



# **Innovation Momentum 2023: The Global Top 100**

**Intellectual Property Report**

## Foreword

The world will always need innovators. To understand why, you need look no further than today's shifts in global health, economics, and geopolitics. Digitalization is accelerating, the global population is aging rapidly, and the legislative landscape continues to evolve. With disruption everywhere, the spirit of innovation is critical if we are to turn lemons into lemonade.

*Innovation Momentum 2023: The Global Top 100* reflects this spirit. Using a methodology based on the Patent Asset Index—an objective measure of global technological strength—the Top 100 presents the companies, industries, and regions leading the charge. With five industries dominating the list—Pharmaceuticals, Information Technologies, Chemicals and Materials, Electronics, and Semiconductors—it becomes clear that global challenges prompt innovation.



Take Semiconductors. Producing components needed for everything from smartphones to cars, semiconductor companies have to adapt swiftly to meet supply chain bottlenecks and U.S. and EU policy. These shifts affect the Information Technologies industry, which is also innovating rapidly as remote working has driven up demand for platforms that connect people and as technology permeates every aspect of daily life.

As the global population ages and evolving coronaviruses continue to evade immunization, the R&D investments of the Pharmaceuticals industry are becoming even more critical. Meanwhile, Chemicals and Materials companies are driving the innovation that enables other industries to make things we use every day, whether it is the energy powering our homes or the batteries underpinning the mobility revolution.

Of course, few businesses would say they welcome disruption. But when faced with unavoidable change, innovation is what enables them to turn adversity into opportunity. We see this most clearly in the cigarette industry, which has responded to global shifts in health policy to create new devices, like e-cigarettes, thereby taking companies in a new direction that will bolster their long-term success.

With change constantly around the corner, it is hard to predict where we will see creative ingenuity appear next. But using the power of patent analytics, we can track Innovation Momentum with objectivity and accuracy. And as this report demonstrates, one thing is certain: In addressing adversity, turning disruption into opportunity, and creating the building blocks for better lives, there is no shortage of innovators who are ready to generate value both for their businesses and for the wider world.

**“With disruption everywhere, the spirit of innovation is critical if we are to turn lemons into lemonade.”**

**Marco Richter**

Global Head of Customer Success  
LexisNexis® Intellectual Property Solutions



## Executive Summary

The innovation landscape is constantly evolving—something that is evident in *Innovation Momentum 2023: The Global Top 100*. For example, this year's Top 100 list includes 27 new companies. The basis for the list also highlights the vast number of inventions being developed today: About 11 million active patent families were taken into account to determine the Top 100 companies. To qualify for consideration, each of these had to have a portfolio of at least 10 active patent families.

Now in its second edition, the 2023 report represents the world's leading patent owners with the highest innovation momentum, based on the Patent Asset Index—the scientifically developed objective measure to evaluate innovative strength. The report explores the most forward-looking technological and scientific developments and innovative industries, the regions in which innovators are concentrated, and the companies and academic institutes that meet the criteria of outstanding Innovation Momentum.

The report's unique methodology captures two years of dynamic innovation. It recognizes owners that are outperforming their peers in the Technology Relevance, the potential to lead to further inventions, and the Market Coverage, the size of the global market a patent family protects, and combines these two to arrive at the Competitive Impact, or the average quality of an entire patent portfolio.

The report takes a closer look into three industries: Chemicals and Materials, Consumer Goods, and Medical Technologies. It explores how these innovators are responding to pressing global challenges, changes in consumer behavior, and shifts in the legislative landscape.

**“Innovation leadership also means covering ground-breaking innovations early on and being agile with regard to the ideal timing and geographies of our patents. Both can be captured by the PatentSight indices.”**

**Peter Berg**  
VP Intellectual Property  
Infineon Technologies



## Key Findings



The Innovation Momentum methodology is unique in that it recognizes patent owners with small but high-quality portfolios, as well as those with well-maintained portfolios. [>Page 6](#)



Five industries—Pharmaceuticals, Information Technologies, Chemicals and Materials, Electronics, and Semiconductors—dominate the Top 100. [>Page 12](#)



An aging global population and the long tail of the COVID-19 pandemic are creating demand for new pharmaceutical therapies and products. [>Page 13](#)



Most patent owners in the Top 100 are headquartered in the U.S., which is also home to almost half of the owners in the Information Technologies industry. [>Page 14](#)



In Asia, China, Japan, and Korea continue to demonstrate their traditional strength in Electronics, as well as in the Chemicals and Materials industry. [>Page 14](#)



As more consumers give up smoking and governments work toward limiting tobacco use, cigarette companies know they must innovate to survive. [>Page 18](#)



As people live longer, medical technology companies such as Medtronic, Masimo Corporation, and ResMed are innovating to ensure people's lives remain comfortable and healthy. [>Page 20](#)



Academia remains a rich source of innovation, with leading universities and institutions found in countries across the globe, from the U.S. to China, France, Germany, and Korea. [>Page 22](#)



# Contents

<b>Foreword</b>	2
<b>Executive Summary</b>	3
<b>Key Findings</b>	4
<b>How to Measure Innovation Momentum</b>	6
<b>The 2023 Global Top 100</b>	7
<b>The 2023 Industry Distribution of the Top 100 Companies</b>	12
Innovation in the World's Regions	14
<b>Q&amp;A with Liren Chen Part 1</b>	15
President and Chief Executive Officer of InterDigital	
<b>Focus Technologies 2023</b>	16
Chemicals and Materials	16
Consumer Goods	18
Medical Technologies	20
<b>Academics and Public Research</b>	22
<b>Q&amp;A with Liren Chen Part 2</b>	23
President and Chief Executive Officer of InterDigital	
<b>Closing Summary</b>	24
About the Patent Asset Index	25
About the Authors	26
About LexisNexis® Intellectual Property Solutions	28
About LexisNexis® PatentSight®	28

## How to Measure Innovation Momentum

As its name suggests, the Innovation Momentum report sheds light on the dynamics of today's technology development. The methodology is unique in that it recognizes patent owners with relatively small, high-quality portfolios as well as patent owners with well-maintained large portfolios, takes into account the differences between developments in all technology fields, and considers the innovators' target markets.

The methodology builds on the Patent Asset Index—an industry-trusted indicator based on a scientifically rigorous method of assessing patent strength—and provides an unbiased way of identifying innovators that have outperformed their peers in the previous two years.

This means demonstrating that a patent portfolio's average Technology Relevance—its potential to lead to further inventions—has significantly increased in the case of small portfolios or has been maintained or even increased in the case of large portfolios. The methodology also takes into consideration the average Market Coverage—the size of the global market a patent family protects—of the patent portfolios. Combining these two indicators results in the average Competitive Impact—or average quality—of an entire patent portfolio.

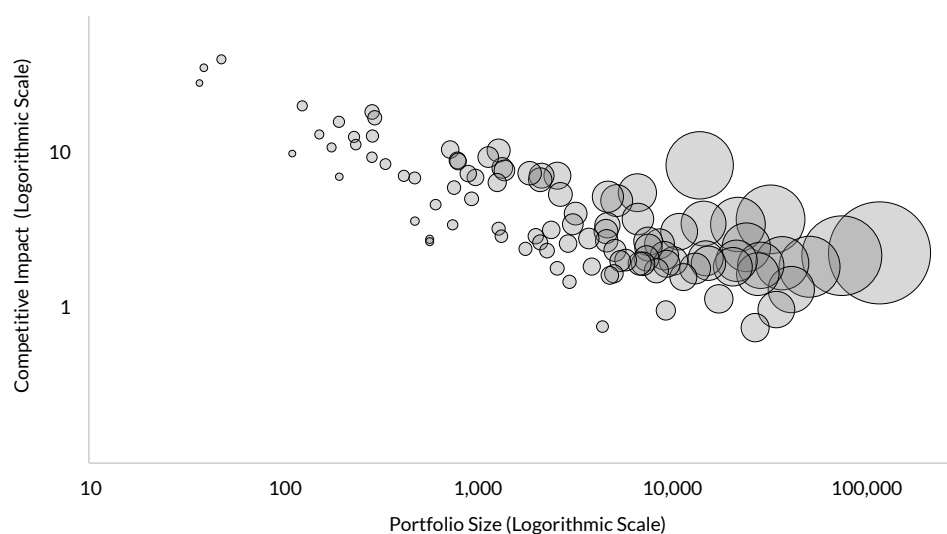
To be included in the Top 100, an owner's patent portfolio must have been well-maintained or must have increased their Technology Relevance over a two-year period. This is easier to achieve

for companies with small portfolios. Therefore, for owners of small portfolios, the increase must be significantly higher than that for holders of large portfolios. Owners of large portfolios must either increase their portfolio in size and maintain or increase their average patent quality, or they must increase their average patent quality while reducing their portfolio size.

