Modelling Determinants of Software Development Outsourcing for Nigeria

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ABSTRACT

Software Development Outsourcing is one of the common practices in global business operations today; a practice that has to a large extent changed the landscape of IT services in Nigeria. This research predicts a fitted model using a number of success factors, for software development outsourcing in Nigeria. The researchers adopted six success factors (Cost Saving and Financial Stability, Effective Communication and Trust, Technical Expertise and Knowledge Transfer, Understanding Software Development Outsourcing Industry, Effective Software Privacy and Security, and Overcome Cultural Barrier) for use from a prior study carried out using factor analysis; and these six success factors were analysed using multiple regression to determine those that are critical for software development outsourcing. The result of the analysis indicates that both individually and collectively, the six success factors are all critical to software development outsourcing in Nigeria. A model was thus derived to predict successful software development outsourcing; $\gamma = -1.109 + 0.211X_1 + 0.234X_2 + 0.225X_3 + 0.252X_4 + 0.196X_5 + 0.188X_6,$ *with* γ *denoting the predicted outcome (successful software development outsourcing), and* X_1 *to* X_6 *denotes the six independent predictor variables. IT Businesses and organizations in Nigeria should therefore pay maximum attention to these critical success factors in other to achieve a significant stride in outsourcing the development of their software. In addition, the result of this research can be applied in further studies as well as in literatures.*

KEYWORDS: *Cost Saving;Critical Success Factors;Outsourcing;Software Development;Technical Expertise*

I. INTRODUCTION

Outsourcing, the contracting out of activities to other businesses, is not a new phenomenon. We have already seen outsourcing in, for example, the health or banking industry. Many people think of software outsourcing in Information Technology as a recent development. This is however not true [1].[2], in her article, describes Outsourcing as an arrangement in which one company provides services for another company that could also be or usually have been provided in-house. Furthermore she posited that outsourcing is a trend that is becoming more common in Information Technology (IT) and other industries for services that have usually been regarded as intrinsic to managing a business. Simply put, Outsourcing is the contracting out of a business process to an independent organization, which an organization may have previously performed internally or has a new need for, from which the process is purchased back as a service.

Some common reasons for outsourcing in the 21st century include:

1. Improving company focus, as the outside experts take on necessary but non-core responsibilities
2. Gaining access to world-class capabilities, systems and services, without the need to build them from bottom up
3. Freeing internal resources - cash and personnel - for other purposes; ensuring staffing flexibility, whereby staffing levels are "in sync" with immediate needs

4. Requiring specific expertise for functions that are either time-consuming or are currently out of control
5. Reducing overall damage to an organisation caused by risks, as associated risks and operating costs are shared with a partner
6. Ensuring overall satisfaction to customer

From a study conducted by [3], Figure 1 shows that outsourcing Information Technology components takes a bulk of the outsourcing market. Software development is a component of Information Technology. This fact is supported by the work of [4] and [5].

Figure 1: Facts on Outsourcing [3]

Software development outsourcing involves sub-contracting or "farming out" certain software development phases and/or functions to independent, third-party companies or individuals, instead of keeping those functions in-house [6]. According to [7], Software outsourcing is a phrase used to describe the practice of seeking resources - or subcontracting - part or all of software development functions. An organization would use outsourcing for functions ranging from infrastructure to software development, maintenance and support. The study of [8] defined it as contracting out the development, planning, management, training, maintenance or operation of software services, skills, products or applications. Previous research shows that software development outsourcing gained a dramatic increase after 2001 and is still growing continuously due to economic downturn [9]. Outsourcing Software Development offers many benefits like access to leading-edge technology, skilled human resource, cheaper and high quality software development.

