

# Envisioning Safe Mainframe Migrations to the Cloud

July 2021

This report assesses the methods and explores the advantages of reengineering legacy applications to modern object-oriented applications in the cloud, enabling IT agility in the support of digital business transformation.

A digital business requires agility to lead market changes or stay apace with competitors. Companies relying on legacy applications fail to rapidly change the business processes they support. In this case, improving agility is a must, and not a choice.

In this report, IT leaders will find a way to remove constraints to agility and save on running costs by replacing mainframe legacy applications with cloud-native applications.



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## About ISG Research™

ISG Research™ provides proprietary research, advisory consulting and executive event services focused on market trends and disruptive technologies driving change in business computing. ISG Research™ gives business and technology leaders the insight and guidance they need to accelerate growth and create more value.

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For more information, please email [contact@isg-one.com](mailto:contact@isg-one.com)

call +1.203.454.3900, or visit [research.isg-one.com](http://research.isg-one.com)

# Summary and Key Takeaway

Mainframe systems have been supporting business applications for close to 60 years, existing alongside emerging technologies that have been adding new solutions in the business space every year. From writing a message to a friend to driving a car or flying an airplane, software is everywhere. In most instances, the new has not been replacing the old. That is how mainframes have survived, quietly in the background, running applications written 30 to 50 years ago.

The vanguard is the cloud. A focus on digital transformation is increasingly driving companies to operate in the cloud. However, this is pushing the limits of connectivity and putting a stress on their architecture — creating a distention of ultra-modern digital systems connected to classic mainframes. This is happening so often that one can portend a breakdown in architecture if this trend continues. Consequently, companies that are dependent on mainframes need to have a plan to prevent this disruption from becoming a reality.

Application reengineering and code writing methods and tools have reached a point wherein full automation is possible to safely and economically transform legacy applications into modern cloud solutions. Reengineering an application offers many benefits, including cost savings, improved business continuity, avoidance of vendor lock-in and, most importantly, increased agility. IT leaders should understand the options to safely retire their mainframes.

## Perspectives

Each year, an increasing number of companies migrate their systems from on-premises to the cloud. Cloud adoption accelerated with the onset of the COVID-19 pandemic in 2020. Social distancing exposed the limitations of on-premises systems to support repeated access from outside a company's physical parameters. While many companies could resolve their problems by easily migrating their systems to the cloud, a number of IT leaders were frustrated because their businesses were dependent on mainframes. In practical terms, mainframe applications need to operate behind a single firewall, on-premises, which restricts collaboration and integration.

Although the first electronic computer was invented in 1930, it was in 1964 that IBM launched the System/360, which is considered as the first commercial mainframe, and the origin of the IBM z. Alternative mainframe vendors emerged but, with less computing power, were called midrange systems, minicomputers or "lower platforms." Several procedural languages co-existed on these platforms, with COBOL reigning as the mainstream business application development language until the mid-90s.

With the emergence of object-oriented programming (OOP) and structured query language (SQL), companies stopped developing COBOL in the 90s, with massive replacements of old systems with commercial off-the-shelf software (COTS), built on OOP and SQL. Enterprise Resource Planning (ERP) systems are good examples of COTS. Consequently, OOP languages such as .Net, C++ and Delphi became popular, but it was Java, launched in 1995, that became the most preferred programming language as the Java virtual machine (JVM) enables it to run on all hardware platforms, including mainframes, x86 servers and all public clouds.

The companies that tried to manually rewrite COBOL to OOP reported high costs and lengthy projects, which, in turn, discouraged other companies from following the same path. However, new automated tools can map complex application portfolios, use reverse-engineer codes to extract business rules, document data architectures and write new OOP applications that leverage libraries and cloud services. These tools use advanced methods, AI/ML and the power of cloud processing to make reengineering applications a reality today.

Google Cloud's G4 (fourth generation) offering from its Professional Services organization offers a reliable and cost-effective solution for reengineering legacy applications. In February 2020, Google acquired Cornerstone Technologies, its intellectual property and a team with more than 25 years of experience in application reengineering. Google's platform includes a code analyzer, loader, repository, hyper model, converter, and runtime. The Enterprise Transformation Practice is multiplying its skills by training consultants, application developers, cloud architects and partners to lead customers through the modernization journey from start to finish. In addition, the company is training and certifying a partner ecosystem to provide mainframe modernization services to clients in all global regions.

