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A Review of: Cloud Centric IoT based Framework for Supply Chain Management in Precision Agriculture

Prashant Satpute[1]
Department of Computer Engineering
Dr. D. Y. Patil SOET
Lohegaon
Pune – India

Omprakash Tembhurne[2]
Assistant Professor Department of Computer Engineering
Dr. D. Y. Patil SOET
Lohegaon
Pune – India

Abstract: ***Cloud computing is aimed at providing IT as a service to the cloud users on-demand basis with greater flexibility, scalability, reliability and availability with utility computing model. This new paradigm of computing has an immense potential in it to be used in the agriculture and in rural development perspective in developing countries like India. There are some crucial issues to be solved to successfully deploy cloud computing for these social purposes. With the evolution of Cloud Computing and its subsequent popularity, the service providers are coming up with very essay and affordable solutions for the end users. This technology is predicted to bring revolutionary changes to the agriculture sector. Supply chains are increasingly virtualized with the objective of building a synchronizing supply with demand competitive infrastructure, creating net value and measuring performance. This paper focuses on how Cloud Computing concept enhances virtualization of supply chains in agriculture sector. Farmers can get most up-to-date farming and propagation techniques, also track and check the whole process from production, distribution to consumption.***

Keywords: Cloud Computing, Internet of Things, Supply Chain Management, Virtual Commerce, Agriculture.

I. INTRODUCTION

Agriculture sector is the broadest economic sector and plays a significant role in the overall economic growth of India. Today, India ranks second worldwide in Agriculture production. Agriculture and allied sectors like forestry and fisheries for 13.7% of the GDP (Gross Domestic Product) in 2013. India is the world's largest democracy with 1.2 billion populations. Despite with its current position, the sector needs to look forward with objective of innovating new things and to stay in the lead. The focus has been given on improving production while reducing food supply chain losses. This benefits issue of food wastage combating hunger and improving food security. It is difficult to know that how much food is lost and wasted in India today due to lack of proper infrastructure. However, a 2011 report by a UN body, gives information about wastage in fruits and vegetables as high as 45% of produce (post-harvest to distribution) in India.

In India, major component of the agro supply chain system is either in the public sector, or strongly associated to it. The Indian government decides produce after analysing the costs of growing a particular crop at Minimum Support Prices (MSPs), decided by the Commission for Agricultural Costs and Prices The role of the buyer, storing the procured produce played by, the 7500+ Agricultural Procurement and Marketing Committee (APMC) 'mandis' provide a marketplace for the transaction and the Food Corporation of India (FCI). This gets distributed through the Public Distribution System (PDS) shops and reaches the consumer. The producer is dependent on the traditional private channels to market her produce, for non-MSP crops.

An application of Information Communication Technology (ICT) will cater to all such information needs of an Indian farmer at a very reasonable and affordable cost. That latest and most promising area of ICT is Cloud Computing. It enables the users to make use of various services and tools with pay-per use basis without the need to know the physical location. Cloud computing is inherits distributed computing, provides On-demand services. Cloud users can provide more available, reliable and

updated services to their clients in turn. Cloud consists of physical machines in the data centres of cloud providers. The cloud provides services like Platform as a Service, Software as a Service or Infrastructure as a Service. Cloud acts as the single point of access for serving all customers and internet is the medium for accessing these services.

Looking at the potential benefits of cloud computing we can list out its role in agricultural development in India. Using the applications of cloud the farmers have nothing to worry about hardware and software investment and also the technical knowledge required to learn them. The farmers will send the request for the specific cloud service using a user friendly device, and the cloud service provider will analyse and handle the request dynamically, and finally the results will be passed back to the client. They can get most up-to-date farming and propagation techniques, pest control knowledge, and can also track and check the whole process from production, distribution to consumption. They can also leverage the systematic methods in information collection, supply chain logistics, market forecasting and business decision-making.

In such virtual supply chains, planning, orchestration and coordination are based on virtual representations of physical products and resources, enabled by new information and communication technologies. The actors responsible for planning, orchestration and coordination are not necessarily the ones handling and observing these physical objects. They can be at total different locations. [1] The latest and most promising area of ICT is Cloud Computing. It enables the users to make use of decentralization or decoupling of physical flows from centralized planning, orchestration, and coordination taking place in other locations and by other partners.