Changes in Innovation Momentum can mean that companies are filing more patents but could equally reflect the fact that older inventions are becoming more applicable to today's challenges or that a company has streamlined its portfolio, divesting from less-relevant patents to focus on a core technology field.

The quality and quantity of patent portfolios is best visualized in a bubble chart. The bubble chart plots the average patent quality (average Competitive Impact) on the y-axis and the portfolio size on the x-axis. Each bubble represents one of the Top 100 patent owners, with the bubble size indicating the strength of the portfolio, as measured by the Patent Asset Index. The owners of the strongest small portfolios are located in the upper-left corner; the owners of the strongest larger portfolios accumulate in the upper-right corner.

The chart shows that the average patent quality tends to decline as the portfolio size increases. However, to appear in the Top 100, an owner's portfolios must have deviated from this general rule over the past two years.



**Figure 1:** Average patent quality (Competitive Impact) versus portfolio size of patent owners in the Top 100. The bubble size of the patent owners represents the portfolio strength (Patent Asset Index).

## The 2023 Global Top 100

The Top 100 in alphabetical order, the headquarter location, and its industry sector.

Patent Owner	HQ	Industry
10x Genomics	US	Biotechnologies
AAC Technologies	CN	Electronics
AGC	JP	Chemicals and Materials
Align Technology	US	Medical Technologies
Alnylam Pharmaceuticals	US	Pharmaceuticals
Alphabet	US	Information Technologies
Amazon	US	Information Technologies
Amgen	US	Pharmaceuticals
Ant Group	CN	Information Technologies
Apple	US	Electronics
Applied Materials	US	Semiconductors
ARAMCO	SA	Chemicals and Materials
Araxes Pharma	US	Pharmaceuticals
Arvinas	US	Pharmaceuticals
ASM International	NL	Semiconductors
ASML	NL	Semiconductors
AU Optronics	TW	Electronics
Aurora Innovation	US	Automotive
AutoStore	NO	Information Technologies
BASF	DE	Chemicals and Materials

US: United States, CN: China, JP: Japan, SA: Saudi Arabia, NL: Netherlands, TW: Taiwan, NO: Norway

## New entrants to the 2023 Top 100 list

### AGC

A Japanese global glass manufacturing company, originally known as Asahi Glass Co., which is one of the core Mitsubishi companies and one of the world's largest glass makers.

### Alnylam Pharmaceuticals

A U.S. company focused on the discovery, development and commercialization of RNA interference therapeutics for genetically defined diseases.

### Applied Materials

A U.S. company that supplies equipment, services and software for the manufacture of semiconductor chips for electronics, flat panel displays for computers, smartphones, televisions and solar products.

### Aurora Innovation

A U.S.-based self-driving vehicle technology company focused on creating the future of autonomous transportation. Its product, the Aurora Driver, is a transferable software and hardware kit designed to adapt to a broad set of vehicle types.

### AutoStore

A global warehouse robot technology company based in Norway. It invented and continues to pioneer cube storage automation. Its focus is to marry software and hardware with human abilities to create the future of warehousing.

### BASF

A multinational chemicals company headquartered in Germany that provides products ranging from plastics, coatings and crop technology, to products for the pharmaceuticals, construction, and oil and gas industries.

## The 2023 Global Top 100

The Top 100 in alphabetical order, the headquarter location, and its industry sector.

Patent Owner	HQ	Industry
Becton, Dickinson	US	Medical Technologies
BOE	CN	Electronics
Boeing	US	Engineering
Bristol-Myers Squibb	US	Pharmaceuticals
British American Tobacco	GB	Consumer Goods
CATL	CN	Chemicals and Materials
CJ Corporation	KR	Consumer Goods
Comcast	US	Information Technologies
CureVac	DE	Pharmaceuticals
Datang Telecom	CN	Information Technologies
Deere & Co	US	Engineering
DJI Innovations	CN	Electronics
Edwards Lifesciences	US	Medical Technologies
Eli Lilly	US	Pharmaceuticals
Ericsson	SE	Information Technologies
Firmenich	CH	Chemicals and Materials
Gilead Sciences	US	Pharmaceuticals
Huawei	CN	Information Technologies
Hyundai Motor	KR	Automotive
Illumina	US	Biotechnologies

DE: Germany, US: United States, CN: China, GB: Great Britain, KR: South Korea, SE: Sweden

## New entrants to the 2023 Top 100 list

### Becton, Dickinson

A U.S. multinational, also known as Becton, Dickinson & Company, which is one of the world's largest global medical technology companies. Its innovations are focused around medical discovery, diagnostics and health care delivery.

### Datang Telecom

A Chinese state-owned telecoms equipment group known for its telecoms networking systems, terminals, computer software, hardware, and microelectronic products. It also provides system integration and network engineering services.

### Eli Lilly

A U.S. drugmaker whose medicines alleviate pain and treat conditions such as Alzheimer's, cancer, diabetes, immunological disorders, and obesity. It has also developed novel antibodies to reduce hospitalization and death from COVID-19.

### Ericsson

A Swedish multinational networking and telecommunications company focusing on infrastructure, software, and services in information and communications technology for telecommunications service providers and enterprises.



## The 2023 Global Top 100

The Top 100 in alphabetical order, the headquarter location, and its industry sector.

Patent Owner	HQ	Industry
Incyte	US	Pharmaceuticals
Infineon Technologies	DE	Semiconductors
Intel	US	Semiconductors
InterDigital	US	Technology R&D
Intuitive Surgical	US	Medical Technologies
Japan Tobacco	JP	Consumer Goods
Jazz Pharmaceuticals	IE	Pharmaceuticals
Johnson & Johnson	US	Pharmaceuticals
Johnson Controls	US	Conglomerates
Juul Labs	US	Consumer Goods
Kernel	US	Medical Technologies
Kia	KR	Automotive
Korea Tobacco & Ginseng	KR	Consumer Goods
Kyocera	JP	Electronics
Lam Research	US	Semiconductors
Largan Precision	TW	Engineering
LG Chem	KR	Chemicals and Materials
LG Electronics	KR	Electronics
Macronix	TW	Semiconductors
Magic Leap	US	Electronics

US: United States, DE: Germany, JP: Japan, IE: Ireland, KR: South Korea, TW: Taiwan

## New entrants to the 2023 Top 100 list

### Japan Tobacco

Japan's leading tobacco and vaping company. The maker of Camel cigarettes outside the U.S., JTI is known for developing a heated tobacco stick.

### Jazz Pharmaceuticals

A global biopharmaceutical company in Ireland focused on neuroscience and oncology, with products treating sleep disorders and epilepsy, and medicines for hematologic malignancies and tumors.

### Johnson Controls

A U.S. company that is a global leader in smart buildings. It uses artificial intelligence and data analytics to develop autonomous heating, cooling, and other buildings systems.

### Kernel

A U.S.-based technology company that creates brain-machine interfaces, leveraging the strengths of TD-fNIRS into their products.

### Kia

A multinational automobile manufacturer based in South Korea. It leverages its investment in technological innovation to provide drivers with improvements in safety, connectivity, and fuel economy.

### Korea Tobacco & Ginseng

The leading South Korean tobacco company that also develops, manufactures, and delivers biopharmaceuticals, medical supplies, food and beverages, and more.

### Kyocera

A Japanese ceramics and electronics manufacturer of solar power generating systems, mobile phones, printers, LCDs, and more.

## The 2023 Global Top 100

The Top 100 in alphabetical order, the headquarter location, and its industry sector.

Patent Owner	HQ	Industry
Masimo Corp	US	Medical Technologies
MediaTek	TW	Semiconductors
Medtronic	IE	Medical Technologies
Merck KGaA	DE	Chemicals and Materials
Meta	US	Information Technologies
Moderna Therapeutics	US	Pharmaceuticals
Murata Manufacturing	JP	Electronics
nChain	CH	Information Technologies
Nike	US	Consumer Goods
Nitto Denko	JP	Chemicals and Materials
Novartis	CH	Pharmaceuticals
Nvidia	US	Semiconductors
Ocado	GB	Information Technologies
Ofinno Technologies	US	Technology R&D
OneTrust	US	Information Technologies
P&G	US	Consumer Goods
Pfizer	US	Pharmaceuticals
Philip Morris International	US	Consumer Goods
Qualcomm	US	Semiconductors
Regeneron	US	Pharmaceuticals

US: United States, TW: Taiwan, IE: Ireland, DE: Germany, JP: Japan, CH: Switzerland, GB: Great Britain

## New entrants to the 2023 Top 100 list

### Murata Manufacturing

A Japanese manufacturer of electronic devices made from fine ceramics. Its products include ceramic passive electronic components, primarily capacitors, and ceramic filters, high-frequency parts, and sensors.

