Automation in the Cloud

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Abstract

Automation in the cloud is becoming a major part of the IT world as we know it. These services are rapidly expanding around the globe and encompass many applications that we use daily. It is beginning to require teams of administrators to spend hours upon hours and costing companies thousands of dollars to make even simple changes.

We can solve these issues using Chef. Chef can assist administrators in everything they do. Even daily tasks such as making templated servers or more complicated tasks such as making global changes to their systems. Chef automation can make all tasks as simple as a few clicks of a mouse. Our Chef Server will contain all the base configurations for all the servers. We have written automated tasks that take configuration changes that have been through our testing environment. They are verified as working and applied to the servers in the cluster.

Introduction

Chef is “Infrastructure as Code” it allows servers to be coded to spec and be dynamically changed as needed. Consider that if you have 100 web servers in the VMware or Amazon cloud and you need to change or update just a few items on them, well instead of taking a team and going to each server and doing your upgrades you can change your Chef “Recipe” and tell all the servers to update from that and you are done. This would save IT organizations 1,000’s of dollars in time (Navin Sabharwal, Manak Wadhwa). This is all done through Java or Ruby code depending on which version of Chef you use (open source or paid solution). There is also a lot of automation that can be done but this is all customized code that needs to be written. Many industry leading companies such as Facebook and GE have already almost fully adopted it into their infrastructures. The remainder of this final report outlines in detail how the project was completed. The report includes the following sections: Project objectives, Timeline, User profile, Budget, as well as our Testing Data and our Testing Plan.

Project Objective

Our project is all about Automation in the Cloud. We want to make the administrator’s job easier managing big clusters and environments that are in the cloud. We want to make our environment as production like as possible. We have purchased several bare bones systems that will consist of two VMware ESXi hosts and a Dell SAN that will be our production machines. These will be connected through a SAN Router then to a Cisco Catalyst switch and ASA Firewall that we will write our own configurations for.

We will then have a 3rd physical server that will be another ESXi host that will contain the Chef Server and a Primary DC and DNS. This will have access to the San that will hold all the Recipes for all the Server Configurations. The SAN will have code base for a basic Web Application and the two physical ESXi hosts will have approximately 10 web servers that will be load balanced behind a single DNS address. When users hit the DNS they should be sent to any one of 10 servers.

Our Network and Production Servers will contain a production area as well as a Dev/Testing area. These servers will sit on the same physical machines (due to cost/hardware limitations) but have their own VM's but will be completely segregated from the production network through access lists within the Cisco router. The Dev Code will also be segregated from the production code on the SAN and put on their own disks.

The SAN will have three areas that are all configured in RAID 6 to ensure data retention and the possibility of drive failures. We would have gone with RAID 10 but due to hardware/cost limitations RAID 6 will be sufficient. The three areas will be Chef's Configurations, Production Code, and Dev Code.

Our Chef Server will contain all the base configurations for all the servers and we will deploy all servers in this manner and Chef will manage and monitor them all. We will then write automated tasks that will take configuration changes that have been put through our testing environment and verified working and apply them to the servers that are in the cluster. These servers will dynamically be downed depending on how many total servers that are in the environment. Once these servers have been redeployed and backed up, and tested to prove that they are again functioning, then it will move on the next set of servers and repeat all the tasks until all servers have been updated appropriately.

