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Enterprise Architecture Assessment and User Satisfaction Model Estimate in Statistical Organizations of African Countries

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Abstract: The objective of this study is to assess the current state of Enterprise Architecture (EA) and estimate the User Satisfaction Model (USM) in Statistical Organizations of African Countries (SOACs). The following inferential statistical techniques were used: hypothesis tests, Principal Components Analysis (PCA), and multiple linear regression, to perform data analysis based on the judgments and opinions of the managers and Information Technology (IT) staff of SOACs. The study is based on several variables related to the performance and support of Information Systems and Technology (IST) in SOACs. The results confirmed the high complexity of IST in SOACs, which is further aggravated by the cyclical nature of statistical surveys and, for this reason, the poor integration and reuse of technological solutions associated with the absence of a formal EA. The results also led us to the conclusion that, as noted in general, in SOACs, user satisfaction is also positively influenced by IST when it is active, available, and reliable. An EA built from scratch will ensure optimised IST implementations, reducing common constraints and increasing the chances of getting real value from IST resources.

Keywords: user satisfaction; statistical organizations; enterprise architecture; information systems; information technology; Africa.

1 Introduction

A brief look at the evolution of the statistical production process (Gjaltema, 2021) suggests that over the years, through many iterations and technological changes, statistical organizations have built their organisational structure and production process, enabling them to establish statistical and IT infrastructure. As in other industries, in official statistics, IT has always promised to bring about new levels of productivity and efficiency to a wide variety of applications and organizations (Dukach, 2022), given the important demand that statistical organisations have for its support (Riecan, 2020). Therefore, IT began to take a leading role, no longer offering prompt support for organisational systems and infrastructure to promote innovations duly aligned to the strategies and goals in the statistical production process. Today, all technological systems are dynamic, regardless of whether they are large support infrastructures or small systems, such as a mobile phone, for example. They all have many different components, multi-part integrations, and a general lack of understanding about how they work. This is a fertile ground for two major problems recognized by Sessions & DeVadoss (2014): the first is managing the increasing complexity of IT systems, and the second is the increasing difficulty of delivering real business value from them. As we can imagine, these two problems are related, i.e., the more complex a system is, the less likely it is to get its value to the business. This means that if we manage this phenomenon better, the organisation's performance improves. In the context of SOACs, IT complexity is explained by the lack of autonomy and stable funding for national statistical systems and the dominance of donor priorities over national priorities, as Beguy (2016) asserts. This situation gives rise to a huge proliferation of technological resources without any planning, facilitating complex IT systems and little chances of integration and reusing them, much less getting value from them. Statistical surveys are cyclical and require a great deal of IST support. However, once a statistical survey

has been finalised, the ISTs are disassociated from it and are left adrift within the SOACs, which exacerbates the problem of technological proliferation and consequent complexity. Furthermore, in 2021, Gjaltema (2021) pointed to the fact that over the years, statistical organisations have not developed processes and solutions in a holistic view, which leads to a lack of a coherent approach to modelling and designing IT solutions supporting statistical production. SOACs are increasingly being challenged to respond quickly to these emerging information needs. In 2017, Pirani (2017) emphasized the role of EA in organisations in general, demonstrating that an EA provides an overarching strategic and design perspective on IT activities, clarifying how systems, services, and data flows work together in support of business processes and institutional mission. (Pirani, 2017) adds that EA helps to integrate new technologies and services, and their data stream seamlessly into an institution's IT environment. This means that implementing a suitable EA in the operating model of the organization, which can provide a holistic view of IT solutions, is one of the best ways to cope with IT complexity. However, in the African scenario, none of the statistical organisations have yet successfully operationalised their EA and taken advantage of its benefits. Therefore, this research aims to assess the current situation of EA in SOACs as well as estimate its USM, considering the cyclical nature of their surveys. Hence, we start by briefly reviewing the statistical production model that has been developed over the years, as well as the concept of EA. We then assess SOACs in terms of EA and estimate the USM based on the judgments and opinions of the managers and IT staff in a sample of thirty-one respondents from eight countries. Then we present the results and the discussion, where the obtained data is explained. Finally, this paper ends with a conclusion and the limitations of the study.

