

# Contact Lenses

## Technology Insight Report

This report covers analysis of all patents published on Contact Lenses over the last 20 years

GRIDLOGICS TECHNOLOGIES PVT LTD

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## Table of Contents

Introduction .....	4
Patent Search Strategy .....	5
Definitions to IPC groups referred to in search query .....	6
Technical Segmentation (Patent Categories).....	7
IP Analysis .....	8
Publication Trend .....	8
Top Companies .....	9
Research activity around world .....	10
Companies - Key Statistics .....	11
Inventor - Key Statistics.....	15
Company activity across contact lens types .....	18
Company activity across contact lens materials .....	19
Contact Lens –Types vs Use .....	20
Contact Lens – Materials vs Types .....	22
Landscape for technologies used for contact lens .....	23
Company focus across different types and use of contact lenses .....	24
Silicone Hydrogel: Filing Trend.....	25
Priority Country.....	25
Trends for Silicone Hydrogel Contact Lens.....	25
Company Trend.....	26
Trends for Silicone Hydrogel Contact Lens.....	26
Assignee portfolio spread across different use of silicone hydrogel lens.....	27
Trends for Silicone Hydrogel Contact Lens.....	27
US: Publication Trend.....	28
Contact Lens - Country Wise Research Trends.....	28
US: Filing Trend.....	29
Contact Lens - Country Wise Research Trends.....	29
US: Company across different contact lens .....	30
Contact Lens - Country Wise Research Trends.....	30
CN: Publication Trend .....	31
Contact Lens - Country Wise Research Trends.....	31
CN: Company Trend .....	32
Contact Lens - Country Wise Research Trends.....	32
CN: Company across different contact lens .....	33
Contact Lens - Country Wise Research Trends.....	33

<i>JP: Publication Trend.....</i>	<i>34</i>
<i>Contact Lens - Country Wise Research Trends.....</i>	<i>34</i>
<i>JP: Filing Trend.....</i>	<i>35</i>
<i>Contact Lens - Country Wise Research Trends.....</i>	<i>35</i>
<i>JP: Company across different contact lens .....</i>	<i>36</i>
<i>Contact Lens - Country Wise Research Trends.....</i>	<i>36</i>
<i>Appendix: Search Strings Used for Categorization .....</i>	<i>37</i>
<i>Summary.....</i>	<i>40</i>
<i>Sources &amp; References.....</i>	<i>42</i>

## Introduction

Contact lenses are considered medical devices and can be worn to correct vision, or for cosmetic or therapeutic reasons. People choose to wear contact lenses for many reasons. Aesthetics and cosmetics are often motivating factors for people who would like to avoid wearing glasses or would like to change the appearance of their eyes. Other people wear contacts for functional or optical reasons. When compared with spectacles, contact lenses typically provide better peripheral vision, and do not collect moisture such as rain, snow, condensation, or sweat.

Contact lenses can be classified in many different ways. Contact lenses can be separated by their primary function, material, wear schedule i.e. how long a lens can be worn before removing it and replacement schedule i.e. how long before a lens needs to be discarded. Typically, soft contact lenses are mass-produced, while rigid lenses are custom-made to exact specifications for specific individual patients.

When it comes to contact lenses, it's very important to know exactly what's inside of them, or better yet, what they're made of. Materials used have varied throughout the years. Earlier times called for more rigid materials that didn't allow much oxygen to get to your eye. But as technology has improved, so has the availability of products.

Points covered:

- Overview of top companies involved in contact lens and their publication trend
- Focus on the types and materials for contact lens
- Trends for different applications of contact lens and their patent activity
- Analyzing key companies within contact lens

## Patent Search Strategy

Using [PatSeer](#) following search query was used to create patent set.

TAC- Title, Abstract, Claims IC– International Class CPC- Cooperative Patent Classification

TAC:(contact\* wd3 lens\*)

AND

(IC:(G02C7/00 OR G02C7/02 OR G02C7/04 OR G02C7/06 OR G02C7/08 OR G02C13/00 OR G02B1/00 OR G02B1/02 OR G02B1/04 OR G02B1/06 OR G02B1/08 OR G02B1/10 OR G02B1/11 OR G02B1/12))

OR

CPC:(G02C7/00 OR G02C7/02 OR G02C7/04 OR G02C7/06 OR G02C7/08 OR G02C13/00 OR G02B1/00 OR G02B1/02 OR G02B1/04 OR G02B1/06 OR G02B1/08 OR G02B1/10 OR G02B1/11 OR G02B1/12))

AND

PBY: [1994 TO 2014]

- The query was directed to search through the title, abstract and claims with one publication per family was generated and imported in Patent iNSIGHT Pro.
- Result set of 2470 records was imported into the software.

The publications included in the report are updated as of 10<sup>th</sup> May, 2014

## Definitions to IPC groups referred to in search query

IPC	Description
<b>G02C7/00</b>	Optical parts
<b>G02C7/02</b>	Optical parts - Lenses; Lens systems
<b>G02C7/04</b>	Optical parts - Lenses; Lens systems -- Contact lenses for the eyes
<b>G02C7/06</b>	Optical parts - Lenses; Lens systems -- bifocal; multifocal
<b>G02C7/08</b>	Optical parts - Lenses; Lens systems -- Auxiliary lenses; Arrangements for varying focal length
<b>G02C13/00</b>	Assembling; Repairing; Cleaning
<b>G02B1/00</b>	Optical elements characterised by the material of which they are made
<b>G02B1/02</b>	Optical elements characterised by the material of which they are made - made of crystals, e.g. rock-salt, semiconductors
<b>G02B1/04</b>	Optical elements characterised by the material of which they are made - made of organic materials, e.g. plastics
<b>G02B1/06</b>	Optical elements characterised by the material of which they are made - made of fluids in transparent cells
<b>G02B1/08</b>	Optical elements characterised by the material of which they are made- made of polarising materials
<b>G02B1/10</b>	Optical elements characterised by the material of which they are made - Optical coatings produced by application to, or surface treatment of, optical elements
<b>G02B1/11</b>	Optical elements characterised by the material of which they are made - Optical coatings produced by application to, or surface treatment of, optical elements -- Anti-reflection coatings
<b>G02B1/12</b>	Optical elements characterised by the material of which they are made - Optical coatings produced by application to, or surface treatment of, optical elements -- by surface treatment, e.g. by irradiation

## Technical Segmentation (Patent Categories)

Types	Materials	Use
<ul style="list-style-type: none"> <li>• Bifocal Contact Lens</li> <li>• Color Contact Lens</li> <li>• Cosmetic Contact Lens</li> <li>• Disposable Contact Lens</li> <li>• Extended Wear Contact Lens</li> <li>• Hybrid Contact Lens</li> <li>• Intraocular Contact Lens</li> <li>• Magnifying Contact Lens</li> <li>• Multifocal Contact Lens</li> <li>• Ortho-K</li> <li>• Photochromic Contact Lens</li> <li>• Rigid Gas Permeable</li> <li>• Scleral Contact Lens</li> <li>• Silicone Hydrogel Contact Lens</li> <li>• Soft Contact Lens</li> <li>• Spherical Contact Lens</li> <li>• Therapeutic Contact Lens</li> <li>• Toric Contact Lens</li> </ul>	<ul style="list-style-type: none"> <li>• Balafilcon</li> <li>• Cellulose Acetate Butyrate</li> <li>• Etafilcon</li> <li>• Fluorine</li> <li>• Fluoroacrylate Polymer</li> <li>• Fluorocarbon</li> <li>• Fluoroether</li> <li>• Fluorosilicone Acrylate</li> <li>• Galyfilcon</li> <li>• Hydroxyethylmethacrylate</li> <li>• Lotrafilcon A</li> <li>• Lotrafilcon B</li> <li>• MethylMethacrylate</li> <li>• N Vinyl Pyrrolidone</li> <li>• Narafilcon</li> <li>• Phosphorylcholine</li> <li>• Plastic</li> <li>• Poly(methyl)methacrylate</li> <li>• Polyacetylene</li> <li>• Polyamide</li> <li>• Polycarbonate</li> <li>• Polystyrene</li> <li>• Senofilcon A</li> <li>• Silicone</li> <li>• Silicone Acrylate</li> </ul>	<ul style="list-style-type: none"> <li>• Astigmatism</li> <li>• Glaucoma</li> <li>• Hyperopia</li> <li>• Keratoconus</li> <li>• Myopia</li> <li>• Presbyopia</li> </ul>

The categorization involved defining a search strategy for each topic and then conducting the search using the Advanced Searching capability in Patent iNSIGHT Pro. Details of search strings used for each category are given in Appendix.

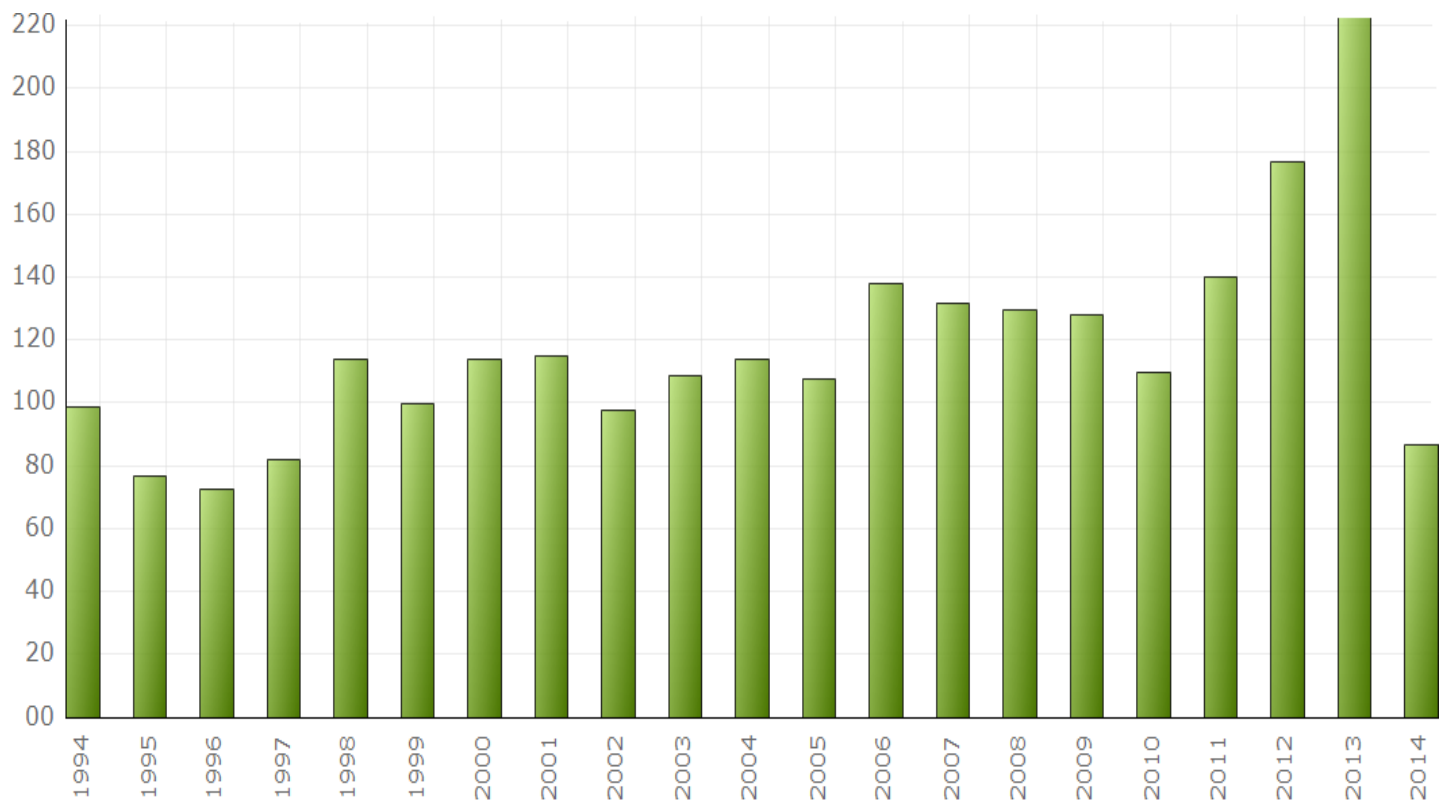
## IP Analysis

### Publication Trend

*What has been the publication trend for contact lens?*

Contact lens publications have emerged before 1994 with the real surge in the activity around this technology has happened in the last 10 years.

It's clear the current activity around these technologies is likely to continue seeing more innovation in the near future.

