Business Administration Dissertations          Programs in Business Administration

Spring 5-5-2012

# Open Source In The Clouds - How Organizational Ambidexterity Shapes and is Shaped by Disruptive Innovation in an Open Source Software Provider

Alexander M. Heublein

Follow this and additional works at: https://scholarworks.gsu.edu/bus_admin_diss

**PERMISSION TO BORROW**

In presenting this dissertation as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or publish this dissertation may be granted by the author or, in his/her absence, the professor under whose direction it was written or, in his absence, by the Dean of the Robinson College of Business. Such quoting, copying, or publishing must be solely for the scholarly purposes and does not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential gain will not be allowed without written permission of the author.

Alexander Montgomery Heublein

**NOTICE TO BORROWERS**

All dissertations deposited in the Georgia State University Library must be used only in accordance with the stipulations prescribed by the author in the preceding statement.

The author of this dissertation is:

Alexander Montgomery Heublein
3655 East Paces Walk
Atlanta, GA 30326

The director of this dissertation is:

Lars Mathiassen
Robinson College of Business
Georgia State University
35 Broad Street, NW, Suite 427
Atlanta GA 30303

# Open Source In The Clouds

How Organizational Ambidexterity Shapes and is Shaped by
Disruptive Innovation in an Open Source Software Provider

BY

Alexander Montgomery Heublein

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

Executive Doctorate in Business

In the Robinson College of Business

Of

Georgia State University

GEORGIA STATE UNIVERSITY
ROBINSON COLLEGE OF BUSINESS
2012

**ACCEPTANCE**

This dissertation was prepared under the direction of the Alexander Montgomery Heublein Dissertation Committee.  It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Executive Doctorate in Business in the J. Mack Robinson College of Business of Georgia State University.

H. Fenwick Huss, Dean

DISSERTATION COMMITTEE

Lars Mathiassen
Mark Keil
Balasubramaniam Ramesh

ABSTRACT


# Open Source In The Clouds
How Organizational Ambidexterity Shapes and is Shaped by
Disruptive Innovation in an Open Source Software Provider

BY

Alexander Montgomery Heublein

May 2nd, 2012


Committee Chair:              Lars Mathiassen

Major Academic Unit:         Robinson College of Business

How do incumbent firms effectively respond to disruptive innovations? The extant literature shows that incumbent firms, while often excelling at incremental innovation, usually fare poorly in the face of disruptive innovation. Even firms that have been the direct beneficiaries of disruptive innovations in the past can fall prey to more agile competitors during these periods of upheaval. Organizational Ambidexterity – the idea of striking the right balance between the exploitation of existing resources and the exploration of new capabilities – can be used as a theoretical framework to investigate how firms adapt and change in the face of disruptive innovation. In this study, we use ambidexterity as a lens to study Red Hat, a leader in Open Source Software, during the company's transition through a period of disruptive innovation – namely Cloud Computing. The study reveals a number of interesting insights. The first is that the nature of the disruptive innovation itself shaped Red Hat's organizational response. The second is that Red Hat demonstrated a high level of contextual ambidexterity in its response which, in turn, led Red Hat to selectively adopt structural ambidexterity principles. The third is that Red Hat's history as a successful Open Source Software company enabled it to implicitly become ambidextrous by adopting and implementing key Open Source cultural values. In conclusion we discuss the implications of these findings for theory and practice.

**Table of Contents**

# List of Tables and Figures

## Tables

## Figures

# Abbreviations

**List of Abbreviations**

BSD – Berkeley Software Distribution

BU – Business Unit

CDDL – Common Development and Distribution License

GLS – Red Hat Global Learning Services

GNU – GNU's Not Unix

GPL – GNU Public License

GPS – Red Hat Global Professional Services

IaaS – Infrastructure as a Service

IP – Intellectual Property

ISV – Independent Software Vendor

LGPL – Lesser GNU Public License

OEM – Original Equipment Manufacturer

OSS – Open Source Software

PaaS – Platform as a Service

RHEL – Red Hat Enterprise Linux

RHEV – Red Hat Enterprise Virtualization

SaaS – Software as a Service

SI – Systems Integrator

## Introduction

How can firms that have been successful in the past deal with present or future disruptive innovations? This age-old question has faced practitioners for perhaps as long as innovations have been disrupting firms and markets with few, if any, truly satisfactory answers. However, just in the last two or three decades has this problem reached the forefront of management scholarship (Tushman & Anderson, 1986; Henderson & Clark, 1990; Christensen, 1997; Christensen & Overdorf, 2000; Christensen & Raynor, 2003). Yet what is even meant by the term "disruptive innovation"? Perhaps the most succinct definition comes from Koberg, et al. (2003): they "encompass higher order innovations that serve to create new industries, products, or markets" (p.23). Regardless of the exact definition, disruptive innovations forever change market dynamics and the nature of competition (Tushman & Anderson, 1986).

From a theoretical standpoint, a possible solution for dealing with disruptive innovation comes to us in the form of organizational ambidexterity theory. The basic premise of organizational ambidexterity is that short-term exploitative capabilities and long-term exploratory capabilities must be carefully adjusted to achieve the right balance for a particular set of organizational and market conditions (Birkinshaw & Gibson, 2004). However, only limited research has been done thus far on how organizational ambidexterity affects, and is affected by, disruptive innovation (O'Reilly & Tushman, 2007; Raisch & Birkinshaw, 2008).

The purpose of this study is to investigate that very question: how does ambidexterity affect, and how is it affected by, a disruptive innovation in the marketplace? The innovation in question is Cloud Computing, which potentially represents one of the most significant disruptions to the information technology landscape in more than a decade (Carr, 2009). Cloud Computing is succinctly defined by Mell & Grance (2011) as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and

services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (p.2). Yet this definition does little to explain the potentially massive effects this new paradigm will have on Independent Software Vendors (ISVs), Original Equipment Manufacturers (OEMs), and System Integrators (SIs) within the IT industry (Holt, et al., 2011).

The specific focus of this study is to understand how ambidexterity plays a role in an organization's response to Cloud Computing as a disruptive IT innovation. The organization in question is Red Hat, an industry leader in Open Source Software (OSS). OSS was, and still is to some extent, a disruptive IT innovation. Thus, not only is this study focused on understanding ambidexterity in the face of disruptive innovation, it is also focused on understanding how a previous disruptive innovator deals with a present disruptive innovation – an area that has little, if any, precedent in the extant literature.

The study itself was conducted as a single, longitudinal case study over a period of approximately three years. The study leveraged both historical survey data and semi-structured interviews with key decision-makers as primary data sources. The unit of analysis was at the organizational level, and both structural and contextual ambidexterity were explored both discretely and in combination with one another.

# The Context: Open Source Software

## Background and Business Model

Open Source Software (OSS) is a rapidly growing movement in the development of both consumer and enterprise software. Open source development is a community-based way of developing software that has no generally accepted academic definition, but whose projects typically have the following characteristics (Gacek & Arief, 2004; Open Source Definition, 2009):

1. Software source code is contributed by a wide variety of individuals, corporations, and governments within a particular community of common interest at no direct cost to the community.

2. The resulting software, including its modifiable source-code, must be made freely available to the public and may be modified or improved by anyone for any purpose as long as the resulting changes are made publicly available to the global community at no cost.

3. Free and open source software communities, in theory, are meritocracies where the brightest ideas and best contributions tend to increase a contributor's perceived merit, while not discriminating on the basis of persons, groups, or fields of endeavor.

Open Source Software is governed by a wide variety of licenses that are designed to uphold the ideas of making the software freely available to the public and preventing the software from being made proprietary by commercial entities. The most common licenses are the GNU Public License and the Lesser GNU Public License, which uphold these principles fully (Free Software Foundation, 2011). Other licenses such as the Berkeley Systems Distribution (BSD) license and the Common Development and

Distribution License (CDDL) are used within various OSS communities but are either more or less restrictive in terms of re-use and redistribution.

Commercial use of OSS has grown rapidly over the last several years and organizations providing commercial implementations of OSS such as Linux and Linux-based services have grown their revenues significantly.

## Open Source Business Models

Proprietary software companies generate revenue via four primary mechanisms: 1) License sales, 2) Support services, 3) Consulting services, and 4) Education services. Commercial OSS vendors, however, cannot charge for software licenses due to the nature of most OSS licensing agreements (for instance: GPL, LGPL, and BSD) and are therefore limited to support, consulting, and educational services for revenue (Watson, 2008). Thus, from a revenue standpoint, commercial OSS vendors are seemingly at a natural disadvantage compared to their proprietary counterparts. On the cost side of the equation, however, commercial OSS vendors have a distinct advantage: since much of the development of OSS comes from the community, the cost of development is significantly lower. Given that research and development (R&D) costs are typically two of the largest cost components in the software industry, in theory this should offset some of disadvantages inherent in a more limited revenue stream.

## Red Hat – An Open Source Leader

Red Hat was originally founded in 1993 as a business selling Linux and Unix books and accessories. The company released its first Linux distribution, Red Hat Linux, in 1994 and since then has grown, both organically and through numerous acquisitions, to become the largest pure-play OSS company in the world. Red Hat employs approximately 5000 people as of March 2012 (Red Hat, 2012).

Red Hat's fiscal year 2012 revenues came in at over $1.1 billion, making it the first billion-dollar OSS company in history. Approximately 85% of Red Hat's revenues are

generated through the sale of support subscriptions while the remaining 15% comes from consulting and educational services. Red Hat has experienced rapid revenue growth over the last several years with a compound annual growth rate exceeding 20%, making it the 6th fastest growing software company in the United States as of 2009 (Van Kooten, 2010).

Red Hat has made several strategic acquisitions over its history including Cygnus Solutions, another OSS company primarily focused on GNU projects; JBoss, an open source middleware software company; MetaMatrix, a data services software company; and Amentra, a middleware systems integrator. These acquisitions have primarily allowed Red Hat to expand beyond its core Linux market into other areas of OSS.

Red Hat is currently organized along four main revenue-generating lines:

1. **Platform** – The Platform business unit accounts for the largest portion of Red Hat's revenue as of 2011. The Platform business unit's primary products are Red Hat Enterprise Linux, which accounts for the majority of the revenue and Red Hat Network Satellite, a management and provisioning system for Red Hat Enterprise Linux that accounts for a small, but significant, share of the revenue.

2. **Middleware** – Red Hat's Middleware business unit accounts for a small, but rapidly growing portion of revenue as of 2011. The Middleware business unit's product portfolio is centered around the JBoss Enterprise Java application server and includes JBoss Enterprise Application Platform (EAP), JBoss Enterprise Portal (EPP), JBoss SOA Platform (SOA-P), JBoss Business Rules Management System (BRMS), and JBoss Developer Studio.

3. **Cloud** – Red Hat's Cloud business unit accounts for a negligible amount of revenue as of 2011. The business unit was formed in 2009 to focus on building a strategy and supporting products to allow Red Hat to leverage its existing

operating system, management tools, and virtualization platform in order to become a leader in open source cloud computing. The Cloud BU is also responsible for Red Hat Enterprise Virtualization, which is a relatively new product based upon a previous acquisition.

4. **Services** – Red Hat Services accounts for a small, but significant amount of Red Hat's revenue as of 2011. Services is divided into three main business lines: 1) Global Professional Services (GPS), which provides consulting services primarily around Red Hat's Platform and Cloud product lines, 2) Global Learning Services (GLS), which provides training and certification across all of Red Hat's products, and 3) Amentra, a wholly-owned subsidiary of Red Hat that focuses on middleware services related to JBoss products, predominantly in North America.

# The Innovation: Cloud Computing

## Overview

Perhaps the most widely accepted definition of the nascent concept of "Cloud Computing" is one developed by the National Institute of Standards and Technology which defines the construct as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (Mell & Grance, 2011, p.2).

## Cloud Computing

While the above definition of Cloud Computing does a good job of describing the concept at a high level, it does little to actually distinguish the concept from past models such as mainframe computing which, interestingly enough, fits the definition almost perfectly. Thus, the NIST definition goes on to specify three dimensions that better define the specifics of Cloud Computing: Key Characteristics, Service Models, and Delivery Models.

### Key Characteristics

According to the NIST definition of Cloud Computing there are five key characteristics that distinguish clouds from traditional forms of computing (Mell & Grance, 2011):

- **On-Demand Self Service** – Users must be able to provision computing capacity and features in real-time and without the intervention of a system administrator or other IT personnel.

- **Broad Network Access** – Computing resources must be made available and accessible via standard networking technologies to a wide range of client platforms, including personal computers, mobile phones, and laptops.

- **Resource Pooling** – Resources must be pooled together to serve all users of computing services and dynamically assigned to those users in a "multi-tenant" model. This must be done in a location-independent fashion (i.e. users neither know nor care about the location of the actual servers their applications are running on.

- **Rapid Elasticity** – Resource capacity for a particular user or group of users must be able to scale dynamically, either up or down, to meet their specific capacity needs at any given point in time. This is intended to give the illusion that computing resources are effectively unlimited for their particular needs.

- **Measured Service** – Utilization of computing resources must be monitored and metered in a cloud environment in order to provide transparency to the consumers and providers of the computing resources.

## Service Models

In addition to these defining characteristics there are three generally accepted service models inherent in Cloud Computing (Mell & Grance, 2011), which are focused on different architectural levels of the computational stack: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).

- **Infrastructure as a Service** – IaaS is a service model focused on delivering IT infrastructure components to users as a service. These infrastructure components typically include computational resources (i.e. servers), raw storage, and networking but can also include virtualization hypervisors, operating

systems, and management tools. Components are usually provided in the form of virtualized resources that are shared by many users in a multitenant environment.

- **Platform as a Service** – PaaS is a service model focused on delivering a development and deployment environment for either end-user applications or SaaS provider applications. PaaS platforms typically reside on top of IaaS platforms but the consumer of the PaaS platform typically does have direct control over the IaaS portion of the stack.

- **Software as a Service** – SaaS is a service model that provides consumers a way of accessing and utilizing software applications running in the cloud. These applications typically perform one or more key functions, such as e-mail or customer relationship management and are typically provided in a multitenant environment where all users of the SaaS application share a common IaaS or PaaS infrastructure. However, as with PaaS, the consumers of SaaS are typically unaware and unable to control or access the underlying IaaS or PaaS environment.

## Deployment Models

Another dimension upon which to define Cloud Computing is deployment models. Deployment models are essentially the contexts in which cloud computing environments are actually deployed and accessed (Mell & Grance, 2011).

- **Public Cloud** – Public Clouds, such as Amazon EC2, are IaaS, PaaS, or SaaS infrastructures that can be accessed by the general public via the open Internet. The infrastructure behind most public cloud infrastructures is typically architected in a highly virtualized, multi-tenant fashion allowing for economies of scale and highly elastic capacity.

- **Private Cloud** – In contrast to public clouds, Private Clouds are not available to the general public via the open Internet. However, the infrastructure architecture is generally similar to public clouds and may be hosted either on-premise (i.e. within a private data center owned or leased by the private enterprise in question) or off-premise by a hosting provider.

- **Hybrid Cloud** – Hybrid Clouds are essentially a combination of both public and private clouds. In a hybrid cloud scenario, organizations deploy their applications and data using a combination of off-premise public clouds and either on-premise or off-premise private clouds. Many organizations employing this strategy use their private cloud for the majority of their applications and workloads and then use public clouds for spillover capacity – a process known in the industry as "cloudbursting".

- **Community Cloud** – Community Clouds are similar to public clouds in the sense that they are usually accessed via the open Internet and are shared by many users. However, they differ from public clouds in the sense that they are set up, operated, and utilized by a group of organizations rather than a single provider. For instance, a group of universities might choose to create a community cloud exclusively for use by members of that group.

## Forms of Innovation

While a great deal of academic research has been conducted on the topic of innovation there is precious little agreement as to the actual definition of the term "innovation". Part of the confusion seems to lie in the fact that the word innovation can be used to describe both the process by which organizations innovate (not to be confused with "process innovation", a distinct type of innovation) and the actual innovations that are produced as a result of the innovation process.

With regard to the notion of innovation as an organizational process, Baregheh et al. (2009) have reviewed the extant literature and have synthesized a consensus definition:

> "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." (p.1334)

With regard to the innovative products, processes, and services that are produced by the aforementioned innovation process, Van de Ven (1986) came up with perhaps the most succinct yet descriptive definition of innovation, which will be used for purposes of this dissertation:

> "An Innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved." (p.591)

It is important to note that in both of these definitions the concept of innovation is relative to the organizational context in which it is applied. That is, what may be innovative to one organization may be viewed as mere imitation by another organization (Van de Ven, 1986).

There is also a great deal of discussion in the extant literature about different forms of innovation, many of which are beyond the scope of this paper, but the most basic distinction comes from Christensen & Overdorf in the form of "Sustaining Innovation" and "Disruptive Innovation" (Christensen & Overdorf, 2000).

### Sustaining Innovation

Sustaining innovations are those produced by organizations that leverage and enhance existing capabilities and competencies. They are generally innovations that "make a product or service perform better in ways that customers in the mainstream market already value" (Christensen & Overdorf, 2000, p.72). These innovations are usually developed by established companies within a particular market and tend to be incremental in terms of their impact on efficiency and value delivered to customers (O'Reily & Tushman, 2004). Sustaining innovations also tend to be competency-enhancing – meaning that they normally leverage and build upon existing competencies rather than forcing the creation of entirely new ones (Tushman & Anderson, 1986).

### Disruptive Innovation

In contrast to sustaining innovations, disruptive innovations generally "create entirely new markets through the introduction of a new kind of product or service" (Christensen & Overdorf, 2000, p.72). The major distinction between sustaining and disruptive innovations is the latter's overall impact to the organizations or markets affected by such an innovation. As the name suggests, these innovations disrupt the market in a significant way that forever changes the dynamics of competition and value creation and they "encompass higher order innovations that serve to create new industries, products, or markets" (Koberg, et al., 2003, p.23). Disruptive innovations can also be defined in terms of their impact on existing competencies in the sense that they typically destroy existing competencies rather than enhancing existing competencies (Tushman & Anderson, 1986).