According to [10] and [3], outsourcing of software development has a number of specific risks that can influence the decision of entering into an Outsourcing Software Development(OSD) contract:

1. **Uncertainty about information confidentiality**. This is a problem of a growing concern. Even though providing a total security for software is a difficult task, outsourcing firms need to assure clients of the secure handling of essential information and the client's core processes.
2. **Lack of proximity to staff**. In a case of an in-house development, the developers' team has constant and quick access to all the employees involved in the use of the software. In a case of Outsourced Software Development, it is necessary to prepare detailed technical requirements and constantly adjust them to any change.
3. **Uncertain financial payback**. While the provider can have some guarantees of his cash flow set by contract conditions, the client is uncertain about the payback on the product in cases of "software crash". The delivered software can meet all the technical requirements; it might also turn out to be obsolete, or do not support some important technologies and standards that appeared during the development period.
4. **Increased complexity of management.** Outsourcing is considered to be a solution to decrease complexity of management of the IT functions. But often management of Outsourcing Software Development project suffers from a lack of control, namely the futility of implementing tightly controlled operations in such projects
5. **The lack of control over the outsourced resources**. A situation when an outsourcing firm developssoftware that will be used over an enterprise-wide IT infrastructure of a client, but the software cannot be replaced or upgraded at the client's will. This creates specific technical challenges that can reduce outcome of an OSD contract.

The aim of this paper is to identify and analyse the contribution of critical success factors to Successful Software Development Outsourcing in Nigeria. The specific objectives include:
1. Identify the critical success factors for successful software development outsourcing in Nigeria
2. Evaluate the contribution of each of the critical success factor to successful software development outsourcing in Nigerian Environment.
3. Evaluate the contribution of the overall critical success factors to the successful software development outsourcing in Nigerian Environment.
4. To rank these critical factors according to the weight of their criticality on successful software development outsourcing in Nigeria.

II. METHOD OF DATA ANALYSIS

Multiple Regression and Correlation Analysis were adopted for this research. The multiple regression analysis measures the relationship existing between three or more variables. It also helps to examine the nature of the relationship between a given dependent variable and two or more independent variables in a regression function. We shall ascertain the tenability of the null hypothesis formulated for this research at 0.05 level of probability. Correlation analysis will be used to determine the degree of relationship between the dependent and independent variables.

For the purpose of this research:

γ = Successful Software Development Outsourcing

X_1 = Cost Saving and Financial Stability

X_2 = Effective Communication and Trust

X_3 = Technical Expertise and Knowledge Transfer

X_4 = Understanding Software Development Outsourcing Industry

X_5 = Effective Software Privacy and Security

X_6 = Overcome Cultural Barrier

While γ is the Dependent Variable, X_1 to X_6 are the Independent Variables (the success factors).

The six success factors were derived from a similar work that was carried out using factor analysis technique [11].

The aim is to statistically and quantitatively establish how critical each success factor is for successful software development outsourcing in Nigeria.

Satisfying Multiple Regression Assumptions

Multicollinearity refers to the relationships among the independent variables. When our independent predictor variables are highly correlated with one another, then we have a case of multicollinearity. Multicollinearity makes the model cumbersome and less accurate since we are using more than one variable that measures the same thing. Thus, the purpose of this test is to ensure that we have maintained a high correlation between our independent variables and dependent variables; while ensuring that there is little or no correlation between our independent variables.

Table 1: Correlations

		Y	X1	X2	X3	X4	X5	X6
Pearson Correlation	Y	1.000	.426	.418	.403	.416	.312	.277
	X1	.426	1.000	.196	.090	.004	-.015	.102
	X2	.418	.196	1.000	.028	-.109	.098	.140
	X3	.403	.090	.028	1.000	.062	-.043	-.011
	X4	.416	.004	-.109	.062	1.000	.032	.032
	X5	.312	-.015	.098	-.043	.032	1.000	-.058
	X6	.277	.102	.140	-.011	.032	-.058	1.000

From Table 1, there is a high correlation between our independent variables and the dependent variable. This indicates that our independent variables are a good predictor for our dependent variable. Furthermore, we see that there is no correlation between our independent variables; as the correlation between the independent variables is below 0.3.

From Table 2, the tolerance values for each independent variable are well above the 0.5 threshold; while the Variance Inflation Factor (VIF) values are all below 10. This is a strong indicator that there are no multicollinearity concerns between the independent variables.

