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ARCHITECTURE AS CODE

WHITE PAPER | 2025

Application Modernization Framework

Transforming On-Prem Legacy Systems with Google Distributed Cloud (GDC) using Application Portfolio Optimization Framework

VERSION | 030425

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ABOUT THIS WHITE PAPER

This white paper provides technology leaders and architects with a comprehensive framework for modernizing legacy applications. Drawing from industry research and real-world implementations, it offers practical guidance for successful modernization initiatives.

Target Audience:

- Chief Technology Officers
- Enterprise Architects
- Technology Leaders
- Solution Architects
- Digital Transformation Leaders

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Executive Summary

Legacy application modernization is critical for business agility, security, and cost efficiency. Organizations with outdated on-prem software experience higher operational costs, security vulnerabilities, and scalability limitations. Research from Gartner (2024) indicates that 75% of enterprises will have embarked on application modernization by 2025—but many will struggle due to unclear strategies and complex migrations.

This white paper outlines a structured approach to application modernization, addressing key challenges and providing actionable strategies for successful implementation.

Key Takeaways

- Comprehensive modernization framework
- Implementation best practices
- Success metrics and KPIs

Introduction

2.1 | Market context

Cloud adoption and digital transformation have become business-critical, with enterprises shifting to cloud-native architectures for agility and cost savings. Legacy applications, while functional, often hinder innovation and agility. According to recent studies:

70%
of IT budgets are spent maintaining legacy systems

65%
of organizations cite legacy systems as their biggest obstacle to digital transformation

70%
of enterprises are investing in application modernization

2.2 | What is application modernization?

Application modernization is the process of converting, rewriting, or porting legacy software applications to operate more efficiently with a modern cloud infrastructure. This can involve migrating to the cloud, creating apps with a serverless architecture, containerizing services with modern DevOps models and delivering continuous authority to operate (cATO) within highly regulated environments.

2.3 | The benefits of application modernization

- Cloud-native modernization reduces infrastructure costs by up to 40% while improving performance and scalability. Enterprises that migrate to Google Cloud and Google Distributed Cloud (GDC) report faster time to market and lower operational overhead.
- Refactoring a database from an older technology to a cloud managed modern alternative not only enables new features and reduces toil, but also makes it secured and compliant.

- Orchestration and container technologies like Docker and Kubernetes allow enterprises to spool and decommission resources as needed. Further aiding in the automation of release management and change.

- Converting legacy apps to new infrastructure enables data-driven analytics, and automation workflows or playbooks to increase operational efficiencies.

2.4 | Business drivers

Organizations pursue modernization to achieve multiple objectives:

Business Agility	→	Faster time to market, improved scalability and flexibility.
Operational Efficiency	→	Increasing automated operations, reduced maintenance costs and improved resource utilization.
Customer Experience	→	Enhanced user experience, providing digital capabilities and omnichannel presence.

2.5 | Strategic approaches

Choose one of the following approaches based on your business demands.

Incremental Modernization: A phased transformation approach that emphasizes risk mitigation and business continuity through gradual adoption of new technologies and processes. This iterative approach is often used in large scale migrations, where an event, such as vacating an existing datacenter, drives large volume activity over individual refactoring activity.

Transformative Modernization: A complete architectural redesign focused on cloud-native principles and modern technology adoption, following a digital-first approach for comprehensive transformation. This application modernization approach is often driven via a portfolio maturity effort, rather than large scale migrations.

Modernization patterns

Organizations can choose from several modernization patterns based on their specific needs and constraints:

Pattern	Descriptions	Benefits	Considerations
Rehost	Minimal changes	Quick wins, cost savings	Limited modernization
Re-Platform	Selective optimization	Performance improvements	Moderate complexity
Refactor	Complete redesign	Maximum benefits	Higher complexity