	Task Mode	Task Name	Work	Duration	Start	Finish
1		Managing the Cloud	150 hrs	112 days	Mon 8/24/15	Mon 4/18/16
2		week 1 - Introduction to Senior design	10 hrs	5 days	Mon 8/24/15	Fri 8/28/15
3		Week 2 - Team Building/ Contracts Method	10 hrs	5 days	Mon 8/31/15	Fri 9/4/15
4		Week 3 - UC Offices Closed for Labor Day	10 hrs	5 days	Mon 9/7/15	Fri 9/11/15
5		Week 4 - Project Managment	10 hrs	5 days	Mon 9/14/15	Fri 9/18/15
6		Week 5 - Innovation/ Our Project	10 hrs	5 days	Mon 9/21/15	Fri 9/25/15
7		Week 6 - Elevator Speech	10 hrs	5 days	Mon 9/28/15	Fri 10/2/15
8		Week 7 - Testing Quality	10 hrs	5 days	Mon 10/5/15	Fri 10/9/15
9		Week 8 - Discuss Draft Report	10 hrs	5 days	Mon 10/12/15	Fri 10/16/15
10		Week 9 - No Class	10 hrs	5 days	Mon 10/19/15	Fri 10/23/15
11		Week 10 - Catch up	10 hrs	5 days	Mon 10/26/15	Fri 10/30/15
12		Week 11 - Prepare for Fall Presentations	10 hrs	5 days	Mon 11/2/15	Fri 11/6/15
13		Week 12 - Discuss Project Plans	10 hrs	5 days	Mon 11/9/15	Fri 11/13/15
14		Week 13 - 15 - Presenations	10 hrs	5 days	Mon 11/16/15	Fri 11/20/15
15		Week 16 - Winter Break/Review	10 hrs	5 days	Mon 12/7/15	Fri 12/11/15

Figure 1. Listed above is our grant chart for the first 16 weeks of our project.

	Task Name	Work	Duratio	Start	Finish
1	Managing the cloud	150 hrs	75 days	Mon 1/11/16	Fri 4/22/16
2	Week 1 - Review server and Chef upgrades from Christmas break	10 hrs	5 days	Mon 1/11/16	Fri 1/15/16
3	Week 2 – UC Offices Closed for Martin Luther King Day. Continue to research Chef and applications.	10 hrs	5 days	Mon 1/18/16	Fri 1/22/16
4	Week 3 – Collect Test Data and Test what we have so far. This will include testing of Server connectivity, operation of Chef code, testing code to make sure everything is as it should be.	10 hrs	5 days	Mon 1/25/16	Fri 1/29/16
5	Week 4 – no class, professional dress pictures. We will continue to work on testing and refine our testing plan. We will also get ready for week 5 deliverables.	10 hrs	5 days	Mon 2/1/16	Fri 2/5/16
6	Week 5 – We will provide our deliverable presentation for this semester as well as our testing plan.	10 hrs	5 days	Mon 2/8/16	Fri 2/12/16
7	Week 6 – We will continue to work on our deliverables for the semester, we will also have our final abstract due as well.	10 hrs	5 days	Mon 2/15/16	Fri 2/19/16
8	Week 7 – Continue to work with Chef code. We will be working on our Final paper and start prepping our Tech Expo posters.	10 hrs	5 days	Mon 2/22/16	Fri 2/26/16
9	Week 8 –Continue to put finishing touches on our servers and Chef code. We continue to work on our final paper as well as out Tech Expo posters.	10 hrs	5 days	Mon 2/29/16	Fri 3/4/16
10	Week 9 – We will have our draft Tech Expo poster, draft paper and draft report finished and ready for review. We will also be preparing for our Final presentation as well.	10 hrs	5 days	Mon 3/7/16	Fri 3/11/16
11	Week 10 - Final presentations. Review what our weakest points are and try to prepare for them at Tech Expo and examine feedback from professors and peers.	10 hrs	5 days	Mon 3/14/16	Fri 3/18/16
12	Week 11 – Spring break. UC will be closed, we will be working on our project trying to finish up loose ends and work on our weak points.	10 hrs	5 days	Mon 3/21/16	Fri 3/25/16
13	Week 12 – Final presentations. We will continue to work on our Expo poster as well as finish up our final paper.	10 hrs	5 days	Mon 3/28/16	Fri 4/1/16
14	Week 13 – Final presentations. Continue to tie up any loose ends with Expo poster. Take final paper to the writing center to check. We will also submit our final paper to safe assign to check for plagiarism.	10 hrs	5 days	Mon 4/4/16	Fri 4/8/16
15	Week 14 – We will use this time for anything related to Tech Expo.	10 hrs	5 days	Mon 4/11/16	Fri 4/15/16
16	Week 15 – Discuss Tech Expo and make any final changes to our paper from feedback that we received from Tech Expo.	10 hrs	5 days	Mon 4/18/16	Fri 4/22/16

Figure 2. Listed above is our grant chart for the Last 16 weeks of our project

User Profile

Our user profile will consist of System Administrators. They should be experienced in using VMware, VCenter, VSphere, and configuring and managing server OS's. The administrators should be familiar with User Interface tools associated with virtual environments. Any Virtual environment experience will be a plus as well as knowledge of scripting language. Task experience that will be required is basic knowledge in server OS's, experience in server configuration and knowledge of VM infrastructure management consoles. System Administrators will use this application daily, as they will use this for most of their tasks.

