White Paper
Information Technology
July 2025

IT@Intel: Enterprise Architecture: Accelerating Intel's Business Transformation

Building on our previous enterprise architecture work, we are modernizing and simplifying practices and processes, more tightly managing assets, and promoting innovation through AI

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Executive Summary

In today's data-driven and fast-paced marketplace, Intel's continued success hinges on quickly adapting to market disruptions and opportunities. Intel IT is committed to contributing to that success by enhancing our enterprise architecture (EA) processes and practices.

From adding new Technical Workgroups (TWGs) that are focused on crucial topics like business transformation and AI innovation to defining a strategy for strengthening software asset management (SAM) and hardware asset management (HAM), we're helping to modernize Intel's business processes and standardize architectures and solutions across the enterprise.

Other current EA initiatives include the following:

- Spreading governance responsibilities across both the business and IT.
- Formalizing the evaluation of emerging technologies.
- Increasing the resiliency of our EA from end to end.
- Infusing AI, Generative AI (GenAI), and agentic AI into our EA workflows.
- Using capability-based planning (CBP) to prioritize and optimize capability evolution.

Our EA provides a framework for business transformation, helping to bring order to chaos across 1,700+ in-house applications and 11,000+ commercial software products. We are reducing technical debt, improving business agility, and supporting Intel's strategic growth imperative. We hope that by sharing our EA solutions and thought-leadership stories, we can help other IT teams do the same.

Contributor

Q Oka, Industry Engagement Manager, IT@Intel

Acronyms

APM	application portfolio management
BU	business unit
CBP	capability-based planning
EA	enterprise architecture
ERP	enterprise resource planning
GenAI	Generative AI
HAM	hardware asset management
PI	Program Increment
SAM	software asset management
TRC	Technical Review Committee
TWG	Technical Workgroup

Business Challenge

Several years ago, we established a baseline for enterprise architecture (EA) maturity, defined EA structures and blueprints, and built an EA community of practice and excellence. Our initial efforts reduced technical debt and provided decision makers with a reliable representation of the enterprise to help them influence the capability and direction of the company. However, Intel IT never stands still; we know we can continue to improve our EA practices and processes to accelerate Intel's business transformation. In particular, we need to fully support Intel's business transformation through better EA.

About three years after publishing our first EA paper in 2019, we engaged with an industry-standard benchmarking firm to validate our EA practices and collateral. The comprehensive benchmarking process covered 48 different IT capabilities across four key areas and seven domains. The firm concluded that overall, our EA organization had made strong progress in adopting a best-practice EA program since the initial 2019 benchmark. To achieve the next level of growth, since the 2022 benchmark, we have continued to improve our data architecture and data management practices (see the sidebar, "Building a Strong Data Foundation") and other key focus areas. Several of the identified initiatives are described in this paper. Over the coming months, we will accelerate these projects to drive better alignment and value delivery with the business.

Overview of Current EA Initiatives

The scope of EA at Intel includes 1,700+ applications; 180+ horizontal platforms spanning private cloud, public cloud, and software-as-a-service solutions; and 11,000+ commercial software products installed on assets within the enterprise. It's our job to ensure these assets are managed as effectively as possible while aligning with Intel's business needs.

To help develop and deliver EA standards that support Intel's business transformation, we've added two new "program-level" Technical Workgroups (TWGs)—one specifically targeted to the transformation of Intel's Product and Foundry businesses, and one focused on AI across the enterprise. Besides adding these two TWGs, we are currently working on the following EA initiatives:

- Improving business value and operational efficiency by spreading governance responsibilities across both the business and IT.
- Defining a strategy for better software asset management (SAM) and hardware asset management (HAM).
- Increasing the resiliency of our EA from end to end.
- Infusing AI, Generative AI (GenAI), and agentic AI into our EA workflows.
- Formalizing the evaluation of emerging technologies as a critical part of our EA practice.
- Using capability-based planning (CBP) to help prioritize and optimize capability evolution.

These initiatives will help us modernize, simplify, and tightly manage EA and assets while optimizing processes with AI. Overall, our work promotes innovation and transformation, reduces technical debt, improves business agility, and supports Intel's strategic growth imperative. The following sections describe each of these initiatives in more detail.

