PROSPECT:
PROcurement **O**f **S**ustainable **P**arameter **E**valuated **CT S**canners

Assoc Prof Paddy Gilligan, Chief Physicist , Mater Misericordiae University Hospital, Dublin / Ireland

Who are you?

0

Radiographer

0%

Medical Physicist

0%

Radiologist

0%

Regulator

0%

Other

0%

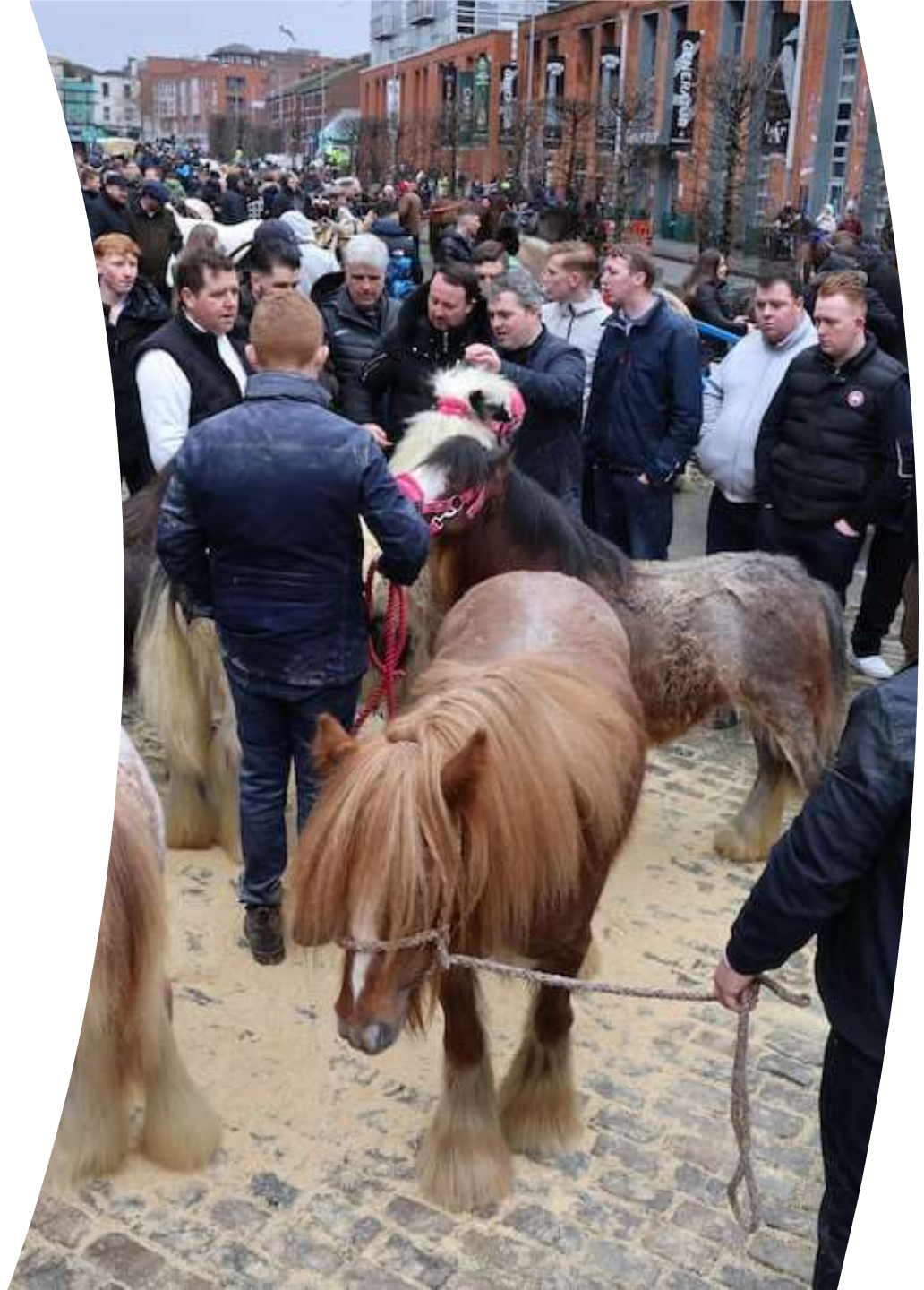
It takes a (global) village

- **Procurement: HSE Mark Smith, Oliver Macken, Mark Mc Mahon, Peter Irvine Tallaght University Hospital**
- **NIMIS Eoin Mc Carthy,**
- **Radiologists Experts: Sophie Murphy, Ferdia Bolster MMUH ,Anthony Cullen UH Waterford ,Tadhg Gleeson Wexford, Terence Farrell, Beaumont, David Murphy SVUH, Julie O Brien LUH**
- **Radiographer Experts: Tanya O'Leary Wexford ,Hannah Turner Tallaght university Hospital ,Louise Beagan , CUH,**
- **Medical Physics Experts: Paddy Gilligan, Emer Kenny, David Caldwell, MMUH ,Mike Rowan St James Hospital,**
- **Data Cleaning and anonymisation, Paul Banahan AI research fellow MMUH,**
- **Facilities & Sustainability John Reilly, MMUH**
- **Osvaldo Rampado , Fisica Medica , Milano**
- **Suppliers**
- **Plus many others**

Disclosures

- This presentation focuses solely on procurement methodology, governance and evaluation framework. All tender outcomes remain confidential and subject to final HSE governance approvals, including Senior Management Team (SMT), Audit & Risk Committee (ARC) and HSE Board approval which is still on going.
- I will not talk about vendors or outcome as the process is still ongoing . I will talk about the process.
- The scoring presented here image quality wise were sample scoring sheets from early in the process and do not represent final scores
- The information and views presented here are personal apart from where it is referenced in the text
- I have no conflict of interest to declare in relation to this work