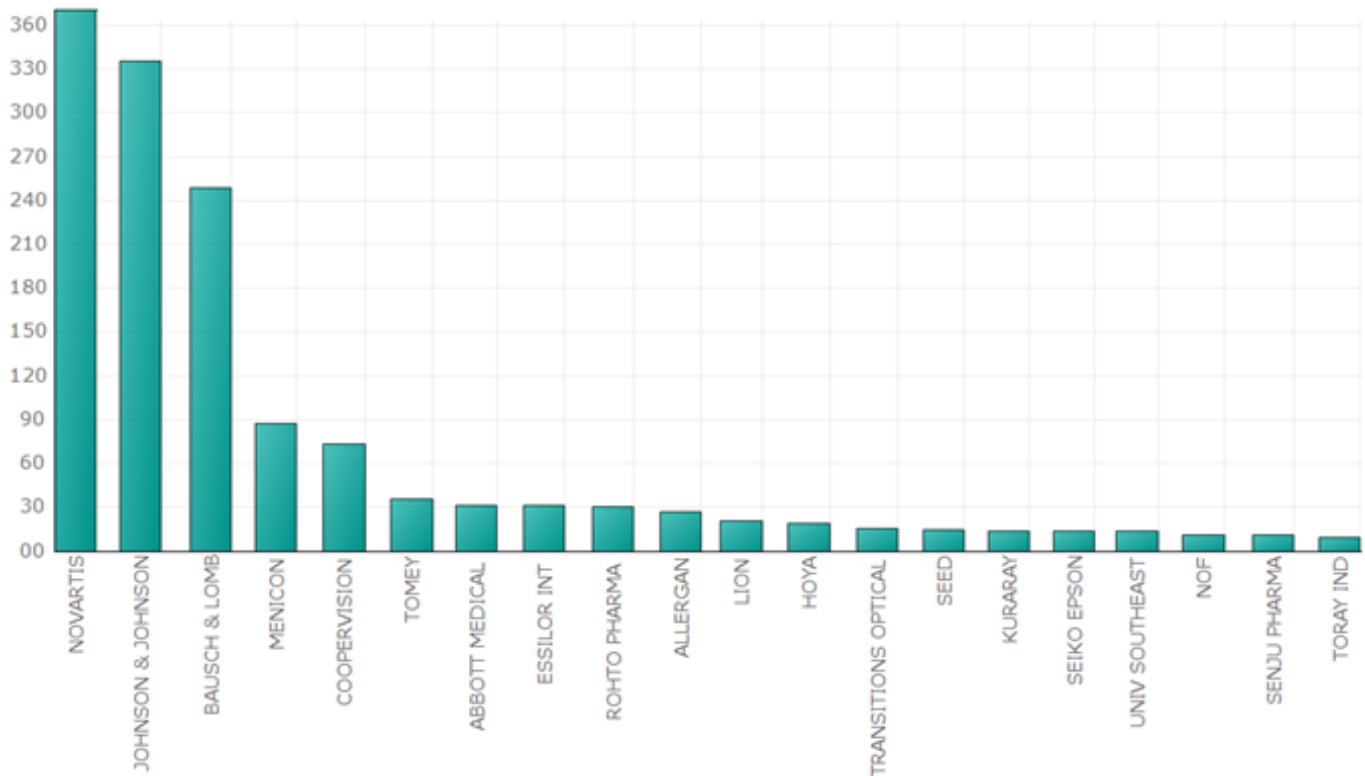


*How we did it?*

Once the patents were populated in Patent iNSIGHT Pro, the publication trend chart was generated on a single click using the dashboard tool.



## Top Companies



The top organizations are:

1. NOVARTIS
2. JOHNSON & JOHNSON
3. BAUSCH & LOMB INC
4. MENICON CO LTD
5. COOPERVISION INC
6. TOMEY CORP
7. ABBOTT MEDICAL OPTICS INC
8. ESSILOR INTERNATIONAL SA
9. ROHTO PHARMA CO LTD
10. ALLERGAN INC

11. LION CORP
12. HOYA CORP
13. TRANSITIONS OPTICAL INC
14. SEED CO LTD
15. KURARAY CO LTD
16. SEIKO EPSON CORP
17. UNIV SOUTHEAST
18. NOF CORP
19. SENJU PHARMACEUTICAL CO LTD
20. TORAY IND INC

Note: Records for Alcon Lab, Ciba Geigy, Ciba Vision, Jessen Wesley have been grouped with Novartis

### How we did it?

Once the patents were populated in Patent iNSIGHT Pro, the assignee clean- up tools were used to normalize the names. Different cleanup tools were leveraged:

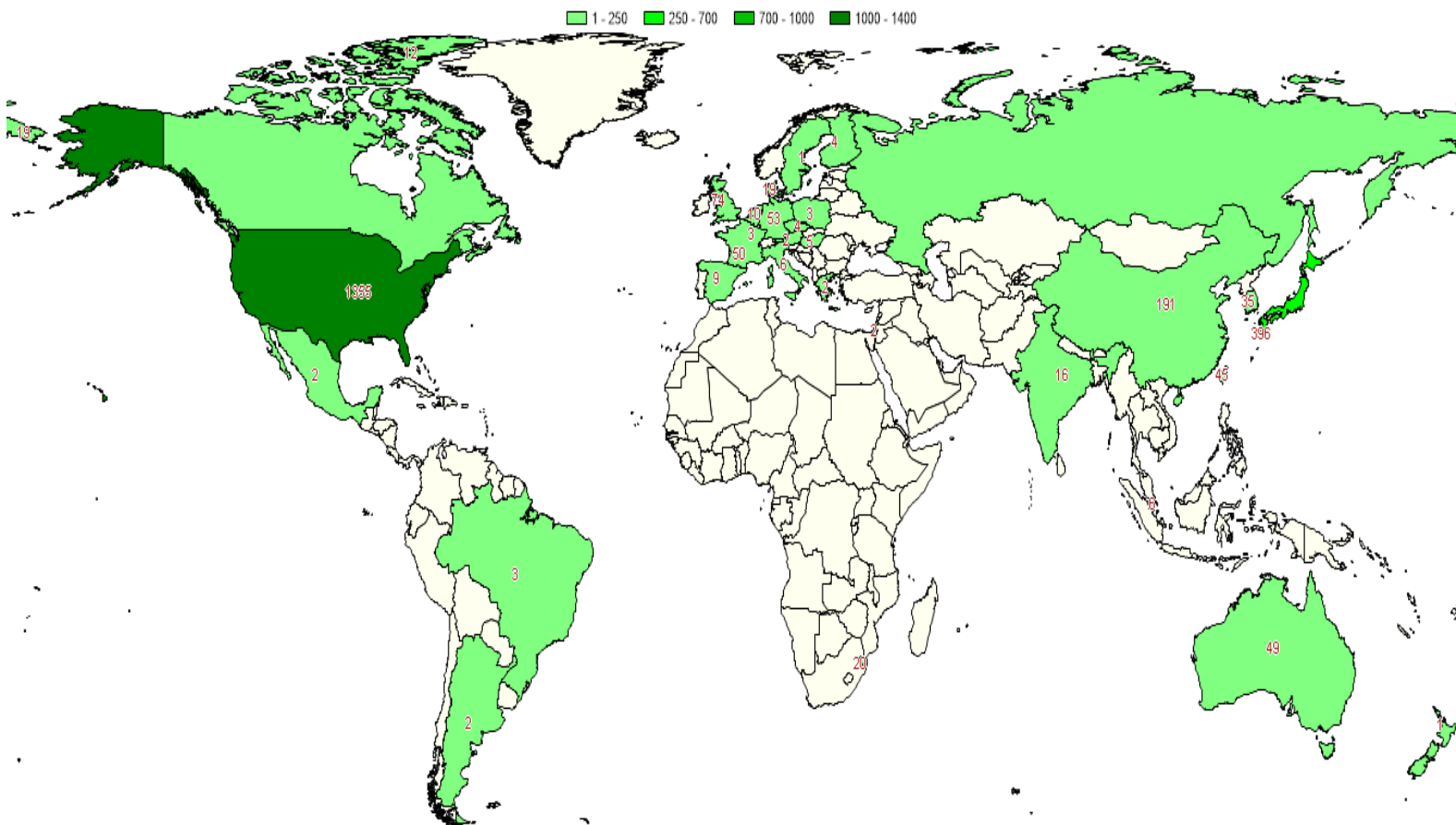
- To locate assignees for unassigned records
- To clean up records having multiple assignees
- To locate the correct assignee names for US records using the US assignments database
- To merge assignees that resulted from a merger or acquisition or name change.

The dashboard tool within Patent iNSIGHT Pro was used to find the top 20 assignees within the given patent set. A visual graph was created based on the results of the top assignees with the number of patents alongside each one. The complete Assignee table is available in the following Excel file:

<http://www.patentinsightpro.com/techreports/0514/List%20of%20Assignees.xls>




## Research activity around world

In terms of regional pockets where patent protection is being sought most frequently for these technologies, US leads the count, followed by the JP and CN. The table below ranks top priority countries and helps provide an indication of where innovation in this area is originating:



## Companies - Key Statistics

Here we summarize key parameters of Top 15 companies such as filing trend, Top inventors in each company and Coverage of underlying patent families

Assignee	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Trend (Absolute)	Filing Year Range	Key Inventor (Top 5)	Co-Assignees	Coverage (Includes families)							
							US	EP	WO	JP	DE	CN	AU	IN
NOVARTIS	371 (15%)	4.4		1994-2013	WINTERTON LYNN COOK(27) LOHMANN DIETER(24) SEIFERLING BERNHARD(19) ASGHARIAN BAHRAM(18) SCHLUETER DOUGLAS C(16)	COMMW SCIENT IND RES ORG(3) HOLDEN BRIEN VISION INST(1)	290	286	244	262	168	133	225	16
JOHNSON & JOHNSON	336 (13.6 %)	4.19		1994-2013	ROFFMAN JEFFREY H(44) FORD JAMES D(30) MOLOCK FRANK F(26) KINDT-LARSEN TURE(24) VANDERLAAN DOUGLAS G(23)	TORAY IND INC(2)	263	261	154	255	131	205	258	95
BAUSCH & LOMB INC	253 (10.2 %)	4.14		1994-2013	SALAMONE JOSEPH C(60) KUNZLER JAY F(55) LAI YU-CHIN(30) AMMON DANIEL M JR(29) XIA ERNING(28)	No Co-Assignee Present	213	158	206	138	79	119	114	37



MENICON CO LTD	88 (3.6%)	1.39		1994-2013	NAKADA KAZUHIKO(13) TANIKAWA SADAYASU(10) TSUZUKI AKIRA(10) MORI OSAMU(7) KAWAI TETSUJI(6)	SHINETSU CHEMICAL CO(3) TOMEY CORP(1) TOYOTA CENTRAL RESEARCH & DEVELOPMENT LAB INC(1) UNIV NANYANG TECH(1)	39	43	39	71	16	12	10	2
COOPERVISION INC	80 (3.2%)	2.59		1995-2013	BACK ARTHUR(28) CHEN CHARLIE(23) LIU YUWEN(17) HONG YE(16) FRANCIS CHARLES A(14)	JAHNKE RICHARD L(1)	67	60	66	41	11	44	21	14
TOMEY CORP	36 (1.5%)	1.53		1994-2007	NAKAGAWA MAKOTO(8) IBARAKI KEIKO(7) NAKAGAWA AKIRA(5) KAMIYA HIDEAKI(4) SUGIURA MAKOTO(4)	CELAGIX RES LTD(1) MENICON CO LTD(1) TANIKA DENKI HANBAI KK(1)	6	9	6	35	1	1	0	0
ABBOTT MEDICAL OPTICS INC	32 (1.3%)	7.38		1994-2013	HU CAN B(4) MAI THUY B(4) DZIABO ANTHONY J(3) YU ZHI-JIAN(3) LIAO XIUGAO(3)	No Co-Assignee Present	31	21	25	20	10	7	26	1
ESSILOR INTERNATIONAL SA	32 (1.3%)	1.5		1994-2011	CANO JEAN-PAUL(8) BAUDE DOMINIQUE(7) BOVET	GALENICA HOLDING SA(1) SUNSOFT CORP(1)	19	26	19	20	9	8	11	3



					CHRISTIAN(7) CALDERARA ISABELLE(5) BALLET JEROME(4)												
ROHTO PHARMA CO LTD	31 (1.3% )	1.42		1997- 2011	KOIKE TETSUHISA(8) KIYOBAYASHI YUKA(5) FUKUSHIMA KAZUHIRO(4) MIWA YUKA(3) ARITA HARUMASA(3 )	No Co- Assignee Present	5	4	5	28	0	2	3	0			
ALLERGAN INC	27 (1.1% )	4.67		1994- 2013	HUTH STANLEY W(5) CURRIE JAMES P(3) LAM SAM W(2) HUNT TERRENCE J(2) DZIABO ANTHONY J(2)	UNIV VALLADOL ID(1)	16	13	24	12	4	3	22	0			
LION CORP	21 (0.9% )	1.76		1998- 2010	TABUCHI TERUTO(9) HATTORI MANABU(8) ARIMURA AKIKO(5) ITO SEIJI(3) KOIDE MISAO(2)	No Co- Assignee Present	2	1	1	21	0	1	0	0			
HOYA CORP	19 (0.8% )	1.16		1994- 2010	IMAFUKU SUGURU(4) IWAMOTO HIDETOSHI(3) NOMURA MASASHI(3) YOKOYAMA YUICHI(3) SHICHIMIYA YUTAKA(2)	No Co- Assignee Present	10	11	6	15	7	8	5	0			



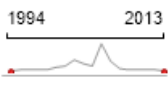




TRANSITIONS OPTICAL INC	16 (0.6%)	8.5		1999-2013	KUMAR ANIL(9) CHOPRA ANU(4) VAN GEMERT BARRY(3) WALTERS ROBERT W(3) FOLLER PETER C(3)	No Co-Assignee Present	12	13	15	10	4	10	11	2
SEED CO LTD	15 (0.6%)	0.13		1997-2011	YANAGAWA YOSHINORI(9) UNO KENJI(9) SAKUSABE KAZUE(4) DEGAWA HIRONORI(2) HIROSE YUTAKA(2)	TAKI CHEMICAL (1)	2	2	3	14	1	2	1	0
KURARAY CO LTD	14 (0.6%)	3.93		1996-2005	MAKABE TAKASHI(4) AKAMATSU SHIGEMI(2) KOMURA IKUO(2) NAGAO MASAHIRO(2) OHARA TOMOKO(2)	SAGAMI CHEM RESEARCH CENTER(2)	2	3	2	10	1	5	0	0







## How we did it?

From the Assignee 360° report options, we selected Top 15 Assignees and the different pieces of information we wanted to include in the singular display and then ran the report. The generated report was then exported to Excel using the option provided for the same.





## Inventor - Key Statistics

Here we summarize key parameters of Top 15 Inventors such as filing trend, key associated companies and top 5 co-inventors.