The Internet of Things (IoT) paradigm has advantage of ubiquitous interconnection of billions of embedded devices that can be uniquely identified, localized, and communicated [2]. IoT architectures are either Internet centric or object centric. Scalability and cost efficiency of IoT services can be achieved by the integration of cloud-computing into the IoT architecture, i.e., cloud-centric IoT [3][5]. Applications that can be improved by the integration of IoT into cloud computing are many, such as pervasive healthcare [6], smart homes [7], smart cities [8], and future transportation systems [9]. Thus, Supply Chain management can be efficiently addressed by taking advantage of cloud and IoT integration.

II. Related Work

Supply chain management (SCM) is the strategic, systematic coordination of the traditional business functions and the tactics across business functions. The purposes of the supply chain are to improve the long term performance of different companies. [10]

The requirements of the SCM are sensing objects, the proposed deployment, development, and management of the IoT applications over the cloud, namely, cloud-centric IoT framework.

In a cloud-centric IoT framework[4], sensors provide their sensed data to a storage cloud as a service, which then undergoes data analytic and data mining tools for information retrieval and knowledge discovery. Built-in sensors in mobile devices can leverage the performance of IoT applications in terms of energy and communication overhead savings [11], [12]. Therefore, It has a benefit of strong candidate for front-end access to the cloud-centric IoT, where mobile devices provide their sensed data based on the pay-as-you-go fashion [13].

In our research work, we present a cloud-centric IoT-based framework for supply chain management. We believe that, this framework act as central means for planning, orchestration and coordination has potential to enhance performance of supply chains. The work gives more focus on how this framework is more helpful in agriculture sector. This sector is making much progress in the transaction processing, remote auctioning, and logistics process. Means more stress is given on analyzing the existing situation and to define future challenges.

An application of Information Communication Technology (ICT), will cater to all such information needs of a farmer at a very reasonable and affordable cost. That latest and most promising area of ICT is Cloud Computing. It enables the users to

make use of various services and tools with pay-per use basis without the need to know the physical location and configuration of the system.

III. Literature Review

Various systems were proposed for the Supply Chain Management. Nowadays Supply chains are increasingly virtualized in response to market challenges and to opportunities offered affording new technologies. Virtual supply chain management has no need of physical proximity, which gives control and coordination can take place in other locations and by other partners. This paper focus on how the Internet of Things concept can be used to enhance virtualization of supply chains in the floricultural sector. The paper defines the concept of virtualization and describes different perspectives. They define a conceptual framework for analysis of virtualization in supply chains. [1]

In survey [14], authors comes with conclusion, the environment accelerate their adoption of this game-changing cloud technology while effectively mediating multiple sources of modularizing architectures that delivering a complete service. Introduction of ICT in the agriculture sector is not new to the world.

Smart phone apps are playing an increasing role on farms for both crop and livestock management. Mobile phones and landlines are also the gateway to Web services, and farmers are as likely to take up Internet services as city residents. Authors have developed smart farm near Arm dale, New South Wales, to be a technology-intensive property of the future. Experiments done with fine scale sensing technologies at Kirby Farm are improving the primary producer's situation awareness and thus contributing to on-farm productivity.[15]

Developing country like China is exploiting the latest technologies like cloud computing and Internet of Things to make direct contribution to agricultural productivity. This paper [16] proposes a cloud deployment model, Agri-assistant to assist farmers in efficient decision making which in turn will improve not only the farm productivity but will also help agriculture sector to increase its efficiency.

Cloud computing technology has brought great opportunities to the development of IRAN's agriculture. According to the advantages of cloud computing, the paper first discussed the impacts of cloud computing for IRAN's agricultural development; and analyzed the field and the prospects of its possible applications in agriculture; then presented the application and promotion of cloud computing technology is a long-term system works with data center, integrate resources. [17]

Cloud computing is still lagging behind in India, but as economic and institutional factors improve, it greatly accelerate a step forward to digital India. If industry and the government can develop products that meet local needs and address issues, the cloud might serve as an important catalyst in enhancing social as well as economic growth. [18]

There are different emerging solutions are available to deal with such problems, such as Private players like Star Agri that provide integrated post-harvest management solutions. TCS' m-KRISHI platform offers personalized advisory services to farmers, via mobile phones to access important information on fertilizers, pesticides, water and soil conservation, and improving access to markets for them. [19].

