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## DEVELOPMENT OF KNOWLEDGE BASED FRAMEWORK FOR AGRICULTURE SECTOR: A STEP TOWARDS SUSTAINABLE e-GOVERNANCE IN RURAL INDIA

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### ABSTRACT

*India is an agricultural country. Indian economy is still based on agricultural productivity. The agricultural sector is often considered as the engine for growth in rural economies in many countries as it is the leading source of rural income, employment and productivity. The implication of usage of ICT has been significantly felt in agriculture sectors for various activities like, crop production, cultivation processes, crop design, weather forecasting, pest control, natural resource management etc. There are some bottlenecks in incorporating ICT in agriculture like, huge investment in infrastructure and network access etc. In the contemporary India, various forces are at work to change the shape of agriculture extension in India, up till now apparent as a process of technology transfer to a process of assisting a wide range of communication and information technology services which are demand driven, sustainable and spread out across entire country. In the middle of this change, experts are struggling with the question of how best to strap up Information and Communication Technologies (ICTs) to improve the quality of life for millions of farmers. Indian Tobacco Company (I.T.C.) had recognized this reality and initiated e-chaupal project that is one of the ICT based solution that contributes to agricultural inputs, purchase and use of agricultural output in the field of agriculture and uses the documented best practices for farming. In this paper the perception of best practices has been taken and improved using a knowledge management framework.*

### KEYWORDS

Agriculture, e-Governance, ICT, Knowledge Based, Knowledge Management Framework.

### 1. INTRODUCTION

India lives in villages and agriculture is the soul of Indian economy. Agriculture is the backbone of the Indian Economy"- said Mahatma Gandhi six decades ago.

Even today, as we have entered in the new millennium, the situation is still the similar, with almost the entire economy being sustained by agriculture, which is the mainstay of the villages. Not only the economy, but also every one of us looks up to agriculture for our sustenance too. The agricultural sector is often considered as the engine for growth in rural economies in many countries as it is the leading source of rural income, employment and productivity. Rural economies are the keystones of food security. Consequently, rural and agricultural problems were considered to be virtually synonymous and it was often assumed that rural and agricultural objectives could be pursued through a single set of policies focused mainly on commodity price support. We first need to recognize that agriculture is a science that is essential to human well-being. Through continuous innovation over thousands of years, farmers have fed ever-growing populations with an increasing variety of products. Agricultural technology is not lifestyle abundance - it fulfills the right to food by making sure that all people should have the capacity to feed themselves in dignity.

Agriculture is a significant sector of the Indian economy. Though its contribution to the overall Gross Domestic Product (GDP) of the country has fallen from about 30 percent in 1990-91 to less than 15 percent in 2011-12, a leaning that is expected in the development process of any economy, agriculture yet forms the backbone of development. An average Indian still spends almost half of his/her total expenditure on food, while roughly half of India's work force is still engaged in agriculture for its livelihood. Being both a source of livelihood and food security for a vast majority of low income, poor and vulnerable sections of society, its performance assumes greater significance in view of the proposed National Food Security Bill and the ongoing Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) scheme [The State of Indian Agriculture 2011-2012, by Target UPSC].

The practice from BRICS countries points out that a one percentage growth in agriculture is at least two to three times more effective in reducing poverty than the same growth radiates from non-agriculture sectors. Given that India is still home to the largest number of poor and malnourished people in the world, a higher priority to agriculture will achieve the goals of reducing poverty and malnutrition as well as of inclusive growth. Since agriculture forms the resource base for a number of agro-based industries and agro-services, it would be more meaningful to view agriculture not as farming alone but as a holistic value chain, which

includes farming, wholesaling, warehousing (including logistics), processing, and retailing. Further, it may be noted that in the last two Five Year Plans, it is clearly mentioned that for the economy to grow at 9 %, it is important that agriculture should grow at least by 4 % per annum. The report on the State of Indian Agriculture calls for wide-ranging reforms in agriculture sector to enable it to meet the growing demands and meet the challenges posed by various human and environmental factors [The State of Indian Agriculture 2011-2012, by Target UPSC].