Inventor	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Trend (Absolute)	Filing Year Range	Key Assignees (Top 5)	Co-Inventors
SALAMONE JOSEPH C	64 (2.6%)	2.52		1995-2012	BAUSCH & LOMB INC(60) SALAMONE JOSEPH C(3) AMMON DANIEL M JR(2) HU ZHENZE(2) MCGEE JOSEPH A.(1)	AMMON DANIEL M JR(20) KUNZLER JAY F(20) BORAZJANI ROYA(19) HU ZHENZE(13) XIA ERNING(12)
KUNZLER JAY F	55 (2.2%)	4.64		1994-2013	BAUSCH & LOMB INC(55)	SALAMONE JOSEPH C(20) LINHARDT JEFFREY G(13) OZARK RICHARD M(13) SCHORZMAN DEREK A(8) AMMON DANIEL M JR(7)
ROFFMAN JEFFREY H	44 (1.8%)	7.89		1995-2012	JOHNSON & JOHNSON(44)	MENEZES EDGAR V(13) CLUTTERBUCK TIMOTHY A(7) COLLINS MICHAEL J(7) DAVIS BRETT A(7) JUBIN PHILIPPE F(7)
AMMON DANIEL M JR	32 (1.3%)	3.12		1999-2012	BAUSCH & LOMB INC(29) AMMON DANIEL M JR(3) HU ZHENZE(2) SALAMONE JOSEPH C(2) GROBE GEORGE L.(1)	SALAMONE JOSEPH C(20) BORAZJANI ROYA(12) HU ZHENZE(7) KUNZLER JAY F(7) LINHARDT JFFREY G(7)
LAI YU-CHIN	32 (1.3%)	6.75		1994-2009	BAUSCH & LOMB INC(30) LAI YU-CHIN(2) RUSCIO DOMINIC V(1) LANG WEIHONG(1)	QUINN EDMOND T(8) LANG WEIHONG(7) RUSCIO DOMINIC V(4) KUNZLER JAY F(3) WEIHONG LANG(3)

FORD JAMES D	30 (1.2%)	4.73		1994-2012	JOHNSON & JOHNSON(30)	MOLOCK FRANK F(14) ALLI AZAAM(13) VANDERLAAN DOUGLAS G(8) STEFFEN ROBERT B(7) ZANINI DIANA(6)
BACK ARTHUR	29 (1.2%)	1.38		2000-2013	COOPERVISION INC(28) ASAHIKASEI AIME CO LTD(1)	CHEN CHARLIE(14) LIU YUWEN(13) FRANCIS CHARLES A(12) HONG YE(12) YAO LI(12)
XIA ERNING	29 (1.2%)	3.38		1998-2012	BAUSCH & LOMB INC(28) AMMON DANIEL M JR(1) BORAZJANI ROYA(1) DOBIE ALYCE K(1) HU ZHENZE(1)	SALAMONE JOSEPH C(12) AMMON DANIEL M JR(6) HU ZHENZE(6) BORAZJANI ROYA(5) DOBIE ALYCE K(5)
WINTERTON LYNN COOK	28 (1.1%)	4.61		1994-2012	NOVARTIS(27) COMMW SCIENT IND RES ORG(1) GABRIEL MANAL M(1) KOTOV NICHOLAS(1) LALLY JOHN MARTIN(1)	LALLY JOHN MARTIN(9) VOGT JUERGEN(9) QIU YONGXING(8) DOMSCHKE ANGELIKA(6) NICOLSON PAUL CLEMENT(6)
MOLOCK FRANK F	27 (1.1%)	6.11		1994-2011	JOHNSON & JOHNSON(26) CULLERTON GINA M(1) MAHADEVAN SHIVKUMAR(1) MOLOCK FRANK F(1) SPAULDING TERRY L(1)	FORD JAMES D(14) ELLIOTT LAURA D(10) HILL GREGORY A(6) MCCABE KEVIN P(5) ALLI AZAAM(4)
KINDT-LARSEN TURE	24 (1%)	15.25		1994-2011	JOHNSON & JOHNSON(24)	MARTIN WALLACE ANTHONY(12) WANG DANIEL TSU-FANG(11) WALKER CRAIG WILLIAM(6) ADAMS JONATHAN P(5) ANDERSEN FINN THRIGE(5)



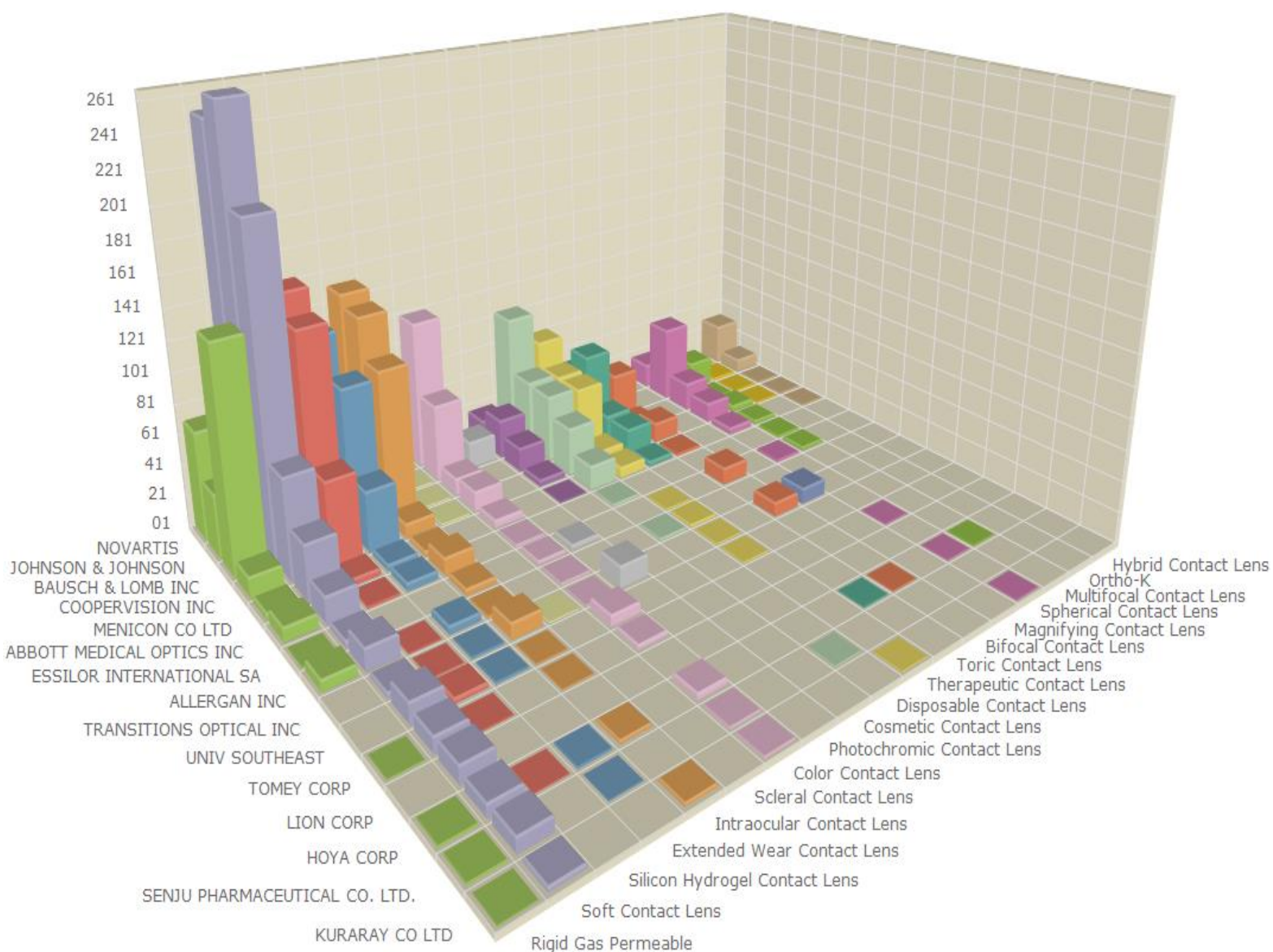
LOHMANN DIETER	24 (1%)	10.88		1995- 2012	NOVARTIS(24) COMMW SCIENT IND RES ORG(1)	CHABRECEK PETER(15) HOEPKEN JENS(11) DOMSCHKE ANGELIKA(8) BARON RICHARD CARLTON(6) LIU QIN(6)
CHEN CHARLIE	23 (0.9%)	0		2007- 2013	COOPERVISION INC(23)	HONG YE(16) LIU YUWEN(15) BACK ARTHUR(14) FRANCIS CHARLES A(12) YAO LI(12)
VANDERLAA N DOUGLAS G	23 (0.9%)	5.74		1994- 2013	JOHNSON & JOHNSON(23) TORAY IND INC(1)	ALLI AZAAM(10) STEFFEN ROBERT B(10) FORD JAMES D(8) MCCABE KEVIN P(5) PETISCE JAMES R(5)
ARTHUR HO	22 (0.9%)	5.77		1996- 2013	NOVARTIS(7) HOLDEN BRIEN VISION INST(3) VISION CRC LTD(3) BRIEN HOLDEN VISION INSTITUTE(3) COOPERVISION INC(2)	HOLDEN BRIEN ANTHONY(13) SANKARIDURG PADMAJA RAJAGOPAL(8) SMITH III EARL LEO(6) BARON RICHARD CARLTON(5) CHABRECEK PETER(5)

## How we did it?

From the Inventor 360° report options, we selected the different pieces of information we wanted to include in the singular display and then ran the report. The generated report was then exported to Excel using the option provided for the same.

## Company activity across contact lens types

- The chart below shows research activity of companies across different types
- Bausch & Lomb have the most number of records in Rigid Gas Permeable type of lens
- Novartis leads publications for Color contact lens

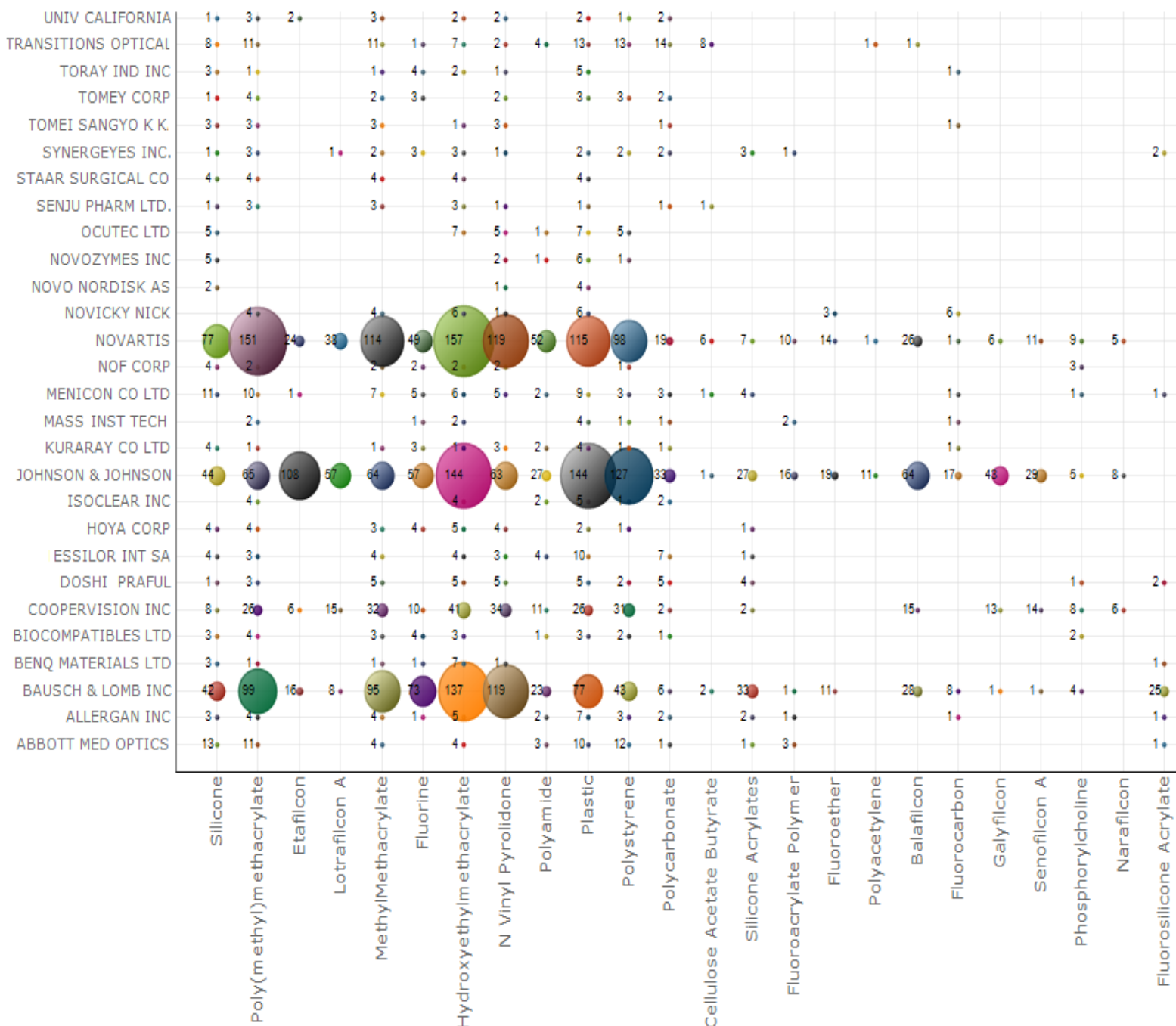


### How we did it?

First various types were identified by manual research. Then by using a combination of semantic analysis tools such as clustering tools and searching tools available in Patent iNSIGHT Pro, records were categorized under different types. A co-occurrence matrix was generated using the co-occurrence analyzer to map the different types with assignees. The matrix was filtered for the top 15 assignees and was converted into column chart using the option provided in software for the same.

