

# Analytical & Measuring Instruments Business Presentation Materials

**Shimadzu Corporation**

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# Contents

## I. Outline of Analytical & Measuring Instruments Business

Sales Trend .....	p. 4
Improved Profitability .....	p. 5
Sales Increase by Region .....	p. 6
Markets and Products .....	p. 7

## II. Growth Strategies

Growth Strategies for Analytical & Measuring Instruments .....	p. 9
Advanced Healthcare .....	p. 10
Materials Science .....	p. 20
Deploying New Products .....	p. 22
Aftermarket Business .....	p. 28
Network Business .....	p. 29
Developing New Demand – Cannabis .....	p. 31
– Participation in Creating Regulations .....	p. 32

## III. R&D

Global Development Capabilities .....	p. 34
Healthcare R&D Center .....	p. 35
Innovation Centers .....	p. 36

## IV. Summary

.....	p. 38
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# Index

## **I. Outline of Analytical & Measuring Instruments Business**

**Sales Trend, Improved Profitability, Sales Increase by Region, and Markets and Products**

II. Growth Strategies

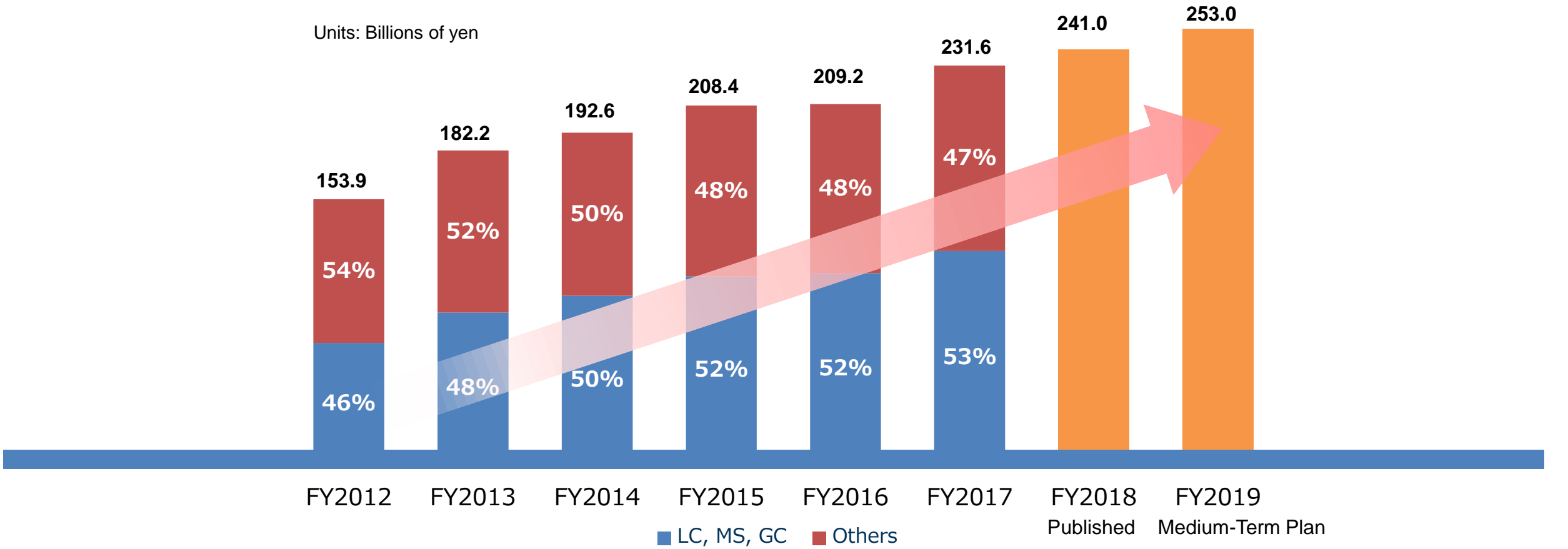
III. R&D

IV. Summary

# I. Outline of Analytical & Measuring Instruments Business

## Sales Trend

Results were strong, driven by liquid chromatograph (LC), mass spectrometer (MS), and gas chromatograph (GC) sales, with a CAGR for the period from FY2012 to FY2017 of 12 % for LC, MS, and GC, and 5 % for other products. Accelerate the deployment of the businesses to ensure the medium-term management plan targets are achieved for FY2019.



# I. Outline of Analytical & Measuring Instruments Business

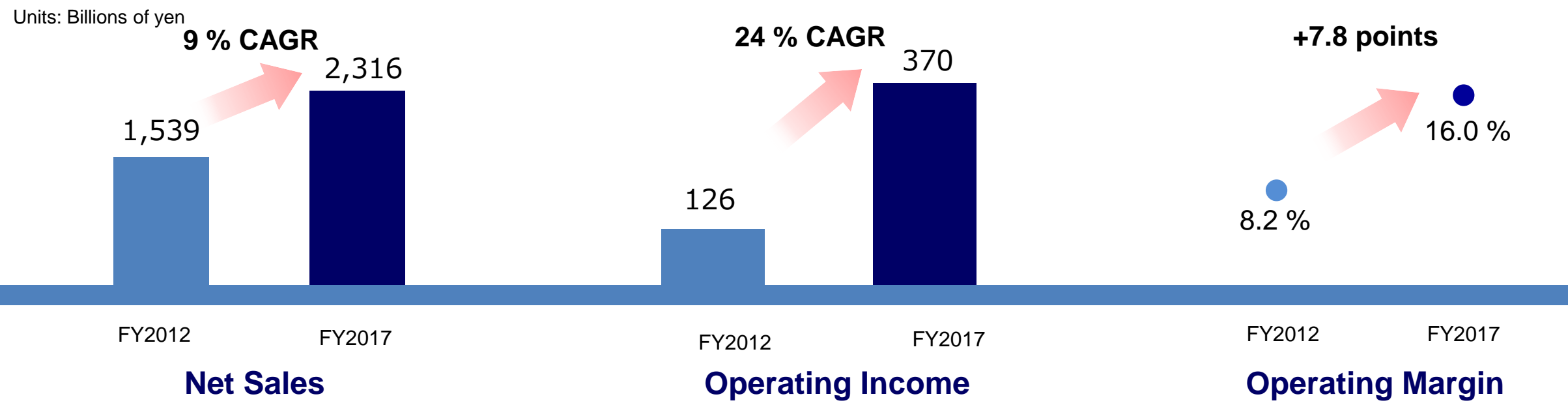
## Improved Profitability

Income increased and profitability improved further. Operating margin improved a significant 7.8 points, due to expanded business size, improved product mix, and other factors.

