INTERNATIONAL JOURNAL ON ECONOMICS, FINANCE AND SUSTAINABLE DEVELOPMENT

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Operations Improvement Function and Economic Sustainability of Petroleum Tank Farms in South South, Nigeria

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ABSTRACT

The study examines the link between operations improvement function (dimensioned by contingency planning and preventive maintenance) and economic sustainability of petroleum tank farms in South-South, Nigeria. The study was underpinned by the stakeholder theory and the theory of routine dynamics. The study adopted the cross-sectional survey research design, as the researchers could not manipulate the variables, and the underlying philosophy is positivism. The questionnaire was the instrument for data collection. The elements of the accessible population comprise 820 middle and top level managers of all the 29 petroleum tank farms owned by members of the Independent Petroleum Products Importers, in South South, Nigeria. The Krejcie & Morgan's formula was deployed to determine the sample size of 262 respondents, and a 10% provision was reasonably made to accommodate non-responses and outliers, bringing the adjusted sample size to 288 respondents. The simple random sampling technique was adopted and the Structural Equation Modeling was deployed to test the hypotheses at 0.05 significance level.The results revealed that contingency planning and preventive maintenance have positive and significant relationships with economic sustainability.

ARTICLEINFO

Article history:
Received 22 Jan 2022
Received in revised form
23 Feb 2022
Accepted 22 Mar 2022

Keywords:
Contingency Planning; Preventive Maintenance; Petroleum Tank Farms; Economic Sustainability.

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Therefore, it is recommended that Managers of petroleum tank farms should improve their level of contingency planning and preventive maintenance by identifying common emergencies that could occur and outlining specific tasks that the facility staff will undertake in an emergency situation as well as having dedicated and skilled preventive maintenance planners.

I. Introduction

The oil and gas sector is the mainstay of Nigeria's economy. The sector contributes about 95% of the country's foreign exchange earnings and above 14% of its gross domestic product (Uwakonye, Osho and Anucha, Hyacinth 2006). Specifically, petroleum tank farms, which are used for the storage of oil and/or petrochemical products, are critical assets of the downstream oil and gas sector. However, the concomitant challenges bedevilling the sector include but not limited to Government's policy somersault, deficit public infrastructure and dwindling revenues occasioned by the weak Naira exchange rate. This has led to economic dislocations around the operations of petroleum tank farms and a consequential inadequate economic sustainability of these tank farms. The importance of economic sustainability cannot be over-stated. As argued by Ballinger (2011), the impetus for a more sustainable approach to business include the need to withstand the pressures of globalization, reduce corporate scandals, provide a panacea to the global economic crisis, as well as answer the demands for greater scrutiny of business by external stakeholders.

The notion of economic sustainability was originated by Hicks (1946), who saw income as the amount one can consume during a period and still be well off at the end of the period. The sustainability that economic sustainability seeks is the sustainability of the economic system itself, as economic sustainability implies a system of production that satisfies present consumption levels without compromising future needs (Basiago, 1999). Basiago, (1999) further argued that the hallmarks of economic sustainability include market allocation of resources, sustained levels of growth and consumption, an assumption that natural resources are unlimited and a belief that economic growth will trickle down to the poor. In essence, the scholar posited that sustainable development expands development's concern with monetary capital to consider natural, social and human capital.

Essentially, the scarcity of US Dollars and the Naira/Dollar exchange rate differentials have made all the unregulated petroleum products in Nigeria like AGO, DPK, LPG, ATK, Butimen, LPFO, HPFO and lube to be very expensive to buy. This explains why cooking gas (LPG) and diesel (AGO) are now very expensive in Nigeria. The implication of this is that most of the petroleum tank farms in South South Nigeria, are not economically sustainable, as they are left without petroleum products for a larger period of time.

One the other hand, operations improvement function is the ability to do the right things better and make it a part of continuous process. Therefore it is important to adopt efficient function improvement technique so as to ensure individuals and organizations growth in productivity. The operations improvement function dimensions adopted in this study are: contingency planning and preventive maintenance. Various economic sustainability strategies have been put forward by several scholars, such as ergonomics adoption (Resnick & Zanotti, 1997), expert line balancing system (Keytack, 1997), Just-in-time production system (Pisuchpen & Chansangar, 2014), among others. Despite the various attempts by several scholars, to provide panaceas to the problem of inadequate economic sustainability, studies that have considered the perspective of operations improvement function are scant. Therefore, this study seeks to close the gap by critically assessing operations improvement function and how it relates to economic sustainability of petroleum tank farms in South South, Nigeria, through the use of

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structural equation modeling.

1.1 Objectives and hypotheses

The purpose of this study is to determine the link between operations improvement function and economic sustainability of petroleum tank farms in South South, Nigeria. The specific objectives of the study are to:

i. Determine the relationship between contingencyplanning and economic sustainability.

ii. Assess the link between preventive maintenance and economic sustainability.

The following research questions directed the investigation:

i. What is the relationship between contingency planning and economic sustainability?

ii. What is the link between preventive maintenance and economic sustainability?

Thus, the following null hypotheses were formulated to answers to the research questions:

H_{01}: There is no significant relationship between contingency planning and economic sustainability.

H_{02}: There is no significant relationship between preventive maintenance and economic sustainability.

II. LITERATURE REVIEW

2.1 Theoretical framework: The theories that underline this study are the stakeholder theory (Freeman, 1984) and the theory of routine dynamics (Feldman & Pentland, 2008). The stakeholder theory suggests that a firm needs to put into consideration, any group or individual who can affect or is affected by the achievement of the firm's objectives (Freeman, 1984). The stakeholder theory does not simply describe existing situations or predict cause-effect relationships; it also recommends attitudes, structures, and practices that, taken together, constitute stakeholder management (Jones & Wicks, 1999). The stakeholder theory is relevant to the study, as it provides a useful basis for understanding the value every stakeholder is adding to the firm. Conversely, the theory of routine dynamics (Feldman & Pentland, 2008) suggests that routines are best conceptualized as generative systems that can produce a wide variety of performances depending on the circumstances. In essence, routines consist of actual performances by specific people, at specific times, in specific places (Feldman & Pentland, 2008).

