Table 2: Distribution of Population size of target respondents

Upstream Oil and Gas Companies	Professionals and Experts in UOGO					
	PG	ME	PM	EE	GP	TOTAL
Addax	7	8	6	7	6	34
Agip	10	7	6	8	8	39
Chevron	13	13	12	14	14	66
Mobil	12	12	10	8	10	52
Shell	15	17	14	16	15	77
Texaco	8	8	12	9	8	45
total	65	65	60	62	61	313

The statistical sample size "n" of the target respondents was calculated from the region population using the formula given by Sediary (1994) as

$$\mathbf{n} = \frac{\boldsymbol{n}^{\mathbf{1}}}{\mathbf{1}+\frac{\boldsymbol{n}^{\mathbf{1}}}{\mathbf{N}}} \text{...(1)}$$

where $n^1 = \frac{S^2}{V^2}$ where S = maximum standard deviation in population at a confidence interval of 95%, $S^2 = P \times (1-P) = 0.25$, V = standard error of sampling distribution = 0.05.

From equation 1 above, the n= 76, and therefore 76 copies of questionnaire were distributed to the target respondent to elucidate their intuitive opinions, perceptions and attitude on the subject matters. The questionnaire was firstly pilot tested in two steps. First two project managers and three academicians verified the questionnaire. Secondly, a group of 10 professionals from the target UOGO companies who were physically contacted assessed and answered the questions contained in the questionnaire. After the feedback from the respondents, the questionnaire was adjusted in both form and content for its final version.

Methods of Data Analysis

The study adopted two major methods of data analysis.

(i) Relative Importance Index (RII) and Relative Severity Index (RSI) which were used to assess the level of importance and severity of each; factors, types, causes and increasing factors of project complexities in UOGO.

RII analysis allows identifying most of the important criteria based on participants' replies and it is also an appropriate tool to prioritize indicators rated on likert-type scales.

$$RII = \frac{\sum \mathrm{w}}{\mathrm{AN}} = \frac{5\mathrm{n}5 + 4\mathrm{n}4 + 3\mathrm{n}3 + 2\mathrm{n}2 + 1\mathrm{n}1}{5\mathrm{N}} \text{............} \qquad (2)$$

where W= Weighting given to each of the factors by the respondent

A= the highest weight i.e. 5 in this case

N= the total number of respondents; in this case 64

n_5 , n_4 , n_3 , n_2 , and n_1 represent the number of respondents, based on the following weighted scores in 5 point scale as: strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree =5.

The formula is also consistent with calculation of RSI, which is weighted score of each factor divided by the total weighted score of all the factors.

(ii) Multiple regression and correlation analysis were used to evaluate the extent of relationship between organizational factors and successful management of project complexity in UOGO. Lee and Xia (2002) and Hussin et al. (2007) used regression model to assess complexities in information system development projects.

Table 3: Questionnaire distributions and returns by professions

Target Respondents	Number of Questionnaires		% Returns
	Distributed	Returned	
PG	18	13	72.22
ME	18	16	88.89
PM	12	9	75.00
EE	15	14	93.33
GP	13	12	92.31
Total	76	64	84.21

Table 4: Questionnaire distributions by upstream firms

Target Respondents	Number of Questionnaires		% Returns
	Distributed	Returned	
Addax	10	6	60.00
Agip	12	10	83.33
Chevron	14	12	85.71
Mobil	12	10	83.33
Shell	16	14	87.50
Texaco	12	12	100.00
Total	76	64	84.21

Table 5: Relative Importance Index (RII) of factors of project complexities in UOGO

S/N	Code	Factors of Project Complexity	Frequency of respondents					Total No of Respondents (TNR)	Total score	RII (%)	Rank
			SD	D	N	A	SA				
1.	OM	Organizational Management	4	10	12	18	20	64	232	72.50	2nd
2.	UN	Uncertainty	3	10	8	20	23	64	252	78.75	1st
3.	OC	Overlap of construction elements	4	7	20	15	18	64	228	71.25	3rd
4.	IH	Inherent	14	4	13	16	17	64	210	65.63	4th
5.	RS	Rigidity of sequences	15	24	16	14	5	64	189	59.06	5th
6.	NT	Number of trade	17	24	13	6	4	64	148	46.25	6th