Christensen & Raynor (2003) go on to define two sub-forms of disruptive innovation: "low-end" and "new market". This distinction is largely based upon differing processes by which innovations disrupt the market. Others make the distinction between "breakthrough" or "radical" innovation and "architectural" innovation, based upon the degree to which a disruptive innovation relies on a breakthrough technology or idea

versus simply combining existing technologies or ideas in a novel way to achieve a disruptive effect (Henderson & Clark, 1990). For purposes of this paper both of these notions will be combined into a single classification framework shown in Figure 1.
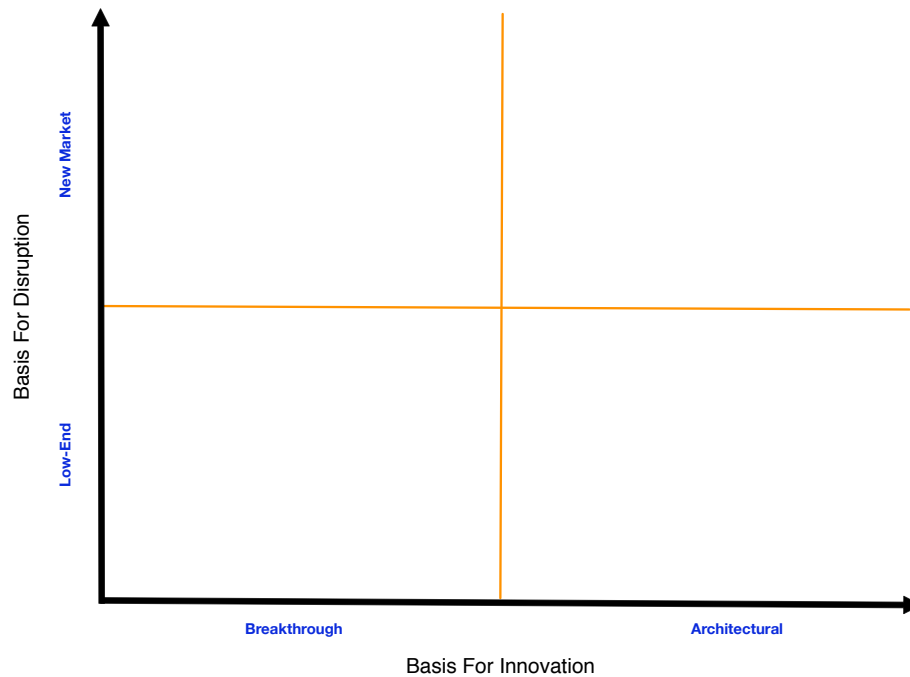


*Figure 1: Disruptive Innovation Classification Framework*

### *"Low-end" Disruptive Innovations*

As their name implies, "low-end" disruptive innovations come at existing markets and products from the low end in terms of features, performance, or both. These innovations start out as generally inferior products compared to those that already exist in the marketplace and then improve over time to become "'good enough' to serve customers' needs" (Christensen & Raynor, 2003). That is, these low-end products eventually exceed the performance or feature levels that the average customer can utilize, and generally force incumbent products into higher-level niches that focus on the most demanding (and often most profitable) customers. Or, as Christensen & Raynor (2003) put it: these innovations "don't attempt to bring better products to

established customers in existing markets. Rather, they disrupt and redefine that trajectory by introducing products and services that are not as good as currently available products. But disruptive technologies offer other benefits – typically, they are simpler, more convenient, and less expensive products that appeal to new or less-demanding customers." (p.34). This process is summarized in Figure 2 (Christensen & Raynor, 2003, p.33).
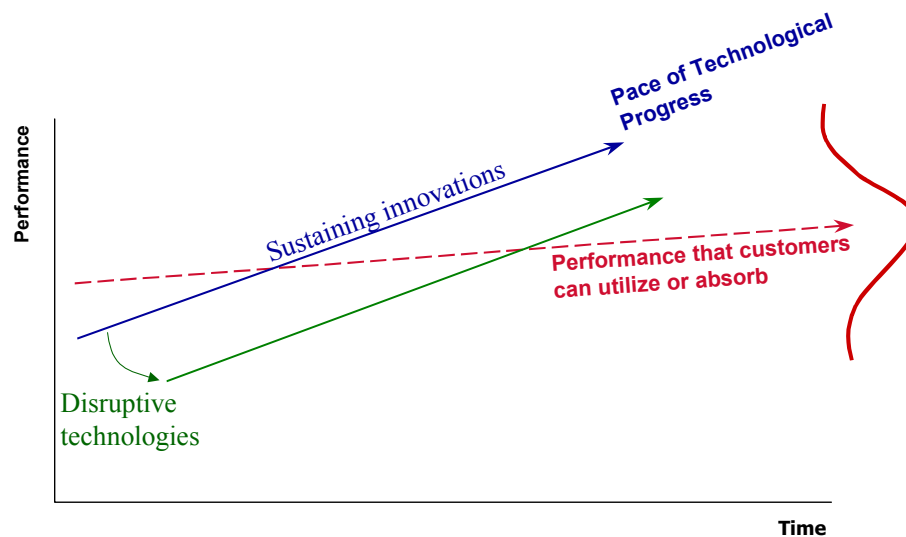


*Figure 2: Low-end Disruption Process*

Some classic examples of low-end disruptive innovations include discount department stores such as Wal-Mart in the 1960's, steel mini-mills in the 1970's, and low-cost airlines such as Southwest Airlines and Jet Blue in the 1990's and 2000's (Christensen & Raynor, 2003).

*"New Market" Disruptive Innovations*

In contrast to low-end disruptive innovations, "new market" disruptive innovations do not try to attack incumbent products and services from below but, rather, "create a new value network" that competes with non-consumption (Christensen & Raynor, 2003). These innovations primarily compete with non-consumption because they "are so much

more affordable to own and simpler to use that they enable a whole new population of people to begin owning and using the product" (Christensen & Raynor, 2003, p.45). However, like low-end disruptive innovations, new market innovations get better over time and eventually draw customers away from incumbent products. This process is illustrated in Figure 3 (Christensen & Raynor, 2003, p.43).
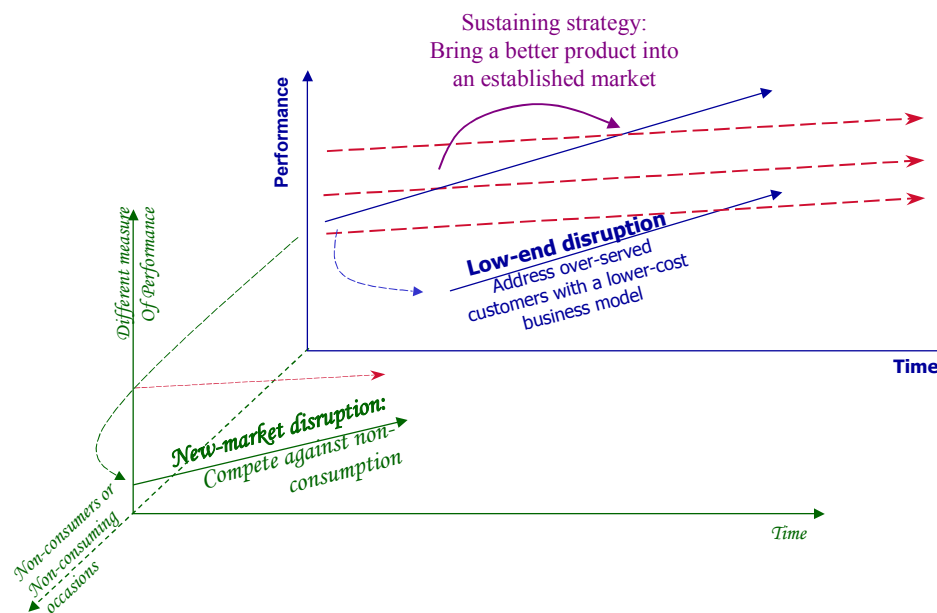


*Figure 3: New Market Disruption Process*

Some classic examples of new market disruptive innovations include the telephone in the 1870's, minicomputers in the 1970's, microcomputers in the 1980's, and ink-jet printers in the 1990's (Christensen & Raynor, 2003).

## *Breakthrough Disruptive Innovations*

Breakthrough disruptive innovations typically "involve the development or application of significantly new technologies or ideas into markets that are either nonexistent or require dramatic behavior changes to existing markets" (McDermott & O'Connor, 2002, p.424). In particular, breakthrough innovations "represent technical advance so

significant that no increase in scale, efficiency, or design can make older technologies competitive with the new technology" (Tushman & Anderson, 1986, p.441).

A good example of a breakthrough disruptive innovation was the development of the laser. Lasers represented a breakthrough innovation in both science and engineering and they created entirely new markets across a wide variety of industries including telecommunications, medicine, and the military (Gross & Herrmann, 2007). They also destroyed existing competencies, such as certain types of surgery and skills associated with many kinds of telecommunications equipment.

### *Architectural Disruptive Innovations*

The concept of "architectural" (Henderson & Clark, 1990) or "integrative" (O'Reily & Tushman, 2007) innovation recognizes the fact that many innovations do not require breakthrough technology to have major disruptive impacts on markets. These architectural innovations essentially take core technologies and ideas that already exist and combine them in new and novel ways to achieve an innovation that is greater than the proverbial sum of its parts (Henderson & Clark, 1990; O'Reily & Tushman, 2007).

Some classic examples of architectural innovations include high-strength-low-alloy steel in the automobile industry in the 1970's and photolithographic alignment equipment in the 1980's (Henderson & Clark, 1990).

## Cloud Computing as Innovation

The notion of Cloud Computing as an innovation is a somewhat controversial topic. According to some, it represents a fundamental paradigm shift in the way computing resources are delivered and consumed. Author Nicholas Carr likens the switch to Cloud Computing as being analogous to the way industrial factories moved from consuming power generated on-site via water wheels and steam engines to power generated at

large, centralized facilities (Carr, 2009). However, others in the industry view Cloud Computing as simply a repackaging of existing technologies into the latest marketing fad – a classic case of "old wine in new bottles" (Voas & Zhang, 2009). Regardless of Cloud Computing being a case of a true paradigm shift or simply the latest fad, the impact it is having on the IT industry is undeniable. Every major vendor from IBM to Microsoft to SAP to Oracle has a cloud strategy and these vendors are bringing new cloud products to market in droves. Morgan Stanley predicts that public cloud workloads may increase at a compound annual growth rate in excess of 50% from 2012 to 2014 (Holt, et al., 2011). In the specific case of Red Hat, the notion of Cloud Computing as an innovation is unquestionable given the company's high level of investment, both in people and in funding, to the development of new cloud technologies and services.

Reviewing Van de Ven's (1986) definition of innovation as "a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved" (p.591), it is clear that Cloud Computing meets most, if not all, of the criteria set forth in this definition. Cloud Computing is certainly a new idea (albeit perhaps a "recombination of old ideas") and, based upon the industry reaction to this new idea and predicted growth rates, it is undeniable that it is perceived as new and impactful by the organizations and markets involved.

However, it is not entirely clear that Cloud Computing can be considered a "breakthrough" innovation in the classic sense. It would be difficult to argue that it is based upon one or more breakthrough technology innovations that typically define an innovation. Almost all of the major technology components required for Cloud Computing – such as virtualization, high-bandwidth networking, universal network access, high-performance low-cost servers, and distributed management tools – existed long before the advent of clouds.

On the other hand, Cloud Computing does meet the criterion of creating "entirely new markets" (Christensen & Overdorf, 2000) as can be witnessed by the emergence of companies and offerings such as Salesforce.com and Amazon EC2 as well as the myriad cloud products and services being developed and released by a wide range of major industry players including Microsoft, IBM, and VMWare. It also certainly involves the "application of significantly new technologies or *ideas* into markets that are either nonexistent or require dramatic behavior changes to existing markets" (McDermott & O'Connor, 2002, p.424). Thus, one could conclude that Cloud Computing represents more of a new market disruptive innovation than a low-end disruptive innovation.

It is equally clear that Cloud Computing is a competency-destroying innovation in the sense that the need for many of the skills and capabilities associated with IT system administration, operations, and application development will certainly be reduced dramatically if Cloud Computing gains broad market acceptance. Thus, one could conclude that while Cloud Computing does not represent a major technological innovation, its influence on the IT industry from both an impact standpoint and a competence-destroying standpoint is clear – which is essentially the definition of an "architectural innovation".

A fundamental key to understanding the market impact of Cloud Computing and its impact on business models within the IT industry is the realization that Cloud Computing, at its core, is largely (although not entirely) about economics. An oft-quoted IT industry statistic states that approximately 70% of all IT spending goes towards operational expenditures, while the other 30% goes to capital expenditures (Gartner, 2001). When server virtualization that could be utilized on inexpensive chipsets from Intel and AMD was introduced in the late 1990's it rapidly gained broad acceptance as an IT consolidation strategy. Since the average server ran at approximately 15% - 20% utilization at any given time, IT executives realized that they could use virtualization to eliminate largely idle physical servers by virtualizing them and consolidating them onto a

smaller number of systems. While this eliminated a great deal of capital spend (i.e. one didn't have to purchase as many servers every year to handle the same workload requirements) its impact on operational spend was limited – thus addressing only 30% of the cost problem (Dawson & Bittman, 2008). Thus, it can be argued that a fundamental reason that Cloud Computing has gained so much more broad momentum than virtualization in recent years is that Cloud Computing is focused on (and capable of) reducing both capital *and* operational expenditures to a great extent (Rosenberg & Mateos, 2011). The net effect of this economic model is that it has the potential to disrupt the existing economic model of software, hardware, and services companies within the IT industry.

Thus, given that Cloud Computing exhibits characteristics of a classic architectural innovation that has the potential to define new markets rather than focusing on attacking existing markets from below, one can make a compelling case that Cloud Computing falls primarily into the category of a new market architectural innovation, as illustrated in Figure 4. However, it is important to note that Cloud Computing does not fit perfectly into this categorization as it does exhibit some characteristics of both breakthrough and low-end disruptive innovations.
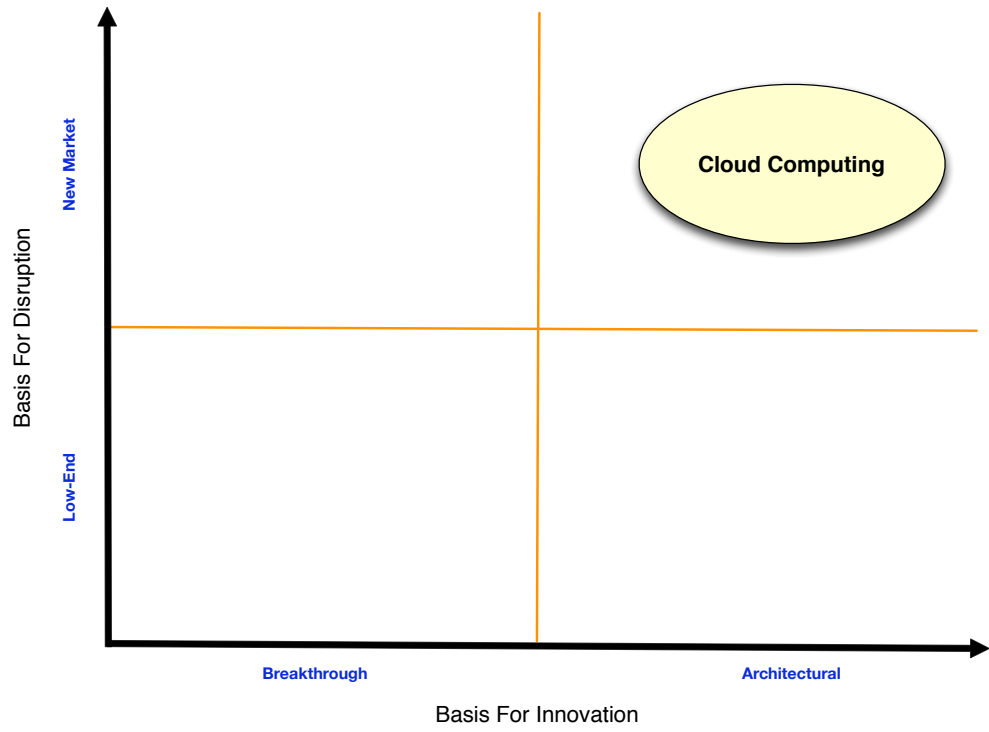
*Figure 4: Cloud Computing as a New Market Architectural Innovation*

# The Framework: Ambidexterity Theory

A focal tenet of Organizational Ambidexterity theory is balancing alignment and adaptability. That is, in order to achieve sustainable competitive advantage firms must balance the priorities of running today's business with the need to adapt to the potential challenges and opportunities of tomorrow's business. While this statement may seem almost tautological in nature, achieving the *right* balance between these two somewhat conflicting goals is a complex and ongoing challenge for most firms (Birkinshaw & Gibson, 2004). Ambidexterity theory primarily focuses on *how* to achieve such a balance.

The theory of ambidexterity is ultimately based upon the Exploration - Exploitation framework developed by March (1991) who described exploration as "things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation". Exploitation, on the other hand, is exemplified by terms such as "refinement, choice, production, efficiency, selection, implementation, execution" (p.71). If firms focus too much of their efforts on exploration then they run the risk of ignoring their current business execution, which is likely the source of their short-term profits, and ultimately starving their exploratory efforts of the investment capital needed to undertake such efforts. On the flip side, if firms focus too much on exploitation and ignore exploration then their long-term profitability may be jeopardized as competitors open up new avenues for future revenue and profits.

## Forms of Ambidexterity

Birkinshaw and Gibson distinguish between two forms of organizational ambidexterity: structural ambidexterity and contextual ambidexterity. These forms of ambidexterity are summarized in Figure 5.

Structural – The structural separation and coordination of entities into those focused on exploration and those focused on exploitation, often with different performance metrics.

Contextual – Ambidexterity as a function of corporate culture. Individuals must actively balance exploration and exploitation activities on a day-to-day basis.

Exploration

Exploitation

*Figure 5: Forms of Ambidexterity*

## Structural Ambidexterity

In structural ambidexterity organizations divide the firm into separate structures, such as divisions, subsidiaries, or spinoffs, for purposes of exploration and exploitation (Birkinshaw & Gibson, 2004). For instance, long-term research & development efforts (focusing on breakthrough innovation) may be split into a separate organization from operational business units and short-term R&D efforts (focusing on incremental innovation). The argument for such an approach is that exploration and exploitation are such completely different activities that they require unique organizational structures, metrics, incentives, and management philosophies in order for each to be successful. If they are left together in a single organizational structure then the needs and priorities of one will often take precedence over the other, resulting in a lack of balance between the two. Structural ambidexterity has proven to be a popular solution for achieving ambidexterity in the past. High-tech firms such as IBM and HP split off their R&D organizations (IBM Labs and HP Labs, respectively) from their main operating business units many decades ago and achieved a great deal of success in the form of breakthrough innovations. HP's Bill Hewlett and David Packard explained the rationale behind such a move as "freeing scientists from day-to-day business problems so they could focus on ideas that would help shape the company's future" (Hewlett Packard, 2011).

However, it can be argued anecdotally that in recent years structural ambidexterity has not shown quite the promise that it did in years or decades past. There are two potential causes that Birkinshaw and Gibson cite as possible inhibitors to success in structural ambidexterity situations: organizational isolation and the development of a "country club culture" (Birkinshaw & Gibson, 2004). The concept of organizational isolation, simply put, is that separate exploration organizations often lose touch with the needs of the core business and produce breakthrough innovations for which there is no route to market. Thus, such innovations cannot effectively be translated into profitable future businesses without a clearly defined technology transfer function that bridges the gap between the exploration and exploitation functions of an organization. The second potential inhibitor is the development of a "country club culture" within exploration organizations, in which there is a high degree of social support for the ultimate goals of the organization but a low degree of expectations with regard to results (Birkinshaw & Gibson, 2004).

### Contextual Ambidexterity

In contrast to Structural Ambidexterity, Contextual Ambidexterity is a more decentralized, ground-up take on ambidexterity. As Birkinshaw and Gibson put it, contextual ambidexterity is "the collective orientation of the employees toward the simultaneous pursuit of alignment and adaptability". The key to contextual ambidexterity is empowering individuals to make day-to-day decisions on how to balance exploration and exploitation, rather than having those decisions come exclusively from senior management. To do so, it is necessary for senior management to create an organizational context that provides support for individual decision-making, flexible roles, and more generalist positions (Birkinshaw & Gibson, 2004).

### Combining Forms of Ambidexterity

When examining these three forms of ambidexterity it is important to note that none of them are mutually exclusive and can be used in a complimentary fashion. One way that

this may play out in actual practice is for an organization to reinforce its existing contextual ambidexterity characteristics by implementing some form of structural ambidexterity. Given that structural changes to an organization can generally be implemented more quickly than contextual changes, this may allow a company to maintain a certain degree of contextual ambidexterity over a long period of time while maintaining the ability to react quickly to the rapidly changing market characteristics that are usually associated with disruptive innovations.

## Antecedents to Ambidexterity

In order to understand how ambidexterity affects, and is affected by, radical IT innovation at Red Hat, it is first necessary to establish what forms of ambidexterity and the characteristics of each form that existed within Red Hat prior to the advent of Cloud Computing. In order to do so, the antecedents of ambidexterity in its various forms must be analyzed with respect to Red Hat's specific organizational characteristics. Without first establishing this baseline of ambidexterity there would be little point in attempting to understand the role that ambidexterity plays in the face of radical innovation.

### Antecedents of Structural Ambidexterity

There are two main categories of antecedents of structural ambidexterity. The first, not surprisingly, is the type of organizational structure implemented to cope with the dilemma of balancing exploration and exploitation. O'Reily & Tushman (2004) examined several different structural responses to disruptive change and determined that separating the organization responsible for dealing with a disruptive change from the existing business with coordination at the senior executive level is the organizational template most closely associated with structural ambidexterity. This organizational structure is illustrated in Figure 6 (O'Reily & Tushman, 2004).
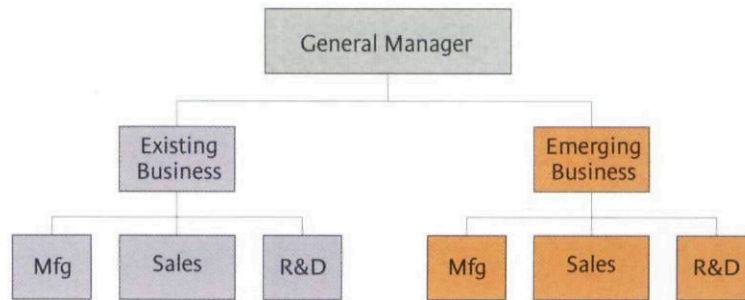
*Figure 6: O'Reily & Tushman's Template for Structural Ambidexterity*

This organizational structure is significantly different than the three other organizational templates that O'Reily & Tushman (2004) examined for dealing with disruptive change, which are illustrated in Figure 7.
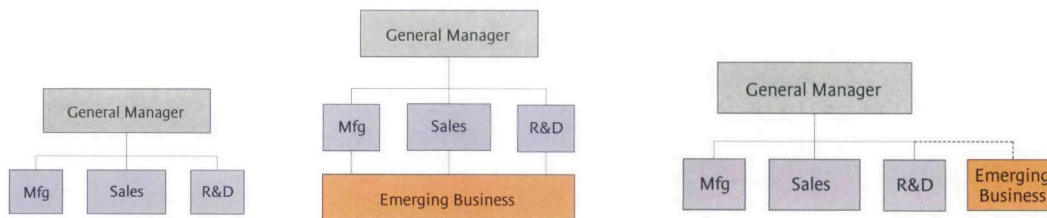


*Figure 7: Alternative Organizational Templates*

*(from left to right: Functional Design, Cross-Functional Team, and Unsupported Team)*

The second category of antecedents of structural ambidexterity is focused on the organizational characteristics and competencies required to sense new opportunities and threats, seize upon them, and then reconfigure the organization to take advantage of the opportunities or counter the threats (O'Reily & Tushman 2007).

