

# Conceptual Model of Technological Change on Telecentre Effectiveness

Zahurin Mat Aji<sup>1</sup>, Nor Iadah Yusop<sup>1</sup>, Faudziah Ahmad<sup>2</sup>, Azizi Ab. Aziz<sup>2</sup> & Zaid M. Jawad<sup>2</sup>

<sup>1</sup> Public Enterprise Computing Research Platform, School of Computing, Universiti Utara Malaysia, Malaysia

<sup>2</sup> Human Centred Computing Group, Artificial Intelligence Research Platform, School of Computing, Universiti Utara Malaysia, Malaysia

Correspondence: Nor Iadah Yusop, School of Computing, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia. Tel: 60-4928-5132. E-mail: [noriadah@uum.edu.my](mailto:noriadah@uum.edu.my)

Received: February 13, 2015

Accepted: March 22, 2015

Online Published: March 17, 2016

doi:10.5539/cis.v9n2p10

URL: <http://dx.doi.org/10.5539/cis.v9n2p10>

*This research is funded by the Universiti Utara Malaysia.*

## Abstract

Telecentre effectiveness is highly related with involvement of people in the community and has been measured by the socio-economic benefit gained from the telecentre. One of the important aspects that are often overlooked in the assessment of telecentre effectiveness is the technological change. It is referred to as the overall process of continuous invention, innovation and diffusion of technology that aims at improving the quality of telecentre operations. This paper presents a conceptual model of technological change on telecentre effectiveness. In achieving this, extensive reviews of literature on related concepts were performed. Several elements of technological change that are expected to have impact on telecentre effectiveness were identified. These elements were categorized into three dimensions of technological change process, which are in accordance with the Linear Model of Innovation namely invention, innovation and diffusion. This model can be used as a basis towards getting empirical evidence on the impact of technological change on telecentre operations.

**Keywords:** technological change, ICT, telecentre, effective usage

## 1. Introduction

Telecentre is commonly associated with Information and Communication Technology (ICT) for development projects (Mishra, 2013). Telecentres are considered as one of the most successful projects of ICT diffusion in developing countries, particularly the poor and people living in remote rural areas (Rajalekshmi, 2007). According to Gomez *et al.* (2012) and Norizan *et al.* (2010), telecentre is a place where ICT facilities such as computers, and Internet services, training, and Internet access are provided to the rural community. Telecentre is a public place where people can find information, create, learn, and communicate with others while developing digital skills through access to information and communication technology (Telecentre.org). The Economic Planning Unit of the Prime Minister Department of Malaysia defines telecentre as a one-stop centre that provides Information and Communication Technology (ICT) and Internet services to various local communities in improving their socio-economic status (EPU, 2007). Telecentres are much like Internet cafés, except that they are placed in underserved communities with the deliberate intention of accelerating their socio-economic growth. Telecentres are often initiated by private or public business initiatives, which provide communities with information and telecommunication services, with the aim of achieving a variety of development objectives (Bailey & Ngwenyama, 2009; Proenza, 2001; Rao, 2008; Bishop & Bruce, 2005).

Telecentres exist in almost every developing country (Harris, 2007) under a variety of names: Internet centre, community centre, community technology centre, online access centre, electronic village halls, communal computing facilities, multipurpose communication centres, and many others. Previous findings showed that communities have opportunities to improve their access to information, job creation, skill development, study opportunities, and increased income, due to effective utilization of telecentre (Bailey & Ngwenyama, 2013; Zamani-Miandashti *et al.*, 2013; Buhigiro, 2012). It was also found that it could enhance information dissemination related to e-government services, e-health as well as e-banking with the aim to improve the

targeted community's socio-economic conditions (Huda *et al.*, 2010).