## Company activity across contact lens materials

- The chart below shows research activity of companies across different materials
- Bausch & Lomb is the only company active in Fluorosilicone Acrylate as a material for contact lens

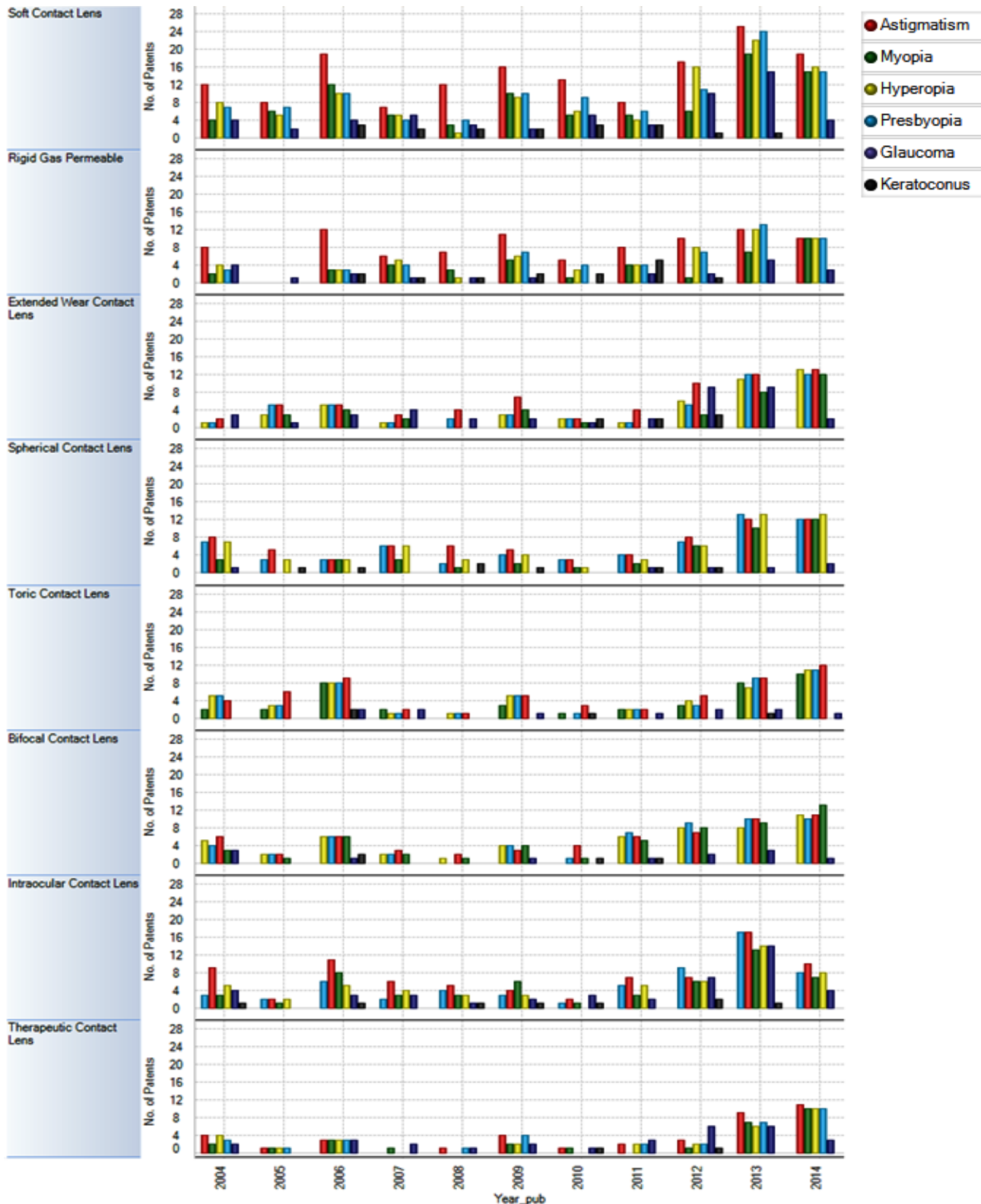


### How we did it?

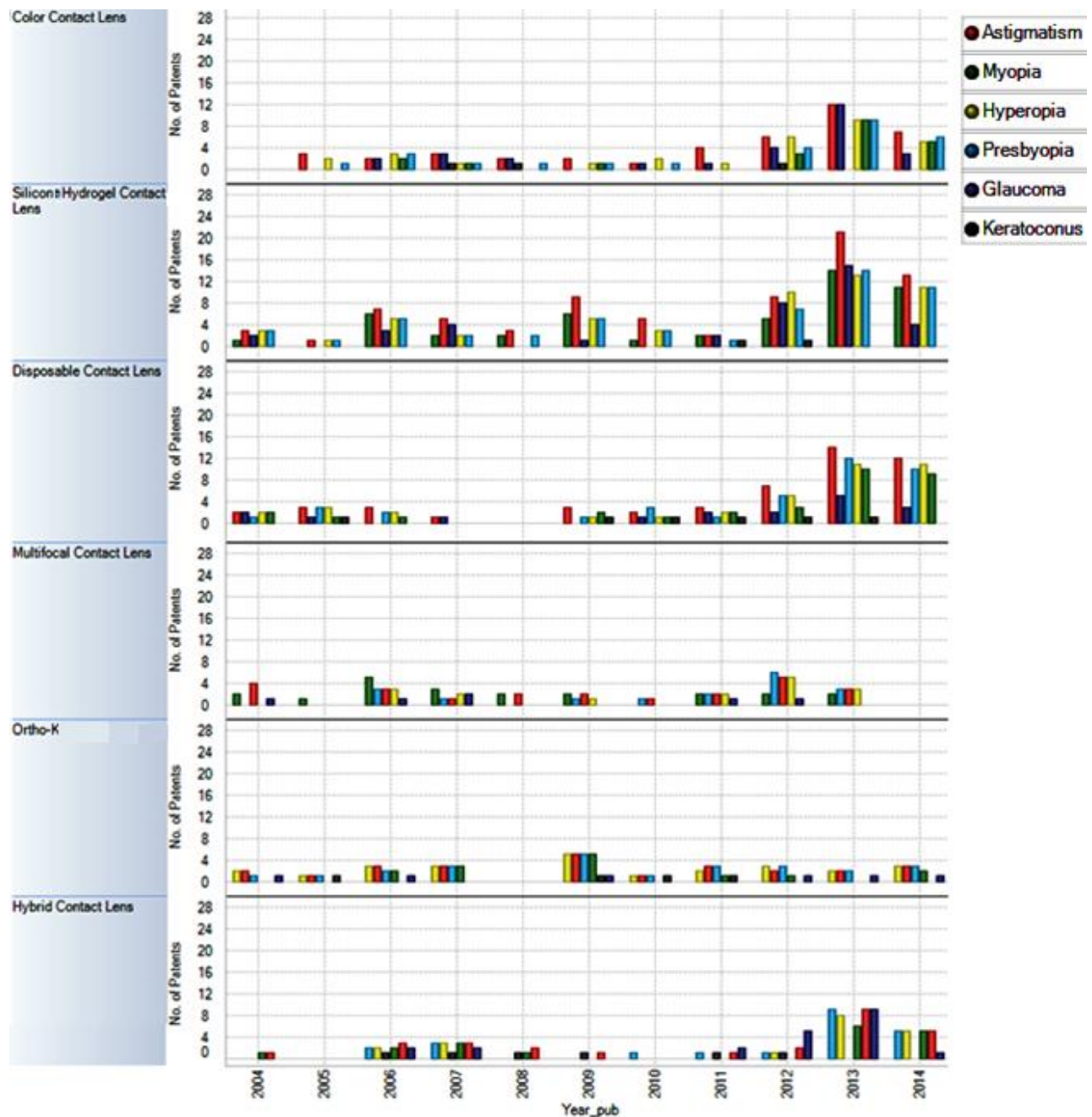
First various materials were identified by manual research. Then by using a combination of semantic analysis tools such as clustering tools and searching tools available in Patent iNSIGHT Pro, records were categorized under different materials. A co-occurrence matrix was generated using the co-occurrence analyzer to map the different materials with assignees. The matrix was filtered for the top 30 assignees and converted into bubble chart using the option provided in software for the same.

## Contact Lens –Types vs Use

- The chart below shows research activity of types with respect to their use
- Bifocal lenses are used for treating Presbyopia
- Soft contact lenses are mostly used to cure Astigmatism







#### How we did it?

First various uses were identified by manual research. Then by using a combination of semantic analysis tools such as clustering tools and searching tools available in Patent iNSIGHT Pro, records were categorized under different uses. The clusters that were created were correlated using the co-occurrence analyzer and the resulting matrix was converted into a 4-D Matrix containing types and their uses, publication year and results were restricted to last decade.

## Contact Lens – Materials vs Types

- Heat map shows materials used in different types of contact lenses

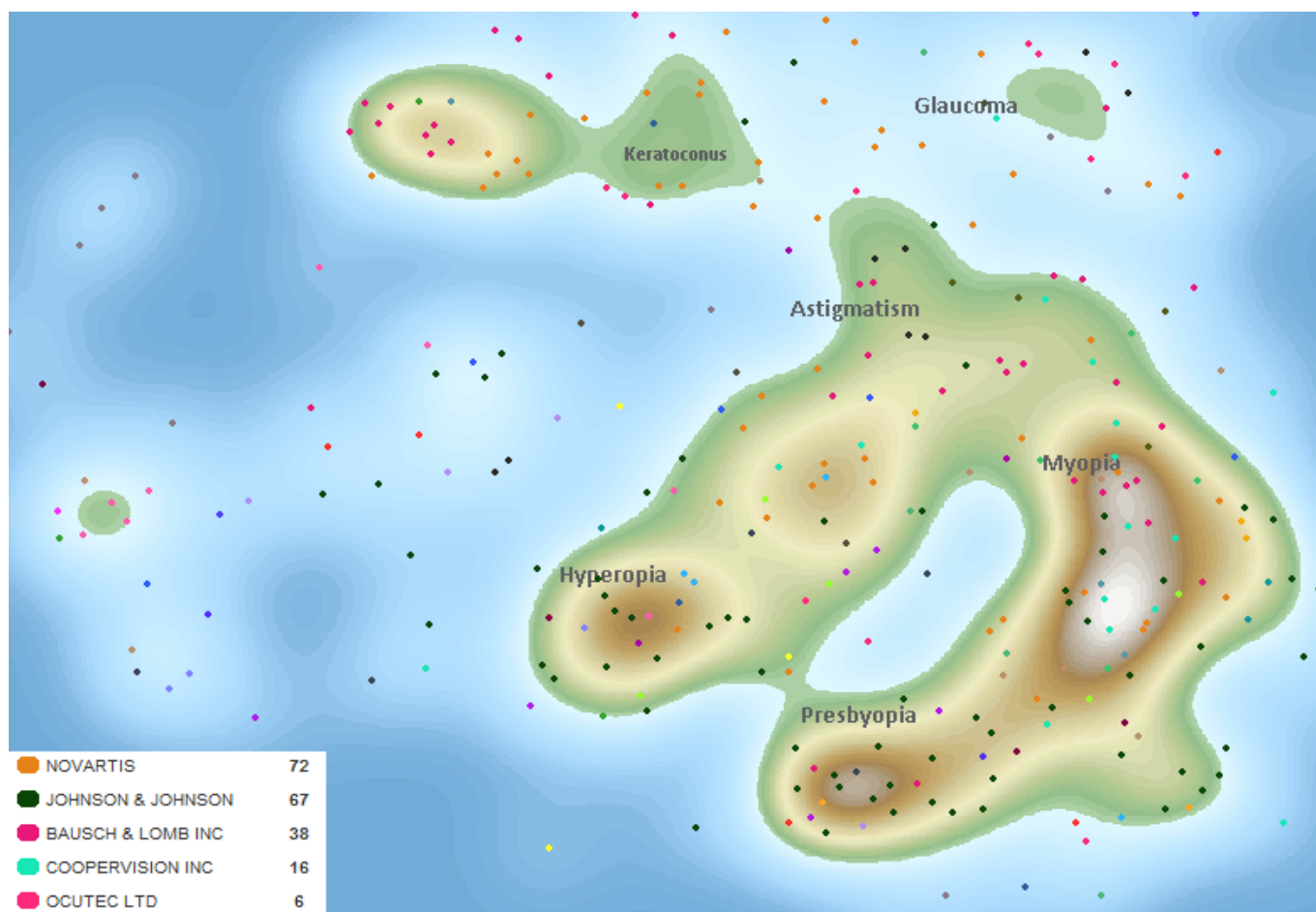
Types																	
Materials	Total	Extended Wear Contact Lens	Soft Contact Lens	Intraocular Contact Lens	Scleral Contact Lens	Color Contact Lens	Rigid Gas Permeable	Photochromic Contact Lens	Silicone Hydrogel Contact Lens	Cosmetic Contact Lens	Disposable Contact Lens	Therapeutic Contact Lens	Toric Contact Lens	Bifocal Contact Lens	Spherical Contact Lens	Multifocal Contact Lens	Hybrid Contact Lens
Total	1217	403	1017	452	18	268	389	53	488	87	267	207	108	120	106	46	58
Plastic	654	222	534	223	7	159	224	40	241	46	159	142	58	82	62	27	43
MethylMethacrylate	460	188	416	222	4	111	198	32	214	37	113	99	40	43	28	12	33
Polystyrene	414	158	346	181	4	116	117	33	218	38	71	77	19	25	17	7	24
Silicone	335	88	254	109	8	71	106	14		21	54	43	27	38	15	11	4
Fluorine	272	128	247	149	4	61	120	18	153	13	49	68	15	17	15	4	11
Etafilcon	178	69	174	89	1	55	40	10	138	26	33	35	31	21	31	11	15
Polyamide	164	74	132	79	2	47	49	13	102	6	23	42	5	15	5		18
Balafilcon	146	80	143	73	2	44	47	12	138	31	21	41	19	13	20	3	13
Polycarbonate	144	55	98	66	2	32	40	28	43	12	22	25	6	24	8	5	10
Lotrafilcon A	132	78	130	65	1	47	27	10	127	27	21	36	16	13	19	4	18
Silicone Acrylate	122	54	114	55	3	21	80	5	70	12	42	27	8	9	13	13	16
Galyfilcon	69	28	68	28	1	29	14	9	68	16	13	12	13	8	11	1	6
Senofilcon A	62	33	61	29		24	15	10	61	9	16	15	7	11	13	1	9
Fluoroether	55	34	54	39		13	10	5	53	10	4	25	1		3	1	9
Phosphorylcholine	46	22	41	22		12	18	4	31		7	16	3	2	5	3	4
Fluorocarbon	46	24	42	32	2	7	17	4	32	9	8	11	2	1	3		
Cellulose Acetate Butyrate	39	9	29	16		13	13	13	6		3	5	1	9	2		1
Narafilcon	21	12	20	9		14	7	3	21	3	7	8	3	2	4		4
Polyacetylene	16	11	14	13		3	1	4	13	9				1	1		

### How we did it?

Using co-occurrence analyzer, a matrix for different materials used in different types of contact lenses was generated and the resulting matrix was exported to Excel using the option provided for the same.