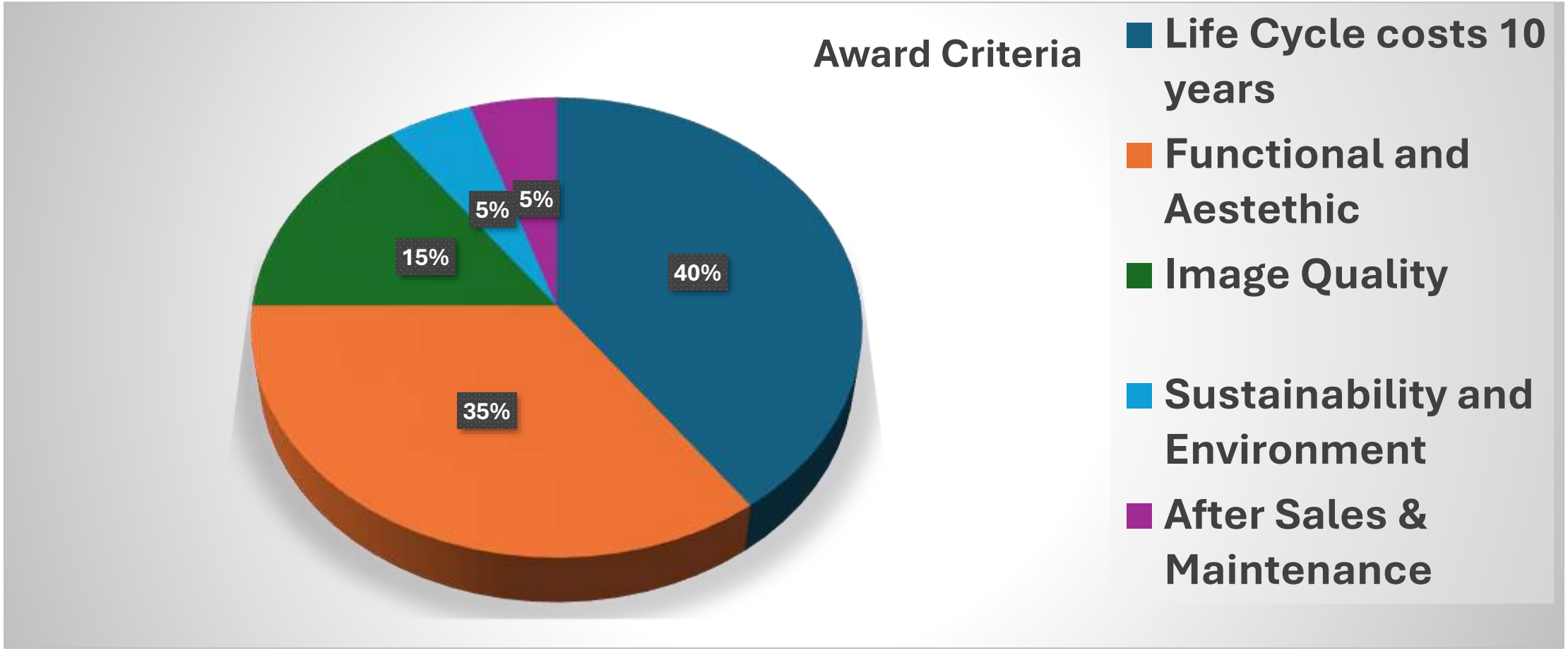
Procurement



- Historical radiology procurement models
- Limitations and opportunities
- Towards a specification driven procurement model
- Rules based Framework
- Ranking and comply or explain
- Evaluation is different than procurement
- Assumed all scanners going into agnostic greenfield site
- Assumed all options are needed but sites can customise prior to installation
- Procurement evaluation group and structure
- Banding

Ethical approach to procurement

Mandatory Requirements Pass/Fail + Scorables Award criteria



The tender is a rules based ranking system based on the tender responses and the scoring

The laws

SI 256 2018, medical physics experts, Practitioners, equipment

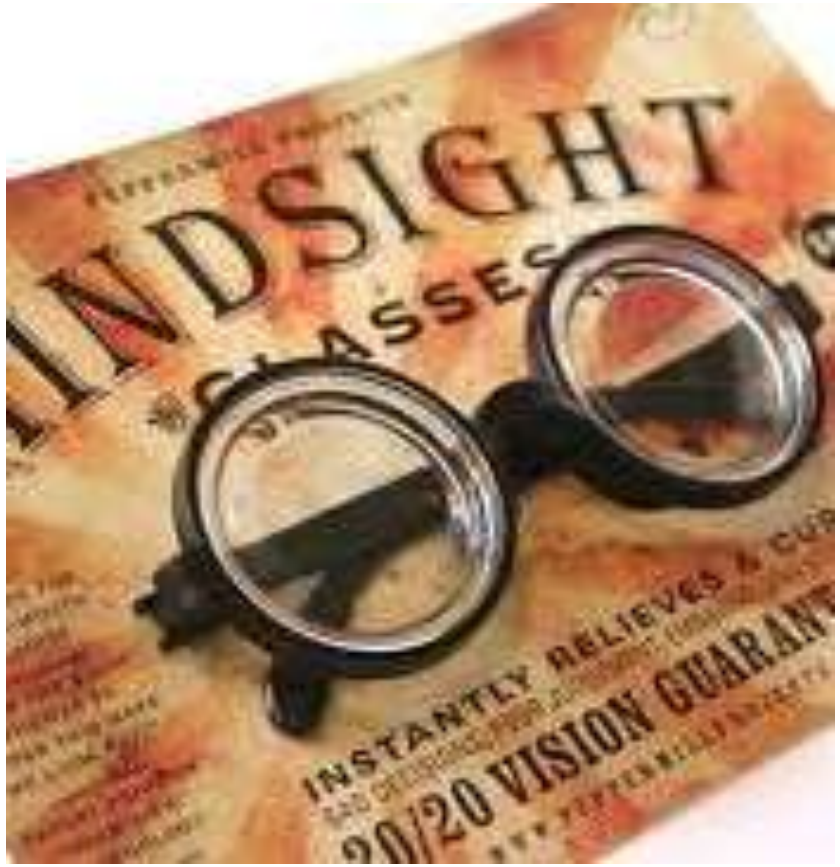
Procurement Laws Conducted under EU Directive 2014/24/EU and SI No. 284/2016

This process ensures public sector procurement integrity, governance compliance and value for money assurance.