Table 2: Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients				
		B	Std. Error	Beta	T	Sig.	Tolerance	VIF
1	(Constant)	-1.109	1.204		-.922	.358		
	X1	.211	.026	.310	8.174	.000	.948	1.055
	X2	.234	.027	.334	8.673	.000	.921	1.086
	X3	.225	.024	.355	9.540	.000	.985	1.015
	X4	.252	.023	.413	11.049	.000	.979	1.022
	X5	.196	.025	.298	7.972	.000	.980	1.021
	X6	.188	.034	.206	5.492	.000	.967	1.034

a. Dependent Variable: Y

In Figure 2, our plots lie close to the straight line. Though the p-p plots deviates a little, but only a very little deviation can be seen. This means that we have a good fit on the Normal P-P plot, thus the variables passes the Normality test.

In Figure 3, we see a roughly rectangular distribution with most of the dots cutting across through the centre. What we don't want to see is a clear or systematic pattern to the dots where they are higher on one side than the other. This also means we have met the linearity assumption. Outliers are defined as cases that have a standardized residual as displayed in the scatter plot of more than 2.0 or less than -2.0. Again from figure 4.10, we see no standardized residual approaching -2 or +2; meaning no residual resides outside the +2.0 and -2.0 plots. This means also that our variable passes the outliers assumptions.
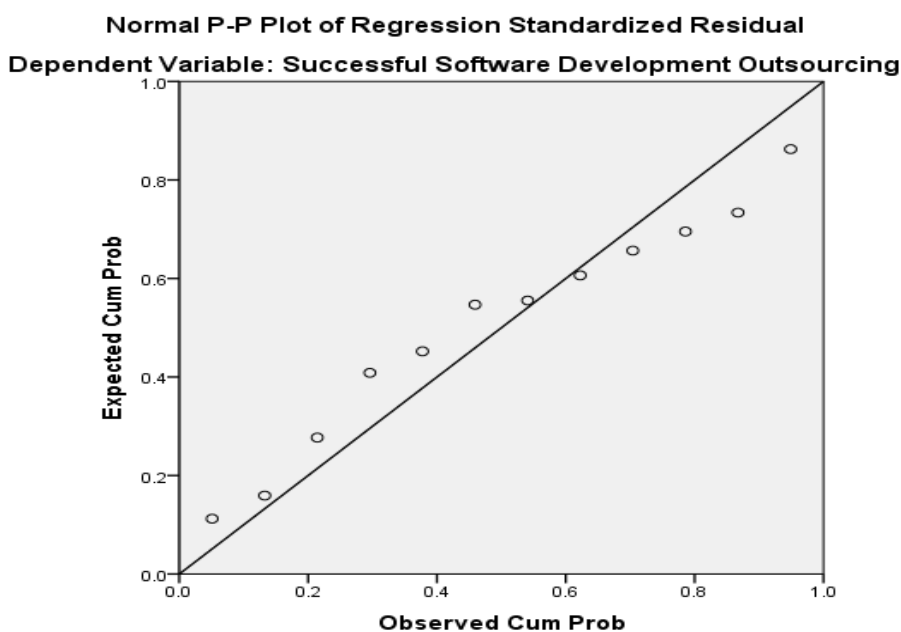

