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Sara Perrott

Limited Edition



IBM IMS

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by Sara Perrott

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IBM IMS For Dummies®, Limited Edition

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Introduction

Enterprise businesses today face the challenge of embracing digital transformation and becoming more agile. For these businesses, not only do their database management and transaction processing systems need to be flexible and scalable on-premises, but also they must be able to extend to the cloud. The same systems must be capable of communicating with a wide range of platforms and applications.

Imagine being able to deploy new versions of applications within minutes without having to worry about whether the new version of the application will be compatible with the back-end databases. Imagine being able to scale your databases and systems to handle capacity needs on demand, rather than having to rely on capacity planning projections. It's time to embrace digital transformation and reap the benefits of flexibility, scalability, and agility so you can help your organization reach its goals of digital transformation.

One example of an enterprise database management and transaction processing system that is currently part of the digital transformation boom is IBM IMS. IBM Information Management System (IMS) has been around since 1968 (it was initially called Information Control System and Data Language/1, and then the name was changed to IMS in 1969) and has continued to grow and innovate since its inception. Cool fact . . . an application that was written for IMS in 1968 could still run on IMS today right alongside new applications. Have I piqued your interest? Read on.

About This Book

IBM IMS For Dummies, Limited Edition, serves as your introduction to the world of IMS. In this book, you discover how IMS got started and how it works, including its core components and architecture, as well as how you can use IMS to enable agility and aid in the journey toward digital transformation. You also find out about the four paths to digital transformation and how IBM IMS can help you be successful in cloud-hosted environments, such as IBM Z Hybrid Cloud.

Icons Used in This Book

As you read this book, you run into icons in the margins that indicate information that may be of interest to you. Reading the information that accompanies the icons can enrich your understanding on the topic of IMS. Here's what the icons mean.



TIP

Tips are sections where I have added some information that may help save you time and effort. These are typically based on real-world experiences and are there to help you hit the ground running with IMS.



REMEMBER

When you see the Remember icon in a chapter, this indicates that above all else in the chapter you should remember this. I use this icon when presenting information that you need to know to gain a better general understanding of IMS.



TECHNICAL
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When you see the Technical Stuff icon, you've found the location where I wanted to share some really awesome technical detail with you; in fact, it was so great I wanted to call special attention to it. This icon marks areas that will broaden your technical understanding of IMS. But don't worry if you're not a techie; you can skip these icons and still understand IMS.

Beyond the Book

This book can help you discover more about IMS, but if you want resources beyond what this book offers, here is some insight:

- » **IBM IMS:** www.ibm.com/it-infrastructure/z/ims
- » **IBM IMS 15:** www.ibm.com/us-en/marketplace/ims-15
- » **IBM Z on YouTube:** www.youtube.com/user/IBMSystemZ/search?query=ims
- » **IBM IMS Community:** <https://developer.ibm.com/zsystems/ims>

- » Getting to know IMS
- » Understanding how IMS aligns with IBM's cloud strategy

Chapter **1**

Understanding a Bit of IMS History

Information Management System (IMS) has a rich history, and I cover a bit of it in this chapter. You discover the role IMS plays in your overall enterprise IT infrastructure and learn how IBM continues to invest in and transform IMS into a modern, cloud-ready enterprise IT system.

Embracing IMS

If you've never heard of IMS, you may be wondering what it is and how long it's been around. IMS got its start with NASA and has become one of the predominant database and transaction processing systems across a multitude of sectors, including banking, manufacturing, finance, healthcare, aerospace, communication, government, and retail.

From its historic beginnings, IMS has continued to grow and develop and is now an enterprise solution for businesses worldwide. IMS even has a large impact with Fortune 500 companies:

- » Seven of the 2018 Top 10 Financial Sector companies run IMS
- » Four of the 2018 Top 5 Insurance Industry companies run IMS
- » Three of the 2018 Top 5 Industrial Sector companies run IMS
- » Four of the 2018 Top 5 Construction & Farm machinery industry companies run IMS

In fact, today's statistics are quite impressive, with IMS processing more than 265 billion daily transactions and serving millions of users in a single day.

So what is IMS? IMS is made up of two components:

- » IMS Database Manager
- » IMS Transaction Manager

These components are covered in more detail in Chapter 2 and Chapter 3. For now, think of IMS Database Manager as the system that manages IMS databases as well as the data stored in those databases. The IMS Transaction Manager is responsible for processing messages and can be used to handle messages for a wide variety of applications.

IMS SUPPORTED THE APOLLO PROGRAM

President John F. Kennedy kickstarted the space race when he issued the challenge to put a man on the moon. One of the hurdles was to manage the massive bill of materials necessary to build the spacecraft that would ultimately make the trip.

IBM partnered with North American Aviation teams and Caterpillar Tractor, and together they developed the Information Control System and Data Language/1 (ICS/DL/1). ICS was officially installed in April of 1968 and helped to make Apollo 11 a reality. It quickly became a foundational pillar in the market for database and transaction management systems.

Understanding the role of IMS

So where does IMS fit into your organization? It's cool that it helped Apollo 11 be successful (see this chapter's earlier sidebar "IMS supported the Apollo program"), but how does that translate into a system that can bring value to your organization?



REMEMBER

IMS brings a long history of maturity and stability to your organization, while providing a scalable backend to support your business-critical applications. IMS can add value as a new system or add additional value to existing investments, allowing you to bring scalability, flexibility, and high availability to your organization.

Bringing value to your clients

IMS can bring value to your organization and your clients due to its performance, reliability, scalability, and flexibility. Whether your transactional workloads are on-prem or you've begun your digital transformation efforts with the cloud, IMS allows you to get more out of your investment. Although IMS runs exclusively on z/OS, it can interact and communicate with a wide range of platforms, including Linux and Linux containers. An application that drives IMS transactions or data can reside on a wide range of platforms. Transactions that are sent to IMS can originate from a wide range of platforms. IMS applications can be written with a variety of programming languages, including

- » Java
- » Enterprise COBOL for z/OS
- » Enterprise PL/I for z/OS
- » IBM Assembler
- » z/OS C/C++

Your applications, whether they're hosted on IBM Z or other distributed systems, can access IMS databases in several ways, including Data Language/1 (DL/1), Java Database Connectivity (JDBC), or Structured Query Language (SQL).