1. **Sensing** – The idea of sensing involves developing "a set of resources and routines such as a strategy-making process associated with variation, resources devoted to competitive intelligence and tracking technological change, and forums for discussions of new opportunities" (O'Reilly & Tushman 2007, p.13). It

also involves achieving the right balance between organizational centralization and decentralization, building a culture of openness, and a senior management team committed to both long-term, exploratory thinking and the resource allocations necessary to achieve long-term goals.

2. **Seizing** – The idea of seizing involves developing the organizational capacity to not only become aware of new threats and opportunities but to be able to formulate a comprehensive strategy to react to the threats or seize upon the opportunities. Specifically, this organizational capacity includes "developing a consensus among the senior team about the strategic intent, avoiding the decision traps that path dependencies and mindsets bring, and aligning the business model and strategy" (O'Reily & Tushman 2007, p.15).

3. **Reconfiguring** – The idea of reconfiguring involves allocating resources "away from mature and declining businesses toward emerging growth opportunities" in order to effectively implement an organization's seizing strategy. This process entails not only the allocation of resources to long-term projects, but the implementation of metrics and incentives to drive long-term behavior that spans multiple business units as well (O'Reily & Tushman 2007).

Thus, there are a total of four characteristics, one structural and three organizational, upon which structural ambidexterity can be evaluated.

### Antecedents to Contextual Ambidexterity

Although there are no universally agreed-upon antecedents to contextual ambidexterity, Gibson and Birkinshaw have shown that the four established characteristics of organizational context, as described by Ghoshal & Bartlett (Ghoshal & Bartlett, 1994), namely Discipline, Stretch, Support, and Trust, are good indicators of contextual ambidexterity (Gibson & Birkinshaw, 2004).

1. **<u>Discipline</u>** - As the name would suggest, "discipline", from the perspective of ambidexterity, refers to organizational and cultural standards that encourage individuals to meet or exceed the expectations of the business, as established by the "implicit or explicit commitments" made by individuals to the organization (Gibson & Birkinshaw, 2004). Specific organizational characteristics under the category of discipline include a) unambiguous standards of both performance and conduct, b) a system that provides for rapid and candid feedback, and c) consistent application of standards, performance measures, and sanctions (Gibson & Birkinshaw, 2004; Ghoshal & Bartlett, 1994).

2. **<u>Stretch</u>** - From a contextual ambidexterity perspective, "stretch" refers to organizational attributes that help individuals "voluntarily strive for more, rather than less, ambitious objectives". This involves the development of "shared ambition", a "collective identity", and "personal meaning". These characteristics ostensibly contribute to the ability of individuals to contribute to achieving the goals of the overall organization (Gibson & Birkinshaw, 2004; Ghoshal & Bartlett, 1994).

3. **<u>Support</u>** - "Support" refers to the organizational attributes that allow individuals access to resources controlled by others and the individual freedom to utilize those resources to achieve organizational goals. This also includes providing the support and guidance of senior management without doing so in an overly controlling or authoritarian fashion  (Gibson & Birkinshaw, 2004; Ghoshal & Bartlett, 1994).

4. **<u>Trust</u>** - The concept of "Trust" involves perceptions of equity and fairness in the decisions of senior management and involving individuals in the decisions that affect them (Gibson & Birkinshaw, 2004; Ghoshal & Bartlett, 1994).

In addition to these four organizational characteristics, Birkinshaw and Gibson also identified four individual behaviors that are associated with contextual ambidexterity (Birkinshaw & Gibson, 2004, p.49):

1. **<u>Initiative</u>** - "Ambidextrous individuals take the initiative and are alert to opportunities beyond the confines of their own jobs."

2. **<u>Cooperation</u>** - "Ambidextrous individuals are cooperative and seek out opportunities to combine their efforts with others."

3. **<u>Relationship Brokering</u>** - "Ambidextrous individuals are brokers, always looking to build internal linkages."

4. **<u>Multitasking</u>** - "Ambidextrous individuals are multi-taskers who are comfortable wearing more than one hat."

Thus, there are a total of eight characteristics, four organizational and four individual, upon which contextual ambidexterity can be evaluated.

# Research Methodology

## Research Design

### Single Qualitative Case Study Design

Given that the primary objective of this study is to understand *how* organizational ambidexterity affects and is affected by disruptive innovation, a single longitudinal case study approach was chosen. This choice is appropriate according to Yin (2009) because it focuses on a "how?" or "why?" question, does not require control of behavioral events, and focuses on contemporary events. The decision matrix used for this choice is shown in Table 1.

| Method | Form of Research Question | Requires Behavioral Control of Events? | Focuses on Contemporary Events? |
|---|---|---|---|
| **Experiment** | How, why? | Yes | Yes |
| **Survey** | Who, what, where, how many, how much? | No | Yes |
| **Archival Analysis** | Who, what, where, how many, how much? | No | Yes / No |
| **History** | How, why? | No | No |
| **Case Study** | How, why? | No | Yes |

*Table 1: Relevant Situations for Different Research Methods (Yin, 2009)*

That said, both survey data as well as historical data was used to establish both antecedents to various forms of ambidexterity as well as changes that have occurred over time.

Yin goes on to elaborate that a case study is defined by five additional characteristics, which are summarized in Table 2 along with a brief description of their relevance to this study.

| Defining Characteristic | Relevance To This Study |
|---|---|
| "Investigates a contemporary phenomenon in depth and within its real-life context…" | Cloud computing is a highly contemporary phenomenon and its role as a disruptive innovation requires an in-depth understanding of how it plays out in the context of a real-life company. |
| "Especially when the boundaries between phenomenon and context are not clearly evident…" | Given that a major theme of this study is understanding how contextual ambidexterity is influenced by a disruptive innovation, the boundaries between the phenomenon and the context are difficult to distinguish. |
| "Copes with the technically distinctive situation in which there will be many more variables of interest than data points…" | Given the complex interplay of different forms of ambidexterity it is likely that there will be a large number of variables and factors at play in this study. |
| "Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion…" | Multiple sources of evidence, including archival data, past survey data, and semi-structured interviews of both present and potentially past employees. |
| "Benefits from prior development of theoretical propositions to guide data collection and analysis…" | Two primary theoretical propositions, ambidexterity theory and innovation theory, will be used to guide both data collection and data analysis. |

*Table 2: Defining Characteristics of Case Study Research (Yin, 2009)*

Given how closely the parameters of this study match both the purpose as well as the defining characteristics of case studies as defined by Yin, a case study was arguably an appropriate methodological choice for this study.

**Longitudinal Study**

A longitudinal approach was chosen in order to gain an in-depth understanding of how ambidexterity has changed over time as a result of disruptive innovation. The time period examined ran from July 2009 until March 2012 – or roughly 34 months. This represents the time period from when Red Hat first began developing a Cloud Computing strategy until the full deployment of the strategy in the form of dedicated products and services. Figure 8 shows the timeline of major events (as well as anticipated events) related to Cloud Computing during this time period:
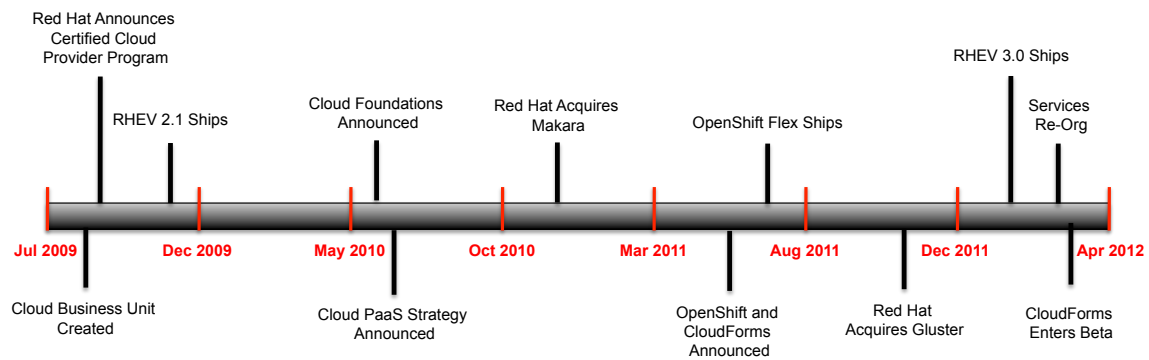
*Figure 8: Timeline of Key Events in Red Hat Cloud Computing*

The study was conducted as a variance study given that the purpose was to understand the how ambidexterity affects, and is affected by, a disruptive innovation.

**Level of Analysis**

The level of analysis for this study was the organization level. This level of analysis was chosen for several reasons:

1. Structural ambidexterity is, by its very nature, primarily an organization-level construct (O'Reily & Tushman, 2004). It would have been quite difficult to study this construct at an individual or workgroup level without also studying it at an organizational level, thus necessitating a multi-level study.

2. In contrast to structural ambidexterity, contextual ambidexterity can be studied at multiple levels of analysis. Contextual ambidexterity generally plays out in real-world organizations at an individual level (Birkinshaw & Gibson, 2004). However, contextual ambidexterity can also be viewed primarily as a cultural phenomenon. That is, the supporting processes, norms, and support structures are what ultimately cause individuals to act in ambidextrous way. Thus, one can

argue that contextual ambidexterity is perhaps best studied at the organizational level.

3. Red Hat has been conducting employee engagement surveys on an annual basis for several years. These surveys are designed to measure the proliferation of key cultural attributes throughout the organization. Much of this data is relevant for investigating the contextual antecedents identified in the "Antecedents to Contextual Ambidexterity" section. Given this wealth of current and historical data pertaining to Red Hat's culture, it made sense to conduct the study at the organizational level of analysis.

4. A multi-level analysis was considered but multiple levels of analysis (potentially involving organizational, individual, and community levels), coupled with the interplay of multiple forms of ambidexterity, would have made the number of permutations grow to a number that is beyond the scope and timeframe available to conduct this study. Thus, a single level of analysis was chosen. However, to improve reliability a fair amount of data was collected on both the individual and community levels of analysis.

## Engaged Scholarship

Van de Ven (2007) defines the term "engaged scholarship" as "a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems" (p.9). In this vein, this study is was designed to be an example of engaged scholarship: it is focused on a complex problem in a real-world setting that requires the perspective of different stakeholders in order to understand the key issues.

Van de Ven goes on to describe four main types of engaged scholarship based upon both the research perspective and the purpose of the research. These forms of engaged scholarship are summarized in Figure 9 (Van de Ven, 2007).
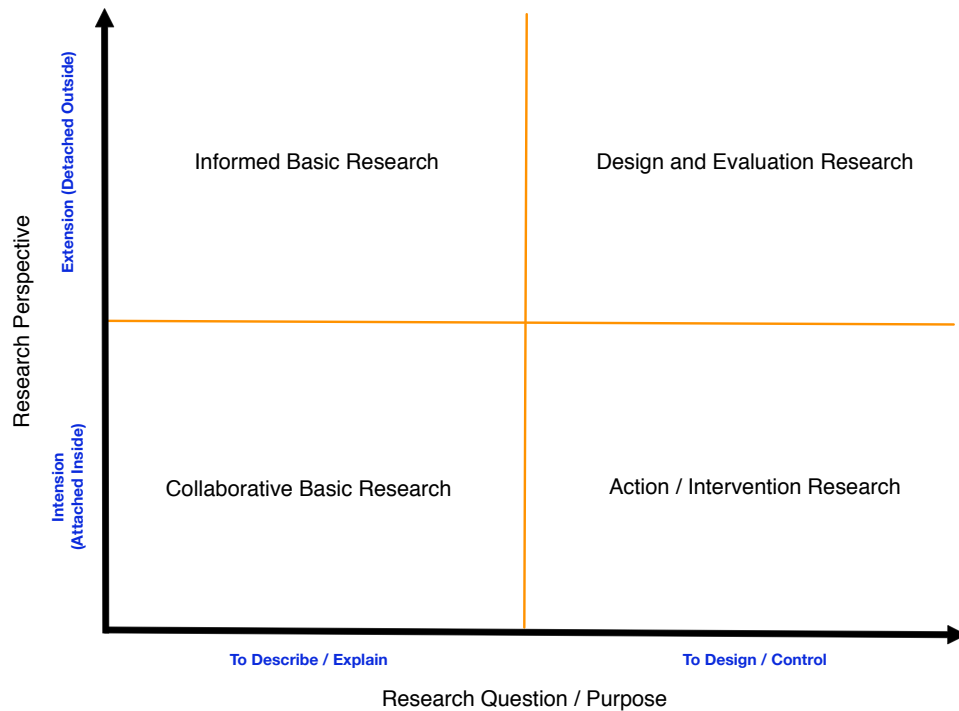


Figure 9: Alternative Forms of Engaged Scholarship

This study primarily falls into the "Informed Basic Research" category given that the researcher is a practitioner examining the organization in question from an academic perspective and there is no explicitly defined collaborator from the practitioner side.

## Insider Advantages and Potential Bias

It must be noted that the author of this paper was employed by Red Hat during the entire course of this research. This insider knowledge presents both opportunities for a deeper understanding of the company context as well as challenges in the form of bias (Van de Ven, 2007).

From an advantages standpoint, the author had virtually unfettered access to senior executives, almost all of whom were reasonably well-known associates. This access, along with a keen understanding of Red Hat's business model and strategy, enabled the author to identify issues and to delve more deeply into those issues than many outside researchers would have been able to. On the other hand, any time a researcher is embedded within an organization for a long period of time, the chance of unintentional bias increases. The author employed several mitigation strategies to account for this potential bias:

1. Using multiple sources of objective data to triangulate and reinforce conclusions that were reached during analysis of the subjective data (Myers, 2009, pp.10-12; Miles & Huberman, 1984, pp. 266-267).

2. Using his dissertation advisor as an independent and unbiased sounding board to validate both data collection and analysis strategies (Yin, 2009, p.72).

3. Reminding each interview participant to attempt to the best of their ability to treat the author as though he was not a Red Hat employee and did not have any prior knowledge (Miles & Huberman, 1984, p. 266).

It is even perhaps worth recounting a small verbal exchange during one of the interviews to illustrate point 3 above:

*Interviewee:   Well, there's other factors, but I think that's probably the catalyst because even when we're engaging with clients we're pulling from different groups behind the scenes and we don't have one story, at least on the delivery side and the selling of services, so it's difficult.*

*Interviewer:   Interesting.*

*Interviewee:   You don't see that?*

*Interviewer:   I'm just a poor college student – a researcher.*

> *Interviewee:* You said, *"Interesting,"* and *you've been totally engaged in all the conversations!*
>
> *Interviewer:* No, I do actually see that. I just wanted you to make that observation rather than me. I can make observations all day long about these things, right? But this isn't about what I think, it's about what everybody here thinks.
>
> *Interviewee:* Oh yeah, right…

## Data Collection

The data for this research consisted of three primary sources: 1) existing employee survey data related to Red Hat culture, values, and employee engagement, 2) semi-structured interviews with key personnel consisting of senior managers and executives with a particular emphasis on those involved with Red Hat's various Cloud Computing initiatives, and 3) a Management Behaviors survey, originally designed by Birkinshaw and Gibson (2004), focused on understanding Red Hat's organizational context.

## Employee Survey

The employee survey data used for this research represents three years of annual surveys from 2009 to 2011, which roughly corresponds to the time period associated with Red Hat's entrance and growth into the Cloud Computing market. This survey was conducted by Red Hat's Human Capital organization and focuses primarily on measuring the degree to which Red Hat's employees a) understand the company's overall strategy, b) desired cultural characteristics are being implemented by the management team, and c) employees are actively engaged in their jobs.

The surveys were conducted via an online survey tool and were targeted at Red Hat's entire employee population. The number of respondents for each survey was 1575 in survey year 2009, 2127 in survey year 2010, and 2322 in survey year 2011. In each year the number of respondents represents more than 50% of the entire employee population. Respondents were asked to evaluate Red Hat by responding to anywhere

from 33 to 46 questions (depending upon the year in question) on the following scale: 1=Very Little/No Extent, 2=Some Extent, 3=Moderate Extent, 4=Great Extent, and 5=Very Great Extent.

## Semi-Structured Interviews

The semi-structured interviews were based upon the primary antecedents of ambidexterity to determine the degree to which ambidexterity was present at Red Hat before Cloud Computing and, perhaps more importantly, the specific forms and characteristics of ambidexterity that were present. The interviews went on to examine how ambidexterity changed at Red Hat during the phase of disruptive innovation presented by Cloud Computing as well as how Red Hat's ambidextrous characteristics influenced the company's response to Cloud Computing. During the course of the interviews the format of the semi-structured interviews changed slightly to allow for deeper understanding of emerging trends and themes (Eisenhardt, 1989).

The main targets for the semi-structured interviews were members of Red Hat's executive team from the Director level to the CEO. A total of twenty-one interviews were conducted with each lasting approximately one hour. The interviews were primarily conducted over the phone with a small number (approximately five) conducted face-to-face. Each interview was recorded in an audio format and then transcribed, resulting in approximately 150,000 words of text. The vast majority of the interviewees were long-term (5+ years) Red Hat employees and thus able to give both an historical perspective as well as a current perspective.

