A Thematic Review of the Models of ICT Integration in Tracking Malaria Drug Administration in Ugandan Health Units.

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Abstract

Background

This study aimed at reviewing models propounding thematic linkage to system integration of ICT transaction processes that inform tracking administration of malaria drugs in health units in Uganda.

Methods

The study engaged structural and thematic review approaches for narrative and meta-synthesis of literature analysis to cite, make comparisons, and contrasts including criticisms of directed stimulation of information-oriented integration, process-oriented integration, service-oriented Integration, user-oriented integration, and other success drivers of the need for ICT integrations. Comparisons of models by case analysis qualified a structured proposition of development of the model for tracking the administration of Malaria drugs in health units.

Scope

Integration review was guided by the Enterprise Application Integration solution model, Model Driven Integration Approach, Technology Transfer of Reference, DeLone & McLean IS Success Model among others, focusing on the stimulation of information, processes service and user-oriented integrations, valid ability, technology context, ease of use, scalability, flexibility, and trainability as success drivers.

Findings

Studies on integration and IC-enabled development reveal that ICT is widely accepted, and its crucial functions increase efficiency, cost-effectiveness, and competitiveness. Failure of integration of ICT in developing countries has a positive relationship with lack of awareness, management commitment, defined ICT based-roles as tools rather than solutions for organizational transformation, responsiveness to vision and mission goals, systemic methods of implementation, system ownership, and poor policy and planning.

Conclusion

Integration of Information Communications Technology in health units is a major driver of information, processes, service, and user-oriented transactions for effective service provision and delivery in Uganda. Technology Context has a negative but linear correlation on ease of use (Intension and Actual) of ICTs (B = - 0.087) and negatively influences the same (β= - 0.050). The intention and actual use of Technology Context in tracking drug administration is influenced by the ability of application of the users.

Keywords: Administration of Malaria Drugs, ICT Integration, Health worker, Health Unit, models,
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1. Introduction

Information and Telecommunications Technology (ICT) is conceived as a diverse set of technology tools and resources to create, access, communicate and/ or disseminate, store and manage information [2] for the execution of various tasks and offer services to the users, is also viewed as a tool to achieve administrative proficiency and personal productivity in organizations. Organizations embrace ICT infrastructural processes to explore innovative ways to improve competencies and competitiveness during service provision. Integration and utilization as adoption processes of ICT innovation influence good decisions in achieving goals, [5] hence a value addition for effective service delivery. Whereas integration refers to the involvement and or / engagement of different information systems modules in form of information, process, services, and/or users of the system are implemented using certain mechanisms or innovations (technologies) to arrive at business goals, ICT Integration has been operationalized to mean the involvement or linking together and use of ICT technologies to introduce, reinforce, coordinate, supplement and extend skills [11] to aid achieving administrative proficiencies and personal productivity by causing interaction in and outside business processes. Integrating ICT in the tracking of the administration of malaria drugs greatly influences malaria management [20]. On the other hand, tracking the administration of malaria drugs is the act of taking an audit and count of drugs and medicines in terms of how they have been administered to different patients and how they are managed at all levels including stock analysis, packaging, dispatching and delivery to destinations of consumption. This is one of the significant components that guide treatment thus reduction of morbidity and mortality [1].

2. Methodology

The review of the literature in this study used structural and thematic approaches for narrative and meta-synthesis of literature analysis to cite, make comparisons and contrasts including criticisms, and make alignment linkages of events that generate relationships towards the intended generalizable connections. These proliferations directed areas that informed the stimulation of Information Oriented Integration (IOI), Process-oriented Integration (POI), Service Oriented Integration (SOI), User Oriented Integration (UOI), Validability, Technology Context, Ease of use, Scalability, Flexibility, and Trainability (Mentability) areas for all the models as key success drivers of the need for ICT integrations. Comparisons of the selected models were made using case analysis and a qualified model was benchmarked for structured development of the proposition model that informs tracking administration of malaria drugs in health units (Section 5.0).

3. Literature Review

4. ICT Integration and Service Improvement

Tusubira and Mulira in their study of 2004 "Integration and ICT enabled human development" revealed that, at the organizational level, ICT is widely accepted and its integration in organizational functions is necessary for increased efficiency, cost-effectiveness, and competitiveness. Although it is fully appreciated that "such approach from the technology level leads to escalating costs without corresponding efficiency gains". This leads to the mayhem of letdown, skepticism, and reduced organizational commitment and resources to support ICT services and systems. That also unless and until the real barriers are understood and addressed, this situation will continue to obtain ground. It was cited that the major challenges which hinder or lead to failure in the integration of ICT in organizations in developing countries include lack of awareness and mindset, lack of top-level commitment, defining the role of ICT as one of the tools rather than the panacea/solution for organizational transformation, making ICT responsive to the organizational vision and mission, developing a systemic method

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of implementation, creating ownership, poor processes of ICT policy planning, appreciating critical stages in information systems implementation, who makes requirements statements - a grouping of staff into departments for administrative purposes other than functions, systems analysis and Business Process Redesign for the already existing businesses and developing the organizational information policy among all the known ones. Information systems and many projects aimed at improving integration and collaboration, electronic information systems contribute to shared information [9]. In other words, integration improves several health services such as the transfer or exchange or discharging of information, ordering of laboratory and radiological examinations inputs as well as improving the overview of the patient's medical information, other advantages include taking the right medical decisions, better treatment approaches and timely responses to medical challenges, providing best practices of tracking malaria drugs from sources to consumption destinations. Therefore, the aim of integration is that multiple information sources can be accessed seamlessly/ perfectly well from a single point of end-user interaction, thus making medical care services more efficient and cost-effective.

