Application Of Intelligent Systems In Rural Agricultural Practice

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Abstract: This article draws multiple theoretical concepts and exploits abstractions from knowledge repositories on rural, social networks literatures to investigate rural agricultural practices with intelligent systems and technological trends. A qualitative research methodology is adopted to gain an understanding to underlying reasons, opinions, and motivations. The methodology also provides insights into the challenges of rural agriculture practice automation and helps to develop ideas and solutions for transforming the rural community. Findings from this work indicate that international food policies and agencies play a significant role in driving innovations for rural agriculturist than governmental institutions and networks. Knowledge management and exchange among producers is limited and does not provide the bridge to formal implementation of intelligent systems. The findings also demonstrate how territorial contingent factors profile automation in the agricultural sector, and how they impact upon involvement in intelligent systems and in turn facilitate or restrict innovation in this context. This paper addresses how to minimize the challenges of intelligent systems implementation in agricultural practise based on the acquaintance of participatory approach during the design and development phases. This has been identified as one of the most imperative factors for framing technology implementation. The maturity of sustainable intelligent systems through theories and methodologies from the fields of human computer interaction and user-centric designs are explored. Despite the challenges this concept presents, intelligent systems can contribute significantly to long-term sustainable development in agriculture.

Keywords: Business Intelligence, Knowledge Management, Agriculture, Integration, Intelligent systems, Information Systems, Rural Community, Business Strategy, Food Policy.

1 INTRODUCTION

Intelligent systems exist all around us. Intelligent Systems are articulated in businesses through varieties of software applications used to analyze the organization’s raw data. This can consist of online analytical processing, data mining and reports. Most enterprises deploy Intelligent Systems to facilitate tracking of information and rely on the software to operate effectively. Companies can use the information from intelligence systems to determine what items within the business need remodelling. Intelligent systems assist organisations in harmonizing individual and team work practices culminating in improved performance. Acquisition of more data for intelligence systems almost always makes deep learning projects more effective. Many Information Systems analyst know that there is essentially no limit to the amount of data needed to drive successful systems projects. The more data made available, the more accurate the analysis produced. In many ways, data intelligence in business analysis is critically important. According to contemporary data by Bluewolf Group (http://www.bloomberg.com/research/), 65% of enterprises have extended their commitment in making analytics actionable and accessible. Whereas 52% of enterprises affirm that their applications are intelligent, 80% of the data that lie beneath these applications are passive, unutilised and often times unstructured. It is therefore not surprising that Oracle and Salesforce have made artificial intelligence (AI) core to their strategies in recent years. In consideration of the foresaid, the question is “how can intelligent systems be applied in rural agricultural practice? Artificial Intelligence (AI) technologies are about bringing to bear intelligence and management of the data that flow into enterprises. The agricultural practice is one such places where vast amounts of information flow ranging from the nature of soil, horticulture, climate change, marketing and plants growth management. It is therefore all about the nature of data, scale of data and the frequency need on data requisition. Precision in agricultural practise addresses important issues regarding sustainability. Many farmers have the essential expertise to operate their site explicitly, but do not apply it in a pragmatic sense on intelligent systems, consequently available information and communications technology systems are not used to their full potential. Therefore global food security may linger as a concern worldwide for decades as crop yield has fallen in many areas because of declining investments in technology, research and infrastructure. This paper addresses how to reduce the challenges of intelligent systems implementation in agricultural practise based on the acquaintance of participatory approach during the design and development phases. This is one of the most imperative factors for framing technology concepts. The maturity of sustainable intelligent systems through theories and methodologies from the fields of human computer interaction and user-centric designs are explored. Despite the challenges associated with this task, intelligent systems can contribute significantly to long-term sustainable development in agriculture. In many ways, several appentencies and scientific disciplines need to act in concert to facilitate a trans-disciplinary approach that can make significance to this concept on society at many levels. Nature has provided through agriculture surfeit of examples of intelligent systems. On a large or macroscopic degree, plants and livestock are part of the daily experience of a farmer. On a lesser scale, we may admire the almost boundless number of diverse insects which, regardless of their relative diminutive nervous systems, still fulfil our exposition of intelligent systems with unparalleled distinction. In agriculture, this can even be further reduced to the micro of even nanometre sphere, where bacteria or cells are examples of systems that adhere to the abstract control intelligence. Given that agro-ecological approaches proffer assurances for meliorating yields, food security in developing countries could be significantly improved by
increased investment in technology and policy reforms. The capability of agriculture to sustain growing populations has been a concern for generations and continues to be high on the global policy agenda. The uncertainties in managing rural farming activities in developing countries are a global problem. From north to south and from west to east across the world, there are comparable asymmetries. Though this can be attributed to divergent and disparate economic, social and political conditions, the same predicaments occur in rural regions such as sustaining extant businesses and/or in commencing new ones, depopulation, senescent, dilapidated facilities, economic recession, detriments of biodiversity, pollution decrepitude, lack of appropriate infrastructures, dearth of services for tourism and a scarcity of job opportunities for the population. There are potential solutions to these challenged and different options to achieving them. Suffice it to assert that this depends on the potential of each community, on its physical qualities, and also on the culture, social and economic policies the communities postulate. Over the last few decades, solutions have been proffered and validated through research, projects and initiatives, and this had been of great interest to the authorities. These solutions had been endorsed with positive outcomes as it created opportunities for more business but nonetheless, it took little cognisance of improvement of intelligent systems and technology. Furthermore, the expansion of small and medium-sized farming communities represented a possible opening strategy for diversification, but in this case, it encouraged crop diversification relegateing the possibilities and benefits intelligent systems can offer. It is generally opined that those solutions should have streamlined policies and guidelines that support specific services of business intelligence, such as access to information, communication technologies, sustainable infrastructures for the innovation, expertise that would promote new initiatives in biodiversity as well as models of organic and biodynamic farming. Obviously this can transform into heterogeneity opportunities in the range of services towards other economic sectors including retail, manufacturing and processing industries. Therefore this work is organised as follow; Section one introduces Intelligent systems and justifies its need in rural agricultural practice. Section two states the aims and objectives of the work. Section three delves into literatures of existing practices with regards to automation of rural agricultural practice. Section four presents the research methodology and the concept of V-PECT. Measures for Formulation for Intelligent Systems are presented in section five while section six evaluates the proposed intelligent system enablers. The article is concluded in section seven where the contributions are highlighted and areas for future research suggested.