### Ocado

A U.K.-based logistics company that has developed software and robotics fulfillment technologies, which it licenses to online grocery retailers around the world.

### P&G

A multinational consumer goods corporation based in the U.S. Its products focus on baby and family care, fabric care, grooming and skin care, personal health, and home and cleaning products.

## The 2023 Global Top 100

The Top 100 in alphabetical order, the headquarter location, and its industry sector.

Patent Owner	HQ	Industry
ResMed	US	Medical Technologies
Revolution Medicines	US	Pharmaceuticals
Roche	CH	Pharmaceuticals
Salesforce	US	Information Technologies
Samsung	KR	Electronics
Samsung SDI	KR	Chemicals and Materials
Sanofi	FR	Pharmaceuticals
Sinochem Holdings	CN	Chemicals and Materials
Snap	US	Information Technologies
Splunk	US	Information Technologies
Stryker	US	Medical Technologies
Sunny Optical Tech.	CN	Engineering
Techtronic	HK	Appliances
Tencent	CN	Information Technologies
Tianma Microelectronics	CN	Electronics
Tokyo Electron	JP	Semiconductors
TSMC	TW	Semiconductors
Välinge Innovation	SE	Chemicals and Materials
Visionox	CN	Electronics
Yantai Jereh Oilfield Services	CN	Chemicals and Materials

US: United States, CH: Switzerland, KR: South Korea, FR: France, CN: China, HK: Hong Kong, JP: Japan, TW: Taiwan, SE: Sweden

## New entrants to the 2023 Top 100 list

### Salesforce

A U.S. information technology company focused on cloud-based sales and customer relationship software.

### Snap

A U.S.-based camera and social media company offering Snapchat, a camera application and Spectacles, an eyewear product that connects with Snapchat.

### Splunk

A U.S.-based digital data analytics company whose data platform generates reports and visualizations that help its customers enhance security, increase innovation, and more.

### Techtronic Industries

A Hong Kong-based multinational that designs, produces, and markets cordless power tools, focusing on construction, infrastructure, and more.

### Tokyo Electron

A Japanese manufacturer of semiconductor production equipment and industrial electronics products.

### Välinge Innovation

A Swedish research and development company with a comprehensive flooring portfolio. They developed the concept of glueless click hardwood flooring.

### Yantai Jereh Oilfield Services

A Chinese multi-industry corporation specializing in high-end equipment manufacturing, oil and gas engineering, environmental management, new energy and more.

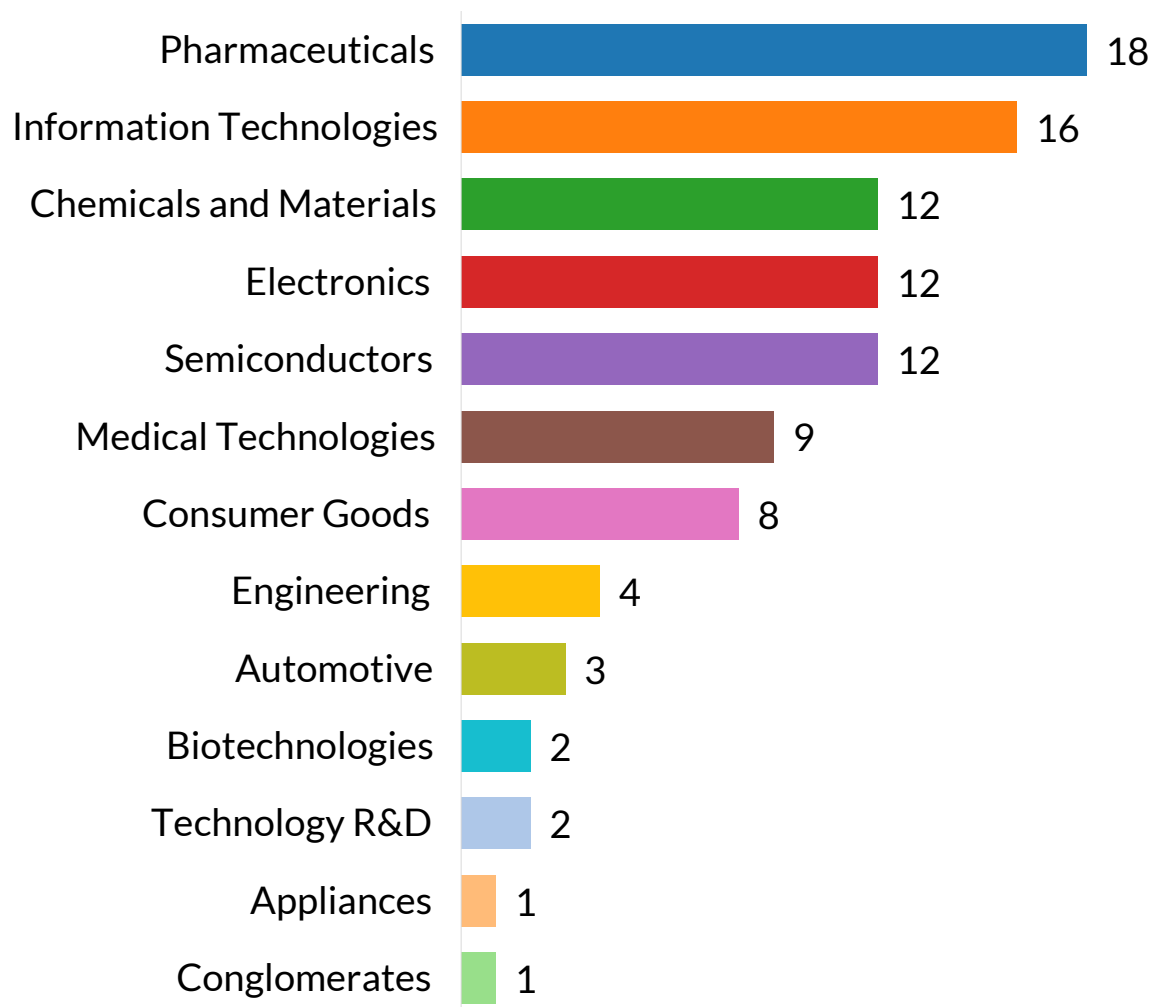
## The 2023 Industry Distribution of the Top 100 Companies

The Innovation Momentum methodology delivers unique insights into global innovation developments across industries and geographies. Using the methodology, we have created a list of the Top 100 innovators across the world showing how global developments continue to shape innovation.

While the top two industries, Pharmaceuticals and Information Technologies, maintained their position in the ranking from last year, Information Technologies closed the gap

from first to second. Chemicals and Materials maintained a top three position from 2022 to 2023, this year tied with Electronics and Semiconductors. Other moves came from Medical Technologies and Consumer Goods, each of which climbed one position.

In the Top 100, the dominance of five industries—Pharmaceuticals, Information Technologies, Chemicals and Materials, Electronics, and Semiconductors—stems from several powerful forces.



**Figure 2:** The number of Top 100 innovators per industry sector.



An aging global population and the long tail of the COVID-19 pandemic are creating demand for new pharmaceutical therapies and products. This provides opportunities for small players with innovative technologies, but also for large companies such as **Amgen**, **Eli Lilly**, and **Moderna Therapeutics**. A market structure that leads Pharmaceuticals to be more numerous in terms of companies pushes the industry to the top of the list when it comes to the number innovators per industry.

As the digital revolution transforms the way we live and work, the Information Technologies industry is leading the charge, with the Top 100 including companies such as **Alphabet**, the owner of Google, Swedish telecoms company **Ericsson** and Chinese technology and entertainment group **Tencent**.

The Semiconductor industry—with big names such as **Intel**, **Qualcomm**, and **TSMC** in the Top 100—also benefits from the technological transformation. Meanwhile, the climate crisis

is providing a catalyst for the development of technologies ranging from energy storage to electric vehicles, all of which rely on semiconductors.

Some things remain constant, however, and the strong position in the Top 100 of the Chemicals and Materials industry reflects its role in providing the building blocks for many other industries. This includes companies like **BASF**, **Firmenich**, **LG Chem**, **Merck KGaA**, and **Nitto Denko**. The industry covers a wide variety of technologies, from batteries and construction materials to glass, food flavors, oil and gas exploration, and refinement.

Starting on page 16, this report presents detailed analyses of patent owners from three industry sectors: Chemicals and Materials, Consumer Goods, and Medical Technologies—and explores how the innovators in these industries are responding to shifting economics and a changing policy landscape.