Building a Strong Data Foundation

Data is a crucial driver of innovation—it's a fundamental force that's shaping the future of Intel. That's why data excellence is one of Intel IT's most important investment areas. High-quality, well-governed data is crucial for Intel's new vision. It is critical to our AI, Generative AI (GenAI), and agentic AI initiatives and is also pivotal to improving operational efficiencies and processes within the company as a whole.

In support of Intel IT's overall data foundation efforts, the enterprise architecture (EA) team focuses on creating a single version of truth about hardware and software assets. This high-quality data can drive business outcomes related to business value delivery, cost optimization, security, privacy, and resiliency.

Federated EA Governance

To accelerate business transformation, it's crucial that Intel IT doesn't stand in the way of innovation. On the other hand, successful EA depends on a high level of alignment with the business and stringent governance. We are taking a federated approach to EA governance (see Figure 1), which combines business governance with technical governance. In other words, IT controls some aspects of EA, but the business units (BUs) also share governance responsibility.

- **Business governance.** BUs can make decisions in concert with business and IT stakeholders through formal review and oversight of IT programs. The BU can recommend EA deviations based on business circumstances but shares the review process with the Technical Review Committee (TRC) to help ensure optimal adherence to EA standards, blueprints, and reference architecture, while still accommodating specific business needs. The business also ratifies Intel IT's commitment to delivery and follows the recommendations of the TRC.
- **Technical governance.** IT provides unified and centralized technology governance across all IT programs to support streamlined decision making. Our TWGs develop and establish transformative technology standards, blueprints, and reference architecture that have high business value, and ratify solution architectures to address business problems in alignment with the reference architecture. It is our responsibility to understand the business needs and select an appropriate technical solution that is cost-effective. We approve deviations from the reference architecture when they are warranted by the business need.

Figure 1. Our federated approach to governance spreads responsibility across the BUs and IT.

Within the technical governance domain, we have three separate domain scopes, each governed by a TRC. The new program-level TWGs are part of the Applications TRC scope described below:

- **Data center scope.** This area includes data center components, network, storage and backup, and data center workloads.
- **Communication, conferencing, content, and collaboration (4C) scope.** This area includes things like email and chat; audio/video conferencing; document creation, sharing, and storage; and collaboration tools.
- **Applications scope.** This area includes end-to-end business models and value creation across various organizations such as product engineering, supply chain, finance, HR, sales and marketing, and more. Applications governance applies to all technical components, like user interfaces, APIs, data storage, workflows, analytics, AI and machine learning, and automation. This scope also includes enterprise data management architectures and enterprise platforms, whether on-premises or in the cloud.

Applying Agile Methodologies to Application Governance

Agile methodologies and DevOps practices can help streamline governance for application development. Although some applications are developed using the traditional linear waterfall method, Agile methodologies can deliver business value sooner rather than later. We use a stage-gate process (see Figure 2), integrated with standard DevOps practices.

Starting from a trigger—such as a new business need, an emerging technology, or a significant architecture change—a project enters a well-defined, three-stage process. Stages include discovery, conceptualization, and feasibility. Proceeding from one stage to the next requires passing a gate, such as proposal ratification, concept ratification, solution architecture feasibility, and execution commit. A project must successfully pass through all four gates to move into the standard DevOps cycle.

