The Journal of Animal & Plant Sciences, 22(3): 2012, Page: 802-805
ISSN: 1018-7081

A ROAD MAP FOR IMPLEMENTING SERVICE ORIENTED AGRICULTURAL INFORMATION MANAGEMENT SYSTEM

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ABSTRACT

The advent of most modern and advanced tools and technologies in the field of information technology has brought revolutionized changes in all fields of our society. Traditional systems have been outdated and increasingly being replaced with new systems, applications and techniques. Almost all public and private sectors are updating themselves with modern information retrieval and management systems. Very sophisticated information systems have been implemented in various sectors. Unfortunately, in Pakistan agriculture is one of the fields in which information systems are not implemented as required. Limitations of resources and poor infrastructural facilities arise the need to rely on information systems in the agriculture sector in Pakistan. In this paper we have presented a road map for implementing an agricultural information system in Pakistan. The proposed system is a distributed service based information system for agriculture sector. Distributed framework is designed and implemented through service oriented architecture (SOA). The communications among the remote components of the system is done through service (component) calls using xml. The outcome of this research is to provide a basic road map to implement a service oriented agricultural information system to link all the agriculture related departments in Pakistan. It would help farmers, researchers, academicians, public and private sectors in information retrieval and sharing. The system is the potential solution of resource limitations and other problems being faced by agriculture sector in Pakistan.

Keywords: Agile, Distributed, Globalization, Information System, Service Oriented.

INTRODUCTION

Information systems have increasingly replaced the traditional approaches of information sharing & retrieval, information management and resource management. A number of private and public sector departments have already replaced their traditional manual systems of filing and documentation with latest information systems. In a consensus Compass Group (2001) has reported that more than 80% organizations have started IT implementation in their business. Along with the advancements in the field of information technology, almost each and every field of our society is getting benefit of it. The applications of information technology in all the fields are quite revolutionized. Modern information systems have increasingly replaced the traditional manual systems at various levels. Latest and advanced systems have been introduced. Very sophisticated approaches, tools and technologies of information technology are being used to design and implement highly functional and user friendly systems. Besides the latest tools and technologies, the planning of implementing an information system according to the requirements is also considered very important. Kearns and Sabherwal (2007) has discussed various aspects of information system planning and integration. They have considered IT investments important for the overall performance of IT based organizational setups.

The field of agriculture has a lot of major, minor, simple and complex problems of numerous types. Communication issues with the farmers, tenants and landlords, poor knowledge of these people, poor disaster control and management, natural and environmental hazards, disease attacks on crops, inability of the governmental departments to approach the farmers to provide in advance and timely help and guidance particularly in remote areas are few of the major problems in Pakistan and other developing countries. Governmental departments and agencies in the developing economies have lack of resources and infrastructures facilities to help and facilitate farmers at their sites. On the other hand, farmers also do not prefer to travel to the other cities or far away areas to contact governmental agencies to seek guidance and help. Sometimes it is even very late. The factors such as financial conditions of the farmers, low literacy rate, lack of confidence and communication, poor help and cooperation from governmental agencies, outdated information, improper communication channels, and poor transportation infrastructure are considered as major bottlenecks in this regard.