Normal P-P Plot of Regression Standardized Residual
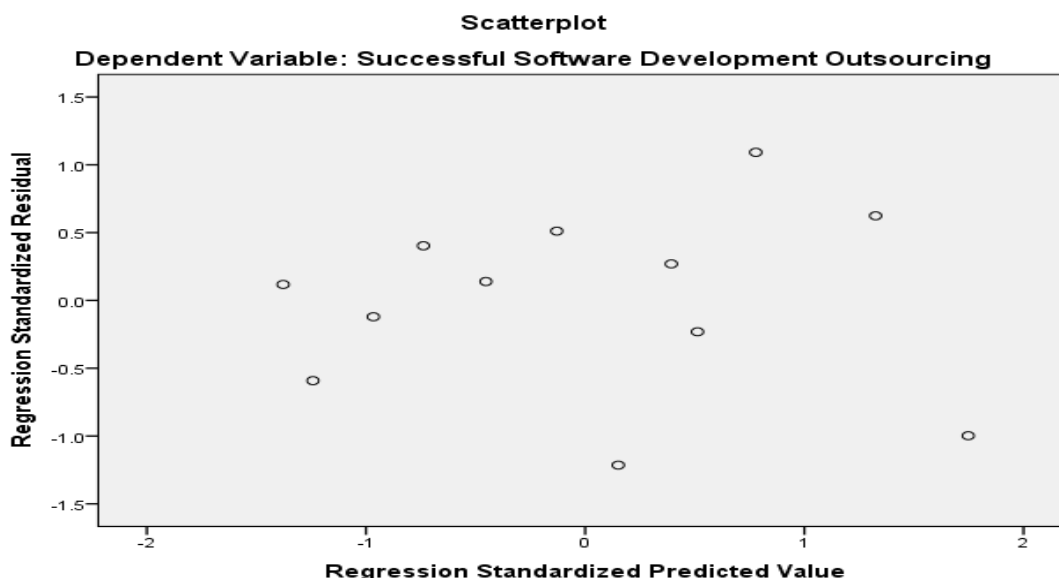**Dependent Variable: Successful Software Development Outsourcing**

Figure 2: *Zresid Normal P-P Plot

Scatterplot

Dependent Variable: Successful Software Development Outsourcing

Figure 3: *Zresid by *Zpred Scatter Plot

III. MODEL ESTIMATION AND HYPOTHESIS TESTING

Relationship Model Estimation and Interpretation

Table 3 shows the correlation coefficients between the Independent constructs; which gives a very low correlation between the independent variables, and this does not affect our multiple regression model (No multicollinearity). Also, there is a very strong correlation between the predictor variables and the outcome; making the independent variables a good predictor for successful software development outsourcing in Nigeria.

Table 3: The link between the predictor variables using Pearson Correlation Coefficient

		Y	X1	X2	X3	X4	X5	X6
Pearson Correlation	Y	1.000	.426	.418	.403	.416	.312	.277
	X1	.426	1.000	.196	.090	.004	-.015	.102
	X2	.418	.196	1.000	.028	-.109	.098	.140
	X3	.403	.090	.028	1.000	.062	-.043	-.011
	X4	.416	.004	-.109	.062	1.000	.032	.032
	X5	.312	-.015	.098	-.043	.032	1.000	-.058
	X6	.277	.102	.140	-.011	.032	-.058	1.000

Based on Table 4 – output of the data subjected to multiple regression analysis, the relationship model is estimated as follows:

$$\gamma = -1.109 + 0.211X_1 + 0.234X_2 + 0.225X_3 + 0.252X_4 + 0.196X_5 + 0.188X_6 \quad (1)$$

The equation (1) can thus be readily used to predict Critical Success Factors for Software Development Outsourcing in Nigeria.

Table 4: Coefficients[a] of the Individual Independent Variables

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-1.109	1.204		-.922	.358	-3.483	1.265					
	X1	.211	.026	.310	8.174	.000	.160	.262	.426	.507	.302	.948	1.055
	X2	.234	.027	.334	8.673	.000	.181	.287	.418	.530	.321	.921	1.086
	X3	.225	.024	.355	9.540	.000	.178	.271	.403	.566	.353	.985	1.015
	X4	.252	.023	.413	11.049	.000	.207	.297	.416	.622	.408	.979	1.022
	X5	.196	.025	.298	7.972	.000	.148	.245	.312	.498	.295	.980	1.021
	X6	.188	.034	.206	5.492	.000	.121	.256	.277	.368	.203	.967	1.034

