Kevin Rudolph

Analyzing Dynamic Capabilities in the Context of Cloud Platform Ecosystems

A Case Study Approach

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Preface

This thesis is made as a completion of the Master of Science in Industrial Engineering and Management (IEM). Yours truly has a Bachelor of Science in Industrial Engineering from the Karlsruhe Institute of Technology, Germany and this thesis is the product of the master period, which is the last part of the IEM study at the Berlin Institute of Technology – School of Economics and Management, Germany.

A motivation for this topic comes first of all from my personal interest in the research areas of strategic management, (open, digital, business model) innovation, platform ecosystems and value co-creation. Furthermore, in this day and age we see high economical dynamism among all kinds of industries. We see companies that need to reinvent themselves. Especially, in the cloud computing industry some players tend to have strong competences in reshaping their companies and services frequently in order to gain market share and to grow in revenue – they have developed dynamic capabilities (DCs). This thesis examines the dynamic capabilities in cloud platform ecosystems. An in-depth case study investigates the microfoundations of dynamic capabilities within a market-leading cloud platform ecosystem. Further research addressing nearby challenges is about to come.

I would like to thank many people who have supported me through the completion of this thesis. First of all, thank you for my supervisor at the Chair of Information and Communication Management at the School of Economics and Management of the Berlin Institute of Technology for guidance – Dr. Christopher Hahn. Furthermore, I would like to express my sincerest gratitude to my family and friends who have supported and encouraged me during the process.

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Abstract

Dynamic capabilities (DCs) refer to a firm's abilities to continuously adapt its resource base in order to respond to changes in its external environment. The capability to change dynamically is crucial in business ecosystems that are composed of a variety of actors.

Amazon Web Services (AWS), the leader in the cloud platform industry, is a promising cloud platform provider (CPP) to show a high degree of dynamic capability fulfillment within its highly fluctuating ecosystem. To date, the full scope of dynamic capabilities in cloud platform ecosystems (CPEs) has not been fully understood. Previous work has failed to deliver a combined perspective of explicit dynamic capabilities in cloud platform ecosystems applied on an in-depth practical case.

With our mixed-method case study on the AWS ecosystem we deliver a thorough understanding of its sensing, seizing and transforming capabilities. We generate a set of strategy management frameworks that support our expectations, lead to unexpected insights and answer the questions of what, how, why and with whom AWS uses DCs. In detail, we provide an understanding about DC chronological change, DC network patterns and DC logical explanations. Our research is based on a self-compiled case study database containing 16k+ secondary data pages from interviews, blogs, announcements, case studies, job vacancies, etc. that we analyze qualitatively and quantitatively. We find out that AWS develops and holds a large set of interacting dynamic capabilities incorporating a variety of ecosystem actors in order to sustain tremendous customer value and satisfaction.

The thesis infers significant theoretical and practical implications for all CPE actors, like partners, customers, investors and researchers in the field of IT strategy management. Managers of all CPE actors are encouraged to critically evaluate their own maturity level and complement a CPP's DC explications in order to boost business by implementing sensing, seizing, transforming and innovating capabilities.

1. Structure

1.1 List of figures

1.2 List of tables

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1.4 List of abbreviations

CPE	Cloud Platform Ecosystem
DC	Dynamic Capabilities
SaaS	Software-as-a-Service
PaaS	Platform-as-a-Service
IaaS	Infrastructure-as-a-Service
CPP	Cloud Platform Provider
quant	quantitative data
qual	qualitative data
RDI	Research, Development and Innovation
IP	Intellectual Property

1.5 Appendix overview

2. Introduction

In this first introductory chapter we justify the ground of our investigation and set the topological frame for the research. It is organized as follows: We (1) present the motivation and problem area for the work ahead, (2) review related work that lead us to (3) research questions. Lastly, we (4) outline the structure of this thesis.