2.2 Conceptual framework: Operations improvement function was dimensionedby **contingency** planning and preventive maintenance as adapted from Umoh and Wokocha (2013); Theodros (2017) and Abbas (2014). Economic sustainability was adopted from Nicolaesal, Alpopi and Zacharia (2015) and Cella-De-Oliveira (2013).

2.2.1 Contingency Planning: Contingency Planning is defined as "First aid kit for future planning (Donalson & Doug, 2007). When faced with a situation of contingency, contingency planning relates to an operational procedure to restore the operation of a business process or a system. Similarly, Erry and Lindell (2003) noted that pre-crisis planning should consist of the following: accurate knowledge of threats and the likely human response, flexibility in response to any crisis, integrating each hazard plan into a multi-hazard approach, training the relevant personnel in crisis management response and adapting to any new circumstances.

2.2.2 Preventive Maintenance: According to Alsyouf (2007), preventive maintenance means the regularly scheduled repair and maintenance needed to keep a facility component operating at peak

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efficiency and extend its useful life, and this includes scheduled activities intended to prevent breakdowns, such as periodic inspections, lubrication, calibrations, and replacement of equipment. As stated by Swanson (2001), a successful preventive maintenance programs has the following benefits: (i) machines will work at full efficiency creating profitable uptime, while reducing downtime. (ii) Reduces the chances of complete machine breakdowns. Problems are recognized earlier with a preventive maintenance plan. (iii) Reduces the chance of emergency repair calls.

2.2.3 Economic Sustainability: Abubakar (2014) argued that economic sustainability refers to consumption of resources in an effective way in order to produce long term positive effects through minimizing adverse impacts of resource exploitation. Similarly, Basiago (1999) argued that an economic system designed in the light of the concept economic sustainability is one constrained by the requirements of environmental sustainability and the way to implement the principle of economic sustainability in a practical sense is to fashion a method of urban design that meets the urban service needs of the general public, particularly the urban poor, while enhancing the naturalness of the urban environment.

2.3 EMPIRICAL REVIEW: Studies have attempted to find the nexus between the dimensions of operations improvement function and economic sustainability. For instance, Skipper, Hall, Hazen, and Hanna (2014) studied achieving flexibility via contingency planning activities in supply chain. This research effort examines four activities that are associated with the contingency planning process to determine which, if any, of these processes are ultimately supportive of organizational flexibility. These activities are: information sharing, external collaboration, internal collaboration, and information technology usage. A survey method is employed to examine the perceptions of 103 contingency planners to determine which of these potential determinants are positively related to organizational flexibility. The data are analyzed using partial least square regression, and reveal that information technology use and external collaboration are significant determinants of organizational flexibility.

Likewise, Laura (1999) studied the impact of new production technologies on the maintenance function. The paper reports the results of a study of maintenance practices. Based on the responses of 222 plant managers and maintenance managers in 180 manufacturing plants, the analysis shows several direct relationships between advanced manufacturing technology and just-in-time and choice of maintenance practices. The study found that advanced manufacturing technology is associated with more extensive use of computerized maintenance management systems, worker training, professional maintenance staff and preventive maintenance; while Just-in-time manufacturing is associated with more extensive operator involvement in performing simple maintenance tasks.

3. Research Methods: The study adopted the cross-sectional survey research design, as the researchers could not manipulate the variables, and the underpinning philosophy is positivism. As such, object reality is deemed to exist. Accordingly, the questionnaire was the instrument for data collection. The elements of the accessible population comprise 820 middle and top level managers of all the 29 petroleum tank farms owned by members of the Independent Petroleum Products Importers, in South South, Nigeria. The Krejcie & Morgan's (1970) formula was deployed to determine the sample size of 262 respondents, and a 10% provision was reasonably made to accommodate non-responses, outliers and attritions, bringing the adjusted sample size to 288 respondents.

Furthermore, the Bowley's formula was used to proportional allocate the sample, and the simple random sampling technique was deployed, to ensure that each member of the accessible population has equal chance of being selected. A total of 288 copies of the instrument were administered, out of which a total of 241 copies were retrieved, representing 83.68% of actual distribution rate. However, 47 copies representing 16.32% were not retrieved, as the concerned respondents could not create time to complete

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them, despite the fact that the researchers embarked on several visits, sent emails and made phone calls as reminders. Of the 241 copies of the instrument retrieved, 11 copies, representing 3.82% were not usable due to missing responses. This tendency is in consonance with the stand of Kline (1998), who argued that only cases with complete records should be included in the dataset, to maintain consistency. In all, due to combined efforts of the researchers and the research assistants, 230 copies of the instrument, representing 79.86% were retrieved and found to be completed and usable. The Structural Equation Modeling was deployed to test the hypotheses at 0.05 significance level.

4.1. Univariate Analysis: This analysis uses measures of central tendencies, particularly the mean (x) and standard deviation in assessing the extent to which each item is considerably accepted by the respondents to be a significant attribute in their activities.