a. Dependent Variable:
Successful Software
Development Outsourcing

From Table 5 – output of the data subjected to multiple regression analysis, the value of coefficient correlation (R =0.858), shows that independent variables combined have a strong relationship with the dependent variable of 85.8%. The R Squared value of 0.736, shows that 73.6% of the variance in Successful Software Development Outsourcingis explained by the model (the predictors). Explicitly, this means in the estimated relationship model, the predictors - Cost Savingand Financial Stability, Effective Communication and Trust, Technical Expertise and Knowledge Transfer, Understanding Software Development Outsourcing Industry, Effective Software Privacy and Security, and Overcome Cultural Barrier explained about 73.6% of the variance in Successful Software Development Outsourcing. This is a very high percentage. It shows that much of the independent variables (Cost Saving and Financial Stability, Effective Communication and Trust, Technical Expertise and Knowledge Transfer, Understanding Software Development Outsourcing Industry, Effective Software Privacy and Security, and Overcome Cultural Barrier) explain the dependent variable (Successful Software Development Outsourcing); and only 26.4% is probably explained by other factors. This indicates that our model is a good fit in determining the dependent variable.

Sometimes, the R squared coefficient could be a bit overestimated. It is therefore best to report the adjusted R Squared value. The adjusted R Squared statistics corrects this over-estimation in the R Squared value to provide a better estimate of how much the independent variables predict and explain the dependent variable. In this case, it is 72.8%. The result helps to validate the correlation result of Table 4 whichshows a positive and strong correlation between the independent variables and the dependent variable.

Table 5: Model Summary[b] for Successful Software Development Outsourcing

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.858[a]	.736	.728	.96478

a. Predictors: (Constant), Overcome Cultural Barrier, Effective Communication and Trust, Understanding Software Development Outsourcing Industry, Cost Saving and Financial Stability, Technical Expertise and Knowledge Transfer, Effective Software Privacy and Security
b. Dependent Variable: Successful Software Development Outsourcing

Hypothesis Testing

In testing our hypotheses, Table 6 – an output of our multiple regression analysis is referred to at 0.05 level of significance.

Table 6: Summary of Multiple Regression Analysis of the collective independent variables on Successful Software Development Outsourcing in Nigeria

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.176	6	.029	3.625	.000[b]
	Residual	.040	5	.008		
	Total	.216	11			

a. Dependent Variable: Successful Software Development Outsourcing
b. Predictors: (Constant), Overcome Cultural Barrier, Effective Communication and Trust, Understanding Software Development Outsourcing Industry, Cost Saving and Financial Stability, Technical Expertise and Knowledge Transfer, Effective Software Privacy and Security

Research Hypothesis One:

H_{01} The Collective Success Factors are not critical to Software Development Outsourcing in the Nigerian Environment

The null hypothesis one was tested using F-test based on Table 6 – the Analysis of Variance (ANOVA) table. The model reached statistical significance at (sig = .000) which is less than the significance level of 5% ($P<0.05$). Therefore, we rejected the null hypothesis (H_{01}) and accepted the alternative hypothesis (H_{A1})and concluded that the Collective Success Factors are critical to Software Development Outsourcing in the Nigerian Environment.

Research Hypothesis Two:

H_{02} The Individual Success Factorsare not critical to Software Development Outsourcing in the Nigerian Environment

The null hypothesis two was tested using test statistics based on Table 4. This test was carried out for each of the factors.

From Table 4, at a significant level of 0.000 for Cost Saving and Financial Stability (H_{02a}), we rejected the null hypothesis (H_{02a})because probability level is less that 0.05 (t=8.174; p<0.05) and concluded that Cost Saving and Financial Stability is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Cost Saving and Financial Stability to Successful Software Development Outsourcing in Nigeria is 0.211 (21.1%); hence Cost Saving and Financial Stability as a factor is critical to a Successful Software Development Outsourcing in Nigeria.

From Table 4, at a significant level of 0.000 for Effective Communication and Trust (H_{02b}), we rejected the null hypothesis (H_{02b})because probability level is less that 0.05 (t=8.673; p<0.05) and concluded that Effective Communication and Trust as a factor is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Effective Communication and Trust to Successful Software Development Outsourcing in Nigeria is 0.234 (23.4%); hence Effective Communication and Trustas a factor is critical to a Successful Software Development Outsourcing in Nigeria.