**“As our goal is to impress our customers through innovation, we are very pleased to receive this award for the second year in a row, which is selected based on the Patent Asset Index that enables us to visualize our technological development capabilities. We will continue to pursue our daily IP activities in an honest manner.”\***

**Dr. Toyohiro Hamasaki**

Deputy Director, Technology and IP Strategy Division  
Nitto Denko Corporation


























*\*(Translated from Japanese)*



## Innovation in the World's Regions

As the Top 100 list clearly demonstrates, innovation is found across the globe. And as industrial production has led to even longer and more complex supply chains, it has also created opportunities for companies of all sizes and types. The analysis of the Top 100 yields insights into this global economic transformation and provides a greater understanding in the geographic distribution of different innovations and technologies.

**Table 1:** The breakdown of the number of innovators by industry sector and region.

Industry Sector	Americas	Asia	EMEA	Total
Pharmaceuticals	 13		 5	18
Information Technologies	 8	 4	 4	16
Chemicals and Materials		 7	 5	12
Electronics	 2	 10		12
Semiconductors	 5	 4	 3	12
Medical Technologies	 8		 1	9
Consumer Goods	 4	 3	 1	8
Engineering	 2	 2		4
Automotive	 1	 2		3
Biotechnologies	 2			2
Technology R&D	 2			2
Appliances		 1		1
Conglomerates	 1			1
Grand Total	48	33	19	100

The U.S. has long been a powerhouse of innovation and it is still to this day. Most patent owners come from the U.S., which is home to almost half of the Top 100, including the majority of the companies in the Pharmaceuticals industry and eight of the nine companies in the Medical Technologies industry. The U.S. is also home to half of the owners in the Information Technologies industry, but none in the Chemicals and Materials industry.

When it comes to Asia, China and Korea are the countries home to most of the owners in the Top 100. The region continues to demonstrate its traditional strength in the Electronics, and Chemicals and Materials industries. Europe, the Middle East, and Africa (EMEA) are also home to a number of owners from the Chemicals and Materials industries, as well as from the Pharmaceuticals industry.

**“Thank you very much for your high evaluation of our company in Innovation Momentum. We are very honored to receive this award, which is a recognition of our technological development and intellectual property capabilities. We will continue to promote strategic IP activities while utilizing PatentSight and provide unique products and technologies for the betterment of society as an Innovator in Electronics.”\***

**Yoshitaka Tanino**

Vice President, Corporate Unit Legal & Intellectual Property Group,  
Murata Manufacturing Co., Ltd.

*\*(Translated from Japanese)*

## Q&A with an Innovation Momentum Top 100 Company

### Liren Chen

President and Chief Executive Officer of InterDigital



**Marco:** Could you briefly describe InterDigital and its mission?

**Liren:** We are a research company that conducts foundational research primarily in advanced wireless, video, and AI technologies. Our work helps power what we refer to as next generation connected ecosystems that increasingly depend on a blend of innovation, such as cellular wireless and more sophisticated and efficient video compression, to deliver evermore immersive experiences. More than half of our employees are engineers, and the majority of them are inventors, and many of them play central roles developing the technologies that billions of us use every day. Since our founding 50 years ago, research and innovation have been our life blood. The way that we generate a return from the painstaking work of our engineering teams is through licensing our patent portfolio of more than 28,000 assets.

**Marco:** As a technology development company, how does InterDigital continue to “stay ahead of the curve” for now over 50 years?

**Liren:** We hire some of the best talent in the industry and operate multiple research centers in the U.S., Canada, and Europe. One of the critical aspects of our business is that we’re innovating five to ten years before our technologies will be implemented in consumer devices and services. For example, our engineers were working on 5G almost a decade before the standard was finalized in 2018, so, in a way, we’re making bets on which technologies are likely to prove successful, commercially viable, and, ultimately, most effective at making connectivity even more seamless. That may sound daunting, but our engineers have been working in these industries for many years, have taken numerous leadership roles in the global standards system and in various industry bodies, and have developed a deep understanding of which direction connected technologies are likely to take. That helps inform our research and, in turn, our patent strategy, allowing us to stay well ahead of the curve.

(Continued on page 23)



**Liren Chen**

President and CEO  
InterDigital

**Lawrence (Liren) Chen** has been the President and Chief Executive Officer of InterDigital since 2021, when he was also appointed to the Board of Directors. Mr. Chen joined the company from Qualcomm Inc. (“Qualcomm”) where he worked for almost 25 years, most recently serving as Senior Vice President, Global Head of IP, Legal Counsel.

Mr. Chen holds 28 granted patents in the U.S. and over 120 granted patents worldwide. He earned his bachelor’s degree in automation from Tsinghua University, Beijing; his M.S.E.E. from the University of Maine; his M.B.A. from San Diego State University; and his J.D. degree from the University of San Diego. Mr. Chen is a member of the State Bar of California.

## Focus Technologies 2023

The next three sections of the present report explore trends among the innovators in three select industries, by comparing peer groups and providing insights into portfolio developments over the past two years in response to economic shifts and evolving policy environments.

### Chemicals and Materials

- AGC
- ARAMCO
- BASF
- CATL
- Firmenich
- LG Chem
- Merck KGaA
- Nitto Denko
- Samsung SDI
- Sinochem Holdings
- Valinge Innovation
- Yantai Jereh Oilfield Services

Chemists like to say chemistry makes the world go round. The industry certainly plays a crucial role in most areas of our lives, from the food we eat and the clothes we wear to the fertilizer needed to grow our food and the textiles used to make our clothes. The growing demand for evermore complex consumer and industrial products is reflected in the activities of the Chemicals and Materials industry.

With a diverse set of patent owners, the industry's innovations include technologies such as lithium-ion batteries. The industry's products are used in the exploration, production and distribution of oil and gas, as well as in glass, fragrances, and food flavors. And its construction materials are what creates the world's infrastructure.

The two companies with the strongest patent portfolios, as measured by the Patent Asset Index, are the German company **BASF**, whose products range from fertilizers and glues to petrochemicals, and **LG Chem**, South Korea's largest chemical company, known for its lithium-ion batteries, which are used in electric vehicles and mobile devices.

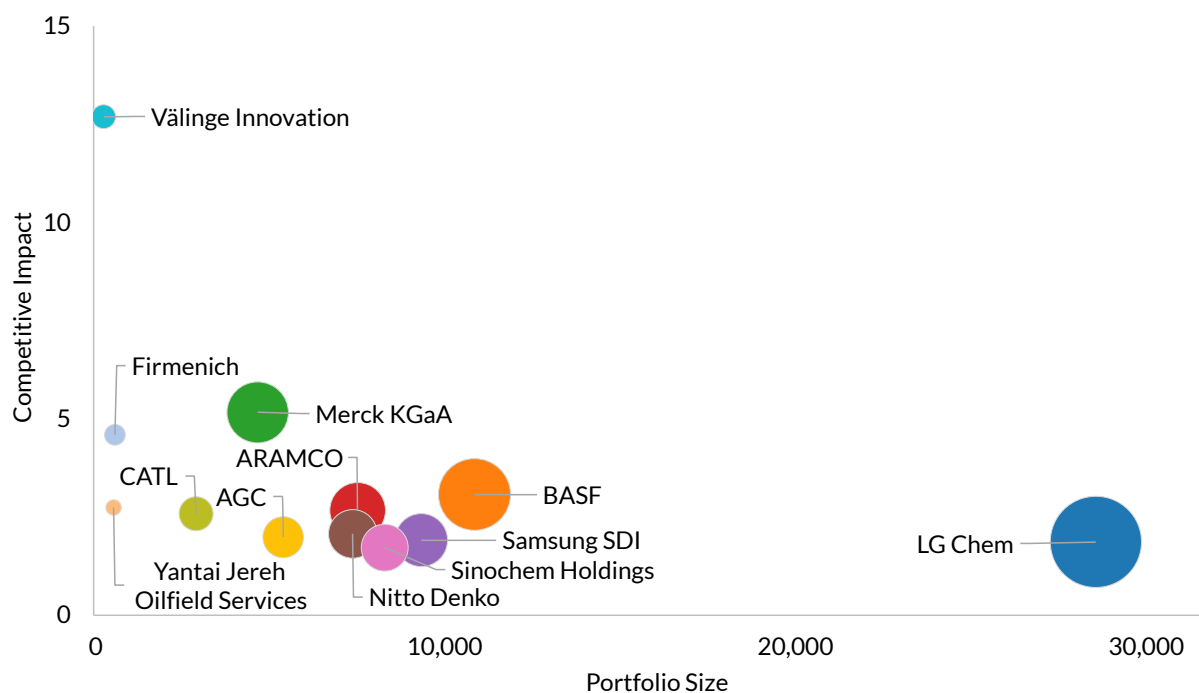
The strengths of these two companies show up in different ways. While **LG Chem** has a

portfolio size more than double that of **BASF**, the average patent quality (Competitive Impact) of **BASF's** patents is almost double that of **LG Chem**.