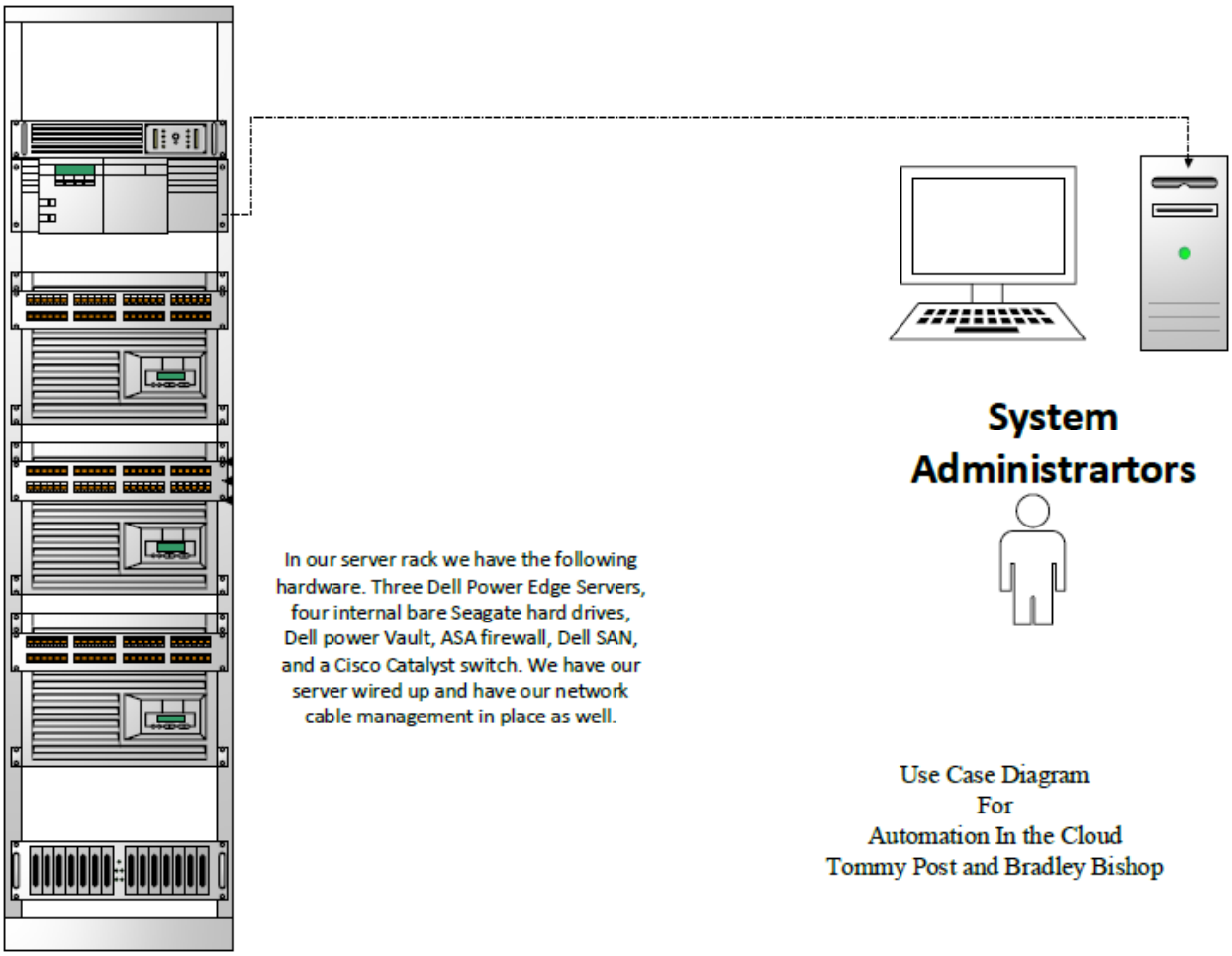


Figure 3. Listed above is an example of what a user setup will look like.

