Powered for Change

Electricity networks in the age of AI

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Context

Electricity network utilities have evolved to efficiently maintain supply. They are frugal businesses, optimised for efficient management of an existing asset base where growth has been steady and predictable.

Teams are lean and costs are minimised with limited investment in data, processes and systems for organisational velocity and end-to-end (E2E) integration. This model has worked well. Networks are reliable and efficient.

The challenge

The incredible growth trajectory of power-hungry AI data centres has compounded the existing challenges of the energy trilemma—a rapidly changing generation mix, ageing assets, increased human and natural threats to security of supply, the demands of electrification and sustained pressure on affordability and competitiveness.

There is more work required than there is capacity and time available, with choices shrouded in uncertainty—from what will connect and when, to the actual condition of assets.

Reconciling competing demands will require scaling, compression and optimisation—work that is bigger, faster and smarter. The current industry model faces scalability constraints across talent, supply chain and network access, with manual and fragmented processes limiting work compression and optimisation.

The challenge of the current model is shown in Figure 1, with fragmentation across the organisation and associated processes, platforms and data;, the drivers of work—risk and resilience, capacity and capability and connections; and the delivery of work across stages and layers.

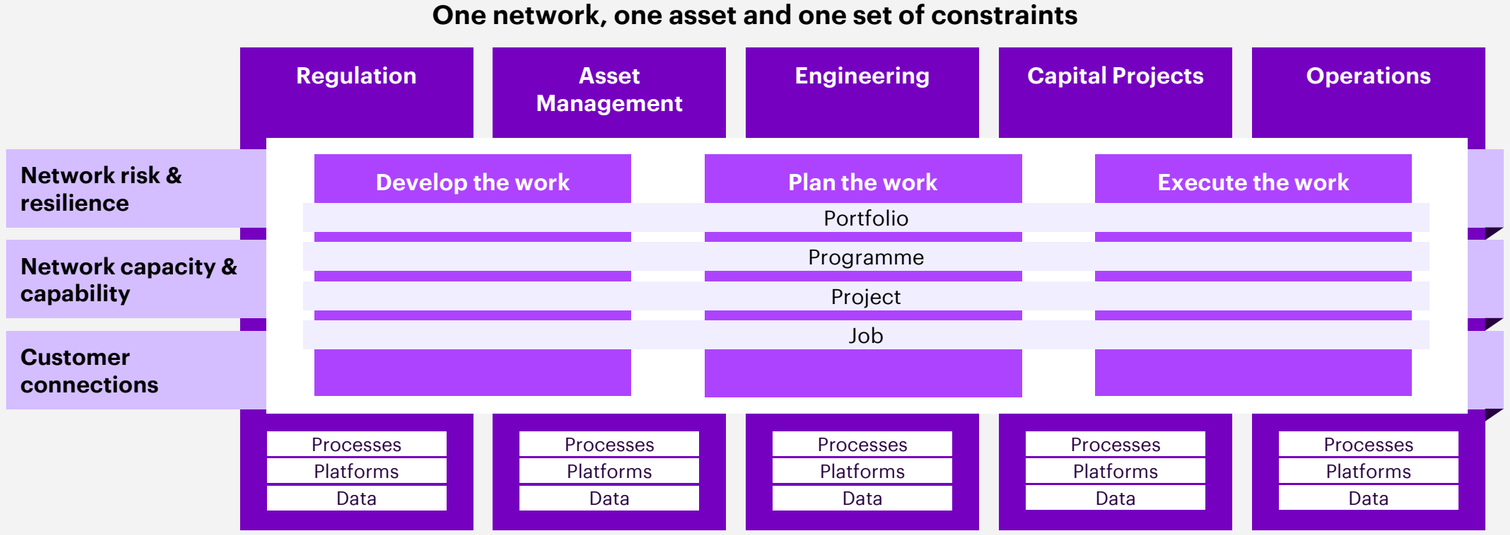

Figure 1
Fragmentation across multiple dimensions

Fragmentation leads to processes that don't scale, compress, integrate or effectively handle uncertainty—the orchestration required is too hard and too complex. Value leakage and risk compound, compromising the ability to connect faster and add capacity whilst maintaining security of supply and affordability. Examples include:

- Continued deferral of large asset health interventions that are hard to fit into a constrained plan, with limited visibility of the overall system risk of these choices.
- Underutilisation of network access, curtailing the flow of work.
- Designs that fail to maximise use of existing network capacity with intelligent solutions.
- Inefficiently touching the same asset multiple times across different drivers.
- A failure to drive a multi-generational approach to designing and building, with replicated designs and repeat teams and supply chains.