### Drivers of Sales Growth for FY2012 to FY2017

**Products: Mass spectrometers 16 % CAGR and liquid chromatographs 12 % CAGR**

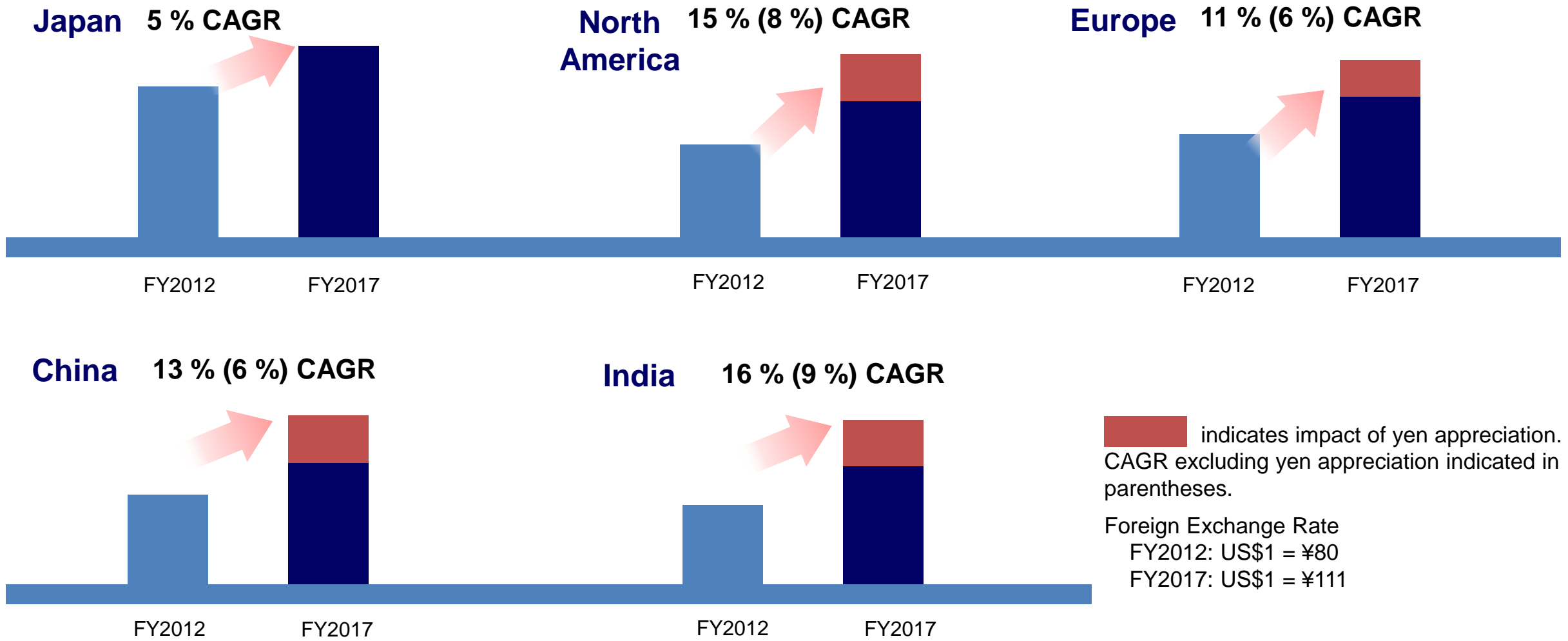
**Regions: India 16 % CAGR, North America 15 % CAGR, and China 13 % CAGR**



# I. Outline of Analytical & Measuring Instruments Business

## Sales Increase by Region

**Expansion outside Japan is leading growth, with the overseas ratio increasing 8 points to 57 % from 49 % in FY2012.**



# I. Outline of Analytical & Measuring Instruments Business Markets and Products

With 3 to 5 % market growth rate for Analytical & Measuring Instruments, stable markets have formed in many fields of industry.

## Life Science

- Drug development
- Genomic drugs
- Clinical research
- Cellular analyses



LCMS-9030 Mass Spectrometer (Q-TOF)



GCMS-TQ8050 Mass Spectrometer



LCMS-8060 Mass Spectrometer



MALDI-8020 Mass Spectrometer



i-Series Plus Integrated High-Performance Liquid Chromatograph System



LC Columns



Cell Picker Cell Culturing Support System

## Chemicals and Foods

- Food safety
- Functionally-enhanced foods
- Chemical products



ICPMS-2030 ICP Mass Spectrometer



Nexis GC-2030 Gas Chromatograph



GC Columns



IRSpirit FTIR Spectrophotometer

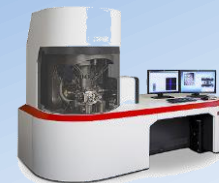
## Materials

- Automotive
- Electrical/electronic
- Materials



AG-Xplus Precision Universal Testing Machine

AXIS ULTRA2 Photoelectron Spectrometer



SMX-225CT Nondestructive Inspection Machine

## Environment/Energy

- Environmental monitoring
- Energy
- Compliance with regulations



NP-4200 Online Total Nitrogen and Total Phosphorus Analyzer



TOC-L Series Total Organic Carbon Analyzer



EDX-LE Energy Dispersive X-Ray Fluorescence Spectrometer

# Index

I. Outline of Analytical & Measuring Instruments Business

## **II. Growth Strategies**

**Growth Strategies for Analytical & Measuring Instruments, Advanced Healthcare, Materials Science, Deploying New Products, Aftermarket Business, Network Business, Developing New Demand**

III. R&D

IV. Summary



## II. Growth Strategies

# Growth Strategies for Analytical & Measuring Instruments

### Growth Strategies

- Accelerate deployment of key mass spectrometer (MS) and liquid chromatograph (LC) models and pursue more high-end models, such as with high resolution or high sensitivity features.
- Develop new demand in healthcare fields, such as for MS-based screening for diseases and drug discovery support.
- Expand the aftermarket business, such as by expanding/improving the line of consumables and releasing new reagents.

	Area	Business Field	Expected Changes in Society and Business Opportunities	Issues Addressed by Shimadzu
Businesses Deployed	Human health	Advanced healthcare	<ul style="list-style-type: none"> <li>• Promote healthcare that is effective for addressing aging society</li> <li>• Promote preventive healthcare</li> <li>• Routine health management based on a growing interest in health</li> </ul>	<ul style="list-style-type: none"> <li>✓ Diagnosis and treatment support</li> <li>✓ Drug discovery support</li> <li>✓ Cellular analyses</li> <li>✓ Food safety and functionally-enhanced foods</li> </ul>
	Global environment	Materials	<ul style="list-style-type: none"> <li>• Widespread use of light-weight materials in automobiles and aircraft</li> <li>• Regulations established to improve safety</li> </ul>	<ul style="list-style-type: none"> <li>✓ Support for developing new materials with enhanced functionality or lighter weight, etc.</li> <li>✓ Environmental impact reduction</li> </ul>
		Environment/energy	<ul style="list-style-type: none"> <li>• Increasing seriousness of environmental pollution</li> <li>• Accelerating pace of global warming</li> <li>• Transition to alternative energies toward achieving a low-carbon society</li> </ul>	<ul style="list-style-type: none"> <li>✓ Environmental measurement of air, water, and soil</li> <li>✓ Support for alternative energy development</li> </ul>

## II. Growth Strategy—Advanced Healthcare

# Advanced Healthcare Measures (1)

**Promote joint research with leading healthcare institutions to develop solutions for supporting diagnosis and treatment of cancer, lifestyle diseases, and psychiatric disorders.**

**Advanced Healthcare:** Deploy solutions in the advanced healthcare field based on combining advanced mass spectrometry, near infrared spectrophotometry, and diagnostic imaging technologies. Contribute to conquering intractable diseases, such as **cancer, lifestyle diseases, and psychiatric disorders.**

### Cancer

- **Development of method for ultra early diagnosis of colon cancer** (joint research with Kobe University Hospital and National Cancer Center): GCMS
- **Supporting development of photoimmunotherapy for cancer** (joint research with the National Cancer Institute in the U.S.): LCMS and near-infrared imaging system

### Lifestyle Diseases

- **Development of primary aldosteronism diagnostic system** (joint research with Tohoku University Hospital): LCMS and angiography system

### Psychiatric Disorders

- **Development of method for detecting Alzheimer's disease** (joint research with National Center for Geriatrics and Gerontology): MALDI-TOF MS



GCMS



LCMS



Near-Infrared Fluorescence Imaging System



Angiography System

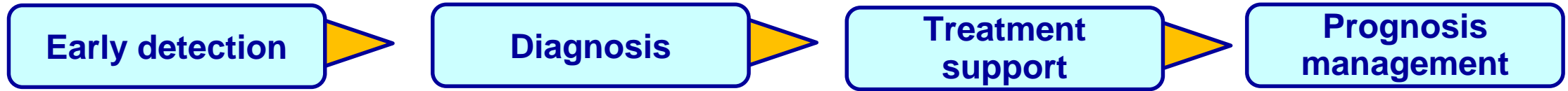







MALDI-TOFMS AXIMA

## II. Growth Strategy—Advanced Healthcare

# Advanced Healthcare Measures (2)

Contribute to solving challenges of society by promoting early detection, diagnosis, and treatment of major diseases.