Table 4.1: Descriptive Statistics for Contingency Planning

	N	Minimum	Maximum	Mean	Std. Deviation
Risk management/contingency planning is part of my wok and I feel involved in the work being done.	230	1	5	2.75	1.177
Our firm has contingency schedules with responsibilities and all staff are aware of this.	230	1	5	3.17	1.222
We identify materials and resources for use during an emergency that are available at our facility or elsewhere and all employees are trained on the contents of the plan.	230	1	5	3.14	1.159
We identify common emergencies that could occur at our facility and outline specific tasks that the facility staff will undertake in an emergency situation.	230	1	5	3.07	1.207
In our firm, there is an established clear chain of command for all employees to follow, during emergencies.	230	1	5	3.26	1.156
There is enough training and information about how to act during a crises situation, in order to evaluate safety.	230	1	5	3.11	1.078
In my firm, we prepare in advance for recovery from disasters.	230	1	5	2.93	1.288
Valid N (listwise)	230				

Table 4.1 illustrates the distribution for Contingency Planning which describes the operational procedure to restore the operation of a business process or a system, when faced with a situation of contingency. The result from the analysis on the indicators presents them as having significant and moderate mean values. CP1:Risk management/contingency planning is part of my wok and I feel involved in the work being done, has a moderate and significant mean (mean = 2.74, SD=1.18) indicating that in generality, respondents agree with the statement as being correct; CP2:Our firm has contingency schedules with responsibilities and all staff are aware of this, has an evident and significant mean (mean =3.17, SD=1.22) suggesting that majority of the respondents affirm the statement as being true; CP3:We identify materials and resources for use during an emergency that are available at our facility or elsewhere and all employees are trained on the contents of the plan, has a substantial and

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significant mean (mean = 3.14, SD=1.16) implying that majority of the respondents agree with the position of the statement.

Similarly, PE4: We identify common emergencies that could occur at our facility and outline specific tasks that the facility staff will undertake in an emergency situation; has a moderateand evident mean (mean = 3.07, SD=1.21) suggesting that majority of the respondents are in agreement with the statement and outline specific tasks that the facility staff will undertake in an emergency situation; CP5:In our firm, there is an established clear chain of command for all employees to follow, during emergencies, has an moderate and significant mean (mean =3.26, SD=1.16) suggesting that majority of the respondents affirm the statement as being true; CP6:There is enough training and information about how to act during a crises situation, in order to evaluate safety, has a moderate and significant mean (mean = 3.11, SD=1.08) indicating that in generality, respondents agree to the statement as being correct; CP7:In my firm, we prepare in advance for recovery from disasters, has an evident and significant mean (mean =2.93, SD=1.21) suggesting that majority of the respondents affirm the statement as being true.

Table 4.2: Descriptive Statistics for Preventive Maintenance

	N	Minimum	Maximum	Mean	Std. Deviation
Our engineers feel free to order spare parts to perform preventive maintenance.	230	1	5	3.06	1.013
The spare parts used for machines to do preventive maintenance are durable and meet the quality standards.	230	1	5	2.95	.933
Our firm has dedicated and skilled preventive maintenance planner	230	1	5	3.02	1.061
Our management is committed for preventive maintenance execution.	230	1	5	3.09	1.106
All our critical machines and equipment have preventive maintenance.	230	1	5	2.92	1.075
Our preventive maintenance program is audited timely.	230	1	5	3.26	1.208
Most employees understands the link between preventive maintenance and the company's strategy.	230	1	5	3.06	1.100
Valid N (listwise)	230				

Source: SPSS output (2021)

Table 4.2 illustrates the distribution for the data on Preventive Maintenance which describes the regularly scheduled repair and maintenance needed to keep a facility component operating at peak efficiency and extend its useful life. The distributions for the variables are revealed to be moderate but yet significant, given the central tendencies for the indicators – PM1: Our engineers feel free to order spare parts to perform preventive maintenance, has a moderate and significant mean (mean = 3.06, SD=1.01) suggesting that respondents agree with the statement; PM2: The spare parts used for machines to do preventive maintenance are durable and meet the quality standards, has a moderate but yet significant mean (mean = 2.95, SD=0.93) affirming that majority of the respondents consider the statement as being a true position of their views; PM3: Our firm has dedicated and skilled preventive

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maintenance planner, has a substantial and significant mean (mean = 3.02, SD=1.06) which indicates that most of the respondents consider the statement to be correct.

Similarly, PM4: Our management is committed for preventive maintenance execution, is associated with a high and significant mean (mean = 3.09, SD=1.11) implying that a majority of the respondents believe the statement aligns with their own views too; PM5: All our critical machines and equipment have preventive maintenance, has a high and significant mean (mean = 2.92, SD=1.18) suggesting that most of the respondents identify with the statement; PM6: Our preventive maintenance program is audited timely, has a strong and significant mean (mean = 3.06, SD=1.10) indicating that a majority of the respondents affirm to the statement as being true. PM7: Most employees understands the link between preventive maintenance and the company's strategy, has a strong and significant mean (mean = 3.06, SD=1.10) indicating that a majority of the respondents affirm to the statement as being true. Based on the evidence presented for the preventive maintenance, it is affirmed that all 7 of the statement items for the latent variable,are substantially and significantly manifested by the respondents and their respective organizations. This suggests the strong manifestation of preventive maintenance as being evident in the dataset.

Table 4.3: Descriptive Statistics for Economic Sustainability

	N	Minimum	Maximum	Mean	Std. Deviation
My organization honors the taxes, tributes, fees, and other government contributions that enhances economic sustainability	230	1	5	2.95	1.155
My organization does not practice disloyal competition, trust, monopoly or dumping on economic sustainability issues.	230	1	5	3.07	1.113
My organization's economic sustainability decisions are taken based on a formal strategic planning that encompasses the organization as a whole, made by professionals.	230	1	5	3.44	1.191
My organization focused on risk management plans and evaluations, My organization focused on risk management plans and evaluations, with concern of the company's capacity to honor financial commitment with collaborators and shareholders.	230	1	5	3.55	1.224
My company has restructuring plans in case of exceptional events (economic market crash, natural phenomena, etc.).	230	1	5	3.12	1.392
My organization is punctual in the payment of salaries, benefits, and contracts with suppliers and other partners.	230	1	5	3.56	1.165
Valid N (listwise)	230				

Table 4.3 illustrates the distribution for Economic Sustainability which describesa system of production that satisfies present consumption levels without compromising future needs. The result from the analysis on the indicators presents them as having moderate but yet significant mean values. ECS1: My organization honors the taxes, tributes, fees, and other government contributions that enhances

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economic sustainability, has a moderate and significant mean (mean = 2.95, SD=1.15) indicating that in generality, respondents agree to the statement as being correct; ECS2:My organization does not practice disloyal competition, trust, monopoly or dumping on economic sustainability issues, has a substantial and significant mean (mean =3.07, SD=1.11) suggesting that majority of the respondents affirm the statement as being true; ECS3: My organization‘s economic sustainability decisions are taken based on a formal strategic planning that encompasses the organization as a whole, made by professionals, has a substantial and significant mean (mean = 3.44, SD=1.19) implying that majority of the respondents agree with the position of the statement as regards economic sustainability decisions.