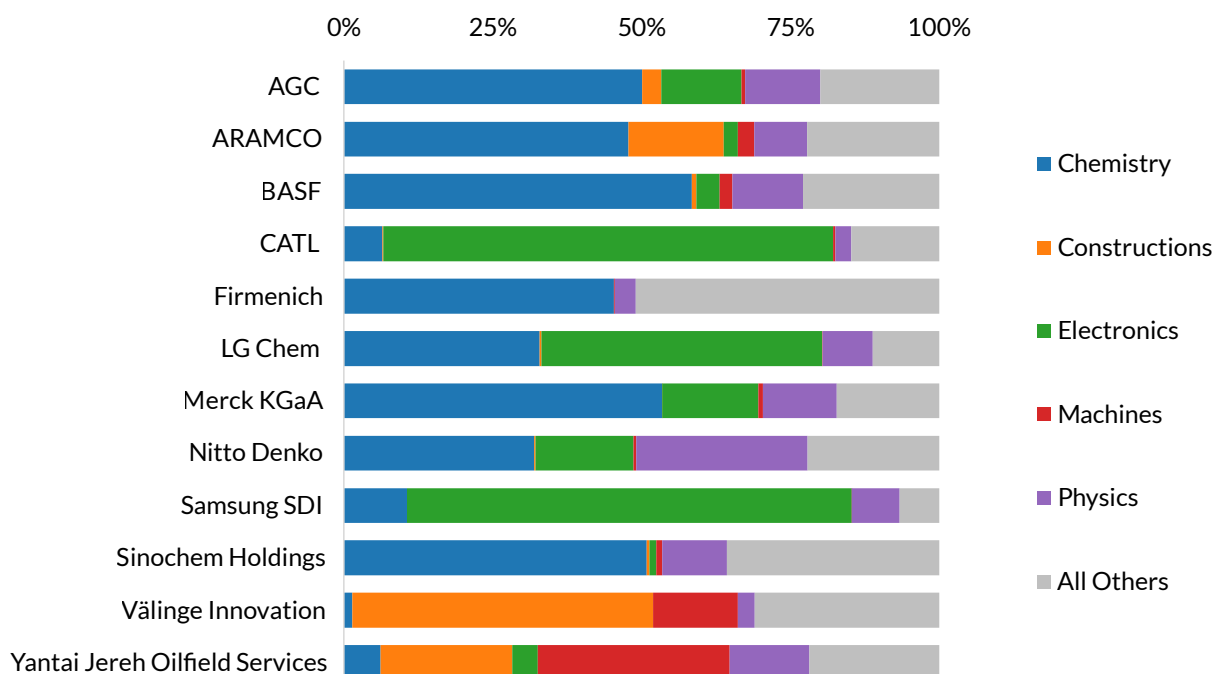
While the average quality of a patent portfolio generally decreases as the portfolio increases in size, **BASF** is an interesting example of bucking the trend. By increasing its average Technology Relevance while slightly decreasing its portfolio size, it has entered the Top 100 for the first time, demonstrating its Innovation Momentum.

Another positive outlier is **Merck KGaA**. With a medium-sized portfolio, the company ranks second among its peers in terms of average patent quality.

Meanwhile, the highest average patent quality in the Chemicals and Materials industry belongs to **Valinge Innovation**, a Swedish company that develops technologies for hardwood flooring. Part of what makes the company so unusual is that, while it develops the flooring technologies, it makes its money by licensing them to manufacturers. **Valinge** demonstrates that innovation can transform both technologies and business models.



**Figure 3:** Average patent quality (Competitive Impact) versus portfolio size of patent owners in the Chemicals and Materials industry sector. The bubble size of the patent owners represents the portfolio strength (Patent Asset Index).



**Figure 4:** Major technology fields covered by the innovators in the Chemicals and Materials industry sector as share of the patent owners' portfolio.



## Consumer Goods

- British American Tobacco
- CJ Corporation
- Japan Tobacco
- Juul Labs
- Korea Tobacco & Ginseng
- Nike
- Phillip Morris International
- P&G

When you think of innovation in the Consumer Goods industry, what usually comes to mind are technologies that have transformed the things we use every day. Take smartwatches. A device that is small enough to be worn around the wrist but, at the same time, allows wearers to do everything, from tracking their fitness and making mobile payments to sending emails and watching videos. Smartwatches use computational power that would once have had to be moved around in giant trucks.

This makes the cigarette an unlikely candidate for innovation. With its forerunners smoked by the ancient Maya and Aztec civilizations, the cigarette has hardly changed in centuries. However, as more and more consumers give up smoking and governments regulate to limit tobacco use, cigarette companies' businesses are coming under threat. Today, these companies recognize that they need to innovate to survive.

Their focus for innovation is the e-cigarette, a device that does not burn tobacco or produce tar or carbon monoxide. Seeing the direction of public health policy, companies have poured billions of dollars into e-cigarettes. **Philip Morris International** has even set a target for phasing cigarettes out of its business by moving into the e-cigarette business.

These developments are all reflected in the Top 100, where the Consumer Goods industry entries are made up almost exclusively of

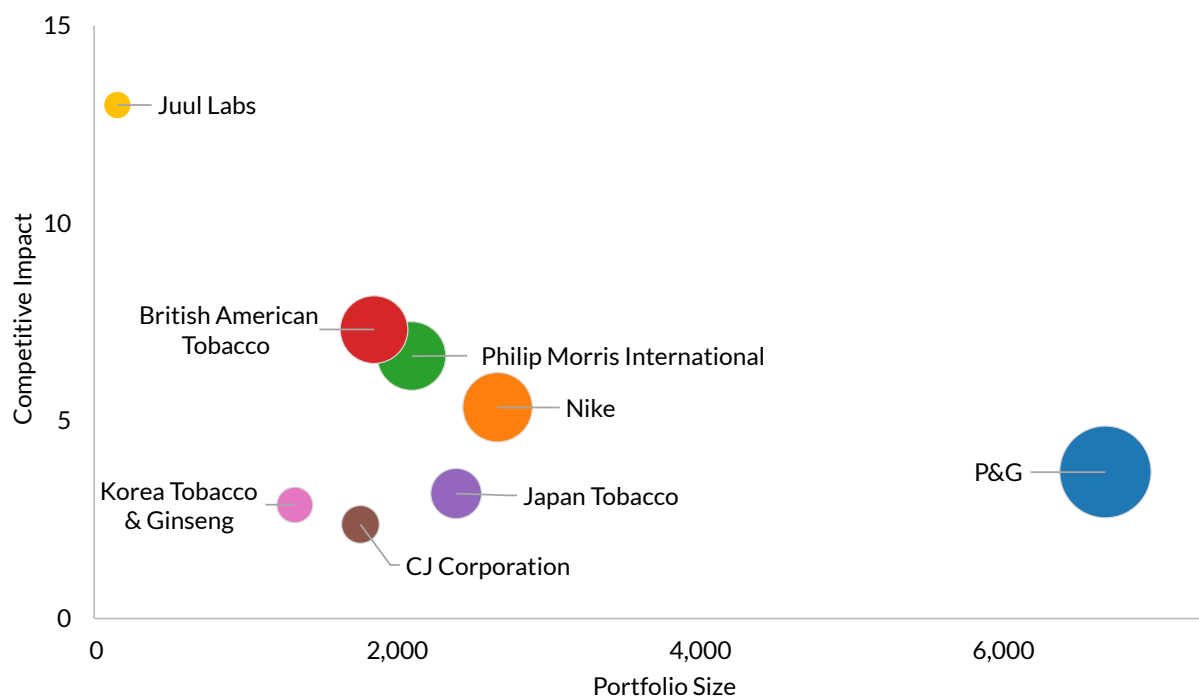
tobacco companies. Some are well-established players, such as **British American Tobacco**, **Japan Tobacco**, and **Korea Tobacco & Ginseng**.

Meanwhile, numerous newcomers have joined the industry, including **Juul Labs**, the e-cigarette company. While **Juul Labs** has faced legal and financial hurdles, it has a strong innovation portfolio that has the smallest number of patent families but the highest average patent quality. As this segment of the Top 100 demonstrates, when facing an existential threat, even the world's oldest of industries can become nimble innovators.