Figure 10 shows the specific individuals and organizations that were selected for interviews highlighted in light red.
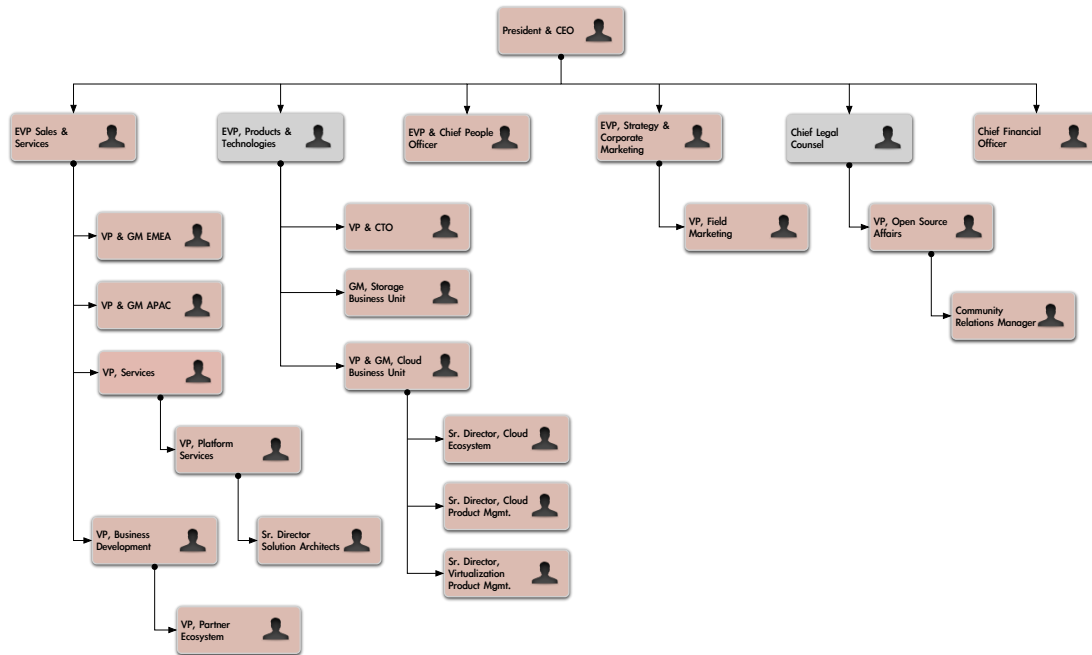
*Figure 10: Interviewees Within Red Hat*

Finally, Table 3 provides a list of each role and the rationale for why they were originally selected for interviews.

| Role Description | Rationale for Selection |
|---|---|
| President & CEO | Given that the President & CEO is ultimately responsible for corporate strategy and execution, interviewing this person was useful to get the "big picture" perspective on OSS, Cloud Computing, and overall marketplace dynamics. |
| Executive VP – Sales & Services | This Executive VP is responsible for the sales, marketing, and services organizations. Interviewing this person helped to understand how Cloud Computing influenced Red Hat's customer-facing strategy with respect to ambidexterity. |
| Executive VP & Chief People Officer | This Executive VP is responsible for traditional human resources functions as well as the employee engagement surveys that were used for this research. Interviewing this person helped to understand how Cloud Computing affected Red Hat's personnel strategy with respect to ambidexterity. |
| Executive VP – Strategy & Corporate Marketing | This Executive VP was recently hired by Red Hat to manage Red Hat's strategic planning process and, on an interim basis, take over corporate marketing functions. Interviewing this person helped to gain an outside perspective on Red Hat's current and future |

| | corporate strategy as well as how Cloud Computing affected Red Hat's corporate marketing activities with respect to ambidexterity. |
|---|---|
| Chief Financial Officer | The CFO is responsible for finance, accounting, investor relations, and Information Technology. Interviewing this person was important to understand how Red Hat allocates resources between exploitative and explorative activities. This person has been with Red Hat for approximately seven and a half years and thus was to give a long-term perspective on how resource allocation processes and activities have changed at Red Hat. |
| VP – Field Marketing | This VP is responsible for all field marketing activities within Red Hat. Interviewing this person was important in understanding how Cloud Computing affected Red Hat's marketing strategy with respect to ambidexterity. This person is also a long-term Red Hat employee, serving in various capacities, so his perspective on how Red Hat has evolved its ambidextrous capabilities was invaluable. |
| VP – Business Development | This VP is responsible for Red Hat's overall partnering strategy. Interviewing this person was important in understanding how Cloud Computing affected Red Hat's interaction with partners with respect to ambidexterity. |
| VP – Partner Ecosystem | This VP is responsible for Red Hat's extended partner ecosystem including venture capital investment functions. Interviewing this person was important in further understanding how Cloud Computing influenced Red Hat's interaction with its partner ecosystem and its investments in other OSS companies. |
| VP – Cloud Business Unit | This VP will perhaps be the most important interviewee of all. This person is ultimately responsible for all Red Hat Cloud products and has worked for the company for many years, previously running the Platform Business Unit. Thus, this person's past, present, and future perspectives on the firm as well as the impact of Cloud Computing with respect to ambidexterity. |
| VP & CTO | The CTO is ultimately responsible for setting the overall long-term technology strategy for the company and is the closest thing Red Hat has to a pure research & development organization. Thus, interviewing this person will be critical in understanding how Red Hat balances exploration vs. exploitation. |
| VP & GM EMEA | This person is responsible for sales, marketing, and services within the Europe, Middle East, and Africa geography and ultimately owns the P&L for that region. Interviewing this person helped to give us a global perspective on changes at Red Hat due to Cloud Computing and how Red Hat has responded to this disruption. |
| VP & GM APAC | This person is responsible for sales, marketing, and services within the Asia-Pacific geography and ultimately owns the P&L for that region. Interviewing this person helped to give us a global perspective on changes at Red Hat due to Cloud Computing and |

| | |
|---|---|
| | how Red Hat has responded to this disruption in the marketplace. |
| VP – Services | This person is responsible for Red Hat's Professional Services organization, which includes Consulting and Training services. Interviewing this person was important to understand how Red Hat's services have changed as a result of Cloud Computing and how those services have influenced the company's response to this disruption in the marketplace. |
| VP – Platform Services | This person is responsible for Red Hat's Platform Services organization, which includes operating system, management, virtualization, and Cloud services. Interviewing this person was important to understand how Red Hat's services have changed as a result of Cloud Computing and how those services have influenced the company's response to this disruption in the marketplace. |
| Senior Director – Solution Architects (North America) | This person is responsible for all of Red Hat's pre-sales technical engineers in North America. This person was important to interview to understand how Red Hat's pre-sales approached has changed as a result of Cloud Computing and how pre-sales activities have influenced the company's response to this disruption in the marketplace. |
| GM – Storage Business Unit | This person is responsible for Red Hat's newly formed Storage Business Unit, which resulted from the acquisition of Gluster. This person was important to interview since Red Hat's main play in storage is focused on "Big Data" in Cloud environments. |
| Director – Cloud Ecosystem | This person is responsible for creating Red Hat's overall cloud partner ecosystem as well as understanding and influencing the company's cloud pricing strategy and modifications to policies and procedures, such as Red Hat' subscription model, as they relate to Cloud Computing. |
| Senior Director – Cloud Product Management | This person is responsible for product requirements definition and marketing for all of Red Hat's Cloud products. Thus, this person was a critical interviewee in order to understand Red Hat's response to Cloud Computing as a marketplace disruptor. |
| Senior Director – Virtualization Product Management | This person is responsible for product requirements definition and marketing for all of Red Hat's virtualization products. Given that virtualization is a fundamental underlying component of Cloud Computing, this person was a critical interviewee in order to understand Red Hat's response to this disruption in the marketplace. |
| VP – Open Source Affairs | This VP is responsible for Red Hat's overall interaction and participation within Open Source Communities. Given that Red Hat's primary R&D model is focused around OSS communities, this person was a critical interviewee. |
| Community Relations Manager | This person is responsible for maintaining relationships with OSS |

| | communities and thus was an important interviewee in order to understand the details of Red Hat's community interaction model. |
|---|---|

*Table 3: Roles Covered In Interviews and Rationale for Selection*

## Management Behaviors Survey

Finally, a Management Behaviors Survey was conducted among the twenty-one interviewees to determine the level of Social Support and the level of Performance Management at Red Hat. The goal of this survey was to understand the organizational context at Red Hat as defined by Birkinshaw & Gibson (2004). Social Support is a measurement that combines two antecedents of Contextual Ambidexterity (Support and Trust) while Performance Management is a measurement that combines the other two antecedents of Contextual Ambidexterity (Stretch and Discipline) (Birkinshaw & Gibson, 2004).

Each respondent was asked to rate the degree to which Red Hat management followed various behaviors on a scale of 1 (being "Not At All") to 7 (being "To A Very Great Extent"). The following management behaviors were surveyed:

**Performance Management Behaviors:**
1. Set challenging and aggressive goals
2. Issue creative challenges to their people instead of narrowly defining tasks
3. Make a point of stretching their people
4. Use business goals and performance measures to run their businesses
5. Hold people accountable for their performances
6. Encourage and reward hard work through incentive compensation

**Social Support Questions:**
1. Devote considerable effort to developing subordinates
2. Push decisions down to the lowest appropriate level

3. Have access to the information they need to make good decisions

4. Quickly replicate best practices across organizational boundaries

5. Treat failure in a good effort as a learning opportunity, not as something to be ashamed of

6. Are willing and able to take prudent risks

Out of the twenty-one original interviewees, nineteen were surveyed (two had left the company between the time of the interviews and the time of the survey) with a total of fourteen responses.

## Data Analysis

### Employee Survey

The employee survey data consisted of between 33 and 46 questions, depending upon the specific year, that were asked to each Red Hat employee. The questions were grouped by the company into five major thematic categories: Strategy, Engagement, Manager, Department Climate, and Red Hat Climate.

Three years of data were analyzed (2009 – 2011) by first mapping specific questions into four main categories representing the four primary antecedents of Contextual Ambidexterity as defined by Gibson and Birkinshaw: Discipline, Stretch, Support, and Trust (Gibson & Birkinshaw, 2004). Individual-level antecedents identified in the extant literature (e.g. Initiative, Cooperation, Relationship Brokering, and Multitasking) were not included in this analysis since the study focused on organizational-level characteristics. Only questions that appeared in all three years of the survey were mapped to antecedents to ensure data consistency from year to year.

To conduct this mapping each question was evaluated to determine how well it fit the definitions of the four antecedents as listed in Table 4 (Gibson & Birkinshaw, 2004).

| Antecedent | Definition |
|---|---|
| **Discipline** | "Induces members to voluntarily strive to meet all expectations generated by their explicit or implicit commitments. Establishment of clear standards of performance and behavior, a system of open, candid, and rapid feedback, and consistency in the application of sanctions contribute to the establishment of discipline." |
| **Stretch** | "An attribute of context that induces members to voluntarily strive for more, rather than less, ambitious objectives. Establishment of a shared ambition, the development of a collective identity, and the ability to give personal meaning to the way in which individuals contribute to the overall purpose of an organization contribute to the establishment of stretch." |
| **Support** | "Induces members to lend assistance and countenance to others. Mechanisms that allow actors to access the resources available to other actors, freedom of initiative at lower levels, and senior functionaries giving priority to providing guidance and help rather than to exercising authority contribute to the establishment of stretch." |
| **Trust** | "An attribute of context that induces members to rely on the commitments of each other. Fairness and equity in a business unit's decision processes, involvement of individuals in decisions and activities affecting them, and staffing positions with people who possess and are seen to possess required capabilities contribute to the establishment of trust." |

*Table 4: Contextual Ambidexterity Antecedent Definitions*

Table 5 shows the specific question to antecedent mappings based upon the aforementioned definitions and pre-conditions.

| Question | Antecedent |
|---|---|
| Where I work, associates are focused on making Red Hat successful. | Discipline |
| Associates at Red Hat take accountability for their work. | Discipline |
| The top performers in my department are recognized for their work. | Discipline |
| The people I work with are passionate about Red Hat's mission. | Stretch |
| People in my department are committed to the strategic direction. | Stretch |
| In Red Hat, departments are working together toward a common goal. | Stretch |
| Associates have a common understanding about what it means to be part of Red Hat. | Stretch |
| Where I work Open Source Principles are supported and encouraged. | Support |
| My manager supports and encourages Collaboration. | Support |
| Departments openly share information with each other. | Support |

| I have positive expectations when I work with associates from other departments. | Support |
| My manager supports and encourages Transparency. | Trust |
| My manager supports and encourages Trust. | Trust |
| My manager supports and encourages Respect. | Trust |
| Red Hat is transparent when it comes to making decisions that affect associates. | Trust |

*Table 5: Question to Antecedent Mappings*

It is worth noting that these question-to-antecedent mappings are necessarily imperfect, as existing survey questions were used rather than creating new survey questions based strictly on the definitions in the extant literature. However, questions were carefully chosen to map to the defined antecedents as closely as possible.

Once the question to antecedent mappings were complete the data was analyzed to determine a) absolute levels of each antecedent present at Red Hat, b) year-over-year changes in specific questions and the level of each antecedent. However, it is worth noting that no formal statistical analyses were performed on the year-over-year changes to each antecedent because the raw survey data was not made available and thus it was impossible to compute the sample variances.

### Semi-Structured Interviews

The semi-structured interview data was analyzed using the following process:

1. Each interview was transcribed within five days of conducting the interview and both the audio and transcripts were entered into NVivo 8.

2. Once the first six interviewers were completed, each transcription was re-read in full while listening to the original audio. Key quotes were extracted during the reading process and general notes were taken on specific points that were raised during the interviews.

3.  Based upon the re-reading of the first six interview transcripts, a first-cycle structural coding scheme was developed based upon key theoretical constructs and the notes that were taken. A structural coding scheme was chosen to reflect the characteristics of this study based upon the following description: "Appropriate for virtually all qualitative studies, but particularly those employing multiple participants, standardized or semi-structured data-gathering protocols, hypothesis testing, or exploratory investigations to gather topics lists or indexes of major categories or themes" (Saldana, 2009, p.66). This first-cycle coding scheme is listed in Table 6.

| Name | Nickname | Description |
|---|---|---|
| Acquisitions | ACQ | Acquisitions that the company has made over the last several years. |
| Acquitision Metrics | ACQ-METRICS | Metrics and valuation models and processes related to acquisitions. |
| Culture | ACQ-CULTURE | Cultural similarities that have arisen between the acquired company and Red Hat. |
| integration | ACQ-INTEG | Integration-related issues as a result of recent acquisitions. |
| | | |
| Ambidexterity | AMB | Characteristics and categorizations of Organizational Ambidexterity |
| Contextual | AMB-CONTEXT | Contextual Ambidexterity characteristics. |
| Discipline | AMB-CONTEXT-DISC | Discipline as defined by Gibson & Birkinshaw, 2004. |
| Stretch | AMB-CONTEXT-STR | Stretch as defined by Gibson & Birkinshaw, 2004. |
| Support | AMB-CONTEXT-SUP | Support as defined by Gibson & Birkinshaw, 2004. |
| Trust | AMB-CONTEXT-TRUST | Trust as defined by Gibson & Birkinshaw, 2004. |
| Structural | AMB-STRUCT | Structual Ambidexterity characteristics. |
| External | AMB-STRUCT-EXTERNAL | Structural ambidexterity implemented outside the organization. |
| Internal | AMB-STRUCT-INTERNAL | Structural ambidexterity within the organization. |
| Role | AMB-STRUCT-ROLE | Role-level splitting, combining, adding, deleting, etc. |
| | | |
| Open Source Values | OSSVAL | Intrinsic cultural values of Open Source communities. |
| Adaptability | OSSVAL-ADAPT | The ability to adapt to changing conditions in technology, the marketplace, etc. |
| Common Purpose | OSSVAL-PURPOSE | Common purpose of a group or team. |
| Freedom | OSSVAL-FREEDOM | Freedom of individuals and groups to pursue new ideas, goals, etc. |
| Global Perspective | OSSVAL-GLOBAL | Taking a global perspective on things. |
| Honesty | OSSVAL-HONESTY | Establishing honesty between community members and the community as a whole. |
| Meritocracy | OSSVAL-MERIT | A system in which the best ideas win rather than personalities, politics, etc. |
| Open Collaboration | OSSVAL-COLLAB | Collaboration between individuals and teams. |
| Open Innovation | OSSVAL-INNOVATION | A model of innovation that emphasizes openness between organizations and projects. |
| Peer-to-Peer Feedback | OSSVAL-PEER | A mechanism by which individuals can give each other feedback on an open basis. |
| Transparency | OSSVAL-TRANSPARENT | Transparency in decision making. |
| Trust | OSSVAL-TRUST | The degree to which trust exists between parties involved in open source projects. |
| | | |
| Resource Allocation | RESOURCE | Allocating resources to existing business functions vs. future business activities. |
| Change | RESOURCE-CHANGE | Changes in resource allocation decisions and processes over the course of this study. |
| Exploitation | RESOURCE-EXPLOIT | Resource allocation decisions focused on exploiting today's business. |
| Exploration | RESOURCE-EXPLORE | Resource allocation decisions based upon exploring new business opportunities. |
| Limitations | RESOURCE-LIMITS | Limitations on the business to pursuue exploration or exploitation. |
| Metrics | RESOURCE-METRICS | Metrics associatedd with making resource allocation decisions. |
| Processes | RESOURCE-PROCESS | Processes by which resource allocations are decided. |

*Table 6: First-Cycle Coding Scheme*

4.  Each of the first six interviews was coded using the first-cycle structural coding theme and additional notes were taken as a result of this coding.

5. The interview format was modified slightly to focus in on specific topics that emerged from the first six interviews and this format was used to conduct the remaining fourteen interviews.

6. The remaining fourteen interviews were then conducted and transcribed within five days of conducting the interview and both the audio and transcripts were entered into NVivo 8.

7. Each of the remaining fourteen interviews was coded using the first-cycle structural coding theme and additional notes were taken as a result of this coding.

8. Based upon the coding and note taking of complete set of interviews, a second-cycle pattern coding scheme was developed. This second-cycle coding scheme was developed in addition to the first-cycle scheme in order to better identify emerging themes across the portfolio of interviews. A pattern coding scheme was chosen based upon the following description: "Appropriate for development of major themes from the data, the search for rules, causes, and explanations in the data, examining social networks and patterns of human relationships, and the formation of theoretical constructs and processes." (Saldana, 2009, p.152). This second-cycle coding scheme is listed in Table 7.

| Name | Nickname | Description |
|---|---|---|
| Emerging Themes | THEMES | Main themes that have emerged as a result of the first-cycle of coding. |
| Ambidexterity Effects | THEMES-AMBIDEX_EFFECTS | Effects of ambidexterity on Red Hat's response to Cloud Computing as a disruptive innovation. |
| Contextual | THEMES-AMBIDEX_EFFECTS-CONTEXT | Effects of contextual ambidexterity on Red Hat's response to Cloud Computing as a disruptor. |
| Structural | THEMES-AMBIDEX_EFFECTS-STRUCT | Effects of structural ambidexterity on Red Hat's response to Cloud Computing as a disruptor. |
| Ambidexterity Implementation | THEMES-AMBIDEX_IMPL | Examples of how Red Hat actually implements ambidexterity. |
| Decision Making | THEMES-AMBIDEX_IMPL-DECISION | Effects of ambidexterity on Red Hat's decision-making. |
| Cloud as a Disruptor | THEMES-CLOUD_DISRUPT | Cloud Computing as a disruptive innovation. |
| Opportunities | THEMES-CLOUD_OPPOR | The opportunities that Cloud Computing represents for Red Hat. |
| Threats from Cloud | THEMES-CLOUD_THREAT | The threats that Cloud Computing represents for Red Hat. |
| Effects of Disruption on Ambidexterity | THEMES-AMBIDEX_DISRUPT | Effects of Cloud Computing on Red Hat's ambidexterity. |
| Contextual | THEMES-AMBIDEX_DISRUPT-CONT | Effects of Cloud Computing on Red Hat's contextual ambidexterity. |
| Structural | THEMES-AMBIDEX_DISRUPT-STRU | Effects of Cloud Computing on Red Hat's structural ambidexterity. |
| Open Source Community Interaction | THEMES-OSS_INTERACTION | Examples of how Red Hat interacts with Open Source communities. |
| OSS Values and Ambidexterity | THEMES-OSS_AMBIDEX_OVERLAP | Evidence of OSS values and antecedents of ambidexterity overlapping. |

*Table 7: Second-Cycle Coding Scheme*

## Management Behaviors Survey

To analyze the data collected from the Management Behaviors Survey an average for each of the Performance Management and Social Support dimensions was calculated based upon the aggregate responses in order to plot Red Hat's overall organizational context on the chart shown in Figure 11 (Birkinshaw & Gibson, 2004).
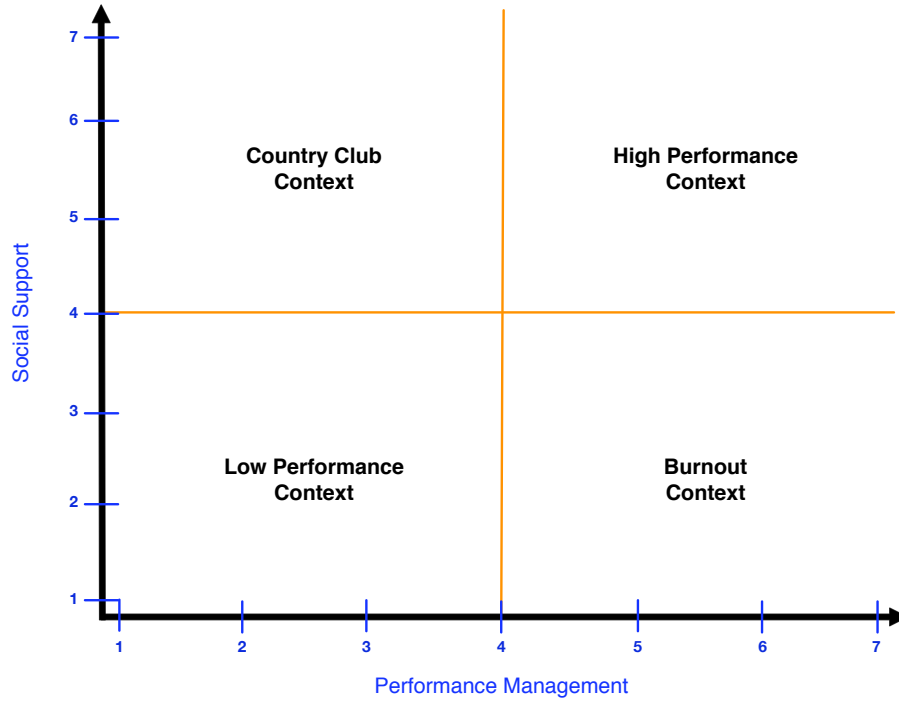
*Figure 11: Organizational Context*

# Results

## Cloud Computing as Disruptive Innovation

Based upon the interviews conducted with Red Hat's executive team it is clear that Cloud Computing represents both a significant threat as well as a significant opportunity for the company. As one of Red Hat's VPs described the situation:

> *"What presents the opportunity, it's still a risk to us, but what presents a big opportunity for share gains is that the elements of lock-in that characterized even new application development in the traditional environment don't exist as strongly in the cloud…That is what presents the opportunity. It's also a threat because they don't need necessarily to have paid Linux. We have to find a way to make people want to pay for us. Those are the real issues."*

> *- VP, Cloud Business Unit*

Several pertinent concerns are brought to light in this commentary. The first is that Cloud Computing, by its very nature, goes against many of the forces of vendor lock-in that have been prevalent in traditional, on-premise computing environments. This represents an opportunity for Red Hat because the company has built a major portion of its value proposition on the concept of openness, thus naturally aligning with Cloud environments and their propensity to enable users to avoid vendor lock-in. On the flip-side, Cloud Computing represents a significant threat to Red Hat's existing business model because virtually all of Red Hat's revenues come from traditional, on-premise environments and with increasing levels of public cloud adoption by customers it is unclear as to whether or not those public cloud providers will find it necessary to implement a paid Linux distribution, such as Red Hat Enterprise Linux. There is the possibility that large public cloud providers may choose to adopt free distributions of Linux for their environments and support those distributions themselves due to the economies of scale inherent in large-scale public cloud environments. If this were to

happen it could have an adverse impact on Red Hat's current, subscription-based business model.