Similarly, ECS4: My organization focused on risk management plans and evaluations, with concern of the company's capacity to honor financial commitment with collaborators and shareholders; has a substantial and evident mean (mean = 3.55, SD=1.22) suggesting that majority of the respondents are in agreement with the statement and are concerned about their company's capacity to honor financial commitment with collaborators and shareholders; ECS5: My company has restructuring plans in case of exceptional events (economic market crash, natural phenomena, etc.), has an evident and significant mean (mean =3.12, SD=1.39) suggesting that majority of the respondents affirm the statement as being true; ECS6: My organization is punctual in the payment of salaries, benefits, and contracts with suppliers and other partners, has a moderate and significant mean (mean = 3.56, SD=1.17) indicating that in generality, respondents agree with the statement as being correct. The implications are that majority of the respondents recognizes the need for system of production that satisfies present consumption levels without compromising future needs.

Table 4.4: Reliability Statistics

SN	CONSTRUCT	NO. OF ITEMS	CRONBACH'S ALPHA STATISTICS
1.	Contingency Planning	7	0.905
2.	Preventive Maintenance	7	0.796
3.	Economic Sustainability	6	0.823

Source: Researcher's Desk, SPSS 25.0 Outputs 2021.

As suggested by Nunnally and Bernstein, (1994), the Cronbach's alpha cut-off point 0.7 was adopted as the reliability threshold. The Cronbach's alpha values for each construct are: Contingency planning (0.905); Preventive Maintenance (0.796) and Economic sustainability (0.823).

Table 4.5: Normality Statistics

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CONTINGENCY PLANNING	230	7	35	21.42	6.627	-.007	.160	-.485	.320
PREVENTIVE MAINTENANCE	230	9	35	21.36	5.039	.078	.160	.049	.320
ECONOMIC SUSTAINABILITY	230	6	30	19.69	5.287	-.234	.160	-.439	.320
Valid N (listwise)	230								

4.1.5 Assessment of Normality: The dataset was found to be normally distributed with the skewness in each case in the range of $\pm$1.0, with standard error of 0.160, and kurtosis values in the range of $\pm$1.0, with standard error of 0.320, as depicted in Table 4.6, showing the mean, standard deviation, skewness

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and kurtosis values for each construct. As suggested by Tabachnick and Fidell (2007) the normal range for skewness-kurtosis value should be ±2.58. However, George and Mallery (2010) recommended that skewness and kurtosis values between -2 and +2 are considered acceptable. In consonance with the various recommendations, there is evidence of normality of data.

4.1.6 Assessment of Linearity: The evidence from the scatter plots of all the latent constructs, shows that the assumption of linearity was not violated. As suggested by Tabachnick and Fidell (2007), if both variables are normally distributed and linearly related, the scatter plot is approximately oval-shaped, but if one of the variables is non-normal, then the scatter plot between latent constructs is not oval-shaped.