The experience of agricultural development in India has shown that the existing systems of delivery of agricultural inputs and purchase and use of agricultural output have not been efficient in reaching the benefits of better linkages between agriculture and agro- processing industry to the farmers or the agro-industry. The timely, quality and cost effective delivery of sufficient inputs still remains a dream despite the marketing attempts of the corporate sector and the developmental programs of the state. The farmers are not able to sell their products remuneratively. There is frequent overabundance in the markets, resulting in low prices and losses to the farmers. On the other hand marketers face problems in acquiring opportune, cost effective, and satisfactory supply of quality raw materials.

Agriculture in OECD (Organization for Economic Co-operation and Development) countries, like other industries, is continuously facing adjustment challenges branching from economic and non-economic factors. [Status of Agriculture in OECD countries, OECD Report ] Farm constitutions and changes in them affect rural areas in a variety of ways. Farm households in different farm size classes organize their labor, production methods, financing and marketing arrangements in different ways. The regional distribution of benefits from agricultural support policies is also influenced by the structural characteristics of the sector. Commodity- and input-coupled support, as well as any change in its level or form, has different rural effects because of the varying importance of each commodity among regions. The scope for changes in labor allocation on and off farms by farm families in different regions will also have a fundamental bearing

on the extent to which adjustment process would be smooth in response to market signals or whether there is a need for policy intervention to address particular income or adjustment problems.

"Slow agricultural growth is a concern for policymakers as some two-thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Poorly maintained irrigation systems and almost universal lack of good extension services are among the factors responsible. Farmers' access to markets is hampered by poor roads, rudimentary market infrastructure, and excessive regulation."

—World Bank: "India Country Overview 2008".

India has a population of over one billion people. It is considered both internally and externally to have the happening of fast growth in all the important phases relevant to fulfill the requirements of this much big population. But the biggest question that is being asked is about the 'truth' in the use of the word 'Growth'. say for example, "Whether economic growth is being reflected in the social growth?". Dissimilarly to the traditional definitions of growth, the yawning difference between various economic level of the society and the gap between urban India and rural India is actually increasing, in this way it is disproving the symmetry aspect of the definitions of 'Growth'. Indian economy, even though now seems to be moving towards service-based quickly emerging areas, is still disgustingly agriculture based and thereby makes use of maximum workforce. Advancement in agriculture productivity can facilitate in reducing rural poverty, which is often quoted as the root source of all tribulations- poor transportation, poor public health, skills meagerness of sustaining developmental efforts to even poor agricultural performance across a vast ecological field hosting majority of total Indian population.

However, the Government of India gives high concern to reduce poverty by increasing agricultural productivity, following issues of agricultural sector should be resolved to build a solid foundation for a highly productive, internationally competitive, and diversified agricultural sector.

