

DATA INGESTION: PANACEA FOR SYSTEMS INTEGRATION IN PUBLIC UNIVERSITIES IN NIGERIA

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ABSTRACT

This study examined the relationship between data ingestion and systems integration in public universities in Nigeria. The study adopted the quasi-experimental research design taken cognizance of the cross sectional survey approach. The study population comprised of 20 public universities in south-south, Nigeria. The study adopted the census approach which covered all the target universities in the South-South, Nigeria. However, the respondents derived from the respective universities which include 3 units' heads of the information technology centre of the universities. Thus, the total respondent is 60 derived from the 20 universities. Data collection for the study was done through the use of questionnaire and gathered data were analysed with simple descriptive and inferential statistics. The study hypotheses were tested using Pearson Product Moment Correlation Statistics and presented with the aid of Statistical Package for Social Sciences. The findings revealed significant positive relationship between data ingestion and systems integration which include collaboration and synchronization. Based on the findings, the study concluded that, there is a significant positive relationship between data ingestion and systems integration. The study therefore, recommended that data ingestion be utilized as it is found to have significant positive relationship with the measures of systems integration; collaboration and synchronization.

Keywords: *Data ingestion, systems integration, synchronization, collaboration, Data*

INTRODUCTION

In the 18th century oil was the most essential resource that drives the industrial era. Fast-forward to the 21st century of the knowledgebase economy, data and information are the greatest assets of the organization. According to Adesina (2018) data is an essential resource that powers the information economy in much the way oil has fuelled the industrial economy. He further asserted that, once upon a time, the wealthiest were those with most natural resources, now its knowledgebase economy, where the more you know is proportional to more data and information that is available to organizations. For instance, the universities as an organization are mostly managed administratively through information sharing. Interestingly, information work in continuum and to achieve the best from information in universities, management needs to build integrated systems that allow for effective communication among institutional units for efficient data management and information sharing capabilities and usage. Moreover, the success of every organization is determined by the level of integration of all its operating components given their structural relatedness and interdependence. The failure of a given organization can be seen from disconnect of its parts and goal diversities.

The university system in Nigeria runs manually with majority of its data ingestion done through traditional method of paper base. As the university grow with large population, data ingestion and management becomes cumbersome as the data could no longer last as expected and the university management started haven issues with the traditional method of data ingestion. The movement of files from office to office and building to building started causing serious data misplacement and record tracing. Fortunately, the emerging of information and communication technology changes the narrative in the data ingestion in

public universities as it is generally accepted as smart method of managing universities data ingestion much better than the traditional method of file cabinet data ingestion and management which does not provide a real time action for data utilization and decision making. Bowen, Cheung and Rohde (2007) asserted that organisations rely heavily on information technology (IT) to support service delivery at every level and to improve institutional performance. Thus, huge IT-related investments are made for the creation of business value, but organisations do not always gain the associated positive returns. This trend is also evident in the education sector. Advances in technology have dramatically changed university education systems over the past few years, information and communication technologies (ICT) continue to play an important role in modernising teaching, learning, research and administrative services in universities as well as the data collection all over the world (Snyder, Marginson & Lewis, 2007).

Data ingestion allows for the collection of this different data sources to a single data warehouse for upward data utilization. Data ingestion is the process of collecting, importing, and loading data from various sources into storage or processing system for further analysis, storage, or processing. This is a crucial step in the data pipeline and is essential for organizations that want to leverage data for decision-making, analytics, and business intelligence. *Data ingestion is the process of obtaining and importing data for immediate use or storage in the organization database/warehouse.* Organization in recent time has realized the value of data as a strategic advantage as well as an organizational necessity. Managing and harnessing the power of data and processes on the other hand is increasingly difficult. It must be accessible and consumable in the institutions with adequate access and visibility based on rules and responsibilities. The university system in Nigeria as an organization fall under the category of public sector organizations, and the public sector organizations are not empowered to make profit, but are design to follow best practices that ensure efficient and quality services delivery to the betterment and improvement of the life of the citizenry. In achieving the core purpose of information and communication technology as a tool for data ingestion, an integrated functional system that manages and warehouse data across the university units is a key factor for cost efficient university management.

