FROST & SULLIVAN

PHILIPS

2022
CUSTOMER
VALUE
LEADER

GLOBAL AI-ENABLED
CT WORKFLOW SOLUTIONS INDUSTRY

FROST & SULLIVAN

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each award category before determining the final award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. Philips excels in many of the criteria in the AI-enabled CT workflow solutions space.

AWARD CRITERIA

Business Impact	Customer Impact
Financial Performance	Price/Performance Value
Customer Acquisition	Customer Purchase Experience
Operational Efficiency	Customer Ownership Experience
Growth Potential	Customer Service Experience
Human Capital	Brand Equity

At a Glance

Leading original equipment manufacturers (OEMs) shaped the computed tomography (CT) market over the past 40 years. Disruptive technologies tackling performance, mainly faster-scanning speed and higher spatial resolution, enhanced diagnostic capability, flexibility, and versatility. Today, CT supports clinical decision-making through the care continuum, from diagnostics to therapy planning and monitoring, and across specialties, e.g., radiology, cardiology, oncology, orthopedics, and emergency and trauma care.

The mid-high CT segment is highly competitive, with products across vendors having many similarities. High return on investment, curtailing capital expenditures, and delivering long-term sustainability through value-based imaging solutions underscores critical business needs among health systems worldwide. With value becoming the primary currency in radiology, OEMs must overcome CT financial, clinical, and operational performance shortcomings to capitalize on strategic market imperatives, aligning their value proposition with global healthcare efforts.

Over the last few years, developments in imaging technologies and image analysis software leveraging artificial intelligence (AI), e.g., machine learning and deep learning, have opened new inroads into value-based imaging. At the same time, radiologists' growing confidence in AI-based solutions as efficient tools rather than substitutes is narrowing the adoption chasm. Despite advancements, most OEMs and AI companies focus on narrowly-defined AI applications, with negligible results at the organizational level.

AI-enabled tools are fundamental for workflow optimization and precision diagnosis, with intelligent, automated processes bridging CT performance gaps to advance enterprise-wide efficiencies. However, vendors must integrate AI-driven applications seamlessly into radiologists' workflows to enhance the user experience and unlock real-world value. Thus, like many disruptive technologies, moving from hype to reality requires a successful implementation to reap its full benefits and propel radiology forward.

Rewind to 2019: A Bold, Unique Approach…

Backed by decades-long innovation leadership, Philips Healthcare (Philips) is at the technological forefront, continuously bringing forth novel AI-enabled CT performance enhancements. Frost & Sullivan recognized Philips' Incisive CT as a disruptive value-based platform in 2019. Incisive's fit-for-purpose design meets customers' cost and budget constraints while supporting full clinical workloads, a unique customer offering.

Philips' Incisive CT

Incisive CT Platform

The platform combines its premium technologies with its customer-centric integrated service and solution portfolio and the industry-leading Philips IntelliSpace Portal.

https://www.chadronhospital.com/services/radiology.html

"We (Philips) believe so strongly in the product's reliability that we guarantee the most stressed and costly component of any CT for the lifetime of the system. The normal question I get is, but what's the catch? There is none."

-Robert Fleck, Performance CT Director, Philips

Tube for Life. The tube for life guarantee on Incisive has been raising customers' eyebrows since March of 2019. Beyond the tube's design, Philips has established consistent, high-quality manufacturing processes to ensure mass production stability. Its two disclaimers further safeguard customer transparency and, subsequently, trust.

1. Tube for life guarantee calculation shows savings above $400,000.

2. *Life* means 10 years, generally accepted as the lifetime for a CT. No scan-second limitations, no procedural restrictions; for example, customers scan about 200 patients a day in some sites in China, whereas customers in the United States (US) perform 50 to 60 studies.

"Customers can know exactly what is going to cost them to own and operate a CT for the next 10 years. It is something nobody else can do."

-Robert Fleck

Technology Maximizer. The subscription-based service allows customers to maintain their assets over the system's life, eliminating the capital budgeting process. Technology updates accommodate dynamic market shifts and cyber threats over 10 years, for instance, emerging regulations, clinical enhancements, and arising security breaches.

