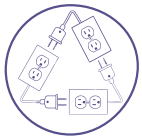
Apena and Adebanjo, J Electr Eng Electron Technol 2016, 5:3
DOI: 10.4172/2325-9833.1000130



Journal of Electrical Engineering & Electronic Technology

Research Article

A SCITECHNOL JOURNAL

Fusing Power Line Communication (PLC) Technologies and Nigerian National Grid Network: Making Sense from Knowledge Management (KM)

Apena WO* and Adebanjo IA

Abstract

This paper presents Power Line Communication (PLC) technology as an efficient means of knowledge sharing among corporate organizations in the power industry. The study considered power system organisational relationship in the conceptual view of knowledge management (KM). National grid system is underutilised in the view of organisational applications in communication system. A designed process could be initiated to address the gap of underutilisation of PLC technology. The integration of PLC technology in Nigeria could unified disjointed knowledge and promote professional efficacies in power system. The study heighted possible challenges and strength of incorporating Power Line Communication (PLC) into the existing power grid in Nigeria.

Keywords

Power line communication; Process; Integration; Knowledge management

Introduction

Knowledge Management (KM) refers to the process of gathering, managing and sharing knowledge capital that will lead to a corporate analysis and creation of knowledge for reuse, modelling, and innovation [1]. Application of Knowledge Management is essential for the implementation of Power Line Communication (PLC) in the power industry in Nigeria. Power Line Communication is a technology that relies on existing power lines for data communication and knowledge sharing. This requires no additional wiring for remote data acquisition, Internet Protocol (IP) telephony and control signal transporting [2]. Knowledge sharing throughout the power industry will enhance efficient, effective business and distribution processes by removing redundancy in the power sector.

The term knowledge management (KM) is widely adopted as knowledge evolution which describes technological process of translating and managing information to obtain the desired output [3].

***Corresponding author:** Apena WO, Department of Electrical and Electronic Engineering, The Federal University of Technology, PMB 704, Akure, Nigeria, Tel: 08033446096; E-mail: woapena@futa.edu.ng

Received: June 29, 2016 **Accepted:** August 27, 2016 **Published:** September 03, 2016

Power industries stands as a beneficiary of dividend of knowledge management (KM) when corporate organizations and stake holders aim to unify both tacit and explicit knowledge in the sector. Introduction of technological process as a KM component could promote efficient organisational structure and address underutilisation of Nigerian power grid. Power Line Communication technologies could be incorporated into the existing Nigerian power grid to provide services such as; home automation, smart metering, remote data delivery, energy management, generation control and smart grid system. This could leads to the integration of PLC technology for efficient customer service delivery.

Power Line Communication (PLC) Integration in Nigeria

Power Line Communication (PLC) technologies maximise the use of existing power grid as a communication point-point network line for the efficient transmission of data and control signal [4]. This enhances smartness across power grid and home automation for the system efficacy. Figure 1, present PLC technologies in the conceptual view of Knowledge Management System (KMS) Bridges Technology Gap.

According to Apena et al. [5] stated that, application of knowledge management (KM) could reveal meaningful interaction of people, designed process to support applied technology and promote knowledge communication. The study categorised KM components in the conceptual view of knowledge management for the successful integration of Power Line Communication (PLC) to the Nigerian existing power grid are People, Processes and Technology as revealed in Figure 2.

The three elements predicts essentialities of smart PLC organisational structure for the existing network. Although, system availabilities are required for smart operation could be militated by designed process for communication channel capacity and energy management initiatives.

Edwards described Leavitt "diamond model" of organisation as the task-structural driving effect on technology rather process [6,7]. The process in Figure 2 refers to the designed technological approach to integrate power line communication technologies into is system for knowledge implementation and technological diversity in Nigeria power system. The process for the integration of PLC technologies begins with knowledge gap to creation. Technological process is design to proffer an empirical solution as an organisational knowledge benefit. The adoption of artificial intelligence (AI) as smart tools for grid system revealed technological process for decision support system. The study mimic [8] model to designed KM process to address underutilisation of Nigerian power grid and monitor knowledge creation through decision support tool as revealed Figure 3. This could promote integration of PLC technologies such as smart system for energy management and organisational knowledge sharing.

Electricity theft is a prominent behavioural act in Nigerian power system network; this occurs in many homes and organisation [9]. The model could address existing behavioural issues on Nigerian power grid such as energy theft and networks vandals. The model could support revenue generation through proposed system and unaccountability billing irregularities elimination.