GDPR

Legacy perspective

- Historical Image quality and other issues in the past with some CT scanners, both private and public sector
- National Procurement driven by site looking for CT scanner with specific needs
- Clinical needs change from original intention
- Sometimes these sites would not have had access to expertise and particularly vendor specific expertise
- Need liaison with national strategies, radiology , cardiology, stroke, cancer
- Availability of good technology across health regions many benefits to patients and tertiary referral centres



AuntMinnie.com Europe

CLINICAL NEWS | CT

ECR: 'Black swan events' demand informed imaging infrastructure

Liz Carey
Mar 5, 2026

European healthcare organizations may be facing decisions about new investments in imaging technology for "black swan events" -- that is, battlefield and mass casualty incidents, according to a March 4 discussion at ECR 2026 led by the European Federation of Organizations of Medical Physics.

Latest in CT

Welding fumes linked to distinct lung CT changes, function

Year	Incident	Radiology Use	Comment
2016	Nice, terror Truck versus pedestrians	42 CTs in 42 patients in 2 Hours	Patient identification a major Issue
2016	Seattle,Transport, tourist vehicle collision	Imaging in 95% of patients, WBCT in 79 %	
2013	Boston Terror Bombing	Imaging in 31 out of 40 (78%) patients, CT in 7 out of forty patients (17.5%)	
2011	Christchurch New zealand , Natural disaster earthquake	21 CT in 6 hours after 5 hour delay from power outages	
2011	Norway terror bombing and shooting	Imaging 22/24 with 15 hours 10 CTs in rural hospitals	

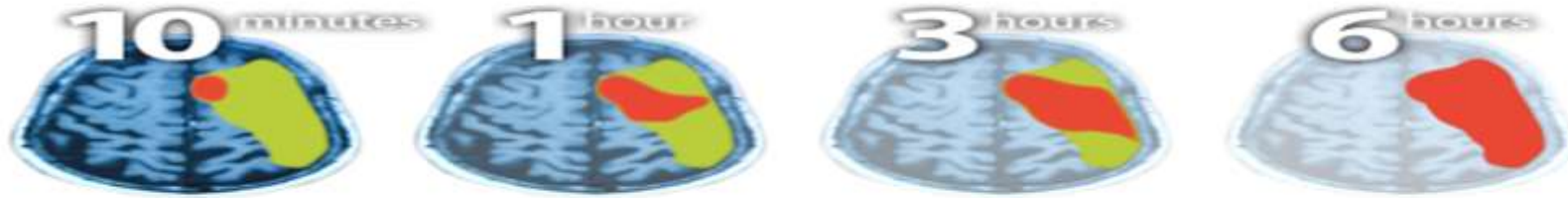
Adapted from Gibney B, Ryan JW, MacMahon PJ, O'Connor GS, Bolster F. Assessment of RAdiopaque Patient IDentification Stickers (RAPIDS) for patient-scan correlation in a mass casualty incident. Emerg Radiol. 2020 Jun;27(3):293-301

Specs of CT that may be useful (available ranges,)

- Table length & Weight capacity (305 Kg, 2 meters table feed)
- Bore size, (> 70 cm)
- Room size >> minimum (50 m2)
- Tube heat capacity and dissipation (7-33 MHU, 1-3 MHU/Min)
- Switch on from cold , detector /tube warm up time (3-15 Minutes)
- Parallel processing of reconstructions
- Local advanced image processing, diagnostic viewing and image storage (TBytes)
- Temperature ranges e.g. 18 -30 degree centigrade , room cooling requirements
- Power consumption (30-102 KWH)
- Availability of Uninterruptible power supply

Time is brain!

Every minute 2,000,000 brain cells die during stroke.



* Source: American Heart Association

Minutes matter. Call 911.

Salvageable time window: tissue clock after acute ischemic stroke onset

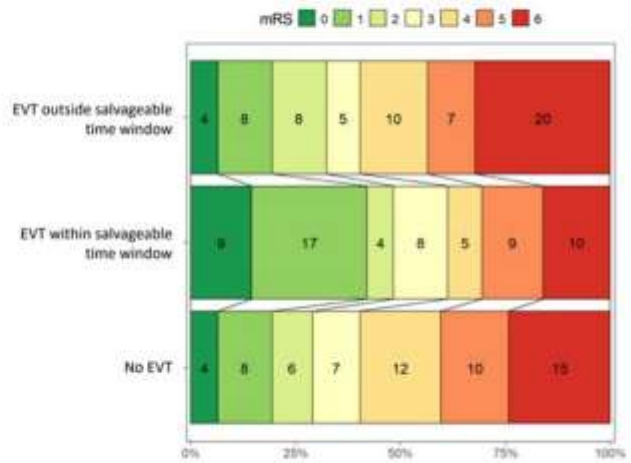
New concept: Salvageable time window = (total ischemic lesion volume - acute infarct core volume) / core growth rate

Methods:

- Retrospective cohort study
- INSPIRE database
- LVO in anterior circulation within 6 hours stroke onset
- No EVT vs. EVT within salvageable time vs. EVT beyond salvageable time
- Propensity score matching to balance covariates

Results: 62 patients in each group after propensity score matching. Good outcome rate (mRS 0-2): No EVT 29% vs. EVT within salvageable time 48% vs. EVT beyond salvageable time 32%.

Conclusion: Patients may not receive therapeutic benefits from EVT if the treatment is delivered beyond the salvageable tissue window.