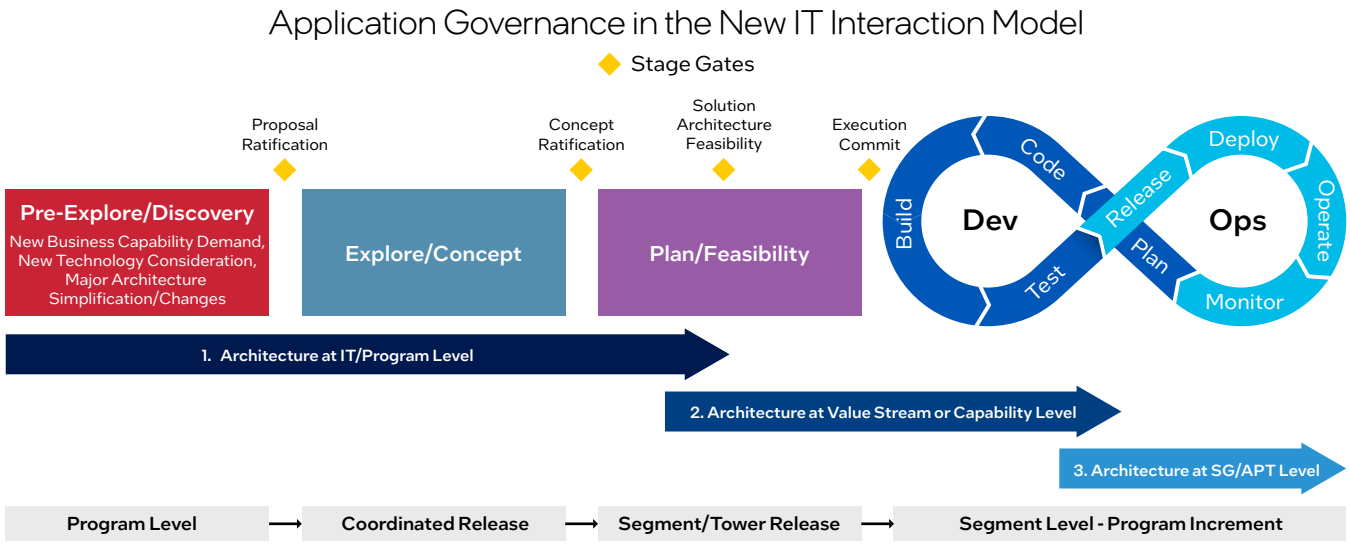

Figure 2. We use a stage-gated approach to integrate DevOps with application governance.

As the project moves along the planning process, we carefully explore the ramifications at varying levels: at the IT/Program level, the value stream/capability level, and the segment/Agile Persistent Team (APT) level. At the IT/Program level, the TRC looks at things like alignment with industry-standard reference architecture and technology selection. At the value stream/capability level, the TWG examines how the new project relates to segment and value stream demand as well as whether the project contributes to our ongoing goal of simplifying EA.

At the segment/APT level, the architecture runway is created, and APTs execute DevOps. An architectural runway is a set of existing blueprints, code, components, and infrastructure that enables the delivery of new features with minimal redesign and delay. It provides a foundation for Agile teams to build upon, facilitating faster development and iteration. An architectural runway allows EA projects to be completed successfully, without significant architectural rework. We can use this runway to make releases at various times—such as a Program Increment (PI) release,[1] a segment/tower release,[2] or a coordinated release.

EA Orchestration

We take a bottom-up approach to EA orchestration (see Figure 3). Standards form the foundation for EA and help define our EA strategy. To execute the strategy, we establish an EA roadmap and plan for appropriate governance. The standards and roadmap are refreshed annually. Transformation initiatives turn EA designs into reality and are aligned with program and PI cadences.

[1] In the Scaled Agile Framework (SAFe), a Program Increment (PI) is a structured, timeboxed period—typically spanning 8 to 12 weeks—during which Agile Release Trains (ARTs) deliver incremental value in the form of working, tested software and systems. Our PIs have quarterly release planning. PIs can be at a segment level or a cross-segment level for coordinated release.

[2] We use the term "tower release" to represent a layered or multi-stage release, where features are released incrementally, building upon previous releases to create a more complex or feature-rich final product.

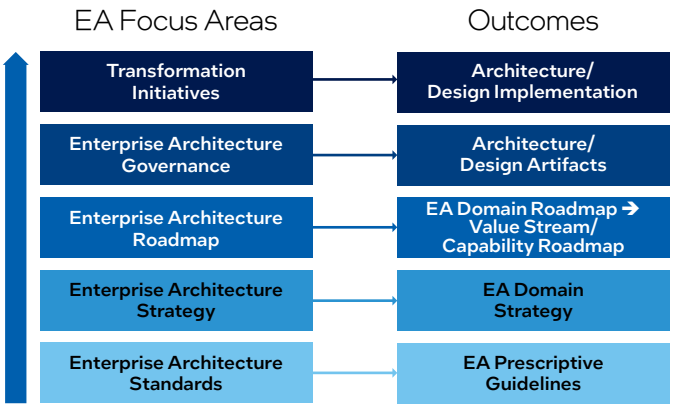

Figure 3. Each EA focus area feeds the next in an orchestrated manner.

