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Adapting Enterprise Resource Planning Systems In Organizational Models (A Case For Research Institutes In Nigeria)

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Abstract

This paper discusses and analyses ERP system integration in relation to business processes in organizational models with a special case for research Institutes in Nigeria. ERP software includes various solutions for user administration, database configuration, system monitoring, and performance measurement. These solutions are either part of the software or available as appendages. This new class of application software package suite has evolved with potential benefits to the enterprise market segments. We present merits of ERP systems and Business Process Reengineering (BPR) while articulating on how organizational models can be integrated into these systems. Regression analysis was carried out to ascertain the extent of correlation between ERP Systems rating and productivity index. The contribution of this paper is to articulate on how these organizations can leverage on ERP system to achieve three major cardinality viz: Optimize cost, improve quality of service and maximize profits. The results of our case study investigations sets the framework for justification and consequent implementation.

Keywords: ERP systems, Enterprise, Market segments, Business , Process ,Reengineering (BPR)

1.0 Introduction

Enterprise Resource planning systems have been viewed as a competitive strategic tool in organizational models. Enterprise resource planning (ERP) integrates internal and external management information across an entire organization, embracing finance/accounting, manufacturing, sales and service, customer relationship management, etc. ERP systems automate this activity with an integrated software application. Its purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders (Hossein, 2004). ERP systems can run on a variety of hardware and network configurations, typically employing a database as a repository for information (Sheilds, 2001).

ERP systems typically include the following characteristics:

- **i.** An integrated system that operates in real time (or next to real time), without relying on periodic updates.
- **ii.** A common database, which supports all ap plications.
- **iii.** A consistent look and feel throughout each module.
- **iv.** Installation of the system without elaborate application/data integration by the Information Technology (IT) department (Vikki, 2010).

i. Finance/Accounting: General, payables, cash management, fixed assets, receivables, budgeting, consolidation

ii. Human resources: Payroll, training, benefits, recruiting, diversity management

iii. Manufacturing: Engineering, bill of materials, work orders, scheduling, capacity, workflow management, quality control, cost management, manufacturing process, manufacturing projects, manufacturing flow, activity based costing, product lifecycle management

iv. Supply chain management: Order to cash, inventory, order entry, purchasing, product configurator, supply chain planning, supplier scheduling, inspection of goods, claim processing, commissions

v. Project management: Costing, billing, time and expense, performance units, activity management

vi. Customer relationship management: Sales and marketing, commissions, service, customer

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contact, call center support

vii. Data services: Various self–service interfaces for customers, suppliers and/or employees

viii. Access control: Management of user privileges for various processes.

This research contributes to the ERP literature in the following ways:

i. It defines and explains the benefits of ERP implementation while creating justification for its implementation through case study investigation in organizational models especially in research institutes in Nigeria.

ii. It addresses ERP implementation in research institutes; the findings of this study can help corporate management in research institutes to better support the deployment of ERP in managing their business processes effectively.

Creating a regression Model to ascertain the extent of correlation between ERP system rating and productivity index.

2.0 Advantages ERP Adoption

This research shows that integrating the myriad business processes in an ERP platform saves time and expenses. Decisions can be made more quickly and with fewer errors. Data becomes visible across the organization. Tasks that benefit from this integration include (Walsh, 2008).

i. Sales forecasting, which allows inventory optimization

ii. Order tracking, from acceptance through fulfillment

iii. Revenue tracking, from invoice through cash receipt

iv. Matching purchase orders (what was ordered), inventory receipts (what arrived), and costing (what the vendor invoiced).

ERP systems centralize business data, bringing the following benefits:

i. They eliminate the need to synchronize changes between multiple systems-consolidation of finance, marketing and sales, human resource, and manufacturing applications

ii. They enable standard product naming/coding.

iii They provide a comprehensive enterprise view (no "islands of information"). They make real–time information available to management anywhere, any time to make proper decisions.

iv. The deployment of ERP systems has the ability to integrate business processes and support collaboration.

v. The use of ERP systems improves quality of service and grantee customer satisfac tion

vi. Speed of business activities like order pro cessing, invoicing, procurement etc is greatly improved.

vii. Enhanced control across the business functionalities and objectives

viii. It supports automated alerts, as well as notification of important business events.

