Cloud as a Service

Understanding the Service Innovation Ecosystem

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About the Authors

Enrique Castro-Leon is a cloud technologist and strategist with the Intel Data Center Engineering Group at Intel working in cloud systems and the integration of cloud technology and platforms toward business process reengineering. He currently manages a lab piloting the use of cloud technology to increase the efficiency and agility of business, technology development and engineering processes. Users of the lab include a number of Intel business units, as well as ecosystem technology players including cloud service providers, original design manufacturers, original equipment manufacturers, system integrators and independent software and operating system vendors in the industry.

He has functioned as consultant and solution architect for data center planning with focus on energy efficiency and power and thermal modeling and analysis of data centers in large corporations. Enrique also has led technology integration projects that combine hardware, firmware and software components to deliver advanced rack-level power management capabilities applicable to cloud data centers and consistent with business requirements.

Enrique holds Ph.D. degrees in Electrical Engineering and M.S. degrees in Electrical Engineering and Computer Science from Purdue University, and a BSEE degree from the University of Costa Rica.

As a technology strategist Enrique investigates the disruptive effects of emerging technologies in the marketplace. He is the lead author of three books. The first explores the convergence of virtualization, service oriented methodologies and distributed computing titled The Business Value of Virtual Service Grids: Strategic Insights for Enterprise Decision Makers. His second book is titled Creating the Infrastructure for Cloud Computing: An Essential Handbook for IT Professionals. He co-authored a third book, titled Building the Infrastructure for Cloud Security: A Solutions View. He has published over 40 articles in conference and journal papers.

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Dr. Robert R. Harmon is Professor Emeritus of Marketing and Service Innovation and Cameron Research Fellow at Portland State University. His areas of expertise are service innovation, product development, strategic marketing, and analytics. He holds a Ph.D. in Marketing and Information Systems from Arizona State University and B.S. and MBA degrees in Finance from California State University, Long Beach. Dr. Harmon is a recipient of the Oregon State Legislature's Faculty Excellence Award and the Tektronix Teaching Excellence Award. He is an American Marketing Association Doctoral Consortium Fellow. Previous faculty affiliations include the University of Oregon Executive MBA Program, Oregon Health & Science University MBA Program, and the American Graduate School of International Management (Thunderbird).

Dr. Harmon has over 30 years' experience in industries that include semiconductors, information systems, healthcare, renewable energy, displays, and software. Industry positions include financial analyst, VP of marketing, director of marketing and sales, and director of strategic planning for firms in the pharmaceutical, mobile payments, and water infrastructure industries. He is currently a consulting partner with Oregon based L.B. Day & Company, Inc., a strategic planning consultancy, in the areas of market intelligence, research and business strategy.

Dr. Harmon serves as Associate Editor in Chief for IEEE IT Professional Magazine, and serves on the editorial boards for Electronic Markets, Technological Forecasting and Social Change, and the International Journal of Innovation and Technology Management. His research has been funded by the National Science Foundation, Intel Corporation, IBM, WebMD, and Tata Consultancy Services, among others. His current research interests focus on smart systems, service innovation in the cloud, and the strategic transformation of technology firms from product to service-innovation driven business models. He is a member of the IEEE Computer Society and the International Society of Service Innovation Professionals (ISSIP).

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Cloud-as-a-Service Prologue

The core idea behind cloud computing is that it is much cheaper to leverage [...] resources as services, paying as you go and as you need them, than it is to buy more hardware and software for the data center.

—David S. Linthicum

The notion of service is central to cloud computing. It is so central that a capability offered through the cloud gains differentiation by appending "-as-a-service" to a legacy product offering, thus presumably increasing its perceived value. Therefore, we get the terms software-as-a-service (SaaS), platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS); and yet there is very little in the cloud literature that clarifies what service, and services, actually are. To some, the concept of service survives as a primitive notion[1]. Within a body of knowledge such as cloud computing, a primitive notion is an undefined concept that defies definition in terms of previously defined concepts. As a result, the IT practitioner informally applies meaning to a concept through experience or intuition. For instance, the Rackspace[2] and National Institute of Standards and Technology[3] publications focus on cloud-based services, but the concept itself is not clearly defined. The presentations contrast cloud services characteristics with those of customer-owned non-cloud product capabilities. The practitioner considers the features, advantages, and benefits in terms of the existing product solution.