As consolidation continues, healthcare systems may have 15, 40, and even 100 sites in a close geographic area. Historically, in-room CT imaging is hard to improve. Nonetheless, the Incisive platform's flexible design allows in-room CT upgradability, including detector coverage, rotation, speed, and generator power, growing alongside customers' evolving clinical needs.

Beyond lifetime upgradability, the platform's scalability across the hospital network is a key market differentiator. A 128-slice CT scanner (high-end), Incisive's configuration goes as low as two-centimeter 64-slice, primarily used outside the US. Incisive allows hospital networks to right-size for-the-site under a standardized platform. Clinical applications range from routine CT procedures, e.g., head, neck, chest, abdomen, and musculoskeletal exams, to CT-guided biopsy, low-dose CT studies, and cardiac interventions, thus expanding customers' clinical breadth.

OnPlan. Technologists perform the entire workflow directly by the patient's side with Incisive's unique touchscreen gantry controls. The calming, reassuring presence of the technologist enhances the patient's overall experience, driving quality care and influencing health outcomes. In the US, patient satisfaction is an increasingly used indicator for hospital reimbursement.[1]

"Philips' validated Incisive CT AI platform enhances financial, clinical, and operational performance across clinical applications. Notably, the cost outlay's perfect predictability supports administrative decision-making on optimizing and sustaining operations long-term."

- Norma Vela Roch,
Best Practices Research Team Leader

Notably, Philips' foundational study by the Oz Radiology Group in Queensland, Australia, sets a clear, relevant operational performance baseline. Technologists using OnPlan on Incisive obtained a 19% reduction in time-to-results.[2] Once having a sizeable installed base, the company contracted a third-party research provider to conduct an unbiased survey. The findings from 145 users across eight countries corroborate the Australian study, with nearly half of the respondents reporting improved throughputs of at least seven more exams per day than their existing CT systems.[3]

Philips' validated Incisive CT AI platform enhances financial, clinical, and operational performance across clinical applications. Notably, the cost outlay's perfect predictability supports administrative decision-making on optimizing and sustaining operations long-term.

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[1] https://www.cms.gov/Research-Statistics-Data-and-Systems/Research/CAHPS/HCAHPS1
[2] Frost & Sullivan's Philips Briefing
[3] Ibid

Play 2021: Transcend Either-Or

Philips' latest AI-enabled workflow solutions improve upon Incisive's customer value offering, advancing diagnostic performance excellence and strengthening its "Intellect at Every Step" motto. Unveiled at the 2021 European Congress of Radiology held in Vienna, Incisive with CT Smart Workflow pushes the platform's performance envelope further into value-based imaging. Intuitive, streamlined, end-to-end intelligent image acquisition and reconstruction workflows simplify technologists' existing tasks, democratize expertise, and maximize image quality.

CE-marked mid-2021, Incisive with CT Smart Workflow is available in Europe with subsequent launches following Food and Drug Admnistration (FDA) approval.
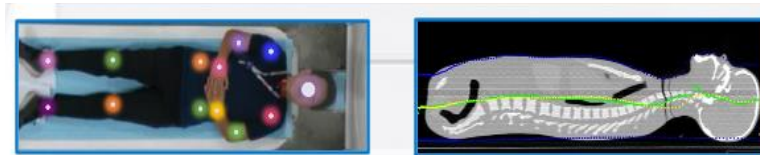
Incisive with CT Smart Workflow: Both-And

Deeply embedded into the technologist's workflow, Philips' AI-powered CT Smart Workflow enhances Incisive's dose, workflow speed, and image quality performance. The robust hardware solution works tightly with sophisticated algorithms to deliver objective, quantifiable results across the radiology value chain. CT Smart Workflow components include:

Precise Positioning

Proper patient positioning, i.e., patient's center of mass at the CT gantry's isocenter, is critical to image and dosage optimization. Typically, radiographers use laser beam guidance to visually check and correct the patient's position on the CT examination table by tweaking the lasers. User-dependent, the manual technique is time-consuming and prone to errors, thus resulting in *either* suboptimal image quality *or* increased radiation.