5. Theories, Models, and Principles OF ICT Integration

5.1. Enterprise Application Integration (EAI Solution Model

This model was developed by a group of experts led by Juha Mykkänen in 2004, it is based on information, service, process, and user-oriented integration. Information-oriented integration approaches to address issues of information exchange, and databases that produce information as primary points of integration. Its advantages include, source and target systems need only a few changes; state, logic, and sequence do not need to be considered; and the approach is simple and widely used. Process-oriented integration handles a layer of defined and centrally managed processes on top of existing processes. The goal is to combine relevant processes to support the flow of information and control logic between them should promote reuse, reduce the need for replicating methods and data in several applications, and enables both information-oriented and process-oriented integration by providing the required intermediary. Service-oriented integration solutions, however often require changes in applications such as adaptation into the common infrastructure, which is often problematic, especially in legacy systems lastly User-oriented integration, allows the user to gain a consistent view of a multitude of systems. This can be accomplished by using a unifying front-end system or/synchronizing the various applications on the user workstation. Thus the gap, in this case, is that in a portal-based situation, this approach has a disadvantage in that it focuses on the single-user aspects of the system, and the applications may not be directly integrated into the data or service level [18] whereas, the advantage of the integration process incorporates features from different integration models, including understanding and description of the processes in healthy environment and specification of information contents, application services and user interaction in the solutions.

5.2. Model-Driven Integration approach (MDA

This method of system integration was proposed by Niels, during a study on the integration of business information systems based on the MDA approach to focus on the integration of software systems, which in this study can be translated as being part of the ICT components which conceptualized to reduce time and costs of development of integration solutions for information business processes in organizations. MDA uses patterns (tools –Languages) to structure models and simplify the transformation from models to other models or code. A critical review of the Model Driven Architecture (MDA) models and processes in the context of system integration suggests that the views of the system are supported by processes and patterns to specify the application to be built. These include the computation-independent model (CIM), the platform-independent model (PIM), and the

platform-specific model (PSM).

In practice, two different instances of integration at this level were employed, and they include integration of modern software systems with existing legacy systems which are valuable for the enterprise and cannot be replaced at once by a new system. The other is integration of standard software with individual software (application) specific to a domain or a certain enterprise. It is observed that both cases were addressed using the same methods as described in figure1. The integration of systems on the level of business processes is a task that requires a lot of knowledge from domain experts. This knowledge surrounds the tasks of the domain that can be facilitated by a software system. These tasks are a combination of business processes to execute the business of the enterprise and domain knowledge which includes the concepts and their correlations inside the domain. In the model some requirements must be met to develop the system(s), however, are determined by the Computational Integration Model (CIM). The structure of a CIM depends on the purpose of the system to be built. The CIM represents all aspects of the system that are important from a domain expert's point of view. The languages used to model the application from a domain expert's point of view should be adapted to their specific needs, thus answering the many unknowns that many problems in software engineering are based on misinterpretations of requirements and misunderstandings between domain experts and software developers. Therefore, MDA holds the opportunity to overcome these misunderstandings since it offers views on the system in languages that are specific for every stakeholder. CIM plays a central role in this approach because it is the initial point for the integration approach since it includes the business processes used as a basis for the integration tasks in all model steps. The CIM also has a domain model that represents the intra- or inter-organizational understanding of the domain in which the application operates. The CIM is very important as far as the development of other processes is concerned because new requirements or changes in the CIM lead to changes in the corresponding PIM and PSM. This would be an important consideration when measuring the effectiveness of the model for tracking malaria drugs, that as a slight variation in the parameters at IV levels, the change must be reflected in the net benefits of the integration as a whole. Domain experts use cognitive patterns in the modeling process and these refer to recurring model templates that are employed during problem-solving/ reasoning activities since these patterns model natural human problem-solving, the domain experts can express their domain knowledge using these instead of business process patterns because business patterns have a different intention (workflow, organization, etc..). Current experience shows that a model-driven software development approach is most successful in rather focused domains which are well-understood and where generated code can build on powerful frameworks.

In conclusion, the MDA approach represents a method to integrate business information systems based on business processes and domain models. Three major tasks are highlighted to implement this method and propose solutions and these are the creation of the computation independent model, the definition of the structure of such a model concerning integration, and the derivation of software architecture from the CIM and the description of methods towards integration based on this architecture. However, MDA successful applications are operationalized and /or geared towards systems development such as software and probably other platforms that are intended to help in information management. Therefore, is not good enough an approach to pin a model development such as tracking systems that are based on a mathematical and formal approach that uses designs like structural equation modeling.

5.3. Technology Transfer of Reference (TFR

Technological Frames of Reference (TFR) was developed by Orlikowski Petter and Fruhling in 2011. This is a model which builds up a repertoire of tacit knowledge to impart meaning to ambiguous social and situational information to facilitate understanding, using assumptions, knowledge, and expectations of technology, visual im-