Application Portfolio, Hardware, and Software Asset Management

Intel tracks enterprise capability assets in three distinct and connected areas: application portfolio management (APM), software asset management (SAM), and hardware asset management (HAM). Our commitment is to establish solutions and processes that comply with Intel policies, optimize costs and operations, and build resiliency. To achieve this, we have initiated programs designed to optimize Intel's hardware and software asset lifecycle management from end to end (see Figure 4).

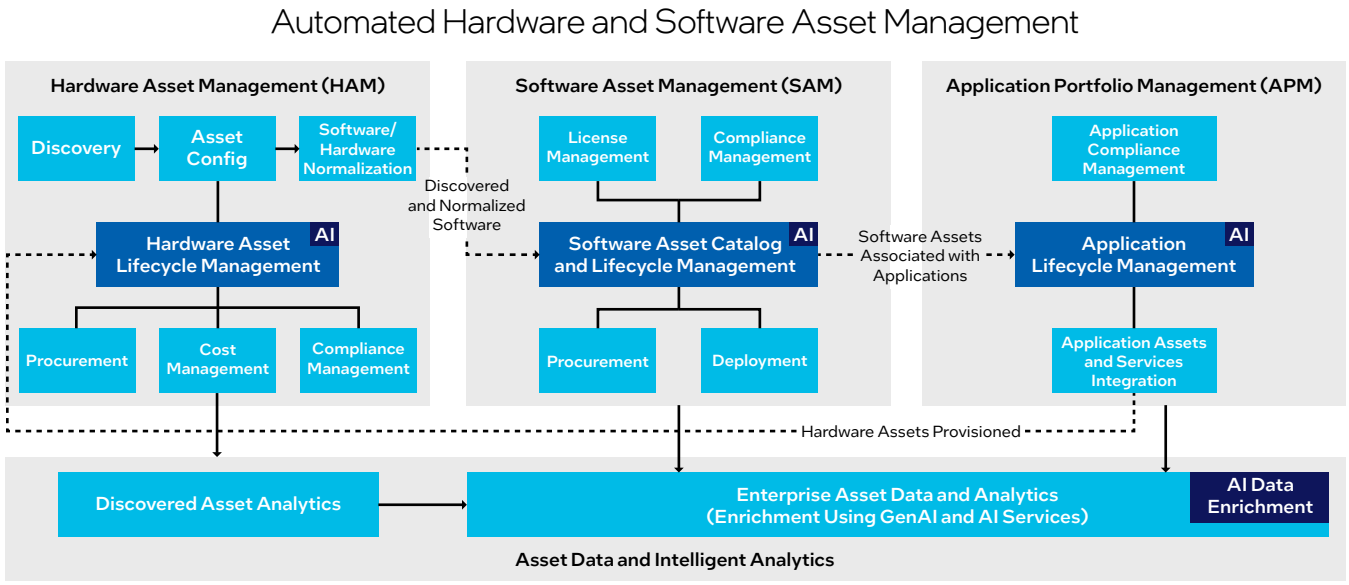

Figure 4. We envision automated and AI-enabled HAM, SAM, and APM capabilities with integrated asset data and analytics.

The EA team defines the application rationalization strategy and establishes roadmaps across all IT segments. Since the beginning of 2024, our APM and SAM efforts have:

- Eliminated 321 in-house applications.
- Removed 1,400 commercial software products from the environment.
- Generated USD 10 million in cost avoidance.

APM focuses on strategically managing and optimizing Intel's applications to align with business objectives and enhance operational efficiency. Our vision for APM includes a single set of simplified compliance rules across application security, privacy, and resiliency, with asset resource requests tied to compliance for built-in enforcement. This approach helps reduce risk and enhance regulatory adherence. The following characteristics define our APM program:

- Unified application resource management, offering a single-entry point for application owners and developers to acquire and modify application-related resources, leading to increased efficiency and faster time-to-market.
- High visibility into an application's solution stack and technical debt management capabilities, resulting in improved system performance and reduced maintenance costs.
- Clear ownership of an application's resources and assets, fostering accountability and streamlined decision-making processes.
- End-to-end application-to-asset traceability, enabling resiliency impact analysis, which enhances the ability to quickly identify and mitigate potential disruptions.