Table 6: Relative Severity Index (RSI) of types of project complexities in UOGO

S/N	Code	Factors of Project Complexity	Frequency of respondents					Total No of Respondents (TNR)	Total score	RSI (%)	Rank
			SD	D	N	A	SA				
1.	ST	Structural	4	8	15	20	17	64	230	71.88	3rd
2.	TT	Technical/Technological	3	8	12	18	23	64	242	75.63	1st
3.	OG	Organizational	12	20	22	3	5	64	155	48.44	5th
4.	DR	Directional	18	17	20	5	4	64	152	47.50	6th
5.	SP	Social-Political	14	10	22	18	0	64	139	43.44	7th
6.	EV	Environmental	2	10	12	20	20	64	238	74.38	2nd
7.	TE	Temporal	3	13	15	17	16	64	222	69.38	4th

Table 7: Relative Severity of Causes of project complexities

S/N	Code	Factors of Project Complexity	Frequency of respondents					Total No of Respondents (TNR)	Total score	RSI (%)	Rank
			SD	D	N	A	SA				
1.	DT	Details- number of variables and interfaces	4	10	15	18	17	64	226	70.63	3rd
2.	AM	Ambiguity – inability to pre-evaluate actions	4	12	15	18	15	64	224	70.00	4th
3.	UN	Unpredictability –inability to know what will happen	6	2	12	21	23	64	245	76.56	2nd
4.	DY	Dynamics –rapid rate of change	9	10	10	17	18	64	217	67.81	5th
5.	SS	Social structure –number of interactions	12	8	20	14	10	64	194	60.63	6th
6.	IN	Interrelationship–many interdependences and interconnections	0	4	15	20	25	64	258	80.63	1st

Table 8: Relative Severity Index of factors that contribute to increased project complexities

S/N	Code	Factors of Project Complexity	Frequency of respondents					Total No of Respondents (TNR)	Total score	RSI (%)	Rank
			SD	D	N	A	SA				
1.	ER	Employed resources	15	15	20	10	4	64	165	51.56	4th
2.	LK	Level of scientific and technological knowledge required	4	4	13	22	21	64	244	76.25	2nd
3.	EV	Environment	0	9	10	20	25	64	253	79.06	1st
4.	WF	Number of different parts in the workflow.	3	6	20	17	18	64	233	72.81	3rd

Regression Results

Table 9: Descriptive Statistics

	Mean	Std. Deviation	N
y	40.63	2.875	64
X_1	19.56	2.462	64
X_2	17.41	2.922	64
X_3	18.81	1.693	64
X_4	17.53	2.245	64
X_5	17.66	2.352	64
X_6	17.28	1.889	64

Table 10: Model Summary

Model	R	R Square	Adjusted R Square	St, Error of the Estimate	Durbin-Waston
1	.809	.655	.572	1.311	2.134

a. Predictors: (Constant) , X_1, X_2, X_3, X_4, X_5, X_6
b. Dependent Variable: Y

Test of Statistical Hypotheses and Significance

Seven research hypotheses were and subjected to statistical test using SPSS computer software, version 21 at 5% significant level.

The Analysis of Variance (ANOVA) was used to establish the level at which all the organizational factors could leverage and influence the successful management of project complexity in UOGO. The null hypotheses , HO_1 is for aggregate relationship between all the independent variables; X_1, X_2, X_3, X_4, X_5, and X_6 with Y as indicated in F-test result shown on table 11. The t -test results of HO_2, HO_3, HO_4, HO_5, HO_6 and HO_7 are for independent variables; X_1, X_2, X_3, X_4, X_5, and X_6, respectively are presented on table 12 for each of individual relationship with Y.

