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Big DATA & CLOUD COMPUTING FOR DEVELOPMENT

Lessons from Key Industries and Economies in the Global South

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BIG DATA AND CLOUD COMPUTING FOR DEVELOPMENT

This book provides a framework for evaluating big data and cloud computing based on how they evolve to fit users' needs in developing countries in key areas, such as agriculture and education. The authors discuss how this framework can be utilized by businesses, governments, and consumers to accelerate economic growth and overcome information and communication barriers.

By examining the ways in which cloud computing can drive social, economic, and environmental transformation, readers gain a nuanced understanding of the opportunities and challenges these technologies offer. The authors also provide an authoritative and up-to-date account of big data's diffusion into a wide range of developing economies, such as Brazil and China, illustrating key concepts through in-depth case studies. Special attention is paid to economic development in the context of the new Sustainable Development Goals formulated by the United Nations, introducing readers to the most modern standard of economic evaluation.

Students of information management, entrepreneurship, and development, as well as policy makers, researchers, and practitioners, will find *Big Data and Cloud Computing for Development* an interesting read and a useful reference source.

Nir Kshetri is a Professor at the University of North Carolina–Greensboro, USA, and a Research Fellow at the Research Institute for Economics and Business Administration, Kobe University, Japan. He is the author of *Global Entrepreneurship*, published by Routledge in 2014.

Torbjörn Fredriksson is the Head of ICT-related work for the United Nations Conference on Trade and Development in Geneva, Switzerland.

Diana Carolina Rojas Torres is an Assistant Professor of Entrepreneurship and Innovation at Universidad de la Sabana, Colombia.

"This book is essential reading for anyone who is interested in the social side of big data and cloud computing, particularly in the developing world. At a time when stories about the promise and peril of new information technologies are front page news, Kshetri, Fredriksson, and Torres provide an indispensable guide that helps us separate facts from hyperbole."

Russell Funk, *University of Minnesota, USA*

"This remarkable book addresses an important area that many books on these topics don't cover, examining how cloud computing and big data analytics drive social, economic, and environmental transformation in developing countries and outlining unrealized opportunities and challenges in realizing them. Illustrated with case studies from several countries, the book is a valuable source of relevant information for researchers, students, practitioners, and policy-makers interested in embracing the cloud and big data for socio-economic progress in emerging markets."

San Murugesan, *Editor in Chief, IEEE IT Professional & BRITE Professional Services, Australia*

"This is an outstanding presentation of big data and cloud computing concepts, issues, opportunities, and challenges, including case studies and lessons learned from developing countries. It offers great inspiration, creativity, and cutting edge information which researchers, academics, businesses, and students will be pleased to read."

Tomayess Issa, *Curtin University, Australia*

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PREFACE AND ACKNOWLEDGMENTS

Big data (hereinafter: BD) and cloud computing (hereinafter: cloud) are likened and equated to the "Industrial Revolution" in terms of technological innovation, structural change, and opportunities for economic growth. BD and the cloud are diffusing at an explosive rate. As cross-cutting technologies, they are having a transformative impact on economies and societies. In some sense, some developing economies are likely to experience more dramatic and significant BD- and cloud-led socio-economic transformations. It is argued that the cloud is providing these economies with an opportunity to leapfrog and overcome barriers related to leveraging information and communications technology (ICT) for development. BD- and the cloud-related systems have been successfully deployed and are being combined with cellphones, blockchain, mapping applications, and other technologies to facilitate information flow, which has already led to some gains in economic productivity and social progress.

In light of the above observations, the major goals of this book are to: (a) document, evaluate, and provide an authoritative and up-to-date account of the diffusion pattern of BD and the cloud in the developing world; (b) review the theoretical rationales for and factors affecting the diffusion of BD and the cloud in the developing world; (c) explain and make sense of the BD- and cloud-related paradoxical policy practices observed in some developing economies such as Brazil and China; (d) evaluate the effects of BD and the cloud in key development areas; (e) investigate the links between formal and informal institutional factors affecting the diffusion pattern of BD and the cloud in the developing world; (f) articulate and show the importance of security, privacy, and intellectual property protection issues raised by BD and the cloud in the developing world; (g) develop systematic knowledge about the appropriateness and worthwhileness of BD, cloud, and mobile phone combination in the developing

world; (h) discuss implications of the findings of this book and make suggestions for businesses, governments, and consumers; (i) identify areas of research needed to improve our understanding of the diffusion and development patterns of BD and the cloud in the developing world; and (j) describe BD and cloud deployments in developing economies in the context of the new Sustainable Development Goals currently being formulated by the United Nations.

Undergraduate and graduate students, researchers from a wide range of disciplines (e.g., economics, business and management, international relations, computer science and engineering, sociology, political science, etc.) represent the primary audience groups for this book. The book is also useful for policy makers and practitioners such as IT professionals, information system developers, information security specialists, CIOs, CTOs, and business executives, who need an informed understanding of the BD and cloud industry and market in the developing world. However, anyone with a broad interest in world affairs would find the book a useful reading and reference source.