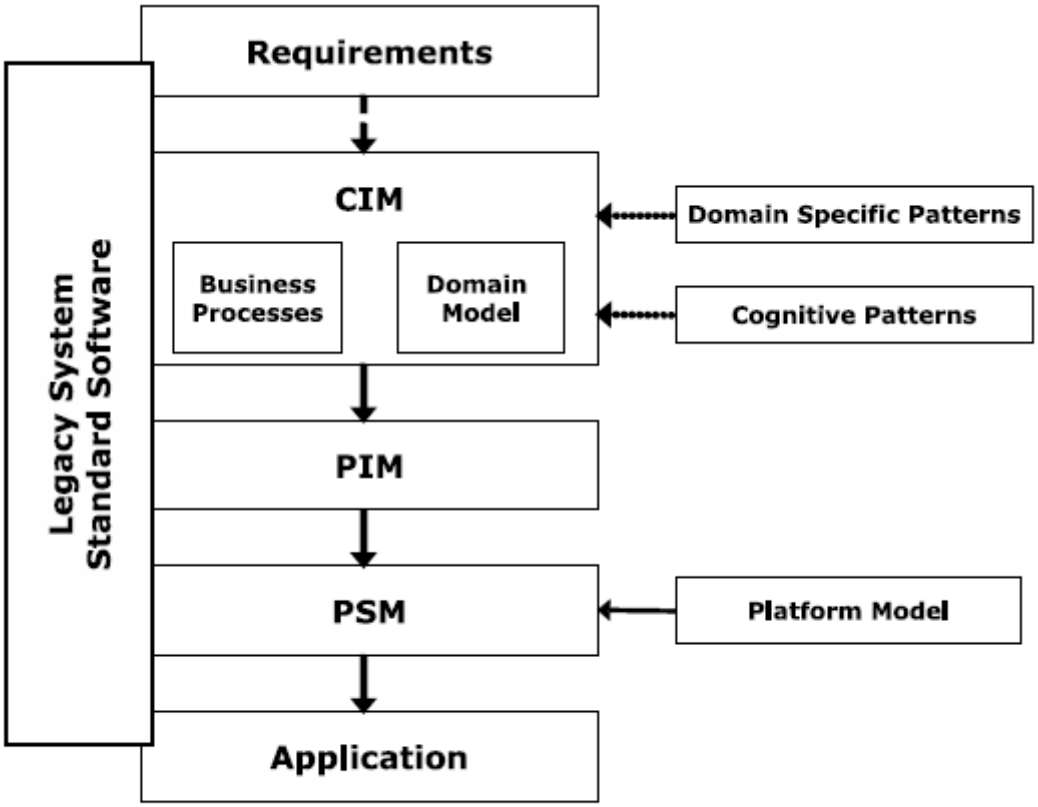

Figure 1: Procedure model of the MINT approach

Figure 1: Depicts the model levels of the MDA and the integration Architecture (Source: Neil, 2006 Mint project)

ages, metaphors, and stories that act as an interaction around a technology artifact or process. Each technology that comes around makes life easier, but the design of technology can become remote and alienated from a user's everyday experiences. Successful outcome(s) of implementation or even demise of the technology may directly be linked to user perception and meaningful interpretation in the context of employment. Therefore, understanding how organizational members make sense of the technology implemented and how their subjective interpretation will influence the actions they take is crucial to its development and use.

5.4. DeLone & McLean IS Success Model (D&M 2002, 2003

This model is a successful model used to measure the success of an IS artifact. Based on this fact, therefore, D & M is highlighted in the measurement and guaranteeing the success of the model for integration of an ICT operationalized for tracking the administration of malaria drugs. The adoption of this model is inclined to support users at the individual, group, and multilateral (organizational) level of analysis [6] based on successive modifications and upgrades [7] tested and validated and thus unifies and integrates most IS models in addressing the quality of information system and service offered to invoke the intention and actual use rotated around the satisfaction achieved for the intended benefits of user needs, thus makes it utilizable by many researchers. The interrelated quality dimensions support the interpretation of the model in terms of how they influence the subsequent use or intention to use the system/technology for the intended satisfaction in the process of achieving certain goals/benefits which can evoke further use. However, the intention to use a system can invariably be looked

at as may be influenced by certain factors such as the ability to use ICT in form of skills of the individuals or groups of people and policy frameworks which regulate the activities/routines supported by the technology. However, Controls as limitations, Integration approaches are significant elements that were not addressed by the D&M model to enforce full adoption.

However, according to the summary of the theories made above, it is evident that the IS success models would still suit the study although none of them focused on information system integration in tracking administration and management of drugs of any sort, however, this model is benchmarked to measure the success of the model for integration of ICT in tracking administration of malaria drugs in Uganda like it has supported studies on telemedicine.

5.5. Validated D&M IS Success Model 2017

(Source: Adebowale (2017) validated D& M success model for information system)

Adebowale focused on the validation of the D &M model as far as the success of information systems such as health information systems are concerned. Key attention was put on the measurement of the relationships between the constructs that make the model and some of his deductions on similar studies basing on the model were: When the model was benchmarked for [4], confirmed that corresponding relations among the variables of the model were found as applicable to healthcare settings as a framework for investigating mobile device usage within healthcare suggestive to maintain the inherent constructs of the original model; TTR an emergency response medical information system confirmed the usefulness of the D&M model in evaluating health information systems where it was found that the quality dimensions depicted in the model influenced user satisfaction and intention to use; which consequently affected the individuals' perception of the system's impact, [6] and further report that the quality dimensions (information, system, and service quality) significantly related to user satisfaction and net benefits, thereby upholding the model newly developed information systems in three public hospitals in Korea. For these reasons therefore the D&M model can be used to assess the success of hospital information systems. However, in the TAMD (Tracking Administration of Malaria Drugs) model (Fig 5), the researcher's objectives were to measure and establish the influence of the quality dimensions on the new constructs, that is to say, controls and ICT integration which exhibited significant and positive correlations for the intended benefit as tracking administration of malaria drugs [20].

