

# An Introduction to IMS

Your Complete Guide to IBM  
Information Management System

Barbara Klein, Diane Goff, John Butterweck, Kenny Blackman,  
Margaret Wilson, Moira McFadden Lanyi, Rick Long,  
Sandy Sherrill, and Steve Nathan

Second Edition



# **An Introduction to IMS**

**Second Edition**

# **An Introduction to IMS**

**Your Complete Guide to IBM  
Information Management System**

**Second Edition**

**Barbara Klein, Diane Goff,  
John Butterweck, Kenny Blackman,  
Margaret Wilson, Moira McFadden  
Lanyi, Rick Long, Sandy Sherrill,  
Steve Nathan**

The authors and publisher have taken care in the preparation of this book, but make no expressed or implied warranty of any kind and assume no responsibility for errors or omissions. No liability is assumed for incidental or consequential damages in connection with or arising out of the use of the information or programs contained herein.

© Copyright 2011 by International Business Machines Corporation. All rights reserved.

Note to U.S. Government Users: Documentation related to restricted right. Use, duplication, or disclosure is subject to restrictions set forth in GSA ADP Schedule Contract with IBM Corporation.

IBM Press Program Managers: Steve Stansel and Ellice Uffer

IBM Press Consulting Editor: Susan Visser

Cover design: IBM Corporation

Published by Pearson plc

Publishing as IBM Press

*Library of Congress Cataloging-in-Publication Data:*

An introduction to IMS : your complete guide to IBM's Information Management System / Barbara Klein ... [et al.]. -- [2nd ed.].

p. cm.

ISBN 978-0-13-288687-1 (pbk. : alk. paper)

I. Management information systems. I. Klein, Barbara, 1947-

T58.6.I598 2012

658.4'038011--dc23

2011036854

IBM Press offers excellent discounts on this book when ordered in quantity for bulk purchases or special sales, which may include electronic versions and/or custom covers and content particular to your business, training goals, marketing focus, and branding interests. For more information, please contact:

U. S. Corporate and Government Sales:

1-800-382-3419

corpsales@pearsontechgroup.com.

For sales outside the U.S., please contact:

International Sales

international@pearsoned.com.

The following terms are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both: IBM, the IBM Press logo, IMS, z/OS, WebSphere, Rational, System z, zSeries, CICS, DB2, Redbooks, RACF, z/VSE, Distributed Relational Database Architecture, Cognos, VTAM, Parallel Sysplex, Tivoli, NetView, InfoSphere, OS/390, Guardium, DataStage, and OMEGAMON. A current list of IBM trademarks is available on the web at “copyright and trademark information” as [www.ibm.com/legal/copytrade.shtml](http://www.ibm.com/legal/copytrade.shtml).

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Windows and Microsoft are trademarks of Microsoft Corporation in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

All rights reserved. This publication is protected by copyright, and permission must be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permissions, write to:

Pearson Education, Inc.  
Rights and Contracts Department  
501 Boylston Street, Suite 900  
Boston, MA 02116  
Fax (617) 671-3447

ISBN-13: 978-0-13-288687-1

ISBN-10: 0-13-288687-1

First printing, December 2011

# Contents

**Acknowledgments**

**About the Authors**

**Preface**

## **Part I: Overview of IMS**

### **Chapter 1 IMS: Then and Now**

### **Chapter 2 Overview of the IMS Product**

IMS Database Manager

IMS Transaction Manager

IMS System Services

IMS Documentation

Hardware and Software Requirements for IMS

### **Chapter 3 Access to and from IMS**

IMS Managed Application Program Access

Access to IMS from Other Application Runtime Environments

Access to and from IMS Using the IMS SOA Integration Suite

### **Chapter 4 IMS and z/OS**

How IMS Relates to z/OS

Structure of IMS Subsystems

Running an IMS System

Running Multiple IMS Systems

How IMS Uses z/OS Services

### **Chapter 5 Setting Up and Running IMS**

Installing IMS

Defining an IMS System

IMS Startup

IMS Logging

IMS Utility Programs

IMS Recovery  
IMS Shutdown

## **Part II: IMS Database Manager**

### **Chapter 6 Overview of the IMS Database Manager**

Functions of the IMS Database Manager  
Implementation of IMS Databases  
Storing Data in IMS and DB2 UDB for z/OS  
Storing XML Data in IMS  
Open Database Manager