However, a number of studies have reported that telecentres did not live up to their potential as most of the rural community did not foresee the importance of ICT (Doshi & Gollakota, 2011; Sey & Fellows, 2009; Huda *et al.*, 2009). Telecentre can be a mean to accelerate economic growth (Toyama, 2011) provided that the users are able to take advantage of the technological infrastructure and services offered in the telecentre (Bar *et al.*, 2013). This is feasible if the users possess certain ICT skills and must see the needs to use the telecentre (Bar *et al.*, 2013; Wang & Shih, 2009). This is also important to ensure sustainability of telecentre operation (Stoll, 2008). However, as the users are mainly from the rural areas and usually are not techno-savvy, the advancement and changes in technologies do give impact to them and thus affect the usage of the telecentre. This is worsened as technology changes very rapidly. Technology or ICT infrastructure is one of the important elements in ensuring the successful and effective usage of a telecentre (Bar *et al.*, 2013; Lo *et al.*, 2013; Bashir *et al.*, 2011; Toyama, 2011; Norizan, 2009; Wan Rozaini *et al.*, 2007; Rao, 2004). According to Reddi (2011), "the availability of telecommunications infrastructure is a precondition to the use of ICT4D (ICT for development) and must be addressed; while issues of access are based as much on technology factors as they are on the enabling environments (economic, social and regulatory) that has to be planned for". In order to sustain the usage of the telecentre, access only is not enough, the available technology needs to be enhanced and innovated (Bar *et al.*, 2013; Lo *et al.*, 2013; Bashir *et al.*, 2011; Reddi, 2011). At the same time, the selection of appropriate technologies for the rural communities should emphasize on the cost effectiveness for rural connectivity and information processing solutions (Ab-Hamid, 2011; Reddi, 2011; Crabtree, 2006). Technological change has an impact on telecentre in terms of infrastructure, costs, IT services, and information accessibility (Meng *et al.*, 2013; Garrido *et al.*, 2012; Gomez, 2011; Jimoyiannis, 2010). A study conducted by Qureshi and Trumbly-Lamsam (2008) showed that technological change provides easy and affordable access to ICT resources and thus, have assisted individual in acquiring useful information. Hence, to remain in line with the needs of the community, telecentre needs to be innovative in diversifying its services (Lo *et al.*, 2013) and thus provides convenience towards the effective usage of telecentre.

Technological change is defined as an expression used to illustrate the overall process of invention, innovation and diffusion of technology. Rapid improvement of technology contributed to knowledge through engaging people and making new resources accessible and affordable for them. Easy access to IT has created a substantial effect to telecentre environments through the usage of the new technology devices (Kremer & Maskin, 2003). The innovation in technology has helped towards the accomplishment of societal development through user involvement (Qureshi, 2013; Wang & Shih, 2009; Qureshi & Trumbly-Lamsam, 2008; Harris, 2001). However, most studies on telecentre effectiveness have not specifically focused on technological change. Hence, a conceptual model that focuses on technological change on telecentre effectiveness, in particular from the dimensions of invention, innovation, and diffusion is proposed. These dimensions are adopted based on Linear Model of Innovation suggested by Godin (2013), Godin (2006), and Roman (2003).

## 2. Telecentre Effectiveness

The concept of telecentre was first introduced in the early eighties in the Nordic countries particularly in Denmark where it is known as telecottage. Telecentre later spread to other countries such as Europe, North America and Australia (Proenza, 2001). Telecentre, also known as multi-purpose community telecentres, public Internet access points, or information kiosks, is an avenue for providing ICT services to rural communities (Gomez, 2011; Best & Kumar, 2008). In line with this, this study adopts the definition by Bailey and Ngwenyama (2009) that define a telecentre as a place where public can have access to ICT facilities and services for economic, social and cultural development.

In general, telecentre can be described as a mechanism, which uses ICT to support a community's economic, social and educational development, bridging the digital divide, and empowerment. In a telecentre, Internet and computer services (ICTs) are provided to the rural community enabling the rural populace who are mostly farmers to increase their income through improved productivity and marketing (Doshi & Gollakota, 2011). Global growth in ICTs industry has created an awareness of the ability of ICTs to transform lives and alleviate poverty. Hence, the use of ICT in enhancing socio-economic development of the targeted community has been used as a dimension in determining telecentre effective usage (Bar *et al.*, 2013; Meng *et al.*, 2013; Doshi & Gollakota, 2011; Reddi, 2011; Toyama, 2011; Bailey & Ngwenyama, 2009).

Several frameworks have been developed to assess the effectiveness of telecentres using various factors such as technology infrastructure, services, technology adoption, and information accessibility (Meng *et al.*, 2013; Naik *et al.*, 2012; Bailey & Ngwenyama, 2009). In addition, the deployment of new technologies has vital impact on

individuals' utilization and satisfaction of telecentre effectiveness (Doshi & Gollakota, 2011; Abdulwahab & Zulkhairi, 2010). These factors revolve around the issue related to user satisfaction (Huda *et al.*, 2010; Gurstein, 2007), improvement of socio-economic (Garside, 2009; Rothenberg-Aalami & Pal, 2005), sustainability (Avgerou, 2010; Proenza, 2001), impact (Avgerou, 2010; Roman, 2003), best practice (Avgerou, 2010; Roman, 2003), telecentre governance (Zahurin *et al.*, 2009; Hudson, 2001), technological infrastructure (Meng *et al.*, 2013; Cheuk *et al.*, 2012; Bashir *et al.*, 2011; Zahurin *et al.*, 2010), and technology deployment (Lashgarara *et al.*, 2012; Bailey & Ngwenyama, 2009). In addition to these challenges and issues on telecentres effectiveness, issues related to technological change are yet to be explored.