Google Cloud's Enterprise Transformation Practice leads customers and partners on accelerated code conversion engagements. The team employs a set of tools, services and strategies to automate the process. Engagements analyze and convert applications written in legacy languages and repurpose business logic by converting to a modern language and packaging the converted application to be deployed on Google Cloud Platform. Multiple languages are supported, and the tools are designed to easily be extended for site-specific constructs and grammar.

Other alternatives to migrate mainframe applications to the cloud include rehosting and replatforming. These methods can use compilers, interpreters or emulators to run legacy applications on x86 servers or cloud. However, these methods preserve legacy source code, without adding the benefits of OOP and SQL. In addition, companies need to continue developing COBOL skills to maintain this legacy code.

ISG assessed more than 70 case studies from over 30 service providers and vendors of mainframe modernization solutions. The findings of the 2021 ISG Provider Lens™ Mainframe Services and Solutions study indicate that application reengineering for automated writing of new applications on OOP languages is the best option for extracting value from legacy applications and increasing their value over time.

In addition, moving mainframe workloads to the cloud offers cost savings on licenses, operations and application maintenance. The assessed case studies suggest savings ranging from 40 to 80 percent.

“ **Companies that stay on mainframes will continue to face the challenge of competitors that are more agile at changing their applications at business speed — hard to achieve with procedural COBOL applications — and be questioned on their ability to provide resilience, integration, collaboration and accessibility that are characteristic of cloud**



# How Application Transformation Works

Typical mainframe applications are monolithic with tightly coupled components. It is a consequence of the development methods employed in the past. Procedural programming languages such as COBOL follow a linear, hierarchical logic, with procedures, routines and subroutines. To understand the application, a new programmer would read the code from start to finish.

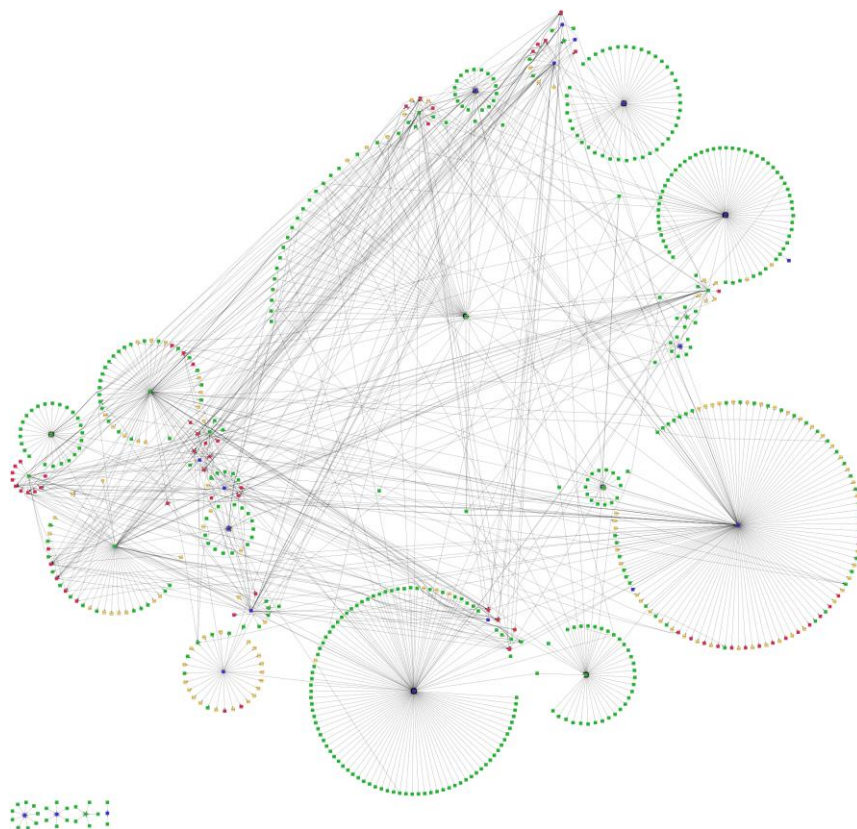
However, these applications can have millions of lines of code, making it very difficult to learn overnight. It requires years to develop experienced programmers. Even for an experienced programmer, injecting new capabilities such as AI or machine learning algorithms can be a challenge because of the hierarchical nature of a procedural application.

Google Cloud Professional Services employs its differentiated G4 technology solution on enterprise transformation engagements.