### **Chapter 7 Overview of the IMS Hierarchical Database Model**

IMS Hierarchical Database Basics  
Basic Segment Types  
Sequence Fields and Access Paths

### **Chapter 8 Implementing the IMS Hierarchical Database Model**

Segments, Records, and Pointers  
IMS Hierarchical Access Methods  
Operating System Access Methods  
IMS Checkpoints  
Locking Data

### **Chapter 9 Data Sharing**

How Applications Share Data  
DBRC and Data Sharing

### **Chapter 10 The Database Reorganization Process**

Purpose of Database Reorganization  
When to Reorganize Databases  
Overview of the Database Reorganization Process

### **Chapter 11 The Database Recovery Process**

Determining When Recovery Is Needed  
Overview of the Database Recovery Process  
IMS Backup and Recovery Utilities

## **Part III: IMS Transaction Manager**

### **Chapter 12 Overview of the IMS Transaction Manager**

IMS TM Control Region  
IMS TM Messages  
IMS Transaction Flow

IMS TM Network Overview  
The Data Communication Control Environment  
Operating an IMS Network

### **Chapter 13 How IMS TM Processes Input**

Input Message Types  
Terminal Types  
Input Message Origin  
Terminal Input Destination  
Message Queuing  
Message Scheduling  
Transaction Scheduling

## **Part IV: IMS Application Development**

### **Chapter 14 Application Programming Overview**

Java Programs  
Application Program Structure  
IMS Setup for Applications  
IMS Application Programming Interfaces  
IMS Application Calls  
Accessing DB2 for z/OS Using a Resource Translation Table  
IMS System Service Calls  
Testing IMS Applications

### **Chapter 15 Application Programming for the IMS Database Manager**

Introduction to Database Processing  
Processing a Single Database Record  
COBOL and PL/I Programming Considerations  
Processing Databases with Logical Relationships  
Processing Databases with Secondary Indexes  
Loading Databases  
Using Batch Checkpoint/Restart

### **Chapter 16 Application Programming for the IMS Transaction Manager**

Application Program Processing  
Transaction Manager Application Design

### **Chapter 17 Editing and Formatting Messages**

Message Format Service  
Basic Edit Function

### **Chapter 18 Application Programming in Java**

Describing an IMS Database to the IMS Java Function



- Supported SQL Keywords
- Developing JMP Applications
- Developing JBP Applications
- Enterprise COBOL Interoperability with JMP and JBP Applications
- Accessing DB2 UDB for z/OS Databases from JMP or JBP Applications
- Developing Java Applications That Run Outside of IMS
- XML Storage in IMS Databases

## **Part V: IMS System Administration**

### **Chapter 19 The IMS System Definition Process**

- Overview of the IMS System Definition Process
- IMS System Definition Macros
- The Extended Terminal Option

### **Chapter 20 Customizing IMS**

- What You Can Customize
- Naming the Routines
- Changeable Interfaces and Control Blocks
- IMS Standard User Exit Parameter List
- Binding the Routines
- Saving Registers
- IMS Callable Services
- Considering Performance
- Summary of IMS Exit Routines

### **Chapter 21 IMS Security**

- History of IMS Security
- Security Overview
- Securing Resources

### **Chapter 22 IMS Logging**

- IMS System Checkpoints
- Database Recovery Control Facility
- IMS Log Components

### **Chapter 23 Database Recovery Control Facility**

- Overview of DBRC
- DBRC Tasks
- DBRC Components
- When Should You Use DBRC?
- Communicating with DBRC
- DBRC Functions
- Overview of the RECON Data Sets