### 3. Technological Change

Technological change refers to the rapid and radical changes and development in ICT. The concept of technological change, also known as technological progress (Hritonenko & Yatsenko, 2013), connotes "the presence of a self-sustaining mechanism of cumulative productivity growth". The issue related to technological change has gained attention in recent years due to various incidents whereby established organization being left behind and taken over by other organizations that are more innovative in using technologies strategically for the survival of their businesses. The scenario in which new firms replacing old ones is not new, but has been accelerated in recent years and thus made much more apparent, especially in rapidly developing fields such as ICT (Benson & Magee, 2012).

According to Crabtree (2006), technological change is based on continuous improvement of technology in a more cheaper and affordable medium to achieve social and economic development. In the same study, technology has been defined in term of space matrix. The space matrix is made of three dimensions of technology elements namely the average value by technology element unit, types of technology elements, and number of technology element units. Technology element refers to the specific type of goods, services or processes. Technology, at a given point in time, can be represented by the presence of these elements, the extent of the diffusion of those elements in economy and society, and the value contributed by each technology element unit, either individually or in conjunction with other elements. This definition is based on the principle of goods, service and process, which is similar to Jaffe *et al.* (2002).

Technological change, which is used interchangeably with technology development or technology advancement, describes the overall processes of invention, innovation and diffusion of processes or technology (Jaffe *et al.*, 2002). The term is also synonymous with technological achievement, and technological progress. They described technological change as the invention of a technology (or a process), followed by the continuous process of improving a technology, and subsequently its diffusion throughout the industry or society. One of the earlier models used to explain technological change process is the Linear Model of Innovation of Godin (2006). It was developed as a theoretical framework to understand science and technology in relation to the economy. The model suggests that change happens in a linear fashion from invention to innovation to diffusion as shown in the Figure 1. This model was also referred to as the traditional phase gate model because the concept of gates and gatekeeper was used to illustrate it (Rothwell, 1994). It involves series of sequential phases arranged in such a manner that the preceding phase must be completed before moving to the next phase. The project is assumed to pass through a gate (phase change) with the permission of the gatekeeper (task completion check) before moving to the next succeeding phase. Hence, technological change has been represented by the process stages of invention, innovation, and diffusion (Godin, 2006). These processes are described next.

#### 3.1 Invention

Invention denotes the development of new idea that can transform product, process or services. As observed by (Antonelli *et al.*, 2013), inventions and scientific breakthroughs have the capability of making some portions of the stock of knowledge or technologies obsolete. It involves studying the relationship between complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers. Shaista (2006) argued that research and development (R&D) efforts resulted into invention and creation of new ideas. In this paper, invention can be regarded as an act or process of introducing something new or making a significant change to an existing system. Invention is found to be influenced by research and development (R&D), government policy, and technological knowledge. R&D efforts produce new ideas that lead to invention (Ma & Nakamori, 2008; Dawid, 2006). Government policy plays significant moderating roles in technological change process through various policies such as funding, operational or patent (Makri *et al.*, 2010). In addition, Makri *et al.* (2010) and Crabtree (2006) also indicate that technological knowledge is an essential ingredient of invention.

#### 3.2 Innovation

Innovation is an economic undertaking aimed at developing or enhancing the quality of product, process or

services that produce novelty, thus it is considered as a very important determinant of technological change (Hekkert *et al.*, 2007). It connotes the ability to blend and weave together several kinds of knowledge to yield completely new, unique and of economic value products or services as knowledge represents a decisive input for innovation (Feldman, 2002). Moreover, the success of any innovation is measured by its success at market place based on the quality of service and societal impact in terms of economic wellbeing, growth and success. Successful innovation requires organizational changes and collaboration at process level as well as conversion of idea into a marketable product (Verloop, 2004). Breakthrough in innovation is highly dependent upon accumulated knowledge in a particular field. Likewise, successful innovation requires organizational changes at process level as well as conversion and collaboration of idea into commercially product adopted in the market (Verloop, 2004). Another factor that can influence innovation is the infrastructural sustainability. Within the context of this study, infrastructure sustainability refers to technological sustainability, as technology is part of infrastructure (Meng *et al.*, 2013; Cheuk *et al.*, 2012; Bashir *et al.*, 2011; Zahurin *et al.*, 2010). The current state of technology, capability and high deployment rate of technology are found to affect innovation (Nor Iadah *et al.*, 2010; Ali & Bailur, 2007). Hence, innovation success is determined by rate of adoption or diffusion.