	<p><b>MS: Cancer screening</b>                  Colon cancer, breast cancer, pancreatic cancer, liver cancer, stomach cancer, and lung cancer  <i>p. 12</i></p>	<p><b>PET: Diagnostic imaging</b>                  Breast cancer </p> <p><b>MS: Diagnostic support during surgery</b>                  Liver cancer</p>	<p><b>Cancer photoimmunotherapy support</b>                  Therapeutic effect measurement  <i>p. 13</i></p> 	<p><b>MS: Follow-up examination</b>                  Presence of cancer recurrence/metastasis</p>
	<p><b>MS: Disease screening</b>                  Diabetic nephropathy</p>		<p><b>Primary aldosteronism treatment support</b>                  High blood pressure <i>p. 14</i></p> 	<p><b>MS: Medication management</b>                  Organ transplants and autoimmune disorders <i>p. 16</i></p>
	<p><b>MS: Dementia screening</b>                  Mild cognitive impairment (MCI) <i>p. 18</i>                  Alzheimer's <i>p. 17</i>                  Depression </p>		<p><b>IR: Rehabilitation therapeutic effect measurement</b>                  Mild cognitive impairment (MCI) <i>p. 18</i></p> <p><b>MS: Drug discovery research support</b>                  Beta-amyloid screening <i>p. 17</i></p>	<ul style="list-style-type: none"> <li>MS: Mass spectrometry</li> <li>PET: Positron emission tomography</li> <li>IR: Near-infrared spectroscopy </li> </ul>

**Comprehensive health management service for extending healthy life expectancy**  
 Using smart devices to provide information about health, diathetic risks, and functionally-enhanced foods

# Promote Colon Cancer Screening

Cancer

## Early Stage Cancer Screening - Part 1 of 2

### Started colon cancer screening on trial basis

Identified biomarkers and started trial in September of this year at medical institution in Kyoto.

- **Description of development:** Joint research with Kobe University and National Cancer Center  
Objective is to build platform for early stage cancer detection based on GCMS quantitative analysis of biomarker compounds unique to colon cancer in the blood.

#### Colon cancer screening

- 1) Acquire blood sample (same method as conventional blood test).
- 2) Pretreat and analyze 50  $\mu$ L of blood plasma by GCMS.
- 3) Determine risk of colon cancer by screening for four types of biomarkers.

- **Next steps**

Expand scope to include analyzing risk of multiple cancers from a single blood sample, such as breast, pancreatic, and stomach cancers. The challenge will be building the capabilities for collecting samples acquired in accordance with a standard protocol.



## Cancer Treatment Support

### Support photoimmunotherapy research and development


Support cancer photoimmunotherapy research at the National Cancer Institute (NCI) in the United States.




■ Description of development

Support developing practical cancer photoimmunotherapy methods based on advanced near-infrared camera and mass spectrometry measurement technologies.

**Camera for NIR-PIT**  
 Uses fluorescent light to observe antibody-drug conjugates accumulated at cancer cells and the destruction status of cells after treatment.

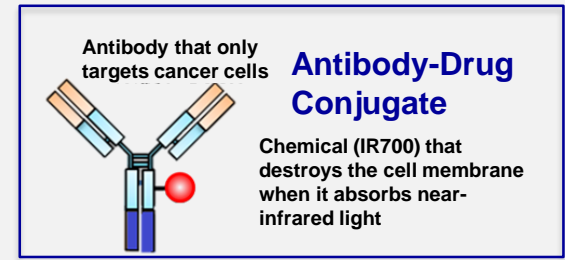


**Mass Spectrometers**  
 Quickly determine therapeutic effect by analyzing components in patient urine.



Photoimmunotherapy

- 1) Inject an antibody-drug conjugate (see illustration on the right), which is an antibody that only targets cancer cells bonded to a chemical substance (that destroys the cell membrane when exposed to near infrared light), into the patient.
- 2) The cancerous area is irradiated with near infrared light to selectively destroy only the cancer cells. Practical commercialization of this method is highly anticipated as a revolutionary method for treating cancer with minimal adverse affects or impact on normal cells.



## Support for Treating Primary Aldosteronism - Part 1 of 2

## Primary Aldosteronism (PA) Treatment Support

Engage in joint research with Tohoku University Hospital to achieve a treatment that reduces the burden on patients with primary aldosteronism, which causes high blood pressure.



### ■ Description of development

- 1) Use a catheter to acquire blood from several locations in the adrenal glands and then immediately analyze the aldosterone concentration and other characteristics in a mass spectrometer.
- 2) Display both mass spectrometer results and an X-ray image of blood vessels. *ref. 15*
- 3) Aim to achieve a treatment that significantly reduces the burden on patients by identifying tumors that are excreting excessive amounts of aldosterone, which in the future will be treated (burned out) immediately on the spot.

#### Angiography Systems

Use high resolution X-ray images for acquiring blood with a catheter and also providing treatment.



#### Mass Spectrometers

Analyze the aldosterone concentration and other characteristics in blood acquired from multiple locations in adrenal veins. Transmit the information via the in-hospital network and quickly integrate it into the blood vessel radiography images.



# II. Growth Strategy—Advanced Healthcare

## Primary Aldosteronism Treatment Support



### Support for Treating Primary Aldosteronism - Part 2 of 2

#### Example of Diagnostic Imaging

#	採血管ID	血管名	採血時刻	Aldosterone	Cortisol	A/C	ステータス
①	SHIMADZU001	RAV_CV	-	RI.E	14.23	-	分析完了
②	SHIMADZU002	LAV_CV	-	RI.E	24.21	-	分析完了
③	SHIMADZU005	EV	-	RI.E	RI.E	-	分析完了
④	SHIMADZU003	LAV_IPV	-	RI.E	23.24	-	分析完了
⑤	SHIMADZU004	RAV_CV	15	2256.09	776.80	2.90	分析完了
⑥	SHIMADZU006	LAV_CV	17	3978.23	1453.25	2.74	分析完了
⑦	SHIMADZU007	EV	17	RI.E	17.65	-	分析完了
⑧	SHIMADZU008	LAV_IPV	19	3346.58	1209.73	2.77	分析完了
⑨	SHIMADZU009	LAV_tribi	22	3511.39	1545.44	2.27	分析完了
⑩	SHIMADZU010	RAV_tribi	33	2416.53	1379.35	1.75	分析完了
⑪	-	-	-	-	-	-	採血管ID読取前
⑫	-	-	-	-	-	-	採血管ID読取前
⑬	-	-	-	-	-	-	採血管ID読取前
⑭	-	-	-	-	-	-	採血管ID読取前
⑮	-	-	-	-	-	-	採血管ID読取前

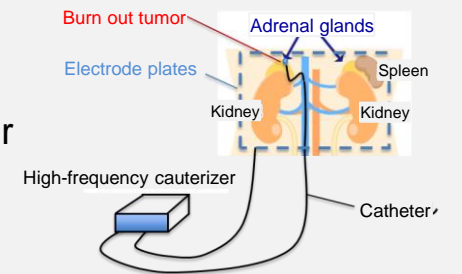
Angiography image

Mass spectrometry data

Data displayed integrated with images clearly shows the local concentrations of aldosterone. Used to treat tumors with excessive secretion.

#### Current Treatment of Primary Aldosteronism

- High blood pressure is caused by primary aldosteronism in about 5 to 10 % of the approximately 40 million patients with high blood pressure in Japan.
- In applicable cases, high blood pressure is caused by excessive aldosterone secretion from either or both left and right adrenal glands.
- Treatment involves using a catheter to acquire blood from multiple adrenal gland locations and examining the secreted aldosterone.
- If excessive aldosterone secretion is confirmed from either left or right adrenal glands, the gland is excised at a later date.