Precise Positioning

Courtesy of Philips

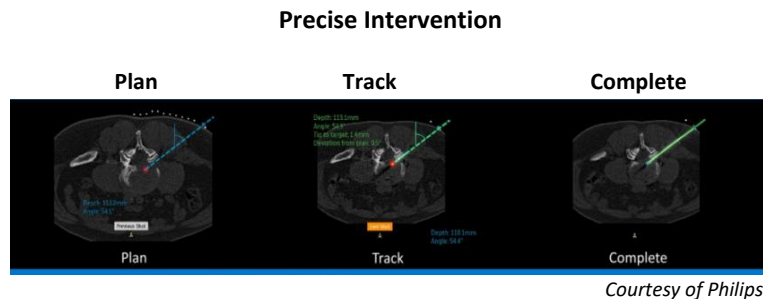*Precise Position*. Incisive's 3-D infrared camera recognizes 13 key anatomical landmarks. It then builds a depth model of the patient and centers the patient at the gantry's isocenter without manual intervention. Notably, Philips reports the embedded AI solution improving vertical positioning accuracy by 50% (single technologist) and user-to-user consistency by 70% while reducing positioning times by 23%.

Precise Intervention

Besides positioning, interventional procedures can hinder radiology department workflows. CT-guided techniques are more time-consuming and pose more variability than routine diagnostic imaging. Patient safety and precise tissue sampling pose additional concerns in CT-guided biopsies. For image interpretation, radiologists rely on Hounsfield units (HU), a relative quantitative radiodensity (or radiopacity) measurement. Low HUs and HU deviations render a higher probability of histological and molecular biopsy success.

Precise Intervention

Plan	Track	Complete

Courtesy of Philips

Precise Intervention recognizes the needle's HU and the targeted lesion's location for interventional procedures. It automatically calculates depth, angle, tip-to-target distance, and deviation from the procedure plan, keeping the radiologist on track from intervention design to completion, particularly significant in challenging procedures.

The solution evens out varying experience and skill levels, enhancing confidence across all interventional radiologists regardless of complexity. Furthermore, the automatic needle tracking and guidance reduces procedural times by 16%, as radiologists no longer go by feel, thus stopping and checking to ensure success.[4]

Precise Image: 80-85-60

"As Low as Reasonably Achievable," known as ALARA, is a universal radiation safety tenant to optimize radiation exposure, i.e., minimizing required dosage for effective CT imaging. Continuous advancements in AI-enabled image acquisition and reconstruction techniques progressively achieve effective dosage reductions, with hybrid-based iterative reconstruction (IR) approaches now comprising the standard of care, e.g., iDose (Philips), ASiR-V (GE), AIDR 3D (Canon), and IRIS (Siemens). The method combines IR and filtered-back projection (FBP) algorithms to improve imaging speed and resolution, respectively. Hybrid-based IR algorithms use one backward projection step.

Still, intrinsic technical limitations often result in performance trade-offs across image quality, radiation dose, and scanning speed, negatively impacting care quality, patient safety, or operational efficiencies. Emerging model-based IR algorithms, e.g., IMR (Philips) and Veo (GE), utilize forward and backward projection steps. The approach seeks to further enhance image quality at lower dosages, particularly valuable in low-dose CT procedures, paving the way for transformational value going forward.

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[4]Frost & Sullivan's Philips Briefing

"Customers cannot take a throughput penalty to lower dose and improve image quality."

-Robert Fleck

Precise Image uses convolutional neural networks (CNN) to reduce radiation dose (80%) *and* lower noise (85%) *and* improve low-contrast detectability (60%).[5] It trains neural networks with FBP cases to preserve the natural image appearance while minimizing dosage and enhancing image quality, i.e., an actual IR near-match. Notably, the CNNs efficiency decreases the computational burden, with all reference protocols across clinical applications reconstructed in less than one minute, delivering the industry's fastest AI-based image reconstruction. The solution fits seamlessly into routine operational workflows.

Precise Image allows more accurate border recognition in difficult-to-see structures like the head of the pancreas and small lung nodules. Thus, the AI-enabled solution enhances radiologists' diagnostic confidence, particularly significant in ultra-low-dose CT applications like lung screening and pediatrics.

Population-based lung cancer screening has gained traction in recent years. Today, marginal image quality often limits its clinical value. The goal is early detection and intervention, i.e., see smaller nodules sooner.