Table 11: ANOVA A[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
1. Regression	169.072	6	38.179	18.34	.000
Residual	46.428	25	1.457		
Total	305.500	31			

Table 12: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std Error	Beta		
1. (Constant)	18.528	4.837		4.307	.000
X1	6.766E-02	.124	.084	.709	.485
X2	.578	.141	.612	4.12	.000
X3	-3.90E-02	.186	.019	.156	.877
X4	.108	.111	.094	.1967	0.048
X5	.387	.159	.295	2.177	.041
X6	.413	.146	.206	2.146	.044

a. Dependent Variable: Y

The predictive regression model established by the study is therefore deduced from table 12 as follows:

$$Y= 18.528 + 0.06766X_1 + 0.578X_2 - 0.039X_3 + 0.108X_4 + 0.387X_5 + 0.413X_6\text{-------}3$$

Statement of research hypothesis; F-test and t-test"

Null hypotheses H_O: The collective and individual influence of organizational factors in the successful management of project complexities in UOGO will not be significant. From tables 11, HO_1 is significant. From table 12, the test results indicate that HO_3, HO_5, HO_6, and HO_7 are significant at 0.05 significant level, while HO_2 and HO_4 are not found to be significant in this study.

Discussion of Results and Findings

The RII and RSI analysis assessed the importance and severity of project complexity characteristics and issues. The multiple regression analysis was used to determine the extent of relationship between the successful management of project complexities and six variables of organizational factors. From table 9, strong relationship exists between organizational factors and successful management of project complexities in UOGO with R= 0.809 and R^2 = 0.655; indicating strong coefficients of correlation and determination respectively. From table 11, HO_1 is significant. Similarly, from table 12, the t-test indicate that hypotheses results; HO_3 for X_2, HO_6 for X_5, HO_7 for X_6 and HO_4 for X_3 are significant. The fitted regression model established in equation 2, implies that taking all the organization factors constant at zero, the success level of managing project complexities in UOGO would be 18.528.

Communication/IT knowledge ranked first in the order of significance as a decisive organizational factor that could influence management of project complexities in UOGO. Communication is usually integrated with IT as ICT. Effective communication tend to encourage teamwork, increase information sharing and ensure involvement of key stakeholders, which favours the probability of projects achieving their goals within the assigned time and resources (Santos et al 2019). IT is the use of computers to store, retrieve, transmit and manipulate data or information. It is considered to be a subset of ICT. Several products or services within the economy associated with IT includes; computer hardware, software, electronics, semiconductors, internet, telecom equipment and e-commerce. IT is an important mechanism which can improve knowledge transfer easier, and which may overcome the difficulties of geographical distance (Ren et al. 2018). Avena Group PLC (2018) concurs that digital transformation holds the key for the oil and gas industry to develop agile business models with higher margin, improve regulatory compliance etc. Hand (2015) also suggests high tech database such as remote sensor monitoring, operating efficiency software and enterprise resource planning to be employed in UOGO. In a similar vein, PSAC industry review (2018) reported that, Canadian Upstream Petroleum Industry has attained international reputation for excellence in many areas due to its operations strategies that include; high tech exploration and production methods among others. EMC (2015) attests that, operational efficiency improvement techniques of oil and gas be categorized and summarized into; blueprinting production, real time production, data acquisition/IT, production data surveillances and deploying production optimization workflow. Managing an oil field effectively requires gathering and analyzing real time and vast operational data from various sources through installed electronic sensors, supervisory control and data acquisition. ICT could help in delivering improved performance in complex operations, facilitates and infrastructure projects of UOGO from the following areas; seismic data and real time data analytics, assessing life of oil well or field, production optimization, collaboration and data access. Chakraborty (2016) attests to alignment of IT/operations technology are examples of most innovative and technologically challenges initiatives in oil and gas production business. It could be therefore be inferred that improvement in ICT innovations will lead to successful management of project complexities in UOGO.

Resource allocation ranks second with t-value =2.117 and p-value = 0.041. Resource allocation assigns resources for project implementation. The project complexity in UOGO requires sufficient and right resources in order to surmount the complexities associated with exploration and production optimization through top management support. The support of top management will have a decisive influence on the success or failure in the management of project complexities in the UOGO. Top management improve project performance by approving and allocating sufficient resources, motivation of workforce and institution of appropriate management system to cope with project complexities. Top management support and decision making structure would as well influence training of team members and allocation of sufficient resources to achieve that by sponsoring and providing state-of-art training facilities.

