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AWARD

Canon

2020 GLOBAL COMPUTED TOMOGRAPHY
NEW PRODUCT INNOVATION AWARD

Contents

Background and Company Performance

Industry Challenges

Healthcare costs worldwide are on the rise as chronic conditions such as cancer, diabetes, and cardiovascular diseases become more prevalent along with the rapidly aging population. In 2016, the global expenditure for healthcare reached $8 trillion, with projections to increase to $15 trillion by 2050.[1] Economic pressures worldwide demand complex and disruptive changes to curb the staggering costs, thrusting value-based care frameworks and reimbursement models front-and-center.

Computed Tomography At-A-Glance

Introduced in the 1970s, computed tomography (CT), a non-invasive technique, uses computer-processed X-rays to obtain cross-sectional and volumetric images of human anatomy. Since the first installed CT scanner in 1971, incremental upgrades in the scanner performance over the last four decades, mainly resolution and speed, led to disruptive technology and product innovations—volume CT scanners and multi-slice technology in the 1990s and wide-area detector systems, advanced visualization (AV) platforms, and spectral imaging, i.e., dual-energy, in the 2000s. CT evolved above and beyond its structural imaging capabilities, into tissue characterization and physiological imaging. Superior diagnostic accuracy and faster scans further expanded CT's clinical utility across specialties, including cardiology, oncology, pediatrics, and trauma care.

Today, CT is a workhorse imaging modality of any healthcare enterprise—nearly 268 million procedures performed worldwide in 2019, growing to 320 million scans per year by 2022.[2] Healthcare providers rely on CT to provide detailed structural information about internal organs to support clinical decision-making across the care continuum, diagnosis, screening, and therapy planning and monitoring. Paradoxically, heavy imaging utilization and associated expenses contribute substantially to the rising healthcare costs. Mainly, overutilization, misuse, and repeat testing—the usual suspects—drive significant unnecessary spending.

Spectral imaging: Pushing the Envelope

Spectral imaging extracts more information compared to conventional CT and, hence, improves diagnosis. Meaningful insights, higher spatial resolution, and faster scanning speeds, along with lower radiation doses, accelerate the imaging workflows and image analysis for fast and efficient patient triage, e.g., stroke, and greater diagnostic certainty, e.g., cardiac examinations. Furthermore, low-dose CT scanning is now also an approved and reimbursable modality in the United States (US) for lung cancer screening and nearing approval for colorectal cancer screening.

While promising to deliver the next-generation of CT imaging, spectral techniques have yet to achieve their full potential. First and second-generation systems remain underutilized. Historically cumbersome workflows and technical limitations impact image quality, radiation

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[1] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)30841-4/fulltext
[2] *Implications on Utilisation of Diagnostic Imaging, 2017–2022* (Frost & Sullivan, February 2019)

dose, and organizational and clinical efficiencies—often hindering routine use and widespread implementation. With value becoming the paramount currency in radiology, leading original equipment manufacturers (OEMs) must overcome shortcomings around key performance indicators affecting care quality, patient safety, and operational efficiencies.

…The Next Frontier: Artificial Intelligence

Continued workflow automation coupled with developments in advanced imaging technologies leveraging artificial intelligence (AI), e.g., machine learning (ML) and deep learning (DL), for real-world data assessment and quantification will drive improved analysis and future market growth. Indeed, Frost & Sullivan projects these ultra-high-end systems playing a critical role in pediatric imaging, colon screening, and lung cancer, among others. Frost & Sullivan estimates the global CT market at nearly $4.5 billion in 2021, with about 65% of revenues stemming from 64 slice and high-end CT scanners.[3]

In the race for leadership in this highly competitive, innovation-driven field, Frost & Sullivan identifies DL-based image reconstruction as a tremendous growth opportunity for next-generation, premium-grade CT systems. A significant amount of valuable imaging information gets lost in current image reconstruction methods. AI can tackle pre-pixel data, i.e., raw signals, thus, uncovering layers of additional information, both anatomical and physiological. At the same time, DL-based image reconstruction can address existing limitations, whether acquisition times, radiation requirements, operator dependence, or reliance on contrast agents, all while enhancing image quality—opening new inroads for value-based imaging.[4] Frost & Sullivan estimates the global medical imaging AI market will reach $1.4 billion in 2022, with a compound annual growth rate of about 74% from 2018 to 2022.[5]

New Product Attributes and Customer Impact of Canon Medical Systems USA, Inc.

