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A COMPUTATIONAL MODEL FOR DYNAMICS IN EFFECTIVE USAGE OF ICT PUBLIC ACCESS CENTRE

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ABSTRACT

In Malaysia, ICTs have been identified as a crucial enabler in the knowledge-based economy to facilitate the acquisition, utilization, and dissemination of knowledge towards enhancing the economic and social values of society. Numerous programmes have been organized, developed, designed and executed to optimize the usage of these ICT Public access centres (telecentres). This paper presents a computational model that addresses important factors contributing to the effective usage of telecentres. Simulation was used to show the behaviors produced by the model. Several cases of different scenarios showed various patterns that are consistent with past literatures. These results indicate that the model is able to illustrate different behaviors when different scenarios are applied. The model could be used as a justification for conducting an inception study to understand the working model of a telecentre's operation given a certain scenario.

Keywords: effective telecentre usage, computational modeling, social simulation.

INTRODUCTION

Obtaining access to ICTs and using them actively has been linked to the advantages of demographic and socio-economic characteristics, namely; income, education, geographic location (urban-rural), skills, awareness, political and cultural perspectives . In this context, it is equally important to ensure that all clusters of society in Malaysia have equitable access to ICT and have the adequate capacity to improve their socio-economic status, as a result from the digital access. To consolidate this initiative, the National Strategic Framework for Bridging the Digital Divide (NSF-BDD) was formulated. The formation of ICT public access centres (telecentres) across the country is one of the initiatives under the NSF-BDD programmes. There are more than 2000 telecentres have been established to support the BDD programmes (Ibrahim et al., 2002). However, a number of telecentres have been under-utilized and even reaching a point of closure due to several factors. Thus, it is important to understand the underlying mechanism that leads to those events and take necessary steps to avoid the risk. The aim of this paper is to present a computational model that can be used to simulate the dynamics of telecentre effective usage as one of the methods to provide early insights of overall telecentre's operation and its possible outcomes.

The paper is organized as follows; Section 2 describes several imperative concepts in telecentre effective usage. From this point of view, an agent model is designed (Section 3). Later in Section 4, a number of simulation traces are presented to illustrate how the proposed model satisfies the expected outcomes. Finally, Section 5 concludes the paper.

IMPORTANT CONCEPTS IN EFFECTIVE USAGE OF TELECENTRE

There are a number of factors associated with users' attitudes and motivation towards telecentre usage (Zahurin et al., 2001). These factors can be classified into three categories namely openness, readiness, and ICT programmes. In general, openness refers to a tendency to accept new ideas, methods, or changes. In the context of telecentre usage, Turpin and Ghimire (2012) define it as the capacity of users to access and share information and applies it for productive practices. This includes the ability to comprehend the importance of ICT in achieving one's goal, acquiring ICT skills and knowledge, and participating in telecentre's activities (Colle, 2005). ICT awareness is about the ability to understand the importance of ICT tools and applications and hence lead to the usage of ICT facilities (Azman et al., 2008; Lwoga et al., n.d.). ICT awareness therefore is characterized by their ability to use ICT facilities and applications to solve problems. In order to drive openness and ICT awareness, relevant ICT programmes have to be organized. The programmes serve as platforms to gain openness and ICT awareness (Ibrahim et al., 2002). The above-mentioned factors are related to perceived control, self-efficacy, competence and motivation as described by (Zahurin et al., 2001).

Perceived control refers to the ability of the users to readily acquire ICT skill and knowledge and seek to be more efficient in getting information and use the skills to improve their socio-economic well-being (Zahurin et al., 2001). Self-efficacy denotes the users' ability to achieve the desired goals when they have the skills and knowledge in ICT. Competence factor reflects the users' needs to improve their technical skills and knowledge. Motivation factors are what motivate themselves in enriching their capabilities. These cover both intrinsic and extrinsic factors. In addition to those factors, other external factors that are pertinent to telecentre effective use are social and economic policy (Kumar & Best, 2006; Walsham, 2010), external support (Colle, 2005; Proenza, 2001), and community engagement (Rao, 2008). Policies, both social and economic, that support such ICT-based projects indicate government's strong support and seriousness in the effort to leverage the ICT uptake by the rural dwellers

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(Azman et al., 2008; Gurstein, 2003). Similarly, external support, particularly in terms of financial and responsible personnel from the government, private institutions and non-governmental organizations is also important in ensuring the life of a telecentre project (Fatuma, 2010; Gurstein, 2003; Kumar & Best, 2006).