Common legacy languages found on IBM-z and IBM-i servers are supported, with the ability to add languages as required. The toolset inspects a full mainframe application portfolio to generate visualizations as illustrated below.

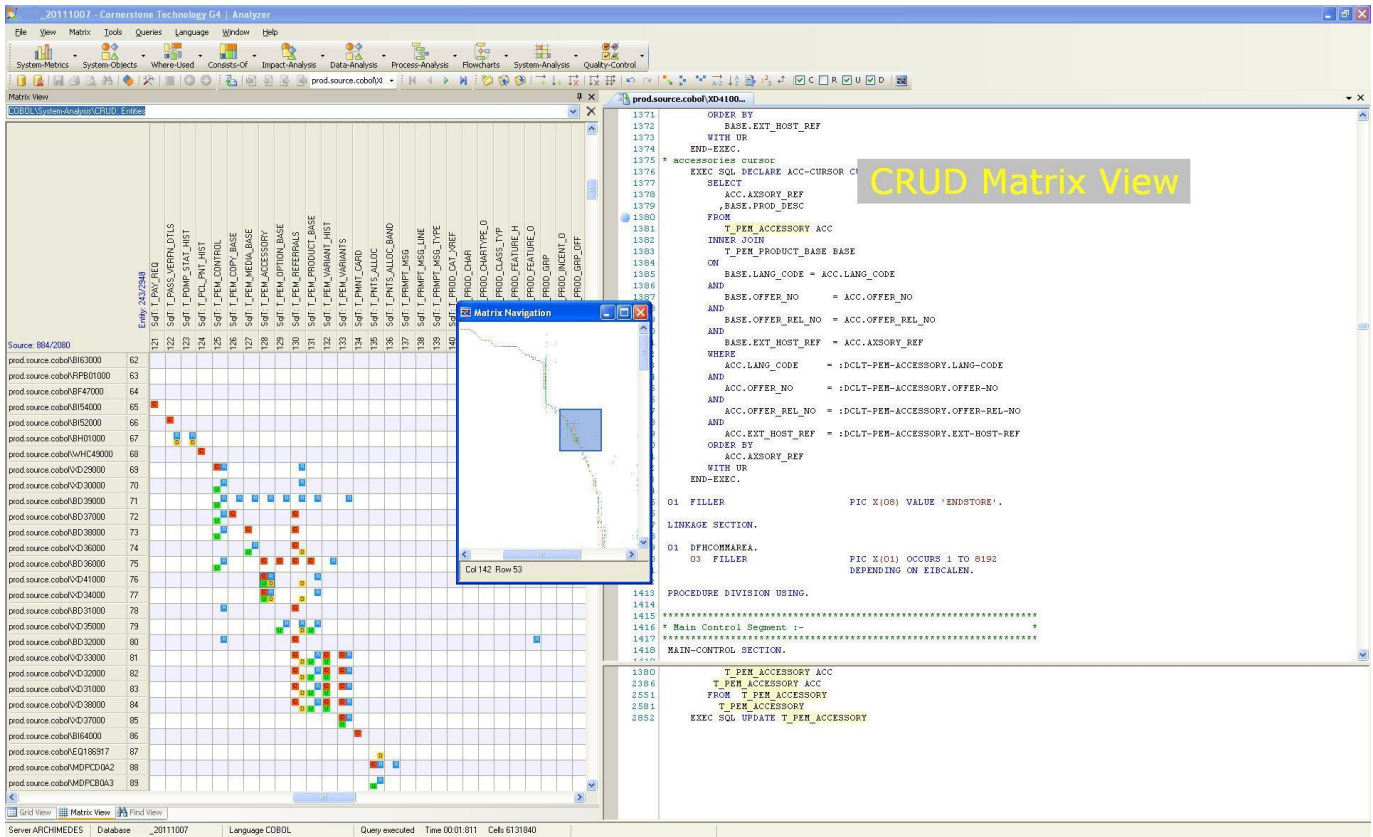
**“ Google's software is designed to parse millions of lines of code and perform automated analysis and conversion tasks that would take humans months or even years. Google's modernization software capabilities include analysis, transformation and software quality measurement**

