International Journal of Advanced Computer Technology (IJACT)

ISSN:2319-7900

Evaluating the Performance of Data Management Research Cooperation from an Operations Management Perspective: A case study

Zarah Bello-Yashe, Kaduna State University, Nigeria

ABSTRACT

This study aims to obtain a better understanding of factors that influence the evolution of a successful data management research cooperation program. A structural equation modeling (SEM) approach was used with the aim of achieving a greater understanding of the intricate network of relationships between variables involved. A detailed theoretical framework was used to formulate the conceptual basis of the research while practical observations were found to be essential. The case of **Nigerian Identity Management Commission** and The **Dept. of Computer Science, Kaduna State University** was presented to define the basis of the model by six different structural constructs derived from literature and their interdependence in the form of hypotheses. The evidence of interdependence among the constructs and their respective operational variables were provided by five different hypotheses carried out on the path diagrams. As a result, the interaction between each construct and its variables define its individual measurement model, which translates into some sets of linear equations. Having obtained the measurement for each construct, their interaction can then be applied to define other sets of linear equations that represent the behavior of the organization in the entire process, which is expected to yield the proposed research and development program.

Keywords: data management, operations management, research partnership, research cooperation.

1.0. INTRODUCTION

A significant value of the entire world economy, mostly in industrialized nations like China, United States, and Germany etc. depends on Information Technology (IT) to meet their security needs. As a result, the IT industry operates at high intensity all over the world. The industry consist of two different segments, the Software segment including software engineering/ design and services (cloud storage, data and information management etc.) and the hardware segment consisting of Computer hardware and peripherals, network infrastructure as well as distribution and marketing (Tuth H. and James B. 2007). But the likelihood in coming time is the growing need for deploying IT into identity management so as to meet global security needs that arise from the continuous collection of unending and multi-dimensional streams of data. With this development, the data management sector of the industry will have to strive harder in discovering a more resourceful approach while at the same time developing more efficient data management methods through enhanced algorithms and research programmes. Data management activities involve investment decisions to undertake active collection, processing, storage and protection/ security of data (Mettler, T. & Winter, R. J, 2016). The data management association (DAMA) defines data management as the development and execution of architectures, policies, practices and procedures that properly manage the full data lifecycle needs of an enterprise (Dama, 2017).

Research and development activities are primarily geared at providing the best concepts and technologies to all users both within the academics, industry and also globally in a bid to ensure overall efficiency, security, reliability at a lower cost. The twin relationship is critical for the advancement of the industry and in ensuring cutting edge success and development in general (Robert W. Gaskins, 1995). In many cases, the method of cooperative research is preferred where people are employed to work alongside personnel from a host organization, not only for the obvious reason of technological and intellectual transfer, but also to provide a more enabling relationship between both. Similarly, training can also be earmarked to facilitate apprenticeship and internship opportunities for partners.

The need for policy to guide all research partnerships (both on an institution to institution basis, and on an institution to private basis, or a private company agreement) should contain all elements of this sort of reciprocal agreement (Zhao, 2008). In order to further encourage this type of agreement in Nigeria, this paper identified an educational institution where IT data management research ought to be undertaken, Kaduna

ISSN:2319-7900

State University herein referred to as KASU, as a potential partner to any successful data management research co-operation. It further went ahead to identify the National Identity Management Commission (NIMC), an institution saddled with a tasks of creating, managing, maintaining and operating the Nigerian National Identity database, thereby serving as a potential partner. This paper developed a model that will aid the proposed research partners to evaluate the viability of their research partnership and or cooperation hence providing platform for an optimized research partnership.

3.0. RESEARCH METHODOLOGY

3.1. Scope

This research is limited to the development of an operations management based model, capable of evaluating the effects of some key variables in respect of a NIMC - KASU research co-operation towards optimizing identity management and security in Nigeria.