Systems integration, also known as systems integration, is the process of connecting different subsystems or components within an organization's IT infrastructure or across multiple organizations to function as a coordinated and cohesive whole. The goal of system integration is to ensure that various systems, applications, and technologies can work together seamlessly to share data and functionality, enabling efficient business processes and information flow. For us in this study, *we defined systems integration as the systematic process of which all organization IT subsystems are interconnected with one another and allow for effective communication with the central IT systems.* In this definition the central IT systems becomes a larger systems that accommodates all other IT subsystem within the organization. The main reason for organization like the universities to use systems integration is their need to improve productivity, and quality of their operations. The goal is to get the institutions various IT systems to communicate together through integration, to speed up information flows and reduce operational costs for the institution. The system integration is not just used to connect an institution's internal systems, but also third parties that the institution operates with.

The adoption of information and communication technology (ICT) and it integration for the management of data and information in the university system is of almost importance to access knowledge and keep up with modern development. The integration of IT systems

gives students and the university management up-to-date information as both can access, share, and retrieve information anytime and anywhere (Suárez, Almerich, Orellana & Díaz, 2018). Unfortunately, public universities in Nigeria despite the establishment of information and communication technology centre, the gap between students data, staff data and other management personnel still persists as the universities are yet to implement effective systems integration where all university systems are integrated to communicate together. Therefore, this study examines the relationship between data ingestion and systems integration in public universities in south-south, Nigeria.

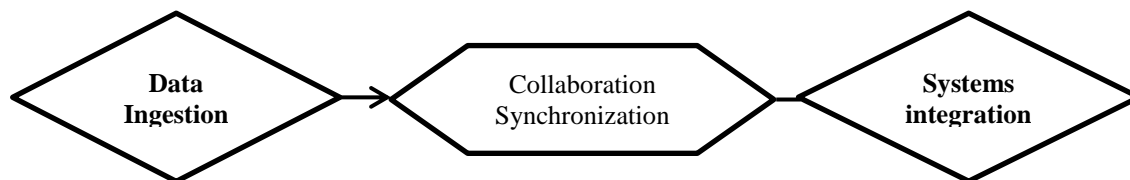


Fig. 1: Data Ingestion and Systems Integration Framework

LITERATURE REVIEW

This study is situated in the *technology acceptance model (TAM)* theory propounded by Davies in 1985. The theory according to Davies proposed that system use is a response that can be explained or predicted by user's motivation, which in turn, is directly influenced by an external stimulus consisting of the actual system's features and capabilities. This explains the fact that, the acceptance of technology in organization depends on the perceived ease of use and perceived usefulness of the system and this is directly control by feature of the system. Technology becomes organizational tool to make work easier for the users and thereby increase efficiency and productivity. Earlier it was thought efficiency and productivity could be obtained by maintaining a substantial amount of functionality, for example a program which contains all the necessary functions needed to solve a given task. However this was not enough, it is important that usability is also present in order to increase productivity. In other words, even if a program has good functionality it is of no use if it cannot be used in an effective way. Therefore, a program's usability is decided mainly by the users. This means that the user has the required amount of knowledge and understanding to interact with the system in the expected manner so that it leads to increased efficiency. Dishaw (1999) stated that, often the training that is given to the users is insufficient and rather ineffective leading to ineffective knowledge on how to use the system. Users develop different practices to interact with the system. Some of these practices will lead to the use of only some parts of the system which means that the maximum use of the system is not obtained. Therefore it is important that the system is user friendly as well as the employees are given sufficient knowledge or training on how to use the system as intended.