Proposed Budget

The total cost of this project will be around $3,300. The budget will be shared equally by the project team. The Server rack will be located at Bradley Bishop's house; all hardware will be delivered to his home as well. We both decided that to best achieve and demonstrate what our project is capable of, this was the proper way to go. Below is a list of some of our main components that will be used for this project. There are many other smaller pieces of hardware that are not listed. All prices include shipping costs as well.

1. **TWO** - DELL Power Edge R710 6 Bay Server 2.26Ghz E5520 Quad Core 24GB 1
PSU PERC 6/I 1 Year Warranty Included
MAX Processors: 2 / Installed Memory Size: 24GB
PRICE: $1,035.00
2. **FOUR** - Internal Bare Drive Seagate Savvio 10K.4 600 GB 10000RPM SAS 6Gb/
S 16MB Cache 2.5 Inch
PRICE: $359.64
3. **ONE** - Dell Power Vault 220S, 3TB 10 x 300GB @ 10K, 2 x PSU, 2 x SCSI
Controllers
ONE - Dell 91PJX Rapid Rails for Powervault PV200s PV210s PV221s PV220s
PRICE: $364.29
4. **ONE** -Tripp Lite SR4POST1224 45U 4Post Open Frame Rack Cabinet Threaded 12-24
Mounting Holes
PRICE: $374.49
5. **ONE** - DELL - SLIM READY RAILS STATIC RAILS (UNIVERSAL 2-POST/4-POST MOUNTING) FOR 1U SYSTEMS POWEREDGE R210 R310 R410 R415

6. **TWO** - DELL - 2U SLIDING READY RAIL KIT FOR POWEREDGE R710 NX3000 (M997J).
PRICE: $245.00

Figure 4. Listed above are some of our main costs for our project. There are many smaller pieces that are not listed due to space limitations.

RAM was $237.11; due to space issues I did not list their exact names. There are many smaller items as well that are not listed, but what you see above are the main physical items that make our project possible. We can connect to our server from anywhere as well from a Cisco Any Connect VPN Client, $250.00.

Testing

Overview

This section of our report will explain how we tested our core components of our project. Our Chef Server, VMware vSphere, Chef Management and Cisco AnyConnect are used heavily in our project and consisted of most of our testing. The users who will use this guide are stated as follows:

- System Administrators
- Developers
- Software Quality Assurance users

Scope

The scope of our testing is to test the functionality and reliability of the Cisco AnyConnect VPN, Chef Management software, and creating Virtual Machines within VMware vSphere. The tests are based on usability, reliability and functionality.

Objective

Our objective of testing is to verify that the user can connect to the VPN using Cisco AnyConnect, the user can create Cookbook Recipes in Chef, and the user can create new Virtual Machines within vSphere. Our test will then confirm that the recipes that the user created are able to be seen with the Chef Management website.

Entry and Exit Criteria

Entry Criteria:

- Create username and password for user/s
- Test that user/s are able to access all environments
- Self-test

Exit Criteria:

- Complete all tests
- Document bugs/errors that are found and then fix

Log testing and Reporting

If an error occurs while testing it will be documented. If it is a fatal error then trouble shooting will start immediately. While testing, if the test does not return what is expected then the issue will be looked into further. In the event that the error or bug is catastrophic to the point of system wide failure revert back to SnapShots to recover. Documentation will then be recorded from what may have caused the issue.

Testing Procedures

Our testing consists of the following:

- Create a test plan based on the scenario at hand
- Create a test document of the steps that you (the user) used to get your test results
- If any errors are found during development/testing phase they should be document in the report.