3.2. Specific Tasks

- Introducing the concept of Operations management with respect to data and identity management research cooperation
- Definition of a **NIMC - KASU** research cooperation model
- Defining model constructs and path diagram
- Hypotheses of the path diagrams
- Integrating components and constructs as a single model
- Model discussion conclusion
- Feature Development

4.0. MODEL DEVELOPMENT

4.1. Operations Management Practices in Data Management

Operations management (OM) in IT and data management identifies all the activities necessary to plan, develop, organize and improve data integrity and security (Salazar-Aramayo, 2013). We therefore refer not only to the core activities of data management but also all operations related to security and the storage environment itself. When modeling OM practices relative to data management research, it is necessary to deal with a range of variables that cannot be measured directly. As a result, we estimate values for these variables by referring to proxy indicators. In such a situation, Structural Equation Modeling (SEM) is an important useful tool for application. It allows the evaluation of this kind of phenomena to be described by a two-step procedure. Several author's (B, 2005; Elisa Battistoni Andrea Bonacelli, 2013; Grace, 2006; Kenneth.A, 1989; Lee, 2007; Muller, 2006; Shipley, 2000; Suhr, 2003) have given out information on how to develop, solve, interpret and apply SEM in various aspects of research. Firstly, a pictorial representation of casual links among the variables influencing the modeled phenomena is carried out in graphical form. These variables are called "latent variables" because they cannot be measured directly. In this paper, we symbolize the latent variables as nodes and the casual links as orient arcs connecting the nodes. In such a representation, some variables are found to be dependent on some specific casual links while others are found to be independent. As a result, variables are classified as exogenous or endogenous to the casual model. "*Exogenous variables"* cannot be influenced by the internal elements of the modeled system, while "*endogenous variables*" are subject to that. These are of key significance for analyzing the system status. Secondly, a measurement model is developed from the graph depicted in step one. In this model, one or more proxy indicators are assigned to each latent variable. The analytic property of the model allows for a weight to be assigned to every arc, so as to define a value for the influence of each variable on the others connected to it.

The developed model can be expressed mathematically with a system of simultaneous equations to be solved using regression analysis and/or other mathematical tools. Every equation in the system originates from one or more casual links of independent variables with other variables exogenous or endogenous and includes measurement errors. Consistently, an endogenous variable can be considered as being independent in one equation and dependent in another.

4.2. Model Definition

The model is a theoretical construct of structural and measurement parameters. It consists of a set of latent variables, operational measurement and hypotheses depicted in path diagrams. This model intends to provide some relationships in the form of

ISSN:2319-7900

mathematical equations that will serve as tools for measuring effects of some defined key parameters that have great influence on the proposed KASU- NIMC research and development cooperation.

4.3. Defining Key Constructs and Hypotheses of the Path Diagrams

We define the bases of this model by six different structural constructs and their interdependences in the form of hypotheses as shown in **Fig 1**. The constructs consist of one latent exogenous variable and five latent endogenous variables. Furthermore, five independent operational variables were established from literature in respect of the latent exogenous variable while twenty five dependent operational variables were also established in respect of the latent endogenous variables as shown in **table 1** and **figure 2**. The evidence of interdependence among the constructs and their respective operational variables were provided by five different hypotheses carried out on the path diagrams as follows:

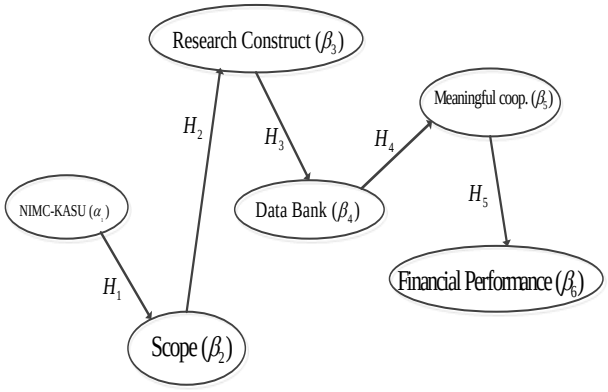

Figure 1: The structural model in path diagrams, showing the interdependence of key constructs

4.3.1. Hypotheses 1 (H1). Relationship between cooperating partners with scope and quality.

Scope definition and management forms the very foundation of any successful project. This is typically applied in a case were two institutions are coming together in respect of an advanced research co-operation. According to several authors, (Close, 2006.; Jugend and da Silva, 2012) without this conceptualization, it becomes impossible to adequately determine cost, time line and processes, which may mutate during the execution phase. Once the scope is defined, detailed planning and execution can be carried out with much reduced risk for error.

