White paper

How Dual-Source CT technology becomes more accessible

Reduced costs and optimized Total Value of Ownership (TVO) with SOMATOM Pro.Pulse

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Introduction

The clinical benefits of Dual Source Computed Tomography (DSCT), especially in the field of cardiac imaging, have been described in several studies [1, 2] and have also been outlined in a separate white paper from Siemens Healthineers [3]. Until now, however, many medical institutions have found this technology financially inaccessible and consequently cannot offer their patients reliable cardiac CT imaging. As surveys, for example from the United Kingdom, have shown [4, 5], large sections of the population therefore still lack easy access to coronary CT angiography (CCTA) exams.

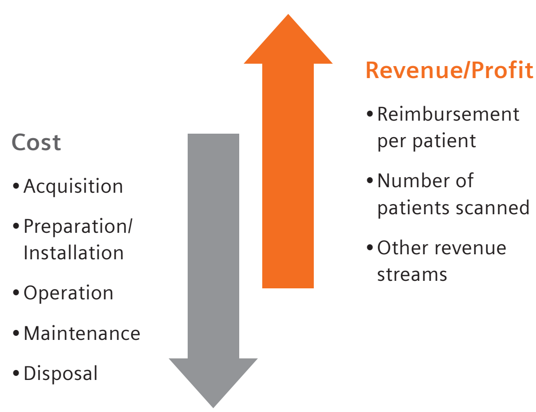
Many hospitals and imaging centers find themselves faced with a multifaceted dilemma: While constantly striving to provide the best possible care, they also face significant pressure to reduce costs. At the same time, they have to cater for an increasing number of cases that require more and more advanced examinations and treatment options. In trying to balance all these different demands, many institutions have found themselves unable to invest in DSCT technology although they are very aware of its clinical benefits.

This white paper will examine how our new generation of DSCT systems, SOMATOM Pro.Pulse, can reduce the Total Cost of Ownership (TCO) and create additional benefits to maximize the Total Value of Ownership (TVO) of a DSCT system. This includes considering many various aspects ranging from site preparation and power consumption to optimized cardiac revenue streams and improved operational efficiency.

The figures and calculations presented here are based on initial customer experiences but they are merely examples. They might not apply to each healthcare provider as individual conditions vary significantly from institution to institution. Nevertheless, when the possible cost reductions together with the additional benefits created along the system life cycle are taken into account, it becomes clear that SOMATOM Pro.Pulse can make DSCT more affordable. It therefore offers many more institutions the opportunity to reap the clinical rewards of this technology for their patients.

Total Cost of Ownership (TCO) vs. Total Value of Ownership (TVO)

When procuring new equipment, medical institutions have to focus heavily on the costs of acquisition and maintenance as these constitute a huge part of the necessary investment. Other costs, such as those for site preparation, installation, operation, and system disposal that accumulate over the life cycle of a system, are also considered, but these "hidden" costs are often more difficult to calculate and compare. As they can add up to a considerable part of the Total Cost of Ownership (TCO) of a system, cost-saving potentials in these fields can make a decisive difference for the accessibility of new technology.



TVO = Total Benefits or Revenue minus TCO

Figure 1: To assess the full value of a system over its entire life cycle, the TCO is weighed against the overall revenue it creates. The TVO is maximized by reducing the TCO but also by creating additional benefits using the new system.

TCO is a well-established concept that provides a useful way to compare costs between different products or suppliers; however, it has limitations in assessing the full value of a new system. This is where the calculation of the Total Value of Ownership (TVO) comes in. Judging the TVO looks beyond a pure cost-based calculation and weighs the TCO against the overall revenue that a particular piece of equipment can generate. This specifically includes all the additional benefits of system that translate into added value. It is obvious that there are two main ways to maximize TVO: by reducing costs and improving revenue. Ideally, both are combined (Fig. 1).

This comprehensive approach can drastically change perspectives on the affordability of new technology and potentially enable a much faster return on investment (ROI) compared with an assessment of acquisition and maintenance costs alone. Furthermore, a decision based on a maximized TVO also considers the benefits created across different clinical pathways. This wider picture considers how the chosen system can realize the potential of an investment for the healthcare institution.