The main question proposed is based on the fact that the lack of a formal EA in organizations, in general, and the consequent complexity, poor reusability and integration of IST have been widely studied (Sessions & DeVadoss, 2014); (Vasconcelos, Da Silva, Fernandes, & Tribolet,

2004)(Rosenthal, 2014); (Bakar, Harihodin, & Kama, 2016); (Nhabomba, Alturas, & Alexandre, 2022); (Leanix, 2019); (Booch, 2006); (Lewis, 2021); (Sjöström, Lönnström, Engdahl, & Ahlén, 2018) and proven to promote lack of vision of IT strategy and long-term business (Pirani, 2017); (Vasconcelos et al., 2004); (Nhabomba et al., 2022); (Booch, 2006); (Lewis, 2021); (Sjöström et al., 2018). On the other hand, it was found that the previous studies focused only on particular companies or states, and no cross-national study of the same phenomenon has been made. To address this limitation in the literature, the current study investigates this phenomenon at the SOAC level and poses the following question: Is there any evidence that the lack of a formal EA in SOACs has contributed to the high complexity, poor reuse, and poor integration of IST in those organisations?

2 Theoretical Background

In this section, existing and up-to-date literature has been reviewed on the statistical production process and EA to assess its practical relevance for SOACs. Whenever possible, the most expressive and approved contributions were used, endeavouring not to compromise the scientifically established concepts and principles.

2.1 Official Statistics Production Process

Official statistical information provides the quantitative basis for developing and monitoring government social and economic policies (Janssen & Forbes, 2014), which makes it indispensable in the information system of a democratic society, serving the government, the economy, and the general public with data. For this purpose, official statistics that pass the practical usefulness test should be compiled and made available in an impartial manner by the statistical organisations to honour citizens' right to public information (UN Statistical Division, 2014). The

national statistical system of all countries in the world has a common legal basis, based on the United Nations Fundamental Principles of Official Statistics, which oblige all producers of official statistics to apply the same set of standards, methods and data collection methods based on international recommendations (United Nations Statistics Division, 2023). The production of official statistics is a complex process. It begins with research of the information needs of various users, filtering and subsequently aggregating them in such a way that generates results to satisfy a large number of needs. Statistical organisations are increasingly using frameworks to organize and structure this process, and nowadays, the Generic Statistical Business Process Model (GSBPM) is one of the most outstanding (Kuonen & Loison, 2019). As a sequential approach, the GSBPM has become a well-established standard that describes statistical output in a general and process-oriented way (Choi, 2020). Subsequently, it was widely adopted by the global official statistics community and formed one of the cornerstones of the High-Level Group for the Modernisation of Official Statistics (HLGMOS) vision and strategy for standards-based modernisation (HLG-MOS, 2019). In the context of the GSBPM, an organisation or groups of organisations carry out statistical business processes to create official statistics. A statistical business process is then defined as a collection of related and structured activities and tasks to convert input data into statistical information (Choi, 2020). The result of this process can be a mixed set of physical or digital products presenting data and metadata in different ways, such as publications, maps, electronic services, among others (Choi, 2020). Figure 1 shows the different phases of the official statistics production process according to the GSBPM standard.

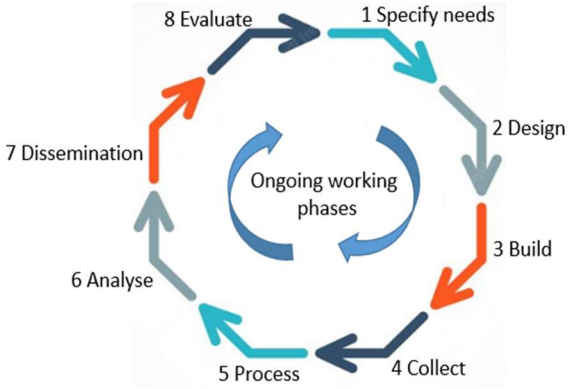


Figure 1: GSBPM phases (Choi, 2020)

Choi (2020) also observed that the use of the GSBPM has revolutionised the statistical production process as far as, in addition to describing and defining the set of processes required to produce official statistics, it provides a standard framework and harmonised terminology to help statistical organisations modernise their production processes, as well as share methods and components. Therefore, GSBPM can also be used to integrate data and metadata standards, to harmonise IT infrastructures, and to provide a framework for process evaluation and quality improvement. Despite the progress made with this and other standards, many statistical organisations still face common challenges. There are major threats to the continued efficient and effective provision of core statistics coming from within statistical organisations. When addressing this problematic, Długosz (2020) states: "the existing drawbacks and problems of the current way of conducting statistical surveys result in the practice of generating and maintaining dispersed, autonomous, inconsistent and ineffective solutions for IT support of statistical surveys and the absence of a process-oriented and metadata driven approach to statistical production". Długosz also adds that identified issues indicate a lack of a coherent approach to modelling and designing IT solutions supporting statistical production. This is largely because, according to Gjaltema (2021), historically, statistical organizations have not designed their processes and solutions from a holistic view. This means that each technical solution was built for a very specific purpose, with little regard for the ability to share information with other adjacent applications in the statistical cycle and with limited ability to handle similar but slightly