Table 1: Constructs and their respective measurement variables for the proposed model (Derived from literature)

Construct	Codes	Observed Variables	Referees
SINOPEC Corp. - NNPC(α_1)	Z1	Policies	Raghavendra D. Rao, 2000.
	Z2	Experience	Al Omoush, K.S., Al-Qirem, R.M. & Al Hawatmah, Z.M
	Z3	Coordination	
	Z4	Budget	
	Z5	Communication	
Scope (β_2)	X1	Accurate definition of scope	
	X2	Quality control	Souder etal., 1997
	X3	Schedule	
	X4	Response ability	Risiketal., 2010., Wejermars,2009.
	X5	Other requirements	
Research (β_3)	X6	Technique	Souder etal.;1997, Chan etal.; 2004, Li etal. (2007)
	X7	Data Gathering methods	Rocca, V., 2009.
	X8	Personnel Welfare	A.A.Modenesietal. 2012.
	X9	Personnel Health	M.Gu. 2012
	X10	Laboratories	Wang, X., Guo, Y., Yang, M. et a
	X11	Machineries	L.E.Doublet. 1995.
	X12	Hardware's	Pam Boschee, 2013.
	X13	Software's	Pam Boschee, 2013.
	X14	Transportation	Mettler, T. & Winter, R. J.
	X15	Security	Raghavendra D. Rao, 2000
Data Bank (β_4)	X16	Quality	Al Omoush, K.S., Al-Qirem, R.M. & Al Hawatmah, Z.M
	X17	Coverage	Holmström Lind, C. & Kang, O.H
	X18	Stability	Pam Boschee, 2013
	X19	User friendly	Buckley, P.J
Successful	X20	Within Budget	

ISSN:2319-7900

Cooperation (β_5)			
	X21	Desired Output	Buckley, P.J
	X22	Timely Completion	Lewis, 2000
Financial Performance (β_6)	X23	Rate of return	Kaplan and Norton, 1992.
	X24	Operating Merging	Yang etal.,2011
	X25	Payback Period	Jahnetal., 2008

All necessary requirements such as identification of specific research directions, data gathering methods, equipment's, application methods, output requirements, welfare of research personnel and supporting staff, knowledge requirements and others are to be clearly stated in the scope, thus, leading to a proper cost evaluation, personnel requirements and other specifications that will provide the required result.

This hypothesis established that a successful KASU - NIMC co-operation on this subject matter requires a well-defined scope and quality.

4.3.2. Hypotheses 2 (H2). Relationship between scope and quality, with Research construct (Research team, research directions, tools and environment)

Different scientific and technological activities are required for successful data management research cooperation. The key areas identified by this work include information technology, software and hardware engineering, data management studies and policy. We identified these areas as the building blocks of any successful scope in respect of a successful data management research in Nigeria.

With respect to identity management, this paper further proposes a research roadmap on identity from five different perspectives as described in (Ruth H and James B, 2007). (1) *Tensions.* It refers to major dilemmas and debates associated with identity in the information society, (2) *Themes*, in this context represent preoccupations, or subjects that cut across boundaries, and we draw attention to three: conceptual foundations, identity management and identity systems and power structures. (3) *Application Areas*, Increasing exploitation of identity information through deployment in ICT has penetrated more and more application areas with considerable effect. Government, Healthcare, Commerce more generally and the Finance sector are illustrative examples. (4) *Research Focus*, refers to current and future research foci on identity. Unlike tensions or themes, research foci operationalize specific concerns that are ripe for investigation, and thus, lead to results and research findings. They are also value indicators of what researchers deem to be worthwhile and feasible studies in the field. The research foci reveal the differing priorities relevant to studies of identity and indicate the kinds of studies undertaken and the type of results that are likely to be forthcoming. (5) *Disciplinary approach*; It considers the relevance of different disciplinary standpoints, and the use of related theories, conceptual frameworks and models to inform research into identity in the information society.

