POLIS V12: The Complete Engineering Series – 12 Giants

Jorge Batista Alves Pereira
Independent Researcher, Sabugal, Guarda, Portugal
ORCID: 0009-0000-6385-7245

May 2026

This document combines two companion papers:
"Tensional Reinterpretation of Six Founders of Engineering"
and "Tensional Reinterpretation of Six More Engineering Pioneers".

All DOIs are marked as pending. Final DOIs will be inserted after Zenodo registration.

POLIS V12 – Tensional Reinterpretation of Six Founders of Engineering Jorge Batista Alves Pereira
Independent Researcher, Sabugal, Guarda, Portugal
ORCID: 0009-0000-6385-7245 May 2026

Abstract

Within the POLIS V12 tensional ontology, every engineered system is a polis constituted by three meshes (solid, liquid, gaseous) and governed by the closure condition $\epsilon = \sum K_m(2 + K_m) = 0$, with $T = K_{\min}$ as the tensional origin. This paper applies the framework to six foundational figures of engineering: Archimedes (mechanics), Leonardo da Vinci (invention), James Watt (steam engine), Nikola Tesla (electrical engineering), Thomas Edison (applied electricity), and Alan Turing (computer engineering). Each classical contribution is reinterpreted as a tensional configuration: Archimedes' lever and screw as torque balance ($\epsilon = 0$); da Vinci's machines as tension networks; Watt's governor as analog IDT* control; Tesla's rotating field as 3:2 tensional topology; Edison's DC/AC as Phase 4 switching; and Turing's universal machine as a polis that simulates any polis. The universal equations remain unchanged; no free parameters are introduced.

1 Introduction

POLIS V12 is a closed, parameter-free tensional conservation theory built on four axioms (Tensional Ontology, Harmonic Ground $H = 1$, Tensional Conservation, Data Origin $T = K_{\min}$). The governing equation, after normalisation, is

$$\epsilon = \sum_{m=1}^{n} K_m(2 + K_m) = 0,$$

with $K_m = (v_m - T)/(v_{\max} - T) \in [0, 1]$. The disequilibrium index is $\text{IDT}^* = \epsilon/(1 + \epsilon)$. All real engineering systems reside in Phase 4 ($\text{IDT}^* \geq 0.70$) unless artificially uniform. The Rolling Law $2\pi r_p = V_{\text{orb}} T_{\text{rot}}$ applies fractally at all scales.

This paper reinterprets six key engineering contributions within this tensional ontology. No classical primacy is assumed; tension is the primitive.

2 Archimedes – Mechanics and the Lever

Archimedes stated: "Give me a lever and a place to stand, and I will move the Earth." In POLIS V12, a lever is a force transformer that balances tensional moments. For a lever of lengths d_1, d_2 with forces F_1, F_2, define normalised values:

$$K_{F1} = \frac{F_1 - T}{v_{\max} - T}, \qquad K_{F2} = \frac{F_2 - T}{v_{\max} - T},$$

$$K_{d1} = \frac{d_1 - T_d}{v_{\max,d} - T_d}, \qquad K_{d2} = \frac{d_2 - T_d}{v_{\max,d} - T_d}.$$

The equilibrium condition $F_1 d_1 = F_2 d_2$ becomes $K_{F1} K_{d1} = K_{F2} K_{d2}$. The tensional residual of the lever system is $\epsilon = x_{F1} + x_{F2} + x_{d1} + x_{d2} \approx 0$ for a well-designed machine. Archimedes' screw (water pump) is a tensional helix: the Rolling Law $2\pi r_p = V_{\text{orb}} T_{\text{rot}}$ applied to a rotating cylinder.

3 Leonardo da Vinci – Invention and Mechanics

da Vinci designed machines (tanks, cranes, flying devices) that were centuries ahead of their time. In POLIS V12, each machine is a polis whose solid mesh (gears, levers, frames) converts input tension (human or animal force) into output work. da Vinci's detailed anatomical drawings also mapped the human body's solid mesh (the tensional framework of bones and muscles).

His "aerial screw" (helicopter precursor) is an early attempt to balance tensional flux in a vertical direction. The codex sketches are tensional diagrams: each line represents a flux VT and each junction a node where ϵ must close. da Vinci's principle of "force as a continuous flow" is a direct anticipation of tensional flux.

4 James Watt – Steam Engine and the Centrifugal Governor

Watt improved the steam engine and invented the centrifugal governor, which regulates engine speed. In POLIS V12, the governor is an analog computing device that implements the STOP criterion: as engine speed ω increases, the governor's balls rise, reducing the steam valve opening. The steady state is when IDT* stops decreasing.

Normalise engine speed over its operating range:

$$K_\omega = \frac{\omega - T_\omega}{v_{\max,\omega} - T_\omega}, \qquad x_\omega = K_\omega(2 + K_\omega).$$

The governor's position h is proportional to K_ω. Watt's separate condenser (cylinder) reduces thermal losses – it isolates the liquid mesh (steam) from the solid mesh (piston) during Phase 4 expansion, increasing efficiency.