## Landscape for technologies used for contact lens

The contour map below represents different contact lens use with respect to complete patent portfolio. Clusters for Myopia (nearsightedness) and Hyperopia (farsightedness) appear far away from each other as per their definitions. The nodes were coloured by companies.

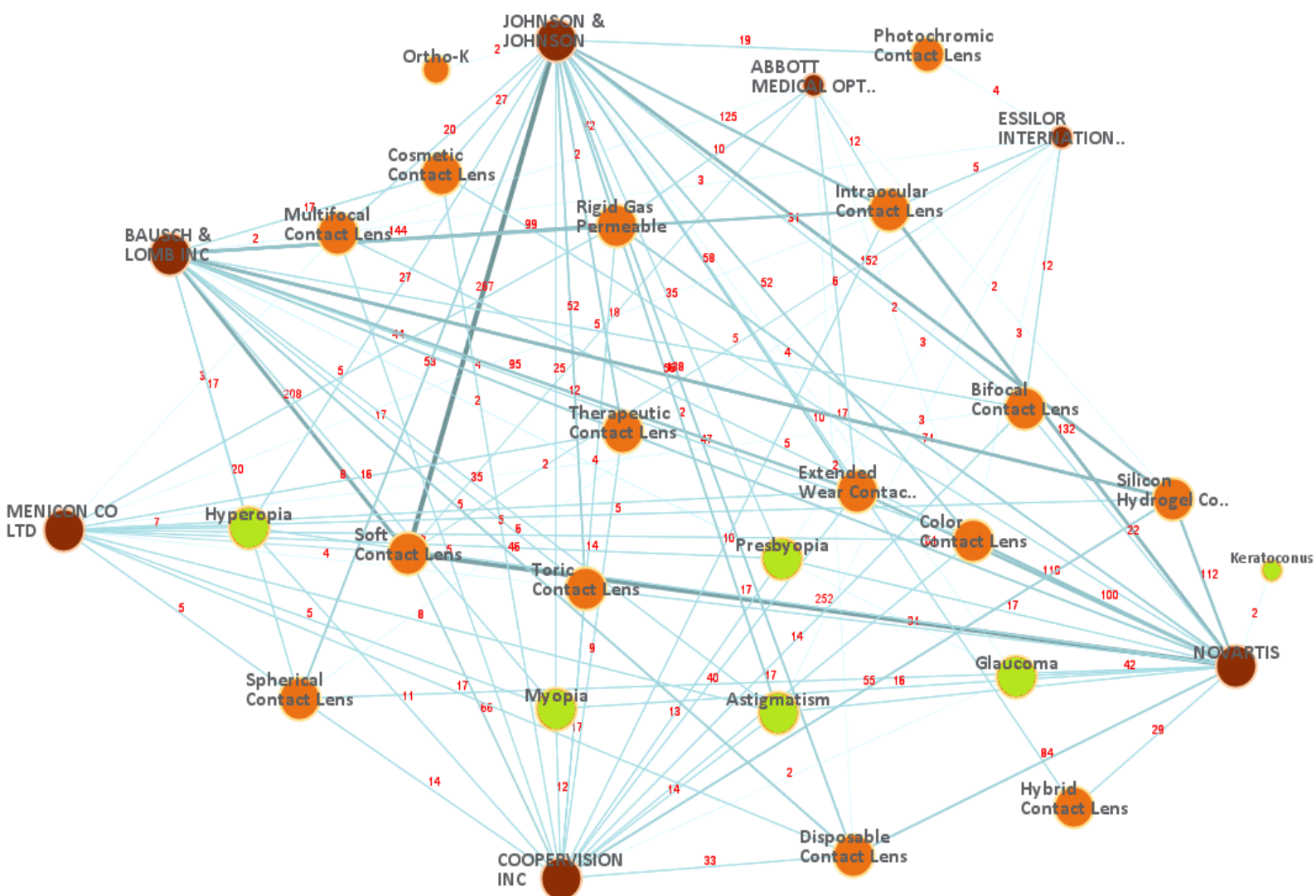


### How we did it?

The VizMAP tool in Patent iNSIGHT Pro was used for this analysis. First the clusters for different use were loaded on the map. They were analyzed on basis of their contextual similarity using title, abstract and claims as Text and technology as UDC from the 'Context mode' option. We removed unrelated patents using the "Hide Unrelated records" option and one patent assignee using the options available in VizMAP.

## Company focus across different types and use of contact lenses

In the map, each company and category is connected through links whose thickness and color intensity is directly proportional to the number of records relating them. The number (in red) next to each line represents the number of records present in the respective category. It can be seen that Johnson and Johnson & Essilor are the only companies focusing on photochromic lens. Johnson and Johnson is the only company focusing on Ortho-K.



### How we did it?

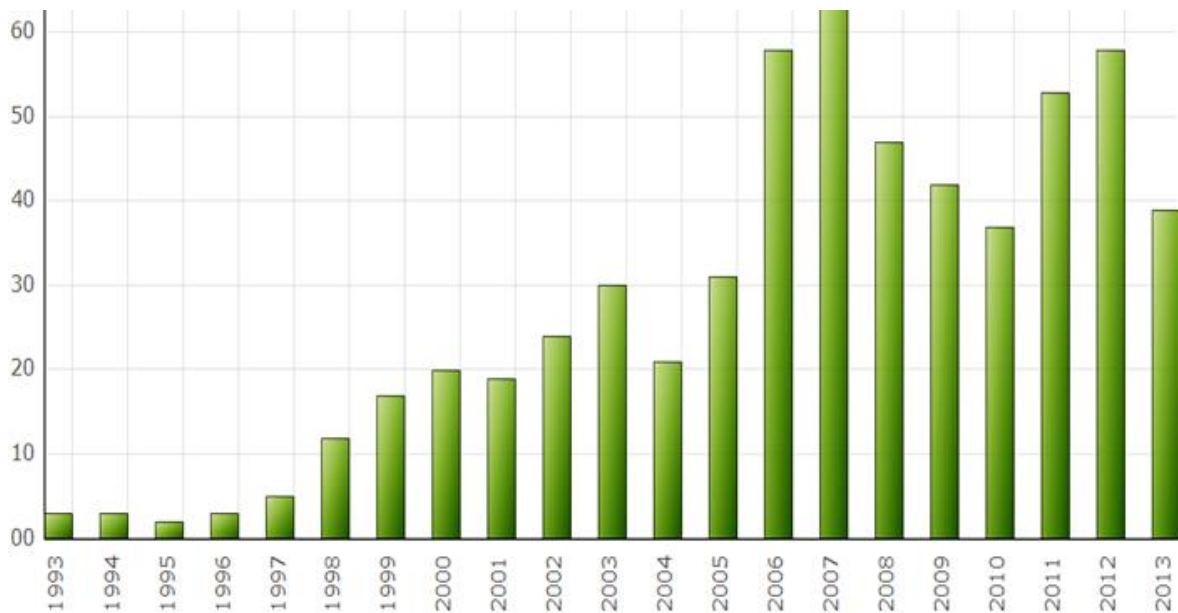
First records for different companies were loaded using the 'Analyze By' option within VizMAP. These were then expanded with respect to different types and use of contact lens. The resulting map was represented as Correlation Map. Also, links between same field types were removed using the option provided.



## Trends for Silicone Hydrogel Contact Lens

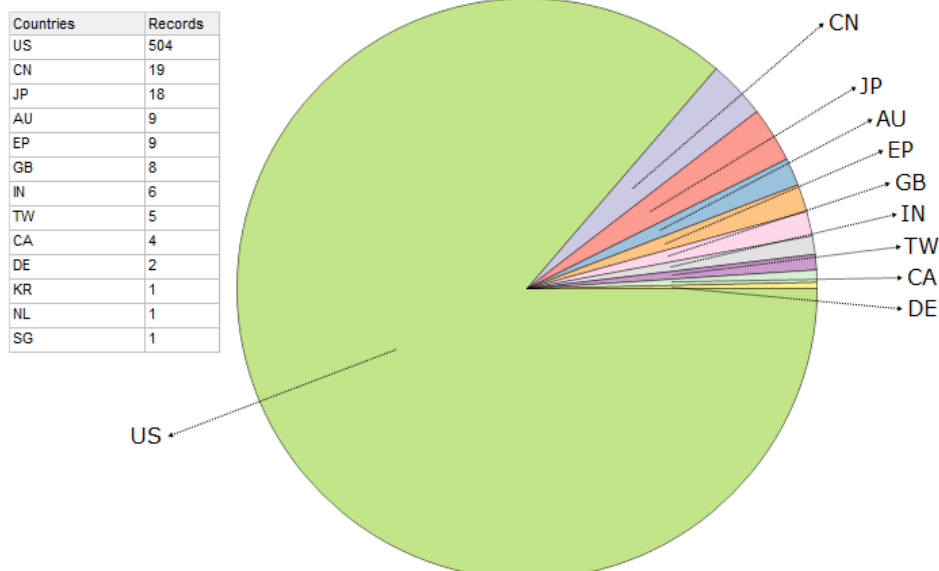
### Silicone Hydrogel: Filing Trend

- Chart shows the filing trend for silicone hydrogel contact lens in the last 20 years
- As can be seen, there is a drastic surge in filings from 2005 onwards



### Priority Country

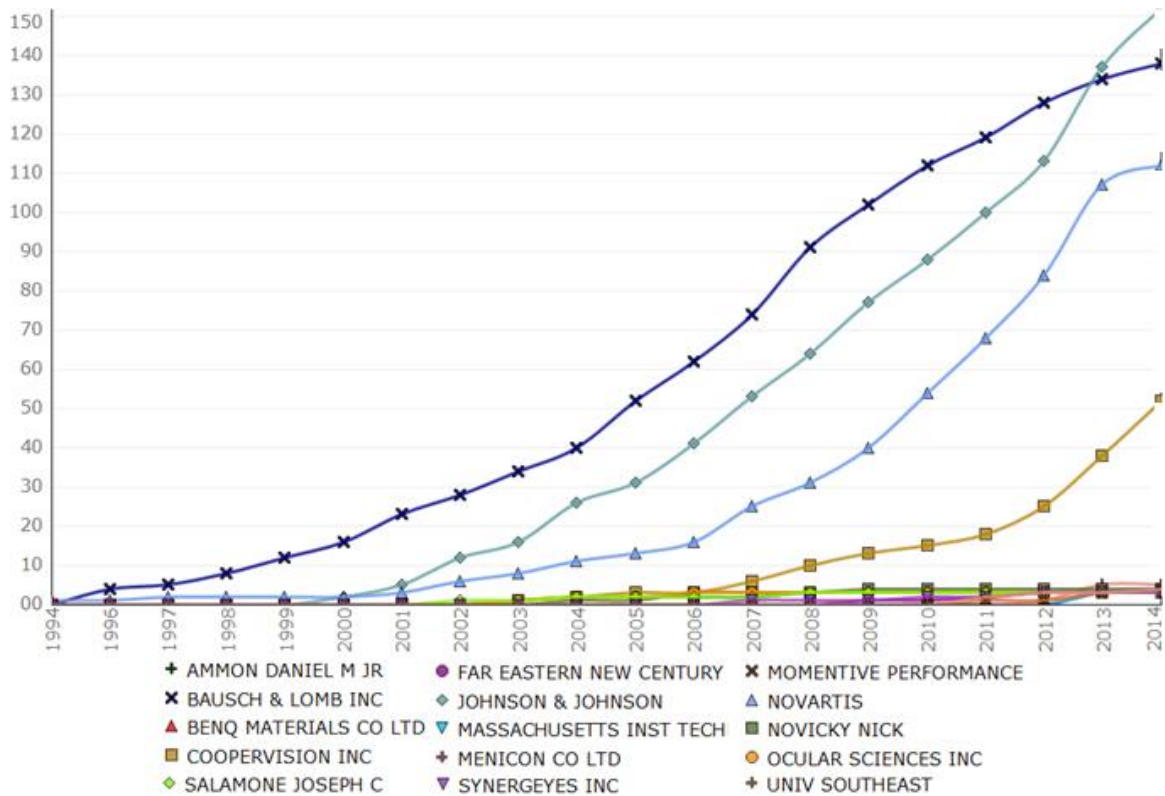
- The pie chart represents the geographical distribution of filings on silicone hydrogel lens