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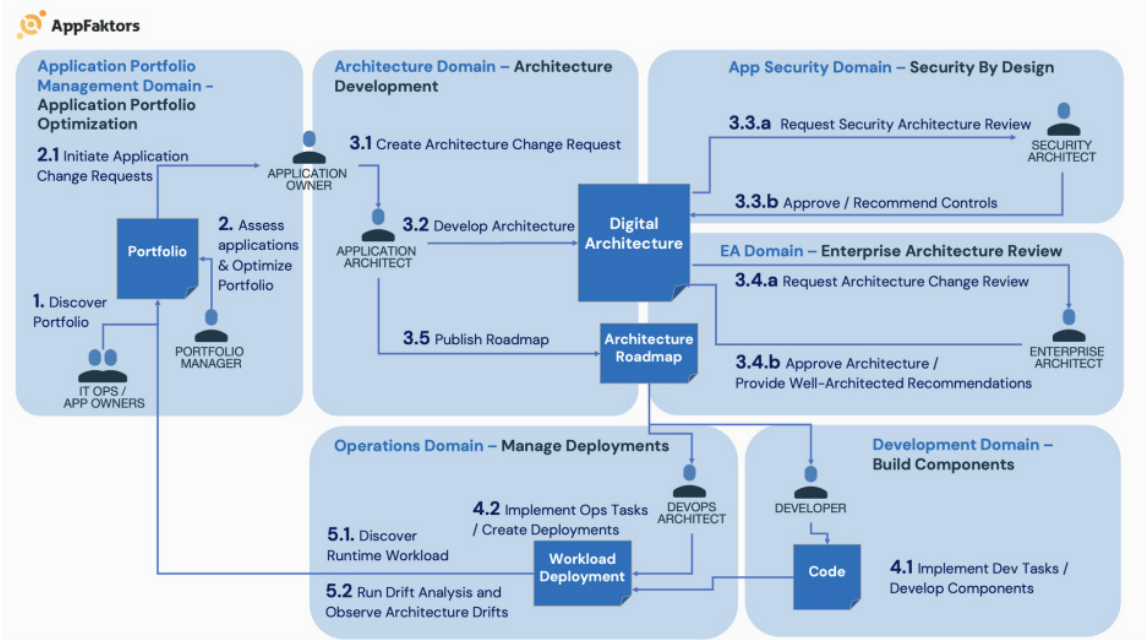
What does an application modernization involve?

Application modernization process starts with Application Portfolio Optimization. The modernization journey requires a well-defined strategy that aligns with business objectives while managing risks and ensuring continuity. Before selecting cloud platforms or technical solutions, organizations must first map and analyze their existing application portfolio. The strategy should prioritize business needs over technology choices, ensuring a future-proof modernization approach.



5-step journey for application modernization:

1. Application portfolio discovery
2. Application assessment and portfolio optimization
3. Architecture development
4. Pre-ATO and Implementation
5. Architecture observability

Let's explore each step in more detail.

3.1 | Application portfolio discovery

3.1.1 Initial inventory collection

Objective:

Establish a single source of truth for all applications and IT infrastructure.

1. **Application layer:** Identify programming languages, frameworks, runtime environments, and tools in use.
2. **Infrastructure layer:** Map out OS, middleware, storage, and security dependencies.
3. **Data layer:** Document data architecture including sensitivity classifications, security protocols, data flow patterns, database systems, volume requirements, external data services, and data warehouse implementations that form the data ecosystem.
4. **Integration layer:** Map system interconnections including external system interfaces, API dependencies, data exchange patterns, authentication mechanisms, and trust zones of external systems that enable seamless integration.

3.1.2 Inventory collection methods

3.1.2.1 Automated discovery tools

Primary purpose:

- Automated discovery from SaaS and cloud APIs.

3.1.2.2 Analysis and extraction from prior documents

Primary purpose:

- Reverse engineering of architecture from past KB sources.
- Reverse engineer architecture from prior architecture and operations docs.

3.1.2.3 Manual discovery process using surveys

Primary purpose:

- Survey stakeholders for application tribal knowledge.
- Design a structured stakeholder engagement through targeted surveys, focusing on identifying current pain points, and critical functionalities that are essential for system operations.

3.2 | Application assessment and portfolio optimization

A comprehensive assessment forms the foundation of successful modernization. Establishing clear application scoring criteria.

3.2.1 Assessment

1. **Application architecture assessment:** Evaluate application's technical foundation, architecture patterns, scalability capabilities, performance characteristics, resilience features, and security mechanisms to determine modernization readiness.