2.1 Motivation and problem area

In today's modern digital society platforms are pervasive and support human life in manifold ways if not just even enable the digital aspect. A platform in this way is an intermediate, a tool or a place to be interconnected with a wider social group or computers in order to innovate and consume, produce and exchange. Famous and historical examples such as

- operating systems (Microsoft Windows, Linux OS),
- microprocessors (Intel, ARM),
- digital distribution services (iTunes, Apple App Store, Google Play),
- social networking sites (Facebook, Twitter, LinkedIn),
- videogame consoles (Sony PlayStation, Microsoft Xbox) and
- payment technologies (PayPal, Visa)
- show that platform offerings can advance to the most diverse areas of modern living (Gawer & Cusumano, 2014).

This importance of platforms can be captured in models of value creation and value appropriation (Jacobides et al., 2006). The economic value is justified by a study of Hidding et al. that shows that 3/5 of the largest companies in this world make more than half of their revenues through platform markets (Hidding et al., 2011).

Innovation today is not purely done by single individuals, more innovative services and products have their origins in the minds of many different actors - especially in high tech industries, such as information and communications technology (ICT) industry (Gawer & Cusumano, 2002).

A steadily growing ICT driver are cloud computing platforms (cloud platforms). Those are the cause for a huge amount of important innovative business models and disruptive innovator for manifold industries, e.g. internet of things (IoT), sharing economy, media and entertainment, gaming and retail (Marston et al., 2011).

Managing the complexity of cloud platforms is enormously difficult because of the usually tremendous growth, dynamic environmental changes and variety of actors in the created ecosystem landscape (Cai et al., 2009).

A vast amount of researchers have tackled platform management research topics, such as platform organization (Venkatraman & Lee, 2004; Kapoor & Lee, 2013), platform architectures (Langlois & Robertson, 1992), platform strategies

(Almirall & Casadesus-Masanell, 2010) and platform leadership (Gawer & Cusumano, 2002).

Not only cloud platforms are important. Moreover, theory and management practice has identified the business ecosystem around CPP as enormously important. For the success of a technology system platform the proper management of the surrounding ecosystem is essential (Gawer & Cusumano, 2002).

These business ecosystems consists of a variety of actors, like customers, developers, researchers, complementors and investors (Teece, 1986; Shapiro & Varian, 1999; Iansiti & Levien, 2004; Tiwana, 2013).

Another crucial aspect of cloud platform ecosystems is their volatility. As technology and consumers change over time, intelligent identification and response abilities are necessary to gain competitive advantages. These managerial and strategic responses to environmental changes can be summarized as dynamic capabilities. The development and management of dynamic capabilities is highly complex and important for companies' success in dynamic environments (Teece, 2007; Eisenhardt & Martin, 2000).

Also professional service firms have specialized in the consulting of dynamic capabilities. This confirms the importance of this research topic for a broad set of industry managers in practice (Michel, 2015).

A cloud platform's success is strongly connected with its dynamic capabilities. Nonetheless, those are not thoroughly understand up to date (Thomas et al., 2014).

2.2 Related work

Although there has been a vast amount of research in the area of (cloud) platforms (Sun et al., 2015) and dynamic capabilities (Barreto, 2009; Eriksson, 2013) few research has been done on dynamic capabilities in the context of platforms and ecosystems but can be seen broadly as related work (Isckia & Lescop, 2009; Salazar, 2012; Tsai, 2013; Thomas et al., 2014; Venkatraman et al., 2014). Thus, the focus of recent research has been a broader view on dynamic capabilities in platform ecosystems.

In an early work by Isckia & Lescop AWS's open innovation strategy (as one explication of dynamic capabilities (Teece, 2007) was examined in a case study approach in order to comprehend the technical and organizational leverage based on web services (Isckia & Lescop, 2009). Salazar indicates from a case study that ARM's (microelectronics manufacturer) success is truly based on its dynamic capabilitites within a larger platform ecosystem (Salazar, 2012). A framework by Tsai proposes a variety of strategic movements that can be performed by platform owners in dynamic platform surroundings in order to gain future competitive advantage. His research is based on a cross-case analysis (Tsai, 2013). The results offered by Thomas et al. suggest that architectural leverage creates platform value and success. This is accompanied by IP protection, platform control and leadership and trend following (some explications of dynamic capabilities (Teece, 2007; Thomas et al., 2014)). Venkatraman et al. developed a series of concepts showing the characteristics of digital business innovation platforms while being dynamic capabilities one dimension to deliver potential value created by the platform characteristics (Venkatraman et al., 2014).