## Trends for Silicone Hydrogel Contact Lens

### Company Trend

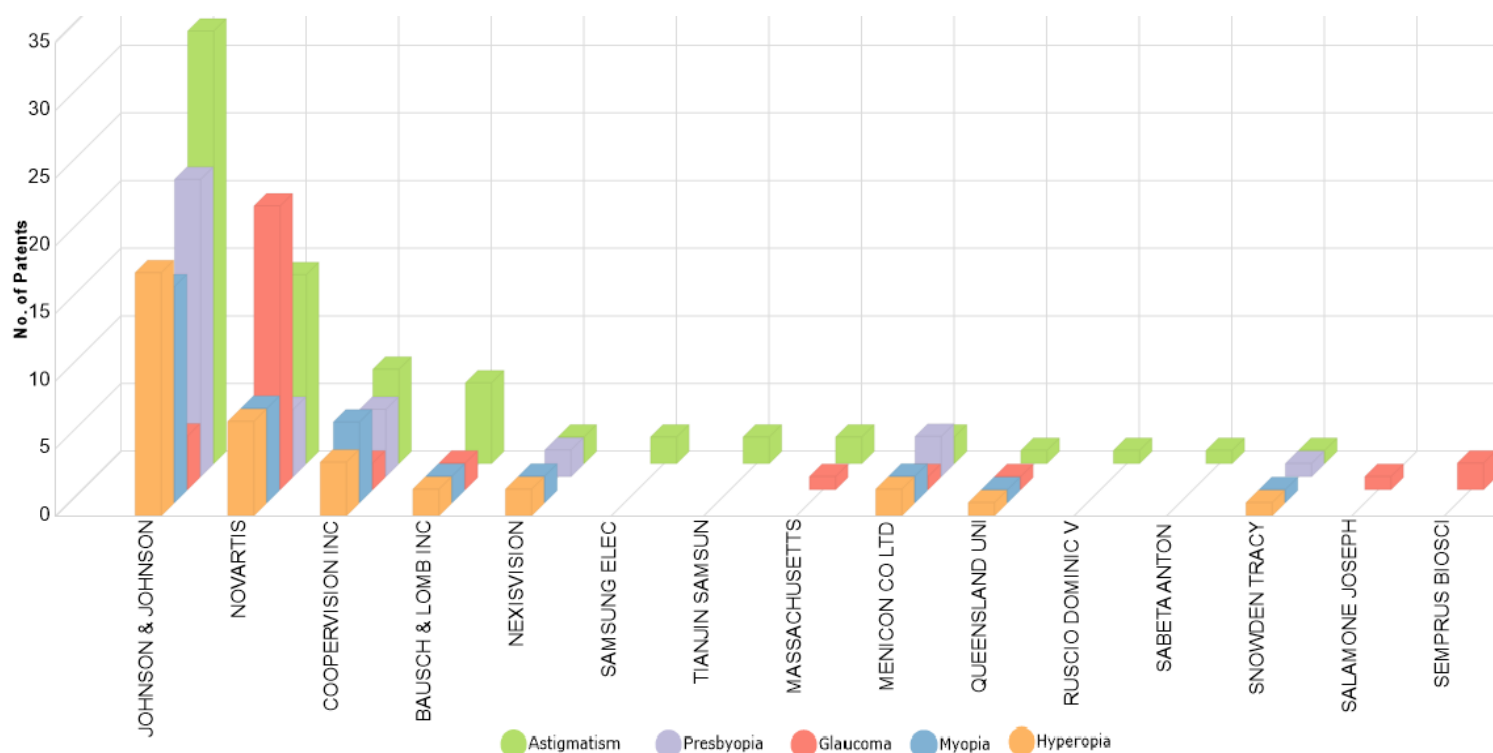
- Chart shows the publication trend for top 15 companies in the last 20 years
- Johnson & Johnson leads in total number of publications, whereas Coopervision has publications 2003 onwards



## Trends for Silicone Hydrogel Contact Lens

### Assignee portfolio spread across different use of silicone hydrogel lens

- The chart below shows how different companies research across use of silicone hydrogel lens
- Bausch & Lomb has no records across Presbyopia



#### How we did it?

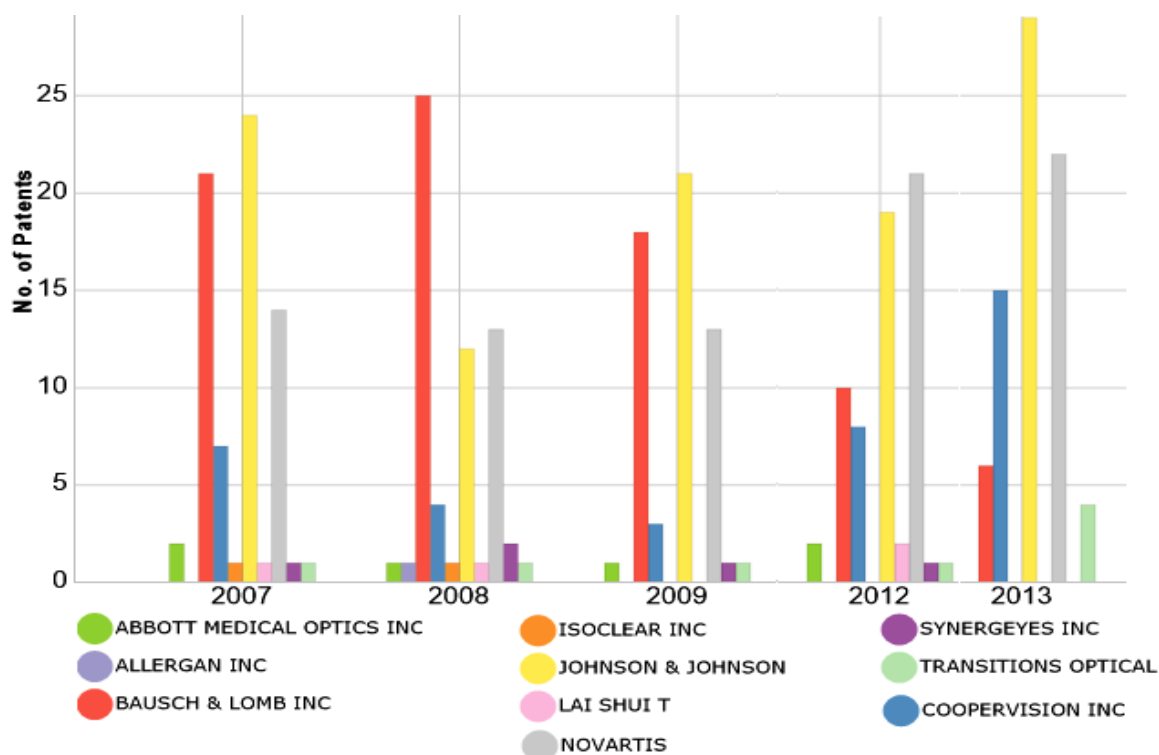
We filtered records for silicone hydrogel contact lens using the filter option in Reports Dashboard. The trend charts were then generated using the options available.

Using co-occurrence analyzer, we used respective category (silicone hydrogel) as data filter to generate a matrix for assignees with respect to different uses. The resulting matrix was filtered for top 15 assignees and was converted into a column chart using the option provided for the same.

## Contact Lens - Country Wise Research Trends

### US: Publication Trend

- The chart below shows publication trend for US firms



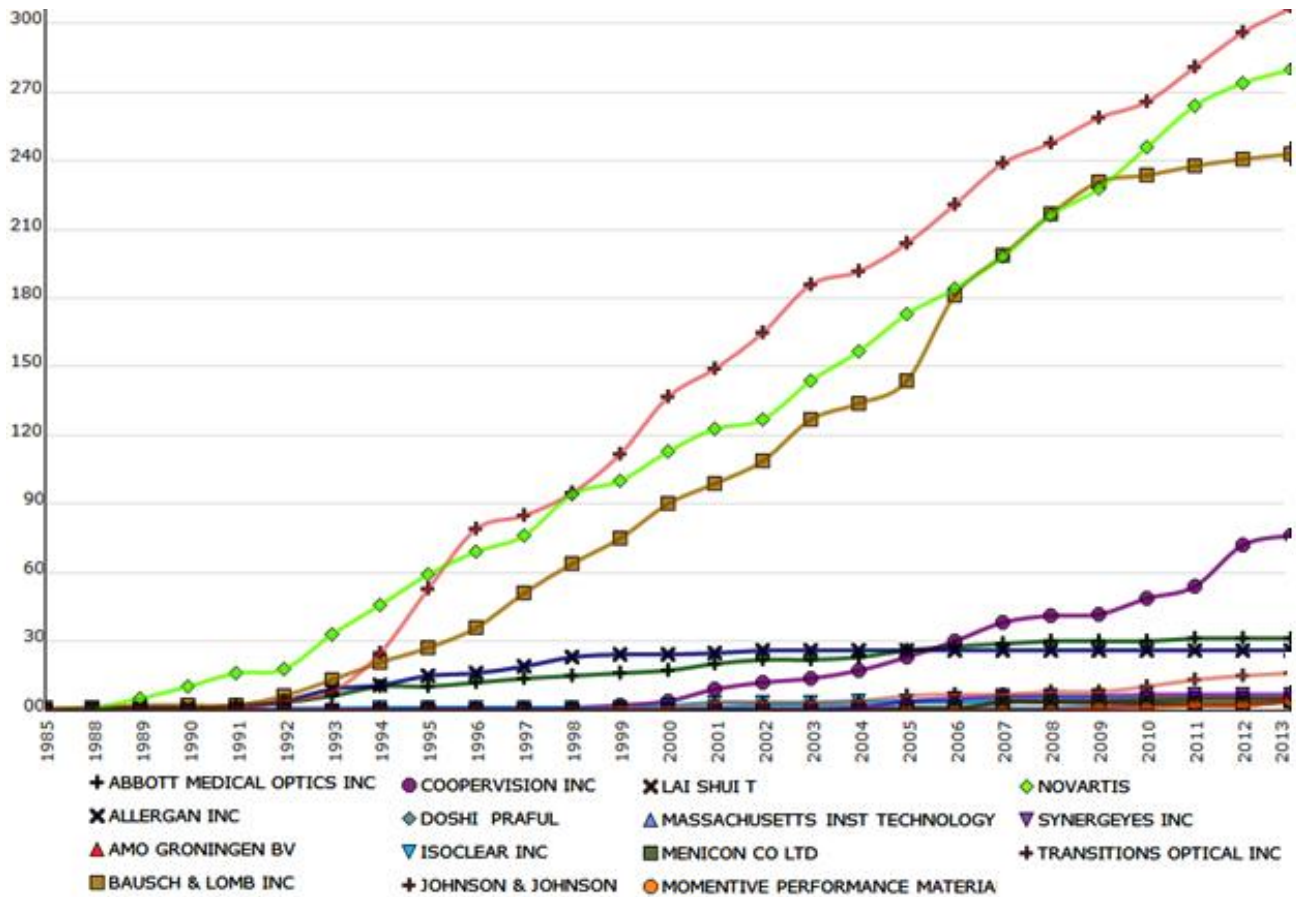
### How we did it?

We selected US as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for companies with respect to time and generated matrix was converted into a clustered column chart.

## Contact Lens - Country Wise Research Trends

### US: Filing Trend

- The chart below shows filing trend for US firms
- Coopervision is actively filing since 2000



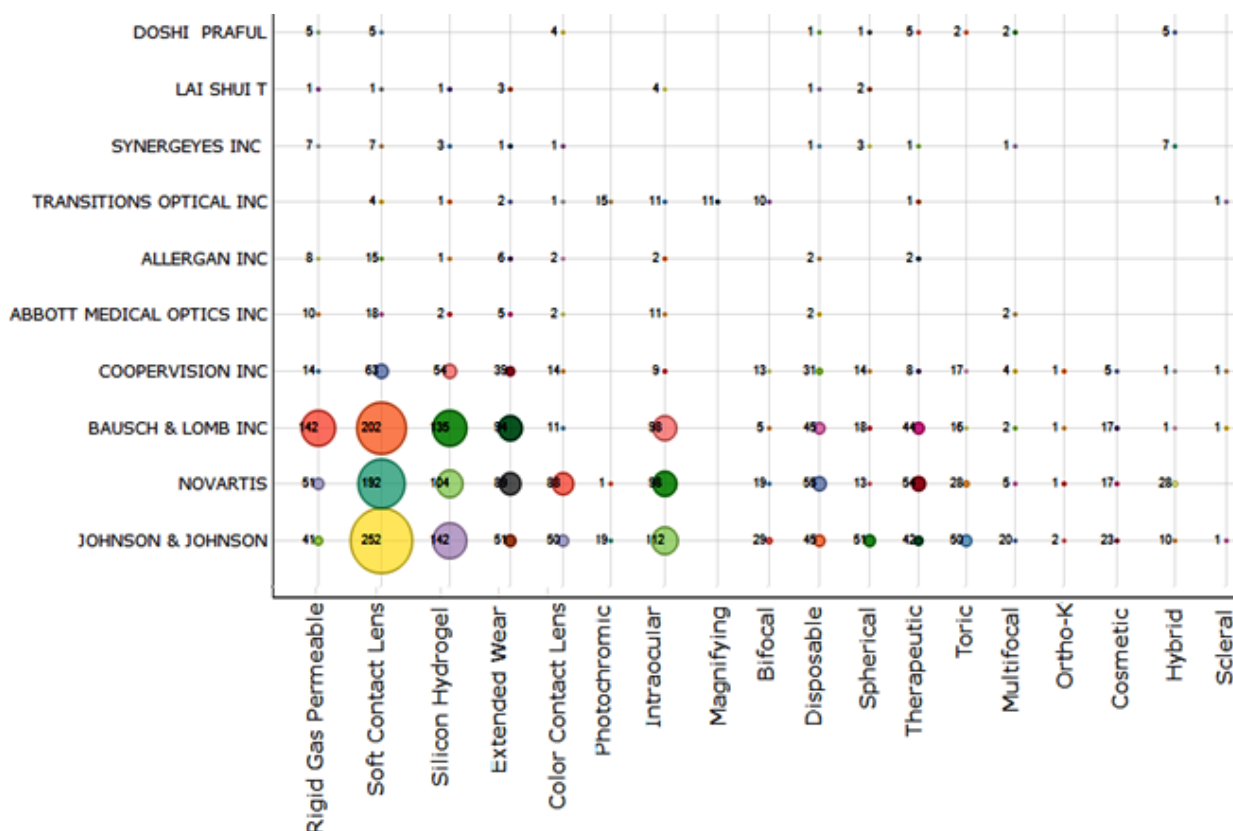
### How we did it?

We selected US as priority country from filter option within Reports Dashboard. The line graph showing the cumulative filings of top 15 assignees with respect to time was created.