From Table 4, at a significant level of 0.000 for Technical Expertise and Knowledge Transfer (H_{02c}), we rejected the null hypothesis (H_{02c})because probability level is less that 0.05 (t=9.540; p<0.05) and conclude that Technical Expertise and Knowledge Transfer as a factor is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Technical Expertise and Knowledge Transfer to Successful Software Development Outsourcing in Nigeria is 0.225 (22.5%); hence Technical Expertise and Knowledge Transferas a factor is critical to a Successful Software Development Outsourcing in Nigeria.

From Table 4, at a significant level of 0.000 for Understanding Software Development Outsourcing Industry (H_{02d}), we rejected the null hypothesis (H_{02d})because probability level is less that 0.05 (t=11.049; p<0.05) and concluded that Understanding Software Development Outsourcing Industry as a factor is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Understanding Software Development Outsourcing Industry to Successful Software Development Outsourcing in Nigeria is 0.252 (25.2%); hence Understanding Software Development Outsourcing Industry as a factor is critical to a Successful Software Development Outsourcing in Nigeria.

From Table 4, at a significant level of 0.000 for Effective Software Privacy and Security (H_{02e}), we rejected the null hypothesis (H_{02e})because probability level is less that 0.05 (t=7.972; p<0.05) and concluded that Effective Software Privacy and Security as a factor is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Effective Software Privacy and Security to Successful Software Development Outsourcing in Nigeria is 0.196 (19.6%); hence Effective Software Privacy and Securityas a factor is critical to a Successful Software Development Outsourcing in Nigeria.

From Table 4, at a significant level of 0.000 for Overcome Cultural Barrier (H_{02f}), we rejected the null hypothesis (H_{02f})because probability level is less that 0.05 (t=5.492; p<0.05) and concluded that Overcome

Cultural Barrier is critical to a Successful Software Development Outsourcing in Nigeria. The contribution of Overcome Cultural Barrier to Successful Software Development Outsourcing in Nigeria is 0.188 (18.8%); hence Overcome Cultural Barrieras a factor is critical to a Successful Software Development Outsourcing in Nigeria.

Having considered the significant level of all the success factors, the researchers concluded that each of the success factor is critical to software development outsourcing in Nigeria.

Research Hypothesis 3:

H_{03}: There is no significant difference between the critical factors for successful software development outsourcing in Nigeria

Pearson Correlation Coefficient on Table 7 shows that there is no multicollinearity between the individual predictor critical factors for Successful Software Development Outsourcing in Nigeria. This is evident in the fact that no factor score between the independent variables were over 0.3; infact, no score came anywhere close to 0.3. Hence we reject the null hypothesis and accept the alternative hypothesis which states that there is significant difference between the critical factors for successful software development outsourcing in Nigeria.

Table 7: Pearson Correlation of Predictor Factors for Successful Software Development Outsourcing

		Y	X1	X2	X3	X4	X5	X6
Pearson Correlation	Y	1.000	.426	.418	.403	.416	.312	.277
	X1	.426	1.000	.196	.090	.004	-.015	.102
	X2	.418	.196	1.000	.028	-.109	.098	.140
	X3	.403	.090	.028	1.000	.062	-.043	-.011
	X4	.416	.004	-.109	.062	1.000	.032	.032
	X5	.312	-.015	.098	-.043	.032	1.000	-.058
	X6	.277	.102	.140	-.011	.032	-.058	1.000

IV. RESULT DISCUSSION

Results are discussed here in the context of the research questions

1. *What are the relevant Critical Success Factors that contributes to the success of Software development outsourcing in Nigeria?*

The six relevant Critical Success Factors are Cost Saving and Financial Stability, Effective Communication and Trust, Technical expertise and Knowledge Transfer, Understanding Software Development Outsourcing Industry, Effective Software Privacy and Security, and Overcome Cultural Barrier. Based on the result of the research in test hypotheses, we concluded that collectively and individually, that the six success factors are critical to successful software development outsourcing in Nigeria.