They protect sensitive data by consolidating multiple security systems into a single structure (RECEI, 2008). ERP implementation is considerably more difficult (and politically charged) in decentralized organizations, because they often have different processes, business rules, data semantics, authorization hierarchies and decision centres (Turban, 2008). This may require migrating some business units before others, delaying implementation to work through the necessary changes for each unit, possibly reducing integration (e.g. linking via Master data management) or customizing the system to meet specific needs. A potential disadvantage is that adopting "standard" processes can lead to a loss of competitive advantage. While this has happened, losses in one area often offset by gains in other areas, increasing overall competitive advantage (Dehning and Stratopoulos, 2003 and Muscatello, 2005). Contemporarily, manufacturing and some service companies has began to make heavy investments in ERP systems offered by SAP and its major competitors such as Oracle, Baan, PeopleSoft and J.D. Edwards (Dalal *et al.*, 2004).

3.0 Business Process Reengineering (BPR)

A business process is a set of logically related tasks performed to achieve a defined business outcome. Within the business process, people, equipment, material resources and business procedures are combined to produce a specific result. BPR literally explains a way of implementing radical changes in business process to achieve maximum results. There are many techniques for modeling enterprise

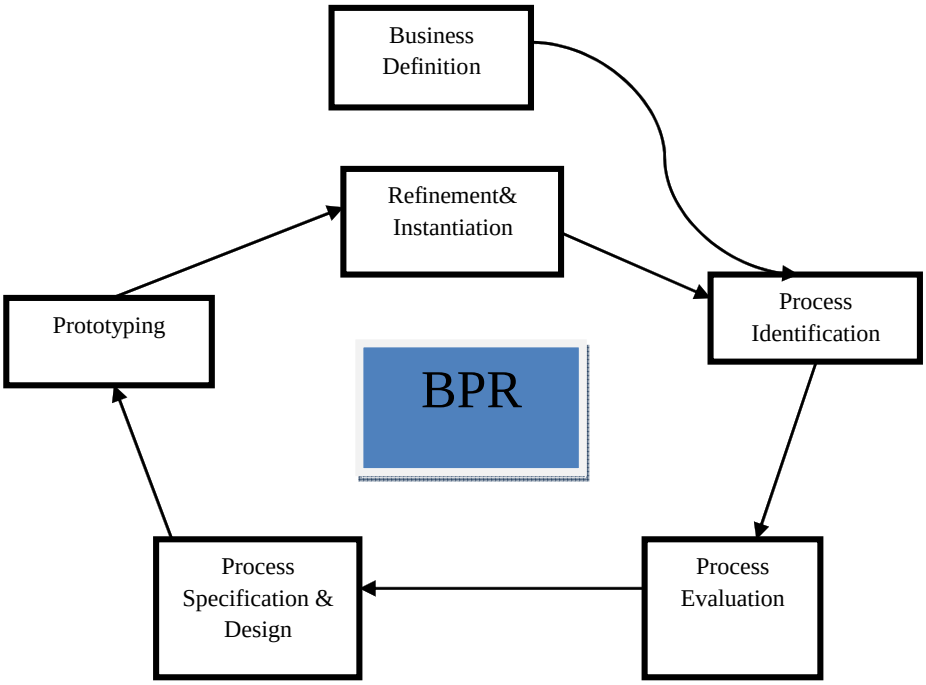


Figure 1: A business process reengineering, (BPR) model.

processes, including Data Flow Diagrams (DFDs), Integration Definition for Function Modeling (IDEF0), and activity diagrams in the Unified Modeling Language (http://www.tech-faq.com/erp.shtml.), however, they all have their roots in process modeling for software development. The business process of our case samples comprises the following:

- **i.** Administration.
- **ii.** Human Resource.
- **iii.** Procurement & Logistics.
- **iv.** Engineering/ R&Ds.
- **v.** Financial Accounting.

Through the concept of object process modeling (OPM), this work seeks to integrate the business processes of the sampled case study into an ERP platform. Business process reengineering is iterative and as such business goals and the processes that achieve them must adapt to a changing business environment. Figure 1 depicts six major activities of a good BPR model. The BPR model is consequently adapted into the ERP system via the OPM concept.