different processes and tasks. Therefore, most cases of sharing will always involve very significant work to integrate a component between different processing environments and technologies, and, as stated by Rosenthal (2014), the reuse of these components is also difficult. The cost of maintaining this business model and the associated asset bases (process, statistics, and technology) becomes increasingly unsustainable. As the variety and the number of IT systems in organizations increase worldwide (Vasconcelos et al., 2004), the complexity and cost increase as well, while decreasing the chances of getting real value from these systems (Sessions & DeVadoss, 2014). Statistical organizations, as producers of large amounts of official information and therefore highly dependent on IT to operate efficiently, are increasingly being challenged to respond quickly to these emerging information needs. Next, we will discuss a concept that will enable us to devise one of the best approaches to cope with these issues.

2.2 Enterprise Architecture in SOACs

(Marcondes, 2020) defines an enterprise as a system made up of people, knowledge, methods, work processes, technologies, organisational structure, policies, rules, and procedures, which interact among themselves, generating synergy to achieve predefined objectives. To fulfil these objectives, they need a support platform. That platform might include buildings, equipment, and IT, and an enterprise is therefore made up of many interrelated elements: management, operational, and supporting pieces (Evernden, 2016). All these pieces are structured and arranged in ways that allow the enterprise to exist and to fulfil its aims. The structure and arrangement of all these pieces is what we call the architecture of the enterprise (Evernden, 2016). Bakar et al. (2016) emphasize this view, defining EA as a hierarchical approach for aligning businesses and IT by integrating the information systems, processes, organisational units, and people in an organisation. So, any organisation has an enterprise architecture. Evernden (2016) adds that there is a process of architecting that applies a discipline of EA and produces these outputs that

describe the architecture of an enterprise. This means this process involves taking stock of relevant components or building blocks that make up an enterprise (communication networks, computers, databases, services, applications, data, processes, etc). An architect then needs to examine how these components enable or constrain the enterprise. So, we need to look at how the components are organised or configured, how they are being used, and how they behave or perform together. To define those architectural components (or artifacts), to describe how they are related to each other, and to provide generic definitions for what they might look like, enterprise architects use an Enterprise Architecture Framework (EAF) (Sessions & DeVadoss, 2014). In 2023, Gillis (2023) observed that the use of EAF rose in response to increases in business technologies during the 1980s, when a need for a way to respond to rapid technology growth was integral to business strategy. This process later expanded to the entirety of a business, not just IT. Thus, the rest of the business would be ensured to be aligned with digital transformation. The most accurate application of these frameworks in general can be through a blended approach, i.e., two or more frameworks, of the most prominent so far, consisting of fragments of each of the EAF that provide the most value in their specific areas, championed by (Sessions & DeVadoss, 2014) and (Nhabomba et al., 2022), or in particular for statistical organizations, through the adaptation of a governmental framework, like the Federal Enterprise Architecture (FEA), for being the most complete of the most prominent EAF and by being a standard framework for state institutions, which statistical organizations fall under (Nhabomba et al., 2022). According to Sessions & DeVadoss (2014), EAFs were introduced to address these problems in IT: the increasing complexity of IT systems and the increasing difficulty in generating real business value. A survey on "Enterprise Architecture" conducted by Leanix (2019) pinpoints the consequences, leading causes, and solutions to IT complexity. This phenomenon, according to the survey, with a high number of applications, processes, and technologies, is linked to higher IT costs (74%) and IT risks (76%) as well as a decreased pace