#### ISSUES OF AGRICULTURE SECTOR

- 1) **Slow Down in Agricultural and Rural Non-Farm Growth:** Both the poorest as well as the more prosperous 'Green Revolution' states of Punjab, Haryana, Andhra Pradesh and Uttar Pradesh have recently witnessed a slow-down in agricultural growth and it ultimately lead for farmer's suicide.
- 2) **Population Pressure:** India has a huge population of over one billion and it is increasing at a very fast rate. This is likely to increase further in future. This has created great demand for land. Every bit of land has been brought under the plough. Even the hill slopes have been cut into terraces for cultivation.
- 3) **Inadequate infrastructure and services in rural areas:** Infrastructure is also a momentous factor in the process of development but country like our rural India does not have the infrastructure such as roads, electricity, fertilizer and pesticides availability which caused the vulnerable harm to the growth of agriculture.
- 4) **Weak Framework for Sustainable Water Management and Irrigation:** Many states lack the policy, regulatory, and institutional framework for the efficient, sustainable, and equitable allocation of water. Public spending in irrigation is spread over many incomplete projects. In addition, existing infrastructure has rapidly declined as operations and maintenance is given lower priority.
- 5) **Insufficient Access to Land and Finance:** While India has a large network of rural finance institutions, many of the rural poor remain excluded, due to inefficiencies in the formal finance institutions, the weak regulatory framework, high transaction costs, and risks associated with lending to agriculture. While land distribution has become less skewed, land policy and regulations to increase security of tenure.
- 6) **Weak Natural Resources Management:** One quarter of India's population depends on forests for at least part of their livelihoods. The forest sector is also faced with weak resource rights and economic incentives for communities, an inefficient legal framework and participatory management, and poor access to markets.
- 7) **Lack of modern farm implements:** Mechanization of farming has taken place in some parts of the country, most of the farmers are poor and do not have enough resources to purchase modern farm implements and tools. This obstructs the development of agriculture.
- 8) **Deficient in proper storage of food grains:** Storage of food grains is a big problem. Nearly 10 % of our harvest goes waste every year in the absence of proper storage facilities. This massive wastage can be avoided by developing scientific ware-housing facilities.
- 9) **Small and Fragmented Land Holdings:** The pressure of increasing population and the practice of dividing land equally among the heirs has caused excessive sub divisions of farm holdings. Consequently, the holdings are small and fragmented. The small size of holdings makes farming activity uneconomical and leads to social tension, violence and discontentment.
- 10) **Inadequate Irrigation Facilities:** By and large the irrigation facilities available in India are far from satisfactory. So for half of the total area under food crops has been brought under irrigation and the remaining half is left to the leniency of monsoon rains which are unpredictable in time and space. [Jac Stienen with Wietse Bruinsma and Frans Neuman]

## 2. PURPOSE OF THE STUDY

Information and Communication Technologies can play a progressively more important role in crop production and natural resource management in the field of agriculture. "ICT in Agriculture" is a promising field focusing on the enrichment of agricultural and rural development in India. Information and communication have always mattered in agriculture. In view of the fact that people have grown-up crops, elevated livestock, and caught fish, they have sought information from one another. What is the most effective planting stratagem on sharp slopes? How can a person obtain a land title? From where can a person buy the improved seed or feed this year? How can I participate in the government's credit program? Who is paying the highest price in the market?

Producers rarely find it easy to find answers to such questions, even if similar ones arise season after season. Farmers in a village may have planted the "same" crop for centuries, but over time, weather patterns and soil conditions change and scourge of pests and diseases come and go. Updated information allows the farmers to cope up with and even getting advantage from these changes. Offering such knowledge can be exigent, however, because the highly localized nature of agriculture means that information must be tailored specifically to distinct conditions. This purpose can be solved by development of knowledge management framework for agriculture sector for sustainable e-Governance in Rural India.

## 3. INCORPORATING ICT IN AGRICULTURE SECTOR

Involving ICT in agriculture sector can help in many ways,

- To provide more and effective information that can decrease the uncertainty farmers or producers face in decision making and unmeasured unpredictability in farming conditions.
- To educate the farmers to use natural resources efficiently, learning from others' experiences and mistakes there by not repeating it in other places or then the years after years, plummeting waste etc.
- To assimilate the entire agricultural population in rural India impeccably by using convergent technology solutions and promoting not just data sharing but also an information and knowledge sharing environment.
- Conservation of land.
- Timely and adequate availability of inputs.
- Development of minor irrigation.
- Support for marketing infrastructure.
- Increasing flow of credit particularly to the small and marginal farmers.
- Enhancing public sector investment in agricultural research and effective transfer of technology along with institutional reforms and two-way linkages between agriculture and rural development.
- To provide the farmers with the latest available technologies and also make them aware about a range of financial options available to them to make them manage to pay for it in terms of



1. Cultivation processes.
2. Crop design - this can be done if supported with structured information-based analysis to develop product portfolios or product mixes are designed by industrial/ service organizations.
3. Various irrigation techniques.
4. Providing weather information.
5. Developing new concepts in fertilizers, pest control and farming etc. e.g. bio-farming, as and when developed by agriculture professionals and agriculture research institutes.