Though, change management and organizational culture are important organizational factors, they were not found significant in the management of project complexities in this study. It could be that the managers of complex projects in UOGO usually adopt the tools such as environmental scanning, strength, weakness, opportunities and threats (SWOT), and stakeholder analysis to contain issues of change management as proposed by Jacobs et al. (2013). Secondly, organizational culture is in-built in the management system as there could be already existing values, belief and behaviour that constitute people's way of life in peculiarities of the UOGO with or without projects.

Conclusion

Complexities are the main causes of many projects failures. Organizational factors in the field of project management are important for the success of projects. Enhancing the capacities and competences of organizational team members would provide a management systems that will be effective in managing UOGO, facilitates and infrastructure projects complexities.

The study identified types, causes, factors affecting, and increasing project complexities in addition to organizational factors to cope and manage them. An exploratory and descriptive survey research and convenient sampling techniques were carried out using some selected upstream oil and gas companies operating in the South South geopolitical zone of Nigeria. A structured questionnaire was designed and modeled in Likert five point scale as an instrument of data collection and measurement. The identified organizational factors which were used as independent variables are; organisational culture, top management support, change management, communication and IT knowledge, allocation of resources and training. RII and RSI were used to assess the importance and severity of types, sources and factors affecting project complexities in UOGO. The results and findings from the data analysis indicate that the most important factor of complexity is uncertainty. Severest types of project complexity in UOGO are technical/ technological, environment etc. The severest causes of project complexities in UOGO are interrelationship-many interdependencies and interactions, unpredictability-inability to know what will happen, dynamics rapid rate of change etc in ranking order. Also the severest factors that contribute to increase in project complexity are environment, level of scientific and technological knowledge required, number of different parts in the workflow etc.

The findings from multiple regression and correlation analyses and test of hypotheses revealed that the following organizational factors are significant in managing project complexities in UOGO: communication/IT knowledge, resource allocation, training and top management support with decision-making structure. Change management and organizational culture were not found to be significant for this study. Development of competence level, innovation in technical skills and acquisition of emerging and trending ICT knowledge as well as regular and periodic capacity building for the team members are recommended for development and effective management of project complexities in the UOGO. In addition, training in environmental management, project design and optimization are also recommended.

References

Aldag R.J and Strearns T.M. (1991) *Management*, South Western OH, ISBN: 13:978 – 0538805627, ISBN_10: 053805628 http://www.amazon.com

AVENA Group Report (2018) Digital Transportation Holds the key for the Oil and Gas Industry. sw.avena.com

Baccarini D (1996). The Concept of Project Complexity. *International Journal of Project Management*. 14(4)

Bennett J. (1991) *Introduction to Construction Project Management. General, Theory and Practice*. Oxford press.

Caietta N. (2016) *How to Manage Complex Project. Leadership Project Management, Risk Management*

Carral L, Fragnela J.A., Diaz E and Iglesias a. (2018), Complexity and Project Management. A general Overview. Hindaw *Journal Overview*. http://www.hindawi.com

Chakraborty K (2016) Improving Operational Efficiency in Oil and Gas Production Using IT solution. Tata Consulting Services Ltd. http://www.tcs.com/rss-feed /pages.aspx?f=w.

Choudhary P. and Sarikwal L (2017) Conceptual Framework of Organizational Factors and Tacit Knowledge Sharing *IOSR Journal of Business and Management*. IOSR – IBM Vol. 19 Issue 1. www.iosrjournal.org.

EIn – Dor P. and Seger E. (1978) Organizational Context and Success of Information System *Management Sciences*.

EMC Executive Briefing (2015) Oil and Gas Operational Efficiency: Making Better Decisions Faster, Reducing Cost www.emc.com

Gate V. (2016) Complexity Part 1: A Case of Project Failure. Retrieve https://www.geoilandgas.com/casestudy/driving- *project execution excellence*. guddu.power-plant-station.