In order to realize this multidimensional and sophisticated research business, some key factors have to be considered which can serve as measurement variables for the co-operating partners in respect of evaluating the overall performance of each of the above mentioned research direction. Firstly, Data gathering and analytics, which requires high technological laboratory equipment's, sophisticated computing system and more importantly, the personnel technique itself.

Other issues are the software and hardware requirements usually applied for observing and manipulating the acquired and processed data. In recent years, the increase in performance as predicted by (Laura Mastella., 2013) and particularly, the advent of parallel computing has enabled data analysts to effectively use larger data. Sometimes back, running models of this type and size would have been possible on only the most powerful computers available and at a high cost.

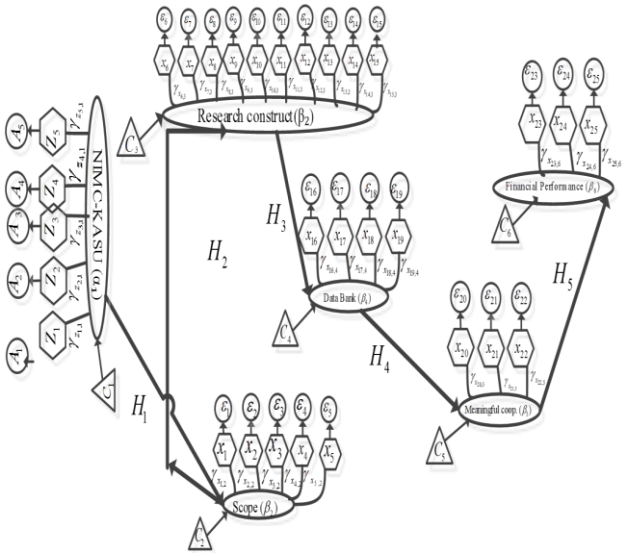

Figure 2: Depicts the Structural constructs and their

ISSN:2319-7900

respective measurement variables. A latent exogenous Pillar (α_1), controlled by five independent operational Variables (Z). Five latent endogenous constructs (β_2, β_3, β_4, β_5, β_6), Controlled by twenty-five dependent operational variables (X). Independent variable errors are represented by letterA while dependent variable errors are represented by ε. C represents errors associated to each construct as a whole. Structural coefficient (H) and factorial weight (γ) represents causes and effect order.

With the current descent in the cost of CPU and a boost in performance, parallel computing has made this easy for most researchers, thereby easing the process of this proposed co-operation.

Again, consideration must be given to external environment, because the co-operation itself will have to exist because of it. Therefore, it is essential for this co-operation to recognize that it must be receptive to it. Environment includes; objective market, geographic location, climatic, social, economic and political settings, in fact, anything that can impact success (Borgersrud and Ellingsen, 1998). All factors mentioned above, from data gathering through equipment's to environment, are capable of affecting planning, organizing, staffing and directing. As a result, should be further scrutinized in a series of meetings.

This hypothesis concludes that, a well-defined scope and quality, that considers all necessary research components, their respective tools and environment, will positively influence the research construct of this proposed Co-operation.

4.3.3. Hypotheses 3 (H3). Relationship between Research Construct and data bank

Organizations imperatives towards sustainability, efficiency and operational challenges to meet regulatory competitive and economic pressures have mandated researcher's to rely more on the knowledge base and operation intelligence (Borch et al., 2012). This amplifies the need to move data towards decision, enhanced operational efficiency and overall performance so as to implement tightly integrated solutions. The key to converting data into actionable, valuable insights lies primarily on the working team's innovative approach, which is based on experience and correct understanding of the task at hand as well as the data itself.

With these developments, these hypotheses have come to the conclusion that, a well experienced team, with good communication skills, knowledge and continuous training positively influence identity and data base management (Data bank).