## II. Growth Strategy—Advanced Healthcare

Support for Follow-up Management by Monitoring Drug Levels in the Blood



# Deploy business for monitoring drug levels in blood using a mass spectrometer and unique reagent kits

- Utilize stable isotope technology essential for quantitative analysis using a mass spectrometer (MS).
- Accelerate development of unique reagent kits by Shimadzu and Alsachim for healthcare fields.
- Pursue synergies between instruments and reagents.
- Application examples: Monitoring immunosuppressants, anticonvulsants, and other drugs in the blood





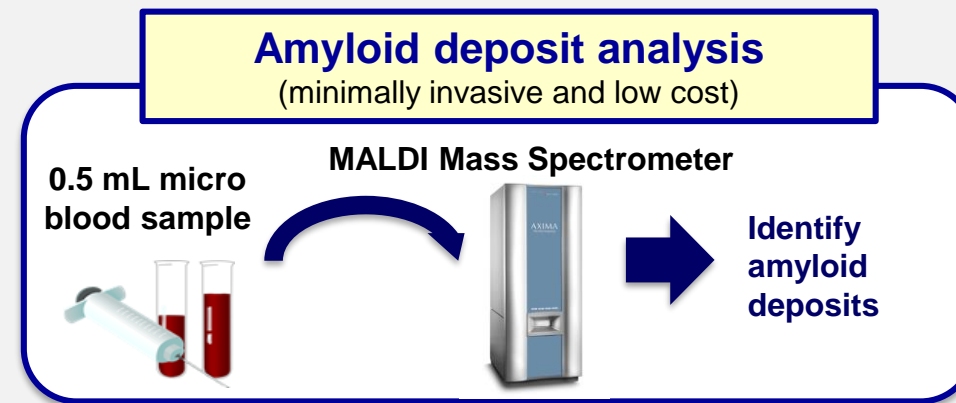
## Deploy Alzheimer's Detection Method

**Use a MALDI spectrometer to detect amyloid deposits associated with Alzheimer's****Started MS-based amyloid contract analysis business**

In August 2018, Shimadzu started a contract analysis business to screen for amyloids in samples from pharmaceutical companies, universities, and others, and contribute to Alzheimer's research and new drug R&D.

**■ Description of development**

- 1) Work with the National Center for Geriatrics and Gerontology to discover biomarkers for amyloid deposits.
- 2) Dramatically less invasive than conventional cerebrospinal fluid examination methods.
- 3) Cost is also less expensive than PET examinations.

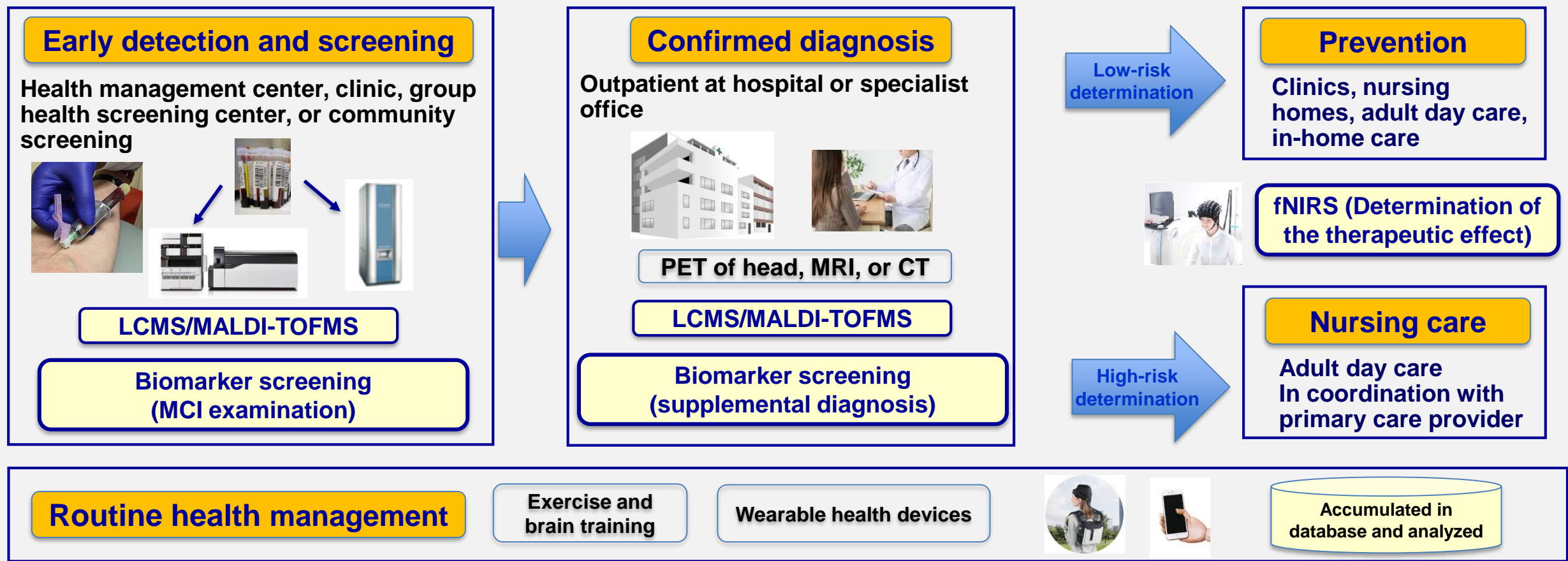


## II. Growth Strategy—Advanced Healthcare

### Comprehensively Deploy Businesses for Dementia



**Measurement based on stage of dementia symptoms**



## II. Growth Strategy—Advanced Healthcare

### Use Cells to Support Drug Discovery and Regenerative Medicine

# Deploy Equipment for Acquisition, Cultivation, and Observation of Cells

## Offer total support for reliable iPS cell cultivation

Together with iPS Portal, Inc, Shimadzu jointly developed Cell Picker, a system for easily and accurately removing unnecessary cells generated during iPS cell cultivation, which was released in March 2018.

Given the progress in iPS and other cell research intended to fully realize regenerative medicine, we will comprehensively deploy devices and services that provide powerful support for observation and cultivation of such cells.



**CultureScanner CS-1 Cell Culture Analysis System**  
Control cell cultivation process



**C2MAP System Cell Culture Media Analysis Platform**  
Use LC/MS/MS to measure changes in culture supernatant components during cell cultivation