- Defining and Creating the RECON Data Sets
- Initializing the RECON Data Sets
- Allocating the RECON Data Sets to an IMS System
- Maintaining the RECON Data Sets
- Reorganizing RECON Data Sets
- Recreating the RECON Data Sets
- Summary of Recommendations for RECON Data Sets

## **Chapter 24 Operating IMS**

- Monitoring the System
- Processing IMS System Log Information
- Choosing Tools for Detailed Monitoring
- Executing Recovery-Related Functions
- Modifying and Controlling System Resources
- Controlling Data Sharing
- Controlling Log Data Set Characteristics
- Connecting and Disconnecting Subsystems

## **Chapter 25 IMS System Recovery**

- Overview of Extended Recovery Facility
- Overview of Remote
- Site Recovery
- Comparison of XRF and RSR
- Summary of When to Use XRF or RSR

## **Chapter 26 IBM IMS Tools**

- Database Administration Tools
- Application Management Tools
- Performance Management Tools
- Recovery Management Tools
- Information Integration Management Tools
- Utilities Management Tools
- TM Management Tools
- Miscellaneous IMS Tools

## **Part VI: IMS in a Parallel Sysplex Environment**

### **Chapter 27 Introduction to Parallel Sysplex**

- Goals of a Sysplex Environment
- IMS and the Sysplex Environment
- Other Advantages of Running IMS TM in a Sysplex Environment

## **Chapter 28 IMSplexes and the IMS Common Service Layer**

- Components of an IMSplex
- Requirements for an IMSplex
- Operating an IMSplex

## **Part VII: Appendixes**

**Appendix A Glossary**

**Appendix B Notices**

---

# Acknowledgments

This book would not be possible without the input and efforts of many people, some of whom are listed here. Our wholehearted thanks go to all who participated in and supported this project, particularly to the following people:

- Dean Meltz, Rick Long, Mark Harrington, Robert Hain, and Geoff Nicholls for the information in the IMS Primer and the first edition of this book, which was the foundation for this second edition
- Susan Visser, Steve Stansel, and Terry Carroll of IBM, and Bernard Goodman, Michelle Housley, and Andy Beaster of Pearson Education, for their guidance and patient assistance in the creation of this book
- Clark Gussin, Visual Designer at IBM, for his assistance with the illustrations in this book
- Don Streicher, Dean Meltz, Suzie Wendler, Kevin Hite, and other members of the IBM IMS organizations for their input to the development of this edition of the book

---

## About the Authors

- Barbara Klein, responsible for the strategy and introduction of new IMS capabilities, has held various positions in IBM Planning, Design, Development, Assurance, Systems Engineering, Marketing, and Management.
- Diane Goff, IBM IMS Advanced Technical Skills Senior I/T Specialist, has presented IMS topics at technical conferences and seminars, worked with IMS customers, and provided System z hardware and software support.
- John Butterweck, IBM Worldwide IMS Technical Support Team member, specializes in assisting customers with IMS installation and maintenance.
- Kenny Blackman, IBM Certified IT Specialist - IMS Advanced Technical Skills, consults on IMS connectivity, IMS application modernization and System z integration architectures, and presents IMS topics at technical conferences and seminars.
- Margaret Wilson, now retired from IBM, spent more than 20 years of her IBM career working with IMS and IMS Tools, testing IMS software, teaching IMS basics, and marketing IMS Tools.
- Moira McFadden Lanyi has been the Technical Editor, Terminologist, and Information Architect for the IMS Information Development team since 2003, and has also worked as a Visual Designer and Project Manager at IBM.
- Rick Long, IMS Development Level 2 Database Support Team member since 2002, began with IMS in the late 1970s working in various programming and database administration roles.

- Sandy Sherrill, IMS Worldwide Market Manager, has spent more than 20 years working on IMS teams.
- Steve Nathan has 38 years of experience as an IMS developer, application analyst, DBA, systems programmer, and performance tuner. He has worked for IBM in IMS Level 2 Support since 2003.