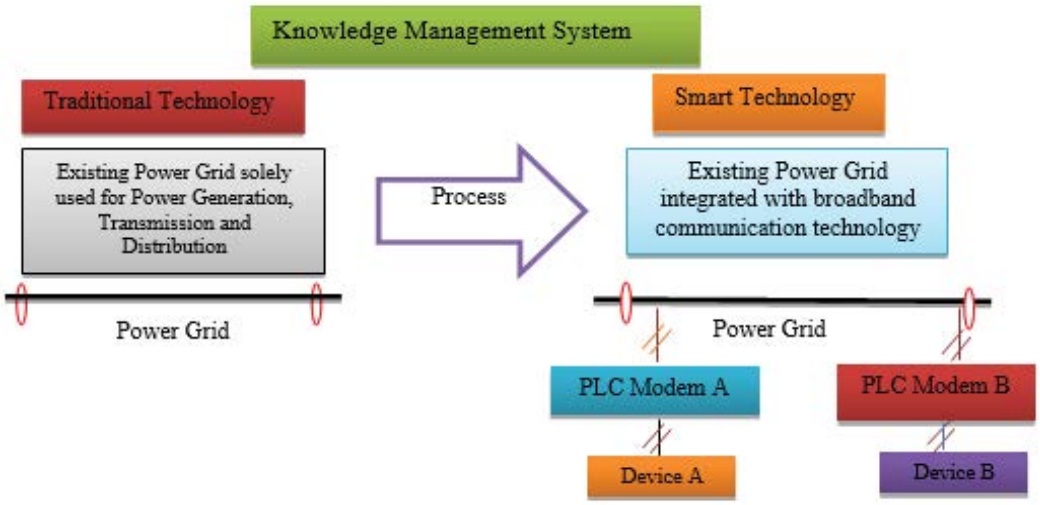


Figure 1: Knowledge Management System (KMS) Bridges Technology Gap.

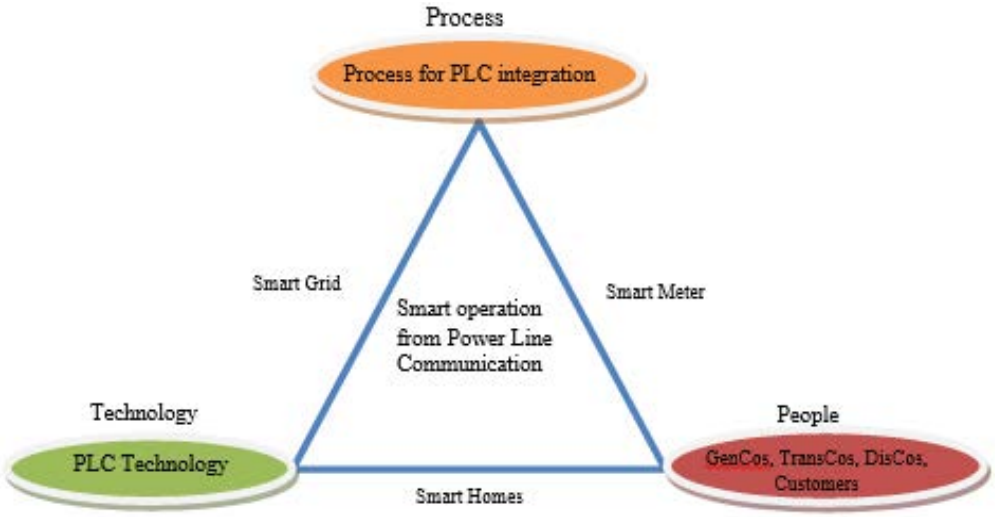


Figure 2: People, Process and Technology.

Processes identification and PLC implementation

The study designed organisational process for the implementation of PLC technologies into Nigerian grid system as revealed in Figure 4. This will promote technological integration and evolutional process to converge knowledge diversity towards common goal.

Identify: Power system industries needs to identify customers' requirement to support implementation of smart intelligence system such as internet and decision support unit. The usage digital data communication has increase in recent times to power and control smart system [2]. Other applications of PLC include smart grid, smart meters, home automation and energy management.

Analyse: Corporate Organization's in power sector need to share information on this tacit knowledge in order to effectively analyse the significance of integration of Power Line Communication (PLC) into the Nigerian existing grid system. Established knowledge acquired through identified system gap and proffer organisational change for the effectiveness of PLC integration.