**Cell Picker Cell Culturing Support System**  
Remove unnecessary cells

### iPS Portal, Inc

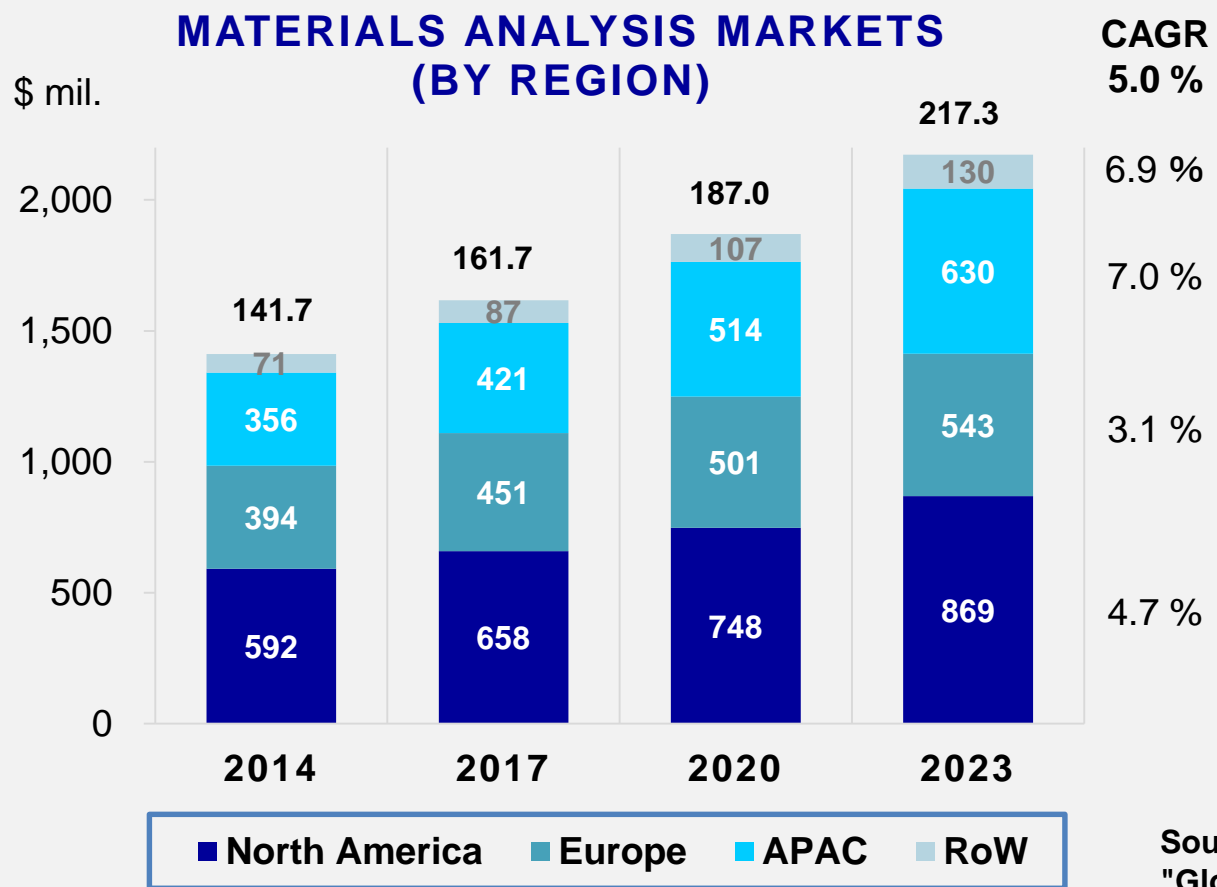


Established in Kyoto city in 2014 to promote the industrial use of iPS cells, iPS Portal provided infrastructure and instruments to companies involved in drug discovery and regenerative medicine. Shimadzu, 15 other major Japanese companies, and Kyoto Prefecture have invested capital in iPS Portal.  
<http://ipsportal.com/>

## II. Growth Strategy—Materials Science

# Deploy Business in Materials Analysis Market (1)

### Growth in Markets for Functionally-Engineered Materials



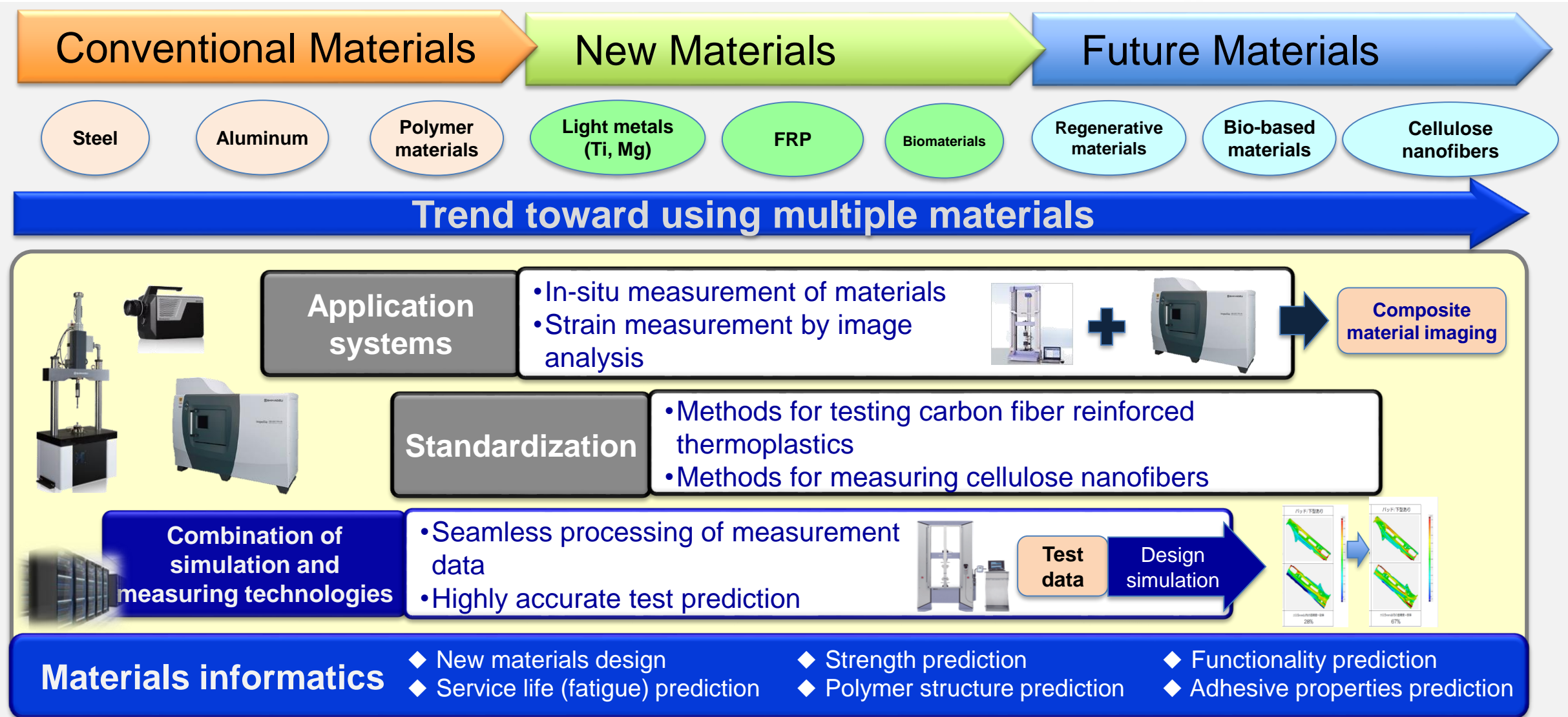
**Growth Factors**

1. Weight reduction promoted for aircraft and automobile
2. Stricter environmental regulations
3. Expansion of inline materials characterization
4. Expansion of markets in newly emerging economies

Source: Frost & Sullivan Report (May 2018)  
"Global Materials Characterization Market, Forecast to 2024"

## II. Growth Strategy—Materials Science

### Deploy Business in Materials Analysis Market (2)



## II. Growth Strategies—Deploying New Products

### Measures to Expand the Mass Spectrometer Business (1)

## Mass Spectrometer (MS) Business Expansion Measures

### • Market conditions

- ✓ Market size is about 600 billion yen, with an estimated growth rate of about 6 %.
- ✓ Demand is mainly expected in pharmaceuticals, biotech, and food fields in the private sector and in environmental measurement and academia/government fields in the public sector.
- ✓ Additional increases in sensitivity and resolution, and widespread adoption of in vitro diagnostics, early diagnosis of diseases, and other technologies are predicted in healthcare fields.

### • Shimadzu's expansion measures

- ✓ Expand/improve product lines of high resolution liquid chromatograph mass spectrometers (p. 23), new gas chromatograph mass spectrometer models (p. 24), and direct mass spectrometers (p. 25).
- ✓ Promote researching new applications for using MS in healthcare fields. (p. 10-p. 18)
  - Cancer: Risk screening, pathological diagnosis support, photoimmunotherapy support, and follow-up examination support
  - Lifestyle diseases: Risk screening, primary aldosteronism treatment support, and medication management support
  - Psychiatric disorders (Alzheimer's): Risk screening and diagnostic support
- ✓ Develop expert systems based on using AI and ICT technologies for sophisticated data processing and analysis.

## II. Growth Strategies—Deploying New Products

### Measures to Expand the Mass Spectrometer Business (2)

# New Mass Spectrometer (MS) Product: LCMS-9030 High-Resolution Liquid Chromatograph Mass Spectrometer

- **High Resolution**  
Highly reliable compound identification
- **High Accuracy**  
High mass accuracy
- **High Stability**  
Maintains high mass accuracy even after operating continuously for long periods in environments with temperature variations

- **High Operability**  
**Simple operability:** Uses highly rated LabSolutions LCMS software, which has an extensive track record in LC, GC, and quadrupole LCMS systems.