Figure 1: Applications dependency map



Source: Google

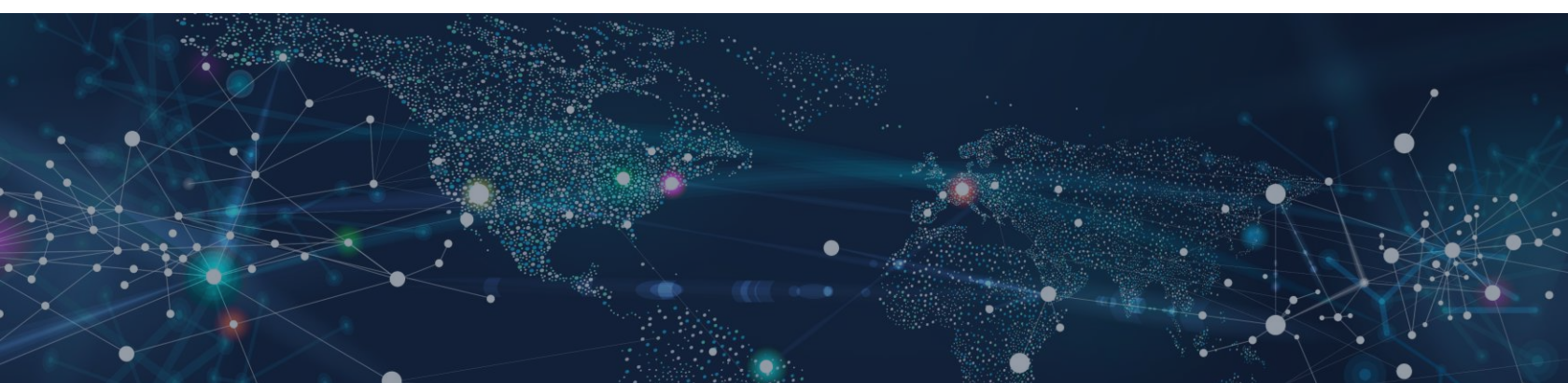
Figure 2: Program to database/files dependencies



Source: Google

Google recommends starting with an assessment engagement to verify that applications are suitable for conversion, followed by either a proof of concept to demonstrate conversion of a subset of the target codebase or a pilot migration of a mainframe workload onto GCP. After a deep dive into the environment, G4 maps the applications and their dependencies, the languages and the associated databases to develop a customer-specific point of view to support the modernization. A discovery workshop explores the current state and target state architectures to define a future-state strategy. Google designs a future state architecture that embraces all that the GCP can offer, allowing clients to enhance their applications to accrue business value.

The circles in Figure 1 illustrate potential groups for modularization. This, and other information gathered during the assessment, provide a blueprint for mainframe migration to GCP.



G4 Analyzer is the tool used to understand an application environment. It inspects the meta-information gathered from all source code business logic, job control, data definitions and schema files, configuration files, and other source codes that make up the application landscape. It breaks down all source code using tools such as preprocessors, generated parsers, linkers and modelers to build a comprehensive meta-information model called G4 Hyper Model. This model eases metadata queries, enabling consultants to visualize an application's current architecture from different perspectives. This benefit allows consultants to choose the best migration strategy, including the feasibility of automated conversion tools.

Consultants can experiment with modularizing applications by analyzing dependencies between programs, business functions and persistent data in databases or files. This helps in identifying the best migration strategy, from "big bang" to phased, data first, logic first, and other approaches, depending on the scale, effort, cost, time required, inter-dependencies and complexity, and by determining whether a database migration is also involved.

Google's consultants and client experts collaborate to decide on the target architecture requirements and components, making optimal use of the GCP and taking into account non-functional technical requirements, such as maintainability, scalability, disaster recovery and performance, and non-technical requirements, such as regulations and compliance, culture and future-proofing. These are the inputs for the conversion rules that will guide the configuration of automated converters.

For each syntax, semantic and idiom of the source language, Google sets an associated conversion rule for transformation to the target language. This conceptual conversion leads to a higher abstraction of the transformation, resulting in improved documentation and maintainability.

Google provides a Java runtime framework for converted applications. The language runtime provides libraries, hiding complexities from the business logic, making the new code more readable and better maintainable. Google's Support Code Library is available for use and modification.

The migration is iterative. Each iteration changes the conversion rules until a fully automated conversion is possible. The conversion engine is fine-tuned, enabling conversion rates of more than five million lines of code, per hour. The conversion process is continuously verified using reference architecture, a collection of unit tests that verify the correctness of individual conversion rules and prevent regression. Any alteration or maintenance of the source application, for whatever reason, has no implication on the overall conversion because the updated code is simply rerun through the G4 Converter to regenerate an updated version of the application.