Network utilities need to find a route that overcomes today's fragmentation and rapidly increases scale, compresses timelines and enables effective optimisation.

From static network efficiency to dynamic system value

Network processes need to dynamically maximize system value—the total value provided to the system from network assets—against constraints and uncertainty. To do this requires three things (See figure 2):

1. Find the optimal solution.

This involves repeatably solving a set of integrated hard problems e.g., prioritising asset health interventions to maximise risk reduction per unit of investment; cross-driver optioneering for sites and circuits; bundling of work against constraints and designing for replication and pre-fabrication. These are discreet hard problems that then must be integrated to create a solution for a single network, asset and set of constraints.

2. Keep it optimal.

Solutions must be dynamically optimised for these interlinked hard problems sufficiently fast that they remain optimal as things change (over the long lifecycle of network projects.) For example, a new customer connection request may mean that the previous substation design no longer makes sense, which subsequently impacts the integrated plan.

3. Deliver as optimised.

This requires integration across the organisation, supply chain partners and other stakeholders, e.g., customers and communities to execute the work in alignment with the optimised solution. Dealing with on the ground realities—e.g., a piece of work overruns, an outage is pulled or ground conditions impact engineering choices—must be managed through delivery optionality and flexibility.

To do these three things in parallel requires the business to be wired differently. Parts of it are there. For example, many network utilities have advanced capabilities to identify which assets to prioritise for health intervention. But finding a theoretically optimal asset health plan means little if the planned interventions get bumped from the plan by prioritised connections work. Annualised plan churn of greater than 50% is not uncommon across the industry and is testament to the challenge of going from a great plan to delivered outcomes.