Salvageable Time Window: Tissue Clock After Acute Ischemic Stroke Onset

Feifeng Liu, MD, Chushuang Chen, PhD, Chen Chen, PhD, Mark W. Parsons, PhD, Gang Li, PhD, and Longting Lin, PhD on behalf of INSPIRE Study Group AUTHOR INFO & AFFILIATIONS

Stroke • Volume 56, Number 11 • https://doi.org/10.1161/STROKEAHA.125.051780

how would you describe CT procurement processes in the HSE or your hospital ?

Nobody has responded yet.

Hang tight! Responses are coming in.

Anecdotal Preconceptions : Overheard in the health services !

“Foregone conclusions”

“Not possible to train staff on new CTs”

“Bias”

“Its all about the cost Most Economically Advantageous Tender “

“Get me what I want “

“ Don’t have time to be dealing with this , what about the day job “

“ Youll go with the company I like “

“ HSE box tickers who couldn’t care less”

“ The PEG member is being evaluated not the product”

“ Joined up thinking the enemy”

“ they lowered to the spec so they will will have less work to do especially at weekends “

“ Too many questions”

“ Companies can be rude , litigious , personal attacks verbal and legal”

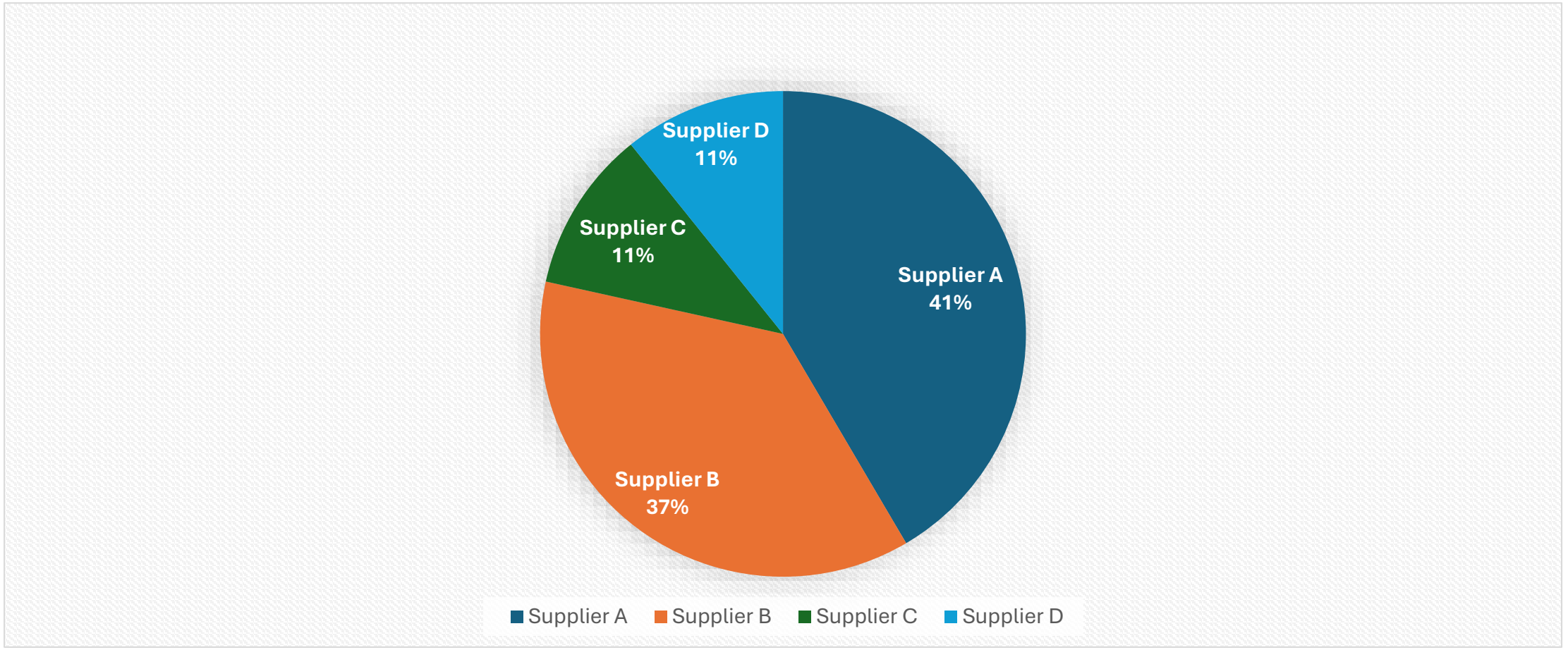
“ Only cranks complain about our scanner “

“ You will cost the state a fortune “

“ If a machine has images quality issues that’s ultimately down to procurement “

“ Perfect I’ll take them” Bestwear Drogheda 1983

Public CT scanners in Ireland, n=65



Page Contents

CT Scanners and Associated Options and Related Services

Type: Contract Extension

Category: Diagnostic Equipment and Services

Reference: 2021/S 000-007768

Supply Route: Direct

Start Date: 1 April 2022

Expiry Date: 31 March 2028

Suppliers

- Canon Medical Systems Limited
- DP Medical Systems Limited
- Fujifilm Healthcare UK Limited
- GE Medical Systems Limited
- Medical Imaging Systems Limited (MIS Healthcare)
- Philips Electronics UK Limited
- Siemens Healthcare Limited
- Stryker UK Limited

Product Categories

- General CT
- Advanced CT
- Premium CT
- Wide Bore CT for Radiotherapy Simulation
- Mobile CT Scanner for Head and Neck Studies
- Mobile CT scanner for whole body studies.

A CT scan is a medical imaging technique that uses computer-processed combinations of multiple X-ray measurements taken from different angles to produce images of a body, allowing the user to see inside the body without cutting. They are used within Medical Physics and Radiology departments.

Overview

This framework starts on **1 April 2022**, runs for **72 months** and ends on **31 March 2028**. This includes an initial **24 month** extension, followed by a further **24 month** extension.