Precise Image
Chest and Abdomen

iDose[4] at routine dose;   Precise Image at 50% less dose
Effective dose 5.1 mSv   Effective dose 2.6 mSv
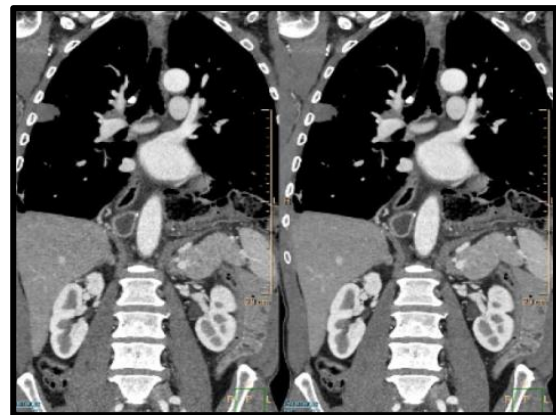
Courtesy of Philips

However, in dealing with an asymptomatic population, the dose must be as low as possible, potentially subverting small nodule detection with the extra noise introduced. Precise Image offers an excellent solution for lung cancer screening programs, reducing the dose substantially while eliminating the extra noise.

Precise Cardiac

Patients with high or irregular heart rates often exacerbate motion, a historically well-known CT issue. Philips has been innovating in cardiovascular CT to overcome these motion concerns for a long time. Advancements such as step-and-shoot scanning, beat-to-beat variable delay algorithm, and arrhythmia detection and handling provide high-quality cardiac imaging, even in challenging patients.

Precise Cardiac

Courtesy of Philips

Precise Cardiac takes Philips advancements one step further with its zero-click technique correcting cardiac motion. The solution understands the motion vector fields around a specific targeted cardiac

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[5] Ibid

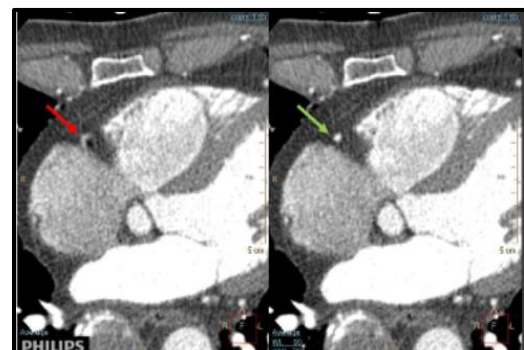phase. It automatically adjusts for that motion, allowing radiologists to assess the coronary accurately (previously non-diagnostic).

Precise Spine and Brain

Philips also drives consistency and improves speed in spine and brain exams. C-spine and L-spine procedures are manual, time-consuming, and prone to error as technologists label segments and disk space. *Precise Spine* automatically performs these tasks with just the click of a button. Similarly, *Precise Brain* automatically creates a symmetrical brain batch parallel to the OEM line without requiring additional work by a technologist or necessitating a separate viewer or post-processing application. When improperly positioned, Precise Brain brings the head back to parallel, improving quality, consistency, and speed.

Application breadth and validated embedded technology fitting within existing radiology workflows distinguish Philips' AI-enabled CT Smart Workflow on Incisive from competitors. It uniquely extends exceptional, quantifiable, coexisting, and validated results on dose reduction, image quality, diagnostic accuracy, and process speed across applications and specialties, taking Incisive to the next performance level.

Looking Ahead

Recently, Philips also released a new Patient Support on Incisive for bariatric patients. The new table goes much lower, facilitating wheelchair transfer, thus enhancing patient experience and comfort. The examination table is also wider and with higher weight capacity than its predecessor, fitting larger patients.

On Demand Clinical Support is also a new feature on Incisive. The company designed it to accelerate the technologists' learning curve. Philips' experts provide support as needed, building staff confidence without disrupting organizational workflows.

"Technologists have expert Philips users at their fingertips for help. Particularly with COVID, more people with varying expertise levels operate CT systems. Additionally, sites increasingly experience turnovers, potentially introducing more variability. On Demand Clinical Support acts a safety net, enhancing diagnostic confidence and improving throughput."