In essence, we offer a comprehensive, 360-degree service for APM that encompasses ownership, compliance, asset management, resource allocation, and traceability.

SAM is the systematic approach to managing, controlling, and protecting Intel's commercial software assets throughout their lifecycle to optimize licensing and usage, ensure compliance, and optimize cost. Our vision for SAM includes a consistent user experience for all Intel employees with the ability to search, comply, pay for, and install the software seamlessly. The following are the defining characteristics of our SAM program:

- Automated compliance checks to help ensure Intel's software assets comply with Intel's legal, resiliency, data protection, procurement, and architecture policies.
- Intelligent under/over license utilization analytics, license risk identification, and license management to optimize software costs.
- Standard onboarding and ownership disposition process for new software, ensuring built-in compliance with Intel's policies from the start.

HAM is the process of procuring, installing, maintaining, and retiring Intel's hardware assets throughout their lifecycle to help ensure efficient utilization, cost-effectiveness, and compliance with Intel's policies. Our vision for HAM includes the following key features:

- Visibility into the current state of hardware assets across all domains (client, server, network, storage, etc.) with over 95% accuracy and completeness, enabling informed decision making and strategic planning.
- Standardized key performance indicators, data quality dashboards, and governance for hardware lifecycle management processes, resulting in consistent performance measurement and enhanced accountability.
- Streamlined end-to-end asset lifecycle management processes resulting from the adoption of industry best-known methods and workflow automations, leading to improved operational efficiency and reduced manual effort.
- Seamless integration between hardware asset processes and ERP systems for procurement and asset depreciation, facilitating accurate financial tracking and optimized resource allocation.

EA Resiliency

In support of the OneIT Resiliency Program across infrastructure, platform, and applications, we are building resiliency planning, automation, and monitoring into our APM program—aligning to the respective scope of technical governance. We want to ensure our EA standards ingrain resiliency across all data center components and services, such as servers, network, storage and backup, database as a service, containers as a service, security services (such as firewalls and proxies), and operations. Table 3 lists some of our resiliency focus areas, such as redundancy, performance and uptime, monitoring, end-of-life considerations, change management, and workforce skill levels. For more information on the OneIT Resiliency Program, refer to the IT@Intel white paper, "IT Resiliency Drives a Resilient Enterprise."

Table 1. EA Resiliency Focus Areas

Category	Risk Factors to Address
Redundancy	▪ Does the service have redundancy at the sub-component level? (Examples: dual power supply units in servers and redundant network switches) ▪ Are components configured to handle sub-component failures without impacting higher layers? ▪ Are the redundancy features tested periodically and validated? ▪ Is there sufficient capacity to handle the workloads in case of a site failure?
Performance and Uptime	▪ Can the service handle bursts without impacting all users? (Examples: rate limiting and throttling) ▪ Does the service meet the quality-of-service requirements of the hosted services?
Monitoring	▪ Are all critical components monitored for uptime? ▪ Can we proactively detect, alert, and fix faults?
End-of-Life Support	▪ Is the service relying on components that are not supported or out of warranty? ▪ Are there enough dependent vendor service-level agreements to meet the need for break-fix parts and spares?
Operations and Change Management	▪ Is there rigorous change management to evaluate change risks, along with validation and back-out processes? ▪ Are there automated controls to avoid human errors that can cause large outages or data loss?
Skills/People	▪ Do we have an adequate number of skilled engineers to maintain the service?

Infusing EA with Intelligence

The integration of AI, GenAI, and agentic AI into EA presents a transformative opportunity to address discovery, interpretability, and governance challenges by automating processes and enhancing productivity. AI, GenAI, and agentic AI can automate tasks across EA phases, from initial architecture vision to implementation governance.

Currently, we are piloting an AI Enterprise Architect agent that can discover existing architecture artifacts, such as policies, principles, standards, business process flows, and solution architecture diagrams. This agent uses a large language model to provide generative content summarization, making complex architecture documents more accessible to both technical and business audiences. This not only improves interpretability but also enhances stakeholder engagement by presenting information in a more personalized format.