### 3.2 Diffusion

Diffusion refers to the number of usage or rate of adoption of an innovation and also serves as a mean of measuring the level of utilization of a particular product or services (Crabtree, 2006). It represents the last and crucial stage in the linear model of technological change. Rogers (1985) described diffusion as a process by which innovation spread across society through communication channels. The rate of service diffusion, which is the dynamism of individual attention to the service being provided, is influenced by the affordability (cost), level of innovation, and satisfaction, derived from such services. Thus, if the level of innovation is high, cost is affordable and the service satisfactory, this may enhance commitment to short-term utilization and if this continues over time, individual commitment grows and thus triggers long-term utilization that aid effectiveness.

## 4. Technological Change Impacts on Telecentre

Technological change has been recognized as an important driver of effective growth and the emergence of new technologies from which user derive the perceived benefits (Misuraca & Viscusi, 2014; Dillon & Morris, 1996). It depends not only on the work of scientists and engineers, but also on a wider range of technological markets (Sun *et al.*, 2012). A study by Hlungulu (2010) mentioned that technological change presents special opportunities to the social and geographical marginalized communities. It is observed that technologies like wireless communications permit easier integration of marginal areas that could not be connected physically (hard wired). The interactive capacities of these new technologies offer an added advantage of allowing previously marginalized communities to transmit information symmetrically.

The advancement and proliferation of technological products as in many ways affect telecentre effectiveness (Huda *et al.*, 2010). This effectiveness can either be seen between the telecentre management and end-users, in whichever case; there is always an applicable technological device to smoothen the relationship. This suggests that technological change can have direct effect on telecentre utilization (Pick & Nishida, 2014), and user satisfaction (Yen & Lu, 2008), thus telecentre effectiveness. Tidd and Bessant (2011) suggested that technological change is the most influential and vital source for economic development. Technological change has a great influence on user satisfaction and utilization in particular with the innovation of attractive and enjoyable devices (Nusair & Kandampully, 2008; Cyr *et al.*, 2006). Technological change and telecentres can facilitate community access to information for socio-economic development purposes (Nusair & Kandampully, 2008; Cyr *et al.*, 2006).

## 5. Applying the Linear Model of Innovation in Conceptualizing Technological Change for Telecentre Effectiveness

Roman (2003) emphasized on the importance of evaluating telecentre effectiveness particularly on economic and social as the results will presumably have important policy implications. Telecentre is regarded as an innovation in itself by Cheang (2015), Ghimire (2012), and Roman (2003). In line with that, Chander *et al.* (2014) considered telecentre as an innovation broker whereby local level of R&D activities can stimulate local innovation thereby lead to better quality of life of the community. In this study, Godin's (2006) Linear Model of Innovation (Figure 1) is used as it is found to be appropriate in understanding the impact of technological change on telecentre effectiveness. Based on the literature as mentioned in Section 3.1 – 3.3, the following factors are extracted to measure each phase in the model:

**Invention:** research and development, government policies, technological knowledge.

**Innovation:** technological sustainability, collaboration, technological knowledge, and Invention

**Diffusion:** satisfaction, cost, and innovation.

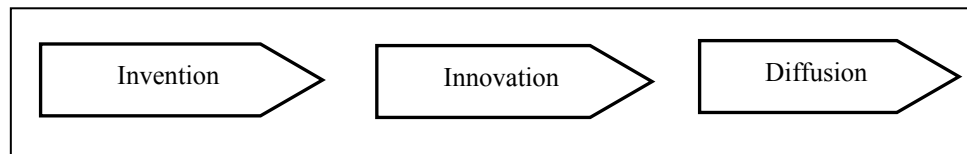


Figure 1. The Linear Model of Innovation (Godin, 2006)

The relationships of the three processes are illustrated as the conceptual model of technological change for telecentre effectiveness as shown in Figure 2. The relationships are derived based on the Linear Model of Innovation. In relating the involved processes with telecentre effectiveness, Invention exists if there is an improvement in research and development or government policies. In addition, adequate adoption of technological knowledge will also contribute to invention. Apart from Invention, Innovation occurs when there are technological sustainability, collaboration, and technological knowledge. In terms of technological sustainability, adequate provision of technological amenities that support services delivery enhances the rate of effectiveness, also updating technical knowledge on efficient services. This will contribute to the level of invention as well as innovation (Makri *et al.*, 2010). Innovation has the aim to develop or enhance the quality of product, process or services that produce novelty. With respect to telecentre operations, ICT facilities, the current state of technology, and market demand of services can be classified as elements of innovation (Crespi & Pianta, 2008). Diffusion happens when the level of innovation is high, cost is affordable and the service is satisfactory. This may enhance commitment to utilization and if this continues over time, individual commitment grows and this will lead to effectiveness.