This concern about the possibility of Red Hat being disintermediated by cloud providers and thus, losing the high-touch relationships with its customers that it has built over the course of many years, was echoed in many interviews. One VP likened the threat of disintermediation and changing customer relationships to renting a car:

> *"Think about when you go to rent a car. You're sort of placing your trust in [the car rental company]…that the car's going to get you from the airport to the meeting. You are no longer placing your trust in Ford or whatever kind of car you climb into. So I think that happens – if I'm buying the car myself, then I care a lot about whether I'm buying a car from Ford or Mercedes or whoever. When I get that from someone else, then I don't care as much. It's potentially that way in the cloud as well."*

> *VP, Partner Ecosystem*

In response to the rise of Cloud Computing, Red Hat has made several acquisitions in order to bolster its capabilities in order to meet both the threats and opportunities inherent in this new model of computing. Over the last four years Red Hat has acquired players in the Virtualization (Qumranet), Storage (Gluster), and Platform-as-a-Service (Makara) markets. A quote from Red Hat's Chief Financial Officer underscores the importance of Cloud Computing and the company's acquisition strategy:

> *"We see Cloud computing is a seismic shift really in the way that computing is going to be done, and so the Makara acquisition, I think going back even to the Qumranet acquisition, even though that was virtualization, there was not as*

*much talk about the Cloud then, it was more about virtualization, but clearly*

*without virtualization you couldn't have been in the Cloud phase."*

*- Chief Financial Officer*

Thus it is reasonably clear, based not only on comments from senior executives but corporate actions such as proactive acquisitions, that Red Hat views Cloud Computing as a significant market disruptor.

It can also be argued, in the absence of any concrete financial success metrics pertaining to Cloud Computing (which were unavailable at the time of this study due to the relatively minor impact that clouds have had on Red Hat's financial performance thus far), that Red Hat has been highly successful in creating and implementing a comprehensive strategy to deal with Cloud Computing as a market disruptor. Red Hat has arguably put together the most comprehensive set of cloud-based products and offerings in the entire industry, with the singular exception of Microsoft. No other player, regardless of size or investment wherewithal, has as many parts and pieces of the cloud puzzle as Red Hat does. Again, aside from Microsoft, Red Hat is the only company in the industry with an IaaS management and provisioning solution, a virtualization platform, a cloud-optimized operating system, a full middleware stack, and a PaaS platform. This is particularly remarkable when one considers Red Hat's relatively small size compared with its major competitors in the cloud market. For instance, Microsoft's 2011 annual report shows that its revenues were just shy of $70 billion (Microsoft, 2011). For the same period, Red Hat's revenues were less than *one seventieth* of Microsoft's. For Red Hat to have created a portfolio of cloud-related products and offerings that is comparable to what Microsoft has created is a testament to the company's ability to quickly adapt its strategy and tactics to deal with an emerging market disruption.

## Effects of Cloud Computing on Ambidexterity

## Effects on Contextual Ambidexterity

### *Employee Survey Results*

The results of the employee survey shed light on Red Hat's level of contextual ambidexterity both prior to the advent of Cloud Computing and during the company's transition towards the cloud. Table 8 summarizes the results of the employee survey from 2009 through 2011. The percentages for each question represent the number of respondents who answered with a positive rating for that particular question and each set of questions is grouped according to which contextual ambidexterity antecedent it was mapped into (e.g. Discipline, Stretch, Support, and Trust). The percentages in the column titled "2011 vs. 2009" represent the change in responses from 2009 to 2011 while the column titled "Antecedent Change" represents the change in the mean of the aggregate responses for each antecedent category over the same time period.

| Antecedent | Question | 2009 | 2010 | 2011 | 2011 vs. 2009 | Antecedent Change |
|---|---|---|---|---|---|---|
| **DISCIPLINE** | | | | | | |
| | Where I work, associates are focused on making Red Hat successful. | 76.4% | 80.4% | 83.1% | 6.7% | **4.13%** |
| | Associates at Red Hat take accountability for their work. | 67.7% | 67.7% | 69.8% | 2.1% | |
| | The top performers in my department are recognized for their work. | 62.0% | 61.5% | 65.6% | 3.6% | |
| **STRETCH** | | | | | | |
| | The people I work with are passionate about Red Hat's mission. | 70.3% | 76.1% | 77.8% | 7.5% | **5.15%** |
| | People in my department are committed to the strategic direction. | 78.9% | 80.4% | 81.2% | 2.3% | |
| | In Red Hat, departments are working together toward a common goal. | 50.9% | 52.9% | 53.1% | 2.2% | |
| | Associates have a common understanding about what it means to be part of Red Hat. | 57.3% | 62.8% | 65.9% | 8.6% | |
| **SUPPORT** | | | | | | |
| | Where I work Open Source Principles are supported and encouraged. | 75.2% | 71.3% | 74.3% | -0.9% | **4.30%** |
| | My manager supports and encourages Collaboration | 75.8% | 75.9% | 78.2% | 2.4% | |
| | Departments openly share information with each other. | 36.0% | 40.5% | 43.4% | 7.4% | |
| | I have positive expectations when I work with associates from other departments. | 59.0% | 63.9% | 67.3% | 8.3% | |
| **TRUST** | | | | | | |
| | My manager supports and encourages Transparency | 67.8% | 69.7% | 72.2% | 4.4% | **5.20%** |
| | My manager supports and encourages Trust | 74.9% | 74.9% | 78.7% | 3.8% | |
| | My manager supports and encourages Respect | 78.1% | 78.3% | 81.1% | 3.0% | |
| | Red Hat is transparent when it comes to making decisions that affect associates. | 36.9% | 44.3% | 46.5% | 9.6% | |

*Table 8: Employee Survey Results: 2009 - 2011*

There are several salient points that can be inferred from this data. The first point is that Red Hat, by virtually any objective measure, had a consistently high level of ambidexterity across all four antecedent categories prior to Cloud Computing. If one averages the scores for the questions in each antecedent category for 2009, Red Hat scores a 68.7% in Discipline, 64.4% in Stretch, 61.5% in Support, and 64.4% in Trust. The second point is that Red Hat's level of contextual ambidexterity in each of these categories increased consistently from 2009 to 2011 (shown in the "Antecedent Change" column). Furthermore, these gains were within a range of approximately 1% (4.13% to 5.2%), indicating that the company increased these values across the board. These year-over-year changes are illustrated in Figure 12.
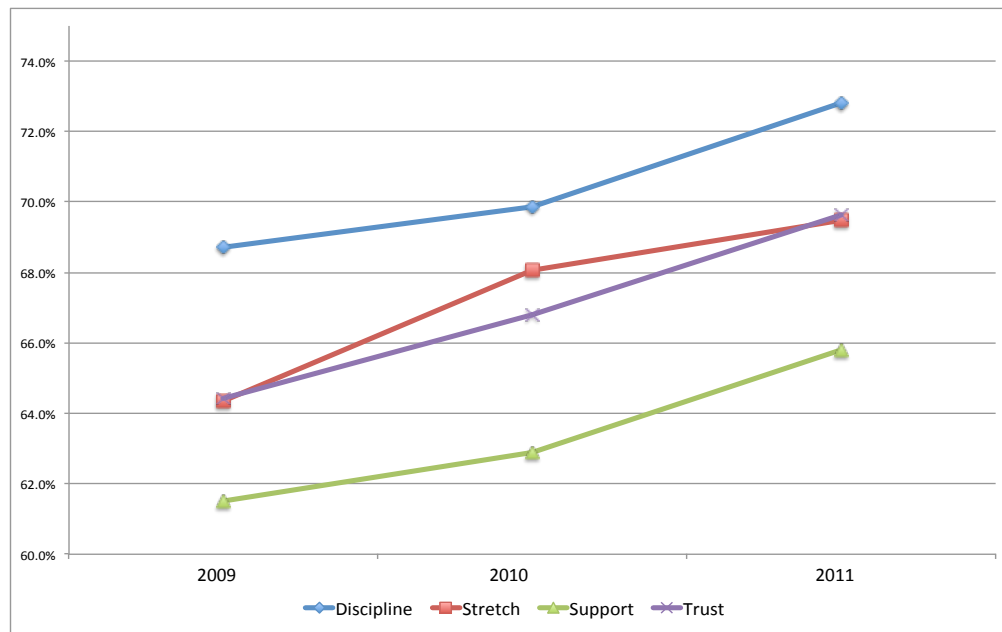
*Figure 12: Year Over Year Changes in Contextual Ambidexterity Antecedents*

What is unclear, however, is what effect Cloud Computing had on these increases in contextual ambidexterity, as there are many confounding factors which must be considered.

The first confounding factor is that Red Hat proactively monitors the results of the employee engagement survey from year-to-year and takes corrective action in areas where it is not performing as well as it could be. As Red Hat's Chief People Officer put it:

> *"So we try to keep our finger on the pulses of people, are we moving engagement in the right direction or at least keeping it flat. We really set a goal of maintaining our level of engagement because with hiring 1,600 people in a year, that's a lot of people. And it's a bit of a concern that we'll be able to onboard them and acculturate them and get them productive fast enough that they would maintain their engagement. They would stay the same level of engagement when measured with everybody else. And so we actually improved that this year,*

*which was a little bit of a surprise, but it's great. We're seeing the correlation between new hires and happiness, so that's good."*

*- Chief People Officer*

Thus, Red Hat's goal was actually to keep the results from the survey from declining primarily due to the fact that Red Hat has grown rapidly in terms of personnel over the time period in question. On one hand, the fact that it was something of a surprise to Red Hat that the results increased, indicates that there may be an external factor such as Cloud Computing at work. On the other hand, the fact that the organization proactively focuses on improving the results could simply mean that the company did better than expected in dealing with scores that were below what the company considered acceptable. Further analysis of the data provides some evidence that the latter situation may be the case as the vast majority of the largest percentage gains were in areas where Red Hat was doing poorly. For instance, if we look at the questions where Red Hat initially (in 2009) scored less than 60% vs. questions where Red Hat scored above 60% initially we find that there is a stark contrast in the average gains. Questions scoring below 60% in 2009 increased by an average of 7.2% by 2011 while questions scoring above 60% in 2009 registered an average gain of only 3.5%, or roughly half the gain of the low-scoring questions. Although one would naturally expect low scores to increase more in absolute terms than scores that were already high, the magnitude of the differential between the increases seem to favor internal factors (e.g. proactive improvement efforts) over external factors (e.g. Cloud Computing) as the primary catalyst for these changes.

The second confounding factor is that the questions selected for mapping into the four antecedent categories were designed by Red Hat's People team with a different explicit purpose than measuring contextual ambidexterity. Thus, the mapping process itself is

necessarily imperfect. Hence, the small changes that were observed may be beyond the error tolerances of the survey instrument given how the data was used.

It is also worth noting that not a single person that was interviewed actually noticed any changes in Red Hat's core values or culture during the time period in question, nor did they believe that Cloud Computing had affected Red Hat's core values or culture. Thus, while there were small increases in the level of antecedents across the board, it is doubtful that they have any practical significance when viewing Red Hat as a whole. As such, it is not unreasonable to conclude that Cloud Computing, as a discrete factor, had little, if any, impact on Red Hat's practical level of contextual ambidexterity from 2009 through 2011.

### *Management Behaviors Survey Results*

The results of the Management Behaviors Survey show that Red Hat is in the "High Performance" organizational context as defined by Birkinshaw & Gibson (2004). Red Hat scored 4.65 on the Social Support index and 5.57 on the Performance Management index. The results of this survey are depicted in Figure 13 with Red Hat's composite score indicated by the red circle, the size of which shows the approximate margin of error for the survey.
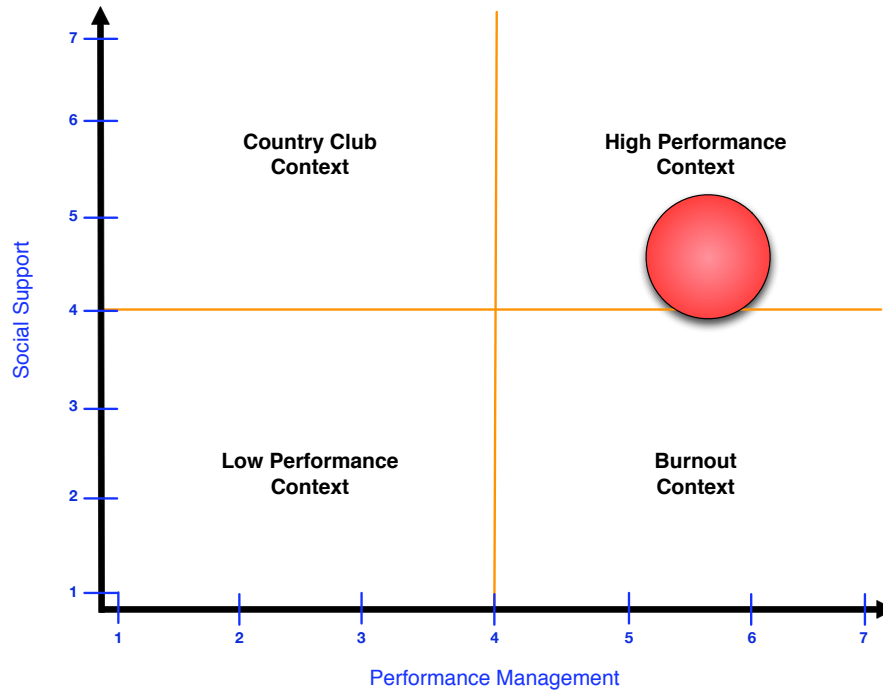
*Figure 13: Results of Management Behaviors Survey*

While these results neither support nor contradict the results of the Employee Survey data with regard to how Cloud Computing has affected Red Hat's level of contextual ambidexterity (since the survey was only conducted after Cloud computing, leaving no baseline for comparison), they do serve to corroborate, at a macro level, the results of the Employee Survey showing that Red Hat is a highly contextually ambidextrous organization. In both the Employee Survey and the Management Behaviors survey Red Hat scored higher in the Performance Management dimension (e.g. Discipline + Stretch) than the Social Support dimension (e.g. Support + Trust). However, it should be noted that the sample size for this survey was very small and thus, the results are subject to a significant margin of error.

At a specific question level this support is more difficult to claim because the characteristics in the Employee Survey do not map cleanly to the questions in the Management Behaviors Survey. One specific characteristic, however, did map

reasonably well: "Departments openly share information with each other" in the Employee Survey mapped to "Quickly replicate best practices across organizational boundaries" in the Management Behaviors Survey. In both cases, out of all of the characteristics measured in both surveys, these were the single lowest-scoring characteristics. While this is a minor piece of evidence it nonetheless further supports the validity of the Employee Survey results.

## Effects on Structural Ambidexterity

In contrast to the limited increase in overall contextual ambidexterity that was observed at Red Hat during its transition to Cloud Computing there was a mix of increases and decreases in structural ambidexterity during the same time period. However, while it was difficult to attribute the increase in contextual ambidexterity to Cloud Computing it is much easier to see this causal relationship with respect to structural ambidexterity.

Please note that the following sections only include organizations within Red Hat that went through relevant changes over the time period in question and do not include administrative functions such as IT, Finance, Accounting, and Legal.

### *Red Hat's Structure Prior to Cloud Computing*

**Product Business Units and Product Engineering**

Prior to Cloud Computing Red Hat's business units (BUs) were divided into three main areas: Platform, Middleware, and Management. All of Red Hat's products fit relatively neatly into each of these BUs and included the following product lines:

- Platform: Red Hat Enterprise Linux (RHEL), Red Hat Cluster Suite (RHCS), Global File System (GFS), and Messaging, Real-Time Kernel, and Grid (MRG).
- Middleware: JBoss Enterprise Application Platform (EAP), JBoss Enterprise Portal, JBoss Business Rules Management System (BRMS), JBoss Service Oriented

Architecture Platform (SOA-P), JBoss Enterprise Data Services (EDS), and JBoss Developer Studio.

- Management: Red Hat Network Satellite, JBoss Operations Network, and Red Hat Identity Management.

The primary responsibilities of each BU were to:

- Analyze market trends and competitive threats related to the various products that the BU was responsible for.
- Manage product feature sets based upon market demands, competitive threats, and customer requirements.
- Drive product-level marketing messages to customers and partners.

Each product BU was managed by a VP and had several Product Managers and Product Marketing Managers reporting into them. Each product BU VP also had a counterpart in the product engineering organization. Product engineering was a completely separate organizational structure, which ultimately reported up to the Chief Technology Officer. Product engineering was structurally similar to the Product BUs and was aligned around the three major product lines (Platform, Middleware, and Management) and also included an "Office of the CTO" which focused on emerging technologies that did not fit cleanly into an existing product BU. Both the Product BUs and the Engineering functions ultimately reported up to the Executive VP of Products and Technologies who, in turn, reported directly to Red Hat's President & CEO. The basic Product BU and Engineering structure at Red Hat prior to Cloud Computing is depicted in Figure 14.
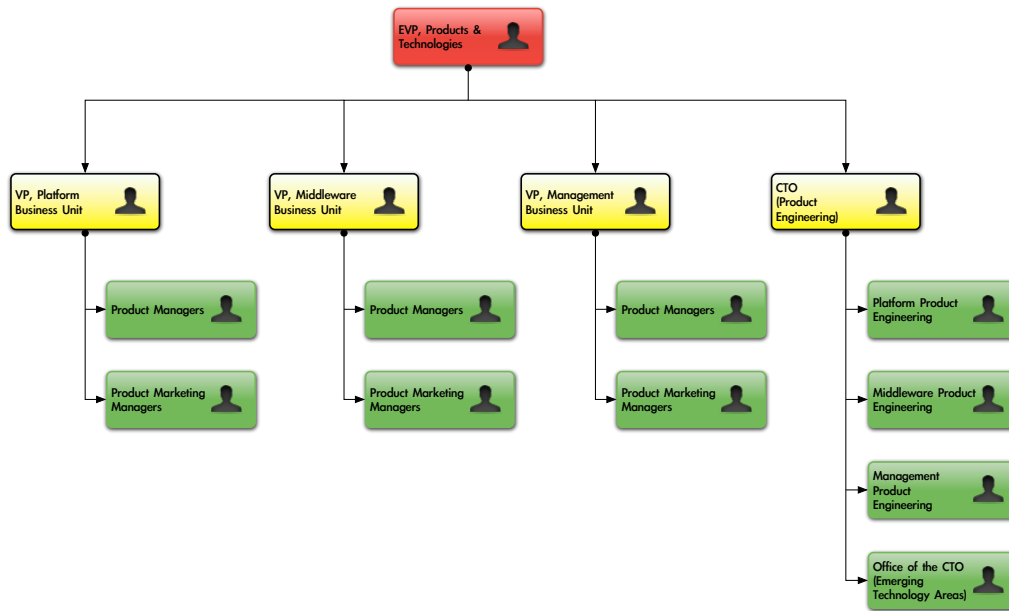
*Figure 14: Product BUs and Engineering Structure Prior to Cloud Computing*

## Sales, Field Marketing, and Professional Services

Prior to Cloud Computing Red Hat's Sales, Field Marketing, and Professional Services organizations rolled up to a single Executive VP. Within North America the Sales, Marketing, and Professional Services functions each had a Vice President who reported directly to this Executive VP while other geographic regions (including Europe-Middle East-Africa (EMEA), Asia-Pacific (APAC), and Latin America (LATAM)) rolled up to a single General Manager per region who then reported directly to the Executive VP of Sales, Marketing, and Services.