4.0 Research Methodology

Firstly, an operationalisation of system performance was obtained by noting performance indicators from our online survey. Online data mapping was used in the questionnaire (http://ecnet.technologyevaluation.com/(S(2th52zaiaj054l55lcec0v45))/ECNet.aspx and http://free-report.technologyevaluation.com/select-vs.asp?LV=88). However, this work adopted two approaches in its implementation, first an object process methodology, (OPM) was used to model the ERP system for our case samples while regression analysis was used to ascertain the extent of correlation between business process productivity and the ERP platform.

4.1 Object Process Methodology Description

Object Process Methodology (OPM) is an approach to designing information systems by depicting them using object models and process models. It is a holistic system paradigm comprising of entities and links for the business processes of our case samples. The entities used in OPM are objects, states and processes. An object is a thing existing for a period of time; a state is a situation an object can be in; and a process is a phenomenon that transforms one or more objects by creating them, altering their states or destroying/consuming them.

The links used in OPM are structural links and procedural links. A structural link forms a relation between two objects and is persistent while a procedural link is used to link a process to an object

Table 1: CASE SAMPLES; Research Institutes in Nigeria:

Research Domains	Research Institutes	Research Mandates	Business Processes	ERP Project Domains
Agriculture	Agricultural Research Council of Nigeria, Abuja.	To advise the Federal Government on national policies and priorities in agricultural research, training and extension activities.	1. Advisory services 2. Policy Development 3. Promote dissemination of Agricultural results 4. Admin and HR	A
Medical	Institute for Advanced Medical Research and training, Oyo State	To Promote Medical & Genetics RD as well as Malaria research	1. Training 2. Medical Lab Research 3. Administration and HR	B
Electronics	Electronics Development Institute, Awka	To promote technological innovations in electronic device production ,Re engineering and Capacity building	1. Electronic Systems development for SMEs 2. Capacity building via Training 3. Administration and HR	C
Manufacturing and Production	Scientific Equipment Development Institute, Enugu.	Scientific Equipment dev/manufacture of scientific products for mass production & commercialization	1. Manufacturing & Production 2. Service Management 3. Quality Management 4. Administration & HR	D
Power Energy	Center for Energy Research, Ife	To Develop nuclear techniques and develop Manpower in nuclear Science and technology	1. Advisory Services 2. Admin &HR 3. Training	E
Raw Materials	Engineering materials Development Institute, Kure	To develop engineering materials for Private sector	1. Consultancy 2. Technical Operations 3. Training services 4. Admin &HR	F

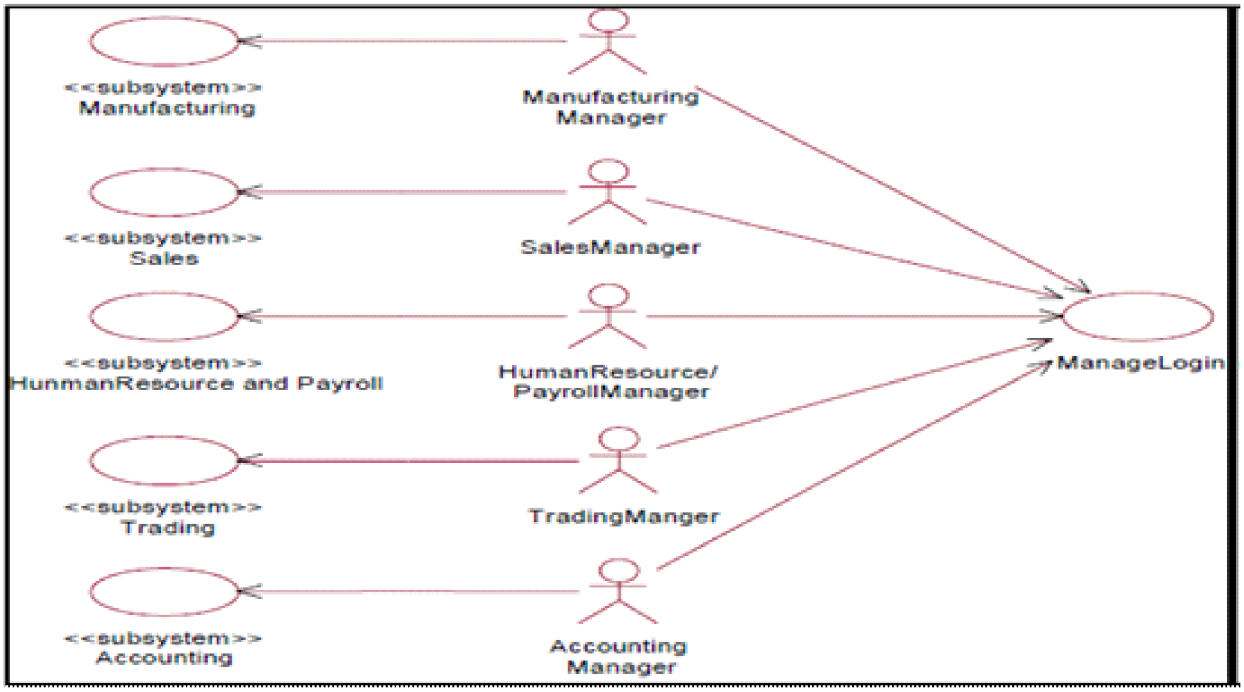
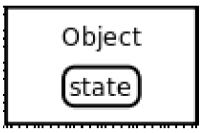