4.3.4. Hypotheses 4 (H4). Relationship between data bank and successful cooperation

The underlying question regarding the value added through data gathering and analytics should be clearly visible when one considers that complicated identity and data management problems worldwide have seen tremendous inversions by intervention or operational improvements (Doublet et al., 1995). Significant potential exist to increase data management efficiency by identifying key drives to establishing an active identity system, through implementing optimization models. (Holmström Lind, C. & Kang, O.H 2017; Yang, Y. &Hao, C. 2011).

There are many examples of initial success of tapping into data to improve operational capabilities as well as efficiencies. Therefore, these hypotheses have come to the conclusion that, a qualitative data, with adequate coverage, stable (not subject to changes), in a user friendly format and language will positively influence the success of a KASU - NIMC research co-operation as proposed herein.

4.3.5. Hypotheses 5 (H5). Relationship between successful cooperation and financial performance

According to many authors, (Jahn, 2008; Kaplan., 1992; Yang, 2011). Research and development have evolved into a business process. Therefore, success in research can now be measured in terms of financial indicators that translate into organizational performance measurements. As a result, the main financial indicators proposed here are rate of return on capital employed, Net operating merging and payback period.

With this in place, there is no doubt that a successful KASU - NIMC cooperation will positively influence their respective financial performance.

5.0. RESULTS

The constructs represent latent variables that can only be measured indirectly through some observations. These observations can only be carried out by establishing the key variables controlling the effectiveness of each construct. As a result, the interaction between each construct and its variables define its individual measurement model that translates into the set of linear equations as shown in **table 2**.

ISSN:2319-7900

Table 2: Measurement equations for each Construct

KASU – NIMC; Measurement Equations		Scope; Measurement Equations	
$Z_1 = \gamma_{Z_{1,1}} C_1 + A_1$	(1)	$x_1 = \gamma_{x_{1,2}} C_2 + \varepsilon_1$	(6)
$Z_2 = \gamma_{Z_{2,1}} C_1 + A_2$	(2)	$x_2 = \gamma_{x_{2,2}} C_2 + \varepsilon_2$	(7)
$Z_3 = \gamma_{Z_{3,1}} C_1 + A_3$	(3)	$x_3 = \gamma_{x_{3,2}} C_2 + \varepsilon_3$	(8)
$Z_4 = \gamma_{Z_{4,1}} C_1 + A_4$	(4)	$x_4 = \gamma_{x_{4,2}} C_2 + \varepsilon_4$	(9)
$Z_5 = \gamma_{Z_{5,1}} C_1 + A_5$	(5)	$x_5 = \gamma_{x_{5,2}} C_2 + \varepsilon_5$	(10)
Research Construct; Measurement Equations		Data Bank; Measurement Equations	
$x_6 = \gamma_{x_{6,3}} C_3 + \varepsilon_6$	(11)	$x_{16} = \gamma_{x_{16,4}} C_4 + \varepsilon_{16}$	(21)
$x_7 = \gamma_{x_{7,3}} C_3 + \varepsilon_7$	(12)	$x_{17} = \gamma_{x_{17,4}} C_4 + \varepsilon_{17}$	(22)
$x_8 = \gamma_{x_{8,3}} C_3 + \varepsilon_8$	(13)	$x_{18} = \gamma_{x_{18,4}} C_4 + \varepsilon_{18}$	(23)
$x_{10} = \gamma_{x_{10,3}} C_3 + \varepsilon_9$	(!4)	$x_{19} = \gamma_{x_{19,4}} C_4 + \varepsilon_{19}$	(24)
$x_{11} = \gamma_{x_{11,3}} C_3 + \varepsilon_{11}$	(15)		
$x_{12} = \gamma_{x_{12,3}} C_3 + \varepsilon_{12}$	(16)		
$x_{13} = \gamma_{x_{13,3}} C_3 + \varepsilon_{13}$	(17)		
$x_{14} = \gamma_{x_{14,3}} C_3 + \varepsilon_{14}$	(18)		
$x_{15} = \gamma_{x_{15,3}} C_3 + \varepsilon_{15}$	(19)		
	(20)		
Meaningful Cooperation; Measurement Equations		Financial Performance; Measurement Equations	
$x_{20} = \gamma_{x_{20,5}} C_5 + \varepsilon_{20}$	(25)	$x_{23} = \gamma_{x_{23,6}} C_6 + \varepsilon_{23}$	(28)
$x_{21} = \gamma_{x_{21,5}} C_5 + \varepsilon_{21}$	(26)	$x_{24} = \gamma_{x_{24,6}} C_6 + \varepsilon_{24}$	(29)
$x_{22} = \gamma_{x_{22,5}} C_5 + \varepsilon_{22}$	(27)	$x_{25} = \gamma_{x_{25,6}} C_6 + \varepsilon_{25}$	(30)