New Fields Being Developed for Q-TOF Mass Spectrometers	
<b>Biopharmaceuticals</b>	Characterization of biopharmaceuticals, identification of impurities, etc.
<b>General Structural Analysis</b>	Structural analysis of impurities in pharmaceuticals and synthetic chemical substances, etc.
<b>Food Safety, Environmental Testing, Forensics</b>	Screening for unknown compounds, etc.
<b>Omics Analysis</b>	Biomarker discovery, etc.

- Sales of 30 units are expected in FY2018.
- Successively expand/improve line of application software, such as impurity analysis software, residual pesticide/toxicological drug screening software, and peptide mapping software.
- Successively release new products with higher resolution.

## II. Growth Strategies—Deploying New Products

### Measures to Expand the Mass Spectrometer Business (3)

#### New Mass Spectrometer (MS) Product: NX Series Gas Chromatograph Mass Spectrometers

- **Configured with a state-of-the-art GC unit and highly accurate mass spectrometer unit**  
Offers maximum sensitivity and better reproducibility based on precise flow control achieved by combining the latest Nexis GC-2030 GC unit with a highly accurate mass spectrometer unit. Furthermore, the software provides more efficient system operability for achieving a smoother workflow.
- **Three models released simultaneously**  
Three models were released simultaneously, two triple quadrupole models (a high-end GCMS-TQ8050 NX model and a standard GCMS-TQ8040 NX model) and one single quadrupole model (GCMS-QP2020 NX).
- **Satisfies a wide range of needs**  
In addition to the three models above, we will also offer a broad line of pretreatment systems and various databases for satisfying customer needs in detail and for satisfying demand in academia/government, chemicals, and energy fields for regulatory compliance, such as environmental measurement and food safety.



GCMS-TQ8050 NX



## II. Growth Strategies—Deploying New Products

### Measures to Expand the Mass Spectrometer Business (4)

# Mass Spectrometer (MS): Deploy Direct Mass Spectrometer

Strengthen the deployment of direct MS systems, which do not need the chromatographic separation process.

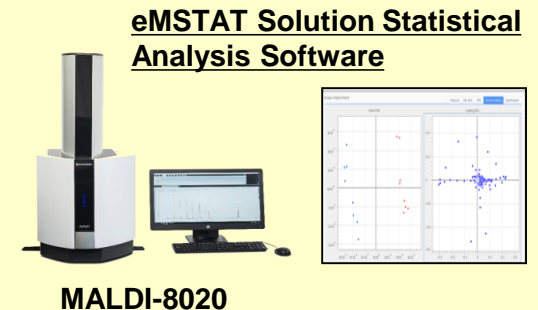
## ■ MALDI-TOF Time-of-Flight Mass Spectrometers



A new more compact tabletop model released in October 2017 is also easier to maintain.

Deploy the model in fields such as drug discovery, diagnostics, and chemicals.

(It was awarded the Japan Institute of Design Promotion Prize at the 48th Machine Design Awards.)



MALDI-8020

**Drug discovery**  
Protein drug analysis  
QC of synthesized compounds (nucleic acids and peptides)

**Diagnostic research**  
Known profiling

**Chemical products**  
Polymer and oligomer analysis  
Additive analysis

## ■ DPiMS-2020/8060 Probe Electrospray Ionization Mass Spectrometers

Able to analyze mass with only simple sample pretreatment, they can achieve quick and easy screening. Deploy them in fields that analyze chemicals, foods, and biological organisms, for example.

(The product was commercialized based on results from a Japan Science and Technology Agency Program for the Development of Systems and Technology for Advanced Measurement and Analysis.)



DPiMS-2020

**Chemicals**  
Check synthetic substances

**Foods**  
Supplement degradation analysis  
Contaminant screening analysis

**Biological organisms**  
Quickly perform screening and metabolic analysis directly from biological samples



DPiMS-8060

## II. Growth Strategies—Deploying New Products

### Measures to Expand the Liquid Chromatograph Business (1)

## Liquid Chromatograph (LC) Business Expansion Measures

### • Market conditions

- ✓ Market size is about 500 billion yen, with an estimated growth rate of about 5 %.
- ✓ Demand mainly expected from private sector pharmaceuticals/biotech and academia/government, etc.
- ✓ Demand is predicted to increase, due to increased automation and labor-efficiency of analysis, improved functionality using AI, and so on.

### • Shimadzu's expansion measures

- ✓ Continuously expand/improve product lines, such as with biopharmaceutical compatible models. *ref. p. 27*
- ✓ Use IoT technologies to strengthen device management systems and expand customer asset management support businesses, such as the preventive maintenance business. *ref. p. 27*
- ✓ Promote product development in closer cooperation with customers, such as with joint development with pharmaceutical company consortiums in the United States. *ref. p. 27*
- ✓ Expand the consumables business by expanding/improving column product line and offering packages. *ref. p. 28, p. 31*
- ✓ Strengthen deployment in China, which has the highest market growth rate, expand sales of integrated and dedicated models (analyzers), and accelerate deployment in promising fields, such as clinical, CRO, and environmental measurement fields.

## II. Growth Strategies—Deploying New Products

# Measures to Expand the Liquid Chromatograph Business (2)

### Liquid Chromatographs (LC) New Products

Perform highly sensitive and reliable analysis of peptide drug products, nuclear drugs, and so on, for research and development or quality control of biological macromolecules or biopharmaceuticals.

#### Nexera Bio



- **High-sensitivity analysis**  
High sensitivity detection achieved by suppressing sample adsorption.
- **Prevent instrument problems before they occur**  
Prevent salt precipitation and other problems during analysis of antibody drugs.

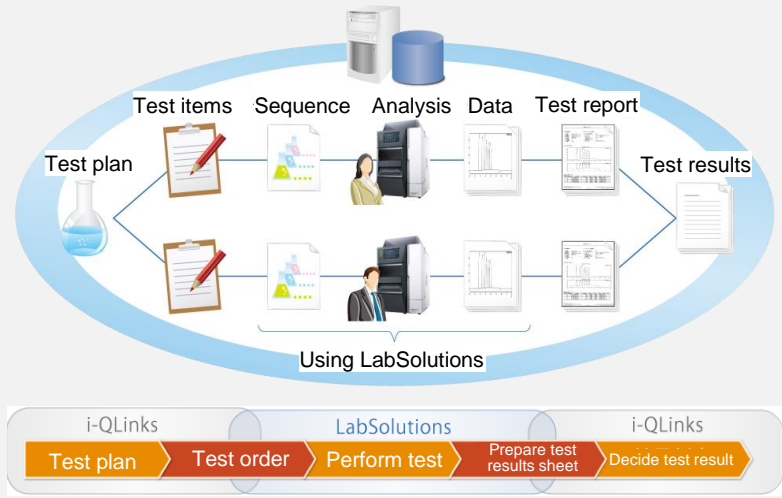
#### High-Sensitivity LCMS Biopharmaceutical Analysis System Nexera Mikros



- **High robustness**  
Achieves high analytical reproducibility even for continuous analysis of plasma samples.
- **Outstanding easy operability**  
Columns can be installed in MS units in one step, without creating any dead volume.

Contribute to improving the reliability of test data for pharmaceutical companies by releasing LabSolutions i-Qlinks, a network system with LIMS functionality to support creating test protocols, analyzing samples, analyzing results, and creating test reports for each pharmaceutical manufacturing process step.

#### Test Information Management System LabSolutions i-Qlinks System



Check the synthesis status or analyze impurities in chemicals, drugs, or other compounds and provide total LC/SFC solutions for supporting preparative purification of optical isomers in pharmaceuticals.