In short, the following relations can be identified from the literature; (1) community engagement, policies (social and economic), support, and ICT programmes are among important external factors to ensure effective telecentre usage; (2) improvement in ICT awareness and ICT competence will increase community's motivation to deploy ICT in their daily living; (3) social and economic development are related to the executed policies, competence, support, community engagement; and (4) a combination of local long-term socio and economic development will reflect the effectiveness of telecentre usage.

MODELING APPROACH

The characteristics of the proposed model are based on the factors discussed in the previous section. These factors are translated into several interconnected nodes (Figure-1). The nodes are represented as variables that can contain values ranging from 0 (low) to 1 (high). The interaction will determine a new value, either by a series of accumulations (temporal relation) or an instantaneous interaction for each node.

In this paper, only temporal relations are shown, namely; ICT awareness (Ca), community engagement (Ce), long-term economic (Le) and social (Ls) development, and effective usage (Eu). In addition, the rates of change for all temporal relationships are determined by flexibility parameters β_C, φ_C, β_L, θ_S, θ_U, respectively.

$$\frac{dCa(t)}{dt} = \beta_c.(Cp(t) - Ca(t)).(1 - Ca(t)) \quad (1)$$

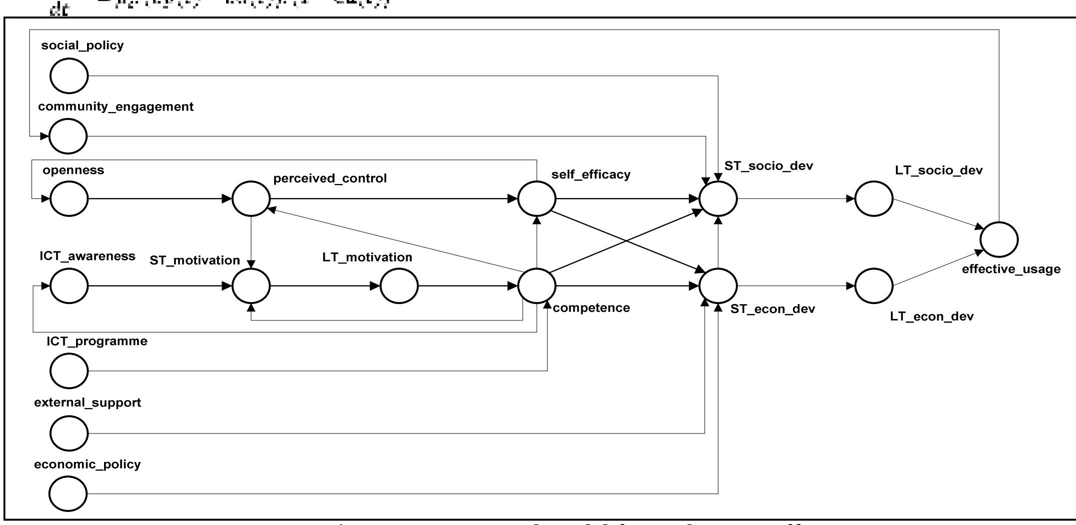

Figure-1. Conceptual model for a telecentre effective usage.

Here, ICT awareness level builds or reduces over time. When community programme (Cp) is higher than the ICT awareness level multiplied with the contribution factor, β_C then the ICT awareness level increases. Otherwise, it decreases depending on its previous level and contribution factor. This condition also can be used to explain for the rest of all temporal relations, according to their respective parameters and attributes.

$$\frac{dCe(t)}{dt} = \varphi_c.(Eu(t) - Ce(t)).(Ce(t)).(1 - Ce(t)) \quad (2)$$

$$\frac{dLe(t)}{dt} = \beta_L.\left[Pos(Ed(t) - Le(t)).(1 - Le(t)) - Pos\left(-(Ed(t) - Le(t)).Le(t)\right)\right] \quad (3)$$

$$\frac{dLs(t)}{dt} = \theta_s.\left[Pos(Ss(t) - Ls(t)).(1 - Ls(t)) - Pos\left(-(Ss(t) - Ls(t)).Ls(t)\right)\right] \quad (4)$$

$$\frac{dEu(t)}{dt} = \theta_u.(Sg(t) - Eu(t)).Eu(t).(1 - Eu(t)) \quad (5)$$

$Sg(t) = \left(\frac{1}{1+e^{-\alpha(W(t)-\tau)}} - \frac{1}{1+e^{\alpha\tau}}\right).(1+e^{-\alpha\tau})$ and

$W(t) = \varphi_u.Ls(t) + (1-\varphi_u).Le(t)$

where α is a steepness factor, φ_u is a proportionate rate and τ a threshold parameter. In this choice, a common practice is followed (logistic function) but other types of combination functions can be specified as well.