Design: Required system design for the implementation of PLC is determine by existing organisational disjointed knowledge and predicts the robustness of PLC implementation in Nigeria. Software designs can be made leading to building prototypes to address electricity theft and support smart grid monitoring system. .

Facilitate: The needs to facilitate implementation of PLC technologies into the existing Nigerian grid system is militated by funding, maintenance culture and government policy. Although, the prospect could address current challenges such as fault detection, fault location, fault analysis and national energy management system. It could also support organisational challenges to aid efficient communication process in the management structure and long term economic effect.

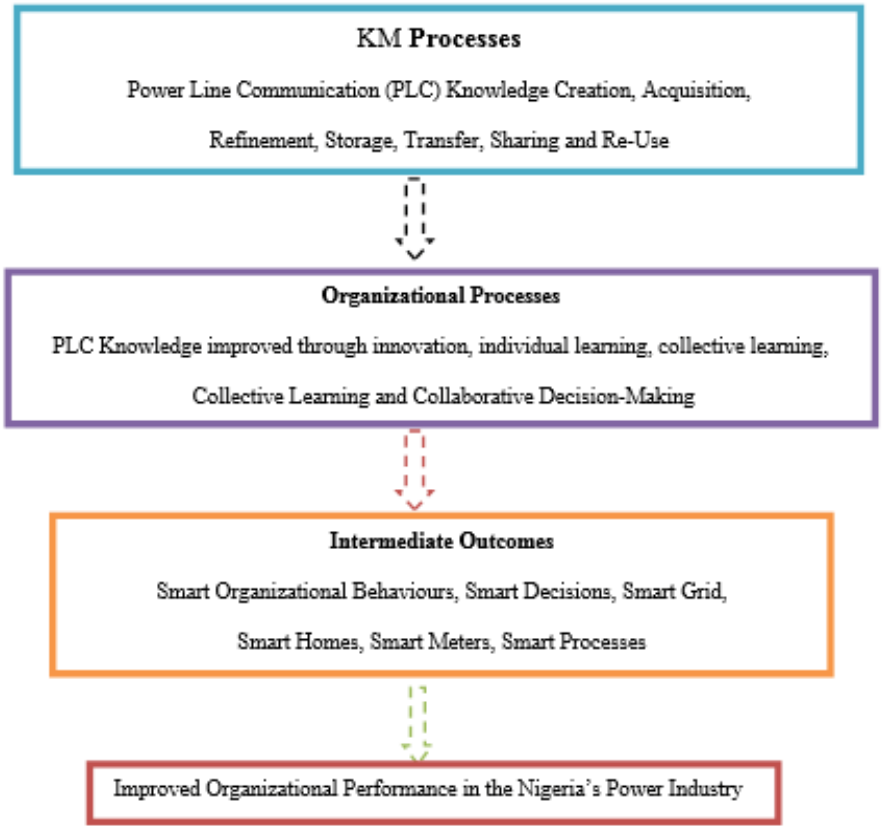


Figure 3: Improved Organization Performance through Integration of PLC.

Power line communication (PLC) application and Nigerian power grid

Power Line Communication is an emerging technology envisaged as a new solution that could provide lower cost of energy management to power grid system [10]. Nigerian power grid system is underutilized; introduction of PLC could maximize the grid towards implementation of potential communication loop (telecommunication) infrastructure. Power line communication (PLC) can provide elegant solution to close gaps between service users (customers) and power system providers through in-home access and network support [11]. These could support current organizational gap in Nigeria power industries to address possible economies as stated below:

Economies of scale - when an organization can reduce the unit cost by high production volumes.

Economies of scope - where the same equipment can produce multiple products more cheaply in combination than separately [12].

Economies of substitution - when the cost of designing a new system through the partial retention of existing components is lower than the cost of designing the system afresh [13].

Although, the required principle of economies depends on energy demands with respect to geographical location to enhance efficient industrial revolution. The economies of scope and substitution are relevant to current organizational challenges in Nigerian power industries; integration of PLC could support the efficacy to greater height. Power Line Communications offers a ubiquitous way of delivering data to remote locations; this will support knowledge creation and diversity. The following PLC applications could be integrated into Nigerian power grid system:

Smart Meter System: This technology provides efficient automated meter reading system to reduces human intervention and eradicate estimate charging system. This initiative could be available for fault detection and location on national grid. End users' consumption could be monitored to provide a reliable, transparent and efficient network billing system.