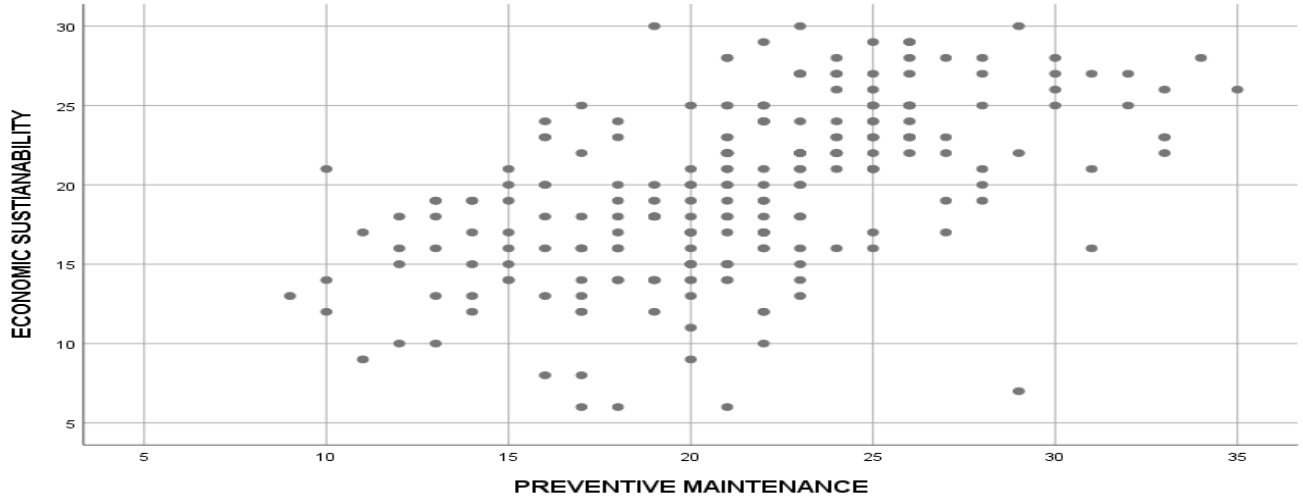

Figure 1.1: Scatterplot for preventive maintenance and economic sustainability

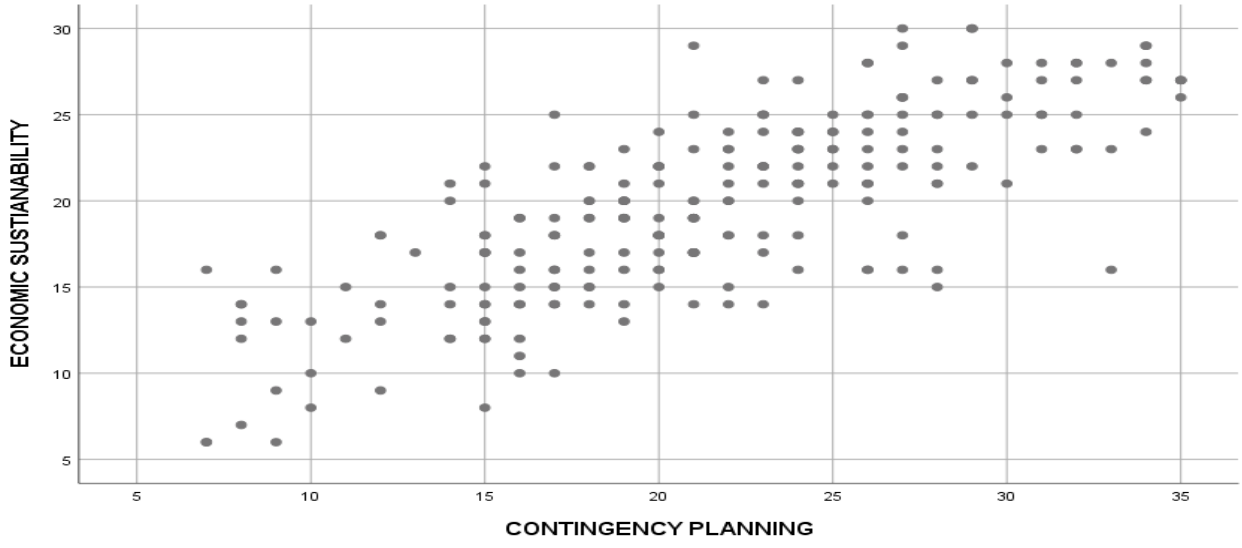

Figure 1.2: Scatterplot for contingency planning and economic sustainability

Source: Researcher's Desk, SPSS 25.0 Outputs 2021.

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Table 4.6: Test of Homogeneity of Variances

			Levene Statistic	df1	df2	Sig.
CONTINGENCY PLANNING		Based on Mean	.447	4	225	.775
		Based on Median	.500	4	225	.736
		Based on Median and with adjusted df	.500	4	208.929	.736
		Based on trimmed mean	.462	4	225	.764
PREVENTIVE MAINTENANCE		Based on Mean	1.023	4	225	.396
		Based on Median	.989	4	225	.414
		Based on Median and with adjusted df	.989	4	219.253	.414
		Based on trimmed mean	1.024	4	225	.396
ECONOMIC SUSTAINABILITY		Based on Mean	1.139	4	225	.339
		Based on Median	1.142	4	225	.338
		Based on Median and with adjusted df	1.142	4	171.374	.339
		Based on trimmed mean	1.076	4	225	.369

Source: Researcher's Desk, SPSS 25.0 Outputs 2021.

4.1.7 Assessment of Homogeneity of Variance: The presence of homogeneity of variance in the dataset was determined by performing the Levene's test on the one-way ANOVA by using Age of Respondents as a the non-metric variable with the aid of SPSS version 25.0 (see Tables 4.6) . The results of the ANOVA and Levene's tests revealed that the differences in variances among the latent constructs were not significant (i.e. $p>0.05$). Thus, the variances for all the constructs within the proposed model were equal within and between groups for the various age groups.

4.2 Measurement Model: The measurement model is based on the common factor model which is depicted by the fundamental equation: $y_j = \lambda_{j1}\,\eta_1 + \lambda_{j2}\,\eta_2 + \ldots + \lambda_{jm}\eta_m + \varepsilon_j$ where y_j represents the j the of p indicators obtained from a sample of $n$independent subjects, λ_{jm} represents the factor loading relating variable j to the mth factor ŋ, and ε_j represents the variance that is unique to indicator y_j and is independent of all ŋ sand all other εs. Hu and Bentler (1999), stated that acceptable model fit is defined by the following criteria: RMSEA (≤0.6), SRMR (≤0.8), CFI (≥0.95), TLI (≥0.95), GFI (≥0.90), NFI (≥0.95) PCLOSE (≥0.5) and AGFI (≥0.90) (Byrne, 2010). Where : RMSEA = Root Mean Squared Error of Approximation, CFI = Comparative Fit Index, TLI = Turker-Lewis index, GFI = Goodness-of-Fit-Index, AGFI = Adjusted Goodness-of-Fit-Index, SRMR = Standardized Root Mean Residual and NFI = Normed Fit Index. Also, Carmines and McIver, (1981) suggested that the value of ratio of the χ^2 statistic to its degree of freedom (χ^2/df) , should be less than 5 or preferable less than 3 to indicate an acceptable fit (χ^2/df <5 preferable <3). Furthermore, Byrne, 2010 suggested that the factor loadings should be greater than 0.5 and preferably above 0.7.