Headquartered in Tustin, California, Canon Medical Systems, USA, Inc., (Canon Medical) is a global technology leader and pioneer in integrated diagnostic imaging solutions.

Canon Medical develops, manufactures, commercializes, and services a range of radiology and cardiovascular systems installed in over 140 countries around the world. Its diagnostic imaging portfolio includes X-rays, digital radiography (DR), ultrasound, CT, magnetic resonance (MR), and positron emission tomography-CT (PET-CT) devices.

Aquilion ONE™: Landmark Innovation

A game-changing CT system, the Aquilion ONE™, the world's first 320-slice scanner, remains unmatched relative to coverage. The wide-area detector revolutionized the industry with 160 millimeters dynamic volume coverage, opening new markets. It allowed complex acquisitions, scanning whole organs, e.g., heart, liver, and brain, within a single

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[3] *Global Computed Tomography Market, Forecast to 2021* (Frost & Sullivan, November 2017)
[4] *Growth Opportunities in the Global Medical Imaging Artificial Intelligence Market, Forecast to 2022* (Frost & Sullivan, October 2018)
[5] *Ibid*

heartbeat. Furthermore, sub-second examinations, i.e., one-fourth of a second—normal heartbeat is 0.8 seconds on average—facilitated high-quality imaging at faster scanning times, further reducing radiation exposure.

With a scalable, innovative platform, Canon Medical further incorporated detector and technical enhancements to its best-in-class performing CT. Next-generation systems respond to the evolving demand for broader imaging, higher resolutions, faster scanning, and lower radiation doses, expanding the clinical utility and increasing procedural ranges. Company releases over the next decade include the Aquilion ONE™ ViSION, 2012—supporting faster rotation and larger patients —and Aquilion ONE GENESIS Edition, 2016—enabling simple X-ray-like clinical workflows and high-resolution with low-dose for greater diagnostic confidence.

World-class Converging Technologies: A New Innovation Era

With its significant presence in photography, Canon leveraged its AI capabilities and know-how, heavily utilized in the field for years, to position Canon Medical at the forefront of AI capabilities in CT, just recently making inroads in medical imaging.

Therefore, the 2016 deal propelled the Aquilion ONE™ family further, entering first the realm of AI, in 2018, with its Advanced Intelligent Clear IQ Engine (AiCE) DL reconstruction (DLR) technology—cleared by the Food and Drug Administration (FDA) in June 2019. The company installed its AiCE DLR on the Aquilion ONE™ GENESIS Edition—FDA-approved in November 2019.

In December 2019, Canon Medical unveiled its latest premium CT technology, the Aquilion ONE™ PRISM Edition, the world's first DL-based wide-area spectral CT seamlessly integrated with its Vitrea® Advanced Visualization spectral solution, at the Radiological Society of North America's annual meeting in Chicago.

Aquilion ONE™ PRISM Edition: Redefining CT Imaging

Spectral imaging involves image acquisition at two different energy levels in a single scan. This enables enhancing distinct anatomical features based on differences in the body's material density or atomic number, typically displayed on-demand as varying shades of gray or colors on the final image, processed and examined to extract more information.

Indeed, with better and more insights into abnormal anatomies, spectral CT potentially improves diagnostic confidence and may reduce downstream imaging, delivering better care at reduced overall costs. Nonetheless, existing spectral systems have intrinsic technical limitations, resulting in trade-offs across capabilities relative to conventional CT imaging, e.g., image quality, radiation dose, scanning speed, time-to-results, and workflowsWhile a superior technique, these concerns are non-negotiable in the value-based care landscape and, thus, fundamental for taking radiology to the next level.

"Adding AI-based reconstruction to the Aquilion ONE™ enables performing complex acquisitions, such as in cardiac, stroke, and pediatrics, and visualizing detailed information . By extending this to spectral, we [Canon Medical] made our Area Detector CT even better with AI-based spectral, finally facilitating meaningful insights in a time-efficient manner and without trade-offs."