High Speed Internet Access: Broadband communication over power line could be initiated to provide point-to-point connections. This allows dual data transmission over existing medium voltage (MV) and low voltage (LV) wiring between transformer and customer outlets typically 180V-240V. The ability to integrate "intelligent" power line networks will support use of real-time supervisory control and data acquisition (SCADA) devices and knowledge acquisition. This will provide market perspectives and promising applications to assess the viability of communications environment.

Home Networking: PLC can be integrated to Nigerian grid system to provide interconnection between home computer and peripherals through Ethernet port. This could allow efficient devices' data communication and enhance knowledge sharing to support secure environment.

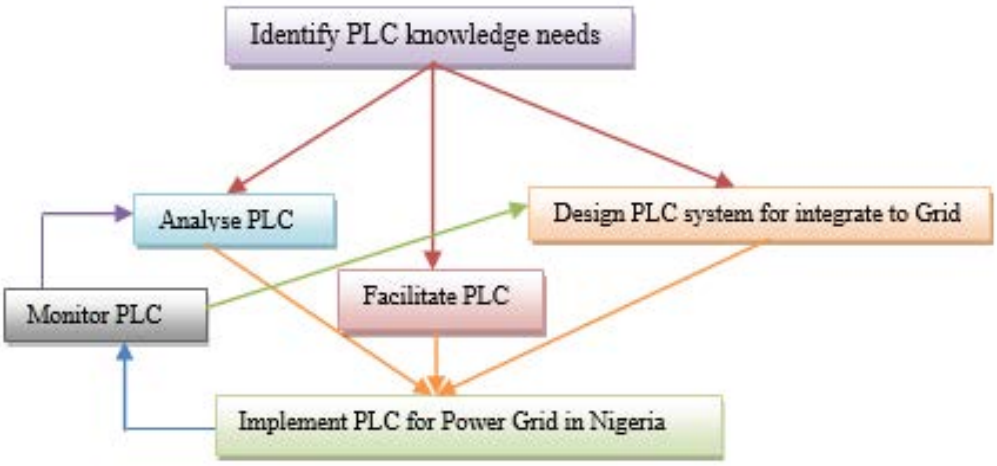


Figure 4: Action-Oriented Power Line Communication (PLC) Process.

Home Automation: Implementing PLC for home automation is a right choice for energy management and monitoring system. Home utility appliances be automated through efficient smart system and proffer a reliable consumption system.

Automotive Use: Power line communication technologies can be adopted towards in-vehicle network data communication system to informatics application.

Power Line Communication (PLC) Smart Operations

Stakeholders and power companies in the developed world have recognized the possibility of introduction of power line communication technologies into the existing traditional grid to buffer solution for organization challenges. This supports maximization of workforce, equipment to promote efficient and intelligent energy distribution networks called smart grid [14]. It comprises of artificial decision support system to enhance network robustness, efficiency and reliability. Smart grid has digital affinity for self-healing energy systems that deliver electricity or gas from generation sources, including distributed renewable sources to the end users'. It optimizes electrical energy delivery and facilitate two-way communication system across the grid, enabling end users' energy management, minimizing power disruptions and losses. The dividend of PLC will bridge gaps of knowledge diversity such as cost efficiency, reliability, system availability and information system.

Nigerian power companies communication structure: Making sense from KM

The Power Holding Company of Nigeria has 6 generation companies (GenCos), 1 transmission company (TransysCo) and 11 distribution companies (DisCo). The study observed lack of knowledge sharing and inadequate information system in the respective arms of power holding companies. Introduction of Power Line Communication could address these gaps through reversible and feedback auto-information system. To achieve this, GenCos, TransysCo and DisCos needs engineering organisational restructure towards process to positively accommodate current business challenges for the effectiveness of PLC technologies initiatives [15-17]. Furthermore, diffused knowledge will be unified towards a common goal and information sharing on PLC technologies efficacy will be enhanced. Knowledge Management (KM) tools such as home automation system, smart meters and intelligent grids system supported by email, internet, intranet, e-research journals will be established. This will buffer knowledge creation and information sharing in Nigerian power companies as revealed in Figure 5.

Power Line Communication (PLC) Technology Solution and Business Process

Integration of Power line communication (PLC) into the Nigerian national grid will offers several advantages with respect to current organisational gaps such as fault detection, electricity theft, information sharing and rural area limitations. Nigerian grid enhancement by the introduction of PLC could support high speed internet access to rural areas and promote reversible information sharing system. PLC will support system availability during load shedding and could address frequency variation during the peak period to address unplanned outage(s). Although, some factors may militate against efficacy of PLC technologies in the conceptual view of management towards organisational challenges.

