DeepAIMind Research Paper 002

The Business State Model

Version 1.1 | August 2026

Abstract. The Business State Model provides a compact representation of the conditions, structure, context, objectives, capabilities, constraints, and history through which an enterprise can be understood and operated. This revision clarifies an important distinction: the Business State Vector is the measurable snapshot of current state, while the Business State Model is the broader representation that places that state within enterprise structure, knowledge, objectives, capabilities, constraints, and provenance. The Digital Business Twin is the operational system built around these representations. In concise form: the vector represents state, the graph represents structure, and loops represent dynamics.

1. Introduction

An autonomous enterprise requires more than a collection of intelligent agents. It requires a shared representation of the enterprise that agents can observe, interpret, act upon, and update. Without such a representation, decisions remain local, context is fragmented, and changes cannot be evaluated against the wider system.

The Business State Model defines that shared representation. It is intended as a conceptual foundation for the Digital Business Twin and for the autonomous business processes that operate through it. The model does not prescribe a single database, graph technology, or agent architecture. It specifies the information that must be represented for enterprise decisions to remain coherent over time.

2. The Business State Model

At time t, the Business State Model is represented as:

$$B_t = \{S_t, G_t, K_t, O_t, C_t, H_t\}$$

where:

S_t — Business State Vector: measurable variables describing the current condition of the enterprise or a defined business domain.

G_t — Enterprise Graph: entities, relationships, dependencies, flows, and structural connections among the elements of the enterprise.

K_t — Knowledge and Context: meaning, rules, policies, interpretations, assumptions, and other context required to understand the represented state.

O_t — Objectives: desired outcomes, priorities, and target conditions that give direction to decisions.

C_t — Capabilities and Constraints: what the enterprise can do, together with limits imposed by resources, risk, authority, regulation, technology, or time.

H_t — History and Provenance: the sequence of prior states, events, decisions, sources, and transformations that explain how the current representation came to be.

3. Vector and Model: A Necessary Distinction

The Business State Vector is not synonymous with the Business State Model. S_t is a measurable state representation: for example, cash position, open orders, available capacity, inventory, service levels, risk exposure, or the status of a process. It is the answer to the question: “Where are we now?”

The broader Business State Model contains that vector but also explains its structure and significance. G_t shows how entities and processes are connected. K_t provides meaning and context. O_t expresses what the enterprise is trying to achieve. C_t describes what is possible or prohibited. H_t preserves history and provenance. Together, these components allow a current measurement to be interpreted as part of an enterprise rather than as an isolated number.

4. Structure, Context, and Dynamics

The model is best understood through three complementary ideas:

- The vector represents state — the measurable condition at a point in time.
- The graph represents structure — the enterprise entities, relationships, and dependencies through which state is connected.
- Loops represent dynamics — the recurring processes through which the enterprise observes, decides, acts, evaluates, and learns.

Loops are therefore related to the Business State Model but are not the model itself. They describe how state changes and how decisions propagate through structure. The detailed treatment of autonomous control loops belongs to Research Paper 003; in this paper, loops are introduced only to complete the conceptual relationship between state, structure, and change.

5. The Digital Business Twin

The Digital Business Twin is the operational system built around the Business State Model. It maintains or accesses the relevant representations, connects current measurements to enterprise structure and context, records history and provenance, and provides a basis for simulation, decision support, coordination, and execution.

The Twin is therefore more than a dashboard or a static model. It is the persistent computational environment in which the enterprise can be represented, queried, simulated, and progressively improved. Agents and automated processes operate against the Twin; they do not replace it. Their actions should be interpretable in relation to the shared state, graph, objectives, constraints, capabilities, and history.

6. Implications for Autonomous Enterprise Design

This distinction has practical implications. First, measurements should not be treated as sufficient context for action. A value in S_t must be interpreted through G_t, K_t, O_t, and C_t. Second, changes to enterprise structure or dependencies should be represented explicitly rather than hidden inside individual agent logic. Third, provenance in H_t is necessary for auditability, learning, and the reconstruction of why a decision was made.

The model also provides a stable vocabulary across the DeepAIMind research sequence. Paper 002 defines what must be represented. Subsequent papers can then address how loops operate, how agents are governed, how candidate changes are simulated, and how enterprise autonomy matures over time.

7. Conclusion

The Business State Model is the broader representation of an enterprise at time t. The Business State Vector is its measurable state component, not the whole model. The Enterprise Graph captures structure and dependencies; knowledge and context provide meaning; objectives and constraints shape decisions; capabilities define what can be done; and history and provenance explain how the current state was reached.

The central relationship is concise: vector represents state, graph represents structure, and loops represent dynamics. The Digital Business Twin operationalizes these representations so that autonomous agents and processes can act with shared context, traceable history, and an enterprise-wide view of consequences.