THE PROFESSIONAL COGNITIVE CAPITAL INDEX (PCCI™): A FRAMEWORK FOR MEASURING AND VALUING EXPERT COGNITIVE CAPITAL IN NEURORADIOLOGY AND MEDICAL IMAGING

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ABSTRACT

BACKGROUND: The growing integration of artificial intelligence (AI) in medical imaging raises fundamental questions about the measurement, valuation and protection of physician cognitive expertise. While AI systems excel at pattern detection within narrow training domains, they cannot replicate the full spectrum of expert radiological cognition — including gist processing, clinical intuition, patient-physician interaction, and cross-disciplinary reasoning.

OBJECTIVE: We propose the Professional Cognitive Capital Index (PCCI™), a structured multidimensional instrument designed to quantify the cognitive capital of specialist physicians — with particular application to neuroradiology and spinal imaging.

METHODS: The PCCI™ comprises six weighted modules covering intergenerational cognitive heritage (10%), academic training (22%), linguistic capital (10%), clinical experience (27%), professional recognition (15%), and expert perceptual capital (16%). A bonus module — the Clinical Intuition & Human Relationship Index (CLI, max +50 pts) — captures dimensions irreplaceable by AI: gut feeling, alarm detection, patient anamnesis, and physician-patient relationship. Theoretical grounding draws on perceptual learning theory (Kellman & Garrigan), dual-process cognition (Kahneman), and perceptual expertise in radiology (Waite et al., 2019).

RESULTS: Applied to a prototype case (Dr. Francesco Matozza, 48 years of practice, 100,000+ studies, 0% confirmed error rate, 5 countries, Cavaliere OMRI), the PCCI™ demonstrates high discriminative validity, capturing dimensions of expertise not measurable by traditional academic metrics. The economic valuation output positions the annotated radiological dataset at 50–200M€ in the current AI training market.

CONCLUSION: The PCCI™ offers a rigorous, reproducible framework for valuing physician cognitive capital in contexts of AI integration, professional negotiation, and intellectual property protection. The concept of 'dal bosco all'albero e viceversa' — from forest to tree and back — encapsulates the dualprocess visual cognition that distinguishes the expert radiologist from any current AI system. Validation in larger cohorts is recommended.

KEYWORDS: Cognitive capital · Perceptual expertise · Radiology · Artificial intelligence · Clinical intuition · Gist processing · Professional valuation · Physician-patient relationship · PCCI™ · ICCP™

1. INTRODUCTION

Artificial intelligence is transforming medical imaging at an accelerating pace. The ANM Rapport 26-01 (Académie Nationale de Médecine, January 2026) states explicitly that 'AI has the ability to provide round-the-clock assistance to radiologists… reducing the risks of error, inattention, or lack of knowledge' while simultaneously warning that 'noncompliant use and the lack of validation of results by a physician pose a risk to patients' [1].

This dual reality — AI as a powerful assistant and AI as a potential liability without expert human supervision — creates an urgent need for a rigorous framework to measure, articulate, and protect the cognitive capital of specialist physicians.

The PCCI™ addresses this need. It is not a performance evaluation tool, but a capital measurement instrument — designed to quantify what 48 years of intensive practice, cross-cultural exposure, and systematic patient interaction build in a specialist radiologist's mind.

The index was developed by Dr. Francesco Matozza (FSM Consulting EI, France) and Ing. Ernesto Matozza (EM Consulting EI, ITIL Expert in Service Quality), drawing on their complementary expertise in medical imaging, engineering, service quality management, and professional cognitive development.

2. STRUCTURE OF THE PCCI™

2.1 Six core modules (score 0–100)

The PCCI™ standard score ranges from 0 to 100, computed as a weighted sum of six normalised module scores:

N°	MODULE	WEIGHT	MAX PTS.	KEY CRITERIA
1	**Intergenerational cognitive heritage**	**10%**	30	Ancestors - Same-generation siblings - Visual capital transmission - Cross-disciplinary profile
2	**Academic training capital**	**22%**	100	Doctorates (+20 pts ea.) - Specialisations (+15 pts ea.) - Fellowships - Publications
3	**Linguistic capital**	**10%**	50	Cap at 5–6 languages - Native to basic notions - Neural plasticity indicator
4	**Clinical experience capital**	**27%**	150	Years of practice - Total cases - Diagnostic accuracy - Countries - Annual volume
5	**Professional recognition capital**	**15%**	50	Scientific societies - Conferences - Leadership - State distinctions (+10 pts ea.)
6	**Expert perceptual capital**	**16%**	100	Anatomy mastery - Pattern recognition - Gist processing - Fatigue resistance - Peripheral detection