2. **Technical architecture assessment:** Evaluate infrastructure readiness for modernization:

   - **OS & Middleware:** Assess compatibility with cloud platforms.
   - **Data & Storage:** Identify database constraints and optimize egress costs.
   - **Security & Compliance:** Ensure alignment with NIST, OWASP, ISO 27001.

3. **Dataflow architecture assessment:** Examine system integrations, analyzing external system dependencies, data exchange patterns, authentication mechanisms, and trust zones of external systems to ensure secure and efficient data flow.

4. **Cloud readiness assessment:** Evaluate cloud migration preparedness, examining container readiness, API compatibility, data portability, and security compliance, while assessing architecture compatibility, infrastructure requirements, and service dependencies.

5. **Business impact assessment:** Value stream analysis provides good insights into user impact and strategic alignment based on business process importance, technology dependency, revenue dependency, and regulatory requirements.

Each assessment component contributes to a holistic understanding of both technical feasibility and business value in the modernization journey.

3.2.2 Portfolio Optimization

1. **Application categorization:** Use a strategic classification framework that assigns appropriate migration strategies to applications, determining suitable candidates for rehosting, identifying re-platform opportunities, defining refactor requirements, and evaluating replace/retire options based on technical and business criteria.

2. **Prioritization framework:** Define a structured approach to migration sequencing based on critical factors including business value contribution, technical risk assessment, migration complexity evaluation, and resource requirement analysis to optimize the modernization roadmap.

3.3 | Architecture development

Target architecture:

- **Cloud-Native architecture:** Create a modern architectural approach leveraging containerization, orchestration, service mesh implementation, and API gateway patterns to ensure scalable and resilient cloud operations.

- **Microservices architecture:** Design a distributed architectural pattern focusing on service decomposition, robust API design, event-driven communication patterns, and efficient state management to enable application agility and maintainability.

- **Cloud architecture design:** Create a comprehensive digital architectural framework encompassing application design, infrastructure implementation, security controls, and network topology to create a robust and secure cloud environment optimized for modern workloads.

3.4 | Implementation

1. **Implementation approach:**

- **Preparation:** This phase includes strategic team formation, tool selection, environment setup, and clear process definition to ensure implementation readiness.
- **Execution:** Create a systematic implementation process including migration execution, thorough testing and validation, performance optimization, and security implementation to ensure successful deployment.

2. **Technical implementation**

   Use standardized migration templates based on modernization strategy:

   - **Rehost:** Lift-and-shift approach for quick cloud adoption.
   - **Re-platform:** Optimize for cloud efficiency without rewriting code.
   - **Refactor:** Re-architect applications for cloud-native capabilities.
   - **Replace:** Adopt SaaS alternatives for faster transformation.

3. **Operational framework**

   Define a comprehensive operations model defining operational procedures, support structures, monitoring frameworks, and incident management processes to ensure sustainable application management.

3.5 | Architecture observability

Once the application is operational, it is very important to continually align operational service with business goals. By observing architecture drifts continually, application services can be governed well for risk and costs. In the case of Federal Government requirements, this translates to ConMon services, POAM activity and continuous ATO ops with integrated management stacks capable of OSCAL based reporting to ATO authorities.

3.5.1 Governance planning

Risk mitigation: Put in place a robust governance structure establishing decision frameworks, policy management processes, compliance controls, and risk management strategies to maintain operational integrity and regulatory compliance.

3.5.2 Financial planning

Cost structure: Cost Planning for Modernization:

- **Migration Costs:** One-time expenses for rehosting, re-platforming, or refactoring.
- **Operational Costs:** Ongoing cloud services, infrastructure, and support.
- **Personnel & Training:** Upskilling costs for DevOps, security, and cloud teams.

Value tracking:

Define value streams to measure return on investment through quantifiable metrics including cost savings realization, performance improvement measurements, business benefit achievement, and innovation value creation across the modernization journey.

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Mitigation Strategies And Best Practices

3.1 | Application portfolio discovery

Effective risk management prevents modernization failures. Organizations should:

- **Identify risks early** (security, cost, downtime).
- **Apply structured mitigation** (encryption, IAM, disaster recovery).
- **Continuously monitor** for architecture drift and compliance gaps.