2.3 Research questions

What is not understood well is what specific dynamic capabilities (DCs) cloud platform providers (CPPs) use in their ecosystems, especially how, why and with whom. Up to this point we define the following broad research questions:

- RQ1: What specific dynamic capabilities do CPPs use within their ecosystem?
- RQ2: Why do CPPs use dynamic capabilities?
- RQ3: How do CPPs use dynamic capabilities?
- RQ4: With whom do CPPs use dynamic capabilities?
- RQ5: What outcomes caused by strategic responses of CPPs that are based on dynamic capabilities can be identified?

2.4 Thesis structure

We elaborate a set of answers to our research questions in a four-step-methodological concept that is shown in Figure 1 (research design inspired by (Van de Ven, 2007)). Part I helps to refine the previously stated research questions. Firstly, a thorough literature review leads us to a series of conceptual frameworks. Furthermore, we sketch our expectations. Consequently, Part II will discover the methodological standards in this research field. Specifically, we introduce our research design and tools, as well as how our mixed-methods research design is overlaid on top. Part III can be classified as the core of this work where we apply our research methodology on the case of Amazon Web Services (AWS). After a short introduction of AWS we expose the data preparation, collection and conversion processes as well as apply analytic techniques in order to gather valuable insights about the answers to our research questions. The results are condensed in conceptual frameworks. Finally, we discuss the implications on theory and practice in Part IV. Even if we cannot fully generalize the insights of the case study, lessons can be drawn about dynamic capabilities in the context of cloud platform ecosystems.

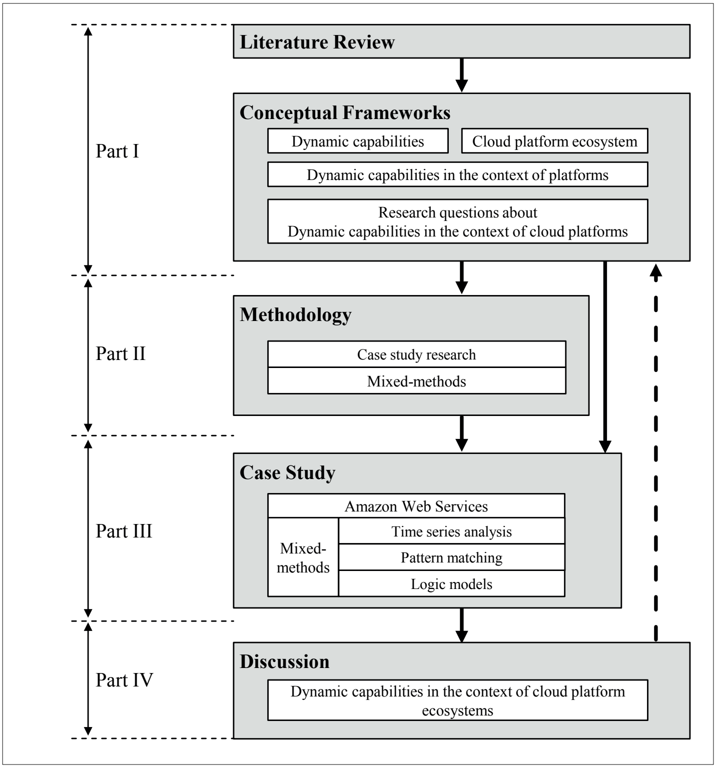

Figure 1: Thesis structure

3. Part I: Literature review

In this chapter we compose a literature review that should introduce unexperienced readers quickly into the topic, reveal state-of-the-art research insights and generate conceptual frameworks for the refinements of previously defined research questions.