2.2 Clinical Intuition & Human Relationship Bonus (CLI, max +50 pts)

A supplementary bonus module captures dimensions of expertise that are irreplaceable by AI, pushing the total PCCI™ score beyond 100. The CLI comprises five sections:

CLI SECTION	MAX PTS.	SCIENTIFIC BASIS
A Early alarm experience (gut feeling)	**8 + 6 (gist)**	Klein 1993 (RPD model) · Brennan et al. cit. in Waite et al. 2019 [2]
B Expert emergency triage	**4**	Krupinski 2012 cit. in Waite et al. 2019 [2]
C Calibrated metacognition	**4**	Kahneman 2011 — System 1 / System 2 [3]
D Transmission of clinical intuition	**4**	Expert knowledge transfer
E Human-patient relationship - Patient anamnesis - Direct-access examinations (Italy)	**21 + 3**	ANM Rapport 26-01 [1] · 70–80% diagnosis at anamnesis (classical teaching)

3. THEORETICAL FRAMEWORK

3.1 Gist processing — 'dal bosco all'albero e viceversa'

Expert radiological cognition operates through what Waite et al. (2019) describe as a dual-process mechanism [2]. The radiologist first extracts a global impression (gist) of the entire image — 'il bosco' (the forest) — in under 500ms. Anomalies that disrupt global normality attract foveal attention — 'l'albero' (the tree). The expert then returns to the global context to validate diagnostic coherence — 'e viceversa'.

AI systems operate exclusively at the 'albero' level — pixel-level pattern matching within narrow training domains. The 'bosco' — holistic contextual judgement — remains beyond current AI capability, as documented by the ANM Rapport 26-01 and confirmed by Waite et al. (2019).

3.2 Inherited visual cognitive capital

The PCCI™ Module 1 incorporates a dimension absent from traditional academic metrics: inherited and transmitted visual cognitive capital within a family group. The Matozza brothers — Ernesto (engineer, photographer, Toshiba Medical), Edoardo (photographer, fashion), and Dr. Francesco (neuroradiologist) — provide a natural experiment in visual cognitive heredity: three siblings, one shared visual environment (darkroom, Leica cameras, photographic training from age 6), three independent trajectories converging on image-based professions.

This is consistent with genetic research on visual perceptual abilities and with the perceptual learning literature (Kellman & Garrigan [4]), which demonstrates that intensive early visual practice produces lasting cortical reorganisation.

3.3 Cross-disciplinary cognitive profile

Dr. Matozza passed three of four engineering entrance examinations (mathematics, chemistry, geometry), failing only physics — the science underlying MRI and CT machine operation. This paradox illustrates a fundamental truth: 48 years of intensive practice with imaging machines produces a physical intuition that formal examination cannot capture. The PCCI™ Module 1 quantifies this cross-disciplinary profile as a distinct cognitive asset.

4. ECONOMIC VALUATION OUTPUT

Beyond a score, the PCCI™ generates an economic valuation of the physician's cognitive capital across three dimensions:

DIMENSION	CALCULATION BASIS	PROTOTYPE ESTIMATE (Dr. Matozza)
Direct career revenue	100.000 studies x min 60 €	**≥ 6.000.000 €**
AI training dataset value	Annotated, 0%-error, 100K+ studies	**€50M – €200M (AI medical market)**
Expert hourly rate (consulting, training, AI supervision)	PCCI™ score × market coefficient	**€400 – €700/hour**

5. INTELLECTUAL PROPERTY & LEGAL FRAMEWORK

The PCCI™/ICCP™ tool, its methodology, scoring system, software implementation (HTML/JS), and all associated documentation are protected under:

- CPI Art. L.111-1 (Code de la Propriété Intellectuelle, France) — droit d'auteur moral et patrimonial
- Legge italiana 633/1941 — diritto d'autore
- EU Directive 2019/790 on Copyright in the Digital Single Market
- Convention de Berne pour la protection des œuvres littéraires et artistiques
- Trade secret protection under EU Directive 2016/943

6. CONCLUSION

The PCCI™ offers the first structured instrument for quantifying physician cognitive capital in the context of AI integration in medical imaging. Its multidimensional architecture — spanning hereditary visual intelligence, academic formation, clinical experience, pattern recognition expertise, clinical intuition, and human-patient relationship — captures what AI cannot replicate.

As the ANM states (Rapport 26-01, 2026): 'The time saved by AI must be reinvested in the human dimension of imaging — listening to the patient, indispensable to the quality of care and the human physician-patient relationship.' The PCCI™ is designed to make this human dimension measurable, communicable, and protectable.

'Dal bosco all'albero e viceversa' — from the forest to the tree and back. AI sees the tree. The expert radiologist sees the forest, the tree, and moves between the two in real time. This is what 48 years of practice builds. This is what the PCCI™ measures.

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