Many IBM Z clients have invested in other IBM Z enterprise software products like IBM Customer Information Control System (CICS) and Db2 for z/OS. Common pairings include the following:

- » IMS Database Manager paired with IMS Transaction Manager

- » IMS Database Manager paired with CICS Transaction Server for z/OS
- » IMS Transaction Manager paired with Db2 for z/OS

Looking at the concept of a trusted master data source

For many IMS clients, the IMS performance qualities mean that they consider their IMS data to be the “master” source. There are benefits to having a singular master data source in a database management solution like IMS. A single trusted source of data can reduce duplicate records, which, in turn, reduces the cost of storage needed. It can also improve the speed of queries and minimize administrative and development efforts as the data is in one spot in a simple, organized fashion.

Because your master data is in a single location, your reporting will be more accurate because you’re using the most up-to-date data set each time.

Exploring IBM’s Strategy

When it comes to IBM’s strategy with IMS, take into account two main considerations:

- » The evolution of z/OS from a traditional mainframe operating system to an offering in the cloud is a strategic change that allows clients to enjoy the security and reliability of z/OS with the availability and scalability of the cloud.
- » As more and more organizations try to get out of the data center business, being able to run and support systems in the cloud has been a driving force.

It should then come as no surprise that IMS is ready to support this drive to the cloud as well, making it a flexible database management solution for traditional on-premises installations and cloud-based installations.

The evolution of IBM Z to the cloud

Most large enterprises rely on the mainframe as the center for their high-volume and secure transactions, like those processed by IMS. Because of the stability, security, and performance of the IBM Z platform, it can host mission-critical IMS applications and is a good choice for whatever cloud you choose, with the data privacy, data security, and open, industry-standard capabilities you need for the mission-critical workloads that IMS drives.

Systems of record like IBM IMS are an integral part of the IT fabric for business. In a cloud scenario, systems of record can maintain their traditional roles and uses, be part of a private cloud delivering services to internal and external stakeholders, or serve as the on-premises side of a hybrid cloud. The end result should encompass the best capabilities of both mainframe and cloud environments.

Supporting IBM strategy with IMS

When it comes to moving to the cloud, IMS is aligned with the IBM Z cloud strategy in a few ways, helping clients succeed in whatever environment they're in, whether it's on-premises, in the cloud, or a hybrid cloud environment.



REMEMBER

IBM strategy with IMS allows you to

- » **Create a more client-focused enterprise solution:** Java developers especially will find that the development experience within IMS allows for a great deal of flexibility; they can leverage open source tooling, Zowe, and IBM DevOps tooling to deliver the best in class applications to clients.
- » **Move seamlessly to the cloud:** You can integrate, access, and deploy IBM IMS system assets (applications and data) with the new hybrid multi-cloud systems that originate in the cloud.
- » **Provide the best data protection and privacy:** The IBM z15 delivers encryption everywhere to protect your IMS data, including write-ahead data sets (WADS), Fast Path Data Entry Databases (DEDB) and overflow sequential access method (OSAM) data sets.

» **Reduce the impact of downtime:** The IBM z15 instant recovery capability ensures that your IMS system can achieve the highest levels of business uptime, from both planned and unplanned system outages.



REMEMBER

As an *enterprise* solution, IMS is by its nature a complex system. This book gives you a high-level introduction of its main components and capabilities. To take it to the next level, check out the links at the end of the Introduction.

- » Understanding hierarchical databases and how they differ from relational databases
- » Using the hierarchical database model to improve your performance
- » Deciding on the best IMS database for your business

Chapter 2

Getting to Know the IMS Database Manager

The IMS Database Manager is a complete database management system. It uses hierarchical databases to achieve fast performance and reduce the duplication of data. In this chapter, I cover the differences between hierarchical and relational databases and highlight the reasons why a hierarchical database may just be a good fit for you. I also show you the different types of IMS databases and why you might choose them and examine a few use cases where IMS databases can help you and your organization succeed.

Understanding Hierarchical Databases

If you're only familiar with relational databases, working with hierarchical databases may be a little intimidating. In this section, you learn about what a hierarchical database is and how it differs from the relational databases you're most likely familiar with. You also discover why hierarchical databases may just outperform your relational databases.

What's a hierarchical database?

An IMS database consists of a series of database records, and a database record consists of a series of segments. Segments are the smallest amount of data that can be stored by IMS. Those segments are stored in a hierarchical structure that includes these basic elements:

- » **Root segments:** The top segment in a hierarchical structure is the root. There can be only one root segment per database record.
- » **Dependent segments:** Segments that depend on other segments are dependent segments. All other segments other than the root segment in the database record are dependent segments. In a hierarchy, these include
 - **Parent segments:** A parent segment is any segment that has a dependent segment beneath it in the hierarchy.
 - **Child segments:** A child segment is any segment that's a dependent of another segment above it in the hierarchy. The root segment by definition is at the top of the hierarchy so it doesn't have a parent. The root segment can have one or more child segments.

Segments can have one or more child segments under them. The segment above the current segment is the parent segment.

A child segment could also be a parent to more child segments further down the line.
- » **Fields:** Segments contain fields, and those fields contain the data that lives in the databases.

Let me give you a visual example of this hierarchical structure. Take a look at Figure 2-1. It's an organizational chart. If you have a business with a lot of employees, here's how an IMS database may be structured:

- » The root segment is **Business Unit**; this instance has an ID of 001.
- » Under the root segment are two child segments: **Department** and **Employee**.

- » The **Department** segment includes instances for **Departments A, B, and C.**
- » The **Employee** segment includes three instances for employees **Jenny Nguyen, Jane Smith, and Jose Velasquez.**

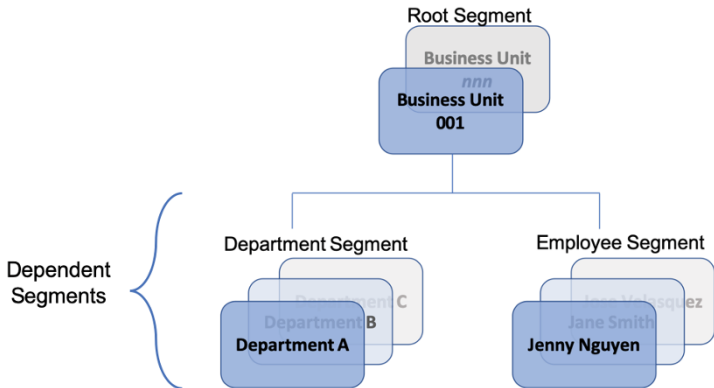


FIGURE 2-1: A simple hierarchical database structure showing parent and child segments.