2 AIM AND OBJECTIVE OF THE PAPER
To this end, the research question is: What strategies can be used to foster the development of intelligent systems in rural agricultural communities? With the objective of advancing a common working hypothesis for intelligent systems in rural agriculture, the precise application domain for this article has been defined. A comprehensive analysis of the premises of this work in comparison with many other western development experiences and principles is unfeasible mainly because there is a societal development gap between these developed countries and developing rural communities especially in Africa. Having clarified this, it can be stated that an outcome of this work would also identify strategies and policies that can be deployed to foster the application of intelligent systems in rural agricultural communities in developing countries. With reference to the solutions predicated in this work, these kinds of rural communities can also serve as a case study and index upon which prospect communities can be built. Based on this aim and objective, it can be asserted that the necessary economic, social and political ingredients are obtainable to develop new collective knowledge which can be coalesced to produce the best results between rural agriculture technology and national organizational implementation skills. Subsequently this work can be used as a reference point to identify (1) strategies and policies relevant to the development of intelligent systems in rural agricultural communities; (2) how to sustain intelligent systems development in rural agricultural economy; (3) the prerequisites for rural communal technological services system; (4) rural infrastructure investment and financing mechanisms; (5) rural ecological protection and environmental protection and (6) rural integrated development.

3 LITERATURE REVIEW
The chronological, and apparently gratuitous, growth of some organisational fervour to the provision of agricultural Decision Support Systems (DSS) has been based on a fundamental category muddle of disparate process models. The intent of such undertaking to demonstrate how model-driven Decision Support Systems can guide practical action as a professional research in food technology had been a fallacy. The intensification of this devoir has had extensive implications on the design and implementation of both modelling as a concept and DSS as a mechanism that supports organizational decision-making activities. Consequently, the need for development of an intrinsic methodology for automating food production such as intelligent systems had been decelerated. The annihilation of poverty and food shortage was incorporated as one of the United Nations Millennium Development goals adopted in 2000 (Pogge, 2004). One of the targets of the goals was to bisect the percentage of people who suffer from hunger between 1990 and 2015. However, this is 2017 and this food security goal has not been met. Prognostication of food security transpiration has been a topical issue for deliberation for years with numerous policies promulgated. Over the past decades, though some experts have expressed concern over the capability of agricultural production to keep up with global food demands, others have forecast that technological advancements would boost production sufficiently to meet rising demands (Rosegrant & Cline, 2003). However, so far calamitous prognosis of global food security catastrophe has been unproven. Nevertheless, crop yield growth has slowed in much of the world because of declining investments in technologically-driven agricultural research and provision of farming and support infrastructure in rural areas. New challenges to food security are posed by climate change, a phenomenon which can be monitored through technology as it were. Therefore can food security goals be met in the face of technological
neglect? Many enterprises have developed quantitative models that depicted global food supply and demand for future food security. According to the most recent baseline projections of the International Food Policy Research Institute’s (IFPRI’s) International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) (20), global cereal production is estimated to increase by 56% between 1997 and 2050, and livestock production by 90% (Rosegrant et. al., 2008). It is estimated that developing countries will account for 93% of cereal-demand growth and 85% of meat-demand growth to 2050. Achieving food security needs policy and investment reforms on multiple fronts, including human resources, technology-based agricultural research, rural infrastructure, water resources, farm and community-based agricultural and natural resources management. To implement technological-based agricultural innovation, there is need for collective action at the local level, as well as the participation of government and non-governmental organizations that work at the community level.