Data Ingestion

Data is not a new concept that arrives from heaven rather it has been around for decade but the breakthrough of information technology in the management of universities changes the nature of data visibility. In today's world, data is regarded as the greatest assets of the organization and the universities are full with diverse types of data from different units of the institutions. Organizations increasingly rely on information gathering and insights to further their institutions growth, make strategic decisions, and bring in a wider set of

audiences. In other words, they need data. But where does it come from? One of the must talk about subject today is the data science in the last decade. Despite being different from what we know now, data did exist. People have been using it for centuries, working hard to innovate new ways to benefit from it. The word 'data' is derives from Latin word datum (singular) which means the thing given. The Meriam Webster online (n.d) defined data as something given or admitted, facts or principles granted or presented that upon which an influence or argument is base or from which an ideal system is form. Technically speaking, *data is any information that has been translated into different forms to be processed, analysed, managed, and transferred.* The word itself is an enormous umbrella term for many concepts and scientific branches, such as statistics and mathematics (El Shatby, 2022).

Data becomes meaningful when it has been analysed, process and interpreted to make sense to the users. The processing facts derive from the analysis of data becomes information. That is why some scholars had argued that, data are fact that has no meaning. Data has changed the way we look at the world and managed institutions of learning and business organization and continues to shape it in different ways. Nowadays, no industries are left out from the benefit of data as organization started prioritizing the employment of data analyst to applied analytical techniques to improve their operations. Data ingestion is the process of obtaining and importing data for immediate use or storage in the organization database. Organization in recent time has realized the value of data as a strategic advantage as well as an organizational necessity. Managing and harnessing the power of data and processes on the other hand is increasingly difficult. It must be accessible and consumable in the company with adequate access and visibility based on rules and responsibilities. Interestingly, the goal of every business organization is to ensure they succeed today without compromising the future. It is on this note that leaders of organizations work round the clock to fine solutions to the improvements of their organization in the midst of environmental instability. As lord denning rightly said, in God will trust, any other things, bring data.

This speaks volume about the important of data availability to organization. The university systems like other organization deal majorly on data and derive much power from its database. In the age of the digital economy, data has been generally acknowledged as one of the greatest asset of the 21st century. It is produced in mass both structured, unstructured and semi-structured and the ability to get inside of these rich resources to extract relevant information is the key to effective organizational decision making (Nwinyokpugi & Fiito 2021).

Data are growing quickly every day in both structured and unstructured format. The arrangements of data in its inception play critical role in information availability to organization. The university management derive information regarding the numbers of students and staff strengths across the faculties and department through data. The segmentation of each data by batches and its arrangement in a single database save organization from excessive spending and usher in efficient university management system. The management of data starts from the inception stages of data intake which give room for good data ingestion. As the university systems are run on faculties and departmental basis, data are scattered at different units with different sources. These sources of data need to be absorbed in the organization database or warehouse as to pave way for easy data utilization. Data ingestion process is an important step in building any big data project; it is frequently discussed with ETL concept which is extract, transform, and load. Traditionally, ETL was built for moving the data from source to destination via created pipeline, but this process is slow and not time-sensitive. Modern applications aim to provide a model for real time processing and decision making, in this case the ETL is created with different architecture to

solve the invisibility problem and to deal with streaming data such as website clicks, sensors and telecommunications, so the new arrived data will be transferred immediately for processing (Meehan, Aslantas, Zdonik, Tatbul, & Du 2017). Data ingestion is a process of moving and transferring different types of data (structured, un-structured and semi-structured) from their sources to other system for processing, this process starts with prioritizing data sources then validating information and routing data to the correct destination (Matacuta & Popa, 2018; Nargesian, Zhu, Miller, Pu, & Arocena, 2019).

Systems Integration

In recent time the use of information and communication technology for the management of universities are on the increase. Information communication technology has come to stay as a tool for effective university management and data storage. The institutions of learning like any other organizations that are design and run on faculties and departmental basis are interconnected in nature and interdependent. An integrated system helps in the connectivity of all subsystems to the central systems for efficient and effective information sharing. In the information system discipline where this study is conducted, systems integration is look at from technical perspective: The technical standpoint in the first perspective suggests that integration is a mechanism to depict the interconnectedness of information technologies within an organization and the extent to which a common conceptual representation of data elements are shared (Chiang, Lim, & Storey 2000; Goodhue, Wybo & Kirsch, 1992). The second perspective, view systems integration as the degree to which two or more independent organizations have standardized business processes and those processes are firmly linked through telecommunications technologies and computers (Dan, Dias, Kearney & Lau, 2001).