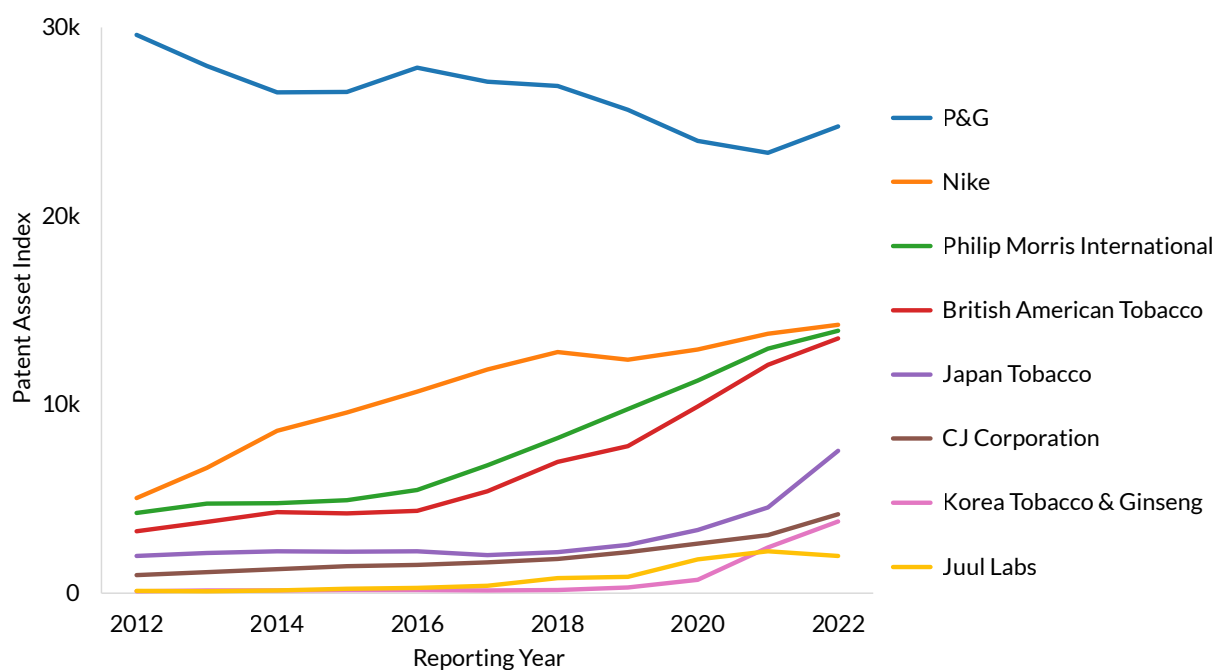
Another company that is innovating to adapt its product lines is **Nike**, which is one of three Consumer Goods companies in the Top 100 outside the tobacco space. The other two companies are U.S. Consumer Goods group **P&G**, and South Korean conglomerate **CJ Corporation**.

**Nike's** business was once dominated by apparel. Today, footwear—with soles as its dominant subgroup—has become the strongest technology in the company's portfolio, contributing to more than 70% of the portfolio strength, an increase of more than 2.5-times over the past decade. And as it integrates computing technologies into sportswear and accessories, **Nike's** innovation growth rate is only likely to go further and faster.





**Figure 5:** Average patent quality (Competitive Impact) versus portfolio size of patent owners in the Consumer Goods industry sector. The bubble size of the patent owners represents the portfolio strength (Patent Asset Index).



**Figure 6:** Patent Asset Index trends of patent owners in the Consumer Goods industry sector over the last 10 years.



## Medical Technologies

- Align Technology
- Becton, Dickinson
- Edwards Lifesciences
- Intuitive Surgical
- Kernel
- Masimo Corp
- Medtronic
- ResMed
- Stryker

By 2030, one in six people around the world will be aged 60 or older, according to the World Health Organization, with the global population of people aged 60 and older doubling by 2050. The reason people are living longer and in greater numbers can partly be attributed to innovations in areas such as diagnostics and monitoring, life support systems, surgery and emergency care—innovations made by the Medical Technologies industry.

In this industry, the U.S. dominates. This is reflected in the Top 100, which reveals that most top patent owners in this industry sector are based in the U.S. In this industry, all companies in the Top 100 have increased their portfolio size, even if only slightly, and managed to maintain or improve the average quality of their patent portfolios.

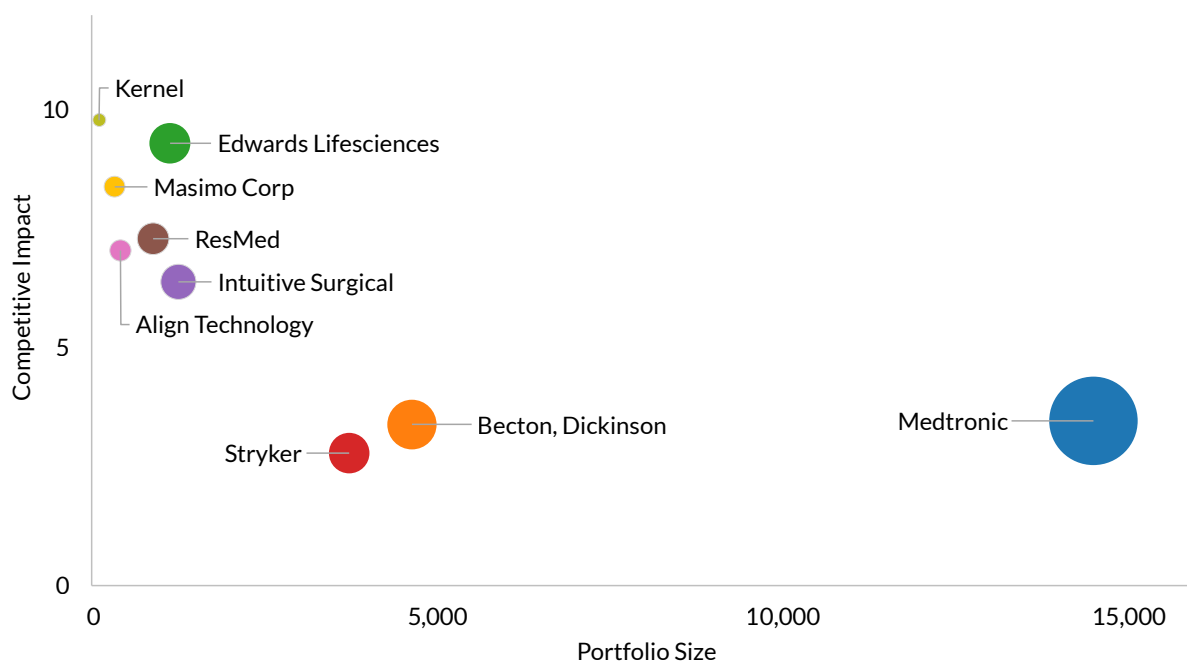
While the growth of their patent portfolios and their geographical location mostly unites them, the companies in this industry—like those in the Chemicals and Materials industry—diverge considerably when it comes to their technologies. This, after all, is an industry that touches a wide variety of technologies, from electronics and computing power to the miniaturization enabling the development of implantable devices.

Medical device company **Medtronic**—which owns the largest patent portfolio, and the strongest according to the Patent Asset