The operator Pos for the positive part is defined by $Pos(x) = (x + |x|)/2$, or alternatively; $Pos(x) = x$ if $x \geq 0$ and 0 else. Using all defined formulas, a simulator has been developed for experimentation purposes; specifically to explore interesting patterns and traces that explains the behaviour of the formal model. All simulation results were generated and stored in spread sheets for further analysis.

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SIMULATION RESULTS

The proposed model was tested through several scenarios to generate a number of simulation traces. However, for the sake of brevity, only three types of scenarios are discussed: a realistic effective usage case **(A)**, a one-off execution case **(B),** and a non-supportive case **(C).** The initial settings for ICT programme, external support, social and economic policies based on the three scenarios respectively are: **A** (consistent, consistent, high impact, high impact), **B** (one-off, one-off, low impact, low impact), and **C** (inconsistent, inconsistent, low impact, low impact). In addition, there are several dynamic parameters that were used to simulate different characteristics. These include the following settings: t_{max} = 500 (to represent a monitoring activity up to 730 days), Δt = 0.3, regulatory rates = 0.5, initial temporal values = 0.5, and flexibility rates = 0.2. These settings were obtained from several experiments to determine the most suitable values for the model.

Figure-2 visualizes a condition when all external factors are consistent (for example, these are; 1) the ICT training programmes are organized as scheduled, 2) good support from various agencies, and 3) effective policies) (Azman et al.; 2008; Ibrahim et al., 2002; Zahurin et al., 2001). Facing such encouraging conditions, it will later boost the development of both, social and economic development in the long run. As a result, the effective usage will increase, which later improve the effect of ICT usage through more positive community engagement. This condition occurs when members of the society believe that ICT usage gives more positive impacts towards improving their quality of life (Zahurin et al., 2001).

In Figure-3 different scenarios can be seen when a new kind of condition to simulate one-off training programmes and external support was introduced. This condition comprises of two parts: the first part is one with very high constant value (up to 90 time steps), and is followed by the second one, with a very low constant value (until the end of simulation steps). The simulation results show that the ICT awareness and local economic development levels slightly rising up at the beginning of the simulation steps, and later gradually decreasing along with several other indicators (Nor Iadah et al., 2007). It reflects a condition when the telecentre is no longer functioning to serve the community after its first inception. Moreover, a number of ineffectiveness of the telecentre usages can be traced back from this very problem. In addition, another case was simulated where all initial values were very low (Case # 3). The effective usage level in this case decreases which shows the direct impact of low ICT awareness and community engagement levels among the community (Nor Iadah et al., 2007). This case represents the effect of having a telecentre just as a quick win project but there is no long-term plan being designed to support its operation.

