PREFACE

These are the presentations made at the 14th edition of the Constructal Law Conference at the Romanian Academy in Bucharest on 10–11 October 2024. The Constructal Law states: "For a finite-size flow system (not infinitesimal, one particle, or subparticle) to persist in time (to live), it must evolve with freedom to provide easier and greater access to what flows."

The flow designs we see in nature have shape, structure, and rhythm. They are macroscopic, finite in size, and familiar as images with names (river basins, blood vessels, trees), indicating that they have appearances that the observer recognizes. Constructal Law accounts for the dynamic, never-ending evolutionary design and nature. It is a law of nature, a self-standing universal tendency (phenomenon), not some artificial method of 'optimization'. By invoking the law, one predicts what and how something should be.

The presentations explored diverse instances that reveal the causal relationship between freedom, evolution, performance, and staying power (longevity) in all domains: bio, non-bio, engineered, and societal human design. Seemingly disconnected phenomena such as gravity, sound, turbulence, swimming, animal and human migrations, plants, and chemical processes are manifestations of Constructal Law in physics, biology, and engineering. The evolutionary design of artifacts (machines) led to the current era of human & machine evolution. When the time arrow of evolution is recognized, humans can predict their future and surroundings and improve their lives.

Constructal Law underpins predictive theories of evolution, bio, and non-bio. Its core concepts are interwoven: freedom with rules, organization, motion, shape, structure morphing, hierarchy, and arborescence. The articles in this volume illustrate perfection and diversity over space and time: the configurations and rhythms of moving and changing designs of people, animals, athletes, technologies, universities, and science itself: divergent evolution hand-in-glove with convergent evolution.

The Constructal law is the law of physics that covers all phenomena of design and organization evolution in nature. It unveils the universal tendency to evolve toward flow architectures that provide easier access to what flows.

In the decades since the first constructal publications (1996), we are witnessing the accelerated use of the Constructal Law to predict design and evolution in nature, from biology and geophysics to technology and social organization. This volume is a timely review of the field's current state and an open door to future advances.

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