Security Risks in Modernization:

- **Data Exposure:** Legacy applications often store sensitive data in outdated encryption standards.
- Insufficient Identity Management: Migrating apps without properly integrating IAM can lead to access control gaps.
- **Compliance Failures:** Some architectures may not meet industry-specific regulations.

Operational Risks in Modernization:

- **Service Downtime:** Poor migration planning can result in extended outages.
- **Unexpected Cost Increases:** Resource misallocation can lead to excessive costs.

4.2 | Success metrics

	Metrics	Targets
Technical Metrics	Response Time	Application Response Time: Reduce latency by 30-50% with cloud-native optimizations
	Availability	Achieve 99.95% uptime through automated cloud failover & Kubernetes scaling
	Error Rate	Decrease system error rates by 40% by migrating to containerized microservices
Operational Metrics	Cost Reduction	Reduce cloud operational costs by 30-50% through automated scaling and cost-optimized workloads
	User Satisfaction	Increase customer satisfaction scores (CSAT) by 20% with improved application performance and reliability
	Time to Deployment	Accelerate release cycles by 50% with DevOps automation and infrastructure as code (IaC)

4.3 | Best practices

Since the application modernization involves critical applications which are already valuable to business, there cannot be any downtime and delays.

Strategic planning: Architecture development should emphasize clear objective definition, stakeholder alignment, detailed architectural views, architecturally significant requirements, risk mitigation plan and thorough reviews for setting realistic timeline development, and resource planning to ensure modernization success.

Implementation success: Apply architecture driven DevOps practices to track the architecture roadmap with DevOps tasks status for regular validation processes, continuous monitoring practices, and effective knowledge transfer to ensure sustainable modernization outcomes.

GDC advantages

Whether managing and running apps in the cloud, on-premise, or a hybrid environment Google Cloud provides the proven tools for infrastructure provisioning, orchestration, security, networking, automation, and monitoring.

Key Services	Description	Key Benefits
Migration & Build		
Migration Center	Infrastructure discovery and assessment platform	• Automated asset inventory & TCO analysis • VM migration with minimal downtime • Right sizing recommendations
Cloud Build & Artifact Registry	Managed CI/CD platform with package management	• Serverless execution • Universal package management • Integrated security and global availability
Infrastructure		
Deployment Manager	Infrastructure as Code service with Apache Airflow integration	• Template-based deployment • Automated provisioning • Multi-cloud orchestration
GKE (Kubernetes Engine)	Managed Kubernetes platform with multiple tiers	• Automated operations • Zero cluster management (Autopilot) • Multi-cluster management (Enterprise) • Scalable and flexible • Customizable machine types to fit your needs
Cloud Storage	A secure, scalable and durable object storage service	• Highly durable and available • Secure and scalable
Cloud SQL	A fully-managed database service for managing relational databases	• Fully managed • Highly available and scalable
Big Query	A data warehouse that helps businesses analyze big data	• Fast, scalable and cost effective • AI/ML built in

Key Services	Description	Key Benefits
Security & Network		
Cloud IAM & Security Center	Comprehensive security management platform	• Fine-grained access control • Threat detection & compliance monitoring • Encryption key management
Network Services	Suite of networking solutions (VPN, Interconnect, Load Balancing, CDN)	• Secure global connectivity & auto-scaling • High bandwidth & low latency
DevOps & Monitoring		
CI/CD Automation	Integrated build and deployment pipeline	• Source repository integration • Progressive delivery • Automated vulnerability scanning & rollbacks
Observability Suite	Comprehensive monitoring and logging platform	• Custom metrics & alerts • Log analytics & Distributed tracing • Real-time error detection
AI/ML		
Vertex AI	A unified platform for generative AI and ML model	• End-to-end machine learning platform • Pre-built models and tools • Scalable and reliable
Application Services		
Cloud Run & Microservices	Serverless container platform with API management	• Auto-scaling, event-driven architecture • API security & management

Modernization for Air-Gapped Environments

In certain industries and government agencies operations occur under stringent security and compliance requirements, often necessitating air-gapped environments that isolate critical systems and data from the public internet. This presents a unique challenge: how to achieve application modernization and migration goals while adhering to strict isolation protocols?