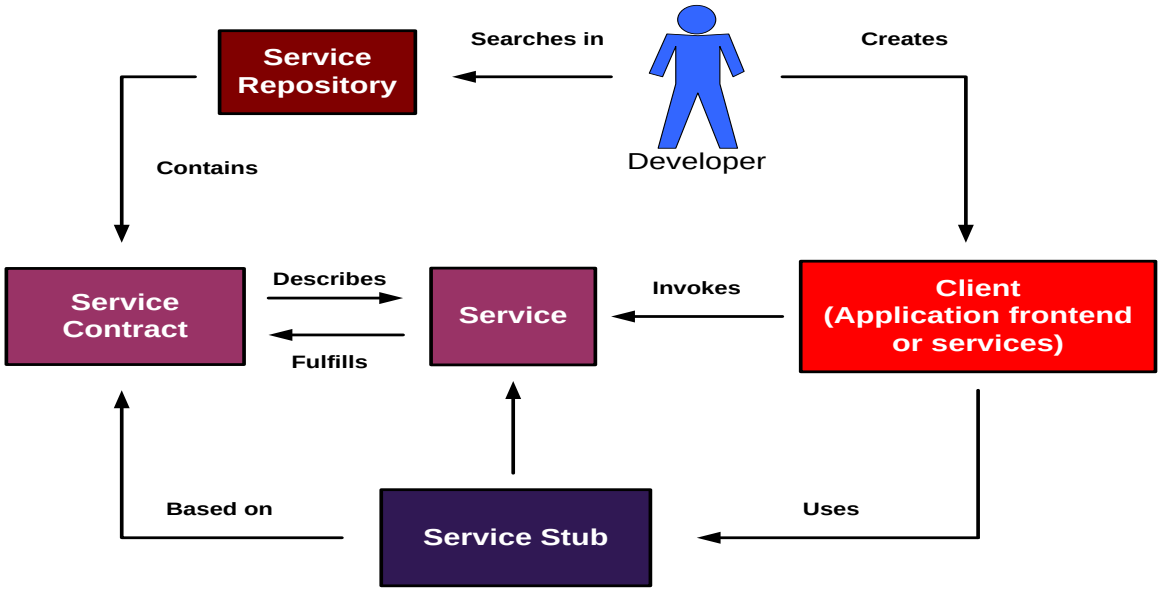

Figure 1. Service Call. Backer *et. al.* (2006)

This paper presents a road map to implement a service oriented agricultural information system to overcome potential problem of agriculture sector in Pakistan. Moreover, developing countries like Pakistan can overcome their issues related to the field of agriculture by implementing such systems. Service oriented architecture (SOA) is selected as the backbone architecture of the whole system. Individually for each department, the information system will be implemented. The application running in each department will communicate with the applications of other departments as required. The SOA paradigm provides support to design such a distributed, independent, autonomous system components which communicate with each other for information sharing. Papazoglou *et. al.* (2007) describes that SOA provides support to develop fast, low cost and interoperable distributed applications. He further states that services are loosely coupled platform independent components. Web services are one of the most common example of service oriented paradigms Weerawarana *et al.* (2005). Internet is the basic communication medium in web services applications.

The outcome of the research is an interactive information system through which farmers can find guidance and solution of their problems. All the agricultural departments would also be able to share and retrieve information from each other. Farmers would be aware of the latest techniques of agriculture at no cost, prevention and control of diseases in advance etc. The system would keep the expenditures of both the users and service providers at minimum level. The modern agriculture would be available to all the farmers, tenants and cultivators at their door step.

Service oriented architecture: Service oriented architecture (SOA) is widely being used for developing distributed applications. Papazoglou *et al.* (2007) states that SOA based approaches are independent of programming languages and operating systems. Based on this architecture our proposed service oriented agricultural information system would be designed and implement. Using the SOA framework different independent components of the system would be developed. Each component would be a complete standalone application for each agricultural department. These components would then communicate and will be called upon by other applications and components through specific standard protocols. Services are itself the components of the applications that are available to other applications upon request. For example farmer wants to see the seed rate of a specific crop, disease remedies and better varieties of wheat. This information would be available from three different departments such as seed certification department, plant pathology department, and entomology or pest control department, and plant breeding research centers. Upon the request of the client generated from its own interface different components would connect to the systems of remote departments and will fetch the required information. Such service protocols are mainly implemented using xml.

Backer *et al.* (2006) has presented the basic architecture of service orientation as shown in figure 1. Each system that implements SOA mainly works on this pattern. The system that we have proposed in this paper also follows the same service architecture a shown in Fig. 1.

The applications of SOA can be seen in e-government, health systems, and student information systems etc. Easy implementation and independent components make it more functional and fast. Information retrieval from distributed components is transparent and feels like that information is being retrieved from our own system.

The developer collects all the required information and develops the application interface at the client side. The farmer or any other agent would use the system through the provided interface. Implementation details are hidden from the users. The management and governance of SOA based systems is a bit complicated. A proper framework for managing services in SOA based applications is required. A number of researchers such as Marks (2006); Shewmaker *et al.* (2006); Mos *et al.* (2008); Peng *et al.* (2008) have presented models and frameworks on this important aspect of service oriented architecture.