Having obtained the measurement for each construct, their interaction can then be applied to define the set of linear equations represented in **table 3**. These equations represent the behavior of the organization for the entire process that will optimize the performance of the proposed research and development cooperation.

Table 3: Modeled Structural equations

Structural Equations	
$\beta_2 = \alpha_1 H_1 + C_2$	(31)
$\beta_3 = \beta_2 H_2 + C_3$	(32)
$\beta_4 = \beta_3 H_3 + C_4$	(33)
$\beta_5 = \beta_4 H_4 + C_5$	(34)
$\beta_6 = \beta_5 H_5 + C_6$	(35)

6.0. DISCUSSIONS

1- The aim of this paper is to contribute towards cooperation among institutions in respect of identity data management.

2- The paper provides a platform in which cooperating institution not only on data/identity management, but on various aspect of research, can use to investigate the viability of their intended cooperation

3- The case applied in this paper, as deduced from literature is expected to be a success in which a better future will emerge, if properly analyzed.

4- In order to support the partnership, an operations management (OM) based model was developed in which key constructs for cooperation were identified from literature together with their respective measurement variables.

5- These constructs and variables translated into mathematical equations that can be applied to capture different operating conditions, therefore creating room for business evaluation. With this, R&D operations management can easily and flexibly be optimized.

6- It is evident that there is a growing evolution of research into the business world; as a result, this proposed cooperation is awake up call.

7.0. RECOMMENDATION

This work did not go as far as obtaining data from both cooperating parties in respect of evaluation. It is therefore advised that such data be gathered for any feature work. This can be generated through

questionnaires as proposed by (Suhr, 2003; Xun Li, 2009). With this data available, measurement of latent variables can be carried out based on cronbach's alpha principle or any other reliable technique, thereby providing a better understanding on the viability of the proposed research cooperation.

ACKNOWLEDGEMENTS

My heart felt gratitude goes to my husband who deserves as much credit as I do for this study; his patience, support and constant encouragement is what helped me accomplish this paper. I would also like to extend my sincere thanks and appreciation to Dr. Mukhtar Habib for his immeasurable support and guidance.

REFERENCES

[1] Al Omoush, K.S., Al-Qirem, R.M. & Al Hawatmah, Z.M. The degree of e-business entrepreneurship and long-term sustainability: an institutional perspectiveInfSyst E-Bus Manage (2017). doi:10.1007/s10257-017-0340-4

[2] B, K.R., 2005, Principles and Practice of Structural Equation Modeling.

[3] Baunsgaard, E.M.S.a.T., 2001, The Tax Treatment of the Mining Sector: An IMF Perspective, World Bank workshop on the taxation of the mining sector.

[4] Borgersrud, O.K., and Ellingsen, D., 1998, Systematic Approach to Working Environment in Design and Construction of Major Off-shore Projects, Society of Petroleum Engineers.

[5] Buckley, P.J. Historical Research Approaches to the Analysis of Internationalisation**.**ManagInt Rev (2016) 56: 879. doi:10.1007/s11575-016-0300-0

[6] Chan, A.P.C., Scot,D.,ChanA.P.L.,, 2004, Factors affecting the success of a construction project: journal of construction management, p. 153-155.

[7] Dama (Data management association), 2017.https://www.dama.org/

[8] Elisa Battistoni Andrea Bonacelli, A.F.C.a.M.M.S., 2013, An Analysis of the Effect of Operations Management Practices on Performance: Int J Eng Bus Manag, v. 5.