There is no need to freeze code changes, irrespective of the migration pattern adopted. G4 automated conversion, testing and validation ensures that all existing functionalities are maintained, mitigating the risk of business-critical or regulatory legacy code changes on the automated conversion.

Mainframe migration to GCP is possible, safe and economical. There is no ongoing license fee for G4. At the end of the engagement, the only leave-behind is a G4 Java Runtime Library, provided as a perpetual license, free of cost.

# Considerations

Google G4 requires planning, human resources and funding to convert legacy applications. Transformation programs can take months, to even years, to complete. The best approach is dividing the program into phases to deliver yearly benefits and cost savings.

Google G4 is a toolset with services, but Google offers more than product support; it provides expert consultation to support clients throughout their journey. It can assist in retraining or reskilling key customer resources. In addition, the GCP has a partner application modernization competency. ISG recommends clients to select a qualified Google Partner with an adequate number of experts to handle their application transformation.

In many cases, companies discover applications that add no business value but are required for batch routines, data updates and connectivity, or are complex, but stable, applications that require no support. Companies should not overspend on reengineering poor code, low value applications as those are candidates to replatform with compilers or emulators on GCP. In such cases, clients can ask their Google partner to use the appropriate tools.

Companies also need to consider the knowledge transfer from legacy application experts to Java or other OOP experts. Teams should work together, from the onset of the application assessment, to learn the business logic behind the applications, which would facilitate the transition and the validation of the final solution.





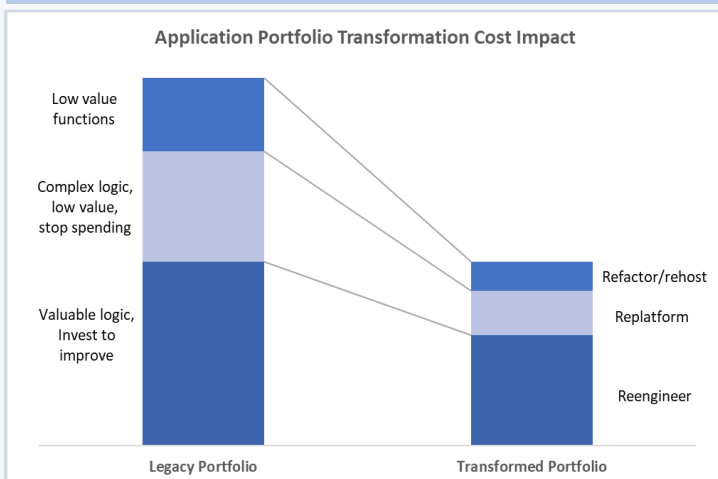
# Assessing the Cost Impact

ISG benchmarking data shows that 47 percent of the cost of running mainframes comes from software licensing — companies pay for operating systems, databases, storage and management tools including subsystems. The foremost saving in migrating to GCP is in terms of such costs.

It is common to find literature comparing mainframe infrastructure costs to cloud costs. Mainframe hardware costs less than 16 percent of the total cost of running them, where, according to ISG benchmarking data, labor represents 36 percent of the total costs. The scarcity of mainframe experts is pushing this cost higher. In comparison, running in the cloud offers a drastic reduction in labor costs.

The skills shortage for COBOL and other legacy programming languages also pushes up the legacy application maintenance and enhancement costs. In this case, companies should consider the gains, in terms of agility, provided by OOP and open-source SQL technologies. Agility improves business value, which is more important than the cost of maintaining legacy codes.

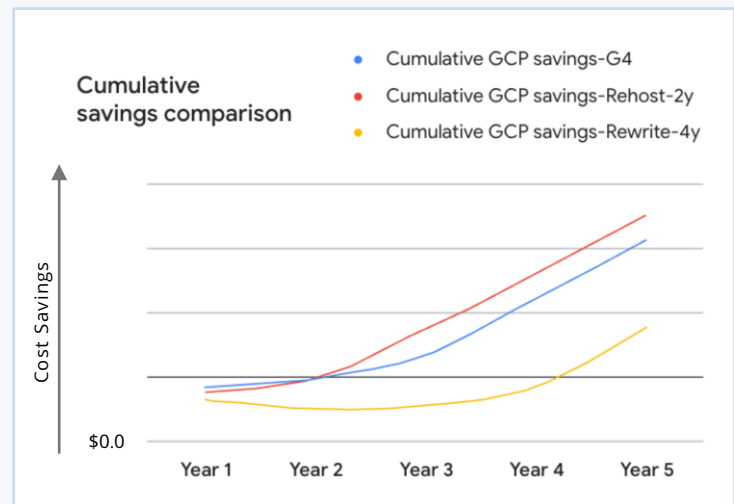
Figure 3: Hypothetical platform savings



Source: ISG

Figure 3 is a simplified illustration on cost savings. It does not include application maintenance and enhancement and the project cost to transform applications. It is based on the reported savings on more than 70 case studies assessed by ISG. Percentages were not audited and can vary by client.