Eventually, automation can extend to architecture governance processes through self-service capabilities. For instance, when defining a business use case, an AI agent could automatically recommend existing business processes and systems, thereby reducing manual effort and enhancing decision-making. Furthermore, the ability to upload a design document and receive automated feedback can significantly improve the quality and consistency of architectural deliverables.

Overall, the integration of various forms of AI into EA offers a spectrum of opportunities, from immediate wins in content discovery and summarization to long-term advancements in governance automation and artifact creation. By embracing these technologies, we can enhance the productivity of our architects and help ensure that architecture deliverables are more accessible and interpretable to business stakeholders, ultimately driving greater alignment between IT and business objectives.

Integrating Emerging Technologies into EA

Since our EA program started, we have established "EA tracks," which are pathways or initiatives that lead us toward North Star reference architectures and digital transformation, and that meet corporate and IT objectives. EA tracks provide complete visibility to all stakeholders as to what is coming up (both short- and long-term). Examples of EA tracks include the following:

- Exploration of new business and technical capabilities within a two- to three-year horizon.
- A "wish list" of disruptors and revolutionary capabilities that are realistic and well-aligned with Intel's strategic objectives. These tracks generally have a three-year horizon or more.

We are now incorporating an emerging technologies flow into our EA tracks (see Figure 5) to centralize the engagements and initiatives that come through multiple channels. This formal integration of emerging technology evaluation into our EA framework will enable us to integrate the evaluation and recommendations into our overarching EA governance execution flow. The centralized tracking and disposition of emerging technologies can integrate into workflows for our APM and SAM programs, accelerating the disposition and enablement of those capabilities and unlocking business value.

Sources for emerging technology evaluation initiatives include internal and external research and engagements, innovations, and ad-hoc evaluation requests. We funnel all these sources of information into a formal EA evaluation process—very similar to the evaluation process we use for application governance, including gates such as proposal ratification, concept ratification, and adoption recommendation.

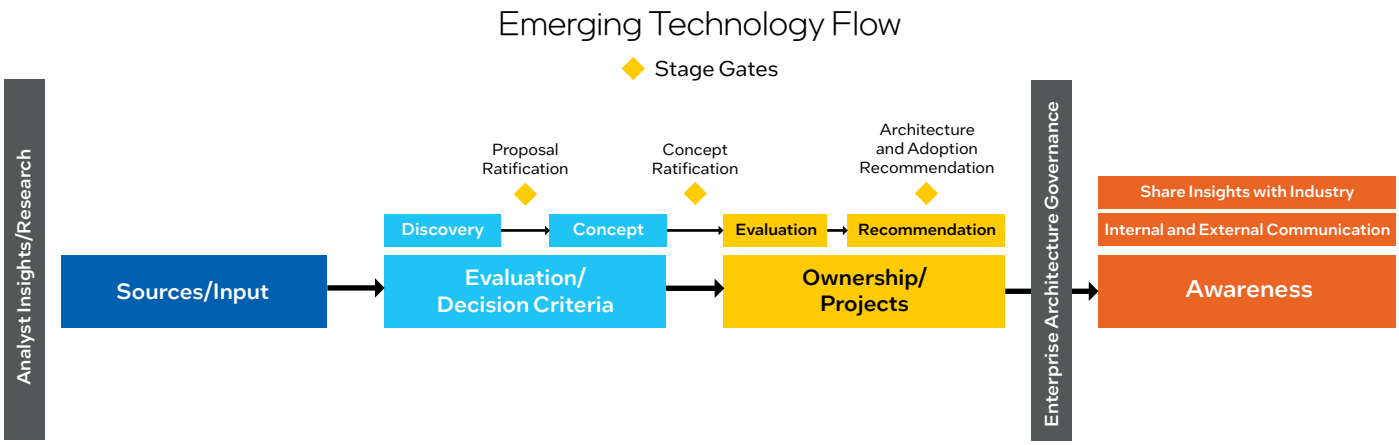

Figure 5. Our formalized EA process includes evaluating, adopting, and evangelizing emerging technologies.