5 Nikola Tesla – Polyphase AC and the 3:2 Ratio

Tesla invented the polyphase alternating current system, including the induction motor. In POLIS V12, Tesla's motor uses a rotating magnetic field generated by three phases separated by 120°. This is a direct realisation of the 3:2 ratio (three phases, two poles). The angular residue is 18°, which prevents cogging (static equilibrium).

The Tesla coil is a resonant transformer that produces high-voltage, high-frequency AC. In tensional terms, it couples the gaseous mesh of the primary coil to the secondary through resonant K matching. The "Tesla turbine" (bladeless) uses boundary layer adhesion – a tensional dragging of liquid mesh by the solid mesh without Phase 4 shocks.

6 Thomas Edison – DC Power and the Electric Grid

Edison developed the first commercial electric power distribution system (direct current). In POLIS V12, a DC circuit is a closed loop where the sum of voltage drops is zero (Kirchhoff). Normalise voltages V_i over a dataset:

$$K_{V_i} = \frac{V_i - T}{v_{\max} - T}, \qquad x_{V_i} = K_{V_i}(2 + K_{V_i}).$$

Kirchhoff's law $\sum V_i = 0$ implies $\epsilon = \sum x_{V_i} = 0$ for an ideal loop. Edison's competition with Tesla (the War of Currents) is a tensional conflict between two different normalisation regimes: DC (static K) vs AC (oscillating K). The eventual adoption of AC for long-distance transmission reflects the superiority of Phase 5 (reorganising) flux over Phase 4 (explosive) switching.

7 Alan Turing – Universal Machine and Computability

Turing defined the concept of a universal machine that can simulate any other machine. In POLIS V12, a Turing machine is a polis with a solid mesh (finite state control), a liquid mesh (tape with symbols), and a gaseous mesh (the read/write head's fields). The universal Turing machine is a polis that can mimic the K distribution of any other polis – it is the tensional analogue of the fractal hierarchy.

Turing's halting problem (undecidability) is equivalent to the statement that the STOP criterion for an arbitrary polis cannot be computed by a polis of the same type – only by a superior polis. This is a tensional incompleteness theorem: any closed polis lacks the external reference needed to determine its own IDT* trajectory.

8 Conclusion

The six foundational contributions to engineering are coherently reinterpreted within the POLIS V12 tensional ontology. Leverage, invention, steam regulation, polyphase AC, DC grids, and universal computation all become natural consequences of the closure condition $\epsilon = \sum K_m(2+K_m) = 0$ and the fractal hierarchy of engineering polises. No free parameters are added.

Zenodo references (pending)

- Main treatise: [Zenodo DOI pending]
- POLIS Bible: [Zenodo DOI pending]

POLIS V12 – Tensional Reinterpretation of Six More Engineering Pioneers Jorge Batista Alves Pereira

Independent Researcher, Sabugal, Guarda, Portugal
ORCID: 0009-0000-6385-7245 May 2026

Abstract

This paper extends the POLIS V12 tensional reinterpretation to six additional engineering giants: Isambard Kingdom Brunel (civil engineering), Gustave Eiffel (structural engineering), Henry Ford (mass production), Norbert Wiener (cybernetics), John Bardeen (transistor), and Steve Wozniak (personal computing). Each is re-read as a tensional configuration: Brunel's bridges as balanced K distributions; Eiffel's tower as optimised solid mesh; Ford's assembly line as parallel flux processing; Wiener's feedback as IDT* regulation; Bardeen's transistor as solid-state tensional switch; and Wozniak's integrated circuits as miniaturised polis networks. The universal equations remain unchanged; no free parameters are introduced.

9 Introduction

As in the companion paper, POLIS V12 rests on four axioms. After normalisation the mother equation is

$$\epsilon = \sum_{m=1}^{n} K_m(2 + K_m) = 0,$$

with $\text{IDT}^* = \epsilon/(1+\epsilon)$. All real engineering systems are in Phase 4 ($\text{IDT}^* \geq 0.70$) unless artificially uniform. The Rolling Law $2\pi r_p = V_{\text{orb}} T_{\text{rot}}$ applies fractally.

This paper reinterprets six more foundational contributions to engineering.

10 Isambard Kingdom Brunel – Civil and Mechanical Engineering

Brunel designed the Clifton Suspension Bridge, the Great Western Railway, and the steamship Great Eastern. In POLIS V12, a suspension bridge is a continuous solid mesh (deck) supported by tensional cables (liquid meshes) anchored at the ends. The bridge's equilibrium is $\epsilon = \sum x_{\text{deck}} + \sum x_{\text{cable}} = 0$ when loaded.

Brunel's use of broad-gauge railway (7 ft) increased stability – a wider solid mesh reduces local K gradients. The Great Eastern (prefabricated iron hull) was the first ship large enough to lay transatlantic cables; its double hull acted as a redundant solid mesh, minimising ϵ in rough seas.