The framework is for the supply of Computed Tomography (CT) Scanners and associated options and related servic

See our Downloads ▼ section for the latest Product Matrix

This framework agreement can also facilitate the following:

- The provision of loan equipment to customers to ensure continuation of service during the decommission and installation process.
- The provision of equipment to customers via a rental agreement for a pre-determined period and cost.
- The procurement of building works / turnkey solutions where work is required to support the installation of equipment procured via the framework agreement.
- Housing solutions; including but not limited to trailers, relocatable housing, modular builds, pods, temporary bunkers etc. as required by a customer due to lack of accommodation on site or to provide a service off site.

Supply Chain

Website | Search

Home | My Supply Chain | Savings | News | Product Information | Categories | Programmes | Teams | Suppliers | Events | Customer Services

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General, Advanced, Premium, what does it mean ?

Objective of the process

- To deliver a solution that meets the current and future clinical needs of the patient population on national level

Objective of the evaluation

To rank lot 1 and lot 2, Only one scanner allowed to be submitted per lot

Lot 1 fully enabled with advanced image processing, stroke , Trauma, high end cardiac, Interventional

- Single tube energy integrating < 0.30s, 70 kVp, > 100 kW generator,

Lot 2 fully capable with advanced image processing, cardiac capable , stroke capable , Trauma high end cardiac, Single tube energy integrating detectors ,

- Single tube energy integrating < 0.35s, 80 kVp, >55 kW generator,

Procurement Timeline — Key Dates

Pre-Tender
Apr – Aug 2025

1

Pre PEG Meeting

1 Apr 2025

Market Soundings

20 May 2025

Stakeholder Outreach

Stroke & cardiac programs

Update RFP

May – Jul 2025

Issue Draft Documents

PEG & vendors – Aug 2025

Tender
Sep – Oct 2025

2

Issue Tender

23 Sep 2025

Clarifications

Thu 9 Oct 2025

Response Deadline

Thu 9 Oct 2025

Extended to Thu 16 Oct 2025

Evaluation
Oct 2025 – Feb 2026

3

Image Quality & Data

Submissions & cleanings

Mandatory Specs

Evaluations

Image Quality Scoring

Site Visits

Dec 2025

Financial & Life Cycle Costs

Done by Procurement

Approval
Mar – May 2026

4

PEG Sign-Off

Mar 2026

Procurement Sign-Off April

SMT, May 2026

Audit and Risk Committee, May 2026 & HSE Board Sign-Off TBC

Current state of CT technology

- Energy integrating detector CT coming toward end stage of evolution
- Photon counting CT, Limited to single vendor for 2025 , 2026 market will increase, high resolution lower dose , capital Cost ++, utility increasing,
  - are we ready for the data ?
- Spectral CT, Many versions but not widely adapted , potential to save on contrast good for environment , patients and costs
- AI reconstruction, rapidly deployed evaluations follow* , 3 out of four vendors use AI Deep learning recon , 2 use model based
- Model Based AI & Deep learning have clinical issues when used with aggressive dose reduction *
- Dose reference levels versus diagnostic reference levels (RPO,CSRS, MPES and Radiologists
- AI driven workflow
- Advanced image processing

***(Lifeng Yu, Guang-Hong Chen, Joel G Fletcher, Lu Jiang, Marc Kachelrieß, Rongping Zeng, Zhongxing Zhou, Deep learning in CT image reconstruction and processing: techniques, performance evaluation, radiation dose, and future perspective, *British Journal of Radiology*, Volume 98, Issue 1175, November 2025, Pages 1775–1787, https://doi.org/10.1093/bjr/tqaf260**

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"Do Not repeat the mistakes of 2014 that happened with Iterative reconstruction : Lifeng Yu ECR 2026 "

*(Lifeng Yu, Guang-Hong Chen, Joel G Fletcher, Lu Jiang, Marc Kachelrieß, Rongping Zeng, Zhongxing Zhou, Deep learning in CT image reconstruction and processing: techniques, performance evaluation, radiation dose, and future perspective, *British Journal of Radiology*, Volume 98, Issue 1175, November 2025, Pages 1775–1787, https://doi.org/10.1093/bjr/tqaf260

Procurement is only a single step in the life cycle of equipment

- The evaluation only covers the scanner not how it will be used
- The Use of the scanner will depend on the culture expertise and commitment of the local Radiologists, Radiographers, Physicists and the vendors
- Optimisation is a legal obligation on Undertaking, Practitioners and Medical Physics expert
- Training
- Best use of technical features

Physica Medica 108 (2023) 102557

Contents lists available at ScienceDirect

Physica Medica

journal homepage: www.elsevier.com/locate/ejmp

Original paper

EFOMP policy statement 17: The role and competences of medical physicists and medical physics experts in the different stages of a medical device life cycle

Wim van Asten *, Erato Stylianou Markidou, Christian Gromoll, George A. Gourzoulidis, Susan Maguire, Gabriele Guidi, Eric Pace, Hugo Spruijt, Jaime Martínez-Ortega, Stephan Klöck

Do you have image quality issues on your CT

0

Yes

0%

No

0%

None that i am aware of

0%

Are you an optimiser or optimist ?

0

Optimiser

0%

Optimist

0%

Have you optmised CT scans in you department ?

0

using Dose reference levels

0%

Using dose reference levels and image quality evaluated by radiologist

0%

none of the above

0%

Have you optimised Iterative reconstruction CT images ?

0

using dose reference levels

0%

using dose reference levels and image quality evaluated by a radiologist

0%

none of the above

0%

Have you optimised AI or deep learning algorithim for reconstruction of CT images ?