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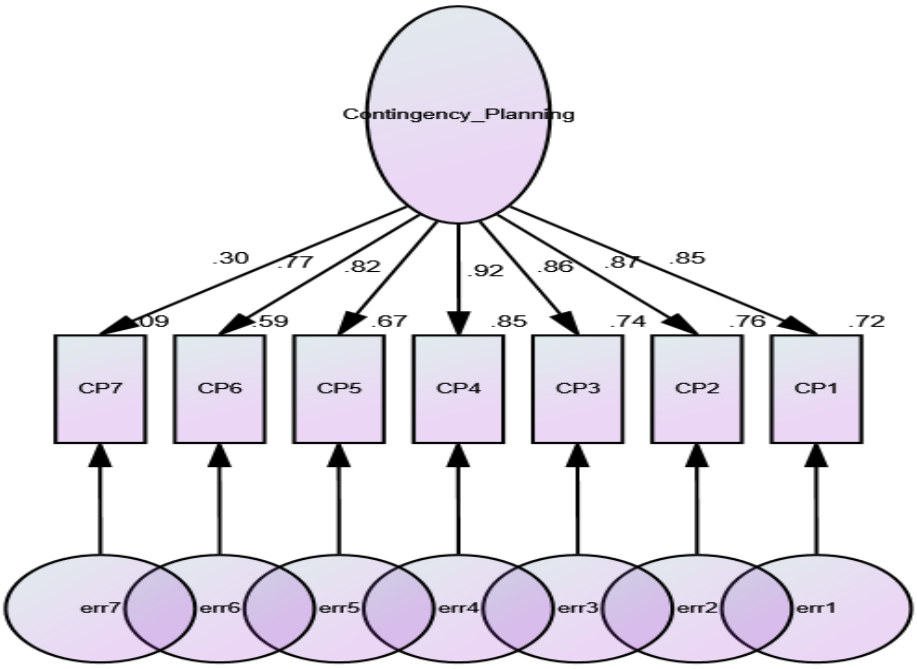

Figure 1.3: Measurement Model of Contingency Planning

Table 4.7: Measurement Model Analysis of Contingency Planning

Model	Chi-Square(df), Significance	χ^2/df	NFI	TLI	CFI	RMSEA	Variable	Factor Loading Estimates	Error VAR
Contingency Planning	(14df) =42,164, P=0.000	3.012	0.965	0.964	0.976	0.094	CP1	0.847	0.72
							CP2	0.870	0.76
							CP3	0.860	0.74
							CP4	0.921	0.85
							CP5	0.819	0.67
							CP6	0.771	0.59
							CP7	0.301	0.09

The results of the goodness of fit indices indicated an acceptable fit to the data for one-factor model (chi-square (14df)=42.164, χ^2/df=3.012, p=0.000, RMSEA=0.094, CFI=0.976, NFI=0.965 and TLI=0.964). Table 4.1.38 summarized the goodness of fit indices, the factor loading estimates and the error variances. Factor loading estimates revealed that seven indicators were related to latent factor - contingency planning - and were statistically significant. The indicators CP1-CP7 had factor loadings of 0.847, 0.870, 0.860, 0.921, 0.819, 0.771, and 0.301 respectively and error variances of 0.72, 0.76, 0.74, 0.85, 0.67, 0.59 and 0.09 respectively. The weak indicator CP7 was deleted. Apart from the indicator CP7, all the other freely estimated standardized parameters were statistically significant.

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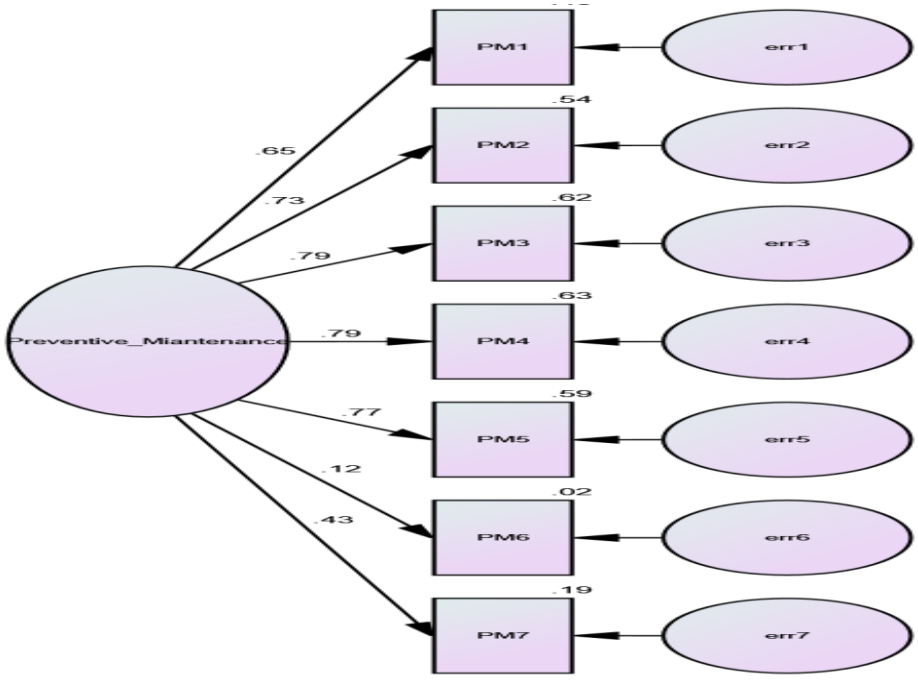

Figure 1.4: Measurement Model of Preventive Maintenance

Table 4.8: Measurement Model Analysis of Preventive Maintenance

Model	Chi-Square(df), Significance	χ^2/df	NFI	TLI	CFI	RMSEA	Variable	Factor Loading Estimates	Error VAR
Preventive Maintenance	(5df) =33.591, P=0.02	2.399	0.941	0.946	0.946	0.78	PM1	0.65	0.55
							PM2	0.73	0.54
							PM3	0.79	0.62
							PM4	0.77	0.63
							PM5	0.76	0.59
							PM6	0.12	0.02
							PM7	0.43	0.19

The results of the goodness of fit indices indicated acceptable fit to the data for one-factor model (chi-square (5df)=33.591, χ^2/df=2.399, p=0.02, RMSEA=0.78, CFI=0.946, NFI=0.941 and TLI=0.946). Table 4.1.35 summarized the goodness of fit indices, the factor loading estimates and the error variances. Factor loading estimates revealed that five indicators were strongly related to latent factor preventive maintenance and were statistically significant. The indicators PM1-PM5 had factor loadings of 0.65, 0.73, 0.79, 0.77, and 0.76 respectively and error variances of 0.55, 0.54, 0.62, 0.63, and 0.59 respectively. However, the weak indicators PM6 and PM7 were deleted from the model, because their weak loadings were 0.12 and 0.43 respectively. The first five freely estimated standardized parameters were statistically significant.