5.6. Activity Theory (AT (Engestro¨m, 1987)

In studies that investigate complexities of real-world situations such as workplaces, communities, groups, or places of learning, engagement of Activity Theory provides a language and framework to interpret what has been discovered about a variety of situations by engaging observations, interviews, and other data collection tools basing on the fact that an activity is the unit of analysis that defines the bilateral relations existing between the subject (doer of activity) and the object (the objective for doing it) within a system [10]. Activity theory (AT) is a general framework for studying different forms of human activity as development processes or a description tool for a system. This model was proposed by Engestro¨m and has been undergoing modifications due to its popular applications. It conceptualizes all purposeful human activity as the interaction of the elements: subject, object, tools, community, rules, and division of labor. In this model of an activity system, the subject refers to the individual or group whose point of view is taken in the analysis of the activity. The object (or objective) is the target of the activity within the system which in this case is the tracking of the administration of antimalarials. Tools refer to internal or external mediating artifacts which help to achieve the outcomes of the activity, this is therefore symbolized as ICT. The community is comprised of one or more people who share the objective with the subject. Rules refer to the explicit and or/ implicit regulations, norms, and conventions that constrain actions and interactions within the activity system. The division of labor discusses how

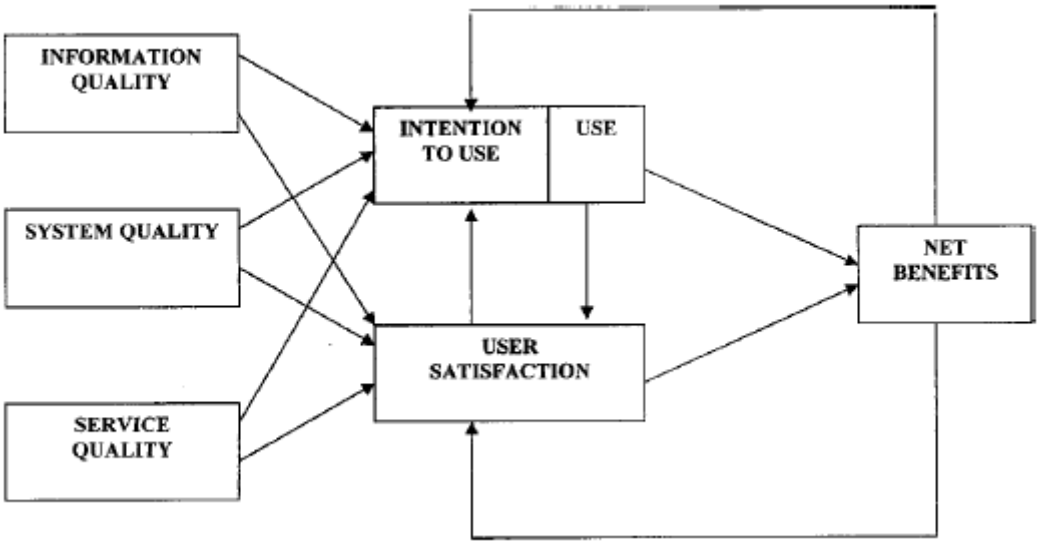

Figure 2: D&M IS Success Model; Source: Updated D&M IS Success Model (2002 and 2003)

tasks are divided horizontally between community members as well as referring to any vertical division of power and status.

Using this model to analyze the ICT integration, the elements have been mapped as follows:

Subject Health workers (experience, drugs identification approach, personal interest, administrational and instructional use of ICT, the knowledge and skills related to ICT).

Object The goals of using ICT in the tracking process (knowledge, Skills acquisition, and problem-solving).

Tools ICT and other tools, methods which are used, problems which are encountered

Rules The evaluation criteria, expectations of the health worker, and medical rules

Community Health Workers, Patients, hospital administration including officials in the hierarchy of the MoH and ICT coordinator

Division of labor The roles and responsibilities of all those above in the community

Outcome The use of ICT in the effective tracking process of drugs in the treatment of patients and instruction

Activity Theory uses the term contradiction to indicate a misfit within elements and between them, between different activities, or between different developmental phases of a single activity. According to, these contradictions can be problematic but if they are handled constructively, they can also invoke development, through expansive racking. Therefore, in AT contradictions are seen as sources of development; activities are virtually always in the process of working through contradictions. The introduction of ICT into the activity systems is likely to bring about contradictions. Because these contradictions hinder the effective integration of ICT, they have to be addressed by re-assessing and re-defining each component of the activity systems. Although Engestro¨m theory refers emphasis all purposeful human activity as the interaction of all the elements which generates an outcome, and contradictions as he presupposes being the source of developments, the original ideas have not deviated from the new ideas which consider object-orientedness, internalization/externalization of activities, mediation by tools although tools an element of artifacts, and development, and that all should be regarded as an integrated system because they are associated with different aspects that make up the whole system [12] Activity theory has remained unchallenged as most ideas have remained consolidated and integrated with other models such as AT aging.