Independent systems would be developed for each agricultural service provider department. Each department would be able to communicate or retrieve information from some other department through service components. For example disease *control* center need to know the weather forecast for effective preventive measures. Large scale farmers can also access the application from their homes. Due to low literacy rate and inaccessibility to technology, farmers should be given training to use the system. Programming languages such as java or .Net and XML can be used to develop the system.

Key potential areas: A number of researchers have presented significant work on the problems of agriculture and their solutions. The disciplines related to agriculture such as livestock, veterinary are also under discussions since years. After a thorough analysis of the existing research work and field experience we have identified six key potential areas of significant importance in Pakistani agriculture as follows:

a) Soil fertility and Fertilization.
b) Irrigation management & planning.
c) Crop harvesting and cultivation techniques.
d) Weather and environmental hazards and control.
e) Weed and disease control (pest control).
f) Agricultural marketing.

In our research work, we have considered these six key areas as the factors influencing healthy crops and fruit plants. We have also found a direct relation between agriculture, live stock production and management, and veterinary sciences. This prototype road map of agriculture information system can further be extended to other related disciplines. The information system would be based on these six sub-systems as service provider components.

Communication: In SOA based systems the service call is the basic component that is required to implement on client side and other distant locations. There are various architectures and approaches being used by the researchers and developers to implement this distributed application. Effectively the system of each department works independently and communicates or calls the service to retrieve information from another department.

The main communication agent for the proposed system is farmer. Direct and indirect communication takes place between the farmer and other agricultural departments. System level communication takes place through protocol based service calls implemented through xml.

Development model: Globalization has affected social, economic, cultural and technological aspects of our societies. IT globalization, a form of globalization in the field of IT, has brought revolutionary changes in the overall software development scenarios. A number of researchers such as Cho (2007); Ramasubbu and Rajesh (2007); Akbar *et al.* (2010) have presented models and frameworks in order to solve the issues associated with the globalization. Traditional approaches of software development have been obsolete. The consequences of IT globalization have emerged in the form of project outsourcing, offshore development and agile methodologies. Agile methodologies have increasingly replaced the traditional heavy weight models and approaches of software development and system applications.

Characteristics of the system: The systems developed through SOA are normally categorized as distributed systems. A number of researchers have presented numerous characteristics of distributed systems. The service oriented agricultural information system also requires to possess characteristics such as transparency and scalability. The system would be that much user friendly that ordinary farmers could use it easily.

RESULTS AND DISCUSSION

After implementation each agricultural department would have its own information system that in turn would be connected to the other departments through service components. Each information system would be a standalone application running in each department. The information system is the requirement of agriculture sector in Pakistan. Getting benefit of latest tools, technologies and implementing information technology in the field of agriculture would be very much helpful in increasing productivity and running this sector on technological fronts. Interdisciplinary approaches are emerging rapidly in all the fields. In countries like Pakistan where infrastructure and resources are limited, applications of information technology in the field of

agriculture as well as live stock, veterinary and textile etc. With the use of sound information systems in all such sectors, the limitation of resources can easily be overcome. The applications of Information technology are the solution of the problems of developing countries.

Conclusion: Healthy and progressive agriculture leads towards more productivity, prosperity and string economy. Developing countries such as Pakistan, India, Bangladesh with the implementation of technological advancements in the sector of agriculture can overcome their issues. Agriculture information systems as well as other applications of IT in the field of agriculture, live stock production and management, veterinary sciences would enable such countries in establishing a technological infrastructure in these sectors. Information systems in these sectors can be implemented with minimum cost and man power. The applications of IT in countries like Pakistan are the ultimate solution that can help in strengthening agricultural infrastructure all over the country.

Future work: Interdisciplinary research projects are increasingly being started from last decade. It has provided solution to many complex problems as well as has introduced several new approaches of production, cultivation, harvesting, pest & disease control and new varieties and breeds of crops and animals. It is now the time to implement this interdisciplinary approach through agriculture based information system and IT infrastructure so that its outcome could reach to the farmers and other stakeholders. In future it would be realized as an important artifact and will open many research and development paradigms.

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