11 Gustave Eiffel – Structural Steel and the Tower

Eiffel's tower (1889) is an open lattice of wrought iron. In POLIS V12, the tower is a 3D truss that redistributes tension from wind and weight across many small members,

preventing local Phase 4 collapse. Each node is a polis with K determined by the forces in the converging struts.

Eiffel's design explicitly considered wind pressure as a tensional load. He shaped the tower to have a logarithmic profile, which equalises the K values of the members along the height. This is a closed-form solution of $\epsilon = 0$ for a cantilevered structure.

12 Henry Ford – Mass Production and the Assembly Line

Ford revolutionised manufacturing with the moving assembly line. In POLIS V12, an assembly line is a sequential (pipeline) polis: each workstation adds a fixed increment ΔK to the product (car). The total ϵ of the final product is the sum of x over all workstations.

Ford's line reduced the idle time (low K) between stations, keeping each worker's IDT* near the optimum (Phase 4). The concept of interchangeable parts means that any sub-polis (component) has a known K that fits into the larger assembly without requiring renormalisation.

13 Norbert Wiener – Cybernetics and Feedback Control

Wiener founded cybernetics, the study of control and communication in animals and machines. In POLIS V12, a feedback loop is a mechanism that adjusts the input K to keep the output IDT* within a target range. Negative feedback reduces ϵ; positive feedback increases it.

Wiener's predictor for anti-aircraft guns (during WWII) used past trajectory data to forecast future position – a real-time iterative IDT* minimisation. His book *Cybernetics* unified the solid mesh (mechanical systems), liquid mesh (biological homeostasis), and gaseous mesh (information transmission) under a single tensional framework – a precursor to POLIS V12 itself.

14 John Bardeen – The Transistor

Bardeen co-invented the point-contact transistor (1947) and later explained superconductivity (BCS theory). In POLIS V12, a transistor is a three-terminal polis (emitter, base, collector) that controls a large current (liquid mesh flux) with a small control voltage (gaseous mesh). The amplification factor β is the ratio of output K to input K.

Bardeen's second achievement, the BCS theory of superconductivity, describes the condensation of electrons in the liquid mesh into a single quantum state (Cooper pairs) where K becomes constant, reducing electrical resistance to zero. A superconductor is a polis with $\epsilon = 0$ at low temperature – the only known macroscopic system that achieves Phase

1 equilibrium.

15 Steve Wozniak – Personal Computing and Integrated Circuits

Wozniak designed the Apple I and Apple II, the first highly successful mass-produced personal computers. In POLIS V12, an integrated circuit (IC) is a miniaturised polis with thousands of transistors (sub-polises) on a single silicon solid mesh. The clock signal is the external tensional load T that synchronises the sub-polises.

Wozniak's integer BASIC (ROM-based) is a set of pre-normalised K values that the CPU executes without interpretation – a hardwired tensional program. His floppy disk controller used fewer chips (reduced ϵ) than competitors, demonstrating superior tensional efficiency.

16 Conclusion

Six additional engineering pioneers are reinterpreted within the POLIS V12 tensional ontology. Civil engineering, structural design, mass production, cybernetics, transistors, and personal computing all become natural consequences of the closure condition $\epsilon = \sum K_m(2 + K_m) = 0$ and the fractal hierarchy of engineering polises. No free parameters are added; the same equations that describe a physical system or a biological organism also describe the art of engineering.

Zenodo references (pending)

- Main treatise: [Zenodo DOI pending]
- POLIS Bible: [Zenodo DOI pending]

References for the twelve engineers

- Archimedes. (c. 250 BCE). *On the Equilibrium of Planes*. (Trans. T. L. Heath, Cambridge, 1897).
- da Vinci, L. (1478–1519). *Codex Atlanticus*. (Biblioteca Ambrosiana, Milan).
- Watt, J. (1784). Patent for the Watt steam engine. London.
- Tesla, N. (1888). "A New System of Alternate Current Motors and Transformers". *Transactions of the AIEE*, **6**, 83–130.
- Edison, T. A. (1880). Patent for electric lamp (U.S. Patent No. 223,898).
- Turing, A. M. (1937). "On Computable Numbers, with an Application to the Entscheidungsproblem". *Proceedings of the London Mathematical Society*, **42**, 230–265.
- Brunel, I. K. (1831–1859). Bridge and railway designs. Royal Institution of Civil Engineers archives.
- Eiffel, G. (1885). *La Tour de 300 metres*. Paris: Eugène Despois.
- Ford, H. (1922). *My Life and Work*. Garden City: Doubleday.
- Wiener, N. (1948). *Cybernetics: Or Control and Communication in the Animal and the Machine*. Cambridge: MIT Press.
- Bardeen, J., Brattain, W. H., & Shockley, W. (1948). "The Transistor, a Semi-Conductor Triode". *Physical Review*, **74**, 230–231.
- Wozniak, S. & Jobs, S. (1977). Apple II Reference Manual. Cupertino: Apple Computer.