From the traditional product perspective, services are add-on extensions of a physical product, intangible products, or services solutions that are developed and marketed as products. This services-for-a-product approach indicates a goods-dominant logic (GDL) that conceptualizes and designs services as units of output that embed and deliver value to the customer. GDL expresses as a value-in-exchange, arm's-length transaction. There is no expectation of an ongoing relationship or collaboration between the service provider and customer. This is the primitive notion that services should be defined in terms of what we know from experience, our product familiarity. Indeed, we differentiate this product view by using the plural services when a GDL perspective indicates.

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[1]Tarski, A., Introduction to Logic: And to the Methodology of Deductive Sciences, Dover Publications, 1995.

[2]Rackspace, Inc., Understanding the Cloud Computing Stack: SaaS, PaaS, IaaS, Rackspace, https://support.rackspace.com/white-paper/understanding-the-cloud-computing-stack-saas-paas-iaas/

[3]Mell, P., and Grance, T., The NIST Definition of Cloud Computing, Special Publication 800-145, National Institute of Standards and Technology, US Department of Commerce.

The service science discipline and its service-dominant logic (SDL) provides an alternative paradigm, with service as a process that involves providers, customers and other complementary actors within a service ecosystem for the purpose of co-creating value[4]. It emphasizes a value-in-use and value-in-context to the service network approaches to value creation. Service providers and customers benefit from the collaborative exchange of knowledge, skills, technology and other resources within the service ecosystem. The co-creation process can result in superior service design, quality, pricing, customer service, and user experiences that inform compelling value propositions and realized value for all participants. Cloud computing has opened the door for the development of SDL service innovation business models. No longer constrained by GDL thinking, the cloud, especially the multi-sided platform models disrupting e-commerce, transportation, and hospitality and big data analytics, to name a few industries, have the potential to not only redefine cloud service business models, but whole industries as well. In our view, to realize the full potential of the cloud requires an integration of service science principles with cloud computing practice. The cloud is about service and increasingly service is about the cloud.

The primary goal for this book is to apply the service innovation principles to cloud computing. This book is one of the first attempts to integrate these disciplines. The motivation for this exercise is eminently practical, especially to technologists, systems and solutions architects, as well as CIOs and business strategists. As we gain insight into technology development and integration dynamics, we can reason and engage in prediction and forecasting exercises. We understand how approaches in use by product-oriented companies do not satisfactorily apply to the service-oriented cloud. We also discover that there is a path for transformation for product-oriented organizations to operate optimally in the cloud space and therefore to attain a sustained and strategic competitive advantage. This is especially applicable to technology companies with long-term product roadmaps. These companies can servitize existing product lines as an interim step in the transition toward becoming cloud-based service enterprises. The cloud-as-a-service opens up opportunities for new revenue streams and revenue modalities, converting "lumpy" revenue that depend on big bang new product launches to a more sustained service-oriented recurrent revenue.

By employing a cloud-service framework, it is now easier to understand emerging technology progressions that seemed related, but difficult to explain and operationalize. For instance, the much-heralded progression from cloud computing to the Internet of Things (IoT) domain. This understanding allows an organization to approach the cloud and IoT under a single, unified and synergistic strategy at a fraction of the cost of developing two separate strategies. In fact, the effect of two separate efforts will be less than synergistic. The overlap of the two functions will likely result in channel conflicts, with the two organizations working against each other. For this reason, we believe that traditional, product-oriented companies cannot just look at the cloud as just a new, emerging market. These companies will need to adopt a service ethic from within,

[4]Vargo, S. and Lusch, R., Evolving to a New Dominant Logic for Marketing, Journal of Marketing, Vol. 68, 1-17, January 2004.

meaning adopting a service ethic from within; in the methodologies used to develop technology and in the way they conduct business processes. These organizations will suffer from the drag of the dissonance between the SDL and GDL approaches. Conversely, companies adopting an SDL approach early on will enjoy an inherent and sustained competitive advantage in the cloud market.