Applications traverse hierarchies to get to the information they need to complete tasks like updating a bank account or changing a health record. If an IMS database uses a secondary index, it helps get you to the correct segment without needing to traverse the hierarchy.



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A secondary index provides a different route to specific segments by using a root or dependent segment as the entry location for the application.



REMEMBER

The key concept to remember is that each segment in an IMS hierarchical database is either related to or dependent on an item that's above or below it in the database hierarchy, except the root segment, which has no segment above it.

To make accessing segments more efficient and faster for different applications, you can define logical relationships, or views, between independent segments. Think of a logical view as a different way to see just the segments that the application needs rather than the actual or physical way the segments are stored in the database.

Noting the differences in hierarchical and relational databases

Relational databases, like Db2 for z/OS, differ from hierarchical databases (see the preceding section) because relational databases consist of tables that have columns and rows that can be linked to one another using primary and foreign keys. This establishes a relationship between tables or between parts of tables. However, unlike relational tables, IMS segments don't need keys to connect segments. By design, all hierarchical segments are implicitly joined in a logical order.

As a rough comparison in structures, you can think of a group of segments in an IMS hierarchical database as similar to a table with columns and rows in a relational database. The main difference is that because IMS databases are hierarchical, the segments are implicitly joined with each other given the parent/child structure of the hierarchical model. A relational database, on the other hand, requires an explicit joining if you want to connect a column or row with another column or row, meaning that the relationship must be manually defined between tables.

An IMS database segment has fields that provide information about that segment, which is similar to the way a relational table defines columns for a set of rows in a table. In this way, segments relate to relational tables, and fields in a segment relate to columns in a relational table.

Understanding why the differences are important



REMEMBER

Keep the architectural differences in mind between hierarchical and relational databases. Because IMS databases have information linked together in a hierarchy, queries don't take as long to run because you don't have to look up other tables or databases. Relational databases, on the other hand, due to the way that tables are linked together with foreign and primary keys, have much higher processing overhead that can result in longer running queries — each query must access multiple tables to get a full return of data.

Choosing the Best IMS Database for Your Business Needs

IMS offers several different types of databases. The type of database that you choose depends on your business requirements. The most important considerations are as follows:

- » How much data you want to store
- » Whether the database must be highly available
- » How big of a workload you throw at it

In this section, you see the different databases supported in IMS.

Full-function database

Full-function databases support most types of database requirements and can be used in many different applications. A full-function database is sometimes called a *DL/I database* because it's accessed through DL/I calls. Like all IMS databases, full-function databases use a hierarchic structure to store data.

Full-function databases can be small or large, can allow up to 15 levels of hierarchical segments, and can use something called data set groups. By using data set groups, some types of segments can be stored in a database record (a group of related segments) in data sets other than the primary data set without changing the hierarchical sequence of the original segments in a database record. By using data set groups, you can give an application faster access to the segments that it needs. The application simply bypasses the data sets that contain unnecessary segments.

High availability large database

The IMS high availability large database (HALDB) was introduced to combat the size limitations with the traditional full-function databases (see the preceding section). A HALDB is a type of full-function database that offers higher capacities and high availability — it's in the name! HALDB can offer higher capacity because it partitions data into smaller data sets, which makes management of the database much simpler and aids in increasing the availability of your data.



A HALDB can have up to 1001 partitions, so segments in a HALDB database can be stored in as many as 10,010 data sets. Each HALDB data set can be up to 4GB, so a HALDB database can contain over 40 terabytes of data.

Fast Path data entry database

Fast Path data entry databases (DEDB) provide high availability with incredibly fast processing for IMS applications. Like full-function databases, DEDBs can have as many as 15 hierarchic levels. They can also have as many as 127 segment types. DEDBs provide efficient storage for and access to large volumes of data. And DEDBs

- » Are often used when there are random access patterns
- » Use streamlined processes during all aspects of database processing, which reduces processing costs
- » Are easy to partition, highly available, and have high-speed sequential access

Choosing the right IMS database

So what type of database do you need to use for your enterprise? Here are a few examples:

- » If you use a database and don't require high availability, high-capacity storage, or extremely fast processing times, a full-function database may be a great fit.
- » Say you *do* have requirements for high availability, or you do need to support larger data capacities. That's when a HALDB would be good for your organization and applications.
- » If you work in an organization that has high-capacity database needs or when high availability, high speed, and low processing cost are required, Fast Path DEDB is going to be a good fit for you.

I cover additional components and capabilities that make up IMS database (DB) in Chapter 1. Check out the links at the end of the Introduction to go beyond the basics.

- » Getting to know IMS TM
- » Assessing IMS TM and other IBM transaction servers

Chapter 3

Introducing the IMS Transaction Manager

In this chapter, I describe the IMS Transaction Manager (IMS TM), how it's positioned within the IBM Z platform, and what you have to gain with the ability to have open connectivity with IMS applications.

Understanding IMS Transaction Manager

IMS TM performs online transaction processing for applications that access IMS data as well as data stored in Db2 for z/OS. IMS TM processes three types of messages:

- » **Transactions:** Most IMS TM activity is this form of message, which can originate from an ATM, a point-of-sale device, a tablet, a mobile device, even a web browser. If the message is from another application, it's called a *program switch*.

- » **Message-switches:** A *message-switch* is when terminals communicate with each other.
- » **Commands:** Commands come into IMS from a variety of paths, including the z/OS console, TSO SPOC, Zowe, a master terminal, a user terminal, and more. Commands are used to control IMS and manage IMS resources.

IMS TM may sound like a single entity, but in reality, IMS TM is comprised of several interdependent components that do much more than manage transactions. IMS TM

- » Processes input messages from a variety of sources
- » Processes messages sent outbound from IMS applications
- » Provides a message queuing mechanism for messages
- » Supports applications

Collectively these capabilities add up to IMS TM's online transaction processing power.

If you've used an ATM before, you've likely used IMS TM. Think about all the financial companies worldwide and all the ATMs associated with them, and you get an idea of the breadth of IMS TM, and the volume of transactions it processes daily: 265 billion. When IMS TM receives a request for work — say, a withdrawal from your savings account — it starts the application needed to complete the request and prepares an appropriate response for the request. Data is transferred to the user that issued the request after it's completed.