#### Preparative Purification System Nexera Prep

- **High efficiency**  
Simulation function saves time.
- **Smaller space requirements**  
About 50 % smaller size than competing products.
- **New Shim-pack Scepter preparative column**  
A line of new columns makes it easy to scale up from analysis to preparative separation.

#### Preparative SFC System Nexera UC Prep



- Engaged in joint development with a consortium of major pharmaceutical companies in the U.S. (ETC).
- Build a system optimized for large-capacity preparative separation of chiral compounds during synthesis for drug discovery.

## II. Growth Strategies—Aftermarket Business

# Measures to Expand the Column/Reagent Business

## Consumables and Reagent Business

### Expand/improve consumables product line and expand reagent sales

Expand sales of LC and GC consumables and MS reagents.

Aim to expand sales and profitability to a new level by achieving synergies between instruments, consumables, and reagents for key models.

#### ■ Expand/improve consumables product lines

- ✓ Expand/improve the LC column product line (adding 750 items in 2018 to about 3400 items), mainly for high value added products, such as products that support analyzing basic compounds, high-speed analysis, or alkaline conditions.
- ✓ Improve line of columns and other consumables for biotechnology fields.
- ✓ Continue to consider business expansion via mergers or acquisitions.

#### ■ Measures to develop reagents

- ✓ Jointly developing new reagents with Alsachim in France (acquired in 2017), releasing immunosuppressant analysis kits in Europe and Japan, and even plan to apply for FDA approval in the United States. Develop a kit for TDM (deployed horizontally).



## II. Growth Strategies—Network Business

# Measures to Expand the Network Business

## Measures to Expand the Network Systems Business

### • Market conditions

- ✓ Market size is about 62 billion yen, with an estimated growth rate of about 4 %.
- ✓ In addition to pharmaceuticals, other major demand fields include CROs and petrochemicals, for example.

### • Shimadzu's expansion measures

- ✓ Develop total systems for integrated management of analytical instruments and test information, such as systems that improve the efficiency of pharmaceutical testing processes or that offer stronger security functionality.
- ✓ Ensure data integrity for all analytical instruments in pharmaceutical or other laboratories.
- ✓ Also strengthen deployment in ferrous metal, non-ferrous metal, rubber materials fields, or other fields where data tampering has been a problem for society.
- ✓ Use AI and IoT technologies to improve network systems and expand the business through cooperation with the service business.



## II. Growth Strategies—Developing New Demand

# Measures for Cannabis Analysis in North America (1)

## Cannabis Analysis

### Develop new demand in North America

Actively develop new demand based on the legalization of medical and recreational cannabis (marijuana) in the United States, Canada, and other locations.

#### ■ Background for expanded demand for analysis and Shimadzu measures

- ✓ Given the progress in the medical research of cannabis, which has shown (WTO) therapeutic benefits for glaucoma, cancer, AIDS, spasms, pain relief, depression, and other conditions, progress toward its legalization has continued ever since it was legalized in Colorado State in January 2014.
- ✓ Currently, it has been legalized for recreational use in six states, including California in 2016, which has the largest population in the United States. In October 2018, it is scheduled to be legalized in Canada as well.
- ✓ Due to the legalization under state law in the United States, production levels within states have been steadily increasing, which is expanding demand for analysis to confirm the active ingredients and control residual pesticide levels.



## II. Growth Strategies—Developing New Demand

# Measures for Cannabis Analysis in North America (2)

## Cannabis Analysis

(continued)

### ■ Background for expanded demand for analysis and Shimadzu measures

- ✓ Shimadzu North America (SSI) got a head start on accommodating cannabis demand.
- ✓ SSI has been successively commercializing liquid chromatograph systems designed specifically for cannabis analysis and specialized consumable and reagent kits.
- ✓ Application software is provided with gas chromatograph mass spectrometer, liquid chromatograph mass spectrometer, and ICP mass spectrometer systems to comply with residual pesticide regulations that vary depending on the state.
- ✓ The systems also satisfy similar demand in Europe.



**Cannabis Analyzer**  
Dedicated LC system for analyzing active components in cannabis



**Specialized Consumables Kit**  
Columns and reagents for cannabis analysis



**Mass Spectrometers**  
Analyzes residual pesticides and heavy metals in cannabis



**Moisture analyzer (left) and analytical balance (right)**

## II. Growth Strategies—Developing New Demand

# Participation in Creating Regulations

### Participate in Creating Various Regulations for Environmental Measurement, Energy, and Other Fields and Strengthen Ties to Regulatory Authorities

Global Regulations	Starting Year	Content	Related Products
Revised RoHS Directive	2019	Participate in creating the international standard IEC 62321—Part 8 (testing method for phthalate esters) and develop products compliant with the standard.	Py-Screener (GC/MS system with pyrolyzer)
Chemical substance regulations by the United States Environmental Protection Agency (EPA)	2019	Participate in round robin testing of the method for testing fluorine compounds (PFAS: polyfluoroalkyl substances).	LCMS high-performance liquid chromatograph mass spectrometers
Chemical substance regulations by the United States Environmental Protection Agency (EPA)	2016	Total nitrogen analysis method adopted as ASTM-D8083	TOC total organic carbon analyzers
Measurement of trace moisture content in LPG	2019	Currently under review as standard testing method submitted to ASTM as official method for United States (WK59649)	Trace moisture content measurement system using GC and BID units
Standardization (adopted by ISO) of high-speed plastic tensile testing method	2023	Participate in creating high-speed tensile testing method for evaluating strain-rate dependence of plastics.	Hydroshot HITS-T series hydraulically controlled high-speed tensile testing machines

Japanese Regulations	Starting Year	Content	Related Products
Drinking water quality testing method	2018	Simultaneous pesticide analysis method jointly developed with National Institute of Health Sciences	LCMS high-performance liquid chromatograph mass spectrometers
Revision to regulation (notification) for controlled medical devices requiring special maintenance, specified by the Minister of Health, Labour and Welfare	2018	Classification for mass spectrometers added to clinical chemical inspection systems	LCMS high-performance liquid chromatograph mass spectrometers



# Index

I. Outline of Analytical & Measuring  
Instruments Business

II. Growth Strategies

**III. R&D**

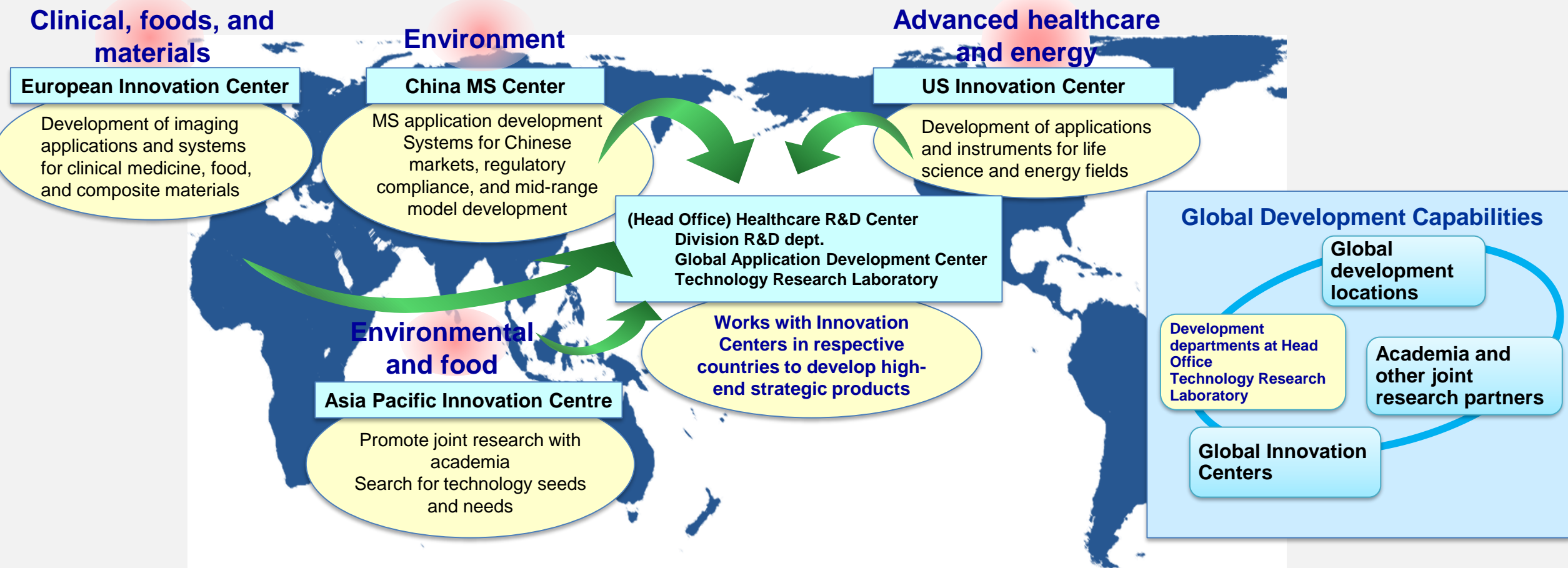
**Global Development Capabilities, Healthcare R&D  
Centers, and Innovation Centers**