Pass/fail

All tests must pass. If there is an error or bug that is found it will be documented and fixed depending on urgency

Testing Plan

#1 Testing functionality and access of Cisco AnyConnect to our servers.

1. The system should allow access to authorized users.

- **1.a.** Username is your name. Password has to be 8 characters long with lower case, upper case, numbers and at least one special character allowed.
- **1.b.** Password will not appear on the screen, as in the key strokes you enter will appear as a bullet point
- **1.c.** An unauthorized user will not be able to connect to the VPN.
- **1.d.** Error message will appear if you do not have correct access to the VPN.

2. Accessing Cisco AnyConnect Secure Mobility Client

- **2.a.** User must have Cisco AnyConnect Secure Mobility Client on their machine in order to access the servers.
- **2.b.** open up the Cisco AnyConnect VPN client  icon.
- **2.c.** Input desired IP address, clink connect.
- **2.d.** Select connect Anyway if a security warning pops up about an untrusted server certificate.
- **2.e.** Select the group if possible, input user name, and then input your password.
- **2.f.** After clicking "connect" you will now be connected. Notice how the icon has changed  showing that it is now connected.
- **2.g.** To disconnect simply click on the  icon and select disconnect to leave the network.

#2 Testing functionality and accessing Chef Server.

1. Once you have signed into the VPN, you will need to access https://chef.bradtommy.com/login to log into the chef server.

- **1.a.** Username and password will be created by a system/Chef admin. Enter username and password and then click sign in.

- **1.b.** You should be at the Chef main screen. Nodes, Reports, Policy and Administration should be present at the top of the screen.
- **1.c.** at this point you will not have any Chef recipes. Check the "Edit Run List" on the left hand side. You should see your current chef recipes, it should be blank.
- **1.d.** Once you have created a recipe you will need to check to make sure that your Chef recipes have successfully been added to the Chef Management page. In order to do this check the "Edit Run List" on the left hand side. You should now see your current chef recipes.
- **1.e.** to see the content of your recipes select: policy, then your cookbook recipe, then at the bottom of the page select recipes. You can then select a recipe you have created to see what is inside (content).

#3 Testing of creation of new VM with WordPress installed using automated script

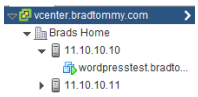
1. Once you have signed into the VPN, you will need to access the following IP address 11.10.10.12, this will allow access VMware vSphere.

- **1.a.** Select "log in to vSphere Web Client" and enter your username and Password.
- **1.b.** An unauthorized user will not be able to gain access to vCenter
- **1.c.** Once you in vSphere Web Client, on the left hand side select "hosts and Clusters". You should then see the following picture.

Under server 11.10.10.10 there is no VM's currently.

2. Accessing the Chef Server to create a new VM using the automated script.

- **2.a.** While still connect to the VPN, open up a Putty session. Icon should look like this  .
- **2.b.** Once Putty is open input the Chef server IP address – 11.10.10.19
- **2.c.** An unauthorized user will not be able to gain access to the Chef Server
- **2.d.** Chef Server will then be connected and will be asking for a username and password.
- **2.e.** In Chef Server access the file by following: **"cd/root/vagrant/webserver/**"
- **2.f.** You should be in the webserver file. Run the following to create a new VM. **"vagrant up - -provider=vsphere"** After 5 to 10 minutes the job will be completed. You can now see the new VM in vSphere as well as in the Chef Management console.



Now under 11.10.10.10 you can see the new VM.

#4 Testing WordPress site after creation of VM via the automated script.

1. Once the new VM is created test the IP address. WordPress setup should appear.

- **1.a**. Go to vSphere and select the new VM. Notice the IP address for the VM. See picture below.

- **1.b.** Take that IP address and input it into an internet Browser. WordPress should appear at the setup menu.

Conclusion

Chef is a very powerful tool that has real world application for all types of businesses. Chef lets us easily deploy and manage our VM's within our vCenter environment, Chef's built in vSphere plug-in also lets us integrate with ease into our existing vSphere installation as well. Using Chef greatly reduces cost and can increase productivity by being able to clone, delete, and manage all within vCenter. As companies look for ways to save money while also trying to increase production Chef could be the answer that they seek.