Google Distributed Cloud (GDC) offers a compelling solution, extending the power and flexibility of Google Cloud into environments where connectivity is limited or non-existent. GDC enables organizations to modernize and migrate applications within their own data centers, edge locations, and, crucially, within air-gapped environments. GDC's air-gapped offering, brings a curated suite of Google Cloud services directly into the isolated environment, allowing organizations to leverage familiar tools and technologies.

Google, WWT and AppFaktors understand that a successful implementation requires not only the right technology but also a deep understanding of the unique operational and compliance considerations.

Our insights are grounded in practical experience supporting the key personas involved in GDC air-gapped deployments – the Infrastructure Operator, the Platform Administrator, and the Application Operator – ensuring that the recommendations and best practices presented are practical and effective.

Furthermore, we recognize the importance of organizational structure and workflows within these environments, including the need for separation of duties, 24x7 staffing models, and multi-party approvals for changes.

GDC air-gapped facilitates:

Containerization and Orchestration:

Leveraging Kubernetes-based platforms like Google Kubernetes Engine (GKE) within the air-gapped environment enables the deployment and management of containerized applications, promoting portability, scalability, and efficient resource utilization.

Serverless Computing:

GDC air-gapped supports serverless platforms like Cloud Run, allowing developers to focus on code rather than infrastructure management, simplifying development and deployment.

Data Management and Analytics:

Bringing Google Cloud's robust data management capabilities into the air-gapped environment empowers organizations to leverage their data for insights and decision-making. This includes options for deploying databases, data warehousing solutions, and analytics tools, all within the isolated setting.

Modern Development Tools:

GDC air-gapped provides access to a suite of modern development tools and APIs, enabling developers to build, test, and deploy applications efficiently. This includes familiar programming languages, frameworks, and CI/CD pipelines.

WWT advantages

While most organizations have embraced a cloud operating model, a significant number grapple with unlocking cloud's extensive capabilities. That's because optimizing cloud environments has become more complex than ever.

We believe today's digital world demands a new approach. One where your people, processes and technology operate in harmony. Where it's easy to achieve the visibility and resiliency needed to scale cloud at the speed of your business or mission. Our services enable cloud adoption at mission speed and offer numerous benefits, such as:

Feature	Description	Benefits
Expertise and Experience	WWT has over 30 years of experience serving the world's largest and most innovative organizations. They have a dedicated cloud practice that started in 2009 and has grown significantly, offering expertise across the cloud spectrum, including cloud & DevOps strategy, private cloud, public cloud, hybrid cloud, and app assessment & migration.	Extensive knowledge and experience in cloud services, ensuring reliable and effective solutions.
Comprehensive Approach	WWT's cloud migration journey includes phases such as Assess, Mobilize, and Migrate. This includes agentless application discovery & dependency mapping, application migration planning, and establishing cloud foundations.	Ensures a thorough and well-planned migration process, minimizing risks and disruptions.
Partnerships and Certifications	WWT has strong partnerships with major public cloud providers like Amazon Web Services, Microsoft Azure, and Google Cloud Platform. They also hold numerous certifications, including 170 AWS, 100+ Microsoft certifications, and 35+ Google Cloud certified individuals.	Access to a wide range of cloud services and expertise, backed by industry-recognized certifications.

Feature	Description	Benefits
Partnerships and Certifications	WWT offers potential discounts on cloud consumption due to their top-tier partnership level with major hyper-scalers. They also provide cost-optimization services to ensure the financial health of client environments.	Cost savings and financial flexibility for customers.
Operational Support	WWT provides ongoing support through their Cloud Management team, which meets regularly to discuss the future state and overall cloud business. They also offer Day 2 Operations support, ensuring alignment with existing enterprise processes.	Continuous support and alignment with business goals, ensuring smooth cloud operations.

For highly regulated environments, WWT provides platform support for GDC Air Gapped clouds. This supports secure environments, such as Secret and Top Secret.