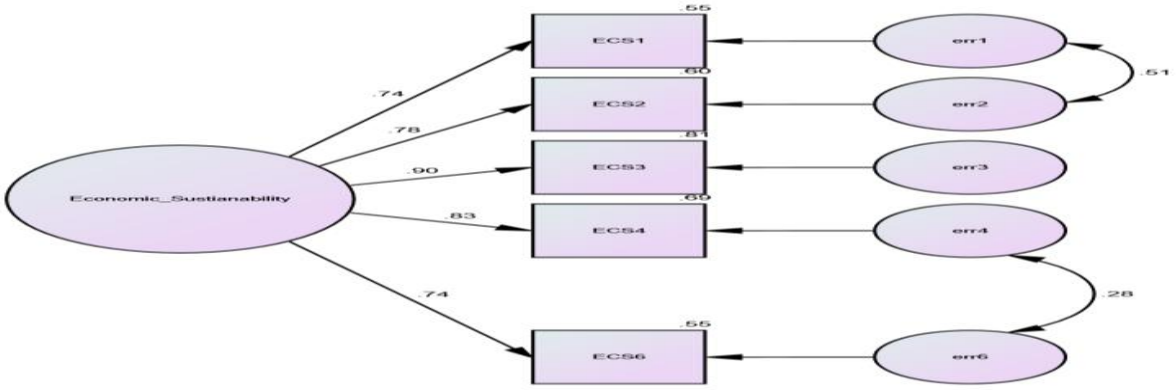

Figure 1.5: Modified Measurement Model of Economic Sustainability

Table 4.9 : Modified Measurement Model Analysis of Economic Sustainability

Model	**Chi-Square(df), Significance**	χ^2/df	**NFI**	**TLI**	**CFI**	**RMSEA**	**Variable**	**Factor Loading Estimates**	**Error VAR**
Economic Sustain-ability	(5df) =67.559 P=0.000	7.504	0.915	0.875	0.925	0.169	ECS1	0.744	0.55
							ECS2	0.776	0.60
							ECS3	0.901	0.81
							ECS4	0.830	0.69
							ECS5	deleted	-
							ECS6	0.744	0.55

Source: Amos 24.0 output on research data, 2021

The results of the goodness of fit indices indicated mediocre fit to the data for one-factor model (chi-square (9df)=67.559, χ^2/df=7.504, p=0.000, RMSEA=0.169, CFI=0.923, NFI=0.998 and TLI=0.875). The indicators ECSL1-CL6 had factor loadings of 0.806, 0.827, 0.863, 0.835, 0.061 and 0.761 respectively and error variances of 0.65, 0.68, 0.74, 0.70, 0.00 and 0.58 respectively. According, indicator ECS5 was deleted because of weak loading. After addition of a covariance between the error terms for ECS4 and ECS6, the result indicated improved fit of the first order measurement model (chi-square (3df)=1.435, RMSEA=0.000, CFI=1.000, NFI=0.998, and TLI=1.007) (see figure 1.4 and table 1.6. The improved estimates (0.744, 0.776, 0.901, 0.830 and 0.744) revealed that the five indicators were related to latent factor -economic sustainability- and were statistically significant.

Table 4.10 : Correlations andAverage Variance Extracted

Variable	**CP**	**PM**	**ECS**	**AVE**	**Sq. Root of AVE**
CP	**1.0**	0.643	0.775	**0.721**	**0.849**
BM	0.781	0.537	0.795	**0.650**	**0.806**
PM	0.643	**1.0**	0.539	**0.550**	**0.742**
ECS	0.775	0.539	**1.0**	**0.642**	**0.801**

Where: CP= Contingency Planning, PM= Preventive Maintenance, BM=Benchmarking, ECS= Economic Sustainability, AVE= average variance extracted, Sq. Root of AVE= square root of average variance extracted.
Correlation is significant at the 0.01 level (2-tailed).

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4.2.1 Convergent Validity: As revealed in Tables 1.8, all the variables have average variance extracted (AVE) values exceeding the 0.50 threshold and all the models are over-identified with degrees of freedom . In tandem with the suggestions by Fornell and Larcker (1981), AVE>0.5 and standardized estimates >0.7, reveal that the model has evidence of convergent validity.

4.2.2 Discriminant Validity: As recommended by Fornell and Larcker's (1981), the criterion for discriminant validity is that the square roots of the Average Variance Extracted (AVE) for each construct must be greater than the correlations with other constructs. Table 1.8 reveals that the square roots of the AVEs are greater than the construct correlations. Therefore, it is sufficient to conclude that the model has evidence of discriminant validity.