[9] Grace, J.B., 2006, Structural Equation Modeling and Natural Systems, Cambridge University Press.

[10] Holmström Lind, C. & Kang, O.H. The Value-Adding Role of the Corporate Headquarters in Innovation Transfer Processes: The Issue of Headquarters Knowledge Situation**.** ManagInt Rev (2017). doi:10.1007/s11575-017-0311-5

[11] Jugend, D., and da Silva, S.L., 2012, Integration in New Product Development: Case Study in a Large Brazilian: 2012, v. 7.

[12] Kaplan.,a.N.D., 1992, The balanced score card; measures that drive performance, Harvard Business review p. 71-79.

[13] Kenneth.A, B., 1989, Structural Equations with Latent Variables.

[14] Laura Mastella.,V.C.a.J.r.a., 2013, PROLAB: An integrated platform for E&P data management: EAGE Conference paper, v. 31.

[15] Lee, S.-Y., 2007, Wiley Series in Probability and Statistics, Structural Equation Modeling, John Wiley & Sons, Ltd, p. 433-441.

[16] Mettler, T. & Winter, R. J. Are business users social? A design experiment exploring information sharing in enterprise social systems. InfTechnol (2016) 31: 101. doi:10.1057/jit.2015.28

[17] Mohsen Tavakol, R.D., 2011, Making sense of Cronbach's alpha: International Journal of Medical Education, p. 53-55.

[18] Muller, H., 2006, Structural Equation Modeling: A Second Course, Information Age Publishing, Greenwich, CT. Enders, C. K. .

[19] Nexant, 2003, National oil and gas policy: A draft report prepared for the Bureau of Public Enterprises (Nigeria) London.

[20] Ogbonna D.N., E.I.K.E., Igwe F. U, 2002, Waste Management: A Tool for Environmental Protection in Nigeria: Journal of the Human Environment, v. 31, p. 55-57.

[21] Pazos, V. & Chalmeta, R. Erratum to: Reusing enterprise models to build platform independent computer models. InfSyst E-Bus Manage (2017).doi:10.1007/s10257-017-0337-z

[22] Pisani, N. & Ricart, J.E. Offshoring of Services: A Review of the Literature and Organizing Framework. ManagInt Rev (2016) 56: 385.

ISSN:2319-7900

doi:10.1007/s11575-015-0270-7

[23] Robert W. Gaskins, I.W.G., Richard C. Anderson and Marlene Schommer. , 1995, The Reciprocal Relationship between Research and Development: An Example Involving a Decoding Strand for Poor Readers: Journal of Reading Behavior, v. 27.

[24] Salazar-Aramayo, J.L., R. Rodrigues-da-Silveira, 2013, A conceptual model for project management of exploration and production in the oil and gas industry: The case of a Brazilian company: International Journal of Project Management, v. 31, p. 589-601.

[25] Shipley, B., 2000, Cause and Correlation in Biology, *in* Press, C.U., ed.

[26] Tuth H. and James B. A roadmap for research on identity in the information society. Identity in the information society journal (2008) DOI 10.1007/s12394-008-0004-0

[27] Wang, X., Guo, Y., Yang, M. et al. Information ecology research: past, present, and future. Information TechnolManag (2017) 18: 27. doi:10.1007/s10799-015-0219-3

[28] Suhr, D., 2003, The Basics of Structural Equation Modeling, *in* Colorado, A.n.o.S.A.U.o.N., ed.

[29] Xun Li, T.J.G., Clyde W. Holsapple, , 2009, Supply chain agility: scale development: The International Journal of Logistics Management, v. 20, p. 408-424.

[30] Yang, M.G., Hong., P., and Modi, S., , 2011, Impact of lean manufacturing and environmental management on business performance; an empirical study of manufacturing fims: International journal of petroleum economics v. 1, p. 251-261.

[31] Yang, Y. & Hao, C. Product selection for promotion planning KnowlInfSyst (2011) 29: 223. doi:10.1007/s10115-010-0326-8