Reduced TCO with SOMATOM Pro.Pulse

Since the TCO covers all costs across the entire life cycle of a system, it offers many options for cost savings. This starts with lowering the costs of acquisition and maintenance but also includes savings in site preparation, installation, and operation, as well as expenses for staff, consumables such as contrast media and energy consumption. A comprehensive calculation takes all these elements into consideration when aiming to optimize the TCO.

In CT systems, several factors contribute to a low TCO, starting with the system design and the CT technology used. However, other aspects should not be overlooked. For example, an optimized workflow based on intelligent software that saves time in image acquisition and reading can also support cost reduction.

This chapter looks at some of the major TCO factors relevant to DSCT systems. It also includes an analysis of how SOMATOM Pro.Pulse enables cost reductions in these areas.

System acquisition and maintenance

Acquiring a scanner that provides the high level of image quality required for complex examinations such as Cardiac CT is a substantial investment. However, there are a few, crucial elements that can optimize the acquisition and maintenance costs of a DSCT system significantly and thus make this technology more easily affordable. The X-ray tube, for example, is one of the most expensive components of a CT scanner and also determines how the system as a whole is designed. When the bore size is reduced from 78 cm to 70 cm, as in the case of SOMATOM Pro.Pulse, a less powerful X-ray tube is sufficient to achieve the same contrast-to-noise ratio (CNR) or in other words image quality. In this case, the AthlonTM X-ray tube requires 30% less power than tubes in previous DSCT scanners, which potentially reduces acquisition and maintenance costs. Beyond this, it also simplifies site preparation (see chapter "Site preparation and installation") and reduces the operational costs over the entire life cycle of the system due to the lower power consumption (see chapter "Operational costs").

Site preparation and installation

Site preparation and installation costs include the expenses associated with preparing the CT room according to the system requirements. While sites have individual preparation needs, the main cost drivers here are electrical infrastructure, cooling infrastructure, shielding, and floor preparation.

In the past, the costs of site preparation and installation for DSCT systems could sometimes become high because of the infrastructure requirements for this high-end technology. Furthermore, site-specific conditions could increase the necessary investment further and, especially if space was limited, the installation of a DSCT system would often not seem viable. Many of these cost drivers have now been reduced with the new generation of DSCT systems.

In order to evaluate the cost impact, a study was conducted by Siemens Healthineers in 2024 [6]. It collected data from the first 17 SOMATOM Pro.Pulse installations, which is used in the following sections to illustrate possible cost-saving potentials.

Cooling infrastructure
One of the most cost-intensive elements of site preparation is the cooling infrastructure. Since all previous DSCT systems required water cooling, an entirely new infrastructure was needed when a healthcare provider wanted to replace a conventional, air-cooled CT scanner with a DSCT system. The extra expenses for the water-cooling infrastructure, including new water pipes for a stable water supply and, if necessary, the installation of a chiller that also needed maintenance, could become daunting. In the case of a radiology department in Germany, for example, the cost of installing a water-cooling system amounted to an average of €50,000 for the installation. This used to be a strong argument against DSCT systems and in favor of conventional scanners, especially if an air-cooling infrastructure was already available in the room.

This drawback has been overcome as SOMATOM Pro.Pulse is the first DSCT system to use air cooling. This allows a conventional, air-cooled CT system to be replaced with minimal changes to the infrastructure if the existing performance capacity is sufficient. The data from the first installations of SOMATOM Pro.Pulse show that the cooling infrastructure at more than 78% of the sites investigated could be reused either without or with only minor adaptations when a CT system was replaced (data on file). At sites where an entirely new cooling infrastructure was required, the costs of the air cooling was rated significantly lower by experts compared with installing water cooling.

Electrical infrastructure

Providing the electrical infrastructure for a DSCT system could also become cost-intensive if the main power supply did not meet the power requirements for the scanner. If healthcare providers had only limited power capacities at their site, the cost of the required upgrade indicated against an investment in Dual Source technology.

This has now also changed as SOMATOM Pro.Pulse requires less power than the previous generation of DSCT systems. An analysis of the first installations of SOMATOM Pro.Pulse has shown that the main power supply needed to be adapted in just 21% of the cases when an existing CT scanner was replaced. If a DSCT system of the previous generation had been installed instead, the main power supply would have had to be adapted in at least 42% of installations.