Other sources of input to the IMS TM include

- » Another IMS instance
- » An IMS Open TM Access (OTMA) client
- » Other IBM Z-hosted transaction servers, such as CICS, IBM MQ, and WebSphere Application Server
- » TCP/IP-based clients through IMS Connect and OTMA
- » IBM z/OS Connect Enterprise Edition
- » Non-IBM application servers

Looking at the main components of IMS TM

IMS TM is made up of several purpose-built components, which all work together to keep IMS humming. The IMS Control Region (IMSCCTL), while not architecturally a component limited to IMS TM, is essentially the brains of IMS. It also

- » Controls how IMS makes data available to an end-user
- » Manages all the telecommunications and the message queues
- » Schedules and manages applications
- » Tracks and logs activity in IMS TM to ensure data integrity and for recovery

The IMS TM components include specialized message processing regions: Not all applications are created equally, nor do they have the same processing requirements. To handle the different needs of certain applications, IMS TM has a variety of regions:

- » **Message processing regions:** Think of this region as the place where online transactions are processed in real time.
- » **Batch message processing regions:** Think of this region as the place where large volumes of messages are grouped, or “batched,” to run as a single unit of work, typically during off peak hours.
- » **Java processing regions:** IMS has supported Java for a long time, so it includes special message processing regions (JMP) and batch message processing regions (JBP) for Java apps.
- » **IMS Fast Path regions:** Some messages just deserve special treatment, especially when speed is critical. Messages in this region bypass standard IMS TM scheduling so they can provide the fastest response.

For additional information on the components and capabilities of IMS TM, see Chapter 1.

IMS message queues

To ensure that the billions of daily transactions are processed seamlessly, with integrity and security, IMS uses message queues to choreograph the activity. To ensure the integrity of its online processing workloads, messages in the message queue are stored by destination, priority, and the time of arrival in IMS.

In a configuration that includes multiple IMS TM systems, you can leverage the z/OS coupling facility to store and share IMS message queues so all IMS TM systems have access to them. This process increases system capacity and availability.

Messages can originate from within IMS itself, and messages can be submitted to IMS from a variety of sources, like CICS, IBM MQ, WebSphere Application Server, and non-IBM servers.

Evaluating IMS TM and Other IBM Transaction Servers

The primary distinction between IMS TM and other IBM Z transaction servers is that IBM IMS is a *complete system*: The transaction server and database manager are paired and therefore provide qualities of service such as enhanced performance and minimized data latency. When you don't have to cross logical partitions (LPARs) or switch platforms to access data and execute transactions, you're going to see better performance.



TECHNICAL
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The cross-collaboration between IMS TM, IMS DB, CICS, Db2 for z/OS, IBM MQ, and WebSphere Application server account for a large portion of the 1 trillion secure web transactions that run on the IBM Z15 every day.

- » Looking at how IMS fits into the IBM Z platform
- » Listing other ISVs

Chapter 4

Picturing the IMS Ecosystem

If you've been reading this book up to this point, you may be wondering how the basic IMS components, the IMS Database Manager and the IMS Transaction Manager, actually fit together. In this chapter, you examine the broader IBM Z platform and discover how to integrate with IMS from various IBM products and look at other independent software vendors (ISVs) that provide solutions for IMS.

Understanding the IBM Z Portfolio Perspective

To understand how IMS fits into the IBM product portfolio, it's helpful to understand the IBM Z platform and ecosystem. IBM Z isn't just software; it's a comprehensive enterprise solution made up of operating systems, hardware, and software.

The IBM z/OS operating system provides agility, resiliency, and security and helps your organization meet the demands of its applications on-premises or in the cloud as part of a hybrid cloud deployment. It also happens to be the operating system on which IMS runs.

THE MULTI-FRAME IBM Z15

IMS runs exclusively on IBM Z hardware. The newest IBM Z hardware is the multi-frame IBM z15, which offers four different frame configurations and a smaller single frame width than previous models. It ships with a minimum of 512 gigabytes (GB) of memory (customizable up to 40 terabytes [TB]) and offers the cryptographic features typically expected from IBM hardware. The z14 is available in a single or dual frame configuration, and each frame is 24 inches in width. This system ships with a minimum of 256GB of RAM and can be customized to a maximum of 32TB of RAM. This means that IMS inherits all of the qualities of service offered by IBM Z.



REMEMBER

Linux on Z, z/VM, and z/VSE are also operating systems that run on IBM Z. IMS doesn't run on any of these operating systems; however, applications that run on Linux on Z, z/VM, and z/VSE can invoke an IMS transaction or make a database call using IMS universal drivers (for example, a JDBC call to IMS). Applications can connect directly to IMS through TCP/IP using IMS Connect, or they can connect using IBM z/OS Connect Enterprise Edition.

Similarly, applications running on IMS can call a service running on Linux on Z, z/VM, and z/VSE using the IMS DL/I ICAL or z/OS Connect Enterprise Edition. This is sometimes referred to as an IMS "call out." In short, IBM IMS can connect with *any* platform. As long as the platform supports TCP/IP, IMS is open for connectivity.

The IBM Z portfolio also includes software that allows you to integrate and extend the functionality of your IBM Z investments, including IMS. Some of the featured applications, including how they integrate with IMS, are listed here:

- » **IBM z/OS Connect Enterprise Edition:** Allows you to create RESTful APIs from your IMS transaction assets
- » **IBM z/OS Cloud Broker for IBM Cloud Private (ICP):** Allows you to provision an IMS system from ICP
- » **IBM Z Open Unit Test:** An automated tool that allows you to test (among others) your IMS batch PL/I programs

- » **IBM Z Operations Insight Suite:** A single place to control and monitor essential processing and analysis of IBM Z operational data, including IMS data
- » **IBM Z APM Connect:** Allows you to track IMS transactions and monitor your IMS resources on z/OS systems
- » **IBM Z Service Automation Suite:** Provides control and automation of your IMS systems
- » **IBM Application Discovery and Delivery Intelligence:** Development and analysis tools that allow you to modernize IMS applications and embrace DevOps
- » **IBM Z Development and Test Environment:** Allows you to develop and test (it's in the name) your IMS mainframe applications on an x86-compatible system
- » **Db2 Analytics Accelerator:** Increases processing speed for complex Db2 queries, which can include IMS data
- » **IBM Open Data Analytics for z/OS:** Allows application developers (and data scientists) to analyze and visualize large volumes of data, including IMS data, hosted on IBM Z
- » **CICS:** A transaction management system that runs on z/OS and is frequently paired with IMS Database Manager as a complete system
- » **Db2 for z/OS:** A relational database management system that runs on z/OS and is frequently paired with IMS Transaction Manager to make a complete system
- » **Zowe:** An open source project delivering modern interfaces that make interacting with z/OS-hosted software, such as IMS, easy and intuitive