Challenges of power line communication (PLC) and knowledge management (KM)

The challenge of knowledge management (KM) towards efficacy of power line communication PLC centred on human behavioural issue towards knowledge transformation.

a) **Knowledge acquisition:** This entails identification of knowledge gap through technical occurrence. This could arise during PLC security smart monitoring system for fault detection and electricity theft. However, the organisational response to address the gap posed challenge on designed process.

b) **Knowledge Modelling:** Modelling bridges the gap between the acquisition of knowledge and implementation through system simulation and evaluation. Knowledge model structures gives room for system replication without the consideration physical factors such as vandals and natural disasters (thunder storm).

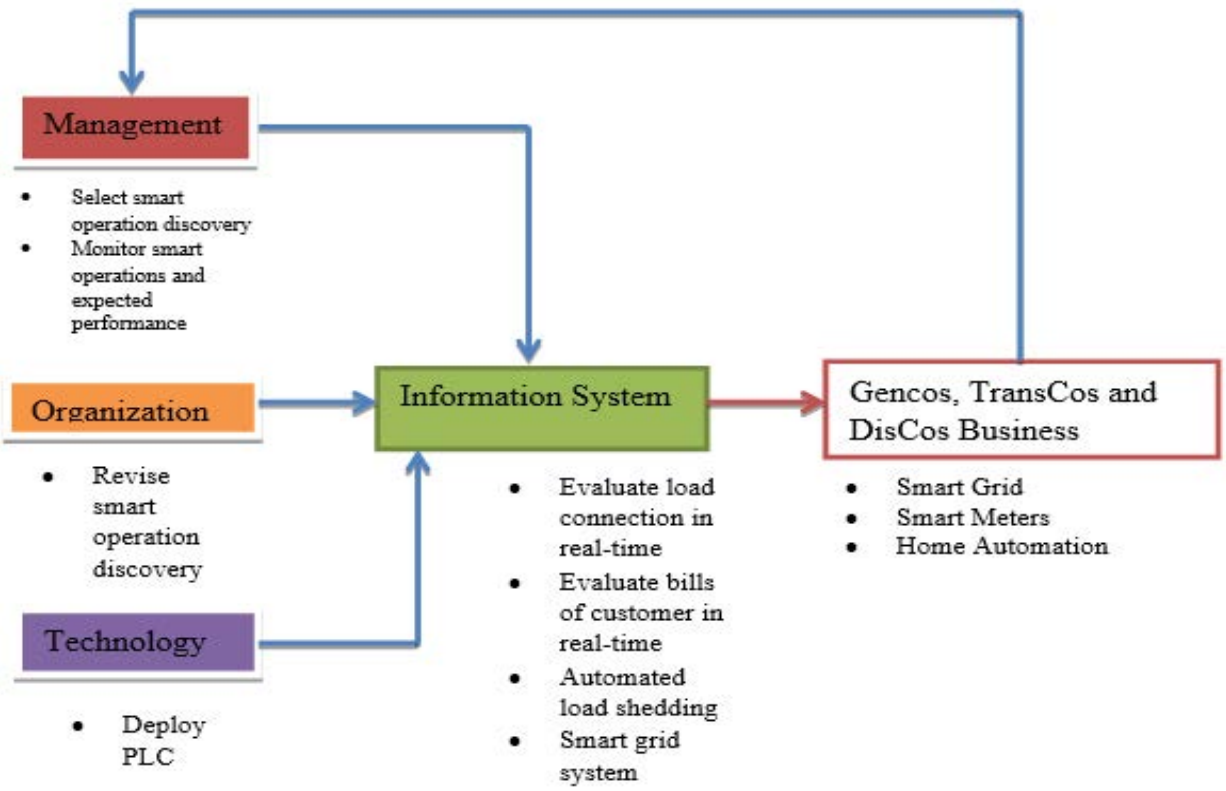


Figure 5: Communication Structure: Knowledge Management Concept.

c) **Knowledge retrieval:** Knowledge diversity is inevitable in a complex network but priority needs to place order of importance. Fault needs to be prioritized and needs to be address accordingly, this is to support PLC system availability. Complex transmission network could experience frequencies variation which a given less attention than problem on distribution. End users (distribution) should be given more attention to retrieve created knowledge towards sharing and proved efficiency.

d) **Knowledge reuse:** Knowledge reuse has always been organisational challenge in developing nations where skilled labour are insufficient. Maintenance culture tends to zero as the management have strong believe in replacement culture. However, this hinder research, knowledge sharing and cost effectiveness.

e) **Knowledge publishing:** Challenge of knowledge sharing such as communication art, publishing, seminar and conference could affect efficacy of PLC in Nigerian grid system. Sharing knowledge creation and evolution among the stakeholders could support common goals towards integration of PLC.

f) **Maintenance:** Organisational culture towards technical maintenance could hinder knowledge sharing and system availability. Furthermore, the Nigerian existing grid needs general overhauling to synchronise with PLC technologies. Adequate maintenance system will promote cost effectiveness towards failure and improve reliability. Also, this involves regular network updates of content and changes in the technical structure.