Depending on the CT system to be replaced, the existing sub-distribution – including power distribution box, fuses, and cables – can be reused or adapted. This may even be required by local regulations. Instead of the two sub-distribution lines required by the DSCT systems of the previous generation, SOMATOM Pro.Pulse requires just one. However, the single line might need to be upgraded. Floor preparation is easier with SOMATOM Pro.Pulse as it is designed with just one power cable leading to the gantry so existing core holes can be reused or adapted.

Space requirements

Healthcare providers often have limited space for a new CT system. In the past, DSCT systems, as with most conventional CT scanners, required a separate technical room in addition to the examination room and control area. If this extra space to accommodate the power distribution components and image control system was not available, any CT system requiring a technical room was generally automatically ruled out.

SOMATOM Pro.Pulse solves this problem by integrating the components for power distribution and part of the image control system inside the gantry. This reduces the minimal room size for the system to just 18 m^2. If SOMATOM Pro.Pulse replaces a system with a larger footprint or one that required a technical room, the space gained can be used in a productive way, e.g., for storage or for a patient changing area (see Fig. 2).

Furthermore, the optional Integrated 3D camera offers a ready-to-run solution for optimized patient positioning that does not require additional mounting and installation.

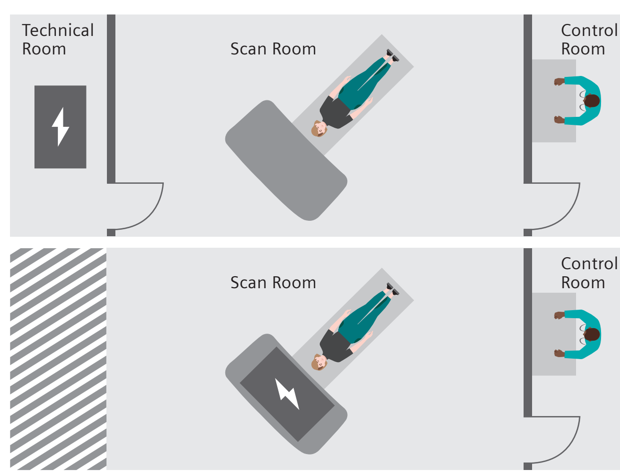


Figure 2: Most CT scanners require a separate technical room. This space is gained with the integrated power distribution units of SOMATOM Pro.Pulse.

Gantry weight
The weight of the gantry can be a decisive cost factor if the proposed CT room is located in a building with limited floor load capacity and therefore might require static construction measures. The SOMATOM Pro.Pulse gantry weighs 11% less than previous DSCT gantries and is much lighter than many other high-end CT systems [7]. If the scanner is to be installed, for example in a listed building, this can support a decision to invest in DSCT technology.

"Our joint practice is located in a listed building. Due to its significantly lower system weight, SOMATOM Pro.Pulse was the only one of the CT systems we considered that met the load-bearing capacity requirements without the need for costly structural measures."

Prof. Henrik Michaely, MD · Medical Director and CEO, MVZ Radiologie, Karlsruhe, Germany

Operational costs

When estimating the TCO, operational costs carry specific weight since they accumulate across the entire life cycle of a scanner. Given that staff-related costs constitute a large part of this, they are usually calculated very precisely when a decision to invest in any new equipment is made. Among the "hidden" cost-drivers of CT scanners are consumables, especially the contrast media used, and power consumption. Both will be addressed in the following.

Contrast-media usage
Several studies have shown that the use of low tube voltage and fast, high-pitch scans allows a significant reduction in contrast media [3, 8, 9]. This is not only a direct clinical benefit of DSCT for the patients, but it could also contribute a significant cost-saving potential in the TCO as the following sample calculation shows:

If a 70 kV protocol is used instead of 120 kV in CCTA imaging, the contrast media volume can be reduced by 49% [10]. Assuming a dose of 70 mL at a price of $0.40 per mL for a 120 kV scan, the reduction translates into financial savings of US$13.70 per examination. With a rate of five CCTA examinations per week for 40 working weeks, this represents savings of US$27,400 for the 10 years of the average scanner life cycle.

Further studies have demonstrated that contrast media usage can also be reduced by optimizing the settings for the scanner in combination with different injection protocols [11, 12].