Within North America, Field Marketing and Professional Services were each run by a VP who was also responsible for their respective functions in other geographies. However, within the other geographies the VP or Senior Director responsible for Field Marketing or Professional Services reported directly to the regional General Manager and had a dotted-line reporting relationship to the North America / Global VP for Field Marketing or Professional Services.

Unlike other regions the Professional Services organization in North America was split into two service delivery functions: 1) Platform Services, primarily focused on delivering services engagements around products from the Platform and Management BUs, and 2) Application Services, primarily focused on delivery services engagements around products from the Middleware BU. The reason for this split in North America was because of an acquisition of an application services provider (Amentra) in 2008 and, for various reasons, senior management decided to keep the newly acquired company as a wholly-owned subsidiary rather than integrating it directly into the broader services organization.

The overall structure of the Sales, Marketing, and Professional Services organization prior to Cloud Computing is depicted graphically in Figure 15.
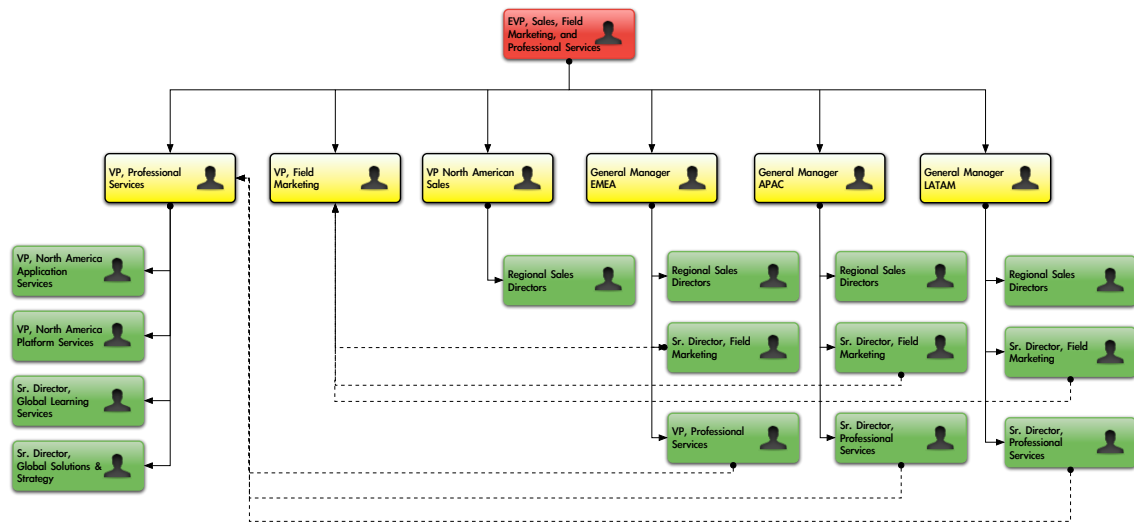


*Figure 15: Sales, Marketing, and Services Structure Prior to Cloud Computing*

## Red Hat's Structure After Cloud Computing

Since the advent of cloud computing at Red Hat, there have been a number of changes to all three types of organizations reviewed in the previous section. Some of these changes have been relatively minor while others have been quite substantial.

### Changes to Product BUs and Product Engineering

Perhaps the most significant organizational change in the Product BUs organization was the creation of a Cloud BU in 2009 designed specifically to address Red Hat's entry into the Cloud Computing space and to create products specifically targeted at cloud customers. This organization was created in place of the existing Management BU, which was eliminated, and the products that the Management BU was responsible for went to the Platform (in the case of Red Hat Network Satellite and Identity Management) and Middleware (in the case of JBoss Operations Network) BUs. This reshuffling of existing products to those two existing BUs is illustrated in Figure 16.
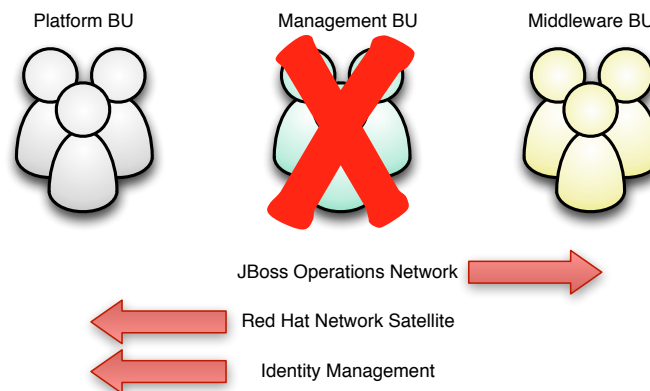


*Figure 16: Existing Product Realignment at Red Hat*

The newly formed Cloud BU took over responsibility for the Red Hat Enterprise Virtualization product due to its fundamental importance in Cloud Computing. The Cloud BU also began development of two new products: 1) CloudForms, a product focused on Infrastructure-as-a-Service management and provisioning, and 2) OpenShift,

a hosted offering focused on the nascent Platform-as-a-Service developer market and based, in part, on technology gained from the acquisition in 2010 of a company called Makara. Red Hat also created a separate Storage BU based upon the acquisition of Gluster, a distributed, cloud-oriented storage technology.

All cloud engineering and product development remained in the engineering organization reporting up through the CTO, but a focused engineering group was created within that organization to concentrate on cloud product development.

By mid-2010 the company was fully engaged around Cloud Computing and moving forward with a clear product direction. In fact, to some within Red Hat it seemed as though the company's focus had perhaps shifted too far toward the cloud:

> *"I saw in the middle of the RHEV cycle that I've been a part of, when there was a lot of 'cloud-mania' going on and everything was Cloud, Cloud, Cloud, I saw the opposite. Everybody forgot about RHEL, forgot which is really about the basic kind of what pays everybody's salaries, right? And, they forgot about RHEV to an extent, which would be the short to medium term kind of future of the company and they focused a lot more than what I thought was appropriate on the Cloud at that time."*

> *- Senior Director, Red Hat Enterprise Virtualization*

The basic structure of Red Hat's Product BUs and Engineering Organization as of March 2012 is depicted in Figure 17.
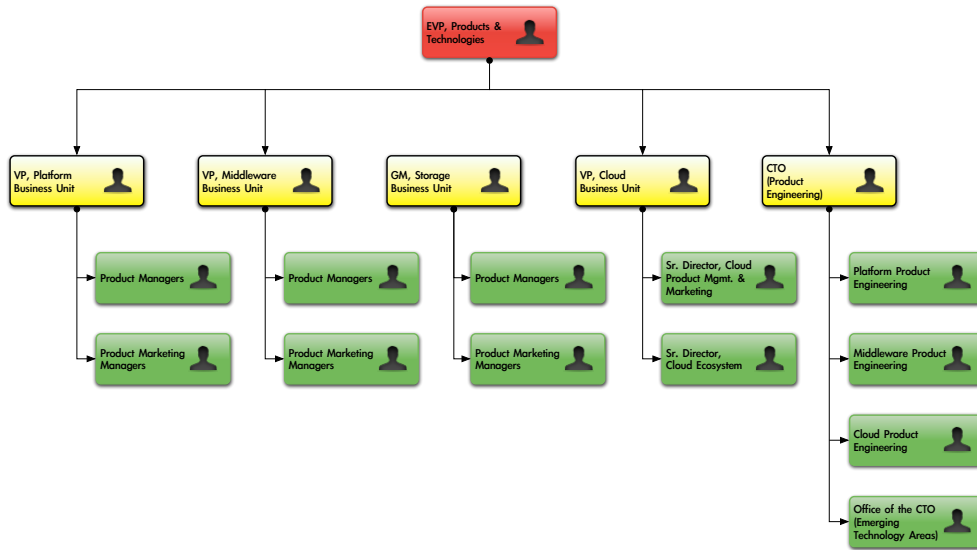
*Figure 17: Product BUs and Engineering Structure After Cloud*

One of the first things one notices is that Red Hat's BU and Engineering structure after Cloud Computing is that it does not conform to O'Reily & Tushman's classic template for structural ambidexterity as shown in Figure 18. In Red Hat's case there is no "Emerging Business" structure and other functions either report into the organizational structure in parallel to the Product BU (as is the case with Product Development and R&D) or in completely separate organizations (as is the case for Sales).
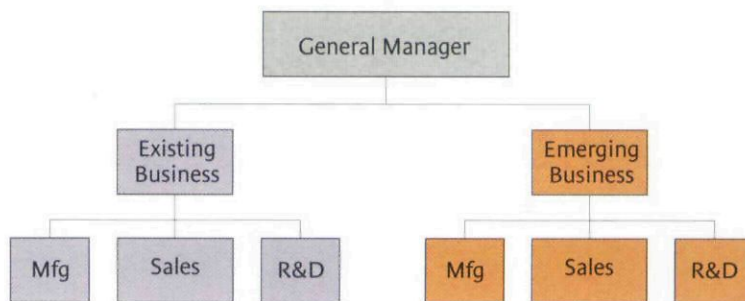


*Figure 18: O'Reily & Tushman's Template for Structural Ambidexterity*

Perhaps more interesting, Red Hat's choice of the person to lead the newly formed Cloud BU was seemingly in contradiction to the conventional wisdom regarding the selection of leaders for emerging BUs in response to disruptive innovation. That is, one should not choose people who have been high-performing managers of "legacy" businesses precisely because they have been so good at doing so in the past. As Clayton Christensen (1997) put it:

> *"But as a general explanation, the managers of the companies studied here had a great track record in understanding customers' future needs, identifying which technologies could best address those needs, and in investing to develop and implement them. It was only when confronted with disruptive technology that they failed. There had, therefore to be a reason why good managers consistently made the wrong decisions when faced with disruptive technological change. The reason is that good management itself was the root cause. Managers played the game the way it was supposed to be played. The very decision-making and resource-allocation processes that are key to the success of established companies are the very processes that reject disruptive technologies." (p.98)*

But this is *precisely* what Red Hat did. Thus, there is a great deal of evidence to support the contention that Red Hat's response to Cloud Computing, at least with regard to its Product BUs and Product Engineering organizations, was not particularly ambidextrous from a structural standpoint and, if anything, almost "anti-ambidextrous".

When comparing Figures 14 and 17 (e.g. Product BU and Engineering organizations before and after cloud) one also cannot help but notice that very little changed at all from a structural perspective. On the surface it would seem that all Red Hat did was replace the Management BU with the Cloud BU, create a new Storage BU based upon an acquisition, and change one of the emphasis areas in product engineering from Management products to Cloud products.

**Changes to Sales & Field Marketing**

There were several small changes to sales and one significant structural change to field marketing during the time period in question. The overall sales structure of the business remained largely the same but the pre-sales organization in North America began to implement an "incubator" model for new technologies such as Cloud Computing. However, the overall structure of the pre-sales organization remained largely constant. Red Hat's Senior Director of Solutions Architects in North America described this shift:

> *"The approach I'm looking at moving forward is really that for some of these new technologies, such as cloud, we start them up almost on an incubator type of approach. From an organizational standpoint, people are still reporting to the same manager and work very closely together. Once it gets to a mature level, and mature being something that I think we define as "we've got enough critical mass in the market, we've got enough technical resources, we've got enough pipeline from a sales standpoint" and other dynamics, we then would spin them out to the regions from the management standpoint."*

> *Senior Director, North American Solutions Architects*

Field Marketing underwent a major structural change prompted, in part, by the departure from Red Hat of the Executive VP of Sales, Field Marketing, and Services during this time period. Field Marketing moved from the Sales, Field Marketing, and Services organization into a newly created Strategy & Corporate Marketing organization, which took over all marketing activities outside of Product BU Marketing. This organizational structure, along with changes to the Professional Services structure, is shown in Figure 19. However, this change appears to be unrelated to Cloud Computing directly and was prompted primarily by the fact that Red Hat's various marketing organizations were somewhat fragmented. As Red Hat's Executive VP of Strategy & Corporate Marketing explained:

*"Marketing was very fractured around the company as far as who's doing what…I'm going through an effort right now to try and clear up responsibility roles and responsibilities in corporate and field marketing. You can ask, 'Who's responsible for social media?' The whole room's going to raise their hand. 'Who's responsible for events?' Everybody raises their hand. 'Who's responsible for sales enablement?' Five people raise their hand. 'Who's responsible for getting campaigns out to the field?' Almost every marketing function you ask, lots of people will raise their hand, and then there's some critical ones where nobody raises their hand."*

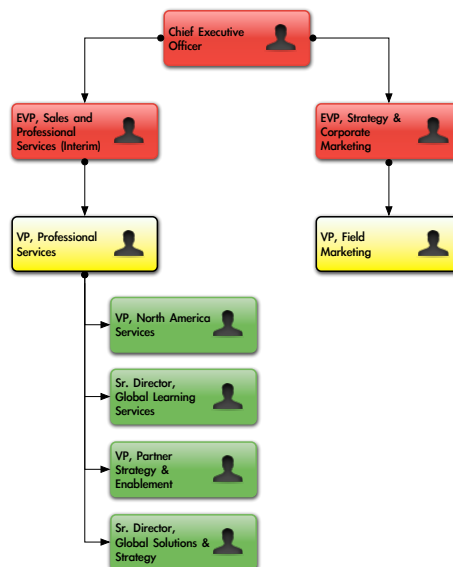*- Executive VP, Strategy & Corporate Marketing*



*Figure 19: Sales, Marketing, and Professional Services Structure After Cloud*

Thus, as was the case with the Product BUs and Product Engineering, Sales and Marketing did not change significantly with regard to structural ambidexterity during Red Hat's transition to Cloud Computing and, other than minor changes in the pre-sales

organization, none of the changes that did occur appear to have directly been the result of Cloud Computing as a disruptor in the marketplace. If anything, functions like marketing moved away from the classic structural ambidexterity template defined by O'Reily and Tushman shown in Figure 19.

## Changes to Professional Services

Like Field Marketing, Red Hat's Professional Services organization went through a significant structural change in North America during this time period that was related, at least in part, to Cloud Computing. The company chose to combine its Application Services and Platform Services organizations into a single consulting entity in North America (shown in Figure 19) partially due to the increasing demands by customers that Red Hat present consolidated solutions around cloud that span multiple product boundaries. The delivery of cloud-based engagements was already becoming a problem because of multiple organizations. As Red Hat's VP of Platform Services explained:

*"I mean, even on our delivery side we've always talked about, 'Oh, what should we do with the multiple organizations?' But then it was really cloud when we started banging heads and trying to work together. There we realized, 'Okay, we've got to change this.'"*

*- VP, Platform Services*

The Professional Services organization also made two additional structural changes, both of which were at least partially related to Cloud Computing. The first change was the creation of a Partner Strategy & Enablement organization focused on enabling partners to deliver services around Red Hat products. The second change was to create a global "Practice Incubation" function within the Solutions & Strategy organization to focus primarily on creating cloud-based consulting solutions for customers. This organization was kept separate from the profit & loss structure of the geographic delivery organizations in order to build critical mass around Cloud Computing due to its

disruptive nature to the professional services market. Red Hat's VP of Global Services explained:

> *"We tried to keep this [Cloud Incubation] function separate from the regional P&Ls, at least at first, because we didn't feel like we could create the right amount of critical mass within each region while still maintaining our focus on high margin levels. So we made an investment at a global level to avoid that potential conflict and create some solutions ahead of market demand…but still based on what we were seeing from our customers."*
>
> *- VP, Global Services*

Thus, on one hand we see some signs of implementing O'Reily and Tushman's prototypical structural ambidexterity model within Professional Services. On the other hand we simultaneously see combinative changes (e.g. combining Application Services and Platform Services in North America) that would seem to go against that model. In either case, however, there is little doubt that many of the structural changes made in Professional Services were at least partially a result of Cloud Computing as a disruptive innovation.

## How Contextual Ambidexterity Affected Responses to Cloud Computing

Both the objective and subjective data that was collected for this study does not easily facilitate an analysis of how structural ambidexterity affected Red Hat's response to Cloud Computing. This is particularly true given how few changes were made to the structure of the organization that can be considered structurally ambidextrous. Therefore, the remainder of the results section will focus on how contextual ambidexterity affected Red Hat's response to Cloud Computing along several dimensions including: Resource Allocation, Research & Development, Decision Making, and Acquisitions.

## Resource Allocation: Part Science, Part Art

At the heart of Organizational Ambidexterity theory is the classic tradeoff between resources to be allocated for exploitative capabilities vs. resources to be allocated for explorative capabilities. It is therefore important to understand how Red Hat allocates resources between exploitation and exploration in order to understand how contextual ambidexterity affected Red Hat's response to Cloud Computing.

Perhaps the most important aspect of Red Hat's decision-making culture when it comes to explorative investments is that the company views it partially as a science and partially as an art form. The "science" part generally focuses on exploitative resource allocation decisions while the more adaptable "art" part primarily focuses on exploratory resource allocation. Together, these different ways of looking at resource allocation give us a glimpse into how Red Hat's contextual ambidexterity affected its response to cloud computing.

Red Hat uses a relatively traditional model for determining the type and extent of investments in its current business. Like many organizations, the company first looks at what it will take to run its existing business and what it will take to make the incremental investments to maintain existing revenues and margins that are inline with investor expectations. Red Hat also makes extensive use of industry benchmarking to ensure that exploitative expenditures are comparable to competitors and other peer groups within the software industry. As the company's Chief Financial Officer explained:

> *"The first thing is to make sure that you have sufficient resources to keep the engine running, so, even before you start thinking about the new businesses you are making sure that you have an idea of what it takes to do the R&D for and what it takes to sell and support your existing business. We do a lot of that through benchmarking and look at other companies in similar sorts of situations and similar sorts of industries. We look at our own past performance and then we*

*also look at productivity measures to figure out how much improvement can we get each year out of productivity. What should we reasonably expect to get from productivity?"*

*- Chief Financial Officer*

In terms of exploratory investments, Red Hat uses fairly traditional financial metrics to determine the overall amount of funding, but the specifics of where to invest appear to be much more loosely defined, rather than a purely scientific endeavor, and focused specifically on achieving the right level of balance between exploration and exploitation. As Red Hat's Chief Technology Officer explained:

*"You know…I don't have a science either, it's more of an art. What I try to do is find the right balance points…I sort of view it as: 'here's the areas that we want to start to evolve in. How quickly do we need to get there?'…It's always a question of should we ever expand out of our core and how far should we expand out of our core?"*

*- Chief Technology Officer*

With regard to Cloud Computing investments, Red Hat's strategy was to be adaptable and forward looking even in light of the prospect of clouds cannibalizing the company's existing, on-premise business. This willingness to make investments in innovations that may one day disrupt the company's current business model is one of the hallmarks of a highly adaptable firm (Christensen & Raynor, 2003) and further serves to corroborate the objective survey results regarding Red Hat's overall level of contextual ambidexterity. Red Hat's CTO went on to explain:

*"So, the cloud model is that there is a disruption of flow. And what I wanted Red Hat to do is, I don't want to be in a position where we're ever dismissive and defensive, right? I think it's a really lousy position to be in. And I saw that with the industry pundits forever: 'Cloud's not secure. Cloud this, Cloud that.' and I'm like, 'That's crazy!' You know, 'Let's not be defensive about it. Let's figure out how to adopt it and drive it and be a leader in it,' right? Even if it disrupts our on premise business because in my mind, over time, those questions will be resolved – security and other things will be resolved. I've always had this view. So we need to invest now so that at the point in time so when the concerns are alleviated we solve a business problem for our customers, even as they move to the Public Cloud."*

*- Chief Technology Officer*

The "science-art" model implemented by Red Hat closely mirrors O'Reilly and Tushman's (1996) conceptualization of a "tight-loose" culture as a key aspect of ambidextrous organizations: "This tight-loose aspect of the culture is crucial for ambidextrous organizations. It is supported by a common vision and by supportive leaders who both encourage the culture and know enough to allow appropriate variations to occur across business units. These companies promote both local autonomy and risk taking and ensure local responsibility and accountability through strong, consistent financial control systems." (p.27).

Thus, we can see that Red Hat used a contextually ambidextrous approach to resource allocation around Cloud Computing by combining traditional resource allocation techniques (e.g. the "science") with a highly adaptable focus on emerging technology spaces (e.g. the "art"), and that this combination significantly affected the way Red Hat responded to Cloud Computing.

## Research & Development: Community R&D

Related to the topic of resource allocation is R&D. To understand the way Red Hat conducts R&D one must first understand the community development model of OSS. Recall that OSS is generally developed through a community-oriented process in which contributors from a wide variety of interests, including individuals, corporations, and governments, participate in jointly developing software around a common area of interest. The results, including the source code, developed from this process are then made available freely not only to active participants in the community but to society in general (Gacek & Arief, 2004; Open Source Definition, 2009).

