

Implementation of Warehouse Management Through Cloud Computing

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Abstract

Cloud computing is the capability to provide computing capabilities over the internet to comfort the day to day use of some application. This capability is provided by various cloud service providers like Salesforce, Amazon Web Services, etc. Warehouse Management System (WMS) is a necessary requirement of all industries today and requires an easy to handle mechanism that can be accessible by anyone at any time and any place. Management of the warehouse can be easily simplified and automated with the help of an appropriate application hosted over cloud.

Keywords: Cloud computing, Warehouse Management System, WMS

I. INTRODUCTION

A Warehouse Management System (WMS) is a software application specializing in supporting the day to day operations within a warehouse. The application does this by allowing the users to have a centralized system where different warehouse tasks are managed through an interface on a handheld device or a tablet working in the warehouse or a desktop in the office.

Handling and storing materials in warehouse management system is termed as material handling. It is defined as the movement of materials (raw materials, scrap, semi- finished and finished products) to, through, and from productive processes; in warehouses and storage; and in receiving and shipping areas [2]. Material handling concerns material flow and warehousing [3].

A distribution warehouse is a warehouse in which products from different suppliers are collected (and sometimes assembled) for delivery to a number of customers. A production warehouse is used for the storage of raw materials, semi-finished products and finished products in a production facility. A contract warehouse is a facility that performs the warehousing operation on behalf of one or more customers.

Warehouses face various challenges such as supply chains are becoming more unified and shorter, globalized operations are adopting new methodologies and innovative strategies such as Warehouse Management System.

A warehouse management system or WMS primarily aims to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving, put-away and picking [1]. A warehouse management system is a database driven computer application, to improve the efficiency of the warehouse by directing cutaways and to maintain accurate inventory by recording warehouse transactions [1].

In this paper, we aim to utilize web based cloud computing infrastructure and its computing architecture as it provides flexibility, security, auto-updating, disaster recovery, capital-expenditure free, ability to work from anywhere, document control, to enhance the computing properties of warehouse management system (WMS) designed for mobile applications and to contrast the superiority of cloud services over virtualization.

Cloud computing is a computing paradigm, where a large pool of systems are connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly. Cloud computing refers to the many different types of services and applications being delivered in the internet cloud, and the fact that, in many cases, the devices used to access these services and applications do not require any special applications.

The cloud model deployed has the capability to run in both private or hybrid mode. This is because the WMS created can be easily molded to any mode as per the user requirement with the help of cloud service provider chosen (SalesForce is used in this paper). A private cloud is owned by a single organization. Private clouds enable an organization to use cloud computing technology as a means of centralizing access to IT resources by different parts, locations, or departments of the organization. When a private cloud exists as a controlled environment, the problems described in the Risks and Challenges section do not tend to apply. Private cloud computing comes equipped with a customizable and thorough firewall and a plethora of security tools which ensure maximum protection against unauthorized use, hacking and other such malicious attempts. [5]

For the purpose of the development of the desired application, we needed to develop a hybrid cloud which follows the property of both public and private cloud. Non-critical activities are performed using public cloud while the critical activities are performed using private cloud. Hybrid architecture requires both on-premises resources and off-site (remote) server.

Cloud computing service used for the scope of this paper is Platform as a Service (PaaS). It is the capability provided to the consumer to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Cloud Computing might be one of the most overused buzzwords in the tech industry, often thrown around as an umbrella term for a wide array of different platforms, services, and systems. Thus, this has led to many misassumptions regarding these two technologies. They are different in many means though, we can say that they do share some similarities.

II. CLOUD VS. VIRTUALIZATION

In regards of this paper, we have emphasized use of cloud services over virtualization services for easier warehouse management system. In reality, both technologies can be executed for making this system but, both have their pros and cons.

The best way to explain the difference between virtualization and cloud computing is to say that the former is a technology, while the latter is a service whose foundation is formed by said technology. The term cloud computing then is best used to refer to a situation in which shared computing resources, software, or data are delivered as a service and on-demand through the Internet.

Transactions in high rate may require high performance requirements. It is evident that virtualization does create a performance issue which however, it is very low. So, when handling millions of transactions, a performance delay of even one millisecond can become a big issue. Thus, even in such cases cloud computing is much more prominently used as compared to virtualization.

Another important note is that the overall expenditure required establishing a virtualization based warehouse management is increased greatly because of all the hardware expenditure which is required to maintain virtually dedicated servers. This cost is greatly reduced by cloud services specially, because of the general “pay as you go” feature provided by cloud based services.

We will be now putting forward all other benefits of the underlying technologies to clear out their respective usage.