Now, the both perspective is critical to the concept of this systems integration in this study. The first perspective give room for organization to deal with its internal business processes and the second perspective give room for organization to deal with its external business partners. By internal business processes, we meant all those activities that are carry out within the organization by its internal members via technology. And the external perspective involves the activities between the organization and those outside the organization but conduct business with the organization. Systems integration aims at facilitating exchange and information sharing within an organization, and achieving inter-firm coordination for better monitoring capability (Auramo, Kauremaa & Tanskanen, 2005). In regard to technological integration, it has been repeatedly stressed that information systems integration needs all application systems, data, and communication to be integrated in order to provide a real-time and consistent connectivity within function component across the organization (Müller & Seuring, 2007). Looking at the various perspective and scholars submission on systems integration, in this study we defined *systems integration as the systematic process by which organization information technology (IT) subsystems are interconnected with one another and allow for effective communication with the central information technology (IT) systems.*

Synchronization

With the cloud quickly becoming a channel for an unprecedented supply of data, importance of data accuracy, consistency, and privacy is growing. Things that may seem like a minor data error or malfunction can have a major negative impact on the organization decision making. However, sorting through data and updating it on a regular basis in existing databases as to maintaining data integrity can be tedious and costly. That is why data

synchronization has become the most valuable tool to manage data. Data synchronization is the process of establishing consistency between source and target data stores, and the continuous harmonization of the data over time (Aashima & Anit Kaur, 2014). As organizations continue to obtain data from different sources in the organization, some operations are performed at same time. Synchronization of data ensures accurate, secure, complete data and successful team and customer experiences. It assures congruence between each source of data and its different endpoints. As data comes in, it is cleaned, checked for errors, duplication, and consistency before been put to use. Synchronization of data in the organization allowed organization to have access to same information across the organization. Synchronization is a method of storing data in more than one place and keeping it up to date. To ensure that systems are consistent, data is continuously synchronized between two or more devices. Data must be consistent throughout the data record at all times. If data is modified in anyway, the changes must be propagated through all systems within the organization in real time. This makes sure that all systems have the same data in them and helps protect organization against database corruption. For instance, if organization runs two databases on different servers, they need to be synchronized so that they both contain the same information. If they don't, then when one server goes down or gets corrupted, it could mean bad news for the organization. Synchronization of data is crucial to an organization for the following reasons: Ensuring data integrity, ensuring data availability and reducing the risk of data loss and corruption. Moreover, synchronization of data means making sure all files and data on different devices stay up to date. When data isn't synchronized, organizations can't use it to perform their operations efficiently. Manually, transferring information between sources can waste time, and result in costly errors. With synchronization, organizations don't have to manually move data around themselves which saves time and effort while also maintaining data integrity. It prevents data loss and helps organizations to be more efficient in their operations. It ensures that all systems have the same data. With synchronized data, you can have a clear understanding of overall aspects of the data driven business decisions and the organization's overall planning and implementation. In many times, synchronization is a lifesaver for business as it can provide backup of data in case of an emergency. In this way, the organization will not lose all its information and will have access to it again in the event of a disaster.

Collaboration

Collaboration is the coming together of two or more persons to perform task that an individual could not perform alone. In organization today, the nature of works has change as a result of information technology. People now collaborate on work than ever before. In particular, teams that work in collaboration can obtain greater resources, recognition and various rewards. Collaboration in the field of business could be found in both inter and intra-organization. Collaboration between team members in a group allows for better communication within an organization and also throughout the organization operating base. The term "collaboration" is not an option, but a necessity, and thus, is often required or encouraged for activities that are so complex or difficult to deal for an individual, people or organization (Denning & Yaholkovsky, 2008). In some circumstances involving information seeking and information sharing also called as collaborative effort. According to Twidale and Nichols (1996) they have argued that introducing support for collaborative work into information retrieval system would help end-users to learn and use the system more effectively. There was a study conducted by Morris (2008) that showed, from 204 knowledge workers that the majority of them wanted to collaborate to every specific goal. Though the demand for information delivery mechanism is not new, but for collaborative information system or mechanism is the demand for today.