## Contact Lens - Country Wise Research Trends

### US: Company across different contact lens

- The chart below shows which companies are conducting research activity across different types of lenses
- Transitions Optical is the only company conducting research in magnifying lenses



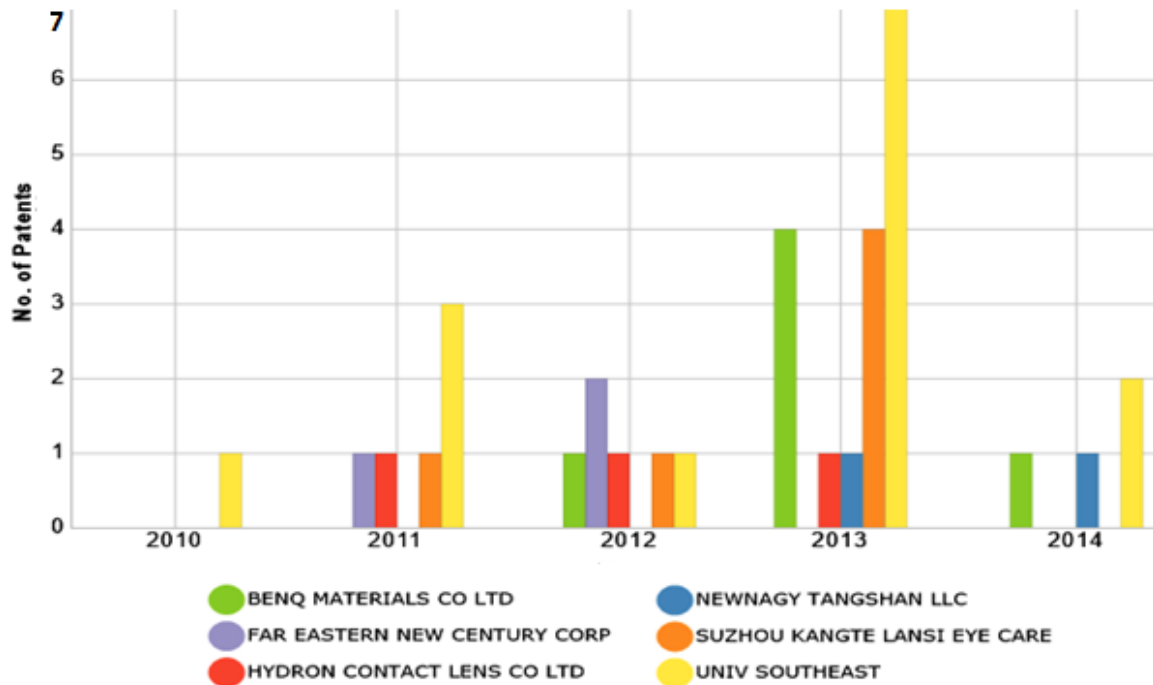
#### How we did it?

We selected US as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for assignees with respect to types and generated matrix was converted into a bubble chart.

## Contact Lens - Country Wise Research Trends

### CN: Publication Trend

- The chart below shows publication trend for Chinese firms



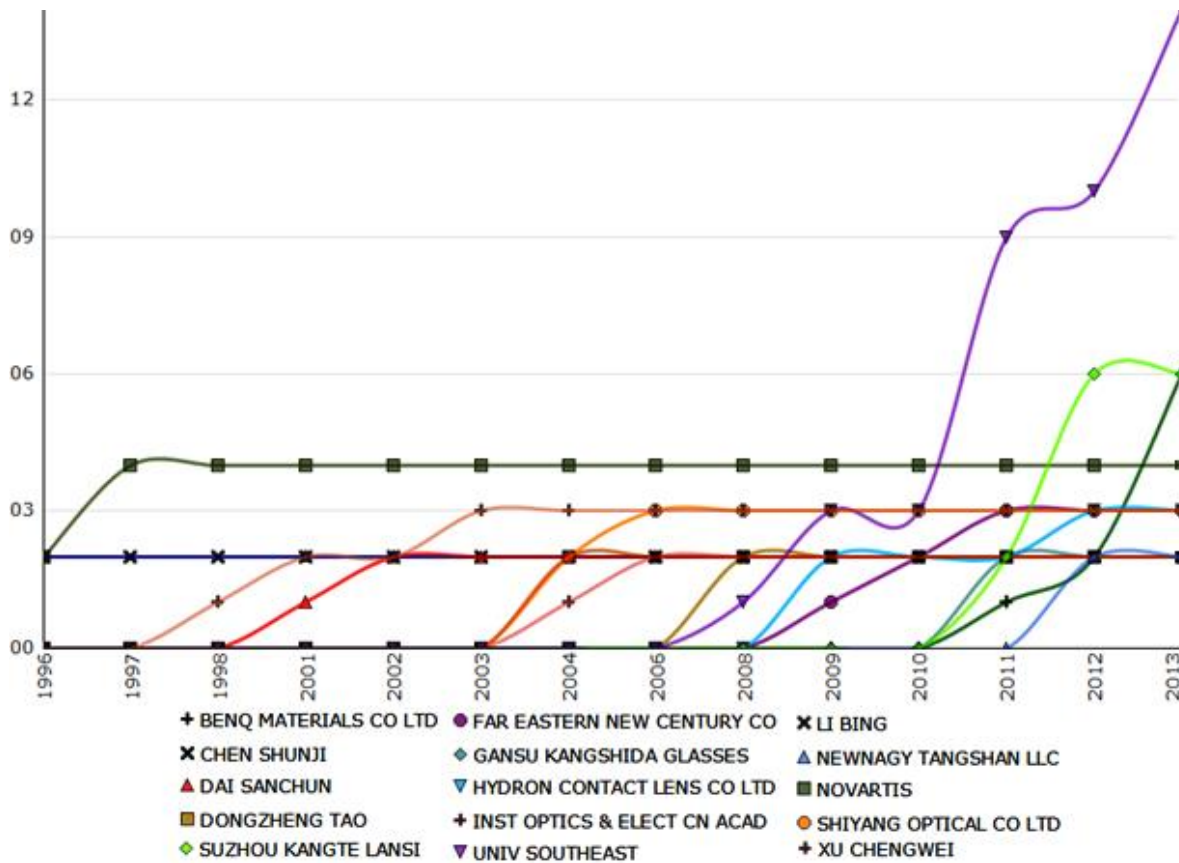
#### How we did it?

We selected CN as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for companies with respect to time and generated matrix was converted into a clustered column chart.

## Contact Lens - Country Wise Research Trends

### CN: Company Trend

- The chart below shows filing trends for Chinese firms



#### How we did it?

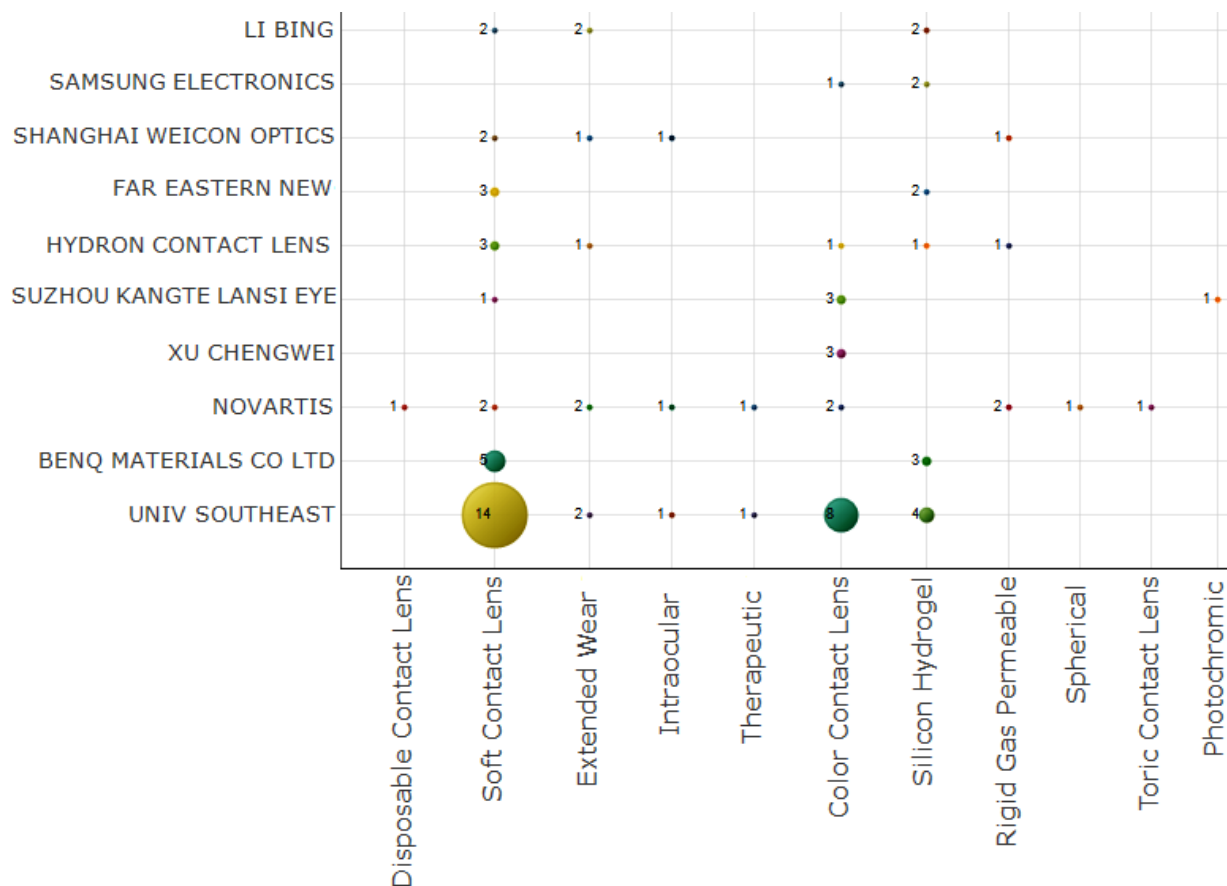
We selected CN as priority country from filter option within Reports Dashboard. The line graph showing the cumulative filings of top 15 assignees with respect to time was created.



## Contact Lens - Country Wise Research Trends

### CN: Company across different contact lens

- The chart below shows which companies are conducting research activity across different types of lenses
- Novartis is active across all types of lenses



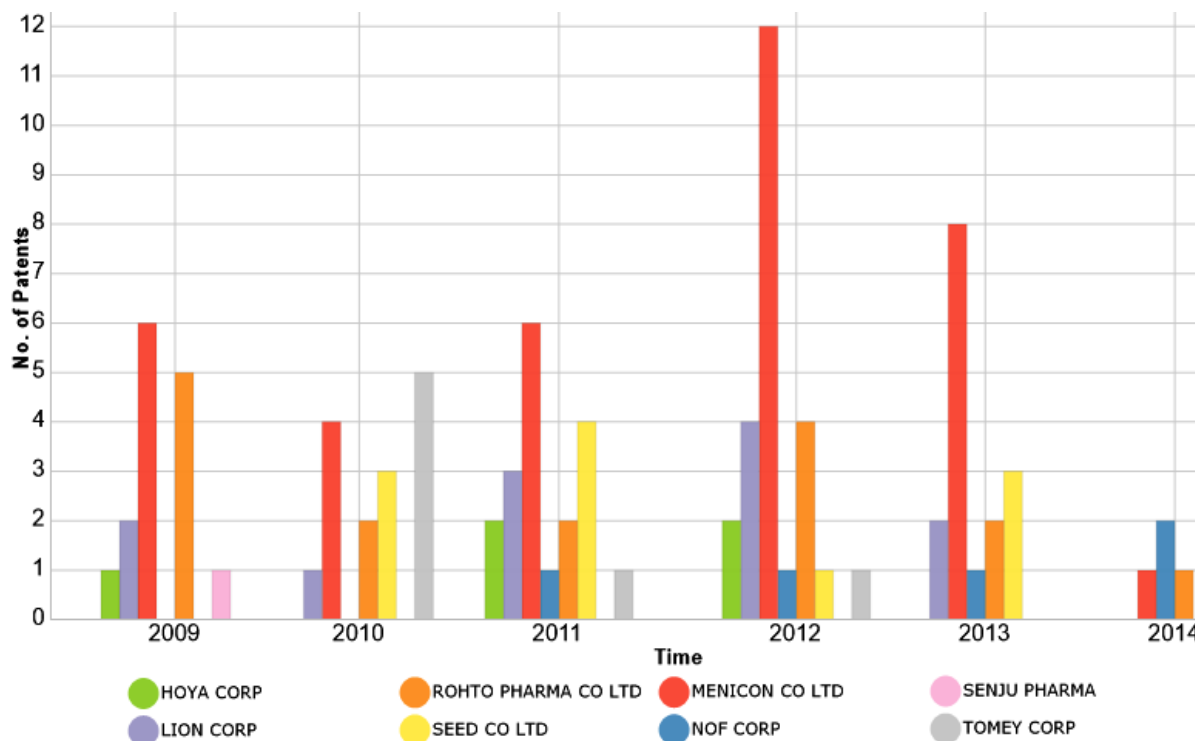
#### How we did it?

We selected CN as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for assignees with respect to types and generated matrix was converted into a bubble chart.

## Contact Lens - Country Wise Research Trends

### JP: Publication Trend

- The chart below shows publication trend for Japanese firms



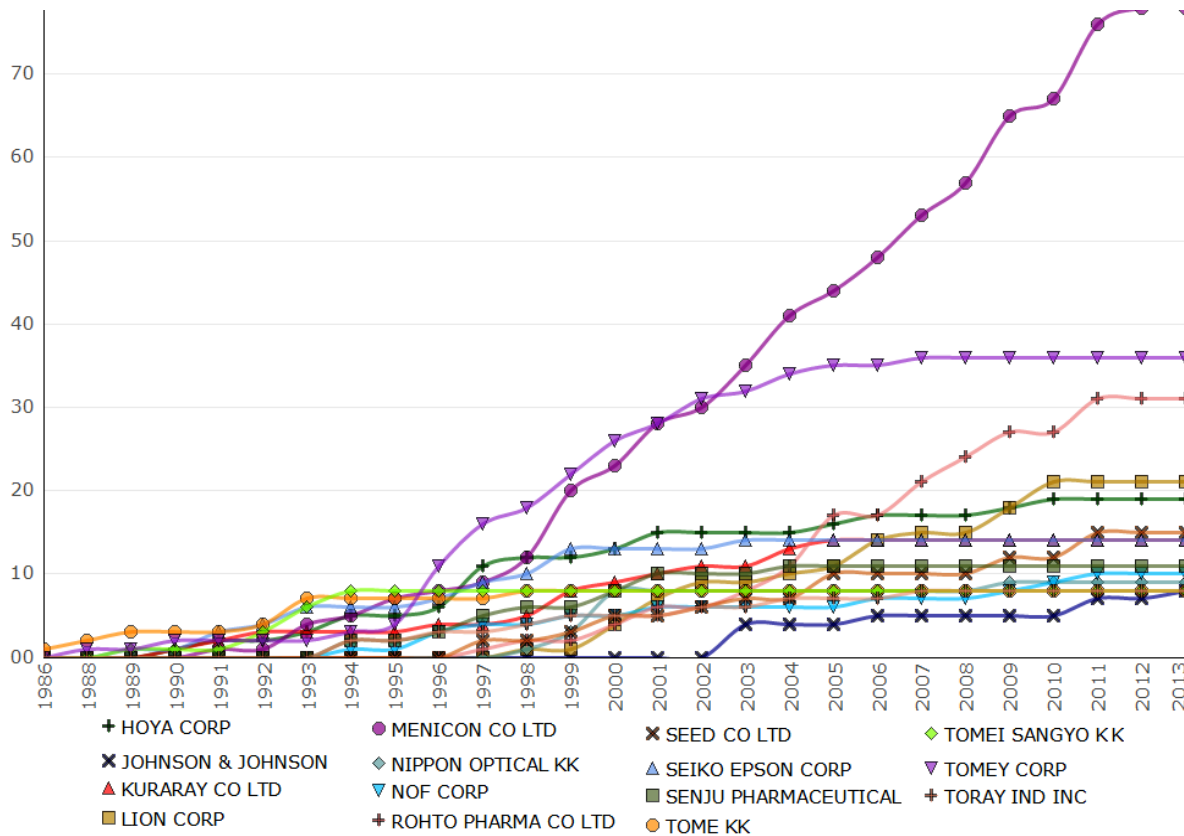
#### How we did it?