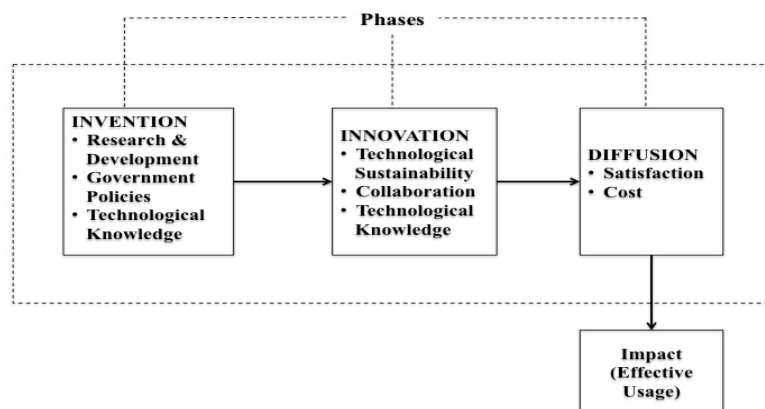


Figure 2. Conceptual Model of Technological Change for Telecentre Effectiveness

#### 4. Conclusion and Recommendations

Research on the impact of technological change on telecentre effectiveness have identified several elements of technological change process that can be classified into three dimensions namely invention, innovation, and diffusion which is in accordance with the Linear Model of Innovation. For the invention dimension, three elements namely research and development, government policy, and technological knowledge have been associated to give impact on it. The innovation dimension is affected by elements such as collaboration, technological knowledge, technological sustainability and invention. The last dimension, diffusion, is affected by the affordability, level of innovation, and satisfaction, gained from the services provided by the telecentre. This clearly reflects the dependency of innovation on invention, and diffusion on innovation. This model is regarded as a contribution in assessing telecentre effectiveness in particular, on the impact of technological change. The model provides a basis for researchers to further explore the relationship of technological change and telecentre effectiveness using various techniques such as simulation or statistical approaches, towards getting more empirical evidence on the issue.

## Acknowledgments

We are grateful for the Universiti Utara Malaysia in funding this research work.