—Sr. Manager, Solutions Marketing, Canon Medical

Designed for deep intelligence, the Aquilion ONE™ PRISM leverages DL for conventional and spectral reconstruction algorithms on its best-in-class performing CT to address the current challenges for routine use in healthcare.

Aquilion ONE™ PRISM Edition

Courtesy of Canon Medical Systems, USA, Inc.

No Compromises

DL spectral reconstruction transforms multi-energy raw data sets into two full separate sinograms, high- and low-energy. These separate full sinograms empower spectral analysis with the same high-resolution and low-noise features as conventional CT exams, but with enhanced visualization, characterization, and quantification insights. Through AiCE DLR, the system enhances diagnostic confidence, delivering fast, sharp, clear, and distinct images at low radiation dose.

With AI deeply embedded in the solution and smoothly integrated into PACS, the Aquilion ONE™ PRISM's end-to-end workflows blend seamlessly into routine CT protocols. Hence, physicians can easily and swiftly capture relevant, vital diagnostic information, potentially defining the patient's care journey, without additional steps to the standard of care, but achieving a more confident diagnosis.

First Time Right

As healthcare moves towards episode-of-care and bundled payments, radiology providers cannot afford the luxury to triage using multiple diagnostic imaging procedures for a definitive diagnosis. The expanding pay-for-performance healthcare model forces OEMs' business strategies and value propositions to evolve along with global healthcare efforts to increase efficiencies, at reduced costs without compromising care quality, to thrive in this new environment

> *"What if physicians can reach a more confident answer on a single CT study versus having to triage patients using multiple imaging procedures? AI may enable us to do just that."*
>
> *—Managing Director, CT, Canon Medical*

Unlike conventional algorithms with pre-programmed rules, AiCE DLR learns to distinguish a real signal from noise from vast amounts of high-quality image training data, improving signal-to-noise ratio substantially. The low-dose technology delivers high-definition images at fast speeds, enhancing precision, and overall diagnostic confidence.

High Resolution and Low Noise
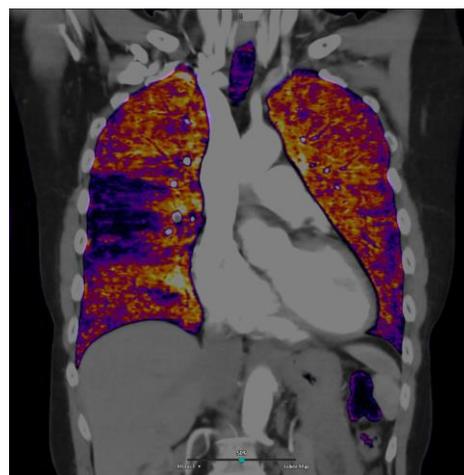
| **Conventional CT** | **Aquilion ONE™ PRISM** |

Courtesy of Canon Medical

Thus, with greater diagnostic confidence while overcoming trade-offs inherent with traditional spectral imaging, Canon's Aquilion ONE™ PRISM empowers healthcare providers to deliver safe, and timely diagnostics, enhancing patients' overall care experience as well as patient flows. Correspondingly, high diagnostic confidence levels may reduce repeat scans or the need for confirmatory testing and, coupled with reimbursement savings, slash direct and subsequent downstream imaging costs.

Most importantly, the Aquilion ONE™ PRISM offers healthcare providers unique strategic agility, advancing CT imaging further into value-based radiology. With fewer resources

and expenses, institutions can optimize assets and resources to improve value in the overall healthcare delivery chain.

By strategizing AI with diagnostic imaging, Frost & Sullivan anticipates the resulting improved workflows and radiology departmental performance outcomes, relative to patient-procedural volumes, to increase by at least 10% depending on the use case.[6]

Envisioning the One-Stop-Shop for All

Whether large or small, private or public, freestanding or hospital-based, all radiology providers need to perform more and better diagnoses in less time and with higher cost-efficiencies for long-term viability and sustained profitability.