Power consumption
Power consumption becomes increasingly significant with the prospect of rising global electricity prices. Beyond the cost argument, there is also growing political awareness of the need for energy savings in the healthcare sector in general as it accounts for 5–8% of world industrial energy consumption [13]. More and more governments across the world as well as individual medical institutions have set goals for environmental sustainability. CT scanners with a reduced carbon footprint due to lower power consumption support these goals.

Compared with a number of conventional single source systems as well as the previous generation of DSCT systems, SOMATOM Pro.Pulse consumes significantly less power. This is thanks to improvements in system design, such as the integrated Stellar Detector used in the imaging chain [14].

To calculate the possible savings, two simplified scenarios are given. The power consumption comparison is based on measurements with the setup recommended by the European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry (COCIR) [15]. Here, 20 abdomen scans, each taking 35 minutes are performed during operational time per working day. The schematic power curve of a CT scanner during non-operational and operational time is illustrated in Figure 3.

The scenarios are as follows:

1. A CT scanner used in a **typical hospital radiology department** with 12 working hours (operational time). The scanner is reduced to low-power mode or **switched off overnight** for 12 hours (non-operational time).
2. A CT scanner used in an **emergency department** with the same number of exams during daytime. In this scenario, however, the scanner is **not switched off overnight** and remains in idle or "ready-to-scan" mode.

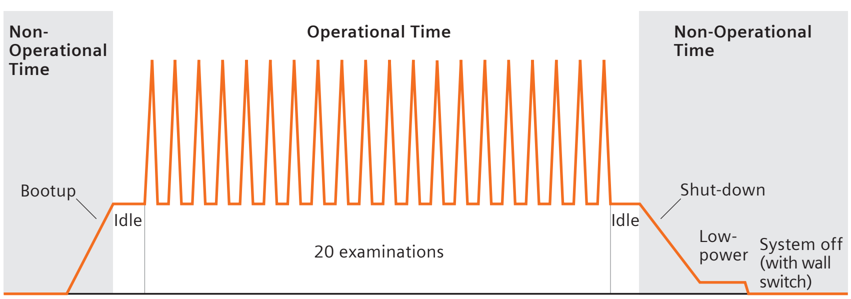


Figure 3: Schematic power curve of a CT scanner during non-operational and operational times.
System off: system shut down via wall switch (zero power consumption)
Low power: minimum energy consumption after shut-down (no wall switch installed)
Idle: system is ready to scan but not actually scanning (no X-ray tube rotation)

Scenario 1 (daytime operation only):
In this scenario, SOMATOM Pro.Pulse consumes up to 30% less energy than the previous generation of DSCT scanners. It also consumes up to 50% less energy in low-power mode than a number of conventional single source scanners [16].

When the scanner is in low-power mode for 12 hours a day, SOMATOM Pro.Pulse consumes about 34.6 kWh in 24 hours. Assuming 260 working days per year (weekends excluded) and a price of US$0.18 per kWh, this represents an annual cost of US$1,619. Calculating with energy savings of 40% compared with a conventional CT scanner, SOMATOM Pro.Pulse enables a TCO reduction of almost US$10,800 over the average 10-year life cycle of the system.

An even greater energy-saving potential can be realized by incorporating a wall switch to reduce energy consumption to zero during non-working hours.

Scenario 2 (emergency use around the clock):
The calculation is slightly different if the scanner is used in an emergency department where it cannot be switched off and has to remain in idle mode both day and night. In this setting, SOMATOM Pro.Pulse consumes up to 20% less energy than the previous generation of DSCT scanners and up to 28% less than a number of conventional single source scanners [16].

In this case, the energy consumption is approximately 65.7 kWh for 24 hours. Again, assuming 260 working days per year and a price of US$0.18 per kWh, this amounts to an annual cost of US$3,075. If the system is used for 10 years and saves about 25% energy compared with other scanners, this represents a TCO reduction potential of well over US$7,500.

SOMATOM Pro.Pulse therefore even enables substantial operational cost savings compared with conventional CT scanners – with the additional benefits of DSCT that add to the TVO of the system.