of innovation (58%). These are very big problems plaguing most organisations worldwide today, especially those whose final product is information, like statistical organisations, due to the high dependency on the support provided by IT. Commenting on that survey, the CEO of LeanIX, André Christ, explained that the EA insights 2019 report reveals how EA is a key driver for digital transformation while also highlighting the economic risks of not modernising IT landscapes (Leanix, 2019). Other studies conducted by Ojo et al. (2012), Al-Nasrawi & Ibrahim (2013), and Shaanika & Iyamu (2015) reveal that in the public sector in general, EA contributes to providing better services to the citizens and businesses. In addition, Bakar et al. (2016) say that through EA, the process of sharing information between organizations will be more efficient. In official statistics, this is very important because data sharing is an indispensable element in the toolbox of statisticians as they develop approaches to the measurement challenges posed by globalisation (UNECE, 2021). Although the concept of EA was inaugurated more than four decades ago (Sessions & DeVadoss, 2014), many organisations, especially those in the public sector, are having difficulties in implementing it due to the inflexibility and complexity of the businesses and IT structures (Raadt, Bonne, Schouten, & Vliet, 2010). Statistical organizations, particularly, are still facing issues in understanding and embracing the most appropriate implementation approach of EA. In SOACs, this problem is even more critical. Beguy (2016) points out some challenges that African countries are experiencing in their statistical systems, namely the lack of autonomy and stable funding for national statistical systems and the dominance of donor priorities over national. In this case, a very significant portion of statistical surveys is externally sponsored. This sponsorship includes not only financial resources, but also technological resources. Since official statistics require several surveys, there is a huge proliferation of IT resources without any planning, which propitiates an extremely complex technology environment, with difficulties in integrating and reusing these resources. Several authors, including Booch (2006), Lewis (2021), and Sjöström et al. (2018), recognise this problem

and suggest that current architectures must be transformed into new ones, i.e., by implementing EA frameworks. Following the same reasoning, Długosz (2020) affirms that a modern approach to statistical production is based on the use of good, worldwide accepted solutions, which are connected with the developed international standards. Hence, we understand that if there is a suitable EA framework for SOACs in place, capable of assisting in the EA implementation process, we can find a way to manage IT complexities through real-time visibility of IT architectures, increase the chances of integration and reuse of IT solutions, streamline IT initiatives with business objectives, and reduce IT costs, most of which remain locked in hidden IT assets and in the inefficiencies accumulated as a result.

3 Research Methodology

In this section, we present a detailed description of the research process we used to support our conclusions, explaining the sample and the data collection procedure, the measures used, and the data analysis procedures.

3.1 Sample and Data Collection Procedure

To meet the purpose of describing the current *status quo* of EA across SOACs and estimate its USM, thirty-one IT staff members and managers from eight SOACs – Botswana, Cape Verde, Ghana, Guinea-Bissau, Kenya, Mauritius, Mozambique, and Uganda – were surveyed. The data were collected physically from two SOACs (Mauritius and Uganda) and electronically from the remaining countries. All participants agreed to provide their opinions; no names or contact details were required in compliance with the ethical process. Participants had the option to participate, refuse, or withdraw from the survey at any time. The same structured questionnaire was used in all eight SOACs to gather datasets (Table 1 shows sample sizes for each country). Initially, the instrument was written in Portuguese and then translated into English. Hence, a

translation was undertaken for Botswana, Ghana, Kenya, Mauritius, and Uganda, but the Portuguese version was administered in Cape Verde, Guinea-Bissau, and Mozambique.

Table 1: Frequencies of country

Country	Counts	% of Total	Cumulative %
Botswana	2	6.5%	6.5%
Cape Verde	4	12.9%	19.4%
Ghana	5	16.1%	35.5%
Guinea Bissau	4	12.9%	48.4%
Kenya	4	12.9%	61.3%
Mozambique	10	32.3%	93.5%
Mauritius	1	3.2%	96.8%
Uganda	1	3.2%	100%

The findings across the eight countries are sufficiently consistent to assume that they to represent a common African reality.

3.2 Measures

The structured survey questionnaire contained three sections: identification of the participants, technological support, and the characterisation of the EA. The measures used in the second section were largely based on the factors influencing information systems acceptance, and a survey on enterprise architecture management in small and medium enterprises (Kalankesh, Nasiry, Fein, & Damanabi, 2020), and user satisfaction (Kassim, Jailani, Hairuddin, & Zamzuri, 2012), (Wißotzki, Timm, & Sonnenberger, 2015), (Mbondji et al., 2014), (WHO Europe, 2015). The other measures relating to the characterisation of the EA were adapted from the research report on "The State of Enterprise Architecture 2021" (BiZZdesign, 2021). These comprised the third section of the questionnaire. The measures were rated on two scales: five-point and seven-point Likert scales.