Regarding the ideas, concepts, and content presented in this book, the authors are grateful to several people for comments, suggestions, support, and encouragement. We would like to express deep appreciation to Sharon Golan, Acquisitions Editor, Business, and Management & Accounting at Routledge, who inspired us to undertake this project. Erin Arata, editorial assistant, US Business and Management at Routledge, did an excellent job in managing the project. Sharon and Erin shepherded the project with the greatest of care and professionalism through its various phases.

We would also like to acknowledge support by Konrad Lorenz University, Bogota, Colombia to work on related projects in big data. Finally, a special mention should be made of Minjing Sun, graduate assistant at the University of North Carolina at Greensboro, who did a very good job in the compilation of the bibliography.

Nir Kshetri, Torbjörn Fredriksson, and Diana Rojas

The views expressed in this book are those of the authors and do not necessarily reflect the views of the United Nations.

ABBREVIATIONS

ACCA	Asia Cloud Computing Association
ACE	Africa Coast to Europe
AfSIS	Africa Soil Information Service
AI	Artificial Intelligence
AIS	Automated Identification Systems
ALICE	A Large Ion Collider Experiment
ATLAS	**A T**oroidal **L**HC **A**pparatu**S**
AU	African Union
AWS	Amazon Web Services
B2B	Business to Business
BD	Big Data
BPO	Business Process Outsourcing
BSA	Business Software Alliance
BSE	Bombay Stock Exchange
CAGR	Compound Annual Growth Rate
CERN	Conseil Européen pour la Recherche Nucléaire
CESI	China Electronics Standardization Institute
CHPC	Centre for High Performance Computing
CIMI	Cloud Infrastructure Management Interface
CKWs	Community Knowledge Workers
CoD	Cash on Delivery
COSTECH	Commission for Science and Technology
CRM	Customer Relationship Management
CS2C	China Standard Software Company
CSA	Climate Smart Agriculture
CSP	Cloud Service Provider

CUO	Cloud User Organization
DMTF	Distributed Management Task Force
DOVEs	Driverless Operated Vehicle Environments
DSCI	Data Security Council of India
DST	Department of Science and Technology
EASSy	East African Submarine Cable System
EC2	Elastic Compute Cloud
ECPA	Electronic Communications Privacy Act
EHR	Electronic Health Records
EIA	Environmental Investigation Agency
EMR	Electronic Medical Records
EthioSIS	Ethiopian Soil Information System
FIP	Fair Information Practices
FTC	Federal Trade Commission
GBPS	Gigabits per second
GCC	Gulf Cooperation Council
GHGs	Greenhouse Gas Emissions
HIPAA	Health Insurance Portability and Accountability Act
IaaS	Infrastructure as a Service
IAMAI	Internet & Mobile Association of India
ICT	Information and Communications Technology
IDC	International Data Corporation
IGF	Internet Governance Forum
IoT	Internet of Things
IP	Internet Protocol
ISP	Internet Service Provider
IT&BPM	IT and Business Process Management
ITU	International Telecommunication Union
IUU	Illegal, Unreported, and Unregulated
IXP	Internet Exchange Points
KBPS	Kilobits per second
KENET	Kenya Education Network
LDCs	Least Developed Countries
M2M	Mothers-2-Mothers
M&A	Merger and Acquisition
MADEX	Mobile Application Data Exchange
MAMA	Mobile Alliance for Maternal Action
MBPS	Megabits per second
MFI	Micro-finance Institution
MIIT	Ministry of Industry and Information Technology
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MOOC	Massive Open Online Courses
NASSCOM	National Association of Software and Services Companies

NCSP	National Cyber Security Policy
NDRC	National Development and Reform Commission
NESAP	New Economy Skills for Africa Program
NIST	National Institute of Standards and Technology
ODCA	Open Data Centre Alliance
ODPS	Open Data Processing Service
OECD	Organization for Economic Cooperation and Development
OVF	Open Virtualization Format
PaaS	Platform as a Service
PII	Personally Identifiable Information
PNBL	Plano National de Banda Larga
PPP	Public–Private Partnership
PSMA	Port State Measures Agreement
RBI	Reserve Bank of India
RFID	Radio-Frequency Identification
RNP	Rede Nacional de Ensino e Pesquisa
SaaS	Software as a Service
SANReN	South African Research Network
SDGs	Sustainable Development Goals
SEO	Search Engine Optimization
SKA	Square Kilometre Array
SMEs	Small- and Medium-Sized Enterprises
SMS	Short Message Service
SOE	State-Owned Enterprise
SSA	Sub-Saharan African
STEM	Science, Technology, Engineering, and Mathematics
TCO	Total Cost of Ownership
TEAMS	The East African Marine System
TNC	Transnational Corporation
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
VATS	Value-Added Telecom Service
VC	Venture Capital
WEF	World Economic Forum
WHO	World Health Organization
WTO	World Trade Organization
YEAPI	Youth Employment Accelerator Program Initiative

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PART I

Big Data and Cloud Computing in the Global South

Key Concepts, Issues, Opportunities, and Challenges

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