IV. Research Objectives

Designing an application for agriculture sector gives efficient optimization of cloud. Farmers use a cloud-based trading system that mobile phones. The research aims towards

1. Design of a cloud-based trading system that disseminates information crop status, harvesting times, and market prices.
2. Smartness comes with optimization, flexibility, predictability by using cloud in agriculture sector.

3. An application will cater to all such information needs of an Indian farmer at a very reasonable and affordable cost.

4. Internet of Things has a huge potential in the agriculture field It gives plants a tongue to speak to us

By using cloud computing we can list out its role in agricultural development in India. Using the applications of cloud the farmers have nothing to worry about hardware and software investment and also the technical knowledge required to learn them. The farmers will send the request for the specific cloud service using a user friendly device, and the cloud service provider will analyze and handle the request dynamically, and finally the results will be passed back to the client.

V. METHODOLOGY

In this research work, The SCM is primarily concerned with coordination of flow dependencies; the business process output of one actor is the input of another actor's processes. The main component supply chain business processes are orders, products, and demand and supply information. Besides these independent dependencies, there are some key dependencies are related to the usage of shared resources [1]. In proposed framework for SCM, the control and Coordination of supply chain process is based on sensed objects instead direct observation of physical objects. This Cloud based IoT Framework removes fundamental constraints concerning place, time and human observations.

Cloud centric IoT architecture has following layers in proposed framework,

i. Object Management

ii. Cloud Computing Platform

iii. Information as a Service

iv. Smart Phone User

Object Management:

Objects have central role in SCM, objects are digital representation of information that communicated and processed via Internet. In SCM objects are information transferred between different partners from primary production to the market. These objects submits sensing task request to the cloud platform and receives sensing data of corresponding task.

Cloud Computing Platform:

Maintains a user database where objects, sensing tasks and associated events are stored. This middleware enables a seamless exchange of object information between different supply chain participants. Cloud centric IoT framework processes functionalities for service management and service composition. The data exchange and information integration is done by this platform.

Information as a Service:

This layer considered as data publisher layer in this cloud centric IoT framework for Supply Chain Management. The specific service for different supply chain user based on the object information made accessible by using web interface application .

Smart Phone Users:

The farmers will send the request for the specific cloud service using a user friendly device such as smart phone users, and the cloud service provider will analyze and handle the request dynamically. A user who to publish his sensed object data on object management layer must use the benefit of smart phones by installing application on his smart phone.

VI. Conclusion

Modern technology is rapidly altering and enhancing all aspects of our lives. The communication sector has been improving continuously. The Cloud computing is a game changing phase of IT that promises several benefits but the challenges too need to be considered when planning for Cloud adoption in agricultural sector. Agriculture has traditionally been maintained by families and communities where passing on and sharing of knowledge is regarded very important. The accumulation and sharing of knowledge has resulted in better productivity and efficiency. Agriculture is the embodiment of large amount of ancient knowledge. If the leverage effects of IT can be widely developed, then we be able to bring about a further leap in agriculture. Research also continues to analyze Cloud computing implementation that provides less or no expenditure, On-Demand, Efficient Agricultural Knowledge Management. The cloud can offer a centralized knowledge bank which plays a big role in agriculture sector.

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AUTHOR(S) PROFILE

Prashant Satpute received the B.E. Degree in Computer Science & Engineering in 2013, From Tatyasaheb Kore Institute of Engineering and Technology, Warananagar. Now, Pursuing M.E. Degree in Computer Networks from Dr. D. Y. Patil School of Engineering and Technology in current academic year 2014-15. His current research focus is on cloud computing domain.

Prof. Omprakash Tembhurne received the MTech. Degree in Computer Science & Engineering, From Nagpur University. Now, Assistant Professor in Department of Computer Engineering, Dr. D. Y. Patil School of Engineering and Technology Lohegaon, Pune.