3.3 Data analysis procedures

To analyse the data, the following inferential statistical techniques were used: hypothesis testing, PCA, and multiple linear regression based on the judgements and opinions of SOAC managers and IT staff. The analysis carried out is based on several variables related to the performance and support of ITS in SOACs. These techniques were used with the necessary caveats to assess their relevance, possible violations of assumptions, and the validity of the reasoning and inference applied, as recommended by Fernandes et al. (2025). It was therefore necessary to check all the assumptions of statistical inference to guarantee the validity and accuracy of the conclusions drawn from the sample used and not run the risk of obtaining incorrect or misleading results. The data analysis procedure was made up of three major drivers according to the aims of the research: (1) estimate the proportion of IT staff in SOACs who admit that IST integration, complexity and reuse is minimally good in current situation; (2) characterise the IST performance and sectoral support in SOACs; and lastly (3) estimate an IST USM in SOACs. For proportion estimates, a key component was setting up the null and research hypotheses. The objective was to compare the proportion of integrated or completely integrated IT in SOACs with a known proportion of fully IT-integrated or fully digital organisations. That known proportion was derived from another study by McKinsey Digital (2020). To characterise IST performance and sectoral support for SOACs, two PCAs were carried out on the set of variables related to IST performance and support for data reduction purposes. New variables (with summarised data) were obtained, on which indices were created, ensuring more precise interpretations of the data. To set up the USM, multiple linear regression was used, and some variables characterising the performance of IST were used as independent variables to predict the outcome of IST user satisfaction in SOACs as the dependent variable. This technique enabled us to determine the variance of the model and the relative contribution of each

independent variable in the total variance. All analyses were developed using Jamovi version 2.3.21. This tool provides an integrated development environment with easy access to the objects under study and the graphics and scripts created in R (Şahin & Aybek, 2019) and very sophisticated analytical capabilities (Ahmed & Muhammad, 2021).

4 Results

In this section, we summarize and present the findings of the study based on the information gathered through the methodology applied. These results confirm the existence of considerable IST complexity in SOACs, which was verified in the literature review, although it proved to have little effect on two variables.

4.1 Sample Characterisation

The distribution of participants' opinions can be summarily described as follows: (1) from Table 1 we can see that Mozambique has the highest number of respondents (ten) and in contrast, Botswana, Uganda and Mauritius have the lowest number of respondents (two for the first and one for the other two); (2) 45% of respondents assume that there is no formal EA in their respective institutions; and (3) 50% suggest government dependency as the reason why they have not yet implemented formal EA.

4.2 Proportion Estimates of IT Integration

Hypothesis tests were carried out for proportion to provide a method to verify whether the sample data brings evidence to support or not the hypotheses that can be formulated from the literature, precisely regarding the integration of IST. Table 2 shows the distribution of responses for IT integration.

Table 2: Distribution of responses for IT integration

Integration degree	Counts	% of Total
Not integrated	3	9.7%
Poorly integrated	7	22.6%
Partially integrated	10	32.3%
Integrated	8	25.8%
Completely integrated	3	9.7%

According to (McKinsey Digital, 2020), there´s one-third (0.33) of fully IT-integrated or fully digital organizations. We will take, as null hypothesis (H0), the proportion of integrated or completely integrated IT, which is statistically represented as "ρ" (in this case, ρ=0.33). As an alternative hypothesis (H1), we assume this percentage is lower in SOACs, ρ<0.33. The statistical test (Z test) for this proportion is as follows:

$Z = \frac{\dot{p}-\rho}{\sqrt{\frac{\rho(1-\rho)}{n}}}$, where n is the sample size (31) and ṗ is the proportion of integrated or completely integrated IT in our sample (0.355). Note that the Z-test can be used when a binomial distribution is given as n*H0>=5 and n*H1>=5, which is the case here. If We take as significance level (α) 5% (α=0.05), the probability of rejecting the null hypothesis when it is true, then $Z = \frac{0.355-0.33}{\sqrt{\frac{0.33(1-0.33)}{31}}} = 0.3$. As H1= ρ<0.33, then the test will be left-tailed (Figure 2) and from the standard normal table. We saw that the corresponding value of α=0.05 is 0.13, which is lower than the value of the Z test (0.3), which places Z in the critical region.

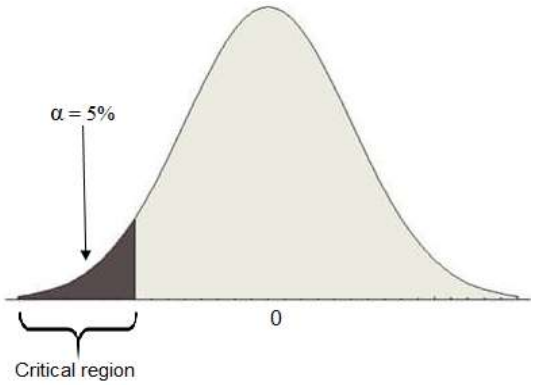


Figure 2: Z-test

In these conditions, with α=0.05, we reject H0, meaning that the percentage of SOACs with integrated or completely integrated IT is less than 33%.