## References

- AbdulWahab, L. (2012). A Modified of the Unified Theory of Acceptance and Use of Technology (UTAUT) from Users' Perspective of Telecentre in Nigeria. Universiti Utara Malaysia.
- Abdulwahab, L., & Zulkhairi, M. D. (2010). A Conceptual Model of Unified Theory of Acceptance and Use of Technology (UTAUT) Modification with Management Effectiveness and Program Effectiveness in Context of Telecentre. *African Scientist*, 11(4), 267-275.
- Ab-Hamid, K., Tan, C. E., & Lau, S. P. (2011, December). Self-sustainable energy efficient long range WiFi network for rural communities. In GLOBECOM Workshops (GC Wkshps), 2011 IEEE (pp. 1050-1055). IEEE.
- Ali, M., & Bailur, S. (2007, May). The challenge of “sustainability” in ICT4D—Is bricolage the answer. In *Proceedings of the 9th international conference on social implications of computers in developing countries*.
- Antonelli, C., Crespi, F., & Scellato, G. (2013). Internal and External Factors in Innovation Persistence. *Economics of Innovation and New Technology*, 22(3), 256-280.
- Avgerou, C. (2010). Discourses on ICT and Development. *Information Technologies & International Development*, 6(3), 1-18.
- Bailey, A., & Ngwenyama, O. (2009). Social Ties, Literacy, Location and the Perception of Economic Opportunity: Factors Influencing Telecentre Success in a Development Context. Proceedings of the 42nd Hawaii International Conference on System Sciences.
- Bailey, A., & Ngwenyama, O. (2013). Toward entrepreneurial behavior in underserved communities: An ethnographic decision tree model of telecenter usage. *Information Technology for Development* (ahead-of-print), 1-19.
- Bar, F., Coward, C., Koepke, L., Rothschild, C., Sey, A., & Sciadas, G. (2013, December). The impact of public access to ICTs: findings from a five-year, eight-country study. In Proceedings of the Sixth International Conference on Information and Communication Technologies and Development: Full Papers-Volume 1 (pp. 34-42).
- Bashir, M. S., Samah, B. A., Emby, Z., Badsar, M., Shaffril, H., & Aliyu, A. (2011). Information and Communication Technology Development in Malaysia: Influence of Competency of Leaders, Location, Infrastructures and Quality of Services on Telecentre Success in Rural Communities of Malaysia. *Australian Journal of Basic and Applied Sciences*, 5(9), 1718-1728.
- Benson, C. L., & Magee, C. L. (2012). A framework for analyzing the underlying inventions that drive technical improvements in a specific technological field. *Engineering Management Research*, 1(1), 2.
- Best, M. L., & Kumar, R. (2008). Sustainability failures of rural telecenters: Challenges from the sustainable access in rural india (sari) project. *Information Technologies & International Development*, 4(4), 31-45.
- Bishop, A. P., & Bruce, B. (2005). Community Informatics: Integrating Action, Research & Learning. *Bulletin of the American Society for Information Science and Technology* (Aug/Sept 2005), 6.
- Buhigiro, S. (2012). The Role of Telecentres in Promoting Socio-Economic Development in Rwanda (Master's dissertation), Faculty of Commerce, Law and Management, University of the Witwatersrand, South Africa. <http://wiredspace.wits.ac.za/bitstream/handle/10539/12464/BUHIGIRO%20Seth%20-Research%20Report-Final%20300412.pdf?sequence=1>.
- Chander, M., Rathod, P., & Balaraju, B. L. (2014, September) Rural Telecentres as Innovation Brokers in Livestock Innovation System in India: A Review. *Indian Res. J. Ext. Edu.*, 14(3), 14-23.
- Cheang, S. (2015). Efficiency and Effectiveness of Telecenters: A Case Study on ICT4D in Cambodia. In *Human Centered Computing* (pp. 656-669). Springer International Publishing.
- Cheuk, S., Atang, A., & Lo, M. C. (2012). Community Attitudes towards the Telecentre in Bario, Borneo Malaysia: 14 Years on. *International Journal of Innovation, Management and Technology*, 682-687.
- Crabtree, P. (2006). A Framework for Understanding Technology and Technological Change. *The Innovation Journal: The Public Sector Innovation Journal*, 11(1), 1-16.

- Crespi, F., & Pianta, M. (2008). Demand and innovation in productivity growth. *International Review of Applied Economics*, 22(6), 655-672.
- Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. *Information & Management*, 43(8), 950-963.
- Dawid, H. (2006). Agent-Based Models of Innovation and Technological Change. *Handbook of Computational Economics*, 2, 1235-1272.
- Dillon, A., & Morris, M. G. (1996). User Acceptance of New Information Technology: Theories and Models. Annual review of information science and technology.
- Economic Planning Unit (EPU) (2007). Rangka Kerja Strategik Kebangsaan bagi Merapatkan Jurang Digital (NSF-BDD), presented at Bengkel Pusat Perkhidmatan dan Ilmu Komuniti Peringkat Negeri Pulau Pinang, 13 Jun 2007. (in Malay)
- Garrido, M., Sey, A., Hart, T., & Santana, L. (2012). Literature Review of How Telecentres Operate and have an Impact on e-inclusion: European Union.
- Garside, B. (2009). Village voice: towards inclusive information technologies: IIED.
- Godin, B. (2006). The Linear Model of Innovation: The Historical Construction of an Analytical Framework. *Science, Technology & Human Values*, 31(6), 639-667.
- Godin, B. (2013). *Invention, Diffusion and Linear Models of Innovation, Project on the Intellectual History of Innovation Working Paper No. 15*. Retrieved from <http://www.csiic.ca/PDF/AnthropologyPaper15.pdf>.
- Gollakota, K., & Doshi, K. (2011). Diffusion of Technological Innovations in Rural Areas. *Journal of Corporate Citizenship*, 2011(41), 69-82.
- Gómez, R. (Ed.). (2011). Libraries, Telecentres, Cybercafes and Public Access to ICT: International Comparisons: IGI Global.
- Gomez, R., Pather, S., & Dosono, B. (2012). Public access computing in South Africa: Old lessons and new challenges. *The Electronic Journal of Information Systems in Developing Countries*, 52.
- Gurstein, M. (2007). What is Community Informatics (and Why Does It Matter)? Milan: Polimetrica SAS.
- Harris, R. (2001). Telecentres in Rural Asia: Towards a Success Model. *Europe*, 40(23.4), 13-7.
- Harris, R. W. (2007, July 10-12). *Telecentre Evaluation in the Malaysian Context*. Paper presented at the The 5th International Conference on IT in Asia, Hilton Hotel, Kuching, Sarawak, Malaysia.
- Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74(4), 413-432.
- Hlungulu, B. (2010). Building a semantic web based e health component for a multipurpose communication centre (Doctoral dissertation, University of Fort Hare).
- Hritonenko, N., & Yatsenko, Y. (2013). Introduction: Principles and Tools of Mathematical Modeling Mathematical Modeling in Economics, Ecology and the Environment (pp. 1-22): Springer.
- Huda, I., Azman, Y., & Zulkhairi, M. D. (2010). Financial sustainability issues in Malaysia's telecentres. *Computer and Information Science*, 3(2), 235.
- Huda, I., Nor Iadah, Y., Zahurin, M. A., Zulkhairi, M. D., & Mohd Khairudin, K. (2010). Lessons Learnt in the Implementation of Pusat Komuniti Pintar. Proceeding of the National Conference on Rural ICT Development (RICTD 2010): Empowering Rural Communities through Broadband Initiatives, EDC UUM Sintok, Kedah, Malaysia, 23-25 November.
- Hudson, H. E. (2001). Telecentre Evaluation: Issues and Strategies. Telecentres: Case Studies and Key Issues, 169.
- Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2002). Environmental Policy and Technological Change. *Environmental and Resource Economics*, 22(1-2), 41-70.
- Jimoyiannis, A. (2010). Designing and Implementing an Integrated Technological Pedagogical Science Knowledge Framework for Science Teachers Professional Development. *Computers & Education*, 55(3), 1259-1269.
- Kremer, M., & Maskin, E. (2003). Globalization and Inequality. Harvard University, Department of Economics.