-Robert Fleck

> *"It [CT Smart Workflow] uniquely extends exceptional, quantifiable, coexisting, and validated results on dose reduction and image quality and diagnostic accuracy and process speed across applications and specialties, taking Incisive to the next performance level. "*
>
> *- Norma Vela Roch,*
> *Best Practices Research Team Leader*

CT Smart Workflow on Incisive delivers transformative performance power, enhancing organization-level diagnostic confidence and agility and cost-effectively achieving enterprise-wide care quality and operational efficiencies. Philips' Patient Support and On Demand Clinical Support complement its value offering further.

The company's technical choices, i.e., hardware and algorithm design, and customer-centric integrated

service and solution portfolio deliver a unique value proposition to customers, keeping it one step ahead in the highly competitive mid-high CT segment. Frost & Sullivan estimates the global mid-high CT segment at nearly $2 billion in 2020, reaching over $3 billion by 2021.[6] Philips's high-value, end-to-end customer proposition uniquely positions it to capture market share.

Conclusion

Frost & Sullivan recognized Royal Philips' (Philips) Incisive computed tomography (CT) system as a disruptive value-based platform in 2019. It combines premium technologies with customer-centric integrated services and solutions and industry-leading IntelliSpace Portal to enhance healthcare organizations' financial, clinical, and operational performance. Incisive's cost outlay's perfect predictability allows customers to optimize and sustain long-term operations across applications, from head, neck, chest, abdomen, and musculoskeletal exams, to CT-guided biopsy, low-dose CT studies, and cardiac interventions, within cost and budget constraints, a unique customer offering.

Deeply embedded into the technologist's workflow, the CT Smart Workflow on Incisive advances its diagnostic performance, strengthening its established "Intellect at Every Step" motto. The AI-enabled software suite, e.g., Precise Position, Precise Intervention, Precise Image, and Precise Cardiac, extend exceptional, quantifiable, coexisting, and validated results on dose reduction *and* image quality *and* diagnostic accuracy *and* process speed. Intuitive, streamlined, end-to-end intelligent image acquisition and reconstruction workflows simplify technologists' existing tasks, democratize expertise, and maximize image quality taking Incisive to the next performance level:

- Enhanced patient care quality and safety

- Higher return on investment

- No additional capital expenditures

- Long-term sustainability

With its strong overall performance, Philips earns Frost & Sullivan's 2022 Global Customer Value Leadership Award in the AI-enabled CT workflow solutions industry.

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[6] *Global Computed Tomography Growth Opportunities* (Frost & Sullivan, July 2021)

What You Need to Know about the Customer Value Leadership Recognition

Frost & Sullivan's Customer Value Leadership Award recognizes the company that offers products or services customers find superior for the overall price, performance, and quality.

Best Practices Award Analysis

For the Customer Value Leadership Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

Business Impact

Financial Performance: Strong overall financial performance is achieved in terms of revenues, revenue growth, operating margin, and other key financial metrics

Customer Acquisition: Customer-facing processes support efficient and consistent new customer acquisition while enhancing customer retention

Operational Efficiency: Company staff performs assigned tasks productively, quickly, and to a high-quality standard

Growth Potential: Growth is fostered by a strong customer focus that strengthens the brand and reinforces customer loyalty

Human Capital: Commitment to quality and to customers characterize the company culture, which in turn enhances employee morale and retention

Customer Impact

Price/Performance Value: Products or services provide the best value for the price compared to similar market offerings

Customer Purchase Experience: Quality of the purchase experience assures customers that they are buying the optimal solution for addressing their unique needs and constraints

Customer Ownership Experience: Customers proudly own the company's product or service and have a positive experience throughout the life of the product or service

Customer Service Experience: Customer service is accessible, fast, stress-free, and high quality

Brand Equity: Customers perceive the brand positively and exhibit high brand loyalty

About Frost & Sullivan

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The Growth Pipeline Engine™

Frost & Sullivan's proprietary model to systematically create ongoing growth opportunities and strategies for our clients is fuelled by the Innovation Generator™.

Learn more.

Key Impacts:

- **Growth Pipeline:** *Continuous Flow of Growth Opportunities*
- **Growth Strategies:** *Proven Best Practices*
- **Innovation Culture:** *Optimized Customer Experience*
- **ROI & Margin:** *Implementation Excellence*
- **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our 6 analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.

Analytical Perspectives:

- Mega Trend (MT)
- Business Model (BM)
- Technology (TE)
- Industries (IN)
- Customer (CU)
- Geographies (GE)