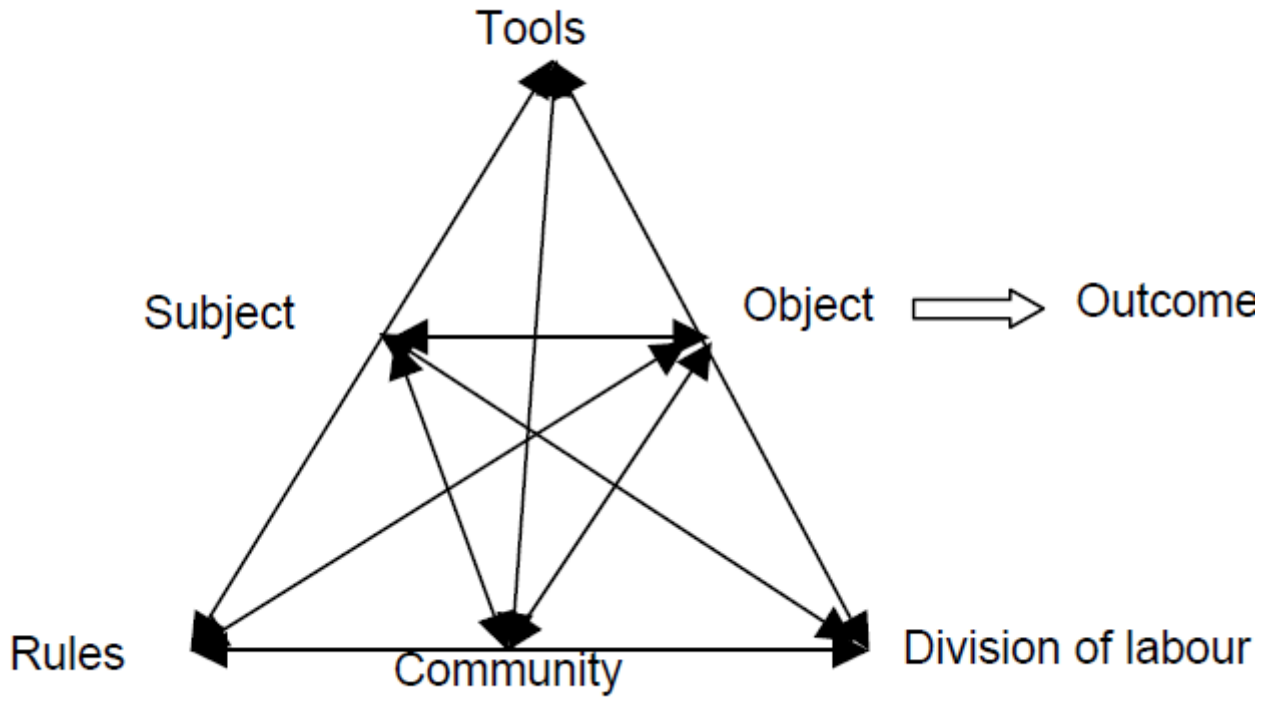

Figure 3: shows Activity Theory; Source:Yasemin Demiraslan and Yasemin Koçak Australasian Journal of Educational Technology (2008)

5.7. Task Technology Fit (TTF

This theory was developed to generate the importance of fit between organizational general tasks and technology and that develops fit profiles for a specific task-technology combination for mobile IS to support managerial tasks. The relationships among technology, organizational processes, and performance are of great interest to organizations as they adopt these new technologies with hopes of enhancing productivity. The theory consists of largely two independent theories of TTF. The first, initiated established TTF as an important concept in assessing and explaining IS success, and the second developed a systematic profile for the task-technology combination of group tasks and group support systems (GSS) focused on individuals' use of IS while focused on groups' use and formulated fit profile applicable specifically to GSS. Task-Technology Fit (TTF) dependent variables are based on individual performance and system utilization, while the independent ones are based on task and technology characteristics. This theory suggests that IT is more likely to have a positive impact on individual performance, and is useful if the capabilities of the IT match tasks the user must perform. Therefore, this theory is very relevant to the study but looks to work more conveniently at an individual level than at a group level setting for any mobile Information system (IS).

5.8. Technology – Organization – Environment (TOE Theory

This theory was derived by Tornatzky and Fleisher when studying how organizations and firms can improve efficiency and productivity while adopting innovations in form of technology. This theory suggests that process by which a firm adopts and implements technological innovations is influenced by three factors which include the technological context, the organizational context, and the environmental context, therefore these provide either constraints or opportunities for technological adoption. To provide a more

profound meaning of each perspective, the technological context includes the internal and external technologies that are relevant to the firm in terms of both equipments as well as processes respectively. The environmental context includes the size and structure of the firm, competitors, the macroeconomic context, and the regulatory environment. The constructs that the theory extends as dependent factors are the technology adoption (likelihood of adoption, Intention to adopt, and Extent of adoption, while the independent factors are technology, organization, and environmental context [22].

5.9. Principles of Successful Integration

[8] suggests that there is no unified agreed-upon conceptual model for integrating health systems, but there are different approaches and strategies of system integration which are also referred to as the universal principles of successfully integrated healthcare systems used by decision-makers to assist in integration efforts. These principles were independent of the type of integration model, healthcare context or patient population served. The principles define key areas of restructuring to allow organizational flexibility and adaptability to the local context. Although neither a one-size-fits-all model nor process for effective integration, nor is there a firm empirical foundation for specific integration strategies and processes, these principles can be considered to define a more successful integration process of ICT in medical health environments. This gives a response to the information needs in health for planning and implementing integrated service delivery models [8]. The principles that were frequently and consistently presented as key elements for successful integration are shown in the Table.1 below

These guidelines support the integration of health systems for the health environment rather than the physical integration of ICT, however, the inherent strongholds of these principles' positions suggest that when their established continuum is followed, some processes may guide ICT integration. This is also supported by EAI as it emphasizes some of the concerns such as information, processes, service, and user-oriented integration which seem to agree with the [19] framework.

6. The Ugandan Context

Several studies conducted in developing countries, including Uganda, have demonstrated an increasing application of e-Health systems for healthcare delivery [3]. However, Uganda recognizes e-Health as a tool to improve health services delivery to her citizens but the inherent e-Health implementation status is unknown; "barriers and opportunities for sustainable e-Health implementation have not been documented" [14]. Uganda has tried several e-Health and m-Health solutions to address healthcare challenges of which many were e-donor funded operated in silos and lacked sustainability because of prior planning stages.