4 RESEARCH METHODOLOGY
This section presents the methodological approach, which underpins the proposed theoretical framework of this article. In consideration of the research hypothesis as it relates to intelligent systems, Information Systems management practices, challenges of the rural community and indices that affects intelligent systems initiatives, a qualitative approach is adopted in this work. Consequently, the experiential and tacit knowledge acquisitions and interview methods that are common in qualitative measurement were deployed. This methodology adopts the V-PECT (Values, Polices, Events, Constraints, Trust) analysis thinking framework using its collection of mental filters and guides and is extrapolated as follows:

4.1 Generic Enterprise Perception
Investigation of the intelligent and information systems practices within an organization and their potential complementarities was carried out. In this perspective, the methodological progression demanded investigation into one of the most important functions of Intelligent and Information Systems, which is information requisition from the rural environment that allows farmers to make decisions and the correlation of these various data artefacts. This phase focused also on ad-hoc research and reading of past reviews and projects on environmental analysis useful for aggregating information for specific project, detecting patterns of information on the environment, and identifying the potential arbitrations on each case. After identifying the patterns of information and procedures which regulate the agricultural activities, the methodology proceeds to assess enterprise motivations which provide support for intelligent system practices.

4.2 Extrapolation of Motivation
At this stage, the V-PECT analysis is applied based on inferences and artefacts collected to identify motivation of the enterprise. The mental filters which constitute the data included stakeholders, principles, values, constraints, policies, goals and business drivers. This illation allows direct identification of business roles and responsibilities of each stakeholder. With this, a concise meta-model can be developed to streamline the operations of the business and align the intelligent systems to the motivation of the organisation.

4.3 Business Process Reengineering
A radical business process review of the rural agricultural organisation is conducted through discussions, related research works and interviews including products, processes, events and actors. The core business processes are scrutinized to identify areas were intelligent systems can be applied. This interpretive method is focused on two factors; it allows alignment of business processes with the organisational motivation as well as with proposed information technology. This ensures optimal delivery of the information system, improvements in productivity, workflow and service quality. The approach proceeds with the analysis of documents and materials for the identification of the most appropriate primary drivers of the enterprise that would allow implementation of the intelligent system. Sequel to the unstructured nature of the data collected in this work and the need to segregate and model the artifacts, this work is scoped at this level. The extension of this work which includes infrastructure, database design can form a basis for future research. However, the information collected and analysed is adequate to provide and insight to answering the hypothesis put forward in this work. Thus the scope of this interpretative research is to demonstrate how sectored contingent factors profile automation in the agricultural sector, and how they impact upon involvement in intelligent systems and in turn facilitate or restrict innovations.

5 MEASURES FOR FORMULATION FOR INTELLIGENT SYSTEMS
The formulation of steps for the implementation of the intelligent systems can be expressed as follows;
(i) The first measure is the definition of the system domain. This involves the collection of base artefacts and specification of the goals and values from a broad and variety of documentations and sources. A commensurate tool is deployed for morphological analysis of the base artefacts.
(ii) The second measure is the identification of constraints, principles and policies of the organization. This would allow checks and balances to be incorporated into the intelligent system so as to achieve the desired goals of food production and sustainability. It would also allow the definition of the main short-term and long-term objectives of the practice.
(iii) The third measure is the creation of models that clearly define the business processes and aligns the events and business behaviour of the organization to motivation and values of the system. For instance, it would be possible to create associations and establish traceability from goals to events and strategies about a specific produce and derivatives.
(iv) The fourth measure is the envisioning of the rural architectural patterns within the selected rural participants through interactions. This strategy would allow external collaborations into the framework and robustness of the design.
(v) Analysis of the territorial attributes to identify the climatic characteristics and sensitivity of the
ecosystem in both natural and atypical conditions. Assessment of social norms, anthropic pressures present therein, the peculiarities of the local communities, comparing these to the regional context to find any homogeneity or discontinuity.

(vi) The fifth measure is the evaluation and adaptation of the results of the stratagem to business intelligent tools. This process would allow varieties of extrapolation and transformation of data into meaningful and actionable information to be carried out. This involves also comparison of the results arising from the verification and querying of the business analytics tool, determining the best potential solution that can be developed into policies and knowledge in the intelligence system.