4.3 IST Performance in SOACs

A PCA was carried out to summarise the initial set of 8 variables that describe the performance of IST in SOACs. Table 3 presents the summary of the PCA results. Three PCs (Principal Components) were identified, and they were responsible for explaining 86.4% of the total variance. The Varimax rotation method was used because it achieved a simpler and theoretically more meaningful solution than the other methods. The significance of Bartlett's test of sphericity ($p<0.001$) and the Kaiser-Meyer-Olkin (KMO) statistic value of 0.865 indicate that the data are suitable to identify dimensions. Two variables, "Updated information" and "Systems aligned to tasks", were removed from this analysis because they presented loadings greater than 1, which would invalidate the model. In the final solution, all loadings and Cronbach's alphas were above the recommended thresholds (0.5 and 0.6, respectively). The PCs were named “IST reliability and accuracy”, “IST availability and user satisfaction”, and “Adequate infrastructure and systems competence”. The first retained PC, “IST reliability and accuracy”, explained 69.98% of total variance, meaning that this new variable relating to the reliability and accuracy of IST explained more than three-quarters of the variability of the initial items set (86.4%).

Table 3: IST performance PCA results

PC	Items	Standardised loadings	% of variance explained	Cronbach's alpha
1. IST reliability and accuracy	Trusted IST	0.826	69.98	0.803
	Accuracy in results	0.897		
2. IST availability and user satisfaction	Users´ satisfaction with IST	0.880	9.51	0.858
	Active and available systems	0.834		
3. Adequate infrastructure and systems competence	Competent and effective systems	0.918	6.96	0.823
	Adequate infrastructure	0.848		

To obtain better interpretations of the results, we created an index of reliability (Cronbach's alpha), which measures the internal consistency of the data within the group of variables concerning each PC. The result of this index was 0.888, indicating that there is a high consistency of the data. Standardised means were used to characterise IST performance according to each PC. The three PC and all items were used except the "Trusted IST" item, for not providing us with a relevant interpretation. The removed item, "Systems aligned to tasks", and "Degree of reuse", "Integration degree", "Complexity", and "Institution has formal EA?" variables were also used to characterise IST performance. The accuracy and reliability of IST tend to be high in situations where the integration, the use of an adequate infrastructure, and systems aligned to tasks are higher. IST availability and user satisfaction are lower in SOACs that do not have a formal EA in place. The more competent and adequate the IST infrastructure is, the greater its reuse. On the other hand, the complexity of IST, which currently takes place in SOACs, did not prove to be adverse to IST competence or infrastructure adequacy.

4.4 Characterisation of IST Sectoral Support in SOAC

A second PCA was carried out to reduce the 12 items of IST support in SOACs (for PCA solution results, see Table 4). Three PCs were uncovered explaining 71.6% of total variance

and named as follows: “Data production, analysis and dissemination”, “Production process support”, and “Register and sales”. Promax rotation was used because it achieved a better solution than the traditional varimax method. Both the Bartlett's test of sphericity ($p < 0.001$) and the Kaiser-Meyer-Olkin (KMO) statistic (value of 0.791) pointed to a suitable solution. All loadings and Cronbach's alphas were also above the recommended thresholds (Hair et al., 2005). Two items (“Statistics products” and “Data management”) were removed from the analysis because of crossloadings in two dimensions, thus avoiding compromising data integrity. The first retained PC, “Data production, analysis and dissemination”, explained 30.2% of total variance.

Table 4 Sectoral support PCA results

PC	Items	Standardised loadings	% of variance explained	Cronbach's alpha
1. Data production, analysis and dissemination	National accounts	0.785	30.2	0.826
	Dissemination	0.810		
	Data analysis	0.826		
	Demographic, vital and social statistics	0.794		
	Sectoral and business statistics	0.806		
2. Production process support	Human and financial resources	0.808	24.8	0.816
	Policy and Planning	0.768		
	Infrastructure	0.773		
3. Register and sales	Sales and Marketing	0.663	16.6	0.666
	Register of administrative records	0.826		

In this second PCA, we also created an index of reliability whose result was 0.858, indicating high data consistency. The three PCs and the "Degree of reuse", "Integration degree", "Complexity", and "Adequate infrastructure" variables were used to characterise IST sectoral support in SOACs. In situations where IST is not reused or rarely reused, rates of production, analysis, and dissemination of official statistics are below average. The situation improves as the reuse of IST increases. There are also low rates of production, analysis, and dissemination of official statistics in situations with less integration of IST and higher complexity. But there are improvements where the IST infrastructure is adequate and IST is aligned with tasks. The processes supporting the production of official statistics (administrative, infrastructure, and planning and policy) are also more efficient where IST reuse and integration are higher. The processes related to the registration of administrative records and marketing and sales are also proving efficient, the more IST is reused and with an adequate infrastructure.