We selected JP as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for companies with respect to time and generated matrix was converted into a clustered column chart.

## Contact Lens - Country Wise Research Trends

### JP: Filing Trend

- The chart below shows filing trend for Japanese firms
- Menicon is consistently filing since the last decade



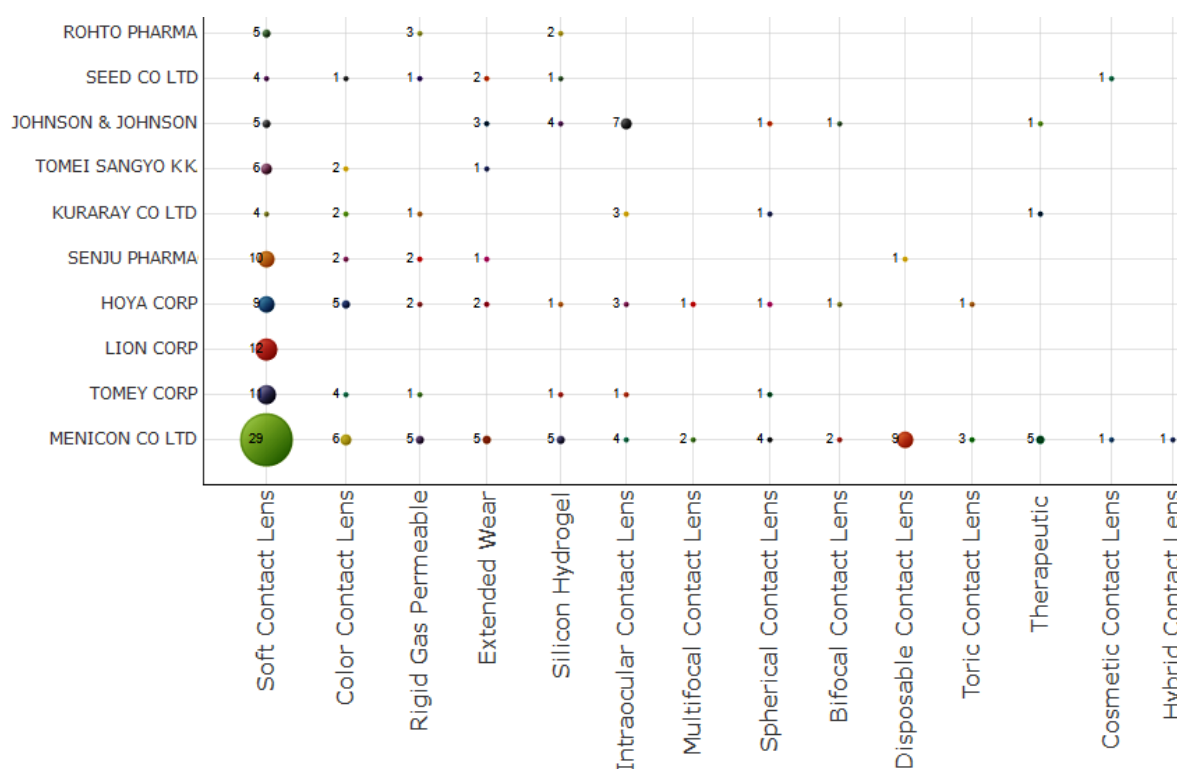
### How we did it?

We selected CN as priority country from filter option within Reports Dashboard. The line graph showing the cumulative filings of top 15 assignees with respect to time was created.

## Contact Lens - Country Wise Research Trends

### JP: Company across different contact lens

- The chart below shows which companies are conducting research activity across different types of lenses
- Menicon has the maximum number of records for soft contact lens
- Johnson & Johnson leads the number of records for intraocular contact lenses



### How we did it?

We selected JP as priority country from data filter option within Co-occurrence analyzer. A matrix was generated for assignees with respect to types and generated matrix was converted into a bubble chart.

## Appendix: Search Strings Used for Categorization



Types	Search Query	Results
Bifocal Contact Lens	(FT) contains (bi-focal* or bifocal* or (bi w/1 focal*)) w/3 (lens* or glass*)	181
Color Contact Lens	(FT) contains (((colour* or color*) w/3 (lens* or glass*)) and not visitint*)	356
Cosmetic Contact Lens	(FT) contains(cosmetic* w/3 lens*)	107
Disposable Contact Lens	(FT) contains(disposable* or daily*) w/3 (lens* or glass*)	368
Extended Wear Contact Lens	(FT) contains (extended* or continuous*) w/5 (duration* or wear* or period* or use*)	489
Hybrid Contact Lens	(FT) contains (piggyback* or "piggy back*" or (hybrid* w/3 (lens* or glass*)))	74
Intraocular Contact Lens	((intra-ocular* or intraocular* or "intra ocular") w/3 (lens* or glass* or implant*) or IOL)	573
Magnifying Contact Lens	(FT) contains (magnify* or telescop*) w/3 (lens* or glass*)	18
Multifocal Contact Lens	(FT) contains (((multi-focal* or multifocal* or (multi w/1 focal*) or varifocal* or progressive* or graduated*) w/3 (lens* or glass*) OR PAL) and not ((bi w/1 focal*) or bifocal* or bi-focal*))	83
Ortho-K	(FT) contains (ortho-k or orthokeratolog* or "Overnight Vision Correct*" or "Corneal Refractive Therapy" or CRT or (corneal* w/3 (reshap* or sculpt*)))	43
Photochromic Contact Lens	(FT) contains (photochrom* and ((ultraviolet* or ultra-violet* or "ultra violet*" or UV) w/1 (radiat* or light* or ray*)))	57
Rigid Gas Permeable	(FT) contains ((rigid* w/3 (lens* or glass*)) or RGP)	487
Scleral Contact Lens	(FT) contains (scleral* w/3 (lens* or glass*))	30
Silicone Hydrogel Contact Lens	(FT) contains (((silicone* or silicon*) w/3 hydrogel*) or SiHy*)	587
Soft Contact Lens	(FT) contains (soft* or hydrophilic* or hydrogel*) w/3 (lens* or glass*)	1383
Spherical Contact Lens	(FT) contains (spherical* or sphere*) w/3 (lens* or glass*)	181
Therapeutic Contact Lens	(FT) contains (((therapeutic* or drug* or medic* or deliver* or infuse* or diffuse* or perfuse*) w/3 lens*) and not medicine*)	262
Toric Contact Lens	(FT) contains (toric* w/3 (lens* or glass*))	166



Materials	Search Query	Results
Balafilcon	(FT) contains balafilcon*	146
Cellulose Acetate Butyrate	(FT) contains((cellulose* w/3 butyrate*) or CAB	50
Etafilcon	(FT) contains etafilcon*	179
Fluorine	(FT) contains (fluorine* or FL)	285
Fluoroacrylate Polymer	(FT) contains fluoroacrylate*	38
Fluorocarbon	(fluorocarbon or fluorocarbons or "Fluoro* carbon" or Perfluorocarbons or PFCs)	51
Fluoroether	(FT) contains fluoroether*	55
Fluorosilicone Acrylate	(FT) contains ((fluorosilicone* or "fluoro* silicon*") w/3 acrylate*)	44
Galyfilcon	(FT) contains galyfilcon*	69
Hydroxyethylmethacrylate	(FT) contains ("Hydroxyethyl-methacrylate" or HEMA or "hydroxyethyl methacrylate" or "Hydroxy Ethyl MethAcrylate" or Hydroxyethylmethacrylate* or (Glycol w/1 (methacrylate or monomethacrylate)) or "Hydroxyethyl methacrylate Ethylene" or "glycol methacrylate" or "2-(Methacryloyloxy)ethanol")	715
Lotrafilcon A	(FT) contains "Lotrafilcon A"	133
LotrafilconB	(FT) contains "LotrafilconB"	53
Methyl Methacrylate	(FT) contains (Methylmethacrylate* or MMA or "methyl methacrylate")	465
N Vinyl Pyrrolidone	(FT) contains ("n vinyl pyrrolidone" or NVP or "N-vinyl pyrrolidone" or "N-vinylpyrrolidone" or "N-ethenyl-2-pyrrolidone" or "N-vinyl-2-pyrrolidone" or "1-vinyl-2-pyrrolidone" or "N-vinylbutyrolactam")	446
Narafilcon	(FT) contains narafilcon*	21
Phosphorylcholine	(FT) contains (Phosphorylcholine* or phosphocholine* or "choline* phosphate*" or "O-Phosphocholine*" or "phosphoryl-choline" or CHOP or "N-Trimethyl-2-aminoethylphosphonate*" or "phosphoryl choline")	50

Plastic	(FT) contains plastic*	728
Poly(methyl)methacrylate	(FT) contains (polymethylmethacrylate* or PMMA or "polymethyl methacrylate" or poly(methyl methacrylate) or "poly(methyl)methacrylate" or "methyl methacrylate")	577
Polyacetylene	(FT) contains (polyacetylene* or polyethyne* or PAC)	16
Polyamide	(FT) contains polyamide*	5
Polycarbonate	(FT) contains (polycarbonate* or "poly(carbonate)" or PC)	150
Polystyrene	(FT) contains (polystyrene* or thermoplastic* or "Poly(1-phenylethylene)" or thermo-plastic* or "thermo plastic*")	434
Senofilcon A	(FT) contains "senofilcon A"	62
Silicone	(FT) contains (silicon*) and not (silicon* w/3 (hydrogel* or acrylate*))	376
Silicone Acrylate	(FT) contains (silicon* w/3 acrylate*)	122



Use	Search Query	Results
Astigmatism	(FT) contains (astigmatism* or astigma* or ((distort* or blurr*) w/2 vision*) or "toric curvature" or (asymmetric* w/5 cornea*) or asymptomatic* or squint* or asthenopia* or fatigue* or headache*)	363
Glaucoma	(FT) contains glaucoma*	
Hyperopia	(FT) contains (hyperopia* or aphakia* or farsight* or longsight* or hypermetropia* or "hyper metropia*" or far-sight* or anisometropia* or "far sight*" or hyperopic* or long-sight* or "long sight*" or asthenopia or ((accommodat* or binocular*) w/3 dysfunct*) or amblyopia or "lazy eye*" or strabismus* or "cross* eye*" or strabismus* or "cross* eye*" or esotropia* or heterotropia* or exotropia* or hypertropia* or hypotropia*)	216
Keratoconus	(FT) contains (keratoconus* or ((corneal* or cornea*) w/3 (transplant* or graft*)) or keratoglobus*)	20
Myopia	(FT) contains (myopia* or nearsight* or "near sight*" or near-sight* or shortsight* or "short sight*" or pseudomyopia* or NITM or "pseudo myopia*" or "near-sight*")	242
Presbyopia	(FT) contains (presbyopia* or presbyopes)	167

## Summary

This report categorizes and graphically analyzes research trends around contact lens and the processes involved and its applications from various perspectives and highlights the key companies involved.

Contact Lenses can be colored, cosmetic, corrective or therapeutic shaped pieces of transparent material. Corrective contact lenses are designed to improve vision, most commonly by correcting refractive error. This is done by directly focusing the light so that it enters the eye with the proper power for clear vision. Recently, there has been renewed interest in orthokeratology, the correction of myopia by deliberate overnight flattening of the corneal epithelium, leaving the eye without a refractive error during the day.

A spherical contact lens bends light evenly in every direction. They are typically used to correct myopia and hyperopia. A toric contact lens has a different focusing power horizontally than it does vertically and as a result can correct for astigmatism. Some spherical rigid lenses can also correct for astigmatism. Because a toric lens must have the proper orientation to correct for a person's astigmatism, a toric contact lens must have additional design characteristics to prevent the lens from rotating away from the ideal alignment. This can be done by weighting the bottom of the lens or by using other physical characteristics to rotate the lens back into position. Some toric contact lenses have marks or etchings that can assist the eye doctor in fitting the lens. The first disposable toric lenses were introduced in 2000 by Vistakon.

A cosmetic contact lens is designed to change the appearance of the eye. These lenses may also correct refractive error. Although many brands of contact lenses are lightly tinted to make them easier to handle, cosmetic lenses worn to change the color of the eye are far less common, accounting for only 3% of contact lens fits in 2004.

Disposable soft lenses in some form are now the first choice for nearly all new contact lens wearers. Soft lenses have evolved from small home style innovation to a multi-million pound industry; from specialist medical application to commodity; from thick low Dk HEMA to high Dk silicone hydrogel; and from heat disinfection to multipurpose solutions.

Global Industry Analysts now estimate the global soft contact lens and solutions market will exceed \$11.7bn (£7.5bn) by 2015.



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