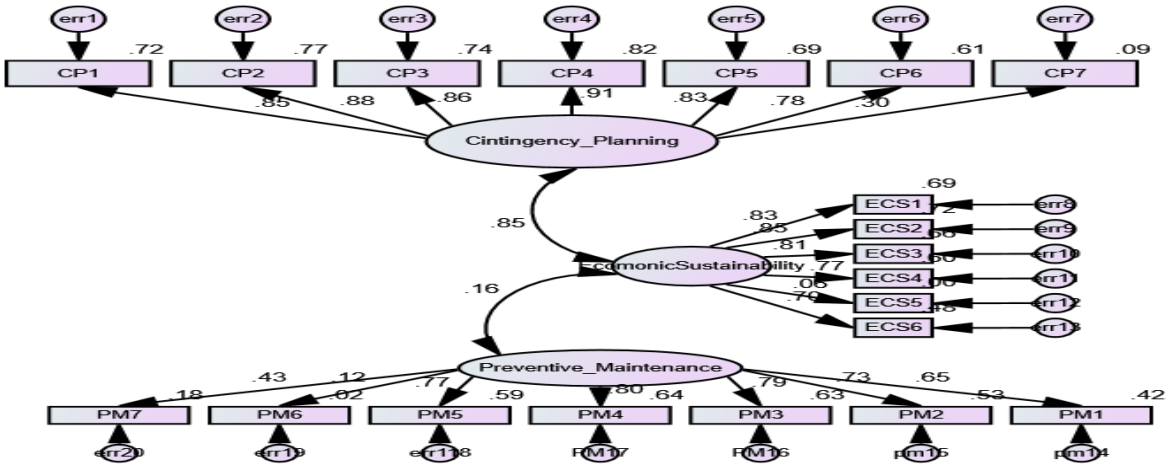

Figure 1.6 Structural model (linking the hypotheses)

4.3 Structural Model: The study adopted the reflective indicator, , reflective measurement model and reclusive structural model framework.

Table 4.11 : Test of Hypotheses

S/N	Mediation Stage	Hypotheses	Standardised Estimate (Beta value) > 0.5; or ≥ 0.7	Critical Ratio (C.R) the t-value) ≥ 1.96	P-value < 0.05	Remark	Decision
1	CP →ECS (Hypothesis 11)	There is no significant relationship between contingency planning and economic sustainability.	0.575	4.511	0.000	Positive and Significant	Not supported
2	PM →ECS (Hypothesis 2)	There is no significant relationship between preventive maintenance and economic sustainability.	0.717	1.848	0.000	Positive and Significant	Not supported

4.4 Interpretation of Results (Inferential Analysis): The first hypothesis (Ho:1), states that there is no significant relationship between contingency planning and economic sustainability. However, table 1.9reveals that contingency planning has a positive and significant relationship with economic sustainability of petroleum tank farms in South-South Nigeria (β=0.575, C.R=4.511, p=0.000). Thus, Ho:1 was not supported and the alternate hypothesis is hereby accepted. This means that the presence of

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contingency planning, in petroleum tank farms in South-South Nigeria, will lead to economic sustainability among the petroleum tank farms. The second hypothesis (Ho:2), states that there is no significant relationship between preventive maintenance and economic sustainability. However, table 1.9 also suggests that preventive maintenance has a positive and significant relationship with economic sustainability of petroleum tank farms in South-South Nigeria (β=0.717, C.R=1.848, p=0.000). Thus, Ho:2 was not supported and the alternate hypothesis is hereby accepted. This means that the presence of preventive maintenance, in petroleum tank farms in South-South Nigeria, will lead to economic sustainability among the petroleum tank farms.

4.5 Discussion of Findings: The study was underpinned by the stakeholder theory (Freeman, 1984) and the theory of routine dynamics (Feldman & Pentland, 2008).

4.5.1 Positive and Significant Relationship between Contingency Planning and Economic Sustainability:

The first specific objective was to determine the relationship between contingency planning and economic sustainability and was captured by a research question and expressed under Ho:1. This hypothesis stated that there is no significant relationship between contingency planning and economic sustainability. The outcome of the data analysis did not support the hypothesis. The result shows that there is a strong and significant relationship between contingency planning and economic sustainability of petroleum tank farms in South South, Nigeria. This implies increase in contingency planning is associated with increase in economic sustainability. This finding is in consonance with Alshamsi and Pathirage (2015) who found that inadequate preparation for disasters can have significant impacts on the environment and people, while the scale of disasters and complex, extreme or catastrophic events have inherent characteristics which put a level of their impact are sometimes difficult prior to their occurrence, is still the responsibility of emergency organizations to prepare to manage them. This finding is in consonance with the Theory of Routine Dynamics (Feldman & Pentland, 2008) which suggest that organizational routines are widely misunderstood as rigid, mundane, mindless, and explicitly stored somewhere, rather, routines are generative systems that produce repetitive, recognizable patterns of interdependent action carried out by multiple participants.

4.5.2 Positive and Significant Relationship between Preventive Maintenance and Economic Sustainability:

The next objective was to examine the relationship between preventive maintenance and economic sustainability and was captured by a research question and expressed under Ho:2. This second hypothesis stated that there is no significant relationship between preventive maintenance and economic sustainability. The result of this study did not support the hypothesis. The result shows that there is a positive and significant relationship between preventive maintenance and economic sustainability of petroleum tank farms in South South, Nigeria. This means that increase in preventive maintenance is associated with increase in economic sustainability. This finding is in conformity with Polese, Gallucci, Carrubbo and Santulli (2021) who found that if companies support investment in predictive maintenance through correct financial decisions, they may create value over time and favor sustainable business balance. This finding of the study validates the theoretical assertion of the stakeholders' theory (Freeman, 1984) which suggests that a firm depends on and needs to put into consideration, any group or individual who can affect or is affected by the achievement of the firm's objectives.

4.6 Conclusion and Recommendations: This study practically implies that Management of petroleum tank farms should understand how they can boost organizational sustainability by adopting contingency planning, preventive maintenance and benchmarking. Therefore, it is recommended that Managers of

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petroleum tank farms should improve their level of contingency planning, preventive maintenance and benchmarking by identifying common emergencies that could occur and outlining specific tasks that the facility staff will undertake in an emergency situation and having dedicated and skilled preventive maintenance planners.

4.7 Contributions to knowledge: The findings validate the stakeholder theory and the theory of routine dynamics. Also, the study provides insight on how adopting contingency planning and preventive maintenance can be enhance decisions relating to economic sustainability of petroleum tank farms in South South, Nigeria.

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