Five main drifts can be the key aspects of the use of ICT in agriculture, particularly for poor producers:

1. adaptable and more affordable tools
2. low-cost and pervasive connectivity
3. advances in data storage and exchange
4. innovative business models and partnerships
5. the democratization of information, including the open access movement and social media.

These aspects are expected to continue shaping the prospects for using ICT effectively in developing country agriculture. But the need is, to have synchronized efforts by a nodal agency under the central government with full participation of the industry, state governments/local administration and agriculture sectors, to provide widespread access to ICTs with important services/information integrated to the rural masses. Even the World Summit on Information Society (WSIS) convened by ITU in December 2003 at Geneva has outlined a target to bring ICTs within the reach of half the world’s population and with all schools, villages and hospitals by 2015. [John W. Berry, 2006]

**4. A CASE STUDY OF E-CHAUPAL : AN ICT BASED SOLUTION**

e-Choupal project has been initiated and set up by the International Business Division of International Tobacco Company (ITC). It is an ICT based project, which aims to build effective farmer-agribusiness linkages, to establish a more efficient agriculture supply chain that can reciprocally benefit the company as well as the farmers by almost eliminating the layers of middlemen that swindle the almost illiterate farmers for the right price for their crop and their hard work. In Madhya Pradesh, the agribusiness division of the company has set up e-Choupal for soyabean that provides the farmers access to market information and quality inputs. The model of the project has been planned and deployed effectively to undertake the challenges pretense by weak infrastructure, fragmented farms, and involvement of numerous intermediaries, as it is seen in rural India. It was launched in the year 2000, and it reaches more than 18,000 villages through 3000 kiosks across five states and adding more links is increasing the chain. [Sukhpal Singh “Leveraging ICT for Agricultural Development: A case study of e-Choupal of ITC”]

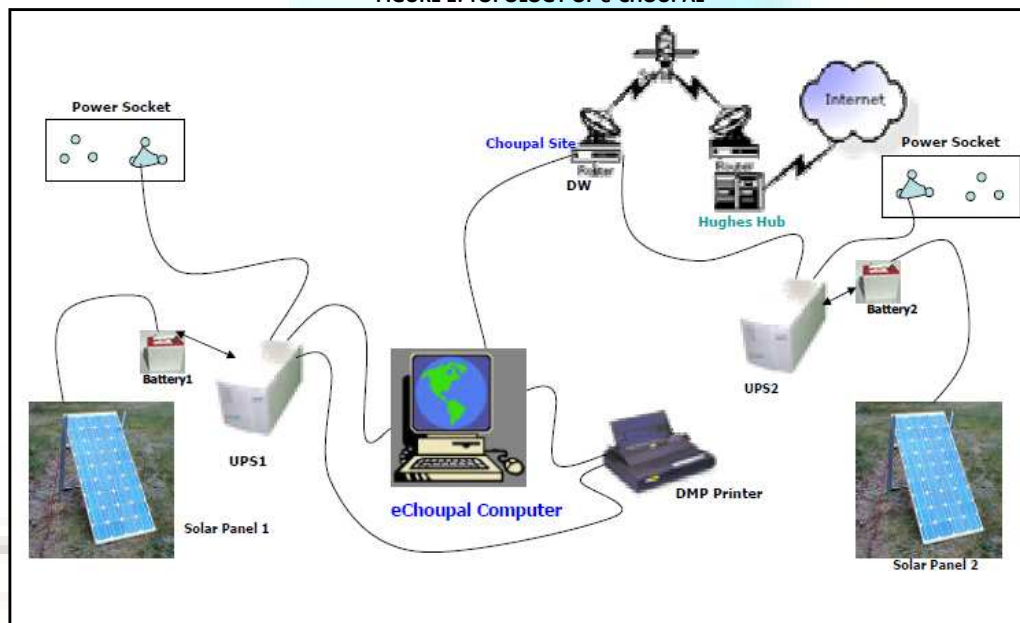
The technology infrastructure supporting e-chaupal has following layered elements:

1. Organization Architecture – Training, support, planning, people, and processes
2. Information Architecture – Data gathered and managed
3. Application Architecture – Applications, goals, resources occupied, performance metrics
4. Technical Architecture – Servers, Clients, Network, System Software

All the four layers are distinct but profoundly unified and contribute to goals and constraints collaboratively.