Improved TVO with Dual Source CT technology

While SOMATOM Pro.Pulse offers TCO saving potentials, as shown in the previous chapter, implementing DSCT technology in general enables a higher TVO with higher revenue, improved operational efficiency, and faster exams.

Optimized cardiac CT revenue stream

One obvious way to increase the TVO is to improve the CT revenue stream through additional reimbursement from advanced procedures such as cardiac exams for a greater number of patients. High temporal resolution is fundamental to achieving this because it improves image quality and helps to reduce motion artifacts caused by high or irregular heart rates. This is enabled by SOMATOM Pro.Pulse with its temporal resolution down to 86 ms.

The great potential to increase revenue with DSCT often lies with outpatient facilities that add cardiac CT to their exam portfolio with the help of a new system. Taking the current reimbursement rate for cardiac CT in the USA (hospital outpatient service) as an example, each additional cardiac exam performed would lead to an additional revenue of US$286.40 (CPT code: 75574) [17]. If six additional cardiac exams were performed each week, this would generate an additional revenue of US$68,740 per year (assuming 40 working weeks a year). If ten additional cardiac exams are performed, the revenue increase totals US$114,560 (Fig. 4). An even higher increase in cardiac CT throughput can possibly be achieved in some countries, which in turn translates into an even higher additional revenue generated by introducing DSCT.

In countries such as Germany, the introduction of new reimbursement rates for CCTA exams and the preceding Calcium Scorning scans in the outpatient scenario will open up a new revenue stream for private practices and make the investment in DSCT technology even more affordable.

Improved operational efficiency

One of the main barriers to offering cardiac CT examinations is the lack of experienced staff for these advanced procedures. While technology alone cannot resolve this situation, a latest-generation DSCT scanner such as SOMATOM Pro.Pulse can help improving operational efficiency with its integrated AI-powered workflow, myExam Companion.

Additional annual revenue with a higher cardiac CT throughput

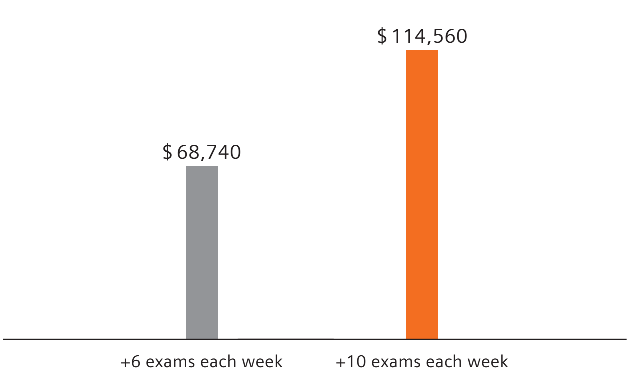


Figure 4: Additional annual revenue generated in a typical U.S. hospital outpatient facility by also performing cardiac CT exams. Reimbursement = US$286.40 per exam; 40 working weeks per year.

Measurements: mean time in seconds

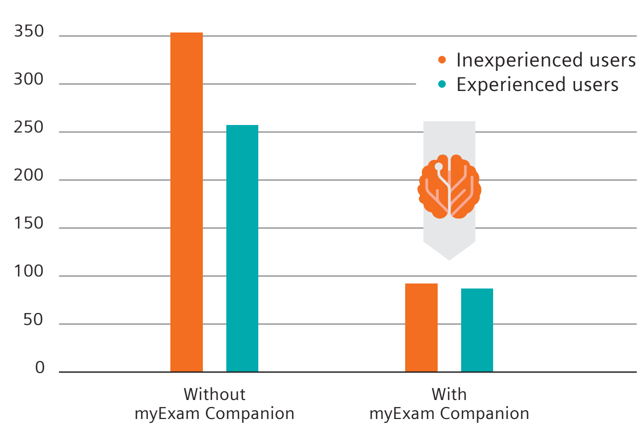


Figure 5: Reduction in the duration of a CCTA exam with the help of myExam Companion.

myExam Companion is an intuitive, guided workflow tool that helps users to perform CT scans. It uses clinical language and visuals that are easy to follow. This simplifies operation, even for users who are less familiar with CT imaging. The guided operational workflow helps to enhance operational efficiency and productivity, which in turn optimizes the utilization of limited resources.