Partnership	Solution	Capabilities	Environment
WWT and Google Cloud	Google Distributed Cloud Air-gapped (GDC AG)	Analyzing sensitive datasets, running training and simulations, translating field intelligence, AI/ML services	WWT IC SCIF environment, client facility or secured 3rd party.

AppFaktors advantages

Not all modernization tools are built for enterprise-scale complexity. AppFaktors goes beyond basic application tracking by automating portfolio optimization, integrating architecture as code (AaC), and embedding threat modeling from day one.

What sets AppFaktors apart:

Unlike traditional EA Tools, AppFaktors automates portfolio optimization—reducing assessment time by 50%.

Unlike traditional well-architected frameworks, AppFaktors provides living architecture models— ensuring modernization is always aligned with business objectives.

Unlike basic cloud migration tools, AppFaktors integrates threat modeling at the architecture level—eliminating security blind spots before deployment.

Why Enterprises Choose AppFaktors Over Alternatives:

- Accelerate modernization initiatives by automating application portfolio optimization
- Cut architecture development time by **50%** through automated processes
- **50%** faster architecture decision-making through AI-driven insights
- Improve efficiency and reduce misinterpretation by streamlining collaboration between architecture, development, and operations teams through live digital architecture
- Eliminates **90%** of security risks at the design stage via built-in threat modeling
- Cuts cloud waste by up to **30%** and maintain efficiencies through quarterly workload well-architected assessments and optimization using builtin assessment manager

When security, speed, and cost matter—AppFaktors delivers.

Feature	Description	Benefits
Application discovery and mapping	Discover applications dependencies and build relations	Map both Business and Technology dependencies for continuous optimization
	Bidirectional integration with ServiceNow CMDB / CSDM	Improve ROI on ServiceNow ITSM use cases with deep CMDB/CSDM integration
	Automated questionnaire based intake assessments	Maintain application metadata using auto generated questions, pre and post fill automation
Application portfolio optimization	Well-defined 8 step application portfolio optimization workflow	Gartner TIME based dispositions and recommendations tracking
	Automated scorecards	Automated insights with actionable findings
Architecture development	Digitize architecture using architecture as code and model	• Innovative model • Architecture automation
	AI driven best practice recommendations for migration	Integrated AI agent framework for cloud recommendations
	Integrated threat modeling	Automated threat assessment for Data flows with risk mitigation recommendations
	Built-in assessment framework and workflows	• Integrated architecture review board • Cloud well-architected assessments
	Generate and track roadmap	Share approved digital roadmaps with DevOps
Architecture observability	Discover cloud resources to generate deployment model	• Deployment tracking • Technology mapping
	Architecture drift analysis using architecture as a code rules	• Visibility into deployment drifts from plan • Visibility into governance controls deviation

Conclusion

Application modernization is no longer optional—organizations that fail to adapt risk losing agility, security, and competitive advantage. Success requires a well-planned strategy, robust implementation approach, and continuous focus on business value and risk management.

About the authors

This white paper was developed by a team of enterprise architects and digital transformation experts with extensive experience in application modernization initiatives.

References

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- IDC (2024). “Digital Transformation Insights”
- Google “Cloud Migration Center”

Why Google, WWT and AppFaktors for your application modernization initiative?

As a Google Partner, WWT has the knowledge and deep domain expertise to enable customers application modernization initiatives at scale.

As a Google Technology build partner, AppFaktors helps you confidently develop well-architected applications and migrate legacy applications to modern architectures, AppFaktors tool and methodology that utilizes high levels of automation and reusable components to drive accelerated and high-accuracy migrations.Together Google, WWT and AppFaktors can accelerate your migration while reducing risks and costs associated with traditional modernization initiatives.

Ready to transform your architecture?

Don't wait—begin your cloud transformation today!

Choose your next step above or reach out for a personalized consultation.

See a live demo of AppFaktors in action

BOOK A SESSION

Get a free application portfolio assessment

SIGN UP HERE

Accelerate your cloud transformation with expert-led modernization strategies.

Sign up for a Free 30-Minute Consultation to assess your application portfolio and optimize for Google Cloud and Google Distributed Cloud (GDC).

BOOK A MEETING

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