2. *To what extent have these factors collectively contribute to the success of Software development outsourcing in Nigeria?*

From F-test of the null hypothesis one, it was concluded factors collectively contribute significantly to the success of Software development outsourcing in Nigeria. It shows that Cost Saving and Financial Stability, Effective Communication and Trust, Technical expertise and Knowledge Transfer, Understanding Software Development Outsourcing Industry, Effective Software Privacy and Security, and Overcome Cultural Barrier) contribute significantly to the Successful Software Development Outsourcing.This result is in line with the works of [12], [13] and [14]. [14]in his work indicated Overcome Cultural barrier and Technical Expertise as factors for software outsourcing. [12], after reviewing 91 factors from 35 literatures, performed a content analysis and reduced the number of factors from 91 to 11. In their work, they identified Cost, trust and software security as critical to software development outsourcing.

3. *To what extent have these factors individually contribute to the success of Software development outsourcing in Nigeria?*

The t-test of the hypothesis two for each of the factors also showed that each success factor contributed critically to Successful Software Development Outsourcing in Nigeria.This research finding is in sync with the findings of an empirical study done by [15] and [16]. In their works, they identified Financial Stability, Communication and Trust, Technical Expertise and Overcoming language as very critical with a high ranking. The work of [17]particularly identified Trust as then most critical factor for software outsourcing. In addition, [18] posits Cost saving as the most critical to software outsourcing.

4. *What are the challenges facing the growth of Software development outsourcing in Nigeria?*
As identified from reviewed literatures and journals, the challenges facing the growth of software development outsourcing in Nigeria are:

1. Socio-Cultural Distance
2. Multicultural and Ethnic Differences
3. Lack of Quality and Efficiency
4. Intellectual Property Rights Issues
5. Knowledge Transfer Issues
6. Lack of Trust
7. Communication, Coordination and Control Issues
8. Political Instability

From the analysis, the major challenge facing the growth of software development outsourcing in Nigeria is Lack of Quality and Efficiency garnering 22%. The next two challenges are Lack of Trust (15.5%) and Communication, Coordination and Control Issues (14%). The least challenge is Socio-Cultural Distance with 8%.

The work of [10] agrees with this result. In his work, Lack of Trust and lack of communication was the major challenge inhibiting the adoption and spread of software outsourcing. In addition, [19] after an extensive survey concluded that if Vendors should possess more expertise, and the adequate knowledge, as well as government incorporating the right policy, then software outsourcing will grow considerably.

5. *How can these factors be ranked in relation to how critical they are on successful software development outsourcing in Nigeria?*
Using the result from model coefficients in table 4, the Critical Success Factors are ranked in the Table 8:

Table 8: Factor ranking in relation to successful software development outsourcing

Ranking	Critical Success Factor	Factor Coefficient
1	Understanding Software Development Outsourcing Industry	.252
2	Effective Communication and Trust	.234
3	Technical Expertise and Knowledge Transfer	.225
4	Cost Saving and Financial Stability	.211
5	Effective Software Privacy and Security	.196
6	Overcome Cultural Barrier	.188

V. CONCLUSION AND RECOMMENDATION

From results of the analysis conducted in this research, all six (6) success factors were collectively and individually critical to success of software development outsourcing in the Nigerian environment. Therefore, client organizations or individuals in Nigeria that are willing to embark on Software Development Outsourcing should pay close attention to all these factors; but most especially Cost Saving and Financial Stability, Effective Communication and Trust, Understanding Software Development Outsourcing Industry, as well as Technical Expertise and Knowledge Transfer. This is because an increase in those factors will significantly result into more successes in outsourcing the development of their software. Clients should look out for these critical success factors in software development outsourcing firms. A further study can also be conducted in line with this research to determine other success factor (s) that

is/are critical to software development outsourcing in Nigeria. This is because our model only explains 73.6% of the variance in our dependent variable. That means other factors that contribute to successful software development outsourcing makes up about 26.4%.

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