Setting up our network infrastructure and servers was a challenge, but it was a challenge that we knew how to handle. Chef is a technology that neither team member had ever experienced before. We are very excited to see how far we have come in understanding all the great potential of Chef and the work that can be accomplished using it.

Tech Expo Post and Feedback about our project

Tech Expo was a great experience. I was pretty skeptical at first about the whole process, from teachers saying it will be fun to the fact that I would be talking to people all day, but it was fun! Bradley and I did a very good job at talking to multiple people all day, from the high school students all the way up to the technical judges, everyone could hear and see what we had accomplished. Our project won the award from CBST in Networking/Infrastructure and we couldn't have been more excited. We put in many hours and long nights to make our project what it is and it was a pretty good feeling seeing it pay off.

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Appendix

Test Report

Cisco AnyConnect test report #1 - 1

Test report for testing basic functions of logging into our servers.

Functional Requirements: Have an active user account.

Tester:	Item #	Input	Expected output	Actual output	Pass/ Fail	Reason for pass/fail	Date	Actions to fix issue
System admin	1.a.	username	Input correct username	Username is accepted	pass	Correct username	12/7/15	None
System admin	1.b.	password	Password comes up in bullet points	Bullet points appear when password is entered	pass	Correct password	12/7/15	None
System admin	1.c.	Username & password	Input wrong username & or password	Login failed message should appear	pass	Wrong username & or password	12/7/15	None
System admin	1.d.	Username & password	Input username & or password	Login failed message should appear	pass	Not an authorized user	12/7/15	None

Table 1 - 1: Cisco AnyConnect Test Report #1

Cisco AnyConnect test report #1 - 2

Test report for testing Connection to selected IP.

Functional Requirements: have Cisco AnyConnect installed on your machine and active user account.

Tester:	Item #	Input	Expected output	Actual output	Pass/ Fail	Reason for pass/fail	Date	Actions to fix issue
System Admin	2.a.	Download or select Cisco AnyConnect	Cisco AnyConnect opens when selected	AnyConnect opened as expected	pass	AnyConnect installed successfully and opened	12/7/15	None
System Admin	2.b.	Select Cisco AnyConnect	Open when selected	Opened as expected	pass	AnyConnect opened successfully	12/7/15	None
System Admin	2.c.	Input desired IP address, select connect	Cisco AnyConnect will contact IP	IP is contacted successfully	pass	IP address and AnyConnect connected	12/7/15	None
System Admin	2.d.	Make sure you are connecting to correct server.	Security warning should appear if it is not a trusted server	Warning appears as expected.	pass	It is our direct server that we know we are accessing	12/7/15	None
System Admin	2.e.	input Group, username, password	Group, username, and password are correctly input	Group, username, and password are correct	pass	Correct group, username and password	12/7/15	None
System Admin	2.f.	Select connect after inputting information	Connected to Cisco AnyConnect	Connected to Cisco AnyConnect	pass	Icon shows connected link, successfully accessed the network	12/7/15	None
System Admin	2.g.	Click on AnyConnect icon, select disconnect	Disconnected from the IP's network	Disconnected from network	pass	Connection show's and says disconnected	12/7/15	None

Table 1 - 2: Cisco AnyConnect Test Report #2

Chef access and functionally test report. #2

Test report for logging into users Chef Management account.

Functional Requirements: Have active user account access to the Chef Management Console, active user account access to vSphere, and active user account for Chef Server.