0

with dose reference levels

0%

with image quality evaluated by a radiologist

0%

no we have not optmised

0%

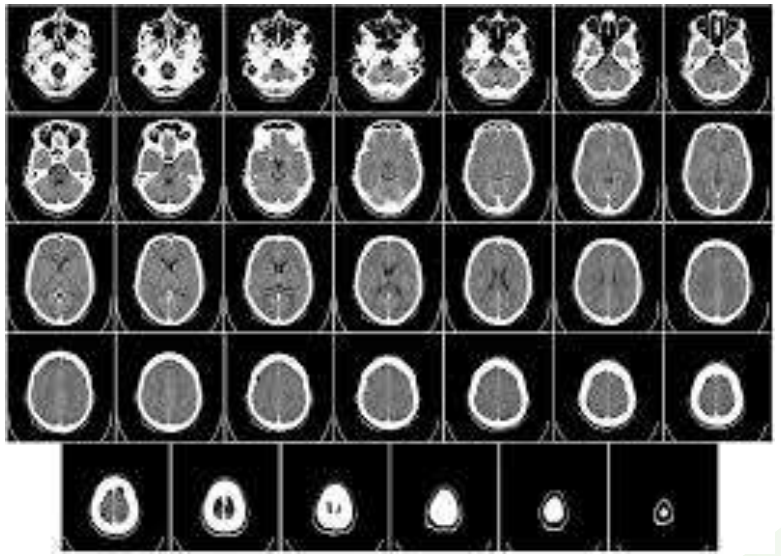
Anonymised Image quality evaluation

Image quality evaluation of anonymised images :

- Based on Italian National Approach
- Anonymisation was challenging particularly for processed images and proprietary filters. Further data clean was necessary (Paul Banahan and David Caldwell)
- Image quality five radiologists evaluated multiple sets of anonymised images put up on NIMIS by Eoin Mc Carthy
- 20 image sets per scanner = 140 image sets
- Scoring based on likert scale doubled up for 1-5,
- Evaluation based on what was offered as part of core package , options scored to zero , if no images available score =0,
- Ranking Based on total score
- App created by Emer Kenny
- Average , number of low scores per vendor (<7, may miss subtleties) and comments useful for calibration
- Dose was used as a sense check rather than overall score. CTDI was more useful than DLP as some cases multiple image sets provided. Where possible calibrated against national DRLS.
- Clinical technique affected some body protocols eg urogram and colonscopy

Clinical Images required

- Anatomical Region / Exam Type Required
- Neuroimaging (Acute and Routine)
- Non-contrast CT brain (acute stroke, trauma)
- CT angiography (CTA) of head and neck (stroke/TIA, dissection)
- CT perfusion (for stroke thrombolysis/thrombectomy assessment)
- CT venography (for suspected cerebral venous thrombosis)
- Temporal bone/high-resolution inner ear imaging



Clinical Images required

- Trauma Imaging (Whole-body and Targeted)
- Whole-body trauma (“pan scan” – head/neck/chest/abdomen/pelvis)
- Cervical, thoracic and lumbar spine CT
- CT facial bones (trauma/fractures)
- CT pelvis (trauma/fractures)
- Cardiovascular Imaging
- CT pulmonary angiography (PE protocol)
- Aortic dissection protocol (CTA thorax/abdomen/pelvis)
- Coronary - CTCA

Clinical Images required

- Chest and Thorax
- High-resolution CT (HRCT) chest (pneumothorax, ILD)
- CT chest with contrast (infection, tumour, trauma)
- Low-dose CT for lung nodule follow-up (if applicable)
- Abdominal and Pelvic Imaging
- CT abdomen/pelvis with contrast (acute abdomen, sepsis, perforation)
- CT urogram (renal colic, haematuria)
- CT angiography of mesenteric vessels (acute bowel ischaemia)
- CT enterography/CT colonography (elective/emergency overlap)
- Musculoskeletal Imaging
- CT extremities (complex fractures, prosthesis planning)
- CT with metal reduction protocol

Clinical Images required

- Oncology
- Staging/restaging protocols (chest/abdomen/pelvis)
- +/- CT-guided biopsy support planning
- Additional Tender Considerations
- *Rapid acquisition protocols (under 1 second per rotation for trauma/stroke)*
- *Post-processing capabilities:*
- *MPR, MIP, 3D reconstruction*
- *Automated stroke perfusion maps*
- *Vessel analysis*

Sample scoring results sheet lot 1

Image Type	Image Number	Total Score	No. of Scorers	No. of Criteria	Avg. Score/10	No. Scores < 7/10	Comments	Comments
CT Brain Non-Contrast Study	IM_1_A	121	5	3	8.1	3		All doses similar. Concerning number of "red flags" for a routine exam on a high-end scanner.
		118	5	3	7.9	2		
		117	5	3	7.8	3		
CT Angiography (CTA) of Head and Neck	IM_1_B	130	5	3	8.7	0		V* - slightly lower dose but all quite similar.
		135	5	3	9.0	0		
		125	5	3	8.3	0		
CT Perfusion (Stroke assessment)	IM_1_C				0.0			Highest dose for V*. Reviewers found it difficult to compare between scanners as no maps were available.
		23	2	2	5.8			
		6	2	2	1.5			
CT Venography (CVT evaluation)	IM_1_D	6	2	3	1.0	6		No venogram provided for V* and V*
		6	2	3	1.0	6		
		138	5	3	9.2	0		
Temporal Bone / High-Resolution Inner Ear Imaging	IM_1_E	90	5	2	9.0			V* uses lowest dose but also has lowest score.
					0.0			
		92	5	2	9.2			
Whole-body Trauma (Pan Scan: Head/Neck/Chest/Abdomen/Pelvis)	IM_2_A				0.0			V* did not provide the correct images. V* had much lower dose than V*.
		125	5	3	8.3			
		137	5	3	9.1			

Lot 1
Overall Sample Scores

Total Score	Avg. Score/10	No. Criteria Scored < 7/10	Rank
1639	6.35	22	3
1821	7.09	17	1
1756	7.11	14	2

Lot 2 .
Overall Sample Scores

Total Score	Avg. Score/10	No. Criteria Scored < 7/10	Rank		
1925	8.3	6.0	1		
1497	6.9	23.0	4		
1679	7.5	30.0	3		
1720	7.6	22.0	2		