# Preface

IBM® Information Management System (IMS™) is one of the world's premier software products. Period. IMS is not mentioned in the news and, until fairly recently, was barely mentioned in computer science classes. But IMS has been and, for the foreseeable future, will continue to be a crucial component of the world's software infrastructure.

Since its origin with the National Aeronautic and Space Administration (NASA) Apollo program, IMS has provided the foundation that enables government agencies and businesses to access, manipulate, and exploit their vast stores of data. As the information age evolves, so does IMS.

The purpose of this book is twofold:

- To introduce IMS and provide basic education about this cornerstone product
- To reintroduce IMS to the computer science field in general

## Prerequisite Knowledge

Before reading this book, you should be able to describe the fundamentals of data processing, including the function of operating systems, access methods, and job control language (JCL). Specifically, you should be familiar with the z/OS® operating system or any of its predecessors. The authors of this book assume that most readers are data processing professionals. You can learn more by visiting the z/OS Basic Skills Information Center at <http://publib.boulder.ibm.com/infocenter/zos/basics/index.jsp>.

## **Learning More about IMS**

This book introduces the fundamentals of IMS. To learn more, including about how to use the product capabilities described in this book, read the IMS product publications, which are available in PDF book and HTML format on the web. Publications for all supported versions of IMS are available in the IMS Information Center at <http://publib.boulder.ibm.com/infocenter/imzic>.

## **We Welcome Your Feedback**

Your feedback helps us provide the most accurate and highest quality information. If you have comments about this book or any other IMS product information, you can send us feedback by either of the following methods:

- Clicking the Feedback link in the footer of any IMS Information Center topic
- Sending an email to [imspubs@us.ibm.com](mailto:imspubs@us.ibm.com)



## IMS: From Apollo to Enterprise

IMS is IBM's premier transaction and pre-relational database management system, virtually unsurpassed in database and transaction processing availability and speed. IMS clients have trusted IMS with their most critical business asset—their operational data—for decades.

Today's IMS has only a superficial resemblance to the product that first shipped in 1969. However, an application program that ran on IMS in 1969 will still run today, unchanged, on the current release of IMS. From the beginning, IBM's focus on the future of IMS has been unwavering.

IMS continues to be a strategic component of today's enterprise computing environments. This chapter highlights some of the history of IMS and describes how IMS fits into contemporary IT multitiered enterprise architectures.

### **In This Chapter**

- IMS and the Apollo Program
- IMS as a Database Management System
- IMS as a Transaction Manager
- Who Uses IMS?
- IMS and Enterprise Integration

### **IMS and the Apollo Program**

On May 25, 1961, United States President John F. Kennedy challenged American industry to send an American man to the moon and return him safely to earth, thus launching the Apollo program. North American Aviation, in partnership with IBM, fulfilled the requirement for an

automated system to manage large bills of material for the construction of the spacecraft in 1965. In 1966, the IBM and North American Aviation teams were joined by three members from Caterpillar Tractor. Together, they designed and developed a system that was called Information Control System and Data Language/Interface (ICS/DL/I).

The IBM team completed and shipped the first release of ICS in Los Angeles in 1967, and in April 1968, ICS was installed. The first “READY” message was displayed on an IBM 2740 typewriter terminal at the Rockwell Space Division at NASA in Downey, California, on August 14, 1968. Less than a year later, on July 20, 1969, Apollo 11 landed on the moon's surface. ICS was subsequently relaunched as Information Management System/360 (IMS/360) and made available to the IT world. In short order, IMS helped NASA fulfill President Kennedy's dream and also became the foundation for the database management system (DBMS) business.

Much has changed since 1968; IMS continues to evolve to meet and exceed the data processing requirements demanded by today's enterprise businesses and governments.

## **IMS as a Database Management System**

The IMS DBMS introduced the idea that application code should be separate from data. The point of separation was the Data Language/Interface (DL/I). IMS controls the access and recovery of the data. Application programs can still access and navigate through the data by using the DL/I standard callable interface.