Unpublished manuscript.

- Kumar, R., & Best, M. L. (2007). Social impact and diffusion of telecenter use: A study from the sustainable access in rural India project. *The Journal of Community Informatics*, 2(3).
- Lashgarara, F., Karimi, A., & Mirdamadi, S. M. (2012). Effective factors on the villagers' use of rural telecentres (case study of Hamadan province, Iran). *African Journal of Agricultural Research*, 7(13), 2034-2041.
- Lo, M. C., Songan, P., Cheuk, S., Atang, A., & Yeo, A. W. Communities' Attitudes towards Telecentre and Its Impact on Rural Tourism. *International Journal of Innovation, Management and Technology*, 4(6), December 2013.
- Ma, T., & Nakamori, Y. (2008, October). Coping with uncertainties in endogenous technological change models. In Systems, Man and Cybernetics, 2008. SMC 2008. IEEE International Conference on (pp. 845-850). IEEE.
- Makri, M., Hitt, M. A., & Lane, P. J. (2010). Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions. *Strategic Management Journal*, 31(6), 602-628.
- Meng, C. C., Samah, B. A., & Omar, S. Z. (2013). A Review Paper: Critical Factors Affecting the Development of ICT Projects in Malaysia. *Asian Social Science*, 9(4), 42.
- Mishra, G. (2013). Role of telecenters in empowering citizens: A case study of 'Mahiti Mitra' project in Kutch district of Gujarat, India. Paper presented at the Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS), 2013 IEEE.
- Misuraca, G., & Viscusi, G. (2014, October). Digital governance in the public sector: challenging the policy-maker's innovation dilemma. In *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance* (pp. 146-154). ACM.
- Naik, G., Joshi, S., & Basavaraj, K. (2012). Fostering Inclusive Growth through E-Governance Embedded Rural Telecenters (EGERT) in India. *Government Information Quarterly*, 29, S82-S89.
- Nor Iadah, Y., Shafiz, A. M. Y., Zahurin, M. A., Huda, H. I., Khairudin, K., Zulkhairi, Md. D. Nor Farzana, A.G., Rafidah, A. R., Syahida, H., & Abdul, R. R. (2010). The Influence of Community Characteristics towards Telecentres Success. *Computer and Information Science*, 3(2), 116-120. [ISSN 1913-8989 (Print), ISSN 1913-8997 (Online)]
- Norizan, A. R. (2009). Empowering the Rural Communities via the Telecentres. *European Journal of Social Sciences*, 9(3).
- Norizan, A. R., Zaharah, H., & Rosseni, D. (2010). Bridging the Digital Divide: An Analysis of the Training Program at Malaysian Telecenters.
- Nusair, K. K., & Kandampully, J. (2008). The Antecedents of Customer Satisfaction with Online Travel Services: A Conceptual Model. *European Business Review*, 20(1), 4-19.
- Pick, J. B., & Nishida, T. (2015). Digital Divides in The World and Its Regions: A Spatial and Multivariate Analysis of Technological Utilization. *Technological Forecasting and Social Change*, 91, 1-17.
- Proenza, F. J. (2001). Telecenter sustainability: Myths and opportunities. *The Journal of Development Communication*, 12(2), 94-109.
- Qureshi, S. (2013). Information and Communication Technologies in the Midst of Global Change: How do we Know When Development Takes Place? *Information Technology for Development*, 19(3), 189-192.
- Qureshi, S., & Trumbly-Lamsam, T. (2008). Transcending the Digital Divide: A Framing Analysis of Information and Communication Technologies News in Native American Tribal Newspapers. Paper presented at the Hawaii International Conference on System Sciences, Proceedings of the 41st Annual.
- Rajalekshmi, K. G. (2007). E-governance services through telecenters: The role of human intermediary and issues of trust. *Information Technologies & International Development*, 4(1), 19-35.
- Rao, S. S. (2008). Social development in Indian rural communities: Adoption of telecentres. *International Journal of Information Management*, 28(6), 474-482.
- Rao, T. R. (2004). ICT and e-Governance for Rural Development. Center for Electronic Governance, Indian Institute of Management, Ahmedabad.
- Reddi, U. R. V. (2011). Primer 1: An Introduction to ICT for Development, A learning resource on ICT for