Figure 2: A subset of Business process mapping with OPM

Table 2: OPM Entities

Object		An object is a thing that exists.
Process		A process defines how objects are transformed
State		A state is a situation an object can be at.

- in which case it indicates a change in the state of the object - or to another process - in which case it indicates the launching of the second process when the first ends. A conceptual ERP platform can be modeled into distinct subsystems viz: Manufacturing, Sales, Human Resource and Payroll, Trading and Accounting. These constitute essential business processes in our case study samples.

From Figure 2, it is shown that OPM supports cardinality constraints, meaning a way to indicate to what extent two objects can relate to each other. In OPM, these constraints are referred to as participation constraints for the entity objects and their attributes. The following constraints were formulated in OPM:

- **i.** 1 to 1 Mapping
- **ii.** 1 to many Mapping
- **iii.** many to many Mapping
- **iv.** Optional (expressed as: ?)

5.0 Conceptual Architecture

For the business process of our sample case, a conceptual architecture is proposed in Figure 3. It shows an integration framework. For domain A to N+1, internalization and externalization business processes can be integrated into the ERP platform. However, ERP's scope usually implies significant changes to staff work processes and practices (see http://carl.sandiego.edu). The next phase of this work will investigate into ERP ratings to ascertain the best platform for our case sample in this work. Generally, three types of services are available to help implement such changes—consulting, customization, and support (see http://carl.sandiego.edu). Implementation time depends on business size, number of modules, customization, the scope of process changes, and the readiness of the R&Ds. Modular ERP systems can be implemented in stages. Customization can substantially increase implementation times (Anderegg, 2007). Figure 3 depicts an integration framework for research institutes used in this work.

The optionality leveling is used to reverse engineer the ERP system and the organizational structure to its full extent. Mapping the organizational business processes of A to N+1 in the ERP platform provides full interaction and collaboration with least administrative efforts. The process sequence to align both the ERP platform and organizational models is as follows in this work (see Figure 4):

- **i.** Convert the ERP system database to an object model
- **ii.** Construct a global business process model
- **iii.** Identify the system configuration-level business process alternatives
- **iv.** Identify the object-level variants of the business processes

Expose the occurrence-level business process options

5.1 Model Development & System Process Model

ERP modeling is the process of reverse engineering an Enterprise Resource Planning software package in order to align it to an organizational structure. Considering table xx, a proposed ERP model is done by analyzing the optionality within the ERP system to identify the different functions of the system that best suites our case organizations, vis-a-vis their organizational structures. Reverse engineering both ERP system and organizational structures to the