Red Hat uses this community model as a source for a great deal of what proprietary companies would call "R&D" and this notion of community development is deeply embedded in Red Hat's corporate DNA. Red Hat also uses the community development model as a vetting mechanism to determine which areas to invest more or less in. Red Hat's President & CEO explained:

> *"I think the original [Red Hat] culture came from the open source community. But then secondly, even if it weren't for that culture, by being involved in open source projects, I don't feel I need to be as directive on my R&D spend. Because I believe that the communities in which these guys are operating will direct them to something that's going to be the right technologies."*

> *- President & CEO*

Indeed, the model of community development can, in many ways, be considered a form of both contextual and structural ambidexterity. It is contextual in the sense that it focuses on building and leveraging the social support dimension of contextual ambidexterity (e.g. a combination of Birkinshaw & Gibson's "trust" and "support"

constructs) and structural in the sense that it creates a line of demarcation between exploitative and exploratory functions.

Red Hat also exhibits contextual ambidexterity characteristics from an R&D perspective by giving key individuals the ability to pursue technologies and areas of innovation that may not be aligned with Red Hat's current product strategy. This notion of allowing individuals to strike the right balance between exploitation and exploration is a defining characteristic of contextual ambidexterity (Birkinshaw & Gibson, 2004). A quote from Red Hat's President & CEO gives us an interesting perspective on this idea:

> *"I would say if you actually looked at our numbers, we are – probably two thirds of our R&D is in the core and a third is in random new things. And that set of random new stuff is very, very blurry. I don't know if we're going to commercialize a product on that or not. But I know if we don't muck around a little bit in the space, then we might miss out on something pretty important. But we don't – I don't think we specifically do a "we're allocating this to current and this to new". It's a little more organic than that…We actually rely a lot on the engineers to self-guide…you get a few rock stars who can go do whatever the they want, right? [A particular engineer] messes around with [a community cloud project]. I'm not telling [him] what to do. Nobody's telling [him] what to do – he figures out what to do, and we believe that he has the capacity to do something great."*

> *- President & CEO*

Two additional effects of contextual ambidexterity on Red Hat's response to Cloud Computing were 1) a clear focus on customer needs when evaluating future technology investment areas, and 2) the creation of a "CTO Office" to incubate new technologies that fell outside of the immediate purview of the existing business units. Red Hat's CTO

travels extensively to meet with senior executives at major customers to ensure that the company's future technology direction is aligned with the market:

> *"I feel like I really understand our customers really well. And, I really understand enterprise IT architecture really well. So I spend a lot of time with customers – I travel almost half the time. I was down with [a customer] CTO this week…I spent a day and a half traveling for a one hour meeting…So I meet with enough people in different verticals that I can see if what we're doing resonates and see if we're missing the mark on something and that kind of thing."*
>
> *- Chief Technology Officer*

Among other new technology projects, the CTO Office initially incubated a project called "Libra" that later became OpenShift, which was Red Hat's first truly cloud-focused product. As Red Hat's CTO explained:

> *"The OpenShift team, which was the Libre effort that I announced two years ago, that was just sort of like – I thought I had and it just took me awhile to convince [key individuals] to come over and join. And what they did, I just sort of incubate things in the CTO office…And so now, they're still in the CTO office, but so it's also a good place to sort of shepherd something without using product dollars to do that and then if you fail, you fail - kill it and move on, you know?"*
>
> *- Chief Technology Officer*

Again, we can see aspects of this customer-focused incubation model reflected in O'Reilly and Tushman's description of highly ambidextrous organizations: "These firms also select 'winners' in markets and technologies by staying close to their customers, by

being quick to respond to market signals, and by having clear mechanisms to 'kill' products and projects." (O'Reilly & Tushman, 1996, p.21).

Thus, we can see that the ambidextrous practices of community development and allowing individuals to independently pursue new and innovative technology spaces have not just affected Red Hat's R&D around Cloud Computing, but are part and parcel of how Red Hat approaches innovation in virtually all technology areas.

### Decision-Making: Meritocracy, Not Democracy

One aspect of Red Hat's contextual ambidexterity that one might, at first, view as somewhat non-ambidextrous is the way the company makes decisions. Simply put, decision at Red Hat usually happen very slowly. This is due, in part, to the level of transparency and internal alignment that the company strives to achieve with regard to both its employees and the OSS communities in which in participates. One of the ways this is manifested is the speed with which it brings new products to market. Red Hat was not a first-mover in the Cloud space and both proprietary competitors, such as VMWare, and other OSS-based Cloud projects, such as OpenStack, were significantly earlier to market than Red Hat's own CloudForms product which, indeed, was still in beta testing at the time this study was concluded.

That said, it would be presumptuous to conclude that Red Hat is a "decision-by-committee" culture. In fact, company executives use the phrase "meritocracy, not democracy" to describe the way Red Hat makes important decisions. That is, ideas are sought from employees, partners, and OSS communities and then an open debate occurs in which some ideas rise to the top and others fall by the wayside. At some point during that debate a go-forward strategy is decided upon and, for the most part, this decision is supported by the various constituents who were involved in the open discussion *precisely because they were included in the discussion in the first place*. Although this has the net effect of slowing down decision-making but Red Hat makes up for it in execution speed due to higher levels of internal alignment. One could also argue

that, because it is an open discussion involving many forward-looking minds, Red Hat is presented with a wealth of options that companies who pursue a strategy of rapid decision-making by a small team of executives might not be exposed to. This may ultimately lead Red Hat to making better decisions in the long run. Red Hat's President & CEO summarized these ideas in the following quote:

*"Decision making happens really, really slow here. And the reason as a leader you go through it…is you believe that if you go through that process – and it's not democracy, it's more of a meritocracy. But if you're transparent and respond to people's feedback, in the end when you make that decision, people might not like it, but they feel like they were heard and listened to, and that the decision was rationally made, even if it's above their objections, and it executes so much better."*

*- President & CEO*

Thus, it is not unreasonable to conclude that Red Hat's continual focus on the contextually ambidextrous characteristics of transparency and meritocracy significantly affected the way Red Hat went about making cloud-related decisions.

### Acquisitions: Cultural Compatibility

As previously mentioned, over the course of the last four years Red Hat has acquired three companies related to Cloud Computing. Red Hat's culture of contextual ambidexterity affected these acquisitions in two ways: 1) Red Hat used these acquisitions to further its community participation and interaction and 2) the company was focused on ensuring that the acquisition candidates had a culture similar in nature to Red Hat's overall corporate culture.

With regard to community participation and interaction, one thing that must be understood about acquisitions in the context of an OSS company is that, unlike

proprietary acquisitions where the primary asset being acquired is intellectual property (IP), there is little IP that can be protected in an OSS acquisition due to the nature of the OSS model. Instead, a large part of the value inherent in OSS acquisitions is in the people working at the acquired company and their relationships with various OSS communities. When this is interpreted in the context of organizational ambidexterity we find that Red Hat was able to use its Cloud-related acquisitions as a form of structural ambidexterity. The company was able to bring in new but compatible cultures and then allow them to function in a capacity similar to the prototypical model of structural ambidexterity.

With regard to cultural compatibility, not only does this create fewer integration challenges, it also ensures that Red Hat's ambidextrous culture does not become too diluted from outside influences. Red Hat's General Manager of their Storage BU summed up the company's thinking when it was seeking to acquire Gluster:

> *"It's an interesting story but the founders of Gluster, the guys in the early days, they used to sit and watch Red Hat videos on how to build a company. So fundamentally they believed that open source was the right way to solve the problem…That, in fact, is one of the things that we were extremely interested in and excited about. It wasn't…saying 'well now that you've done this you've got to shift to open source'…it was in the DNA so it made it a lot easier."*

> *- General Manager, Storage BU*

So not only did Red Hat's ambidextrous culture lead it to pursue an acquisition strategy around Cloud Computing in the first place, the desire to maintain and enhance this culture actually influenced the types of organizations that the company considered as acquisition candidates.

# Discussion

## Red Hat's Structural Decisions Through The Lens of Contextual Ambidexterity

When reviewing Red Hat's structural response to Cloud Computing as a disruptive innovation one cannot help but notice that, while the company pursued multiple organizational strategies, very few of them can be considered structurally ambidextrous in the classic sense. Indeed some of the decisions, particularly within the Product BUs, could almost be considered structurally "anti-ambidextrous". That is, instead of the classic approach of splitting emerging technology functions into a separate organization, in many ways Red Hat chose a highly integrative strategy – the exact opposite of what structural ambidexterity theory would suggest. This leaves one with the initially puzzling question of "Why would Red Hat do that?" Why would a company with demonstrably high levels of contextual ambidexterity not only ignore structural ambidexterity but, in many cases, choose a contrarian strategy?

There are three primary explanations to this conundrum: 1) the nature of the disruption itself precluded a structural solution, 2) the fact that Red Hat was already a highly contextually ambidextrous organization led it away from structural ambidexterity as its primary mechanism for dealing with disruptive innovation, and 3) Red Hat had already implemented a structurally ambidextrous solution, albeit an unconventional one. These explanations highlight the real-world interplay between different forms of ambidexterity.

## The Nature of Cloud Computing as an Architectural Innovation

One of Red Hat's ostensible organizational goals with regard to Cloud Computing was to create a BU that focused on bringing multiple technology areas together to meet the disruption in the market. As one Red Hat VP explained it:

> "At least what I understood as the original intent for the Cloud BU was that it would be the all-encompassing BU or the integrator of the other BU's...I think

*that was the original intent. I think we're still challenged, in the sense that we are very product-focused and siloed across the board, and I don't think the structure is completely there, but it's always been clear that the Cloud is the all-encompassing factor…But there's this group over here who owns this product and it maybe should be over in the Cloud BU, or it maybe should be in the Platform BU. So, I don't think we have it right yet, but I think we've made a first attempt."*

*- VP, Platform Services*

Thus, it is not surprising that Red Hat did not choose a classic approach to structural ambidexterity, which involves splitting the emerging business off into its own separate structure, because one of the organizational goals for the newly created BU was to bring previously siloed products and organizations together in an integrative fashion. Given this piece of knowledge, the question then naturally becomes "Why was that an organizational goal for Red Hat with regard to Cloud Computing?"

The answer to that question lies in the nature of Cloud Computing as a disruptive innovation. It is worth recalling that Cloud Computing can primarily be classified as an architectural innovation, as shown in Figure 20. Henderson and Clark (1990) defined Architectural Innovation in the following way:

*"The essence of an Architectural Innovation is the reconfiguration of an established system to link together existing components in a new way…innovations that use many existing core design concepts in a new architecture and that therefore have a more significant impact on the relationships between components than on the technologies of the components themselves." (p.12)*

While Henderson and Clark's definition was focused on the domain of product development within an organization, it is a relatively small intellectual leap to envision how this concept can be scaled up to an entire market ecosystem of products, such as Cloud Computing. Recall that virtually all of the parts and pieces required to implement clouds already existed before Cloud Computing came to the forefront as a marketplace disruptor, including virtualization, high-bandwidth networking, universal network access, high-performance low-cost servers, and distributed management tools.
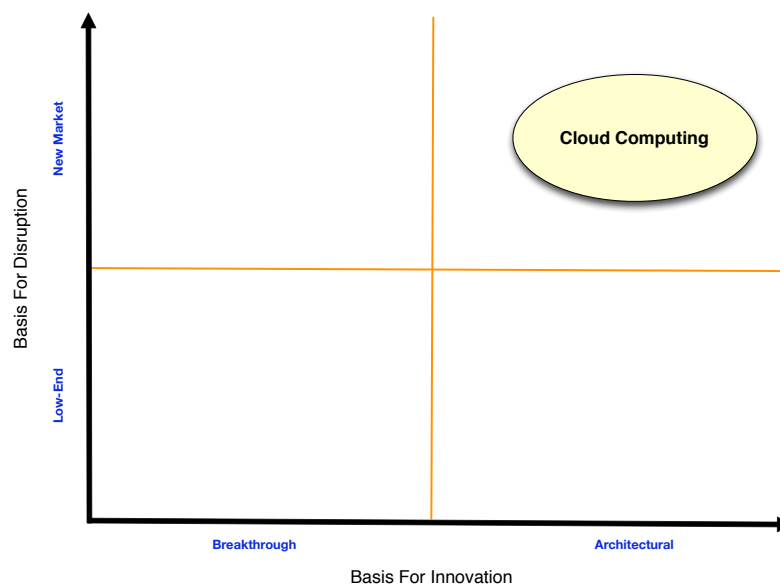


*Figure 20: Cloud Computing as an Architectural Innovation*

Thus, a case can be made that Red Hat pursued a primarily integrative organizational strategy, rather than the classic seperational template for structural ambidexterity, because it had to bring together many parts of the organization and leverage their collective strengths in order to respond effectively to the nature of the disruption. A quote from Red Hat's VP of Global Services explains this rationale:

> *"One of the key reasons that we decided to combine the Platform and Application Consulting organizations in North America was to better serve our*

*customers' needs in the cloud. By their very nature, cloud engagements cut across multiple product lines and our customers expect us to bring an integrated…really, I guess what you would call an 'holistic' perspective to the table when it comes to cloud consulting."*

*- VP, Global Services*

A similar strategy and rationale was also pursued within the BUs organization. In fact, a new organization was created within the Cloud BU, a "Cloud Ecosystem" team, to explicitly deal with the integrative challenges inherent in Cloud Computing. As the Director of Cloud Ecosystem explained:

*"We could have an hour conversation on this, but [my organization is] effectively looking at existing models inside the company that are – that have to be modified to reflect what's happening in the industry. So, we can talk about an embedded program, we can talk about a hosting program, the systems integrator stuff that's been going on, but basically looking cross-company at the programs so that we can actually match what's actually happening in the Cloud space…effectively saying, 'What products do we have today? What is the demand? How would they be consumed?  And how would we provide them under Cloud models for my purposes or Cloud providers to consume, and resell?' But ultimately it's, 'How do we change our business into a Cloud business?' So, effectively saying first 'build a program'. Second is fix the programs that we already have that don't match what's going on in the market, hence the creation of a new program. And then third is fix our products so that they can match the market of the world as well."*

*- Director, Cloud Ecosystem*

The idea of an integrated approach also affected the engineering organization and was echoed by Red Hat's Chief Technology Officer:

> *"The idea of creating the Cloud BU is something that needed to happen. And so then, subsequent to that, I reorganized my engineering organization to map against a cloud engineering organization as well and the reason why is because I wanted to sort of set the model…that cloud is really all about sort of operational management. And it felt to me that it was too narrow. I didn't view, I don't view, Cloud as a silo. So, if it was viewed as a silo, for example, we would just have kept our existing sort of management products, and Satellite, and everything else, and virtualization. And then, we would've added some Cloud products for people that want to do Cloud. But, in my view, and I think the industry's view, is that Cloud's not an alternative product offering. Cloud's an IT architecture and a business model."*

> *- Chief Technology Officer*

This integrative philosophy also helps explain Red Hat's seemingly perplexing choice of who should lead the new Cloud BU. As discussed earlier, conventional wisdom regarding disruptive innovation would indicate that choosing someone to lead the new organization who had been highly successful at leading previous organizations would be a poor choice precisely because of that person's success in the "legacy" business. However, in addition to the aforementioned emphasis on the need to integrate Red Hat's product portfolio to deal with an architectural disruptor, it is worth noting that the company's "legacy" businesses were nothing of the sort in traditional terms. As the VP of the Cloud BU explained:

> *"We talk about our 'legacy' businesses but the fact is that the legacy businesses are growing at rates that are two, three, four times market rates. In fact, what*

*we call legacy businesses, any other company would call high growth businesses.*
*You take our RHEL business or our JBoss business, and you go to an IBM or HP or*
*Dell and they'd say, 'My God, these are fast growth businesses!' If you look at the*
*classic business school matrix, it doesn't fit the definition whatsoever."*

*- VP, Cloud BU*

Therefore, Red Hat was not placing someone in charge of running an emerging disruptive business who had been running a "mature" business but, rather, they were selecting a person who had already been running a high-growth, disruptive business to start with.

Given this evidence, it can be argued that not only would classic Structural Ambidexterity have been a sub-optimal solution for Red Hat in dealing with an architectural disruptive innovation, it may have been the *worst possible solution* because, by its very nature, it focuses on a seperational strategy rather than an integrative strategy - and an integrative strategy is precisely what an organization needs to effectively combine the appropriate parts and pieces to achieve a solution whose value as a disruptor is more than the mere sum of its parts.

## Red Hat as a Highly Contextually Ambidextrous Organization

A second factor that is useful in explaining Red Hat's structural decisions in terms of contextual ambidexterity is that Red Hat, as evidenced in the analysis, was a highly contextually ambidextrous organization prior to the advent of Cloud Computing. Thus, it is not surprising that the company may have favored contextual ambidexterity over structural ambidexterity simply out of a lack of need to have both. While organizations frequently do implement multiple forms of ambidexterity as a way of dealing with disruptive innovation in general, there is little (if any) evidence in the extant literature of firms combining both forms of ambidexterity to deal with the *same* disruptive innovation. This is perhaps due to the fact that contextual ambidexterity, by its very

nature, cuts across the entire organization and implementing an additional form of ambidexterity may simply be redundant. Gibson and Birkinshaw (2006) seem to support the notion that, while different forms of ambidexterity are used within organizations, contextual ambidexterity is more broadly applicable:

> *"These two approaches [structural and contextual] are often used in combination in large organizations. But our expectation is that the more sustainable model is the latter one [contextual], in which essentially every individual has to be aligned and adaptive - that is, they have to be able to deliver value to existing customers in their existing functional area, but at the same time they have to be on the lookout for changes in the task environment, and be prepared to act accordingly. This is a more sustainable model because it facilitates the adaptation of the entire organization, not just the separate unit that is responsible for new business development." (p.6).*

Interview data from Red Hat executives supports the idea that structural ambidexterity was unnecessary due to the high levels of contextual ambidexterity already present within the organization. When asked specifically why Red Hat not chose to create a completely separate organization focused on exploration of Cloud Computing, the company's VP of their Cloud BU replied:

> *"The fact is that [the CTO] and I, we're both very highly motivated to drive the new business. There's no risk of us getting too concerned about the legacy business to do that. In other words, we have a healthy fear of what will happen to our legacy business if we don't pave the new way. Our incentive structures in that regard cause us to, if anything, probably err on the side of pushing for; we recognize the organizational inertia's around the legacy business so our incentives are to counteract that. I think with other people it probably wouldn't*

*work. The two of us are very tightly aligned around that. We have a lot of interest in that. That's how we make it work."*

*- VP, Cloud BU*

## Red Hat's Implementation of External Structural Ambidexterity

A third factor in explaining Red Hat's structural decisions is the fact that Red Hat had already implemented an external form of structural ambidexterity and thus, the classic template for internal ambidexterity was unnecessary. The OSS community development model is predicated on the idea that no single individual or company controls an OSS community. These communities are external to traditional corporate structures and depend upon decentralized governance and coordination of resources to achieve their goals (Markus, 2007; O'Mahony, 2007). Red Hat's VP of Community Relations emphasized the care with which Red Hat interacts with OSS communities from a control standpoint:

*"So in the case of the community, one of the most common ways to destroy or disrupt the community is to try to bring command and control, objective oriented, mission oriented stuff too heavily upon the community from outside. And I think a lot of companies have really mucked up their own community relationships by basically saying, 'okay, we're going to be a company and we're going to create a community which we control'. And I think that Red hat has done a very good job, first by accident and then by design, of not trying to control the community."*

*- VP, Community Relations*

Red Hat participates in OSS communities by contributing resources and source code to them while simultaneously using the results produced by the community and providing packaging and support for them to enterprise customers. Indeed, this is the foundation for Red Hat's entire business model. Thus, one can view Red Hat's participation in OSS communities as a form of structural ambidexterity in the sense that Red Hat uses the communities for exploratory purposes while simultaneously utilizing the results produced by the communities for exploitative purposes, as shown in Figure 21. One might even argue that this idea of "external ambidexterity" is a more rigorous form of structural ambidexterity because not only are the organizational structures highly segregated, the control of the exploration functions are not entirely within the control of the organization as a whole.
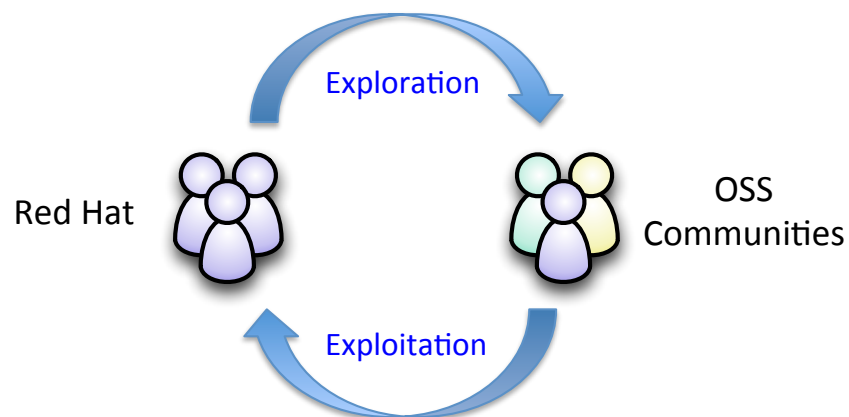


*Figure 21: External Structural Ambidexterity Between Red Hat and OSS Communities*

Red Hat also used its Cloud-related acquisitions to further promote this virtuous cycle by enhancing its access to important communities such as KVM (an OSS virtualization standard) more rapidly than it would have been able to in a purely organic growth model.