The current status of such systems may translate integration of ICTs and its implementation within Uganda reveals more on tracking and surveillance of malaria levels including other diseases through the use of Short Messages (SMS) based systems [15] which provides a "disease-specific application of an m-Health tool (malaria), RapidPro based Family-Connect and the iHRIS based Community Health Worker (CHW) Registry. (Ministry of Health's Community Health Information Systems) and m-Hero Connector of 2020 [21]. The m-Hero further supports the use of m-Hero by enabling integration between multiple systems, for example, RapidPro, DHIS2, and iHRIS to enable an integration between the RapidPro-based, FamilyConnect, and the iHRIS-based Community Health Worker Registry".

These systems are majorly SMS base communication systems for example m-Trac would furnish surveillance teams of malaria fighting agents with levels of endemicity and prevalence in the country through SMS communication therefore would not ably translate into generic baselines for model development for integration of ICT in tracking administration of malaria drugs in Ugandan health units. They could explicitly inform the development and adoption of applications to support understanding the levels and surveillance of endemicity of malaria and other associated

Table 1: Principles for Health System Integration

	Principle definition	**Strategy x-ristics**	**Authors**
1	Comprehensive services across the care continuum	• Cooperation between health and social care organizations	Leatt, et.al., (2000)
		• Access to care continuum with multiple points of access	Marriott and Mable, (2000, 1998)
		• Emphasis on wellness, health promotion and primary care	Simoens and Scott, (2005)
2	Patient focus	• Patient-centered philosophy; focusing on patients' needs	Simoens et.al (2005). Shortell, et.al (2001), Roberts, (1996)
		• Patient engagement and participation	Linenkungel (2001), Wilson, et.al. (2003)
		• Population-based needs assessment; focus on defined population	Coddington, et.al, (2001a), Roberts (1996).
3	Geographic coverage and rostering	• Maximize patient accessibility and minimize duplication of services	Coddington (20001b),
		• Roster: responsibility for identified population; right of patient to choose and exit	Leatt, et.al. (2000, 1996), Marriott and Mable (2000, 1998)
4	Standardized care delivery through inter-professional teams	• Inter-professional teams across the continuum of care	Robinson and Casalino (1996)
		• Provider-developed, evidence-based care guidelines and protocols to enforce one standard of care regardless of where patients are treated	Robinson and Casalino (1996)
5	Performance management	• Committed to quality of services, evaluation and continuous care improvement	Coddington (2001 c) and Leatt, et.tal. (2000)
		• Diagnosis, treatment and care interventions linked to clinical outcomes	

Source: Healthcare Q. Author manuscript; PMC (2010). Author Manuscript / Manuscrit d'auteur PubMed Central CANADA

Table 2: Principles for Health System Integration. (continuation of table 1)

6	Information systems	• State of the art information systems to collect, track and report activities	Coddington, et.al. (2001 d), Leatt, et.tal. (2000), Wilson, et.al. (2003) and Hunter (1999)
		• Efficient information systems that enhance communication and information flow across the continuum of care	Leatt, et.tal. (2000), Marriott and Mable (2000, 1998
7	Organizational culture and leadership	• Organizational support with demonstration of commitment • Leaders with vision who are able to instil a strong, cohesive culture	Wilson, et.al. (2003) and Hunter (1999), Shortell, et.al. (2000), Miller (2000), Friedman, et.al (2001) and Drazen, et.al. (1998)
8	Physician integration	• Physicians are the gateway to integrated healthcare delivery systems • Pivotal in the creation and maintenance of the single-point-of-entry or universal electronic patient record • Engage physicians in leading role, participation on Board to promote buy-in	Coddington et.al. (2001 d), Appleby, et.al. (1999), Burns (1999, 2012), Gillies, et.al. (2001) and Hawkins (1998)
9	Governance structure	• Strong, focused, diverse governance represented by a comprehensive membership from all stakeholder groups	Coddington (2000 c), Shortell, et.al (2000), Hawkins (1998)
		• Organizational structure that promotes coordination across settings and levels of care	Hurster et.al. (2002), Marriott and Mable, (2000, 1998)
10	Financial management	• Aligning service funding to ensure equitable funding distribution for different services or levels of services	Leatt, et.tal. (2000),
		• Funding mechanisms must promote inter-professional teamwork and health promotion	Hardy, et.al. (1999), Lin et.al. (1999)
		• Sufficient funding to ensure adequate resources for sustainable change	Leatt, et.tal. (2000), Marriott and Mable, (2000)