Conclusion

Knowledge Management (KM) is an organizational approach that can be implemented to promote system efficacy and availability. The study review knowledge sharing in the introduction of power line communication (PLC) into the Nigerian existing national grid in the conceptual view of KM. An organisational structure is proposed to support effective PLC initiative to the existing national grid (Figure 5). Therefore, corporate organizations in the power sector should be sensitive to knowledge evolution for robust and intelligent network. Furthermore, management of Power Holding Company of Nigeria (PHCN) needs to implement knowledge management (KM) concept to unify organisational disjointed knowledge and promote engineering efficacy towards common goals of PLC technology initiative. Future study aim to investigate channel capacity and energy management for the integration of PLC to the Nigerian existing grid through modelling.

References

1. Bhojaraju G (2005) Knowledge Management: Why do we need it for Corporates. Malays J Libr Inf Sc 10: 37-50.
2. Hrasnica H, Haidie A, Lehnert R (2004) Broadband Powerline Communications: Network Design, John Wiley and Sons Ltd, USA.
3. Apena WO, Adebanjo IA, Olasoji YO, Akingbade KF, Oyetunji SA, et al.(2016) Knowledge Management Perspective in Communication Security System. Bri J Math Comp Sci 13: 1-9.
4. Mlynek P, Koutyny M, Misurec J (2010) Power Line Modelling for Creating Power Line Communication System. Int J Commun 4: 13-21.
5. Apena WO, Olasoji YO, Oyetunji SA, Akingbade KF, Adegoke OA et al, (2015) Iintorduction of Fingerprint Biometric Technology in Nigeria Banking System: A Knowledge-Based Security Perspective. IJESRT 4: 677-686.
6. Edwards J (2011) A Process View of Knowledge Management: It Ain't What you do, it's the way That you do it. EJKM 4: 297-306.

7. Leavitt H, Cooper W, Shelly M (1964) Applied Organization Change in Industry: Structural, Technical and Human Approaches. New Perspectives in Organization Research 55-71.
8. Kulkani R, Ravindran S, Freeze R (2007) A Knowledge Management Success Model: Theoretical Development and Empirical Validation. J Manag Info Syst 23: 309-347.
9. Dike DO, Obiora UA, Nwokorie EC, Dike BC (2015) Minimizing Household Electricity Theft in Nigeria Using GSM Based Prepaid Meter. AJER 4: 59-69.
10. Yigit M, Gungor VC, Tuna G, Rangoussi M, Fadel E (2014) Power line communication technologies for smart grid applications: A review of advances and challenges, Comput Netw 70: 366-383.
11. Rahul T (2004) Can Broadband over Power Line Carrier (PLC) Compete?. A Techno-Economic Analysis.
12. Goldhar J, Jelinek M (1983) Plan of Economies of Scope. Harvard Business Review 141-148.
13. Garud R, Kumaraswamy A (2002) Technological and Organizational Designs for Realizing Economies of Substitution, in Choo CW, Bontis N, The Strategic Management of Intellectual Capital and Organizational Knowledge. Oxford University Press, USA.
14. Gungor VC, Sahin D, Kocak T, Ergut S, Buccella C, et al. (2011) Smart Grid Technologies: Communication Technologies and Standards. IEEE Trans Ind Informat 7: 529-539.
15. Perner L (2008) Consumer Behaviour. Department of Marketing Marshall School of Business University of Southern California Los Angeles 213: 740-7127.
16. Sackmann S (1991) Cultural Knowledge in Organizations: Exploring the collective mind. Newbury Park, CA, Sage, USA.
17. Shadbolt N, Hara O, Kieron (2003) An Overview of the Aims, Ambitions and Assumptions of the Advanced Knowledge Technologies. Interdisciplinary Research Collaboration. Aktuality.

Author Affiliation

Top

Department of Electrical and Electronic Engineering, The Federal University of Technology, PMB 704, Akure, Nigeria