Given this external structural separation it is not difficult to see how Red Hat uses this relationship as a form of structural ambidexterity and thus has little, if any, need to pursue a structurally ambidextrous solution internally.

## Open Source as an Enabler of Red Hat's Ambidextrous Capabilities

From its very first days, Red Hat has been a company focused on OSS. This may seem to be primarily a technical or business model distinction between Red Hat and proprietary software companies, but perhaps the most important distinction is actually one of organizational culture. While there is no commonly accepted definition of "Open Source Culture", because such cultures vary widely, there does seem to be several key values that permeate most, if not all, OSS communities. Among these community values, the ones that virtually all interviewees at Red Hat agreed were the most important are: 1) open collaboration, 2) transparent communications, and 3) a meritocracy of ideas. Among others, these values have become key foundational elements of Red Hat's corporate culture.

The link between a broadly accepted corporate culture and organizational ambidexterity is an important one and is highlighted by Tushman and O'Reilly in the following quote:

> *"A common overall culture is the glue that holds these [ambidextrous] companies together. The key in these firms is a reliance on a strong, widely shared corporate culture to promote integration across the company and to encourage identification and sharing of information and resources – something that would never occur without shared values. The culture also provides consistency and promotes trust and predictability." (Tushman & O'Reilly, 1996, p.26)*

Interestingly, this quote not only refers to culture as being a key element of organizational ambidexterity, it also refers to two important aspects of the culture:

"integration across the company" and "sharing of information and resources". These descriptions map well to the aforementioned OSS values of "open collaboration" and "transparency" (respectively) that Red Hat has adopted. Thus, it is not unrealistic to posit that Red Hat's culture of ambidexterity was enabled by these OSS values. Indeed, we found a great deal of support for this notion in the interviews with senior Red Hat executives. As Red Hat's VP of Community Relations explained:

*"I think [OSS Communities] have affected [Red Hat's culture] tremendously. I think we have done a remarkable job. I truly believe, I am surprised, but more importantly, I am really pleasantly surprised that our culture has remained as strong and as coherent as it has. And I do believe that our executives do not disregard or otherwise fail to appreciate how beneficial, how powerful, and how meaningful our community relationship are."*

*VP, Community Relations*

This link between Open Source community values and organizational ambidexterity raises two interesting discussion points. The first is that Red Hat may not have explicitly tried to build an ambidextrous culture but, rather, built its ambidextrous capabilities via an indirect route (e.g. via OSS community participation). This implies that there may be a more general link between the broader concept of Open Innovation (Chesbrough, 2003) and ambidexterity.

The second discussion point centers around how an organization goes about implementing ambidexterity via this indirect route. While a full discussion of the genesis and subsequent reinforcement of Red Hat's culture is beyond the scope of this dissertation, it is worth noting at a high level how Red Hat maintains and reinforces its cultural values. The company does so in four primary ways: 1) rich participation and interaction with OSS communities as part of its day-to-day business activities, 2) hiring

the best and brightest from select OSS communities to bolster its common culture, 3) acquiring OSS companies with an emphasis on cultural compatibility, and 4) a deliberate and constant reinforcement of Red Hat's cultural values by enabling open collaboration, transparent communications, and a meritocracy of ideas, with measurement and feedback mechanisms in place to ensure that the company is moving in the right direction. This model of cultural maintenance and reinforcement is summarized in Figure 22.
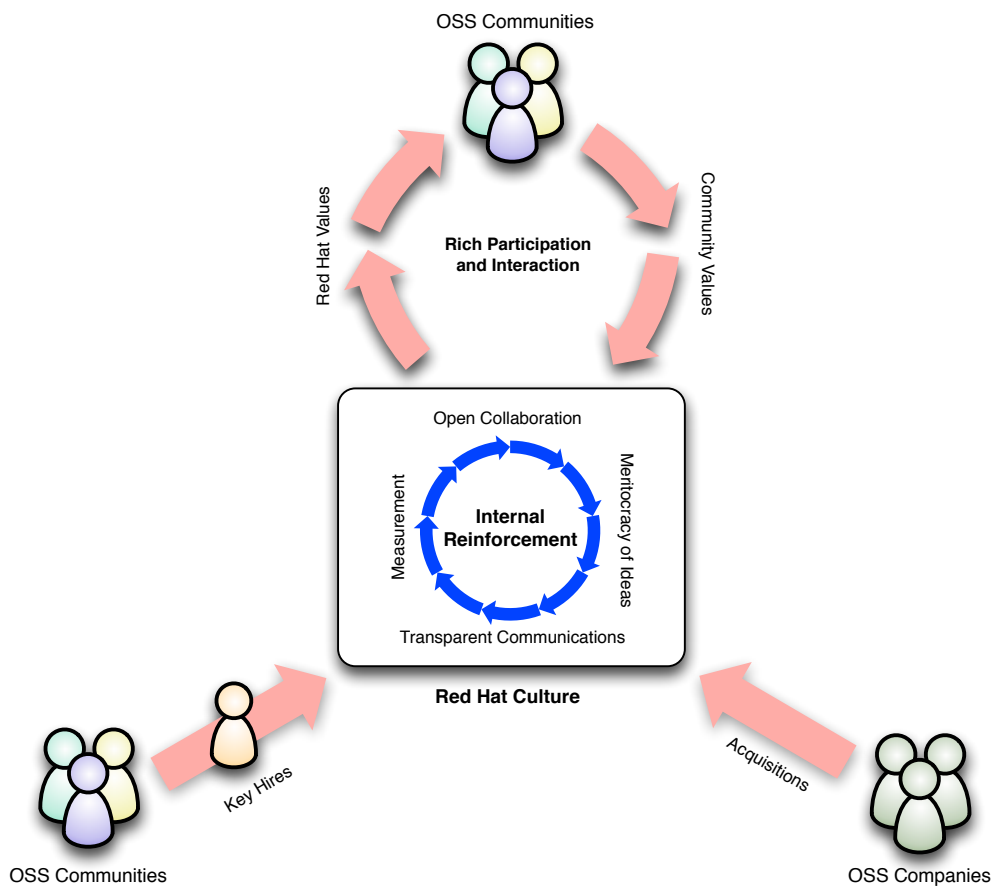


*Figure 22: Building and Reinforcing Ambidextrous Capabilities at Red Hat*

## Implications for Ambidexterity Theory

This study's contributions to ambidexterity theory perhaps lie more in the questions and issues that it raises than the definitive answers that it provides. It does, however, provide early indications and suggests some of the contours upon which the answers may lie. The first question it raises is: "Are certain forms of ambidexterity better suited to dealing with particular types of disruptive innovation?" This topic has not been explored extensively in the extant literature and may be a fertile area for future research. Red Hat's example suggests that the classic form of structural ambidexterity (O'Reily & Tushman, 2004) may not be well suited for dealing with architecturally disruptive innovations.

A related question it raises is: "Are certain forms of ambidexterity more broadly applicable to various types of disruptive innovations than others?" Red Hat's case suggests that contextual ambidexterity may be able to effectively deal with multiple types of disruption, given that the company seems to have been able to apply the contextually ambidextrous characteristics it developed in response to a previous type of disruptive innovation (e.g. a "low-end, breakthrough" innovation in OSS) to a new type of disruptive innovation (e.g. a "new-market, architectural" innovation in Cloud Computing). More research is clearly required to illuminate this topic but the implications for both theory and practice could be significant.

The final question the study raises is "Are there alternative routes for organizations to become ambidextrous?" With some notable exceptions (Napier et. al. 2011; Birkinshaw & Gibson, 2004) the extant literature has focused largely on the reasons for, and effects of, ambidexterity rather than specific routes that organizations may pursue to achieve ambidexterity. Red Hat's example suggests that it may be possible to build an ambidextrous culture by going about it indirectly rather than explicitly focusing on the practical implementation of a theoretical construct. The pursuit of the concept of "Open

Innovation" (Chesbrough, 2003; West & Gallagher, 2006) may indirectly create the necessary antecedents for a contextually ambidextrous culture.

## Implications for Practitioners

The implications of this study for practitioners are related to the study's theoretical implications. With regard to the question "Are certain forms of ambidexterity better suited to dealing with particular types of disruptive innovation?", it may very well be the case that contextual ambidexterity is better suited for architectural innovation than a purely structural approach. Thus, practitioners should carefully analyze the type of disruption they are being confronted with and choose a path to ambidexterity that complements the type of disruption.

With regard to the second question, "Are certain forms of ambidexterity more broadly applicable to various types of disruptive innovations than others?", both academics such, as Birkinshaw and Gibson, and Red Hat's particular example seem to lean towards contextual ambidexterity being more broadly applicable to multiple forms of disruptive innovation than structural ambidexterity. However, it is also likely that contextual ambidexterity takes longer and requires more resources to implement than structural ambidexterity because it requires fundamentally changing and subsequently sustaining an organizational culture. Thus, practitioners may want to consider a long-term strategy of building a contextually ambidextrous culture to protect them from future disruptive innovations, regardless of their type.

Finally, with regard to the third question, "Are there alternative routes for organizations to become ambidextrous?", Red Hat's case would seem to indicate that an indirect route to building ambidexterity via Open Innovation (Chesbrough, 2003) may be a viable option. Open Innovation requires organizations to increase their levels of collaboration and transparency in order to adopt this type of innovation model and those effects may contribute to the organization's overall level of ambidexterity. Thus, practitioners may

want to consider both direct and indirect routes to achieving ambidexterity rather than

depending upon one or the other.

## Conclusion

There are two limitations of this study related to generalizability. As with all case studies, the first involves generalizability to a broader context (Yin, 2009). In this particular case, the ability to generalize to even theoretical propositions may be limited by the fact that the organization being studied has many highly unique organizational and cultural attributes that may not exist in mainstream firms. Thus, given that contextual ambidexterity is predicated largely on cultural aspects, the results of this study may not be easily generalizable to different corporate cultures. The second potential limitation is that it can be argued that Cloud Computing may represent one of the most fundamental paradigm shifts in the history of information technology, rather than just a disruptive idea or technology that only impacts a few key players within an industry. While the jury is certainly still out on this question, it is possible that the magnitude of this paradigm shift may skew the theoretical generalizability of this study's findings. That is, what this study uncovers may only be applicable to large-scale paradigm shifts that affect the very foundations of an industry.

Another potential limitation is that all of the subjective data for this study came from executives within the company, rather than individual contributors or lower-level managers. As a result, the perspective of the study may be biased toward a high-level management view of the world and may not be indicative of the actual situation "on the ground" at Red Hat. The final potential limitation of this study is that it is impossible to definitively determine how successful Red Hat's ambidextrous response was to Cloud Computing because the innovation has not fully played out its course at this point in time. Cloud Computing currently represents a very small percentage of Red Hat's revenue and thus, it is difficult to make any quantitative financial judgments regarding the degree of success or failure in Red Hat's response.

In summary, we have used ambidexterity as a lens to study Red Hat during the company's transition through a disruptive innovation in the form of Cloud Computing.

The study has brought to light a number of interesting insights including: 1) The nature of the disruptive innovation itself shaped Red Hat's organizational response, 2) Red Hat demonstrated a high level of contextual ambidexterity in its response which, in turn, led Red Hat to selectively adopt structural ambidexterity principles, and 3) Red Hat's history as a successful Open Source Software company enabled it to implicitly become ambidextrous by adopting and implementing key Open Source cultural values. These insights may have significant implications for both academics and practitioners alike.

This study is also a good example of the concept of "engaged scholarship". Recall that engaged scholarship is "a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems" (Van de Ven, 2007, p.9). This study brought together concepts from both the academic and practitioner spheres of knowledge in order to better understand a complex, multi-faceted problem in a novel way. It is difficult to envision a scenario where one or the other spheres of knowledge alone would have been sufficient to investigate Red Hat's foray into Cloud Computing with the same level of depth and clarity that a truly engaged scholarship model allowed.

# References

Andriopoulos, C. and Lewis, M. (2009) "Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation" <u>Organization Science</u> 20(4):696-717

Baregheh, et al. (2009) "Towards a multidisciplinary definition of innovation." <u>Management Decision</u> 47(8): 1323-1339

Birkinshaw, J. and Gibson, C. (2002) "Contextual Determinants of Organizational Ambidexterity" <u>Center for Effective Organizations</u>

Birkinshaw, J. and Gibson, C. (2004) "Building Ambidexterity Into an Organization." <u>MIT Sloan Management Review</u> 47-55

Carr, N. (2009) "The Big Switch: Rewiring The World, From Edison to Google" WW Norton & Company, New York

Chesbrough, H. (2003) "Open Innovation: The New Imperative for Creating and Profiting from Technology" Harvard Business School Press, Cambridge, MA.

Christensen, C. (1997) "The Innovator's Dilemma" Harvard Business School Press, Cambridge, MA.

Christensen, C. and Overdorf, M. (2000) "Meeting the Challenge of Disruptive Innovation" <u>Harvard Business Review</u> March-April: 67-76

Christensen, C. and Raynor, M. (2003) "The Innovator's Solution: Creating and Sustaining Successful Growth" Harvard Business School Press, Boston, MA.

Dawson, P. and Bittman, T. (2008) "Virtualization Changes Virtually Everything" Gartner Research Report G00156488.

Eisenhardt, K. (1989) "Building Theories From Case Study Research" <u>The Academy of Management Review</u> 14(4): 532-550

Free Software Foundation (2011) "Licenses" http://www.gnu.org/licenses/index_html *(Retrieved August 6th, 2011)*

Gacek, C. and Arief, B. (2004) "The Many Meanings of Open Source." <u>IEEE Software</u> 21(1): 34+.

Gibson, C. and Birkinshaw, J. (2004) "The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity" <u>Academy of Management Journal</u> 47(2): 209-226

Gross, A. and Herrmann, T. (2007) "History of Lasers" <u>World Journal of Urology</u> 25(3): 217-220

He, Z. and Wong, P. (2004). "Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis." <u>Organization Science</u> 15(4): 47-55

Henderson, R. and Clark, K. (1990) "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms" Administrative Science Quarterly 35(1): 9-30

Hewlett Packard (2011) "About HP Labs" http://www.hpl.hp.com/about/ *(accessed August 13th, 2011)*

Holt A. et al. (2011) "Cloud Computing Takes Off: Market Set to Boom as Migration Accelerates" Morgan Stanley Blue Paper

Gartner Group (2001) "IT Spending: Its History and Future" http://www.gartner.com/4_decision_tools/measurement/measure_it_articles/july01/mit_spending_history1.html *(Accessed Aug 5th, 2011)*

Red Hat (2011) "Red Hat History" http://www.redhat.com/about/companyprofile/history/ *(Accessed Aug 6th, 2011)*

Koberg, C.S., Detienne, D.R., and Heppard, K.A. (2003) "An empirical Test of Environmental, Organizational, and Process Factors Affecting Incremental and Radical Innovation." The Journal of High Technology Management Research 14 (1): 21–45.

March, J. (1991) "Exploration and Exploitation in Organizational Learning" Organization Science 2(1): 71-87

McDermott, C.M. and O'Connor, G.C. (2002) "Managing radical innovation: an overview of emergent strategy issue". The Journal of Product Innovation Management 19(6): 424–438

Mell, P., and Grance, T. (2011) "The NIST Definition of Cloud Computing (Draft)" National Institute of Standards and Technology Special Publication 800-145 (Draft)

Microsoft (2011) "Microsoft Corporation 2011 Annual Report – Financial Highlights" http://www.microsoft.com/investor/reports/ar11/financial_highlights/index.html (*Accessed Mar 17th, 2012*).

Markus, M.L. (2007) "The Governance of Free/Open Source Software Projects: Monolithic, Multidimensional, or Configurational?" Journal of Management and Governance, 11(2), 151-163.

Miles, M. & Huberman, M. (1984) "A Handbook of Qualitative Analysis" Sage, Newbury Park, CA

Myers, M. (2009) "Qualitative Research in Business & Management" Sage, Thousand Oaks, CA

Napier, N., Mathiassen, L., and Robey, D. (2011) "Building contextual ambidexterity in a software company to improve firm-level coordination" European Journal of Information Systems 2011(20): 674–690

Open Source Initiative, 2010, "Open Source Definition: Version 1.9" http://www.opensource.org/osd.html *(Accessed Nov 21st, 2010)*

O'Mahony, S. (2007) "The Governance of Open Source Initiatives: What Does It Mean To Be Community Managed?" Journal of Management and Governance, 11(2), 139-150.

O'Reilly, C. and Tushman, M. (2004) "The Ambidextrous Organization" Harvard Business review April, 2004

O'Reilly, C. and Tushman, M. (2007) "Ambidexterity as a Dynamic Capability: Resolving the Innovator's Dilemma" Stanford Research Paper Series Paper #1963

Raisch, S. and Birkinshaw, J. (2008) "Organizational Ambidexterity: Antecedents, Outcomes, and Moderators" Journal of Management 34(3): 375-409

Raisch, S. et al. (2009) "Organizational Ambidexterity: Balancing Exploitation and Exploration for Sustained Performance" Organization Science 20(4): 685-695

Rosenberg J. and Mateos, A. (2011) "The Cloud at Your Service: the when, how, and why of enterprise cloud computing" Greenwich, CT: Manning

Saldana, J. (2009) "The Coding Manual for Qualitative Researchers". Sage, Thousand Oaks, CA

Tushman, M. and Anderson, P. (1986) "Technological Discontinuities and Organizational Environments" Administrative Science Quarterly 31(3): 439-465

Van de Ven, A. (1986) "Central Problems in the Management of Innovation" Management Science 32(5): 590-607

Van de Ven, A. (2007) "Engaged Scholarship: A Guide for Organizational and Social Research" Oxford University Press, New York, NY.

Van Kooten, M. (2010) "Top 100 Largest Software Companies In The US" http://www.softwaretop100.org/top-100-largest-software-companies-in-the-us (Accessed Nov 21st, 2010)

Voas, J. and Zhang, J. (2009) "Cloud Computing: New Wine or Just a New Bottle?" IT Professional 11(2): 17-17

Watson, R. et al. (2008) "The Business of Open Source." Communications of the ACM 51(4): 41-46

West, J. and Gallagher, S., "Challenges of open innovation: the paradox of firm investment in open-source software" (2006). SJSU ScholarWorks Faculty Publications. Paper 3.

Yin, R. (2009) "Case Study Research Design and Methods". Sage, Thousand Oaks, CA

# Vita

**Summary**

Alex Heublein is the Senior Director of Solutions and Strategy for Red Hat Services. He is responsible for the technology vision and strategy for the business unit as well as a portfolio of productized service offerings focused on solving complex business and IT challenges.

**Experience**

Alex has over twenty years of experience in the IT industry encompassing a wide variety of roles including senior management, strategic technology and business consulting, enterprise architecture, and mission critical solution architecture, design, & development.

Prior to joining Red Hat, Alex was an HP Distinguished Technologist and the Chief Technologist for HP's Consulting & Integration business unit. Prior to HP, he served as the Director of Application Services for IBM Global Services in North America, and the Chief Technologist for Enterpulse, an IT professional services company focused on enabling customers to build and connect to B2B marketplaces. Additionally, Alex has held several management and technology roles at a number of other corporations.

**Education**

Alex holds a Bachelor of Science degree in Computer Science and a Master of Business Administration (MBA) degree, both from the Georgia Institute of Technology. Alex has also done post-graduate work in Computer Science at the Southern Polytechnic State University and holds advanced entrepreneurship and management certificates from the Instituto Tecnológico de Buenos Aires in Argentina and the Institut Commercial de Nancy in France.