4.5 IST User Satisfaction Model

The IST USM was estimated concerning the "IST User Satisfaction" variable using multiple linear regression. We found that the variables "Active and available systems" and "Trusted IST" (the predictors) influence the user satisfaction. All assumptions that validate the multiple linear regression were verified (linearity of the phenomenon, normality of the random error, nullity of the random error mean, homoscedasticity, non-autocorrelation of errors, and non-multi-collinearity between the explanatory variables (Rodríguez del Águila & Benítez-Parejo, 2011). From our results, we found that the model fit measures where p-value <0.001, less than 0.05, which validates our model. Our Variance Inflation Factor (VIF) value for both predictors was 1.38, which is less than 10, indicating that multicollinearity is not a problem with our data. The R^2 is quite large, with 0.623. This means that our two indicators explain 62.3% of the variation in IST user satisfaction, which is very good. The significance (p-value) of our predictors is less than .05 for both predictors. This means that both "Active and available systems" and "Reliable IST" are statistically significant predictors of IST user satisfaction. The Durbin-Watson test for autocorrelation was 1.84, which indicates that no autocorrelation was detected between the two predictor variables. We also performed the Shapiro-Wilk normality test and found that the test was not significant (p=0.329>0.05), which indicates that the sample distribution is not significantly different from a normal distribution. This test also explains the nullity of the random error mean and the homoscedasticity. The points (observations) on Figure 3 tend to concentrate around the line of slope 1 passing through the origin, which proves that the distribution of errors is normal.

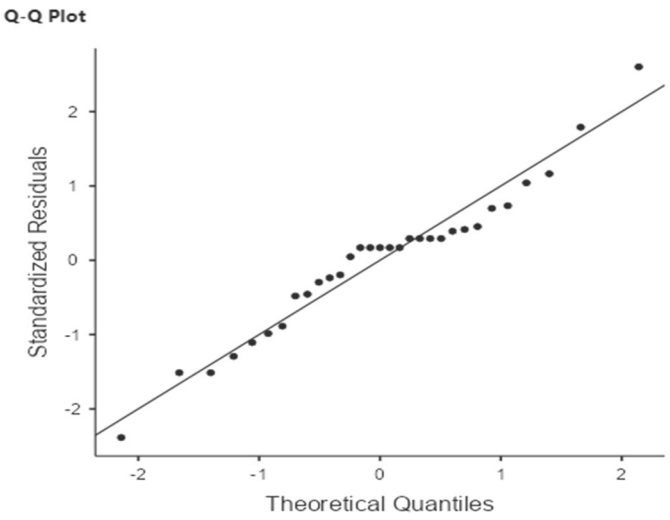


Figure 3 Shapiro-Wilk test for normality

With the observation of these assumptions, the assumptions of linearity of the phenomenon under study are also justified, as well as the nullity of the random error mean. We can also observe the nature of these relationships by looking at our standardized estimated coefficient. The standardized estimated coefficient associated with "Active and available systems" was 0.60, while the coefficient associated with "Trusted IST" was 0.286. This indicates that both predictors have strong and positive relationships with "IST User Satisfaction", with "Active and available systems" being a stronger predictor than "Trusted IST". The estimated values obtained were 0.586 for "Active and available systems", 0.318 for "Trusted IST", and 0.346 for "IST User Satisfaction". Thus, the equation of the estimated model will be as follows: USM = 0.346 + 0.586*Active and available systems + 0.318*Trusted IST. Using the averages of the values of the “Active and available systems” and “Trusted IST” variables for each country, we have the following levels of user satisfaction: Botswana: 74.05%, Cape Verde: 73.87%, Ghana 62.25%, Guinea Bissau 51.8%, Kenya 75.97%, Mauritius 69.51%, Mozambique: 68.67%, and Uganda: 74.05%. These levels of satisfaction show that there is more work to be done on the reliability, availability, and activity of the systems to increase user satisfaction, as these two factors contribute around 62.3 per cent to user satisfaction.