- development for institutions of higher education, Primer Series on ICTD for Youth, Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT), UN-APCICT/ESCAP.
- Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed). Free Press.
- Roman, R. (2003). Diffusion of Innovations as a Theoretical Framework for Telecenters. *Information Technologies & International Development*, 1(2), 53-66.
- Rothenberg-Aalami, J., & Pal, J. (2005). "Rural Telecenter Impact Assessments and the Political Economy of ICT for Development (ICT4D)", Berkeley Roundtable on the International Economy (BRIE), University of California, Berkeley, UC Berkeley. Retrieved from <http://128.48.120.222/uc/item/18q2282h>
- Rothwell, R. (1994). Towards the Fifth-Generation Innovation Process. *International Marketing Review*, 11(1), 7-31.
- Sey, A., & Fellows, M. (2009). Literature Review on the Impact of Public Access to Information and Communication Technologies, CIS Working Paper No. 6, Global Impact Study of Public Access to Information & Communication Technology, University of Washington's Center for Information & Society (CIS), [www.cis.washington.edu](http://www.cis.washington.edu).
- Stoll, K. (2008). The Future of Telecenter Sustainability: A Multi-Sector and Multi-Stakeholder Approach.
- Sun, Y., Fang, Y., Lim, K. H., & Straub, D. (2012). User satisfaction with information technology service delivery: A social capital perspective. *Information Systems Research*, 23(4), 1195-1211.
- Toyama, K. (2011, February). Technology as amplifier in international development. In Proceedings of the 2011 iConference, pp. 75-82.
- Wan Rozaini, S. O., Zahurin, M. A., Huda, I., Nor Iadah, Y., & Nafishah, O. (2007). Ke Arah Memperkasakan Komuniti Luar Bandar: Penilaian Situasi Semasa Pusat Internet Desa (PID). Paper presented at E-Community Research Center Coloqium, 8 February 2007, Bangi, Selangor, Malaysia.
- Wang, Y. S., & Shih, Y. W. (2009). Why do People Use Information Kiosks? A Validation of the Unified Theory of Acceptance and Use of Technology. *Government Information Quarterly*, 26(1), 158-165.
- Yen, C. H., & Lu, H. P. (2008). Effects of e-Service Quality on Loyalty Intention: An Empirical Study in Online Auction. *Managing Service Quality*, 18(2), 127-146.
- Zahurin, M. A., Huda, I., Mohd Khairudin, K., Nor Iadah, Y., Shafiz Affendi, M. Y., & Zulkhairi, M. D. (2009). Management Practice in Sustaining Telecentres. Proceedings of National Seminar on e-Community 2009 (SKeKom2009), Hotel PNB Darby Park, Kuala Lumpur, Malaysia, 18 – 19 March, pp. 273-280.
- Zahurin, M. A., Shafiz, A. M. Y., Wan, Rozaini, S. O., & Nor Iadah, Y. (2010). A Conceptual Model for Psychological Empowerment of Telecentre Users. *Computer and Information Science*, 3(3), 71-79. [ISSN 1913-8989 (Print) ISSN 1913-8997 (Online)].
- Zamani-Miandashti, N., Pezeshki-Rad, G., & Pariab, J. (2014). The Influence of Telecenters on Rural Life and their Success Correlates: Lessons from a Case Study in Iran. *Technovation*, 34(5), 306-314.

## Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/3.0/>).