA
NedernadeseOrganisatievoor Toegepest	Netherlands	12	0	3	2	7	EU(58%)	SLA
DSM IP Assets	Netherlands	12	3	6	1	2	US(50%)	SLA
Therics	US	11	0	8	2	1	US(73%)	SLA SLS
DWS SRL	Italy	11	4	4	0	3	US/KR(36%)	SLA

Table 4. Major players by nation

Rank	KR		US		JP		EU		CN	
1	KIMM	48	3D SYSTEMS	248	3D SYSTEMS	45	3D SYSTEMS	153	STRATASYS	17
2	Z CORP	35	STRATASYS	122	TOHO TITANIUM	25	STRATASYS	49	Z CORP	13
3	POSTECH	22	Z CORP	105	Z CORP	20	MIT	45	SUZHOU	12
4	KAIST	22	MIT	88	MIMAKI ENGINEERING	20	Z CORP	44	ENVISION TECHNOLOGIES	9
5	VANTICO	16	SILVERBROOK RESEARCH PTY	55	TOPPAN PRINTING	18	ENVISION TECHNOLOGIES	20	3D SYSTEMS	8
6	Son, Jungo	8	OBJECT GEOMETRIES	42	HUNTSMAN INTERNATIONAL	16	OBJECT GEOMETRIES	16	HUAZHONG SCIENCE AND TECHNOLOGY UNIV	7
7	KIWA CHEMICAL INDUSTRY	7	JOHNSON &JOHNSON PROFESSIONAL	39	DAINIPPON PRINTING	15	JOHNSON &JOHNSON PROFESSIONAL	13	EZER EREM	6
8	3D SYSTEMS	6	ENVISION TECHNOLOGIES	32	KOBE STEEL	15	NEDERLANDSE ORGANISATIE VOOR...	13	SHANGHAI JETCOAT CORP	6
9	HEWLETT-PACKARD DEVELOPMENT	6	SOUTHPAC TRUST INTERNATIONAL	28	HEWLETT PACKARD DEVELOPMENT	14	MIMAKI ENGINEERING	10	SUN YAT SEN UNIV	6

Table 5. Patent status by technology

Tech.		Plastic	Metal	Ceramic	Bio	Alloy	Polymer	Top5
SLS	Top1	3D systems	3D systems	MIT	MIT			
	Patent	102	110	46	27			285
	Top5	3D systems	Z Corp	MIT	Stratasys	Johnson & Johnson		
	Patent	93	52	44	40	21		250
FDM	Top1	3D systems	3D systems	MIT	MIT	-		
	Patent	102	110	46	27	0		
	Top5	3D systems	Z Corp	MIT	Stratasys	Johnson & Johnson		
	Patent	93	52	44	40	21		250
DLMS	Top1		Z Corp		Nutsman& ETC	Silverook Research PTY		
	Patent		17		1	12		30
	Top5	3D systems	Z Corp	Silverook Research PTY	J&J	MIT		
	Patent	24	20	20	19	12		95
SLA	Top	3D systems	MIT	Z Corp	Stratasys	Postech		
	Patent	170	21	12	11	10		224
	Top5				3D systems	-	MIT	
	Patent				167	0	7	174

3D systems is the top applicant as of 24 patent applications. Z Corp focuses on the Metal materials and Silverook Research PTY focuses on the alloy and 5 companies including Moltex focuses on the Bio materials. For SLS technology, 3D systems is the top applicant as of 170 patent applications. 3D Systems focuses on the optical polymer materials and MIT focuses on the Bio materials

4. Acknowledgement

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