**TOPOLOGY OF E-CHOUPAL**

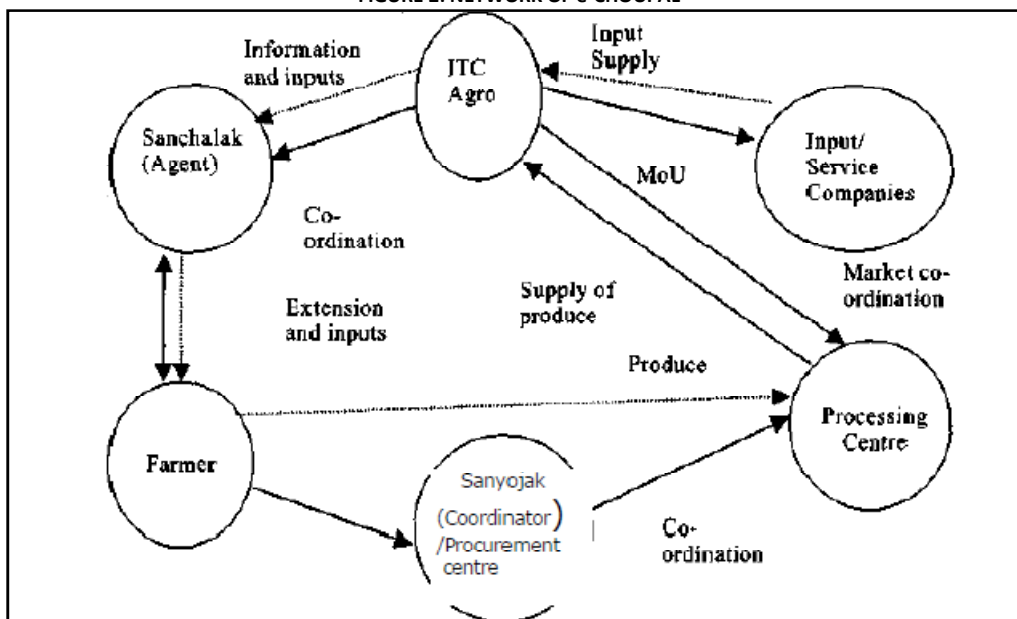
**FIGURE 1: TOPOLOGY OF e-CHOUPAL**



Source: Sanjiv Sharma (2006)

Figure 1 demonstrates the topology of e-Choupal project. Within this topology, the computer hardware used is PC with Intel Celeron processor. Other devices used are Dial-up modem for dial up connectivity, VSAT modem, VSAT: Solar battery charger, antennae, UPS, Power Solar battery charger, Printer.

FIGURE 2: NETWORK OF e-CHOUPAL



Source: Sukhpal Singh (2004)

Figure 2 describes the network of e-Choupal. First of all farmer takes only a sample of his crop product to the local Sanchalak and receives a spot price quote from the Sanchalak. Sanchalak is located in the village. Sanchalak is the agent of the company who interacts with farmers for input transaction and output transaction. Sanchalak is an interface between the computer terminal and the farmers. Then farmer takes his product to the ITC procurement center situated at the block or district level. Sanyojak or coordinator at there, manages physical flows in the supply chain, collects price information from local mandis and maintains records of it. Farmer has the option to sell the product to the company warehouse, factory and collection center. e-Choupal portal <http://www.echoupal.com> is the access point, protected by userID and password for login. Sanchalaks are the only registered users. Website provides various services like pricing of agro-products at different markets, weather forecasts, best farming practices, risk management, question & answer feature, financial services – life, general, health & crop Insurance. Above and all, the feature which can be improved by using Knowledge based framework is “Best Farming Practices” so that producers can salvage their accumulated pragmatic knowledge and can dig out best possible benefits, in a way stepping towards converting existing system into an expert system.