Discussion

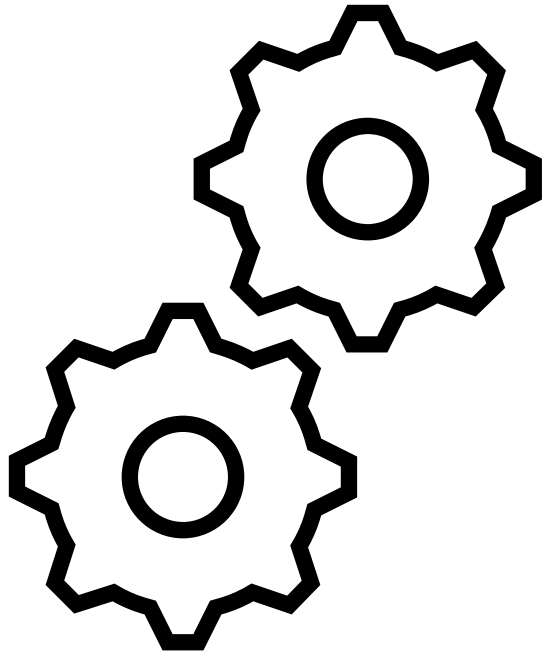
- This was not a clinical trial and we did not know pathologies
- Spread of scores , Method of evaluation seems reasonable, We could do further digging into data e.g. intra observer , image processing (training, deployment)
- Vendor based workstation image processing not possible
- Scoring reflects that certain scanners are better at different things e.g high contrast , high resolution, soft tissue imaging, cardiac , reflect market maturity for certain scanners and options for recon
- Gargantuan amount of Work thanks to Radiologists : Sophie Murphy, Ferdia Bolster MMUH ,Anthony Cullen UH Waterford ,Tadhg Gleeson Wexford, Terence Farrell, Beaumont, David Murphy SVUH, , Eoin Mc Carthy NIMIS, Medical Physicists(David and Emer for app and analytics), Paul Banahan , Sophie Murphy for sense checking and criteria
- Anonymised image quality based evaluation provided an unbiased assessment of feature rich CT scanner image quality on national PACS system by nationally represented expert radiologists which reflected technical capability of the tendered scanners

Aesthetics and functional

- Highest scoring part of tender
- Clinical specialist radiographers, medical physics experts and radiologists
- Hundreds of questions (~750)
  - I would have asked more
- A lot of them were around image processing
- Phrasing really important :
  - musts, preferred ,should, and information
- Experts in each of the vendors scanners really useful

After sales

- At least four trained engineers on Island of Ireland at time of tender
- warranty period and what cover provided
- Remote servicing
- Tube replacement time
- Top five components
- Packages available
- Catphan 600

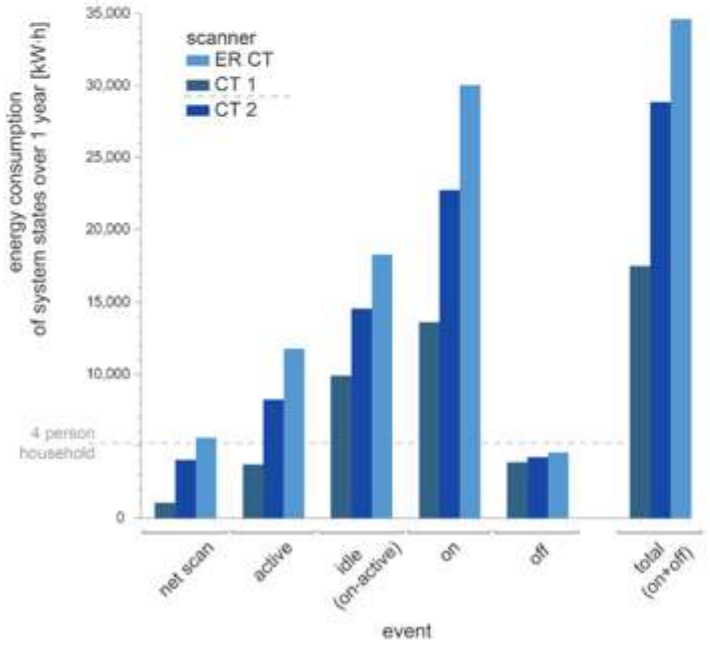


Sustainability

- DGMP
- Sustainable Procurement | DGMP
- Medical equipment proactive alliance MEPA
- On off times including detector
- Low power, idle and off mode
- Room temperature requirements
- Type of cooling available
- Carbon foot print
- Recycling packaging

Motivation

- energy and resource consumption of large medical devices in radiology, radiotherapy and nuclear medicine, *e.g.* CT, MRI, linac, contributes significantly to the CO2 emissions of clinics and practices.
- It is therefore of particular importance to take aspects of sustainability into account when purchasing equipment.
- DGMPgoesGreen has drafted a sustainable requirements that can be integrated into the tendering process during procurement



Heye et al., 2020

CT → 5 households

MRI → 26 households

Heye T, Knoerl R, Wehrle T, Mangold D, Cerminara A, Loser M, Plumeyer M, Degen M, Lüthy R, Brodbeck D, Merkle E. The Energy Consumption of Radiology: Energy- and Cost-saving Opportunities for CT and MRI Operation. Radiology. 2020 Jun;295(3):593-605. doi: 10.1148/radiol.2020192084

Motivation

DGMP
sche Gesellschaft für Medizinische Physik e.V.