Today's organization and their workforce are no longer mandated to stay in a confine building but are increasingly involves in remote work setting where workers work from anywhere in the world. The success of remote work today is heavily anchor on collaborative systems that allow members of organizational work team to share ideas and work together by a remote server. Collaboration is the mutual engagement of participants in a coordinated effort to solve a problem together. Collaborative interactions are characterized by shared goals, symmetry of structure, and a high degree of negotiation, interactivity, and interdependence. Interactions producing elaborated explanations are particularly valuable for improving employee learning. Roschelle and Teasley (1995) define collaboration analysis as coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem. They define the joint problem space as the shared knowledge structure that supports problem-solving by integrating goals, descriptions of the current problem state, and awareness of potential strategies, as well as the links between these things through technology. Collaboration analysis takes place within this joint problem space, which provides the structure needed to allow meaningful conversations about the problem. To construct a joint problem space, partners must have ways to introduce and accept knowledge, monitor exchanges for evidence of divergent meanings, and repair any divergences identified. As Van Boxtel (2000) explains collaborative analysis activities allow workers to provide explanations of their understanding, which can help other employees to elaborate and reorganize their knowledge. Social interaction stimulates elaboration of conceptual knowledge as group mates attempt to make themselves understood, and research demonstrates that providing elaborated explanations improves employee comprehension of concepts. Once conceptual understandings are made visible through verbal exchange, workers can negotiate meaning to arrive at convergence, or shared understanding. Collaboration involves participants working together on the same task, rather than in parallel on separate portions of the task.

METHODS

The study adopted a quasi-experimental survey design which do not subject research variables to laboratory test but measured by the researcher's interaction and experience. The non-contrive studies are normally conducted in the natural and normal work environment. The above research design is correlational and it helps researchers to determine the degree to which variables are related. The population of the study comprised of 20 public universities in south-south, Nigeria. The study adopted the census approach which covered all the target universities in the South-South, Nigeria. However, the respondents derived from the respective universities which include 3 units' heads of the Information Technology Centre of the Universities. Thus, the total respondent is 60 derived from the 20 Universities. The study data collection was done through the use of primary data source which involve the use of questionnaire. The collected data for this study was analysed by coding the retrieved questionnaire copies into machine readable format. The analysis was done on the demographic characteristics of the study respondents, followed with the univariate analysis as well as the bivariate analysis which involved the test of the study hypotheses. Furthermore, gathered data were analysed with simple descriptive and inferential statistical tool. The study hypotheses were tested using Pearson Product Moment Correlation Statistics and presented with the aid of Statistical Package for Social Sciences to establish the relationship between the predictor and the measures of the criterion variable. In testing the study hypotheses our confidence interval was set at 95% and at 0.5 level of significance (two tailed) to test the statistical significance of the collected data in this study. Below is the Pearson's Product Moment Correlation Coefficient formula.

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{\left(n \sum x^2 - \sum x^2 \right) \left(n \sum y^2 - (\sum y)^2 \right)}}$$

Table:1 Correlation matrix for Data Ingestion and Systems Integration Measures

		Data Ingestion	Collaboration	Synchronization
Data Ingestion	Pearson Correlation	1	.782**	.755**
	Sig. (2-tailed)		.000	.000
	N	52	52	52
Collaboration	Pearson Correlation	.782**	1	.927**
	Sig. (2-tailed)	.000		.000
	N	52	52	52
Synchronization	Pearson Correlation	.755**	.927**	1
	Sig. (2-tailed)	.000	.000	
	N	52	52	52

** . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output 2023 version 20.0

The correlation coefficient (r) result in table 1 was used to answer the research question. Table 1 showed a Pearson Product Moment Correlation Coefficient (r) = 0.782 on the relationship between data ingestion and collaboration and p-value of $0.000 < 0.05$. This value implies that strong relationship exists between the variables. The direction of the relationship indicates positive correlation which implies that an increase in collaboration was as a result of the adoption of data ingestion. Therefore, there is a strong significant positive relationship between data ingestion and collaboration in public universities in south-south, Nigeria.