Hand A. (2015) Oil and Gas Industry Looks to Operational Efficiency. *Automation World*. http://www.automatioworld.com

Harrin E. (2019) *Three Ways to Reduce Complexity in Project Management* https://www.projectmanagement.com.

Hussin R, Shahriza N, Karin N.S.A and Mohammed N (2007). The Influence of Organizational Factors on Information Systems Success in E–Government Agencies in Malaysia. *Electronic Journal of Information System in Developing Countries*. 29(1), 1-17 http://www.ejisdc.org.

Ishtiag F and Jahanzaib M (2017) Impact of Project Complexity and Environmental Factors on Project Success. A case of Oil and Gas Sector of Pakistan. *Journal of Basic and Applied Sciences*. 2017,13,351-358.

Jarushub (2013) *List of Oil and Gas Companies in Nigeria and Difference Between Upstream, Downstream, Servicing*. www.jarushub.com

Creery J, Philips E and Cigala F. (2018) *Operational Excellence, The Imperative for Oil and Gas Companies Brain and Company*. http://www.bain.com.

Mosaic White Paper Report (2011) *Complexity Theory*. http://www.mosaicproject.com

Nolan C.T. and Garavan T.N (2016) Human Resource Development in SMEs; A Systematic Review of the Literature. *International Journal of Management Reviews*. 18(1), http://dx.doc.org/10.1111/ijmr.12062.

Poveda – Baustista R, Diego – Mas J. and Leon – Medina D (2018) Measuring the Project Management Complexity Using Structural Equation Modelling *International Journal of Project Management* (33)(2015)

PSAC Reports (2018) Industry Overview, *Annual Report*. https://www/psac.ca.business-industry

Rahim A.R.A. Sabric H, Yew W.K and Ismail S.(2017). Project Management in Oil and Gas Industry. A Review. *November 2017 Conference 26th International Business Information Management Association Project* (IBIMA) Conference at Madrid Spain; Project Management. http://www.rechargegate.net.

Remington and Pollack (2018) Project Management 101: How to Profile Project Complexity, tps//www.copperproject.com, *Copper – Blog*.

Santos I.O.M.D, Barriga G.D.C, Jugend D. and Gauchick – Miguel P.A (2019) Organizational Factors Influencing Projecting Success; An Assessment in the Automotive Industry. *Production.* Prod.vol.29 SAO Paulo 2019. Epub.

Schwalbe K (2006). *Introduction to Project Management*. Thompson Course Technology. www.course.com

Sediary S.T. (1994); Management of Conflict: Public Sector Construction in Saudi Arabia. *International Journal of Project Management*. 12(3) Pp143-151

Sheikhzadeh M, Arasti M.R. and Kotobzadeh R. (2012). Identifying Key Success factors in upstream Sector of Oil and Gas Industry in Iran. *African Journal of Business Management* Vol.6(20). http://www.academicjournal.org AJBM:

Shenhar A.J. (2001) One Size Does not fit all Projects. Exploring Classical Contingency Domain, *Management Science*. Vol.47,No.3

Venkatesh X. (2019). *Three Organizational Theories; Classical, Neo – Classical and Modern*. Venso Consulting http://www.yourarticlelibrary.com

William T. (2005) Assessing and Moving on from the Dominant Project Management, Discourse in the Light of Project Overruns. *IEEE Transactions Engineering Management*. Vol,52,No.4

Wixon R.T. and Waston H.(2001) An Empirical Investigation of the factors Affecting Data Warehousing Sources. *MIS Quarterly* 25, 1, 17-32

Wood H. and Ashton P. (2010) *The factors of Complexity In 18th CIB World Building Congress*. http://cibworld.xs4all.nl/dl/ publications/tg62.pub353.

Wright C. and Gallun D. (2018). Performance Measurement and Management in the Upstream Oil and Gas Sector. *Journal of Business and Management*, Vol.18, Issue 8. iosrjournal.org.

Zadiat W.M. (2019) A study of Complexity Factors in Oil and Gas Project Management and finding New Methods to improve Project Performance Using Complexity Theory Concepts. *IJMRND* www.ijmrnd.com> engineering