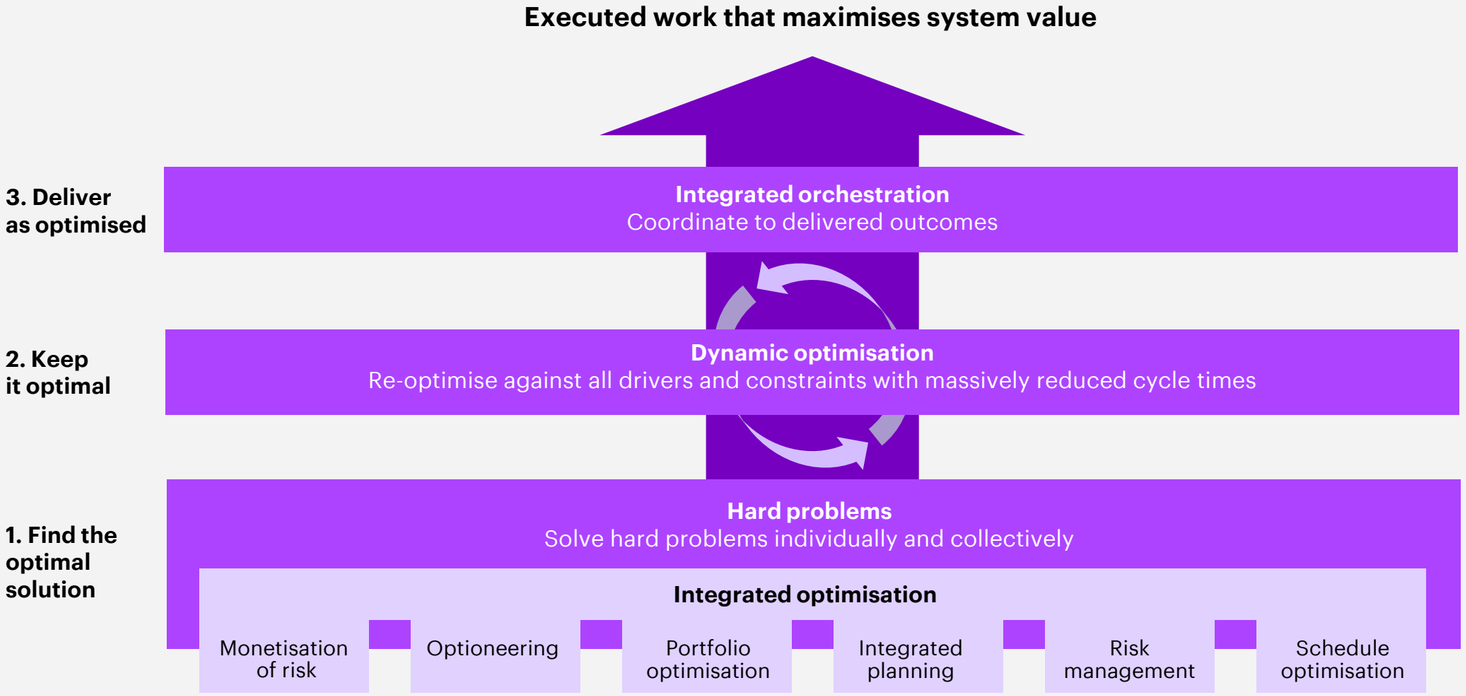

Figure 2
Optimisation to outcome

So, what needs to change?

The temptation is to tweak processes, throw more people at the challenge and make point infusions of digital and AI.

Given the time available—data centres and generators need to be connected right now—a solution that minimises the level of change feels faster and less risky. Evolution, not revolution. This makes sense if it is possible to evolve to the required state. If tweaks and incremental capacity and capability are sufficient.

This paper contends that they are not and that there is a superior and necessary pathway. One that is built on what AI makes possible.

The case for an AI-native approach

Some problems are tailor made for AI. This is one of them. It requires:

1.

Rapid integration and enhancement of fragmented data providing a clear business logic to technical structured data (e.g., asset registers and cost books) and unstructured data (e.g., gate papers, project plans, maintenance notes and engineering designs).

2.

An increase in productivity for talent doing complex work that requires intelligent automation from power system engineering to portfolio management and project controls.

3.

Solving hard analytical problems that require dynamic optimisation across multiple dimensions, e.g., cross-driver prioritisation and work bundling by site and circuit.

4.

Effective process orchestration across organisational boundaries with massively compressed cycle times. For example, updating the plan to reflect delayed work or a new connection request.

AI agents—steered by humans and backed by platforms and data—are uniquely able to address these requirements. They can do so rapidly with big productivity gains, compression of key processes and the kernel of integrated optimisation in place within 6–12 months and E2E reinvention executed and embedded in 18-24 months. Agents can:

- Make sense of large and technical structured and unstructured data sets, closing data gaps, connecting the data and creating a layer that enables humans to understand what the data means.
- Automate complex and technical tasks that require adaptive reasoning, (i.e., cannot be addressed by rule-based logic), massively increasing the tasks that are machine-addressable.
- Dynamically optimise across many dimensions, illustrating trade-offs and presenting choices that increase decision quality.
- Adaptively orchestrate across complex processes, consistently applying brilliant basics (across applicable policies, standards and procedures) and using all available data to execute to an outcome in minutes.

This will involve a major shift in how work is done and in the respective roles of humans, agents and platforms, (Figure 3). In this future world:

- **Humans** will bring empathy and trust, judgement and accountability, and originality and strategic thinking. They will no longer spend time wrangling data, managing handoffs and performing repetitive tasks.
- **Agents** will autonomously and adaptively run processes and journeys, orchestrate the underlying platforms, enrich and connect data, and generate actionable insights and provide a conversational interface for human interaction.
- **Platforms** will remain the workhorse of the enterprise, acting as systems of record and driving scale, execution and control across transactions and repeatable, static and high-volume process steps.

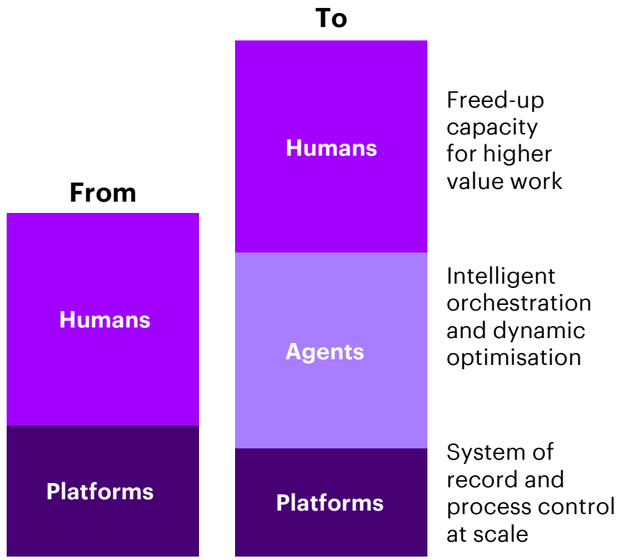

Figure 3
The role of humans, agents and platforms

Infusing AI into existing processes will not be sufficient. Current processes are designed around current limitations. They assume that tasks and handoffs are executed to the clock speed of human-orchestrated organisations where things take days, weeks and months. Steps within these processes can be accelerated and optimised by AI, but the outcomes will remain constrained by the process foundation upon which they sit. For example, the plan can be optimised for value and constraints at a point in time, but if this plan becomes progressively less deliverable as things change, the realised outcomes can diverge significantly because the AI wiring can't dynamically optimise through to execution.