When evaluating an emerging technology, we consider several aspects, such as cost, alignment to business problems, business value, and whether it is redundant with capabilities we already have. If we recommend that an emerging technology be adopted, we assign the project to one or more enterprise architects who will guide proofs of concept and wider adoption. Communication is key to bringing a new technology to its fullest potential. We use a variety of communication channels, such as Tech Talks, events, emails, newsletters, white papers, and more. These communications not only help spread the technology's value across the enterprise but also help establish Intel IT as a thought leader and innovator in the IT industry.

Using CBP to Prioritize and Optimize Capability Evolution

Years ago, Intel IT made business architecture a foundational component of our EA capability. By focusing more on business drivers, vision, goals, capabilities, roles, processes, and information flows, we were able to ensure that our focus on the corresponding data and application technology architectures would align more closely with the needs of the business. Furthermore, Intel IT's Information Security (InfoSec) group recently adopted CBP because it provides a foundational framework and methodology for evolving its capabilities to help securely enable Intel's overall business strategy. This shift helps align the InfoSec group's strategies, prioritize projects and resources, communicate more effectively with business stakeholders, and, most importantly, reduce complexity. This also makes InfoSec operations more agile and responsive to changing business needs.

CBP Stages

CBP involves a recurring cycle of four stages: align, assess, plan, and manage (see Figure 6). The first stage, align, is mostly about establishing the architecture and strategy, and more importantly, setting the common capability language that will form the basis for improvement and evolution. The second stage, assess, involves a systematic approach to assessing a capability's maturity, gaps, and opportunities for improvement. The third stage, plan, is all about establishing the work plan and roadmap to address the identified gaps and to increase the capability's maturity. The final stage, manage, involves the control and governance to ensure what was planned was actually implemented, and that the implementation can be traced back to the business strategy, goals, and architecture that were set at the beginning.

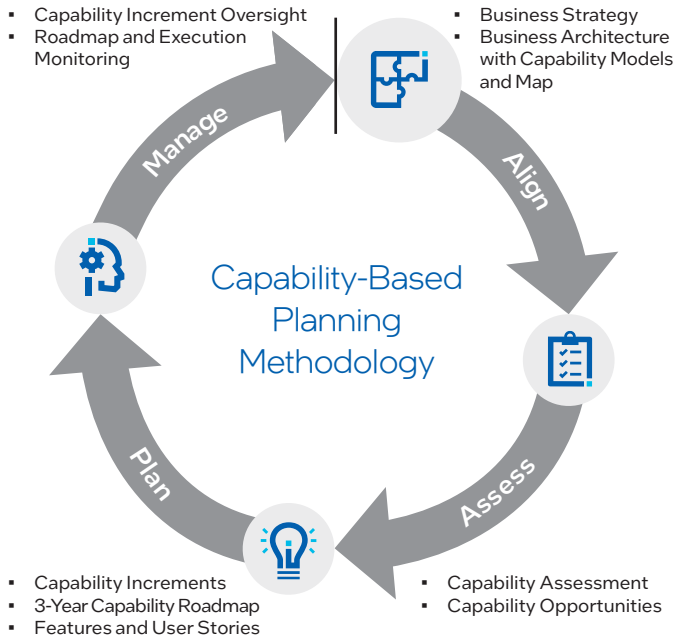

Figure 6. The four stages of capability-based planning (CBP).

Benefits of CBP

As other Intel IT groups—and even BUs—see the positive outcomes of CBP, we hope they also begin to adopt it, which would multiply the benefits across Intel. Furthermore, CBP has already fostered collaboration across departments and teams. With a unified understanding of capabilities and objectives, teams can work in sync to break down silos and optimize cross-functional efficiency.

For more details about our CBP methodology, please refer to the recently published IT@Intel white paper, "Prioritizing Investments and Maximizing Security Using Capability-Based Planning."

Conclusion

Modernizing, simplifying, and tightly managing applications and infrastructure assets while optimizing EA processes with AI promotes innovation and transformation, reduces technical debt, improves business agility, and supports Intel's strategic growth imperative. As we mentioned in our previous EA paper, our EA framework continues to evolve with Intel's business.

While many EA initiatives are still works in progress, we are excited about our results so far. For example, existing EA processes have significantly helped with application rationalization and technical debt reduction, and our two new program-level TWGs are helping accelerate business transformation and produce new capabilities. We hope our ongoing EA journey inspires other IT departments; we'd be happy to engage in a conversation to answer questions and share best practices.

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