> *"What makes the PRISM most interesting is that we can finally take spectral to broader customer segments. It enables broader utilization - across patients and users."*
>
> —*Sr. Manager, Solutions Marketing, Canon Medical*

> *"The PRISM's superior technologies bring to table the ability of a more confident diagnosis within a single modality, and may reduce the need for repeat and/or further downstream imaging procedures."*
>
> —*Managing Director, CT Canon Medical*

Currently, most premium institutions operate dual-energy CT due to its associated complexities. However, Canon Medical expands this solution to broader customer segments potentially benefitting from this technology by leveraging premium CT features with DL-based conventional and spectral reconstruction, harnessing the power of spectral imaging, and the ease of conventional CT. The Aquilion ONE™ PRISM can enhance patient care across settings, from community hospitals to standard universities as well as top-notch institutions, and specialties, from oncology and cardiology to diagnostic and interventional radiology.

Furthermore, while every modality has its place in healthcare, the AI-driven CT scanner can potentially become a one-stop-shop for specific clinical conditions, such as oncology imaging.

Canon Medical: "Made for Life"

> *"We take innovative technologies and make it easy for our customers to extract the most out of these systems in their facilities."*
>
> —*Sr. Manager, Solutions Marketing, Canon Medical*

Leading with Trust

While still ramping-up production, Canon Medical reports approximately 30 shipped (as of Feb 2020) Aquilion ONE™ PRISM systems globally in the short time since it was launched (Dec 2019), with extremely positive feedback from customers. The company's industry-leading customer service further support ongoing commercialization efforts.

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[6] *Global Healthcare Market Outlook, 2019* (F&S, Dec 2018)

Canon Medical first determines whether the scanner is appropriate for a given customer by asking questions on performance needs and goals moving forward. Once it determines fit and potential benefits, it deploys a three-phased approach to ensuring customers' extract the most of their system's advanced capabilities.

Phase 1—*Before the installation*: Canon Medical takes customers to its Advanced Imaging Institute in California and trains them on how to optimize utilization at their facility.

Phase 2—*Immediately after installation*: The company sends multiple applications teams focusing on specific aspects across the operational value along with the respective person in charge, e.g., technologists and clinicians. Canon Medical's expert team ensures these key operands and end-users can set their specific setting to attain the most benefits.

Phase 3—*One-month follow-up:* A company analyst returns a few weeks later, after the customer used the system, to evaluate end-user comfort and satisfaction as well as system utilization; if needed, Canon Medical then develops and executes a plan to address any potential issues.

Today's value-minded landscape and tomorrow's healthcare challenges are driving the demand for next-generation systems. Notably, Canon Medical enjoys a first-mover advantage in the next-big evolution towards value-based CT imaging with the Aquilion ONE™ PRISM system, positioning the company to capture market share along the way.

Frost & Sullivan anticipates the Aquilion ONE™ PRISM will strengthen Canon Medical's position in the global CT market and, as customers experience the system's benefits, will increase its market share across the United States, Europe, and the Asia-Pacific region.

Developed economies, in particular, present huge opportunities for replacement with high-end CT scanners—20% of the equipment in most countries is over 10 years old.[7] Frost & Sullivan estimates the global mid-high CT scanner segment will reach $1.4 billion in 2021.[8]

...Customer-led Innovation

"We have a track record of bringing solid products to market, and the reason behind such success is our close collaboration with our customers."

—*Sr. Manager, Solutions Marketing, Canon Medical*

Canon Medical attributes its decades-long success to its deep-seated understanding of customers' needs. The company has several strategic collaboration sites globally. Canon Medical then leverages its expertise in diagnostic imaging, digital imaging, and intelligent technologies and, incorporating key customer input into its innovation pipeline, brings those products to market.

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[7] *Global Computed Tomography Market, Forecast to 2021* (Frost & Sullivan, November 2017)
[8] *Ibid*

Reportedly, the company allocates over 8% of its annual revenues to research and development efforts. This ongoing innovation cycle keeps Canon Medical at the CT technology forefront, contributing actively to advancing the field.