Also, table 1 showed a Pearson Product Moment Correlation Coefficient (r) = 0.755 on the relationship between data ingestion and synchronization and p-value = $0.000 < 0.05$. This value implies that a strong relationship exists between the variables. The direction of the relationship indicates positive correlation which implies that an increase in synchronization was as a result of the adoption of data ingestion. Therefore, there is a strong significant positive relationship between data ingestion and synchronization in public universities in south-south, Nigeria. Therefore, to enable us accept or reject hypotheses 1 and 2 as well as generalize our findings to the study population the p- value was used as shown below:

- Table 1 is the statistical test of significance (p-value) which makes possible the generalization of our findings to the study population. From the result obtained from table 1, the sig- calculated is less than significant level ($p = 0.000 < 0.05$). Therefore, based on this finding the null hypothesis earlier stated is hereby rejected and the alternate upheld. Thus, there is a significant positive relationship between data ingestion and collaboration in public universities in south-south, Nigeria.
- Also displayed in the table 4 is the statistical test of significance (p-value) which makes possible the generalization of our findings to the study population. From the result obtained from table 4, the sig- calculated is less than significant level ($p = 0.000 < 0.05$). Therefore, based on this finding the null hypothesis earlier stated is hereby rejected and the alternate upheld. Thus, there is a significant relationship between data ingestion and synchronization in government owned universities in the south-south region, Nigeria.

Therefore, the results for the first set of hypotheses with regards to the relationship between data ingestion and system integration measures are stated as follows:

- i. There is a strong significant positive relationship between data ingestion and collaboration in public universities in Nigeria.
- ii. There is a strong positive significant relationship between data ingestion and synchronization in public universities in Nigeria.

DISCUSSION OF FINDINGS

The findings in table 1 revealed that there is a strong positive significant relationship between data ingestion and systems integration in public universities in Nigeria. The finding corroborates with the earlier study by Naveen and Chaudhary (2014) conducted a research which aims to provide an algorithm in order to solve the problem, which occurs when all clients rely to a single server. When the server is unavailable, due to server failure or planned server downtime, all users – remote workers will be disconnected from their data, and all the data used by the remote workers will be stored in their local system. Data will then be automatically transferred from their local system (client) to the server when user connects to the internet. The file handling system use the same behaviour as well, all the files uploaded by users will be saved on the client machine folder when internet is not available and all files will be automatically transferred from client to server when internet connection is available. And this is achievable through systems collaboration. They concluded that data collaboration is enabled through specialized software that tracks data version where data elements are created and utilized between several integrated systems.

Also deduced from the study finding is consistent with Muhsin, Rini, Rendy & Eko (2015) conducted research in Indonesia. The research objective was to implement synchronization algorithm through data ingestion which is able to maintain consistency of data owned by different databases through web service, so that data is always up to date. In this study, the implementation describe the difference of data synchronization algorithm between unidirectional synchronization with bidirectional synchronization in different device through Web Service so users can still use the same data although using a different device. The implementation also added additional information called as a marker to decide whether the data is need to ignore or synchronized to another database and this achievable through data ingestion. And by ingesting datasets into analytics platforms, organizations can leverage these technologies to gain deeper insights, improve predictive capabilities, and automate decision-making processes.

CONCLUSION

The study finding in table 1 revealed that there is a strong positive significant relationship between data ingestion and measures of systems integration which are collaboration and synchronization in public universities in Nigeria. Therefore, the study concluded that there is a significant positive relationship between data ingestion and systems integration in public universities in Nigeria.

RECOMMENDATIONS

Based on the study findings, the study therefore, recommended thus:

- i. Management of public universities should tap more professional job skills from the information and communication technology centre of their institutions by proper utilization of data ingestion as it enhances efficient institution data resource availability and systems integration leading to effective collaboration.
- ii. Management of public universities should ensure data ingestion are utilized as it enhanced data availability and provides institution with up-to-date data and strengthen systems integration with effective data synchronization.

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