In a study carried out at Kantonspital Baden, Switzerland [18], 15 inexperienced users needed 74% less time with the support of myExam Companion to perform a CCTA examination. Even 31 experienced user profited significantly from the support of myExam companion with an average exam time reduction of 66% (Fig. 5).

According to interviews with clinicians and business managers in medical institutions across Europe, Asia, and the USA [19], the intuitive workflow support offered by systems such as SOMATOM Pro.Pulse was one of the main reasons to invest in DSCT technology, as it maximizes both clinical quality and operational efficiency. This enables healthcare providers not only to provide advanced CT imaging, but also to provide it in a more cost-efficient way. Moreover, the higher workflow efficiency also enables a potential further revenue increase through more CT examinations.

Time gains without beta blocker usage

Usually, optimal image quality in cardiac imaging can only be achieved when the patient has a low and regular heart rate. The recommended target rate is 60–70 bpm during the scan to avoid motion artifacts. When a patient has a higher heart rate, beta blockers are often used to slow down the heartbeat. This is usually done in increments to achieve the right amount of beta blocker to reach the desired heart rate. However, this step-wise administration takes extra time, material, and staff resources. In addition, the patient needs to be monitored for a prolonged period of about 30 minutes after the exam for adverse effects or a further heart rate drop (see Fig. 6).

With its high temporal resolution, DSCT has the potential to reduce or avoid the use of beta blockers because it delivers reliable image quality even at heart rates significantly higher than 60 bpm. This eases the CCTA workflow and may save time for patient preparation and post-examination monitoring. Therefore, the high intrinsic temporal resolution of DSCT scanners like SOMATOM Pro.Pulse not only may save experienced staff time needed but also potentially more CCTA scans can be performed, including exams of patients who are intolerant to beta blockers and were previously excluded from CCTA scans.

CCTA protocol with beta blocker

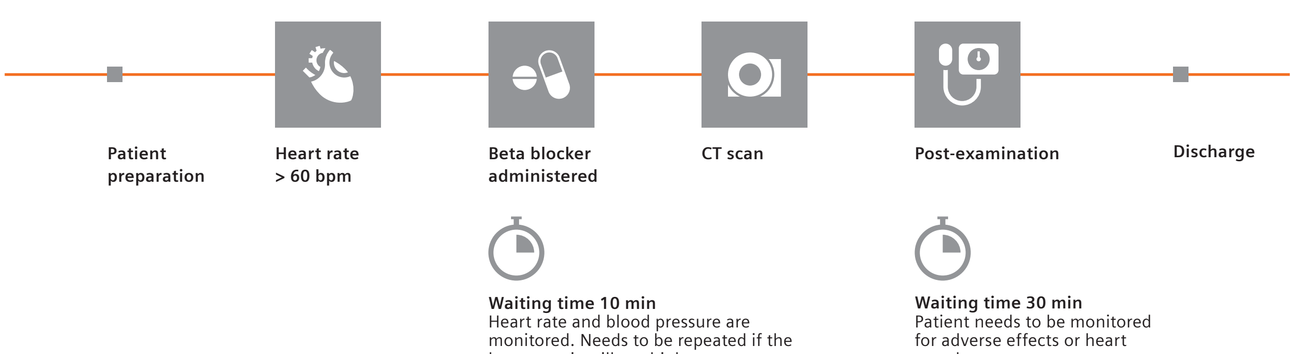


Figure 6: Conventional CCTA workflow with beta blocker for heart rates over 60 bpm.

In a recent study, Kim et al. have shown that with the help of DSCT, the overall CCTA examination time can be reduced by more than 20 minutes when beta blocker administration and heart rate monitoring is not required [20].

These findings have been confirmed by a 2024 analysis of the first SOMATOM Pro.Pulse installations. At an institution in China, technologists reported that they do not use beta blockers for up to 90% of cardiac scans thanks to the new DSCT scanner. This not only reduces patient preparation and observation time, but also avoids the possible risks and side effects associated with beta blockers. Of the 20 cardiac patients examined per day on average for the study, between 16 and 18 were scanned without beta blockers. This amounts to between 320 and 360 minutes saved per working day. During this time, more patients could potentially have been scheduled or the staff could perform other tasks that generate additional revenue or improve the service quality at the institution (data on file).