IMS Enterprise Suite and related integration components

Just as IBM Z has its own ecosystem, IMS does as well. A key component of the IMS ecosystem is the IMS Enterprise Suite, which helps you extend and integrate your IMS system and simplifies application development. IMS Enterprise Suite includes the following components:

- » **IMS Explorer for Development:** An IDE based on Eclipse that makes application development much simpler and can

be used to view and edit IMS databases and their internal components: segments and fields

- » **IMS Data Provider for Microsoft .NET:** Allows you to use standard SQL queries to retrieve IMS data when using .NET applications
- » **IMS SOAP Gateway:** Allows your IMS applications to call web services or be called by web services, independent of platform, environment, programming language, or programming model
- » **IMS Connect API for Java:** The interface that simplifies connectivity for applications that are written in Java and need to access IMS

With the advent of DevOps, companies are developing applications, services, and more that need access to IMS data and transactions. The IMS Enterprise Suite provides the technologies that make new application development simple and provide secure access to IMS transactions and data.

IBM IMS tools

To simplify the management and use of your IMS investment, IBM offers IMS tools solution packs and other tools:

- » **IMS Database Solution Pack:** Manage IMS full-function databases and HALDBs.
- » **IMS Performance Solution Pack:** Analyze IMS transactions end-to-end to keep performance optimal.
- » **IMS Recovery Solution Pack:** Simultaneously back up and recover IMS data sets and Fast Path areas.
- » **IMS Database Utility Solution:** Manage IMS full-function databases and HALDBs, including support for offline reorganizations.
- » **IMS Fast Path Solution Pack:** Analyze, maintain, and tune IMS data entry databases (DEDBs) to keep them in peak form.
- » **IMS Transaction Manager Solution Pack:** Fine-tune IMS Transaction Manager, including application resource changes, manageability of workloads, management of message queues, and management across multiple IMS systems.

There are other IBM IMS tools available to you across many different categories, including system and database cloning, buffer pool analysis and recommendations, transaction tracking across several z/OS subsystems, and program restart. View the complete list of all these tools at www.ibm.com/it-infrastructure/z/ims/tools.

IMS as a data source for analytics engines

Because the data in IMS is secure and reliable, you can use various tools to analyze that data to gain useful business insights. Those tools include

- » **IBM Data Virtualization Manager for z/OS:** Ensures applications can access, update, and join mainframe data — including IMS data — in real time using modern APIs
- » **IBM Z Common Data Provider:** Makes data that's hosted on z/OS — including IMS data — available to analytics platforms
- » **IBM Db2 Analytics Accelerator for z/OS:** Processes high-speed complex Db2 queries on transactional data, including IMS data
- » **IBM Z Operations Analytics:** Provides search, visualization, and analysis of large amounts of structured and unstructured data to simplify problem identification, isolation, and resolution

Looking at Other ISVs That Deliver IMS Tools

In the realm of ISVs, you can find many other tools and solutions that help you extend your IMS capabilities. Rather than supply you with an exhaustive list of offerings, I identify the ISVs and let you check out their solutions at their websites:

- » Akana
- » ASG Technologies
- » BMC

- »» Broadcom
- »» CONNX Solutions
- »» Compuware
- »» DataVantage
- »» GT Software
- »» Macro4
- »» Marble Computer
- »» MicroFocus
- »» Qlik
- »» Software AG
- »» SysperTec Group

This list isn't an advertisement for a particular ISV or its solutions; it simply serves as an example of ongoing development support outside of IBM to provide additional tools to help you leverage your IMS investment.

- » Taking advantage of APIs
- » Gaining application agility
- » Integrating IMS into your DevOps practices
- » Making your data in IMS more accessible

Chapter 5

Exploring the Four Paths to Transformation

While Information Management System (IMS) is traditionally referred to as a mainframe system, that doesn't mean it's outdated or that its capabilities are limited to a mainframe environment. IMS has continued to evolve since its beginnings in 1968 and has had many major releases with significant new function that have made it the go-to system for enterprise organizations that value performance, reliability, and security.

For many organizations, the non-trivial task of mainframe modernization, including embracing more of a DevOps mindset, can be intimidating. Going from manual processes to a newer and more agile model is a change in the way they do things, and going from a major code release once a year, to more frequent, smaller code releases can be an even more difficult change to get accustomed to. It's something that the entire IBM Z platform is undergoing.



REMEMBER

Being able to embrace change is one of the most important components of succeeding at a digital transformation.

Hybrid cloud is the way of the future, and modernization, which spans a number of actionable efforts, is the enabler for successful hybrid cloud deployments. From being able to work with APIs to

enable communication between systems to being able to rapidly create and deploy new IMS instances in the cloud, you can choose four paths to lay the groundwork for a successful digital transformation and hybrid cloud deployment.



REMEMBER

IBM gives you the tools necessary to be successful and to remove some of the intimidation of embarking on your IMS modernization journey with its four paths to digital transformation. Each path provides a simple framework on how to change and adapt processes to modernize your IMS infrastructure and reach digital transformation nirvana.

Path 1: IMS Assets as APIs

IMS clients have decades of investments that have built the mission-critical assets (like applications) that run their businesses. The IT industry literally grew up around IBM Z and IMS. IBM focuses on helping clients continue to benefit from those investments.

As IMS itself evolved from a proprietary model (yes, there was a time when IMS apps and data were kept under IMS lock and key, metaphorically speaking) to an open model, beginning way back in the days of Service Oriented Architecture (SOA), clients realized they could repurpose IMS assets. They took advantage of open access to IMS data and transactions to transform IMS assets initially as services and now as APIs. Legacy IMS code can be exposed as RESTful APIs without writing any code. New cloud and mobile apps can easily access IMS data via APIs.

By utilizing REST APIs, you can make your IMS assets far more open, which opens up new opportunities both inside and outside of your data center. You don't need to be an expert with mainframes to take advantage of APIs. Now clients maximize business opportunities by connecting their IMS on-premise assets to the cloud. The possibilities are endless!