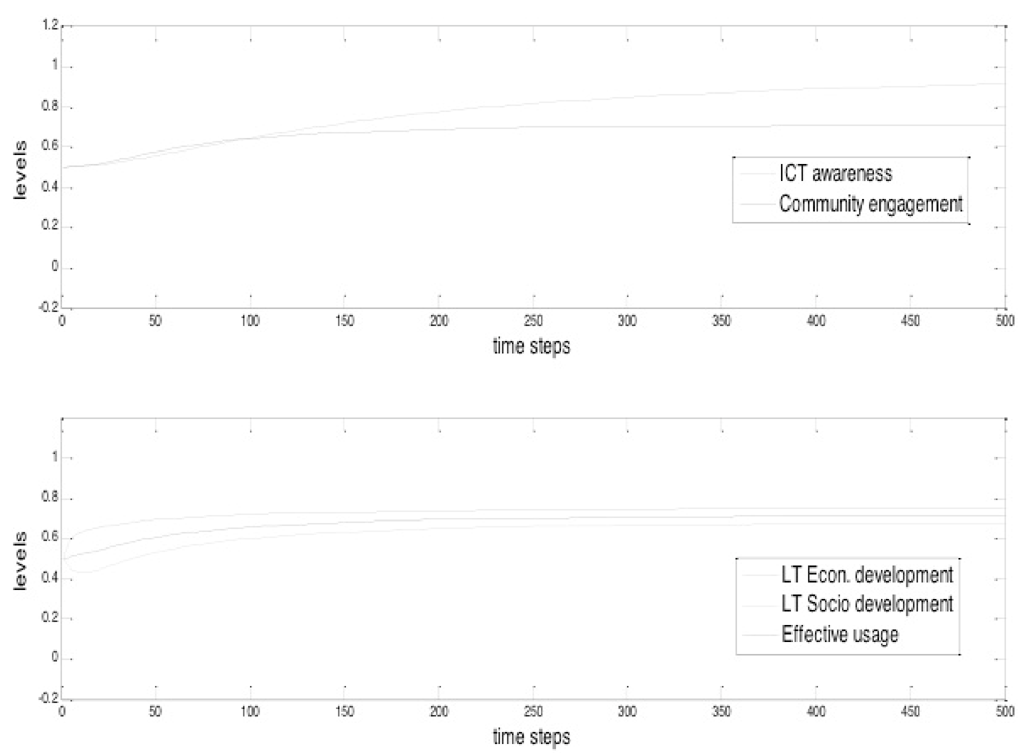

Figure-2. Simulation trace for Case #1.

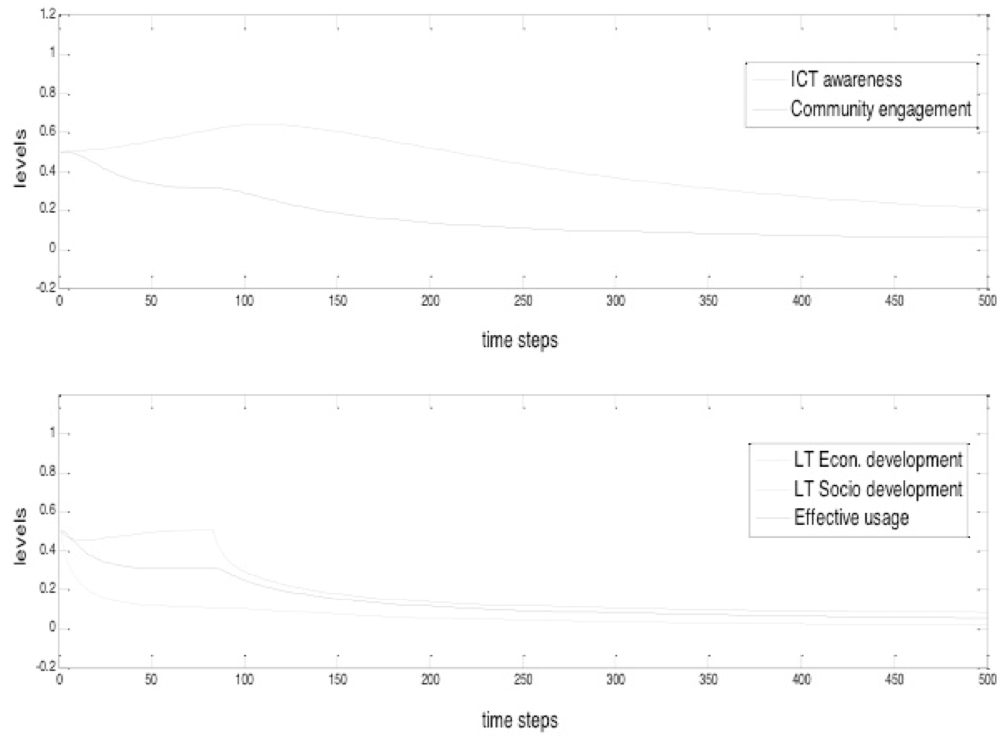

Figure-3. Simulation trace for Case #2.

CONCLUSIONS

In this paper, an approach to model behaviors on telecentre's effective usage is presented. The computational model was simulated using three different cases that describe the level of positive and negative contribution towards telecentre's effective usage over time. The simulation traces exhibit patterns that are consistent with reports found in past literatures. The resulting model can be considered as an alternative method to analyze a telecentre's effective usage when various scenarios occur. This could also provide a basis for conducting an inception study to understand the working model of related telecentre's operation.

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