Improved patient pathways

To judge the overall value of a new CT scanner, it is also helpful to look beyond its immediate use in individual exams and consider its impact on clinical pathways in general. With its high cardiac image quality, DSCT has the potential to simplify and speed up diagnostic and therapeutic pathways as the example of the EHC Morges Hospital in Switzerland shows.

Nicolas Barras, MD, Head of Cardiology at EHC, decided to use cardiac CT for broader screening of coronary artery disease. With high-quality CT imaging, they could reliably detect the severity levels of the narrowing in the coronary arteries of the patients who subsequently underwent coronary angiography and then benefited from a more precise treatment.

With the installation of a SOMATOM Pro.Pulse, the screening scans have now become an integral part of the clinical pathway within the same facility and ideally complement the treatment in the cardiac catheterization lab (cathlab) of the hospital. According to Nicolas Barras, the use of DSCT can potentially reduce the number of diagnostic procedures in the cathlab. This might help reducing the risk for the patients that results from an invasive diagnostic procedure. The time saved in the cathlab can, in turn, be used to focus more intensely on therapeutic procedures.

At the same time, the new SOMATOM Pro.Pulse at EHC Morges has proven to be reliable in the acquisition of CCTA scans in an emergency setting. This then opens up yet another field of clinical and financial benefits. Several studies at other institutions have shown that performing CCTA in an emergency situation can help reduce the length of stay and improve cost effectiveness of the services offered by the hospital [22].

In some institutions where the potential of DSCT beyond cardiac imaging has been explored, operational efficiency was improved, especially for patients suffering from bone edema. In the previous pathway without DSCT, patients had to be scheduled for MRI imaging with long waiting and examination times. Using DSCT instead not only added extra diagnostic quality but also helped reduce waiting times, increased patient throughput, and optimized revenue [23].

Conclusion

This white paper outlines some key factors that make high-end CT technology more affordable with the introduction of the next generation of Dual Source CT (DSCT) scanners. It has shown that a system such as SOMATOM Pro.Pulse can maximize the Total Value of Ownership (TVO) by lowering the Total Cost of Ownership (TCO) and also increasing revenue.

Considering the TVO and TCO as well as the individual factors that can influence them, provides a reliable basis to decide on an investment in a new technology like DSCT and select the most suitable scanner for purchase. While the situation at different institutions can vary, it has been shown that SOMATOM Pro.Pulse enables a lower TCO by reducing the costs of acquisition, site preparation, installation, and power consumption compared with the previous generation of DSCT scanners.

At the same time, healthcare providers can optimize the TVO with the increased revenue that DSCT can bring to their institution in addition to its well-documented clinical benefits. This white paper shows the possibility to improve revenue streams and operational efficiency as well as how DSCT was used in different clinical areas, also beyond cardiology. Further benefits of DSCT include increased patient and staff satisfaction. Although these factors are difficult to quantify economically, they also contribute to an optimized TVO and should be considered in any purchasing decision.

This white paper explains how SOMATOM Pro.Pulse, the latest addition to the CT portfolio of Siemens Healthineers, is a system designed to tackle the financial challenges in healthcare and improve patient access to DSCT imaging.

List of abbreviations

bpm	beats per minute
CCTA	coronary CT angiography
COCIR	European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry
CPT	Current Procedural Terminology (the US procedural code set)
CT	Computed Tomography
DSCT	Dual Source CT
MRI	Magnetic Resonance Imaging
ROI	return on investment
CNR	contrast-to-noise ratio
TCO	Total Cost of Ownership
TVO	Total Value of Ownership

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Our portfolio, spanning in vitro and in vivo diagnostics to image-guided therapy and cancer care, is crucial for clinical decision-making and treatment pathways. With the unique combination of our strengths in patient twinning[1], precision therapy, as well as digital, data, and artificial intelligence (AI), we are well positioned to take on the greatest challenges in healthcare. We will continue to build on these strengths to help overcome the world's most threatening diseases, enable efficient operations, and expand access to care.

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Siemens Healthineers does not recommend off label usage of contrast media. Contrast Media labeling indicates the appropriate volume of contrast media for use. The decision to reduce contrast media should be made at the discretion of the healthcare provider.

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[1] *Personalization of diagnosis, therapy selection and monitoring, after care and managing health.*

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