While your traditional IMS assets used IMS Connect to talk to application servers or web services, you can instead take advantage of IBM z/OS Connect Enterprise Edition to enable communication via REST APIs. Not only does this standardize access, but also it simplifies it. IBM z/OS Connect Enterprise Edition exposes

your IMS and/or z/OS assets as RESTful APIs, which allows you to enable communication between them without special programming knowledge — just familiarity with REST APIs and JSON is needed. With the API Editor, which is a part of the API toolkit, you can create and define your APIs with a user-friendly graphical interface.

Path 2: Application Agility with Java in IMS

In the early days of IMS, communication (in the form of programming languages supported) was rather limited. Way back in the 1990s, IMS enabled Java. This delivered multiple benefits. Not only did it create a broad community of programmers who could easily work on IMS applications (because of Java and COBOL interoperability in IMS), but also it meant that app developers tasked with writing code that needed to access IMS data could do so without requiring them to develop aptitude in COBOL, PL/I or DL/1.

One method clients use to gain application agility is to extend their existing IMS apps with Java. Applications require ongoing care and feeding, so being able to do that using Java greatly simplifies that task. Some clients choose to convert heavy CPU consumption routines to Java.

Another method is to write new or convert existing IMS applications by using Java. By creating your new applications in Java, you only have one programming language to manage, and learning Java or finding Java developers is relatively simple. Java code can be stored and deployed in most of the common code repositories and/or pipeline tools.



TECHNICAL
STUFF

Currently, IMS Java transaction processing executes around 29,000 transactions per second. Performance is improved because the apps and the Java server all are co-located on IBM Z.



TIP

So how can you start working Java into your IMS existing applications? Extend the capabilities of your existing applications written in COBOL or PL/I by using Java Native Interface (JNI). JNI allows you to use Java-based code running in a Java virtual machine to interact with other applications, even applications written in other languages such as C, C++, COBOL, and Assembler.

Path 3: Rapid IMS Provisioning and Integrated DevOps

Modern tooling and modern programming languages enable IMS to be integrated into your DevOps practices, which is essential to your journey to hybrid cloud. The concept of provisioning is also key. With IBM IMS as part of your hybrid cloud infrastructure, you can easily provision a full IMS Transaction Manager (TM) and IMS Database Manager (DB) system.

The provisioning of IMS resources occurs through Ansible, which helps automate IMS provisioning. Ansible Collections for z/OS puts Ansible content, such as playbooks, roles, modules, and plug-ins, into your hands and helps accelerate your journey to hybrid cloud.



TIP

If you need help getting started, the IMS GitHub has Java samples available for you, in addition to API tutorials and DevOps deployment samples. Visit <https://github.com/imsdev>. Also, the IMS Makerspace is a free resource that allows you to partner with IMS experts at hands-on workshops and work through proof of concepts. Visit <https://developer.ibm.com/zsystems/ims/ims-makerspace> for more information.

Maybe you're wondering what a developer can do to speed up the entire IMS development cycle: code, test, manage source code, and deploy. A developer can create automated CI/CD pipelines, making rapid development and deployment of IMS applications and resources a snap.

Modernizing IMS using DevOps provides:

- » Continuous delivery and integration across your mainframe assets
- » Cloud provisioning of IMS resources
- » Self-service application development and deployment without mainframe skills

DevOps on IMS uses familiar tools like Git, Jenkins, IBM Z Open Development Tooling, as well as Zowe. For each step along the pipeline, whether it's code, build, provision, deploy, test, release, monitor, plan, or analyze, you'll find an end-to-end DevOps tool-chain that can be used with IMS applications.

I don't go too deeply into the DevOps space here, but if you're interested in learning more, check out *DevOps For Dummies*, 3rd IBM Limited Edition. DevOps on IBM Z, and for IMS, is ready to help you on your journey to cloud. You can download a free copy at www.ibm.com/cloud/devops.

Path 4: Open IMS Data Access with JDBC and SQL

In its early days, IMS was a closed system, operating exclusively on IBM Z and limiting access to its resources to other systems running on IBM Z (such as CICS and Db2). Although it still runs exclusively on IBM Z, as an open system the world is now IMS's oyster. The open nature of IMS started nearly 25 years ago with the introduction of Open Transaction Manager Access. Together with IMS Connect, this solution allows z/OS or TCP/IP applications to issue transactions or commands to IMS.

The introduction of IMS Java made the JDBC interface, which continues to evolve, possible. Application programs running on z/OS or on a non-z/OS platform can use the JDBC interface to access IMS using SQL calls. Not only does this allow you to tap into the breadth of available SQL skills and tooling, but also it means you don't have to replicate or move IMS data; these applications access IMS data in-place. That access extends to both IMS message queues (via OTMA) and IMS databases (via the Open Database Manager and IMS Catalog).

Open access is also directly linked to API enablement. As part of IBM Z digital transformation, clients are re-purposing IMS resources (transactions and data) as APIs. API enablement of IMS data is simplified through the use of IBM z/OS Connect Enterprise Edition. Clients can expose critical IMS data assets as APIs without the need to proxy through a middleware transaction.



Java clients running in IMS itself or on distributed platforms can use SQL/JDBC or DL/1 calls to directly access IMS data in IMS databases, as shown in Figure 5-1. IMS supports SQL for both data access and data manipulation (meaning you can retrieve, insert, update, and delete IMS data using SQL). IMS Explorer makes working with databases even simpler because it allows you to visualize your databases and author your SQL queries.

Distributed Java access to IMS data

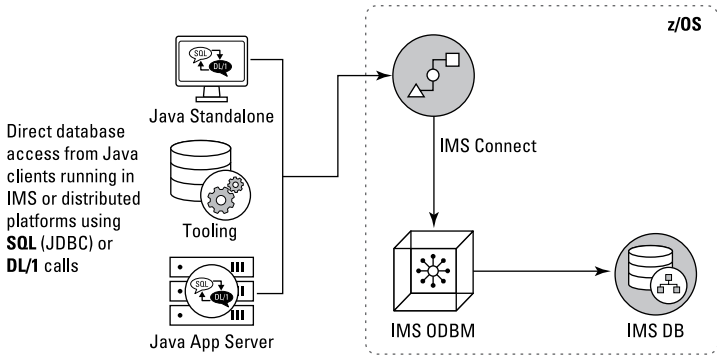


FIGURE 5-1: Distributed Java access to IMS data.