After a short methodological justification, we first expose a general theoretical background introducing the topics of cloud computing, platform management, ecosystem theory and strategy management. After this, we develop coherent conceptual frameworks based on recent literature about a) dynamic capabilities (DCs), b) cloud platform ecosystems (CPEs), c) dynamic capabilities in the context of platforms (DCs in CPEs) and d) a specification of the previously stated research questions. We compare the typologies of each domain that will help us to define mutually exclusive and collectively exhaustive code schemes. Lastly, we state our expectations.

In this initial phase of investigation we make use of conceptual frameworks in order to guide the research. As we address a qualitative research problem, we create conceptual frameworks inductively after synthesizing and integrating existing models. Later, we compare previous research outcomes with the case of AWS to ensure that we identify discrepancies and define our research contribution (Imenda, 2014).

3.1 Theoretical background

We present the fundamentals of cloud computing and platforms, as well as ecosystem theory and origins of dynamic capabilities. Since a comprehensive symbiosis of these topics has not been addressed before, we consider each topic separately.

Cloud computing and platforms

Cloud computing and platforms have emerged during the last years extensively (Qian et al., 2009). Much is known about specific technical specification (Furht & Escalante, 2010) and business models (Strømmen-Bakhtiar & Razavi, 2011). But less is known about organizational and managerial aspects of complex cloud platforms and companies that respond to enormously dynamic environment. What about the strategies, organization, governance and innovation?

Cloud computing platforms

When we talk about cloud platforms we always mean cloud computing services that cover the whole set of "as-a-service"-models, including, software, platforms and infrastructure. As stated by Landis & Blacharski (2013) "cloud platforms are offered 'as a service', [...] taking advantage of underlying cloud infrastructure, elasticity and as-a-service models". The corresponding advantages are manifold, e.g.

lower costs and risks and faster time-to-market by use of rapid prototyping (Landis & Blacharski, 2013).

Buyya et al. (2008) compares a set of cloud platforms. They name examples as Amazon's Elastic Compute Cloud (infrastructure) and Google's App Engine (platform) (Buyya et al., 2008). Cusumano et al. (2010) focuses on SaaS platforms as platform mode and shows examples such as Microsoft Azure, Google App Engine and Amazon EC2 (Cusumano, 2010).

Cloud computing deployment models

Cloud deployment models determine the degree of openness of a cloud infrastructure. A public cloud is accessible to the general public. A private cloud is provisioned for an exclusive user group only. At last a hybrid cloud is an aggregation of singular private/public cloud infrastructure (Mell & Grance, 2011).

Cloud computing definition

Cloud computing is a characterized as a service model delivering network-based access to a variety of computing resources that are configurable, e.g. servers with computing power, storage, networks, applications and services. This means that services do not need to be established, installed, configured and run on a local machine, but rather on remote machines usually accessible through the internet. Those services generally have a set of features that are highly desirable for the optimization of IT architectures and business models. The National Institute of Standards and Technology (NIST) categorizes the features as follows:

- "On-demand self-service": Customers can make use of the services instantly and without provider intervention.
- "Broad network access": Services can be utilized through a broad network (e.g. internet), through standard interfaces. Furthermore, the integration of heterogeneous systems and platforms is provided.
- "Resource pooling": The provider aggregates various resources (e.g. CPU time, storage) physically and virtually to allocate capacities to several customers.
- "Rapid elasticity": The provision of resources can scale out or up at any time, thus also automatically adapt to changing demand.
- "Measured service": A measuring service is offered to supply proper measuring, monitoring, steering and reporting functions (Mell & Grance, 2011).

Cloud computing services models

A range of service models specify the extensive cloud computing offering. The NIST defined three services models that can be imagined as a stack going from Software-as-a-Service (SaaS) over Platform-as-a-Service (PaaS) to Infrastructure-as-a-Service (SaaS). To distinguish those we give a definition of each.