- energy and res
- It is therefore
- DGMPgoesGre

uclear medicine, *e.g.*
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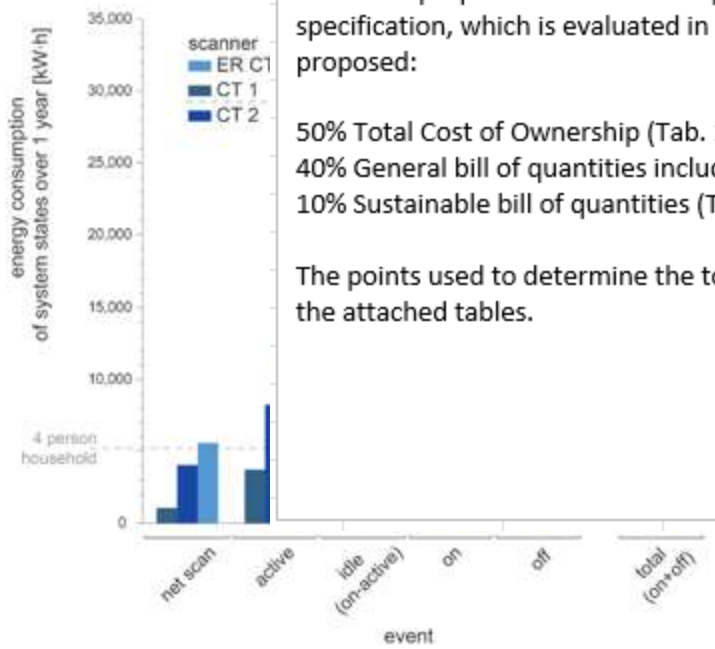


Heye et al., 2020

DGMP
Deutsche Gesellschaft für Medizinische Physik e.V.

DGMP | Office
Ernst-Reuter-Platz 10 | 10587 Berlin
office@dgmp.de

DGMPgoesGreen – Sustainable Procurement

The energy and resource consumption of large medical device in radiology, *e.g.* CT, MRI, contributes significantly to the CO2 emissions of clinics and practices. It is therefore of particular importance to take this and other aspects of sustainability into account when purchasing equipment. With the present recommendation, DGMPgoesGreen has drafted a sustainable bill of quantities that can serve as a template for different devices and tendering forms. Both the ratings and the scoring are suggestions and can be modified for individual purposes. Sustainable aspects are included both in the total cost of ownership and in the sustainable specification, which is evaluated in addition to the actual bill of quantities. The following assessment is proposed:

50% Total Cost of Ownership (Tab. 1)
40% General bill of quantities including user rating
10% Sustainable bill of quantities (Table 2)

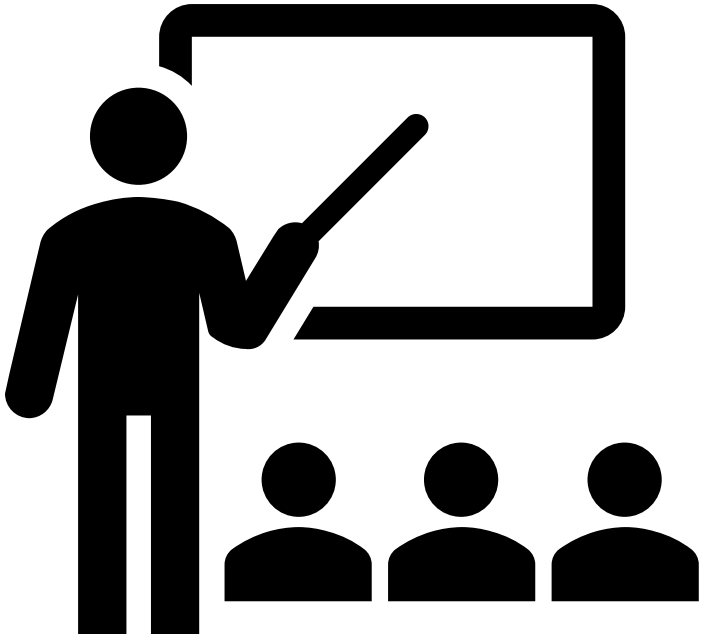
The points used to determine the total cost of ownership and the sustainable bill of quantities can be found in the attached tables.

Site visits

- Really important
- Clinically relevant sites
- Aesthetics heat and noise
- actual through put
- DRLS
- Talked to radiographers, radiologists and physicists if available

Conferences, Networks and education

- Contacts made through EFOMP, ECR, IAPM, ESR, EFRS, IOMP
- ECR really useful to know how scanners were pitched and stage of product maturation
- Great sense of challenges in terms of CT technology
- Necessary expertise to make decisions and advise
- Not a luxury or folly, Expertise , research, presentation at conferences needs to be funded for Medical Physicists, radiographers and radiologists in training .
- Not doing so presents financial and patient safety risk to health systems



Lessons learned

All scanners have strengths and weaknesses

Experts familiar with the vendor very useful

Resourcing procurement

Slim down on the number of exams for image quality assessment

More mandatories

Increase image quality score

Increase sustainability score

Would like to add greater physics assessment of objective image quality

Better modelling of data , power, Install costs etc for financial

Congresses workshops expertise is essential for this

Significant Evolution in Health care procurement

Before

- Single hospital driven tender
- Mixed expertise
- Cost of ownership up to 60% in award criteria
- Lots based on subjective terms e.g, High end, advanced
- Multiple submissions from single vendor per lot
- Image quality assessed on site visit and sample images with vendor details
- Sustainability evaluation not consistent with best European practices

After

- Strong stake holder consultation
- Developed national Multidisciplinary procurement team with multiple hospital types and experience of different vendors
- Used European experience and expert knowledge to develop evaluation criteria and technology assessment
- Reached out to national stroke and cardiac strategy
- Decreased life cycle costs award criteria from 50% to 40%
- Moved banding of lots from descriptive subjective terms to technical parameter based stratification
- Delivered value for money by limiting to single tube , energy integrating detector
- Restricted submission from each vendor to one scanner for each lot
- Introduced anonymised image quality evaluation in NIMIS by radiologists
- Introduced quantitative sustainability and scoring criteria based on MEPA COCIR and DGMP

Upsides

- thorough, objective and transparent process based on science and global knowledge of Current CT technologies capabilities and limitations
- National representation from number of hospital types
  - You are better off in than out
- Experts with experience of most vendors
- Dedicated Motivated procurement team and PEG
- Scanners capable of delivering requirement, getting the best out of them is for each site and vendors
- Based the development of a collaborative approach with the suppliers to optimise workflow efficiencies, optimal dose levels to provide best image quality to enhance patient experience and outcomes

Thank you , Any questions ?