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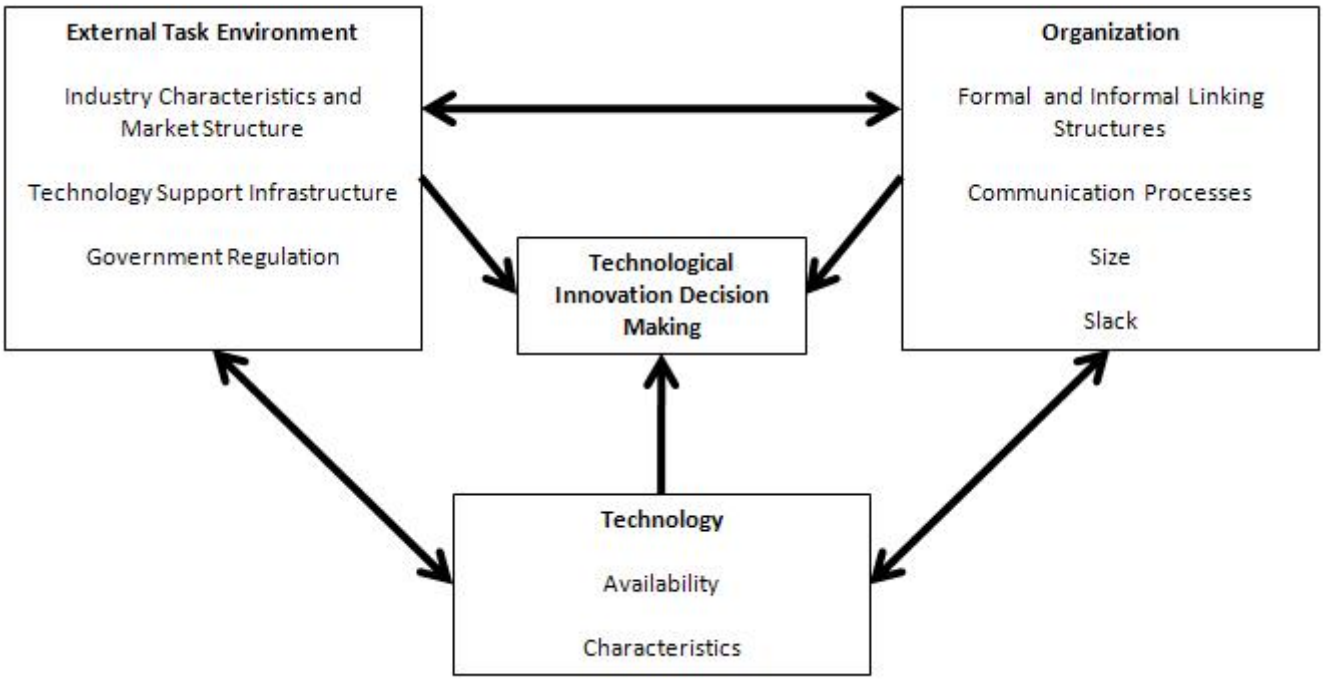

Figure 4: Technology – Organization – Environment (TOE Theory); Source:Tornatzky and Fleisher 1990

healthcare services required to manage malaria. "The SMS function is expected to facilitate fast and easy communication between the Ministry of Health and the country's CHWs during emergencies, as well as general support supervision and coordination.

ICT applications available in the area of health care into the following four categories:

1. ICT-enabled applications encourage wider diffusion of health information from formal (e.g., community health workers) or informal (e.g., health opinion leaders) sources.

2. The use of the internet enables advocacy coalition members to interact online, develop a shared identity and common agenda, exchange information, and mobilize for collective action. Furthermore, offline activities can also be coordinated via SMS (mobile phone text messages).

3. The use of ICTs for distance education enhances the traditional face-to-face TOT (training of trainers) model while fostering networks that trainees can rely on as a resource when they return to the field.

4. Integration of new ICTs (e.g., computers and the web) into programs utilizing traditional ICTs (e.g., radio, telephones, and print) to increase the scale or scope of the program, but lacks content for models as artifacts for a benchmark of ICT integration in health units".

In Uganda, more 'traditional' ICTs like radio and television have been used to educate the public on HIV/AIDS prevention and treatment, polio immunization, and malaria prevention, through short messages, talk shows, and plays, including various programs targeting the youth. There is a need to extend these initiatives to more recent ICTs like computers, emails, and the internet not just for the elite, but also for everyday people [16].

This literature doesn't appoint the thematic literature alignment for the models for ICT integration for tracking the administration of malaria drugs in health units in Uganda. The pride of increased usage and implementations of ICTs in health systems stops at engagements through the use of the Internet and electronic communication, mobile phones, TVs and Radio, and computers for medical information storage and dissemination. There is an eminent lack of structured infrastructural artifacts such as models, e-Systems, frameworks, and principle guidelines for tracking

malaria drugs as a realistic means of implementation and management of malaria burden by tracking malaria drugs to explain the Ugandan context fitness for thematic literature review qualifying to this study

7. Discussion:

8. Comparisons of Studies on Models, Theories, and Integration

Numerous studies (Ssegawa, et.al, 2019) that benchmark D & M success model were conducted and many suggested additional variables such as service quality and intention to use, whereas others implicated a collapse of some of them such as the original individual and organizational impacts into a more parsimonious net benefits construct in the updated model of 2003, none of these have incorporated effective integration and tracking administration parameters or variables. Nevertheless, a comparison of the different theories and models that commit this study was represented in the table below.

$\surd$ means Yes and indicates the model or theory supports the factor or variable of consideration and $\times$ means No indicating that it does not support.

Key:

MDA - > Model Driven Architecture (Niels et.al 2006)

EAI - > Enterprise Application Integration solution models (Juha Mykkänen, 2004)

D&M - > DeLone and Mclean 2003

TTF - >Task Technology Fit (Goodhue and Thompson, 1995)

TTR - > Technology Transfer of Reference (Orlikarskis and Gash, 1994)

TFR - > Technological Frames of Reference (Orlikowski and Gash 1994; Orlikowski, 1992)

TOE - > Technology- Organization – Environment theory (Tornaltzky and Fleisher, 1990)

AT - > Activity Theory (Cole & Engestro¨m, 1993; Engestro¨m, 1987; Leont'ev, 1981)

IOT

- > Information Oriented Integration

POI - > Process Oriented Integration

SOI - > Service Oriented Integration

UOI - > User Oriented Integration

Basing on the evaluation of the findings after the review of the literature of the models (Enterprise Application Integration (EAI) solution models, Task Technology Fit [TTF], Technology- Organization – Environment theory [22] Technology Transfer of Reference [TTR] and Activity Theory, models of integration agree with the selected theories on concerns that are considered basic reasons for conducting ICT integration in tracking administration of malaria drugs in health units. This reveals that the most suitable theory on which tracking administration of malaria drugs in health units was based is the DeLone & McLean IS Success Model because it reveals that it supports the process, service, and user-oriented integration. It also supports issues like availability, ease of use, scalability, flexibility, and mentality (trainability) which were selected as variables that furnish quick integration of an information.