This is the difference between **AI-infused** and **AI-native** processes. Infusion takes what exists today and adds in point AI solutions. AI-native reinvents the process with what AI makes possible. Figure 4 shows the difference between AI-infusion of as-is and AI-native reinvention for the E2E process for work planning. It shows how the process runs to respond to a change in context, such as a new connection request or updated asset health information.

As-is AI infused: Highly manual and human orchestrated on top of fragmented data. Infusion of point AI tools e.g., plan optimiser.

Takes weeks due to the number of hand-offs and task durations. Suffers from poor decision quality due to trade-off complexity and optimism bias.

AI-native to-be: Massive compression and improved decision quality as agents run the E2E on all the structured and unstructured data across domains eliminating hand-offs and silos.

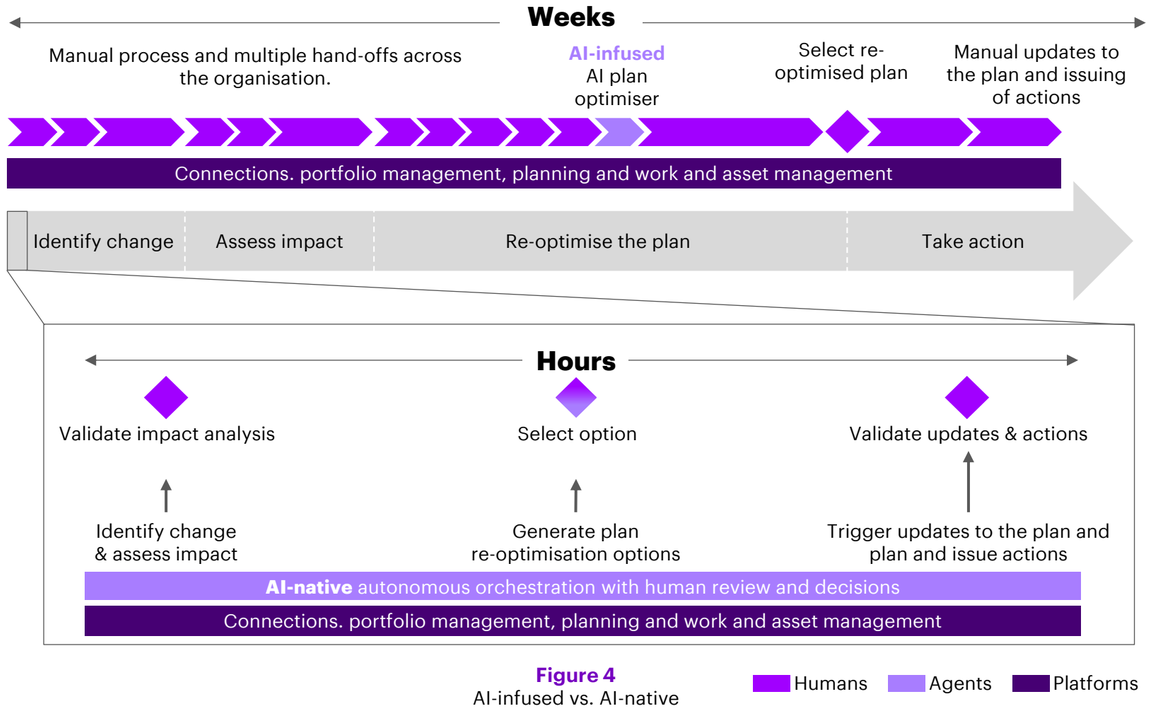

Figure 4
AI-infused vs. AI-native

By eliminating human-performed and orchestrated tasks and hand-offs, the AI-native approach massively reduces cycle times and enables humans to act as accountable and specialised decision-makers supported by machine intelligence.

So, what will an AI-native future look like?