This combination of measures would allow the engineering strategy system tool able to support the designers, researchers, decision-makers and stakeholders that operate in rural areas in developing countries. Theories in support of this approach are exemplified in the procedures adopted in the design of T-LAB tools. In comparison to the semantic analysis procedure, the examples and methodology on the logic of T-LAB tools (Lancia, 2012, Lancia, 2015) present an all-encompassing set of linguistic, statistical and graphical tools for data analysis and are used in research fields, such as content analysis, sentiment analysis, semantic analysis, thematic analysis, text mining, perceptual mapping, discourse analysis, network text analysis, document clustering and text summarization (Lancia, 2015). It also enables the creation of semantic dimensions that represent dynamic aspects of the artefacts and correlative relationships between values, events, processes, perspectives and goals. The five focal measures describe the appropriate strategy to apply intelligent systems in rural agricultural practice. This framework would constitute a predictive assessment of sustainable projects variables in rural communities paving way for technology-driven endeavours and integration into global trends and markets. It would also facilitate the creation of new lines of services for the rural community and precepts that can strengthen the rural communitarian awareness in terms of technology while increasing the quality of decisions made regarding food production and markets.

6 EVALUATION OF INTELLIGENT SYSTEM ENABLERS

Business strategy and organizational innovation can spur an organization to develop new products or services in response to environmental challenges (Silber & Kearny, 2010). Thus, among many enablers Intelligent Systems provide a context for open innovation based on partnerships between participating rural area farmers. This section discusses the strategies for developing, implementing and operating rural Intelligent Systems for innovative collaborative farming environments. The process of conceptualizing the Intelligent Systems, the involvement of farmers, the gestation and modernization processes, the technical and business process reengineering and the impacts on the rural environment. This approach entails the establishment of stakeholder forum, the creation of farm user communities, the iterative and spiral approach to development, and participative collaboration. Initial prognosis infers that in order to be successful, the strategies must be customized in each farming community. Evaluation of the approach indicates that Intelligent Systems for farming communities must be user-centric and adapted to the environment for which it is applied. The malleable innovation is characterized by primordial and continuous participation of farm users, driven by rapid prototyping cycles. Constituting sustainable collaborations with stakeholders who share common values is a strategic enabler in the planning and preparation phases of Intelligent Systems. This also sets the conditions and support for the subsequent phases of iteration. The business models must also take into consideration concerns, peculiar and common interests of open collaboration and participating stakeholders. Also, alliances with support and external service providers must be complementary with understanding of need for adaptation to environmental changes and conflict management between stakeholders and individual requests. In consideration of technologies, peer-to-peer technologies, service-oriented architecture, ubiquitous systems and fundamental collaboration tools are essential to create platforms that would enable the implementation of the context-specific Intelligent Systems. Service-oriented architecture for instance would provide the platform for contextualization, provide the building blocks for construction of open collaborative systems, cloud computing and would also enable the realization of the vision of open innovation. In order to ensure the success of the proposed system however, the Intelligent Systems must be complemented by ardent support from the key stakeholders. There is need for early involvement of the farm user communities, contributing synchronously with implementers and other service collaborators, in carrying out structured analysis (via process modeling), information engineering (via data modeling), prototyping (via rapid application development), and joint application development. Furthermore, the Intelligent Systems is a holistic approach characterized by close collaboration with the farm users and information technology service providers. It focuses on the vertical value chain which associates producers, customers and suppliers with open ubiquitous technologies.

7 SUMMARY AND CONCLUSIONS

This article has proffered significant contributions to knowledge in terms of architectural and social evolution of technology in rural communities. In view of the local and global trends and challenges in agriculture, there is the need for continuous resilience and adaptation of this paradigm in other rural settings for communal collaboration of knowledge. The key contributions include innovative insight into intelligent systems opportunities in rural communities and the strategic approaches that can be adopted for future sustainability. Promulgation of specification for modelling business perspective oriented enterprise architecture models for rural agro centric intelligence collaborations; an evaluation trans-scalar support for decision-making and process control and ways to extract those set of indices that characterize constraints in rural food production cycle using the concepts of V-PECT. This study has presented a theoretical approach for developing a viable framework for intelligent systems by focusing on business processes, constraints and motivation. Intelligent systems consist of entwined interdisciplinary
paradigms that can be deployed to aid decision making thus booster many quests for information in agriculture, ecosystem and food production. An intelligent organization has the potential to scan the environment with the purpose of detecting the threats therein and how to take advantage of emerging opportunities. An intelligent organization can develop a knowledge-intensive culture and build knowledge infrastructure needed to improve the process capabilities. An intelligent organization has the capability to identify processes that generate entropy phenomenon and adopt measures to avoid the loss of opportunities. An intelligent organization is able to foster innovation and preserve competitive advantage. However, to collaborate this work, there is need to investigate the implementation of intelligent systems in other non-agric oriented organisations in order to effectively benchmark and integrate knowledge of worldwide trends in rural information systems endeavours. This would be apt as an area of further research.

REFERENCES