- » Planning your move to the cloud
- » Moving your IMS resources to the cloud

Chapter 6

Looking at IMS and Hybrid Cloud

The IMS cloud story is the IBM Z cloud story: As a subsystem hosted on the historic IBM Z platform, IMS cloud strategy is naturally aligned with the IBM Z cloud strategy. That really simplifies things.

So you've decided (or rather your organization has decided) that you're going to move some of your assets to the cloud, perhaps including some IMS assets in that move, and adopt a hybrid cloud model. Maybe you've decided that the increased flexibility and scalability are crucial to your business, or maybe you simply don't want to manage as many physical IMS systems. Either way, you've decided to embrace hybrid cloud.

In this chapter, I cover some of the considerations that you need to think about when contemplating incorporating IMS assets in your move to the cloud, as well as how IMS can become part of the IBM Z Hybrid Cloud.

Planning to Move to the Cloud

As your company considers when and how to move to the cloud, it must assess all the assets it currently leverages to run its business. Moving to the cloud doesn't happen overnight. It's a journey. The reality is that any company that's moving to the cloud will make that journey in steps — some large, some small. And each step requires important decisions.

You can start the process by asking yourself some questions. With respect to IBM Z, you may think:

- »» How do we connect all these clouds with our traditional, existing IT?
- »» How can we move applications, workloads, and data between all these clouds?
- »» How can we manage this mix of clouds, traditional IT, and related environments consistently, while minimizing security and compliance risk?

Specific to your IMS assets, you may think:

- »» How much of our IMS systems will remain on-premises, still part of traditional IT, and how much will be moved to the cloud?
- »» How will we ensure that IMS systems on-premises can communicate with systems in the cloud while still keeping latency low?



REMEMBER

If you're considering both private and public cloud, consider that public clouds are commercially owned (think IBM Cloud, Azure, AWS, Google Cloud), and private clouds are typically owned by your organization.

Cloud native development and IMS

While in most cases the mainframe still has a place on-premises to support business-critical applications, IMS resources can easily be deployed to the cloud. In Chapter 5, I describe the different

kinds of IMS resources that can be provisioned in a hybrid cloud environment:

- » A full IMS TM and IMS DB system
- » IMS Catalog with Managed ACBs
- » A Fast Path DEDB onto an existing IMS system

The current support for hybrid cloud implementation on IBM Z can deliver a cloud native developer experience for z/OS — the same kind of developer experience on non-Z platforms.

Cloud journey begins with modernization

The cloud journey that IMS clients worldwide are beginning actually started some time ago in the form of modernization. Let's face it, when IMS is 50 years old, it needs a bit of modernizing.

That modernization work is key because it dovetails with the early stages of cloud enablement. By modernizing existing IMS applications, you enable them to interface with cloud services through APIs; you can leverage the latest cloud application development tools, languages, and processes, to make life (and DevOps) easier for your developers.

With IBM Z at the center of your hybrid cloud, you get performance, security, scalability, and resiliency; with the support of open source tools and programming languages, communication with other systems and services is simplified.



REMEMBER

The IBM Z platform offers many security benefits such as encryption for data at rest and in flight, workload isolation with Secure Service Containers, Key Management, and multi-factor authentication (MFA). IMS can take advantage of these security abilities to ensure that your data is well protected. Pervasive encryption for IMS data includes OSAM, VSAM, and DEDB data sets, plus several other data sets. Check out the next section, “Benefitting from Moving to the Cloud,” for more benefits of moving to the cloud.

Benefitting from Moving IMS Resources to the Cloud

Moving some of your workloads to the cloud does come with its perks. In this section, you examine those perks a little closer.

Embracing the pipeline – DevOps at scale with IMS

One of the benefits to embracing the DevOps mindset is more frequent code releases that add features or fix bugs. In DevOps speak, this is referred to as the continuous integration and continuous development (CI/CD) pipeline.

Continuous integration refers to the practice of integrating small changes to code multiple times throughout the day, and continuous delivery expands on that concept by adding the automatic testing and deployment of the code into the overall process. IMS has been delivering continuous development since 2018.



TIP

The CI/CD pipeline is the way that organizations are keeping up with competition in the current digital climate, and with IMS and cloud integration, you can too. By moving to the cloud, you can realize the following benefits:

- » You can automatically scale your IMS systems if needed to support your growing workloads.
- » You can take advantage of the DevOps mindset and do blue/green deployments on new versions of your applications to determine whether any issues with the application exist before rolling it out to everyone.

Embracing multiple clouds delivers new benefits

Enterprises that are moving to cloud are doing so in numbers: That is, most are using multiple clouds as part of their IT infrastructures. New business requirements help drive this move to a hybrid cloud strategy. The kinds of workloads that IMS drives are often considered mission critical. It may be that IMS workloads

will be split across on-premises, public, and private clouds, or some combination of those, creating a dynamic hybrid cloud.

In this dynamic hybrid cloud model, IMS data and apps can be rapidly integrated across and between clouds. They can run wherever business demands. The IBM Z qualities of service ensure that they will still be protected with enterprise grade security.

Imagine the ability to run processes and develop apps and APIs that can be deployed and scaled independently. Just as IMS is comprised of multiple interdependent components, so is a dynamic hybrid cloud model. In both cases, the whole becomes greater than the sum of its parts.

IN THIS CHAPTER

- » Looking at the longevity of IMS
- » Using open and accessible systems
- » Opening your business up to new opportunities
- » Thriving with IMS
- » Positioning your business in the cloud

Chapter 7

Ten Reasons to Choose IMS

In this chapter, I present you with ten reasons to choose IMS. I cover different topics throughout this book, but if you didn't read from cover to cover, have no fear! Here, I compile all the reasons to choose IMS into one short chapter — the *For Dummies* Part of Tens.

IMS is Still Vital and Relevant after 50 Years

While IMS got its start with the space program in 1968, it has continued to evolve and adapt and is unmatched for stability and reliability. By embracing digital transformation, you can expand your IMS system into the hybrid cloud and gain the speed and agility that come with cloud deployments. Review information about this topic in Chapter 1.

IMS Data is Valuable Thanks to its Performance Metrics

There's an old saying, "Time is money." That is true in today's economy. Because queries in hierarchical databases are able to follow a treelike structure instead of having to "jump" from table to table like in a relational database, accessing IMS data is much faster. Spend less time on running queries and more time on analyzing and using the data.