Conclusion

Canon Medical Systems is at the forefront of the computed tomography (CT) industry. By leveraging artificial intelligence (AI) technologies, the company has introduced the Aquilion ONE™ PRISM Edition, the first deep learning (DL)-based wide-area spectral CT system. Frost & Sullivan's research has identified that AI, specifically DL can bring new demonstrative value and capabilities to diagnostic imaging, resulting in clinical, financial, and operational gains for providers.

The Aquilion ONE™ PRISM Edition enhances diagnostic confidence substantially. It delivers sharper, clearer images, while enhancing the diagnostic information with spectral insights, without the trade-offs inherent to existing technologies. Overall, the Aquilion ONE™ PRISM Edition enables safe, and timely diagnostics, enhancing patient care experiences and improving patient flows. In recognition of these efforts with Aquilion ONE™ PRISM Edition, Canon Medical Systems earns Frost & Sullivan's 2020 Global New Product Innovation Award in the computed tomography market.

Significance of New Product Innovation

Ultimately, growth in any organization depends upon continually introducing new products to the market and successfully commercializing those products. For these dual goals to occur, a company must be best-in-class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.

Understanding New Product Innovation

Innovation is about finding a productive outlet for creativity—for consistently translating ideas into high-quality products that have a profound impact on the customer.

Key Benchmarking Criteria

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated two key factors—New Product Attributes and Customer Impact—according to the criteria identified below.

New Product Attributes

Criterion 1: Match to Needs

Requirement: Customer needs directly influence and inspire the product's design and positioning.

Criterion 2: Reliability

Requirement: The product consistently meets or exceeds customer expectations for consistent performance during its entire life cycle.

Criterion 3: Quality

Requirement: Product offers best-in-class quality, with a full complement of features and functionalities.

Criterion 4: Positioning

Requirement: The product serves a unique, unmet need that competitors cannot easily replicate.

Criterion 5: Design

Requirement: The product features an innovative design, enhancing both visual appeal and ease of use.

Customer Impact

Criterion 1: Price/Performance Value

Requirement: Products or services offer the best value for the price, compared to similar offerings in the market.

Criterion 2: Customer Purchase Experience

Requirement: Customers feel they are buying the most optimal solution that addresses both their unique needs and their unique constraints.

Criterion 3: Customer Ownership Experience

Requirement: Customers are proud to own the company's product or service and have a positive experience throughout the life of the product or service.

Criterion 4: Customer Service Experience

Requirement: Customer service is accessible, fast, stress-free, and of high quality.

Criterion 5: Brand Equity

Requirement: Customers have a positive view of the brand and exhibit high brand loyalty.

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate Award candidates and assess their fit with select best practice criteria. The reputation and integrity of the Awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 **Monitor, target, and screen**	Identify Award recipient candidates from around the globe	• Conduct in-depth industry research • Identify emerging sectors • Scan multiple geographies	Pipeline of candidates who potentially meet all best-practice criteria
2 **Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best-practice criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3 **Invite thought leadership in best practices**	Perform in-depth examination of all candidates	• Confirm best-practice criteria • Examine eligibility of all candidates • Identify any information gaps	Detailed profiles of all ranked candidates
4 **Initiate research director review**	Conduct an unbiased evaluation of all candidate profiles	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best-practice positioning paper
5 **Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• Share findings • Strengthen cases for candidate eligibility • Prioritize candidates	Refined list of prioritized Award candidates
6 **Conduct global industry review**	Build consensus on Award candidates' eligibility	• Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates	Final list of eligible Award candidates, representing success stories worldwide
7 **Perform quality check**	Develop official Award consideration materials	• Perform final performance benchmarking activities • Write nominations • Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8 **Reconnect with panel of industry experts**	Finalize the selection of the best-practice Award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best-practice criteria
9 **Communicate recognition**	Inform Award recipient of Award recognition	• Present Award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance	Announcement of Award and plan for how recipient can use the Award to enhance the brand
10 **Take strategic action**	Upon licensing, company is able to share Award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess Award's role in future strategic planning	Widespread awareness of recipient's Award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree-view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to accelerate growth and achieve best-in-class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages more than 50 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on six continents. To join our Growth Partnership, please visit http://www.frost.com.