Tester:	Item #	Input	Expected output	Actual output	Pass /Fail	Reason for pass/fail	Date	Actions to fix issue
System Admin	1.a.	input username and password	Signed in	Signed into Chef Management	Pass	Username and password are authorized	12/21/15	None
System Admin	1.b.	Check functionally of Chef site	Successfully navigate and check options on site	Successfully navigate site	Pass	Website is running successfully	12/21/15	None
System Admin	1.c.	Check Chef "Edit run list"	The list should appear and be blank	The list was blank, as expected	Pass	There were currently no recipes listed.	12/21/15	None
System Admin	1.d.	Check Chef "Edit run list"	The list should appear and be populated with your recipes that you created	The list will now show the Chef recipes that you have created	Pass	Once you have created a Chef recipe, it will populate the list	12/28/15	None
System Admin	1.e.	Checking script code in the web interface	You will be able to see the exact script/code in the web interface	I was able to view my script/code from the Chef recipe I wrote	Pass	Code from Chef updated successfully to the web interface	12/28/15	None

Table 2: Chef Access and Functionally Test Report

vSphere login test report #3 - 1

Test report for vSphere login

Functional Requirements: Active user account for vSphere/vCenter.

Tester:	Item #	Input	Expected output	Actual output	Pass/ Fail	Reason for pass/fail	Date	Actions to fix issue
Developer	1.a.	Input username and password	Active username and password allow user to access vSphere	Signed into vSphere without any issue	Pass	User is active in AD and meets the correct requirements for name and password	3/5/2016	None
Developer	1.b.	Input wrong username and password	Unauthorized user will not have access to vSphere	Unable to sign into vSphere	Pass	User does not have access, therefore no access is given	3/5/2016	None
Developer	1.c.	Access vSphere, select/click on “hosts and Clusters”	You should see “Brads home” and below that the IP of the Chef Server. There should be no VM’s at this point	Saw the correct IP address for the Chef server. No VM’s were present at this point	Pass	No command has been given to create a new VM. Until we give the command a new VM will not be created	3/5/2016	None

Table 3 – 1: vSphere login Test Report #1

Creating a Virtual Machine with automated script test report #3 - 2

Test report for Script Automation

Functional Requirements: Active user account for Chef Server, Chef Management and vSphere/vCenter.

Tester:	Item #	Input	Expected output	Actual output	Pass/ Fail	Reason for pass/fail	Date	Actions to fix issue
Developer	2.a.	Open up a Putty session	A new Putty session should be open	New Putty session is open	pass	Putty is installed and works	3/5/ 2016	None
Developer	2.b.	In the Putty session, enter the IP address 11.10.10. 19	Connect to Chef Server	Chef Server opens and asks for username and password	Pass	Chef Server is configured correctly. It should ask for username and password by default	3/5/ 2016	None
Developer	2.c.	Input unauthori zed user	User will not be able to access Chef Server	Unauthori zed user is not able to access the Chef Server	Pass	User was not authorized to access the Chef Server, therefore it passed	3/5/ 2016	None
Developer	2.d.	Input active user	Active user should be able to log into the Chef Server and make changes	User is accepted and is able to make changes in the Chef Server	Pass	User has been authorized to access the Chef Server and has permissions to make changes.	3/5/ 2016	None

Developer	2.e.	input the following to get to the correct file **"cd/root/ vagrant/ webserve r/"**	You should now be in the correct file in order to create a new VM	File has been created and user has rights to access and modify the file	Pass	File has been created in order to create the VM. The user has been given access and modify rights to the file	3/5/ 2016	None
Developer	2.f.	User should now be in the webserver file. Run the following command to create a new VM: **"vagrant up - - provider =vsphere "**	Input the comman d. It will take anywher e from 5 to 10 minutes to create the new machine	New VM is created. You can see the new machine in vSphere and as well as Chef Managem ent console	Pass	User has access to create new VM's with the Chef server. The VM was created because of the automated script that was ran	3/5/ 2016	None

Table 3 – 2: Creating a Virtual Machine with automated script Test Report

WordPress Test Report #4

Test report for WordPress functionality

Functional Requirements: Have WordPress installed on newly created VM.

Tester:	**Item #**	**Input**	**Expected output**	**Actual output**	**Pass /Fail**	**Reason for pass/fail**	**Date**	**Actions to fix issue**
System Admin	1.a.	Look for new IP address	Find new VM IP address	IP address is found	Pass	New VM was created	3/5/ 2016	None
System Admin	1.b.	Input IP address into web browser	WordPress setup menu appears	WordPress setup menu appears	Pass	WordPress was created successfully	3/5/ 2016	None

Table 4: WordPress Test Report