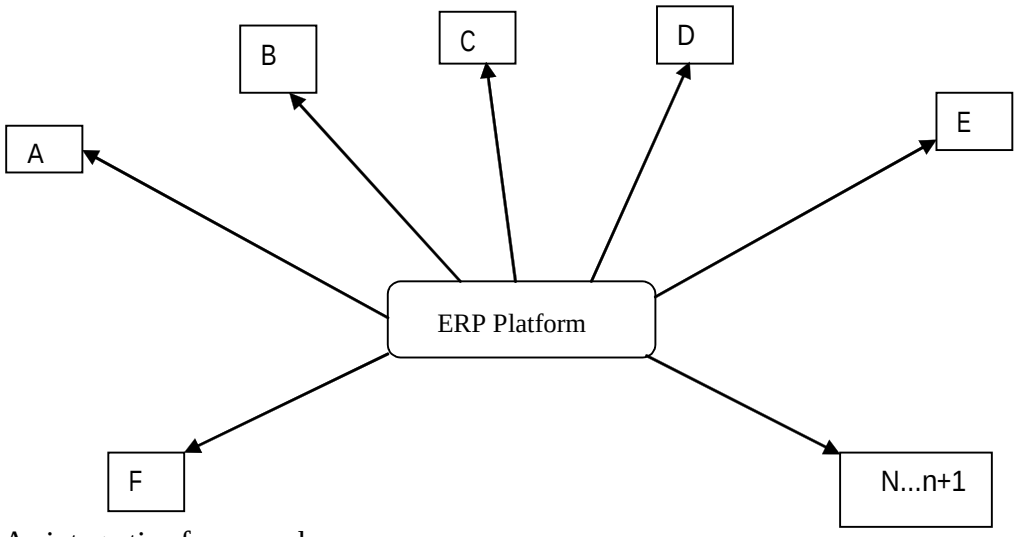


Figure 3: An integration framework

same level of granularity makes both layers compatible for aligning the package in our case studies.

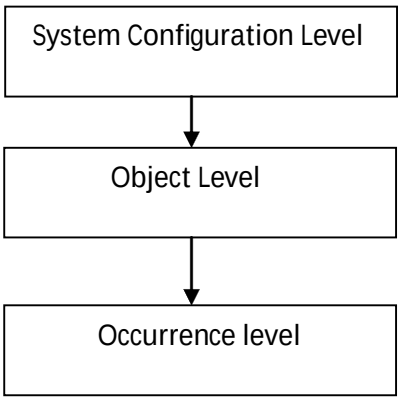


Figure 4: Business Process Model

6.0 Econometrics Analysis

Regression analysis is a statistical tool for the investigation of relationships between variables. This paper quantitatively establishes the correlation between ERP system integration rating and productivity index. This forms the basis for adaptation in our case samples in Figure 1. From econometrics perspective, the effect of research efficiency and productivity by adapting to ERP systems is discussed in this context. Firstly, this paper defines a linear regression function for ERP system rating and productivity system rating and productivity index as follows:

$y = \beta 0 + \beta 1\ x + \varepsilon$ ...1

where y = ERP System rating

x = Productivity index

x = Crd + Proft Max + QoS ...2

x (Productivity index) = Cost reduction + Profit Max + Quality of Service.

Neglecting the nature of the variable ε and focusing on the x - y relationship.

The paper establishes that: $y = \beta 0 + \beta 1x$ is the equation of a straight line;

β0 is the intercept (or constant) and β1 is the x coefficient, which represents the slope of the straight line the equation describes.

6.1 Regression model (hypothesis formulation)

6.1.1 Assumptions of a proposed Regression Model:

i. The relation between x and y is given by $y = \beta 0 + \beta 1\ x + \varepsilon$

ii. e is a random variable, which may have both positive and negative values, so e is normally distributed

iii. E() = 0

iv. The standard deviation of ,yx, is constant over the whole range of variation of x. This property is called "homoscedasticity."

v. since E() = 0, we're supposing that E(y) = $\beta 0 + \beta 1\ x + E(\varepsilon) = x$

6.1.2 Finding the regression line (the method of "ordinary least squares" or OLS):

This work begins with assumed values for b_0 and b_1 and suppose that the relation between x and y is

given by $y = b_0 + b_1x$; some b_0's and b_1's will give us better fits than others. Let y = a + bxi be the value of y estimated by the regression equation when x has the value xi; then if y_i is actual value, yi - y^ i is called the residual or the error substituting, let $e_i = y_i - \hat{y}_i = y_i - b0 - b1x_i$, different b_0's and b_1's will cause each e_i to have a different value.