IV. Summary

III. R&D

# Global Development Capabilities

Promote global research and development by strengthening cooperation between development departments at Head Office and locations outside Japan and promoting joint research with academia or other leading research institutions.



### III. R&D

# Healthcare R&D Center

**Strengthen ties to advanced research institutions. Strengthen synergies to Shimadzu technologies and accelerate deployment in healthcare field.**



### III. R&D

# Innovation Centers

Location	Number of Projects	Representative Development Project	Field	Joint Research Organization
US	8	<b>Development of System for Measuring Antibody Drug Concentrations in Tumors</b> Develop a method to analyze antibody drugs in tumors by using nSMOL and use it to develop new treatment method.	Clinical Pharmaceutical	Providence Cancer Ctr
		<b>Development of System for Analyzing Allergens</b> Develop a food allergen analysis system based on combining automatic protein pretreatment with LCMS.	Foods	FDA and NIST (candidate)
		<b>Development of Preparative SFC System</b> Develop a preparative SFC system jointly with a consortium of major pharmaceutical companies (ETC).	Pharmaceutical	Enabling Technologies Consortium
China	5	<b>ICP-MS Elemental Analysis for Omics Applications</b> Develop a system for observing the status of schizophrenia and autism treatment.	Clinical Pharmaceutical	Peking University Health Science Center
		<b>Development of System for Analysis of Functional Ingredients</b> Develop a Nexera UC method package for analyzing ingredients with functional benefits in vegetables.	Foods	National Engineering Research Center for Vegetables
Europe	6	<b>Development of Method for Directly Analyzing Biomarkers from DBSs by SFE/SFC-MS Intended for Tailor-Made Healthcare</b> Direct DBS analysis system using SFE/SFC-LCMS-8060 system	Clinical	University of Geneva (Switzerland)
Other Asian Countries	7	<b>Environmental phosphate monitor</b> Develop a high-sensitivity and compact online river nutrient monitor	Environment	National University of Singapore (NERI)

# Index

I. Outline of Analytical & Measuring Instruments Business

II. Growth Strategies

III. R&D

**IV. Summary**

## IV. Summary

# Achieve Additional Growth

### **Expand/improve high-end products and accelerate development of new fields and new demand.**

- **Satisfy broad demand for analytical systems, for applications ranging from cutting-edge to general-purpose, by offering an extensive line of products and services.**
- **Create new demand, not only in the healthcare field, but also in other growth fields, such as new materials, environmental measurement, and food safety.**
- **Release an unbroken stream of high value-added products and services based on a core of liquid chromatographs and mass spectrometers in a broad range of fields ranging from pretreatment to aftermarket. Also use software applications to strengthen efforts to generate demand.**
- **In the case of mass spectrometers in particular, develop new demand more quickly in the recently entered field of high resolution Q-TOF systems and create new demand for probe electrospray ionization mass spectrometers by offering dedicated models.**
- **Also create new demand by actively participating in creating global regulations, such as environmental and food safety standards.**
- **Take on the challenge of creating number-one and truly unique products by strengthening R&D functions globally, such as Innovation Centers and the Healthcare R&D Center, by accelerating joint research projects with academia, leading hospitals, or others in advanced fields.**

**New Products**

**Key New Products Released During the Past Year (1)**

**Life science, chemical, and food fields**



**LCMS-9030 Mass Spectrometer**

**Food safety, environmental testing, forensics, and omics**



**GCMS-TQ8050 NX Mass Spectrometer**

**Environmental testing and food safety**



**MALDI-8020 Time-of-Flight Mass Spectrometers**

**Biopharmaceuticals and chemicals**



**C2MAP System Cell Culture Media Analysis Platform**

**Drug discovery and regenerative medicine research**



**Cell Picker Cell Culturing Support System**

**Drug discovery and regenerative medicine research**



**Stable isotopes**



**Intestinal pathogenic bacteria genetic testing reagent kit**



**Protein Sequencer PPSQ-51/53A**

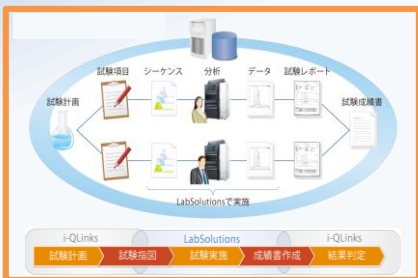
**Biotechnology research**



**LabSolutions Insight Multi-Analyte Quantitation Software**



**LC/MS/MS Method Package for Aminoglycoside Antibiotics**



**LabSolutions i-QLinks Test Information Management System**

**Pharmaceutical quality testing**



**Nexera Mikros Micro-flow Mass Spectrometer**

**Biopharmaceuticals**



**Nexera UC Prep Preparative Purification System**

**Drug discovery and chemicals**



**Nexera Bio Biological Macromolecule Analysis Kit for Nexera XR Systems**

**Biopharmaceuticals**



**Smart Forensic Toxicological Database for GCMS-TQ Series Systems**



**LC/MS/MS Method Package for Mycotoxins**

## New Products

# Key New Products Released During the Past Year (2)

### Materials, environmental and energy fields



**GC-MS Phthalate Ester Screening System**

**Electrical/electronics  
(revised RoHS compliant)**



**Thermal Desorption System  
(GC-MS Pretreatment Unit)**

**Environment**



**EDX-LE Plus Energy Dispersive X-Ray Fluorescence Spectrometer**

**Electrical/electronics**



**IRSpirit FTIR Spectrophotometer**

**Environmental,  
chemicals, and foods**



**UV-1900 UV-VIS Spectrophotometer**

**Environmental and chemicals**



**VOC-3000F FID Type VOC Analyzer**

**Environment**

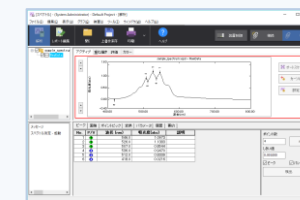


**TP-4210 Online TP Analyzer**

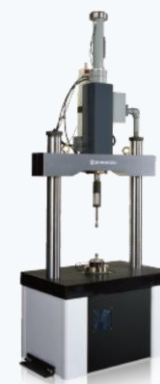
**Environment**



**LabSolutions UV-Vis**



**UV-Vis Control Software**



**HITS-X High-Speed Impact Testing Machine**

**Materials and automotive**



**XDimensus 300 Non-Destructive CT Inspection System**

**Automotive and electronics**





This document contains forward-looking statements. Forecasts of future business performance that appear in this document are predictions made by the company's management team that are based on information available when these materials were prepared and are subject to risks and uncertainties. Consequently, actual results may differ materially from the forecasts indicated above. Factors that may influence actual business performance include, but are not limited to, economic conditions within and outside Japan, changes in technologies in markets, and fluctuations in exchange rates.