This separation established a new paradigm for application programming. The application code could now focus on the manipulation of data, without the complications and overhead associated with the access and recovery of data. This paradigm nearly eliminated the need for redundant copies of the data. Multiple applications could access and update a single instance of data, thus providing current data for each application. Online access to data also became easier because the application code was separated from the data control.

## **IMS as a Transaction Manager**

IBM developed an online component to ICS/DL/I to support data communication access to the databases. The DL/I callable interface was expanded to the online component of the product to enable data communication transparency to the application programs. A message queue function was developed to maintain the integrity of data communication messages and to provide for scheduling of the application programs.

The online component to ICS/DL/I became the Data Communications (DC) function of IMS, which is known today as the IMS Transaction Manager (IMS TM).

## **Who Uses IMS?**

Over 90% of the top worldwide companies in the following industries use IMS to run their daily operations:

- Manufacturing

- Finance
- Banking
- Retailing
- Aerospace
- Communications
- Government
- Insurance
- High technology
- Healthcare

IMS remains a viable, even unmatched, platform to implement very large online transaction processing (OLTP) systems and, in combination with web application server technology, is the foundation for a new generation of web-based, high-workload applications.

The following quote describes how one analyst<sup>1</sup> views IMS:

IMS is not “old technology,” but it is time-tested technology. Its platform, the main-frame, is far from obsolete and in many ways is out in front regarding virtualization and consolidation capabilities that new technologies are still catching up to. For the vast majority of IMS users, the emphasis should be on “How can I expand my use of IMS to take maximum advantage of its potential?”

Here are some interesting facts about how IMS is used.

- **IMS manages a large percentage of the world’s corporate data.**
  - Over 90% of top Fortune 1000 companies use IMS.
  - IMS manages over 15 million gigabytes of production data.
  - More than \$3 trillion per day is transferred through IMS by one customer.
- **IMS processes over 50 billion transactions per day.**
  - IMS serves more than 200 million users every day.
  - IMS processes over 180 million transactions per day on a single IMS system via IMS Connect for one customer.
  - IMS manages over 375 million accounts for one customer.

---

<sup>1</sup>Quote taken from IDC white paper, *A Platform for Enterprise Data Services: The Proven Power and Flexibility of IMS from IBM*.

## IMS and Enterprise Integration

Today's IT architecture requires end-to-end integration across the enterprise and with key partners, suppliers, and customers. Such an architecture enables enterprises to respond with flexibility and speed to any customer demand, any market opportunity, and any external threat. This level of IT complexity must be addressed by an infrastructure that meets the following requirements:

- **Based on open standards.** IMS fully supports Java standards for application development and XML for transparent document interchange.
- **Heterogeneous.** IMS applications can be developed on workstations and run in the host environment. IMS applications and data can be accessed from any platform, including Linux®, almost anywhere on the Internet, through the IMS Connect function, the IMS TM Resource Adapter, and the IMS Universal drivers. IMS Enterprise Suite SOAP Gateway enables IMS applications to provide and request web services independent of platform, environment, application language, or programming model.
- **Integrated.** Integration has always been an IMS priority. IMS ships connectors and tooling with IBM WebSphere® solutions so that customers can connect to IMS applications and data by using the tools and connectors of their choice. IMS delivers Eclipse-based plug-ins for use with Rational® Developer for System z® that simplify common application development tasks.
- **Scalable.** IMS continues to address scalability needs by providing the highest possible availability, performance, and capacity.
- **Enabled with self-managing capabilities.** IMS addresses the need to assist technical support staff in being more productive, keeping systems continuously available in an operating environment that is growing increasingly complex.
- **Reliable.** One large IMS customer has operated for more than 10 years (and counting) without an outage in a 24x7 environment. Most IMS customers will say that they cannot recollect when their last unplanned outage occurred.

The ongoing focus that IMS has in support of an open, integrated, simplified, on-demand operating environment, and the success of those who capitalize on their IMS investment, suggests that IMS will remain a major factor in enterprise architectures worldwide and continue to be a great fit for the future of IT.