Supplemental Materials For Audio Edition

Digital Transformation

Survive and Thrive in an Era of Mass Extinction

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FOREWORD BY

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Discontinunity, Driven by Distruption, Is the Rule

Evolutionary development is marked by isolated episodes of rapid speciation between long periods of little or no change.

Figure 1.1

Evolutionary Mass Extinction Events

Earth has witnessed five mass extinction events where as much as 96 percent of species disappeared because of environmental disruption.

Figure 1.2

Digital Transformation Will Create Trillions of Dollars of Value

While estimates vary regarding the global economic impact of digital transformation, leading studies forecast on the order of trillions of dollars annually.

Potential Economic Impact

Increase in Global Business and Social Value	Timeframe	Source
$100 Trillion	2016–2030	World Economic Forum, 2016

Increase in Annual Global GDP		
$15.7 Trillion (driven by AI)	By 2030	PwC, 2017
$13.0 Trillion (driven by AI)	By 2030	McKinsey, 2018
$11.1 Trillion (driven by IoT)	By 2025	McKinsey, 2015
$3.9 Trillion (driven by AI)	By 2022	Gartner, 2018

Figure 2.1

Virtualization Dramatically Increases Hardware Utilization

Virtualization enables infrastructure resources to be shared across multiple applications, resulting in a dramatic increase in hardware utilization.

Figure 3.1

Cloud Services Models

X-as-a-Service (XaaS): Today's cloud computing providers enable organizations to access a range of resources "as a service," from infrastructure to software.

Figure 3.2

Multi-Cloud and Hybrid Cloud

To avoid vendor lock-in and to take advantage of differentiation among public cloud service providers, organizations are adopting multi-cloud and hybrid cloud approaches.

Figure 3.3

Global Growth of Connected Devices

Today there are three times as many devices connected to the internet as there are people in the world, increasing at 10 percent annually.

Figure 3.4

Machine Learning and Deep Learning Drive the AI Renaissance

First conceived in the 1950s, artificial intelligence has rapidly evolved in recent years, demonstrating dramatic impact through the application of machine learning and deep learning methods.

Figure 3.5

How a Neural Network Recognizes a Car Image

Using multilayered neural networks, deep learning AI enables computers to build complex concepts out of a simple hierarchy of nested concepts.

Training
Neural net is fed thousands of labeled car images.

Input
An unlabeled image is fed to the trained neural net.

First Layer
Simple shapes like edges, corners, and contours are recognized.

Higher Layer
More complex structures like wheels and headlights are recognized.

Top Layer
The neural net forms the more abstract concept of a car.

Output
The neural net predicts what the object most likely is.

Figure 3.6

Cloud Deployment Models

Organizations have a range of choices in cloud deployment models, from a purely public cloud (owned, managed, and operated by a business for anyone's use) to hybrid cloud (a mix of public and private).

Public Cloud

Cloud infrastructure is provisioned for open use by the general public.

It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

Private Cloud

Cloud infrastructure is provisioned for exclusive use by a single organization.

It may be owned, managed, and operated by the organization, a third party, or some combination of them. It may exist on premises or off premises.

Hybrid Cloud

Cloud infrastructure is a combination of public and private clouds, which remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability.

Figure 4.1

AI Evolution from Rules-Based Systems to Deep Learning

AI has evolved from the rule-based, expert systems approaches that characterized its early days, to today's advanced deep learning methods that leverage sophisticated neural networks and powerful hardware.

Figure 6.1

Workflow for Developing and Deploying a Machine Learning Application

A typical machine learning workflow involves multiple steps, from data loading and labeling, to feature development, algorithm training and testing. Some deep learning approaches eliminate the need for time consuming feature engineering.

Figure 6.2

Growing Demand for AI Skills

Jobs requiring AI-related skills are growing at a rapid rate, and many are going unfilled. A shortage of talent is leading to a global war for AI software engineers and data scientists.

Figure 6.3

IoT Technology: Connecting the Edge to the Enterprise

Taking advantage of the internet of things requires a new technology solution that connets edge devices, an IoT platform, and the enterprise.

Figure 7.1

Figure 7.2

Figure 7.3

Figure 7.4

Figure 7.5

Figure 7.6

Figure 7.7

China Is on Track to Outspend the U.S. in R&D

With ambitions to be the world's undisputed technology leader, including AI, China is making massive investments in R&D.

Figure 8.1

Projected Costs for Procuring New Aircraft, 2019–2050

The U.S. Congressional Budget Office projects that costs to procure new military aircraft will substantially increase over the next decade. Using AI to improve aircraft availability and reduce operations costs can free up billions of dollars for modernization efforts.

Figure 8.2

Artifical Intelligence Predictive Maintenance Drives 40 Percent Improvement in Aircraft Readiness

Based on initial results of deploying AI-driven predictive maintenance for its fleet of E-3 Sentry aircraft (left), the USAF expanded the project to include its fleet of F-16 Fighting Falcon (center) and C-5 Galaxy (right) aircraft.

Figure 9.1

Reference Architecture for AI Suite

The successful development of AI and IoT applications requires a complete suite of tools and services that are fully integrated and designed to work together.