This book comprises nine chapters in five parts:

1. The first part comprises Chapter 1, Cloud-as a Service and covers the service context for cloud computing and the convergence between historical trends toward a service economy and the information technology (IT) that enables it. The chapter introduces the goods-dominant logic (GDL) and service-dominant logic (SDL) conceptual paradigms as the primary lens by which organizations analyze, understand, and interact with their business ecosystems from a service innovation and value co-creation perspective. The chapter also covers other aspects of cloud services including the effects on employment and privacy.

2. The second part comprises two chapters that introduce the foundational principles of the emerging service science discipline with implications for service transformation as it relates to cloud computing. Chapter 2, The Service Science Foundations of Cloud Computing introduces the core principles of Service Science and SDL. Emphasis is on foundational premises and processes for value co-creation within service ecosystems. We present the product-service systems (PSS) model as a practical interim approach to service innovation as firms transition from GDL firms to service innovation enterprises. The Service Thinking section presents the five mindsets of service thinking that can inform the development of successful cloud service business plans. The chapter concludes with sections on T-shaped professionals and a view of the future in terms of the emerging frontiers of service innovation. Chapter 3, Cloud Computing: Implications for Service Transformation presents service transformation processes for GDL organizations to transition to SDL business models needed to operate in cloud space successfully.

3. In the third part, comprising chapters 4, 5 and 6, we look at a central technology component of cloud computing, namely the servers that power cloud data centers. These servers were initially developed and marketed under a GDL approach. We see that in the few years since cloud computing became a central element in the delivery of IT in the industry, the way these servers are planned, manufactured and deployed is changing fast. Chapter 4 covers the evolution of standard high volume servers, the staple for enterprise data centers and the starting point for cloud server platforms that we name application-specific cloud platforms, or ASCPs. Chapter 5 defines the ASCP concept, and Chapter 6 describes the process to build them as a variant of processes used to build enterprise servers. While the process did not change much in terms of architecture, design and manufacturing, the implementation of these processes brought new players, with cloud service providers as the platform drivers, and an original design manufacturer (ODM) carrying out a manufacture-to-order (manufacturing-as-a-service) role. This is a prime example of an emerging service-oriented technology development process to supply the needs of a service-oriented industry.

4. One of the benefits of the cloud is the potential it brings for business and technical process optimization, which in turn can bring lasting competitive advantage to its adopters and practitioners. Chapter 7 covers the concept of a hardware-as-a-service (HaaS) lab service that allows bringing together the cloud service provider driving the platform, the ODM manufacturing and other contributing technology partners all together at a single place to accelerate engineering platform debug and validation. Today these tasks are usually carried out a serial fashion, in an inefficient and time-consuming process. Collaborating partners working through a lab in the cloud can carry these tasks in parallel and complete them in a fraction of the original time. This is another example of an organization adopting service-oriented processes from within.

   Chapter 8 covers additional case studies, including platform power management design, a federated database for precision medicine, and an IoT deployment. These seemingly disparate examples have in common that they are cloud-as-a-service deployments.

5. Chapter 9 constitutes the last part, a look into the future of cloud-as-a-service: the next evolutionary points for cloud platforms are a landing with the Internet of Things, and more sophisticated governance through service metadata and meta-services. We conclude the book with a case study on smart cities.

The authors wish to acknowledge the contribution of Ronald Newman as the architect, designer and implementer of the advanced technology under the bare metal-as-a-service, lab-in-the-cloud concepts described in Chapter 7. We would like to thank our spouses, Kitty and Daisy for their infinite understanding in a project that seemed to have no end. One of the continuing challenges in compiling this book is the ever present rapid evolution of cloud technology, with new research results both in service science and in cloud computing emerging at a fast pace every, and current concepts becoming obsolete almost as fast. The conceptual frameworks in this book are by no means definitive. The authors hope that students in related fields use the concepts as a departure point for their research and that industry practitioners find the concepts useful in their quest to define service-oriented architectures, as well as business and engineering processes. The rapid changes in the industry made it difficult to close the book, literally. We are grateful to our editors at Apress, Natalie Pao and Jessica Vakili for their patience and gentle nudging, bringing sense and practicality to the authors to find a graceful close to the project.