### 5. DEVELOPMENT OF KNOWLEDGE BASED FRAMEWORK FOR AGRICULTURE SECTOR

To narrate ICTs and knowledge, a comprehensive definition of knowledge has been specified by Davenport and Prusak (1998) as: “Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knower. In organizations, it often becomes embedded not only in documents but also in organizational routines, processes, practices and norms.”

A knowledge base is an information storage area that provides a mean for vital information to be collected, organized, shared, searched and utilized. It can be either machine-readable or intended for human usage. A Knowledge Based System (Expert System) is a problem solving and decision making system based on knowledge of its task and logical rules or procedures for using knowledge. Both the knowledge and the logic are acquired from the experience of a specialist in the relevant area. During the various phases of processes, in order to take rectifying actions for any variations, one often needs timely information and analysis reports to assist in making more informed and precise decisions.

In this way when knowledge management comes in to the picture, it essentially means that to deliberately provide an environment that is contributing to knowledge creation, knowledge incorporation and knowledge propagation in making appropriate decisions. Now an Expert System is software based solution that imitates the interaction a user might have with a human expert to solve a problem. The end user provides input by selecting one or more answers from a list or by entering data. The program will ask questions until it has reached to a conclusion. The conclusion may be the selection of a single solution or list of possible solutions arranged in order of likelihood. This is where this paper proposes a Knowledge Based Framework for sustainable e-Governance in agriculture sector of India. This framework can work on the top of the existing smoothly functioning system.