Table – 1

Comparison between cloud and virtualization

<i>Properties</i>	<i>Cloud computing</i>	<i>Virtualization</i>
<i>Customize features in reference to performing a specific task</i>	<i>x</i>	<i>✓</i>
<i>Ability to run legacy applications</i>	<i>x</i>	<i>✓</i>
<i>Automated management</i>	<i>✓</i>	<i>x</i>
<i>Support parallel workloads</i>	<i>✓</i>	<i>x</i>
<i>Flexibility of capacity on demand.</i>	<i>✓</i>	<i>x</i>
<i>Management of dynamic workload</i>	<i>✓</i>	<i>x</i>
<i>Increase of self service</i>	<i>✓</i>	<i>x</i>

III. METHODOLOGY

A. Choosing the cloud service provider

First and foremost, selection of the cloud service provider is very crucial for developing and using any application as per the requirements. For example, one can prefer Amazon Web Services (AWS) for running their application. For our application development, we opted for Force.com platform to develop the application.

B. Creating objects

It is very necessary to decide the appropriate objects required for the development of an application. It has to be properly encapsulated with the desired fields as per the requirements and need to be able to perform appropriately.

C. Setting validations and business rules

Putting proper validations is a must to instill a certain level of reliability and protection from incorrect data. Hence, it is a necessity to implement business rules and other validations to ensure data integrity in the application.

D. Using Visual force pages

Visual force is a component based framework made for Force.com developer platform. Visual force pages can compose components, HTML and optional styling elements available on the platform. Additional controllers and their extensions can be added to visual force pages with the help of Apex.

E. Using Apex code

Apex is a strongly typed, object oriented programming language that allows one to centralize and execute flow and control statements on Force.com platform. Its syntax is closely similar to Java and it lets one add powerful business logic to most events, including button clicks, record updates and UI pages.

IV. RESULT AND OBSERVATIONS

Results obtained after implementation of the defined methodology are illustrated as:

On implementing Force.com platform's features, one can create objects. We can view created objects as shown in figure 1.

Action	Label	Master Object
Edit Del	Invoice	
Edit Del	Line Item	Invoice , Merchandise
Edit Del	Merchandise	

Fig. 1: Object List

The visual facilities are aided by Visualforce pages. The code implemented can be viewed as similar to the snapshot shown below.

```
<apex:stylesheet value="{!URLFOR($Resource.styles, 'styles.css')}" />
<h1>Inventory Count Sheet</h1>
<apex:form >
  <apex:dataTable value="{!products}" var="pitem" rowClasses="odd,even">
<apex:column headerValue="Product">
<apex:outputText value="{!pitem.name}"/>
</apex:column>
<apex:column headerValue="Inventory">
<apex:outputField value="{!pitem.Quantity_c}"/>
</apex:column>
<apex:column headerValue="Physical Count">
<apex:inputField value="{!pitem.Quantity_c}"/>
</apex:column>
</apex:dataTable>
<br/>
<apex:commandButton action="{!quicksave}" value="Update Counts" />
</apex:form>
```

Fig. 2: Visual force page

Flow control of the application is manipulated with the help of apex pages which will look similar to as shown in the snapshot shown below.

```
global with sharing class InvoiceUtilities {  
    // Class method to renumber Line Items for a given Invoice number.  
    // Returns a string that indicates success or failure.  
    webservice static String renumberLineItems(String invoiceName) {  
        // Create a copy of the target Invoice object and its Line Items.  
        Invoice__c invoice =  
        [SELECT i.Name, (SELECT Name FROM Line_Items__r ORDER BY Name)  
        FROM Invoice__c i  
        WHERE i.Name = :invoiceName LIMIT 1];  
        // Loop through each Line Item, re-numbering as you go  
        Integer i = 1;  
        for (Line_Item__c item : invoice.Line_Items__r) {  
            item.Name = String.valueOf(i);  
            System.debug(item.Name);  
            i++;  
        }  
    }  
}
```

Fig. 3: Apex page

V. CONCLUSION

It can be viewed that the necessity of an automated warehouse management is a necessity which can be easily overcome with the help of a suitable cloud application.

Cloud services provide us with the flexibility to manage the capacity on demand of the viewers because of the “pay as you go” policy of cloud services. Another valuable feature provided is the capability to access the system anywhere due to the availability of the required resources over the cloud. Additionally, there is no need to maintain any database on the user side. Every update in the entry is reflected over the application because of the cloud service itself.

Thus, it can be concurred that cloud based service provides provide a huge advantage over other methods of developing and maintaining automated services.

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