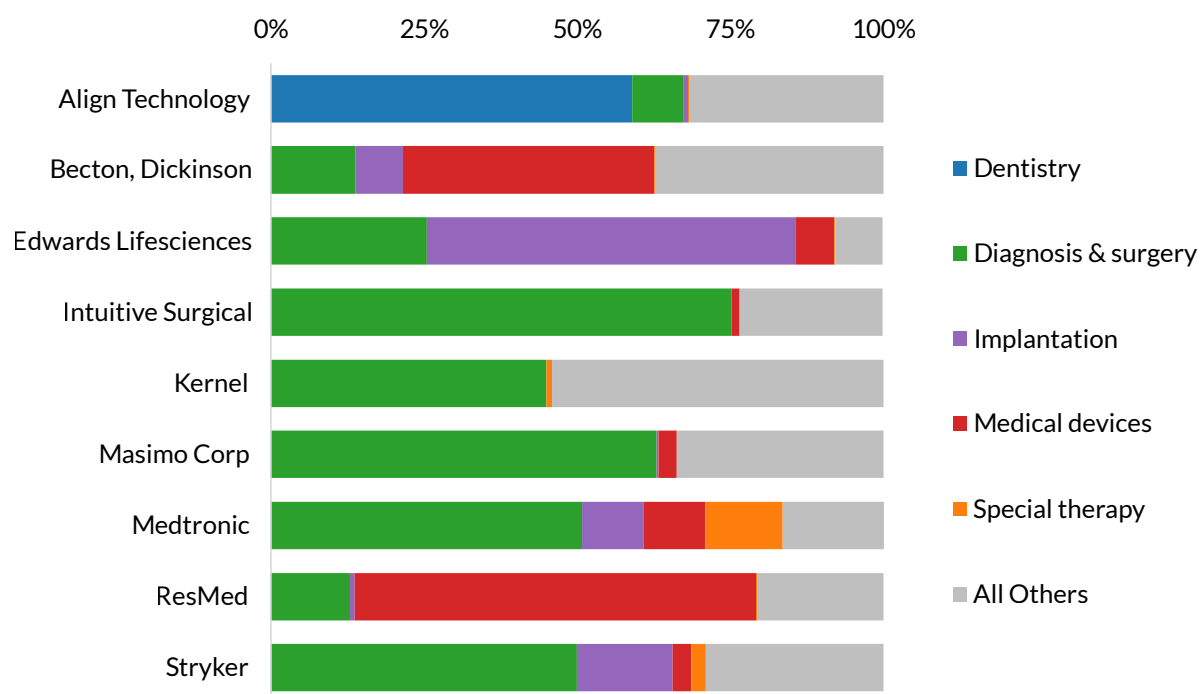
Index—is a prime example. Another company that, contrary to the norm, has managed to significantly increase its patent portfolio while maintaining average patent quality, **Medtronic's** technologies enable everything from digital diabetes monitoring to minimally invasive surgery and tiny leadless pacemakers that can be implanted directly into the heart.

By contrast, **Masimo Corporation**, known for its pulse oximeters and patient monitoring technologies, is an owner with a small portfolio that has one of the highest average patent quality increases in the industry. Another outlier is **Align Technology**, whose clear aligners adjust teeth. The company uses scanners, 3D computer modeling, and additive manufacturing to scale up production while customizing products for individual patients. By focusing on one type of device, it has been able to improve its average patent quality on a consistent basis.

Some inventions become more important as new challenges arise. For example, the ventilator technology invented by **ResMed** used in the production of medical devices for respiratory disorders, such as sleep apnea, became more relevant at the height of the COVID-19 pandemic. This development likely explains the increase in **ResMed's** average patent quality.



**Figure 7:** Average patent quality (Competitive Impact) versus portfolio size of patent owners in the Medical Technologies industry sector. The bubble size of the patent owners represents the portfolio strength (Patent Asset Index).



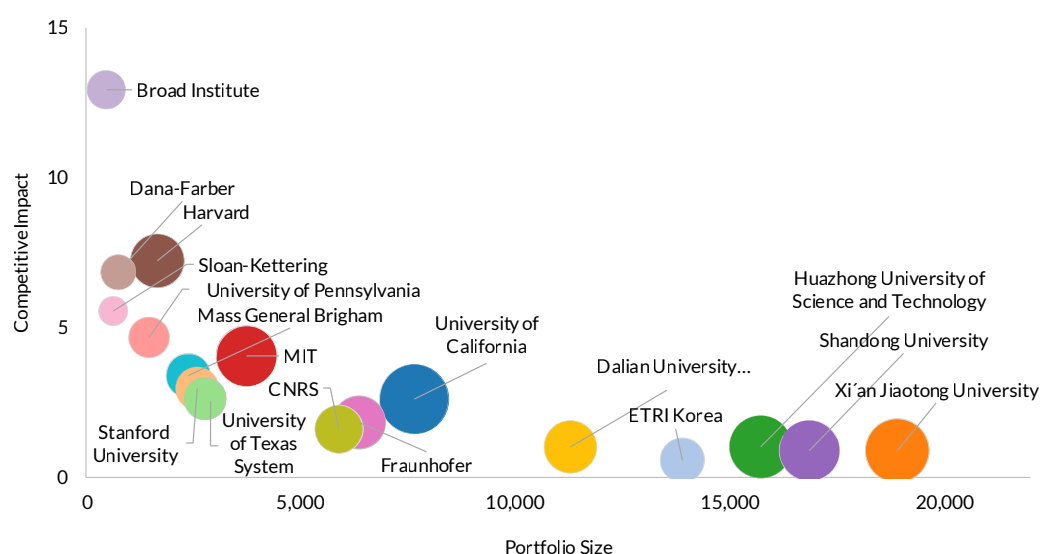
**Figure 8:** Major technology fields covered by the innovators in the Medical Technologies industry sector as share of the patent owners' portfolio.

## Academics and Public Research

- Broad Institute
- CNRS
- Dalian University of Technology
- Dana-Farber
- ETRI Korea
- Fraunhofer-Gesellschaft
- Harvard
- Huazhong University of Science and Technology
- Mass General Brigham
- MIT
- Shandong University
- Sloan-Kettering
- Stanford University
- University of California
- University of Pennsylvania
- University of Texas System
- Xi'an Jiaotong University

The Top 100 includes only companies. However, a number of academic and public research institutions met the same criteria of outstanding Innovation Momentum, and we recognize them here. Most are located in the U.S., with others in China, France, Germany and Korea.

- The **Centre National de la Recherche Scientifique (CNRS)** is a national research organization in France focusing mostly on basic research. However, the center is also active in applied sciences.
- Founded in 1949, the **Fraunhofer-Gesellschaft** is a research organization with a large number of institutes spread across Germany, working in different fields of applied science. It is the largest applied research and development services organization in Europe.
- The **Electronics and Telecommunications Research Institute (ETRI)** is a research organization in Korea that was founded by the Korean government. The **ETRI** is active in technologies such as telecommunications and semiconductors.
- The **Dalian University of Technology** is a Chinese university with a large patent portfolio whose growth is likely to have resulted from past government programs designed to incentivize patent filing.



**Figure 9:** Average patent quality (Competitive Impact) versus portfolio size of patent owners in the Academics and Public Research sector. The bubble size of the patent owners represents the portfolio strength (Patent Asset Index).

(Continued from page 15)

## Q&A with an Innovation Momentum Top 100 Company

### Liren Chen

President and Chief Executive Officer of InterDigital



**Marco:** We frequently see InterDigital rank high in patent benchmarks of various technology areas, and certainly again in this year's (2023) Innovation Momentum Report, which shows us the recent impact of a company's innovations. What role do patents play for InterDigital?

**Liren:** When I talk to employees, to investors, and to other stakeholders I like to talk about the cycle that drives our business. To summarize, it runs like this: Our engineers conduct research; the best of our inventions are then patented; where applicable we collaborate with our peers and make contributions to certain technology standards; and we then license all or parts of our patent portfolio to many of the world's leading smartphone and consumer electronics companies, automakers, and a growing universe of other connected device manufacturers when they build products in compliance with certain standards. We then re-invest a large chunk of our revenue—more than 20% since 2000—in our research. So, intellectual property, particularly patents, is essential to what we do and how we operate as a business—patents are the bridge between our foundational innovation and how we generate our revenue via licensing.

**Marco:** How do you ensure that your patent strategy fits with your overall business strategy?

**Liren:** Given the nature of our business, our patent strategy plays a central role in our overall business goals. We own one of the world's largest patent portfolios, but we also know that we're smaller than some other innovators in cellular wireless and video. Our business strategy, therefore, calls for not only the critical mass that you need to operate a successful licensing business—one that generated more than \$400 million in revenue in 2021—but also a very high-quality portfolio. This enables us to stand out from our peers and to demonstrate to existing and prospective licensees how our patented innovations are fundamental to their devices. Ultimately the proof is in our license agreements, and our licensing success. Recently we've agreed on multiple deals with a contract value of more than \$1.5 billion which clearly demonstrates that we're doing a good job in ensuring that a patent strategy focused on high-quality IP supports our business goals.

**Marco:** Which role does patent analytics play at InterDigital to maintain and develop its top patent portfolio, and to identify and evaluate future technologies?

**Liren:** We are constantly monitoring all aspects of our portfolio—from its size to which jurisdictions we file in—and monitoring what I will call our patent prosecution pipeline.

We also keep very close tabs on those companies that are in our peer group, be it for a technology like 5G or the various video compression standards. This is where patent analytics can play an important role, in benchmarking our portfolio against other companies' patents. For example, we have used PatentSight to study the strength of our 5G and our VVC codec portfolios and have found that we lead the way in terms of quality for 5G and come second for VVC.

This kind of analytics can be incredibly helpful because some poorly informed analyses of various patent landscapes rely far too much on simple patent counting. We have seen this particularly in relation to 5G where headlines have been written about who is leading the "5G race" based simply on which companies own the most patents. I would argue that any assessment about which innovators lead the way, should place the most weight on the quality of a portfolio not its size. My hope is that more advanced analytics platforms can help to inform broader conversations about the nature and direction of innovation.