6.2 Bivariant Linear Regression Computation:

In this section, the summary of our computations based on Table 3, is shown as follows:

N= 12 : $\sum x = 910$: $\sum y = 732.4$: $\sum x^2 = 72486$: $\sum xy = 58727.5$: $a = 0.888$: b = 21.62 : R: 0.9.

Since the coefficient of correlation r = 0.9, hence x and y are highly positively correlated.

7.0 Discussion

In this research, the use of linear regression in Figure 5 to elicit the correlation in our bivariate data model scales positively thereby justifying ERP systems adaption in organizational models The results certainly suggests that the regression equation may be used to interpolate (predict values within the limits of observation) and extrapolate (or forecast): predict values outside the range of observation or experience. The scatter diagram with its attendant regression curve demonstrates a linear relationship that quantitatively justifies cost optimization, improved quality of service and profit maximization as core components of productivity index defined in this paper.

8.0 Conclusion

We show that ERP system can help create a collaboration platform for business process management, allowing institutions to define best practices, formalize activities, and streamline cross-departmental functions. We have also presented a regression analysis to ascertain the correlation between ERP system ratings and productivity index. It was observed that ERP implementation is considerably more difficult (and politically charged) in decentralized organizations, because they often have different processes, business rules, data semantics, authorization hierarchies and decision centres.

A potential disadvantage is that adopting standard processes can lead to a loss of competitive advantage. While this has happened, losses in on an area often offset by gains in other areas, increasing overall competitive advantage. Future work will investigate on ERP rating analysis for Microsoft Dynamics, SAP ERP and Oracle E- Business Suite via an iterative online survey.

Table 3 : Online survey from online analytics (Engr Kennedy Okafor Online account)

S/N	ERPs Platforms	ERP Systems Ratings (Y)	Productivity Index(X)
1	SAP	98.5	100
2	Oracle	83.4	98
3	Microsoft Dynamics	79.8	89
4	Consona	68.9	87
5	Bann	58.7	86
6	InfoSys	57.7	79
7	Exact	56.3	76
8	Solar	50.9	73
9	ShopTech	49.1	69
10	Epicor	45.8	58
11	Plex	42.8	50
12	Global Shop Solutions	40.5	45

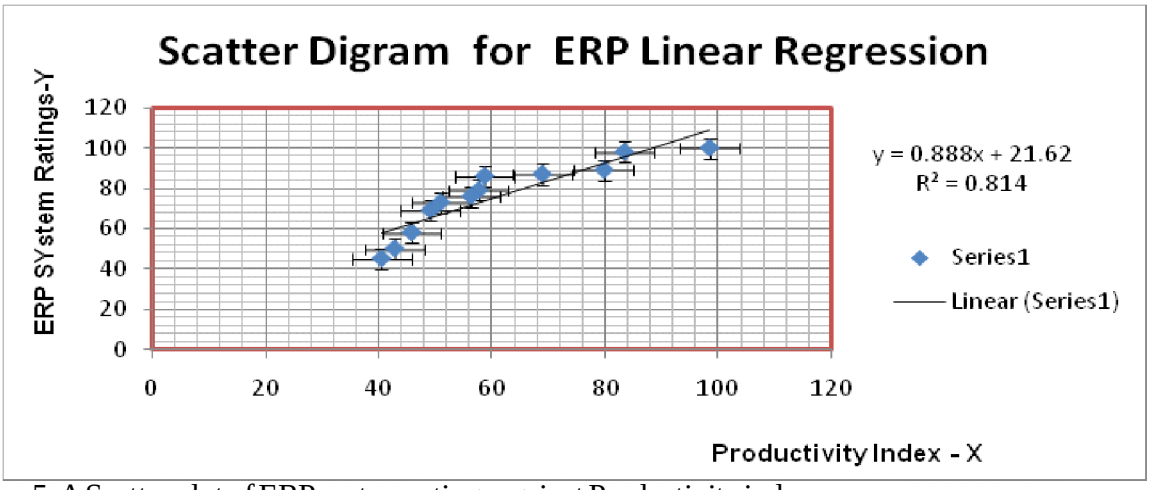


Figure 5: A Scatter plot of ERP system ratings against Productivity index

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