5 Discussion

Based on the performance and sectoral support offered by the IST, this study evaluates and estimates how SOACs, whose statistical surveys have a cyclical and repetitive behaviour, are affected by the fact that they have not formally defined EA. Studies using samples involving different countries are scarce in the EA literature, especially regarding official statistics. To fill this gap in the existing literature, this study uses samples from eight SOACs representing their respective countries on the African continent. To achieve the aim of this study and answer the research question posed in the background section, a list of IST performance and sectoral support variables in SOACs was summarized to assess respondents' perceptions. The study's research question aims to assess whether there is evidence that the lack of formal EA in SOACs contributes to the high complexity, poor reuse, and poor integration of IST in these organizations, given the cyclical and repetitive nature of statistical surveys. This situation tends to worsen as technological solutions increase in number and variety, and, in the case of SOACs, the situation is further aggravated by the fact that, historically, they have not developed solutions according to a holistic vision, either to support statistical surveys or day-to-day operations. Findings of the current study suggest that in the African context, the percentage of SOACs with integrated or fully integrated IT is less than 33%. Poor integration is a symptom of high complexity and weakens IST reusability. Further, the study sought to draw lessons on IST performance and sectoral support within SOACs. In this regard, J R Soc Med (2014), at least in health systems, describes the information systems in many African countries as weak and fragmented, and unable to provide robust data promptly. The author further states that household surveys are of multiple types and vary in complexity and emphasis, i.e., with serious problems of integration between the systems. Some interesting insights emerge from an analysis of the current study, which reveal that IST performs well and offers a good sectoral support

where the use of adequate infrastructure and systems aligned to tasks is higher. But their performance is diminished in SOACs that do not have a formal EA in place. The more competent and adequate the IST infrastructure is, the greater its reusability. Rates of production are below average where IST is not reused or is rarely reused, with less integration of IST and higher complexity. Against our expectations and what has been demonstrated by other researchers, the study revealed that IST complexity has less adverse effect on IST competence and does not negatively affect the adequacy of IST infrastructure in SOACs. We understand that this is because, sometimes, from the point of view of IT staff, just the fact that IST is allocated to SOAC tasks represents a gain to be considered, even though it is not exempt from the complexity issues. Ultimately, the study enabled us to estimate the USM through multiple linear regression. Here, we demonstrated that, in SOACs, user satisfaction is greatly and positively influenced by active and available systems and trusted IST, meaning that user satisfaction can be easily achieved by enabling IST to be more active, available, and trusted. The estimated satisfaction levels of each SOAC show that there is more work to be done on the reliability, availability, and activity of the systems to increase user satisfaction. These findings lead us to the conclusion that SOACs need a suitable EA framework, capable of assisting in the EA implementation process, to find a way to manage IT complexities, increase the chances of integration and reuse of IT solutions, since EA is a good tool to achieve IT-business alignment (Gellweiler, 2022). This will also help to reduce common constraints and increase the chances of getting real value from IST resources.

6 Conclusion and Limitations

This study contributes to the limited research in EA with a focus on a specific industry by investigating 31 responses from eight SOACs. It differs from most previous studies conducted in EA, which have focused on only particular companies or states, as it generates new insights investigating those eight SOACs using the same survey instrument. The objective, at the beginning of the study, was to assess the *status quo* of the EA in SOACs and estimate its USM. The assessment suggested that the lack of formal EA in SOACs contributes to the high complexity, poor reuse, and poor integration of IST. The assessment also revealed that less than one-third of IST in SOACs are integrated or fully integrated, and this poor integration is a symptom of high complexity and weakens the integration and reuse of IST. Further, the results of the assessment showed that the use of formal EA, which provides adequate infrastructure and task-aligned systems, will enable IST to perform well and offer better sectoral support. We also found that production rates, integration, and reuse of IST will be increased by this measure. In contrast, the study found that the complexity of IST has a less adverse effect on IST competence and does not negatively affect the adequacy of IST infrastructures in these SOACs. Through multiple linear regression, we estimated the USM, in which it was revealed that user satisfaction can be easily achieved by enabling IST to be more active, available, and trusted. Based on the USM, user satisfaction levels were estimated for each country, which showed that there is more work to be done in terms of system reliability, availability, and activity to increase user satisfaction. With the results obtained in this study, it was demonstrated that the implementation of formal EA is the right measure to resolve or, at least, to minimize the impact of the "IT complexity" phenomenon and its effects. Finally, like all studies, this one has limitations which relate to the subjectivity of responses and, hence, the results should be

considered in light of this. Moreover, the different opinions of respondents from the same country on certain questions should be targeted by future studies.

Conflict of interest statement

The authors have no potential conflict of interest to declare.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

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