Figure 10.1

A Sea of "AI Platforms"
The market is awash with hundreds of open source components that purport to be an "AI platform." Each component can provide value, but none provides a complete platform by itself.
Amazon Aurora
Amazon Kinesis
AWS Lambda
talend
ECLIPSE FOUNDATION
Azure Data Catalog
mongoDB
KNIME
hadoop HDFS
cassandra
confluent
APACHE STORM
Azure Data Explorer
DATASTAX
Amazon RDS
databricks
Amazon CloudWatch
HDInsight
SQL Data Warehouse
Amazon S3
Amazon SageMaker
sas
IBM MQ
TensorFlow
Cloud Spanner
Amazon DynamoDB
H2O.ai
TIBCO
Search
tableau
NVIDIA
DOMO
DataRobot
Azure Data Lake
HIVE
OOZIE
Azure Blob
MicroStrategy
skymind
cloudera
Azure Data Lake
AWS IoT
Amazon SQS
Azure Data Factory
Qlik
AWS CloudTrail
Elastic Load Balancing
rapidminer
Azure Event Hubs
alteryx
jupyter
Solr
Stream Analytics
APACHE Spark
Azure ML
Azure Analysis Services
Amazon SNS
kafka
AWS Lake Formation
AWS CloudFormation
Grafana
Amazon API Gateway
Amazon Firehose
Amazon CloudFront
AWS IoT Events
HORTONWORKS
Apache Ambari

Figure 10.2

Figure 10.3

Figure 10.4

Cloud Vendor Tools—AWS
Public cloud platforms like AWS, Azure, and Google Cloud offer an increasing number of tools and microservices, but stitching them together to build enterprise-class AI and IoT applications is exceedingly complex and costly.
AWS Trust Advisor
AWS Data Pipeline
AWS SMS
AWS Directory Service
AWS Snowball
AWS Service Catalog
Amazon Macie
IAM
Amazon Lex
Amazon DynamoDB
Elastic Load Balancing
AWS Config
Amazon Polly
Amazon API Gateway
Amazon Lightsail
Amazon Machine Learning
Amazon Inspector
AWS Storage Gateway
Amazon SNS
AWS Shield
Amazon GameLift
Amazon Route 53
Amazon EC2
Amazon Pinpoint
Amazon Chime
Amazon SWF
AWS WAF
Amazon ECR
AWS OpsWorks
Amazon EMR
AWS CodePipeline
AWS Mobile Hub
Amazon Redshift
Amazon WorkDocs
Amazon AppStream 2.0
Amazon Cognito
Amazon EFS
Amazon DynamoDB Accelerator
AWS IoT
AWS Certificate Manager
AWS Glue
Amazon Connect
Amazon ES
AWS Device Farm
AWS CodeCommit
Amazon Athena
AWS Application Discovery Service
Amazon EC2 Systems Manager
Amazon CloudFront
AWS KMS
Amazon SQS
AWS Managed Services
Amazon Rekognition
AWS Elastic Beanstalk
Amazon QuickSight
Amazon SES
AWS Artifact
AWS Batch
AWS DMS
Amazon WorkMail
AWS CodeBuild
Amazon WorkSpaces
Amazon Kinesis
AWS X-Ray
Amazon Cloud Directory
Amazon CloudWatch
AWS CloudFormation
Amazon ECS
Amazon Mobile Analytics
AWS Direct Connect
Amazon RDS
AWS Organizations
Amazon CloudSearch
AWS CloudTrail
Amazon S3
Amazon VPC
AWS Step Functions
Amazon ElastiCache
AWS Migration Hub
AWS CodeStar
AWS Lambda
AWS CodeDeploy
AWS Greengrass
Amazon Elastic Transcoder
AWS CloudHSM
Amazon Glacier

Figure 10.5

Figure 10.6

Figure 10.7

Multi-Cloud Deployment

Organizations require an AI architecture that enables them to deploy applications on multiple public cloud platforms as well as on bare metal behind the firewall in a private cloud or data center.

Figure 10.8

Polyglot Cloud Deployment

Polyglot capability enables application portability from one cloud vendor to another and the ability to run AI and IoT applications on multiple clouds simultaneously.

Figure 10.9

Figure 11.1

Figure 11.2

Digital Transformation Roadmap

A digital transformation roadmap—as shown in this example for a financial services organization—provides an actionable plan to guide and measure progress.

Operation & Incremental Application Development

Active Application Development

2019 1st Half	2019 2nd Half	2020 1st Half	2020 2nd Half
			Retail Banking Predictive Credit Risk Analytics
			Private Banking Anti-Money Laundering
		Commercial Banking Transaction Value Optimization	**Commercial Banking** Transaction Value Optimization
		Commercial Banking Securities Lending Optimization	**Commercial Banking** Securities Lending Optimization
	Merchant Banking Fraud Detection	**Merchant Banking** Fraud Detection	**Merchant Banking** Fraud Detection
	Retail Banking Cross Sell/Upsell Recommendations	**Retail Banking** Cross Sell/Upsell Recommendations	**Retail Banking** Cross Sell/Upsell Recommendations
Merchant Banking Fraud Detection	**Commercial Banking** Transaction Value Optimization	**Retail Banking** Predictive Credit Risk Analytics	**Trading** Trading Policy Compliance
Retail Banking Cross Sell/Upsell Recommendations	**Commercial Banking** Securities Lending Optimization	**Private Banking** Anti-Money Laundering	**Trading** Intraday Liquidity Management

Figure 11.3

Data Sources for Figures

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