Key:

CE Communication Effectiveness

QT Technology Quality

CE has a positive significant correlation with the Intention and Actual use of ICTs in tracking the administration of malaria drugs. (B = 0.351). IQ is revealed not significantly (P-value = 0.612) correlated to Intention and Actual use (B = 0.029). This means that although it is clear that it influences positively the Intention to Use ICTs (β = 0.042) the impact is very low, so it is not an important factor to influence Intention and Actual use of ICTs in the tracking of administration of malaria drugs in health units in Uganda. Technology Quality (TQ) was revealed to have a negative linear correlation with Intention and Actual Use of ICTs (B = - 0.087) and further has a negative influence on the same (β) = - 0.050). The intention and actual use of ICT in tracking drug administration is influenced by the ability of the medical personnel to put it into use. Drug administration in this context is considered to mean all activities undertaken from the time the malaria drugs are dispatched from the stores to the time when it is delivered to the patient. The Controls, Technology, Malaria intrinsic and extrinsic con-

Table 3: Summary of comparison of the theories and Models operationalized to this study

Model Factor	EAI (2004)	AT (1994)	D&M (2003)	TTF (1995)	TOE (1990)	TFR (1994)	MDA (2006)
Support of: IOI	√	√	√	√	√	√	√
POI	√	×	√	×	√	√	√
SOI	√	×	√	√	×	×	√
UOI	√	√	√	√	×	√	√
Validability	×	√	√	×	×	×	×
Technology context	√	√	√	√	√	√	√
Ease of use	×	×	√	×	×	×	×
Scalability	√	×	√	√	×	×	√
Flexibility	×	√	√	×	×	×	×
Mentability (Trainability)	×	×	√	×	√	√	√

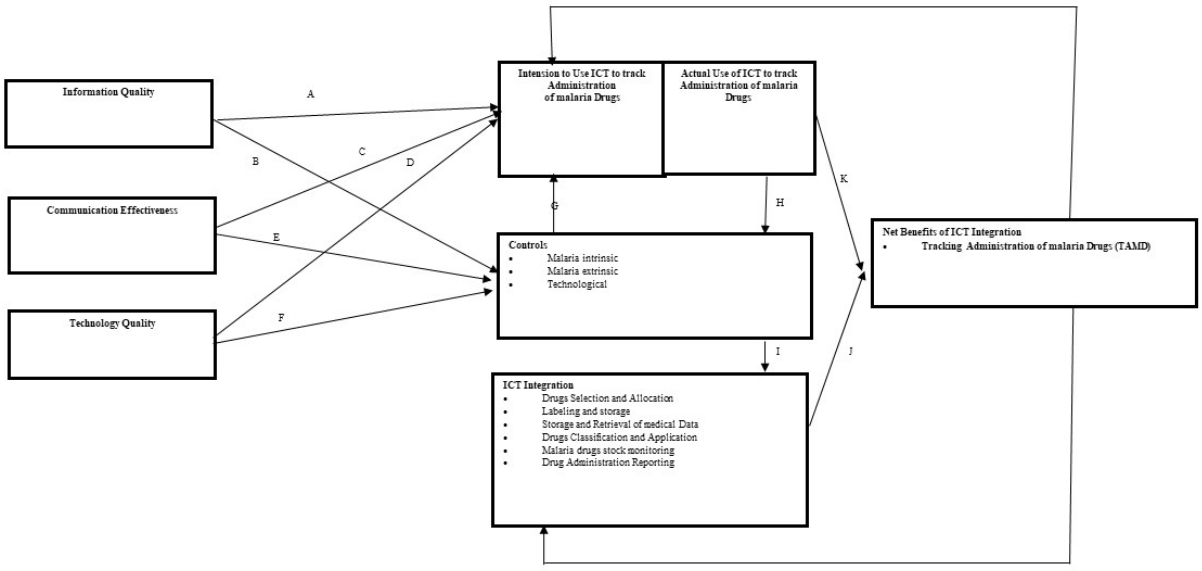

Figure 5: Conceptual framework for ICT integration and tracking administration of malaria drugs. Source: extended from Success Model DeLone & Mclean, (2002 & 2003)

cerns are therefore the purported limitations that are peculiar to the Ugandan situation generalized to affect tracking of the malaria drugs for the intended net benefits of tracking administration of malaria drugs using ICT. In achieving integration of ICT in tracking these drugs, some of the constructs of the D & M IS model was extended while others were dropped, user satisfaction was not addressing the issues of constraint that were thought to impact total management of malaria concerns, thus, Controls and ICT integration constructs were added where the "controls" are considered moderating variables together with the intention to use and actual use of ICT for the same process.

9. List of Abbreviations

IOI ..... Information Oriented Integration
POI .....Process Oriented Integration
SOI .....Service Oriented Integration
UOI .....User Oriented Integration
ICT..Information Communications Technology
SMS.....Short Messages based systems
MoH.....Ministry of Health
CHW.....Community Health Worker.
DHIS.....District Health Information System
HRIS...Human Resource Information System

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