Figure 4: Cumulative savings



Source: Google

In Figure 4, we can see Google estimates. It provides cumulative savings, including the cost to transform applications.

# Guidance

To leverage modern code libraries and natively integrate with cloud services, enterprises should assess the maintainability and extensibility of the generated applications, and the ease of integration of cloud services into the transformed application.

**“ Of the many mainframe modernization options, only reengineering to write new OOP can transform application behavior to leverage modern code libraries and natively integrate with cloud services and SQL technologies**

A simple checklist of integration capabilities should include data access and manipulation methods, microservices, application programming interfaces (APIs), agile development practices, DevOps, Kubernetes, AI/ML and real-time analytics.

Google offers a series of services that can be incorporated in the modernization program: Google's CloudSQL is an open-source database; Cloud Spanner is a distributed SQL database; BigQuery is a serverless data warehouse for deep

analytics; Anthos is a managed application platform for agile development; Google Kubernetes Engine handles containers; Google's AI/ML models can power applications to generate the next-best actions in real-time, and engage customers in new ways to increase revenue; and converted applications can leverage Google's AppSheet, a no-code development platform.

Migrating core applications to the cloud is an essential aspect of digital transformations. Faster time-to-market demands IT agility that mainframes cannot provide. For better alignment with business goals, IT leaders need a strategy to eliminate any agility constraints.

## ISG Placements and Recognition

Google Cloud Platform has been featured in ISG reports published in Australia, Brazil, France, Germany, Nordics, Switzerland, the U.K. and the U.S. in 2020 and 2021. ISG has named GCP a Leader in 18 quadrants and Rising Star in two, including:

- Digital Workplace of the Future - Services and Solutions UK 2020
- Digital Workplace of the Future - Services and Solutions Nordics 2020
- Digital Workplace of the Future - Services and Solutions US 2020
- Digital Workplace of the Future - Services and Solutions Brazil 2020
- Public Cloud – Solutions and Services UK 2020
- Public Cloud – Solutions and Services US 2020
- Public Cloud – Solutions and Services Nordics 2020
- Public Cloud – Solutions and Services France 2020
- Public Cloud – Solutions and Services Brazil 2020
- Public Cloud – Solutions and Services Switzerland 2020
- Public Cloud – Solutions and Services Germany 2020
- Analytics – Solutions and Service Partners Brazil 2020
- Mainframe Services and Solutions U.S. 2021

# About the Author



## **Pedro L. B. Maschio**

### **Distinguished Analyst**

**[Pedro.Maschio@isg-one.com](mailto:Pedro.Maschio@isg-one.com)**

Distinguished analyst and author, Pedro brings extensive experience in research in the Americas and Southern Europe Middle East and Africa (SEMEA) markets. With more than 30 years of experience in sourcing, he has developed vendor assessments plus contract restructuring, services scope and IT benchmarking programs for diverse vertical markets in the Americas and APAC. Before joining ISG, Pedro was a partner of TGT Consult and managing vice president at Gartner Inc., responsible for the consulting business in APAC and Latin America.

## Associated Research

- ISG Provider Lens™ Mainframe Services & Solutions – U.S. 2021 – Mainframe Modernization Software
- ISG Provider Lens™ Analytics - Solutions and Service Partners – U.S. 2020 – Data Infrastructure and Cloud Integration Services
- ISG Provider Lens™ Digital Workplace of the Future – Services and Solutions – U.S. 2020 – Enterprise Collaboration Solution
- ISG Provider Lens™ Public Cloud – Solutions & Services – U.S. 2020 – SAP HANA Infrastructure Services

# Summary Facts



## Google Cloud



### Headquarters

California, U.S.



### Revenue

Google is part of Alphabet Inc., a **US\$161** Billion revenue company



### Markets

Global



### Core portfolio

Public cloud IaaS and PaaS, AI/ML services digital workplace services, collaboration solutions, application development platforms, mainframe modernization solutions



### Industry groups

All verticals



Google Cloud

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