An AI-native business operates seamlessly across one integrated value stream that converts the drivers for work into system outcomes. The existing organisational construct remains; there are specialised teams with clear accountability for domain performance e.g., Engineering is accountable for design assurance and Ops is accountable for the safe execution of work. Platforms also remain but are now triggered by agents as they run the process.

The big change is in E2E optimisation and orchestration, which is performed by agents, steered by humans and underpinned by platforms and data (Figure 5).

Agents also require an "organisation," as they, like their human counterparts, are specialised e.g., solve specific hard problems. The agent organisation exists across three layers:

1. Orchestrator agents that act as the human interface layer and manage across the underlying super agents to execute against intent.

2. Super agents that are managed by the orchestrator agents and themselves work across utility agents to complete tasks.

3. Utility agents are highly specialised, and task-focused and managed by the super agents.

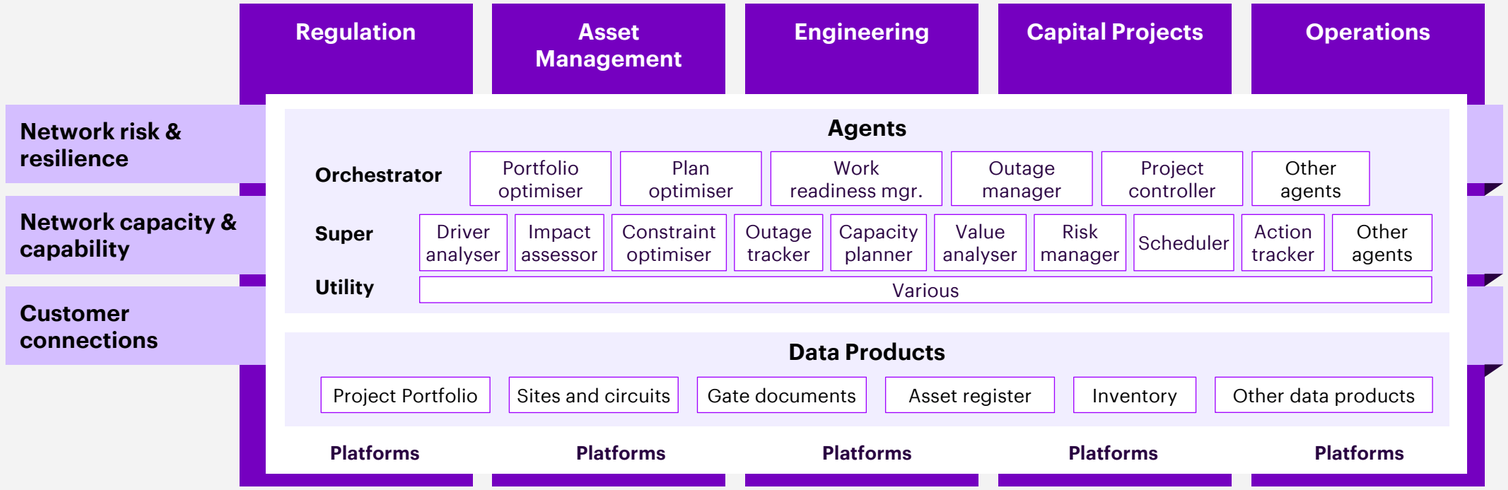

Figure 5
Agentic optimisation and orchestration

The agent organisation operates in a radically different way. It can coordinate, collaborate and integrate instantaneously and with no loss of information fidelity and quality at the interface and access to all the information with close to zero latency. This is what enables massive acceleration in clock speed, integration and dynamic optimisation that collective human intelligence cannot replicate.

Agents also bring built-in discipline—aligned to policy and standards—whilst retaining sufficient adaptability to problem solve. Machines provide effective points of control, e.g., checks against standardised designs and work readiness reviews and increased rigour and discipline in tracking actions to completion.

With the agents and data products in place, the constraints of human-run processes are removed, creating the ability to continuously solve hard problems, dynamically optimise and rigorously execute to outcome.

What to do next

The need for change is compelling, and an AI-native approach is uniquely able to meet the challenge. The level of change is significant but justifiable given the value at stake. Now is the time to act, with process reinvention across the value stream that goes from the drivers of work to delivered system outcomes.

The change is underpinned by fixing the data layer, creating a set of data products upon which AI agents and humans can operate and then deploying an agent organisation piece by piece with people and platform change driven in parallel.

The rapid development of AI over the last 12–18 has made the need for change more pressing and created the means to act. This is an industry defining moment and a huge opportunity.

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