REMEMBER

IMS reduces data duplication as well, which saves on expensive extract-transform-load cycles as well as storage space and enables you to better leverage your investments in your storage architecture. Find out more about how IMS databases work in Chapter 2.

Performance, Availability, and Reliability

I have used this phrase — performance, availability, and reliability — throughout the book many times. That is not an accident. These concepts are some of the most important in relation to IMS systems.

IMS databases are highly reliable and can be made highly available depending on your use cases. When paired with IMS Transaction Manager (see Chapter 3), you gain an even higher degree of performance than you ever thought possible.

Find out more about IMS Database Manager in Chapter 2, and IMS Transaction Manager in Chapter 3.

Open and Accessible System

IMS provides many open source options, taking away the idea that it is a closed system. Not only does it use some open source protocols, but also it supports open source programming languages and development, including RESTful APIs. Because IMS is open

and accessible, you can query your data using JDBC and SQL, which means you aren't confined to any *one* way to work with your IMS system. Read more about accessibility options for your systems in Chapter 5.

IMS is a Key Subsystem within the IBM Z Ecosystem

While there are many systems available within the IBM Z ecosystem, IBM IMS is an integral part of the overall portfolio. Its rich history and continued innovation make it an excellent solution for modern organizations. Additionally, its ability to integrate with other IBM products and non-IBM products make it a perfect solution for organizations that value performance, security, and reliability. Check out Chapter 4 for more information. You can learn more about the IBM Z ecosystem, and how IMS fits into it in Chapter 4.

Four Paths to Digital Transformation Success

With the four paths to success that I discuss in Chapter 5, you have a framework that enables you to succeed in your digital transformation journey on your terms. Whether you begin with API enablement, Java enablement, DevOps, or opening access to IMS data and transactions, you can find innovative new solutions that support business growth. These four paths help you extend your capabilities to the cloud, and you can be well on your way to creating agility, flexibility, and scalability with IMS.

Open New Opportunities

The evolution of IBM IMS provides new solutions and drives new opportunities. First of all, because IMS can take advantage of REST APIs, you can open the door to new opportunities both inside and outside of your data center. You can add integrations to web applications to enhance the capabilities of your own IMS

applications. Using the REST API gives you the flexibility to connect with other systems, even if they're coded in a different language than your IMS application is. Secondly, IMS JDBC support lets you take advantage of the large population of Java and SQL developers; not only will you find abundant talent to keep your applications thriving, but also you don't have to move IMS data to continue to leverage its value. This is covered in Chapter 5.

You Don't Need a Ph.D. on IMS to do DevOps

IBM gives you the tools you need to succeed. With IBM z/OS Connect Enterprise Edition allowing you to work with REST APIs, and IMS Explorer allowing you to visualize your databases and build queries, you have a great start.



TIP

The ability to provision IMS resources using Ansible Collections for z/OS puts key capabilities directly in your hands as you begin your journey to hybrid cloud. Add to that the familiar tools and open source solutions that enable end-to-end DevOps on IBM Z, like Git, Jenkins, Zowe, and more, and you've got yourself a robust DevOps pipeline. For more information, check out Chapter 5.

Skills to Help IMS Thrive are Readily Available

All you need to succeed in your IMS journey is a willingness to learn. From resources like the IMS GitHub to the IMS Makerspace to the IMS Community page, you can access the tools and information you need to succeed. For more information, visit the following:

- » **IMS GitHub:** <https://developer.ibm.com/zsystems/ims/ims-github>
- » **IMS Makerspace:** <https://developer.ibm.com/zsystems/ims/ims-makerspace>
- » **IMS Community:** <https://developer.ibm.com/zsystems/ims>

Perfectly Positioned to Assist with Your Cloud Journey

IBM Z defines the future of hybrid cloud, and IBM IMS is a key component in that vision. Together they hit the target where mission-critical workloads (IMS's wheelhouse) and ongoing innovation intersect, bringing about the reality of a hybrid multi-cloud world.

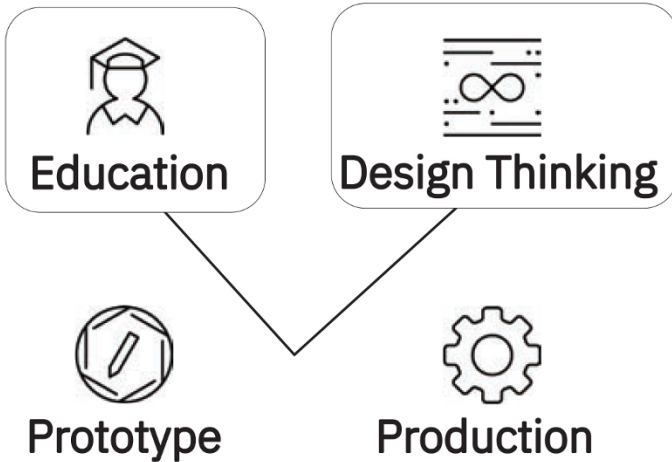
The business value that clients have both engineered into and subsequently benefitted from by modernizing their IBM IMS infrastructure continues in the cloud. Modernization dovetails with the early stages of cloud enablement. Choosing hybrid cloud on IBM Z delivers the performance, security, scalability, and resiliency that IMS clients have come to rely on. For more information on IMS in the cloud, check out Chapter 6.

Notes

Notes

IMS Makerspace

Modernization through Education and Co-Creation



Potential Makerspace Offerings

- Open IMS transaction and database access as APIs
- Integrate IMS assets into enterprise DevOps pipeline
- Access IMS DB with JDBC and SQL
- Administer IMS DB with catalog and DDL
- Extend existing or develop new IMS apps with Java

Visit developer.ibm.com/zsystems/ims/ims-makerspace/ for more information

Learn the role of IBM IMS on IBM Z and beyond

IBM IMS has been around for more than 50 years. From helping to put a man on the moon in 1969 to driving 265 billion transactions per day in 2019, the world has grown to depend on IMS time and again. This book brings you up to date on the IMS of 2020: how digital transformation can extend the value you derive from the IMS ecosystem, how your IMS assets can drive new value in hybrid cloud environments, and how IMS continues to be a strategic component on the IBM Z platform.

Inside...

- The origin and worldwide impact of IMS
- The IMS Database Manager
- The IMS Transaction Manager
- The IMS ecosystem
- Four paths to IMS digital transformation
- How IMS fits into hybrid cloud
- Ten reasons to choose IBM IMS



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