FIGURE 3: PROPOSED NEW MODEL FOR KNOWLEDGE BASED FRAMEWORK

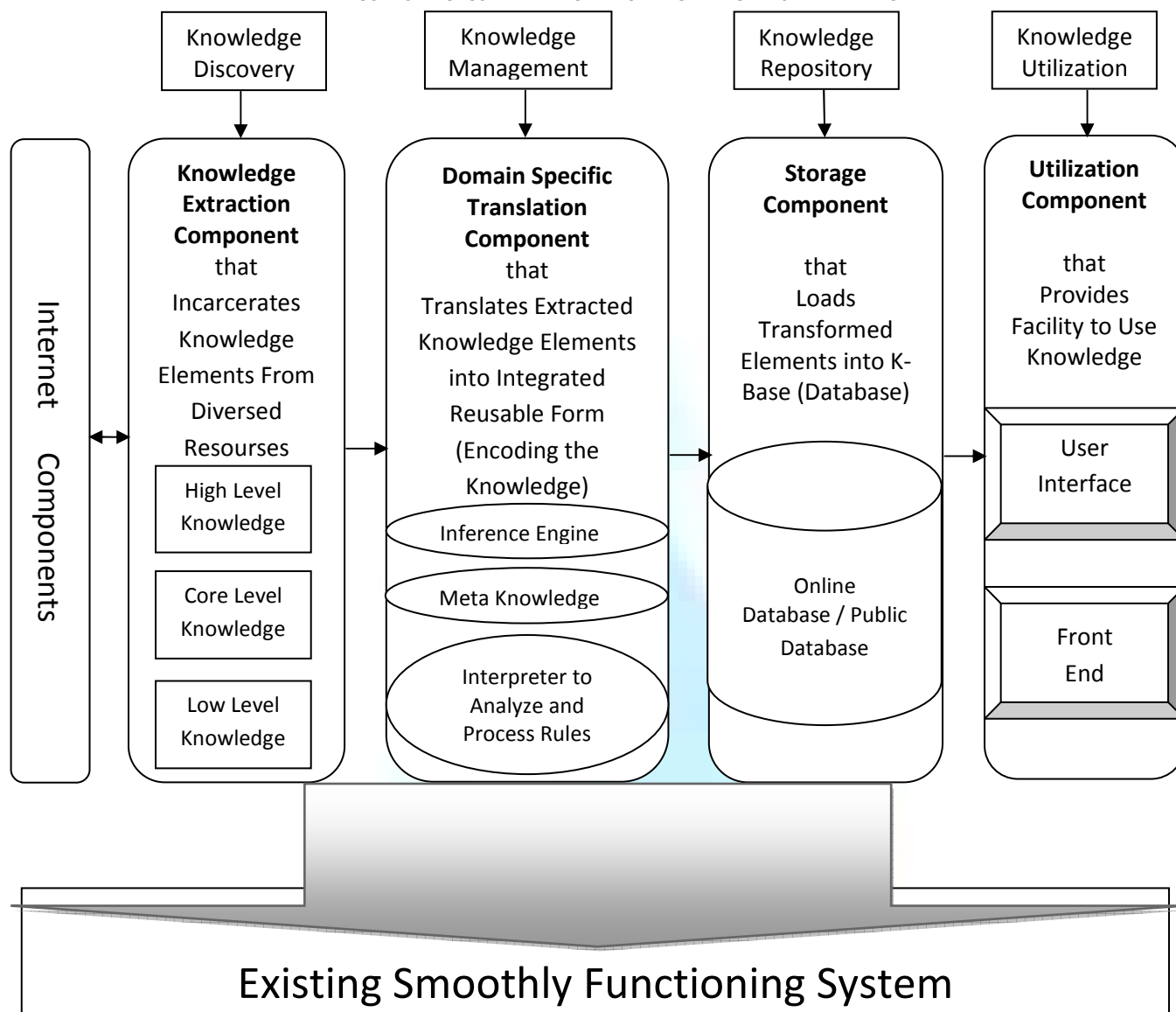


Figure 3 demonstrates the new Knowledge Based Framework that can be built up on any existing smoothly functioning e-Governance system, so that the existing framework can be converted to Knowledge Based Framework.

**SUPPLEMENTARY NECESSITIES TO IMPLEMENT SUGGESTED MODEL**

Step-1 : **CREATE A SOFTWARE MODULE USING ANY RAPID APPLICATION DEVELOPMENT LANGUAGE CONTAINING FOLLOWING BASIC COMPONENTS.**

1. Reusable Extraction component, Translation component, Loading Component for Knowledge Management (Rule based reasoning or Code base reasoning).
2. Knowledge base (K-base) for knowledge repository with appropriate knowledge representation design.
3. The Front End or User Interface through which the queries can be processed and knowledge can be retrieved from K-base. The interface should preferably be very simple having natural language based query system with translator software to translate the query into English phrases and a query processor with a proficient pattern matching algorithm for retrieval of an appropriate answer to the submitted query.

Step-2 : **CREATE AN INTERFACE BETWEEN KNOWLEDGE BASED MODULES AND EXISTING SYSTEM MODULES.**

In this way, the existing e-Governance system can be converted into Knowledge Based system, in away converting existing e-Governance system into an expert system for sustainable e-Governance in rural sectors of our country.

**6. CONCLUSION**

In this paper, new knowledge based framework can provide many of the advantages like

1. Timeliness : Information is available sooner for decision making
2. Completeness : An expert system can review all the possible solutions for an agricultural problem
3. Risk reducing :Proper decision always reduce risk of farmers
4. Consistency : Provides consistency in decision making process
5. Expertise : Gives expertise to producers in various decision making situation
6. Persistence – Expert system does not forget, but human experts may be, Knowledge can be preserved so available at any given time
7. Cost Effective - Although expert system is expensive to build and maintain, they are inexpensive to operate. Development and maintenance costs can be spread over many users

By looking at these advantages the model proposed in this paper has significant potential for application as an additional feature to improve the performance and to provide sustainable e-Governance as well as it is having further research opportunities in various magnitudes.

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