**Marco:** Thank you very much, Liren.



## Closing Summary

As the second edition of the Innovation Momentum reveals, this is an exciting time for the world's innovators. Driven by global trends such as changing demographics, the continuing impact of the pandemic and an increasing focus on health care by both consumers and policymakers, innovation is coming from a broad range of industries. Meanwhile, the pace of the technological revolution continues to accelerate, providing opportunities for companies of all sizes.

Using the Patent Asset Index to make sense of vast amounts of global patent data, the Innovation Momentum methodology makes it possible to track these developments and, through sophisticated patent analytics, to provide a window into the most important scientific and technological advances of our time.

In the 2023 Innovation Momentum, the entry of new companies to the Top 100 in combination with the shifting positions of the different industries represented, present a landscape that is constantly evolving. Scientists, technologists, and engineers identify emerging trends and make the most of opportunities that arise from economic and regulatory changes, such as changing public health policies on tobacco sales.

In a complex, interconnected world, innovation is the lifeblood of successful organizations. And given the challenges the world faces, it is essential that their innovators continue to use their inspiration, knowledge, and experience to seek solutions. The good news is that, as new challenges emerge, we see no shortage of potential solutions.

Every organization in the Top 100 is making a vital contribution to human development, whether that is extending healthy lives or providing the building blocks for essential infrastructure. We look forward to next year's Innovation Momentum report, when we will track yet more waves of the scientific and technological developments that help make the world a better place.



## About the Patent Asset Index

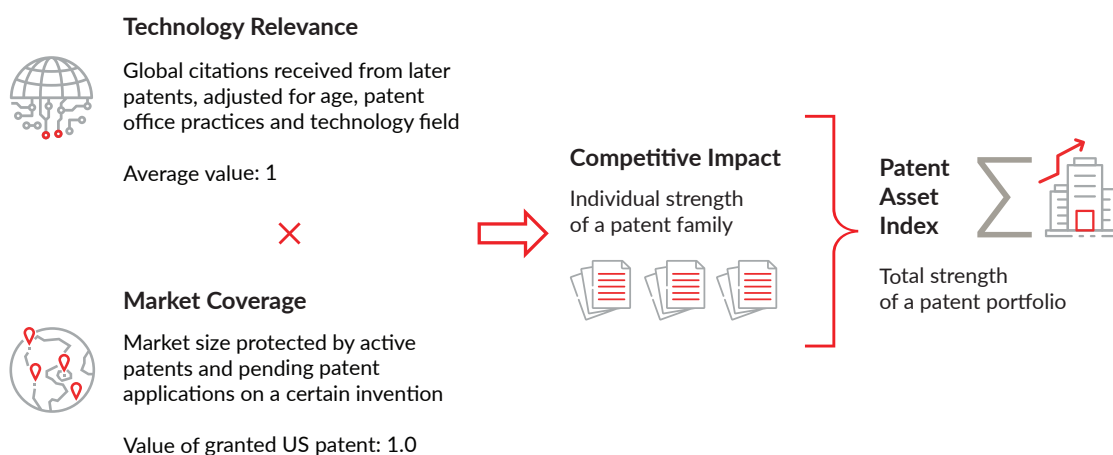
The Patent Asset Index represents a measure of the innovative strength of a patent portfolio. A patent family is more valuable when other innovations build on the technology protected by this patent family and by the scope of protection that the patent family holder considers appropriate.

Technology Relevance is a measure of the importance of a patent family and the technological invention it protects. It is calculated based on the total number of worldwide citations that are received from other patent families and is adjusted for the facts that (1) older patents are cited more often, on average, than younger patents; (2) international patent offices follow different citation rules; and (3) different citation practices are prevalent in different technology fields.

Market Coverage is measured as the size of the markets in which a patent family is protected, as benchmarked against the world's largest economy—the United States. In this context, the gross national income (GNI) of a country is used as a proxy for the relative size of its national market. Market Coverage is calculated based on granted and pending patents, adjusted for the patent family's protected market size.

Competitive Impact represents the individual strength of a patent family and is obtained by multiplying the Technology Relevance and the Market Coverage of each patent family. It is stated relative to the other patent families in the same field. For example, a value of three means that the patent family is three times as important as the average patent family in the field. The value obtained by adding up all the Competitive Impact values of all patent families constituting the portfolio is defined as the Patent Asset Index, which measures the overall strength of a patent portfolio.

The Patent Asset Index methodology is based on many years of scientific research and was validated in peer-reviewed academic publications and studies. Our patent analytics platform LexisNexis® PatentSight®, featuring the Patent Asset Index, has been used for several years by leading companies in many industries, as well as governmental bodies and organizations, e.g., in antitrust consideration or merger clearances. Numerous companies trust the Patent Asset Index to illustrate the strength of their patent portfolios in annual shareholder reports and other stakeholder communications.



Ernst, H., Omland, N. (2011): The Patent Asset Index - A New Approach to Benchmark Patent Portfolios. World Patent Information 33, pp. 34–41.

## About the Authors



**Dr. Dirk Caspary**  
Senior Consultant  
LexisNexis® Intellectual Property Solutions

Dr. Dirk Caspary is a senior consultant with excellent knowledge in the field of patent search, portfolio analysis, and competitive intelligence. He has extensive experience in the analysis and evaluation of patents and patent portfolios, e.g., in the context of patent prosecution, licensing programs, or defense against third-party patent assertions. He has broad technical knowledge, demonstrates rapid comprehension of complex technologies; and has comprehensive expertise in semiconductor technologies, which he has acquired through many years of consulting work for leading global semiconductor manufacturers, reverse engineering, and his work in the semiconductor industry.



**William Mansfield**  
Head of Consulting and Customer Success  
LexisNexis® Intellectual Property Solutions

William Mansfield is the head of consulting and customer success in the Americas and EMEA for LexisNexis® Intellectual Property Solutions. He is responsible for overseeing the negotiation, creation, and delivery of customer consulting, along with managing the Customer Success team. He works closely with numerous international and Fortune 500 companies and others to ensure effective deployment of patent analysis for business strategy, M&A due diligence, portfolio management, and other needs. William Mansfield has an economics background and experience in market and R&D strategy in the solar industry.

# Our Mission: Bringing Clarity to Innovation

At LexisNexis® Intellectual Property Solutions, we believe when a person works on a patent and understands the future trajectory of a specific technology, that person has the potential to fundamentally change how society operates. We are proud to directly support and serve these innovators in their endeavors to better humankind.

## About LexisNexis® Intellectual Property Solutions

LexisNexis® Intellectual Property Solutions bring clarity to innovation for businesses worldwide. We enable innovators to accomplish more by helping them make informed decisions, be more productive, comply with regulations, and ultimately achieve competitive advantage for their business. Our broad suite of workflow and analytics solutions (LexisNexis® IP DataDirect, LexisNexis® IPlytics, LexisNexis PatentAdvisor®, LexisNexis PatentOptimizer®, LexisNexis® PatentSight®, and LexisNexis TotalPatent One®), enables companies to be more efficient and effective at bringing meaningful innovations to our world. We are proud to directly support and serve these innovators in their endeavors to better humankind.

## About LexisNexis® PatentSight®

PatentSight® is a powerful and easy-to-use analysis platform that makes quick answers accessible to both top management and intellectual property experts, as well as data experts in a wide array of application areas. The software and its underlying data enable the evaluation of companies and technologies, as well as deep, varied, and practical analysis for strategic decision making. It also enables searching of patent families and viewing of individual patents and important patent details.

PatentSight is recognized for its intuitive usability, flexibility, and powerful visualizations. The business intelligence platform compiles bibliographic patent data from over 95 authorities worldwide utilizing the DOCDB, the European Patent Office's master documentation database with worldwide coverage, and has vast full-text patent data, with over 100 million patent documents in English, approximately 700 million drawings and illustrations of inventions, and nearly 100 million PDFs that are searchable (via OCR) and quickly downloadable.

LexisNexis® Intellectual Property Solutions.  
Bringing clarity to innovation.

To learn more visit [LexisNexisIP.com](https://LexisNexisIP.com)

Publication Date: January 2023

LexisNexis, LexisNexis PatentAdvisor, LexisNexis PatentOptimizer, LexisNexis TotalPatent One and the Knowledge Burst logo are registered trademarks of RELX Inc. PatentSight is a registered trademark of PatentSight GmbH. Other products or services may be trademarks or registered trademarks of their respective companies. © LexisNexis 2023.

