



RESEARCH ARTICLE

DECISION-MAKING MODEL FOR OPTIMAL MANAGEMENT AT SOYO PORT COMPANY ON THE CURRENT ECONOMIC SCENARIO IN ANGOLA

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ABSTRACT

This paper aimed to propose a decision-making model for optimal management at Port Company of Soyo in Angola. The model based on qualitative-quantitative analysis approach of management and on hybridization of the rational, administrative and political decision models according to data analysis collected from two questionnaires applied to a sample of 42 common workers and 15 members of management team, taking into account the company's results during the period 2009 to 2018. The company performances observed a decreasing trend of 127.7% on the annual net results. The proposed hybrid model included annual forecasting models for income and costs and a deterministic optimization model of gross profit until 2028 on the current scenario. The model validation shows the increase of 99.1% on the company's net profit.

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INTRODUCTION

In improving port management, several assumptions are taken into account, such as the concrete objectives to be achieved, investments for the expansion and modernization of ports, the involvement of private economic agents, the increase in the quality and efficiency of services and the reduction of costs (Rocha, 2012), the analysis of profitability, cost and profit optimizations, performance analysis and business decision-making based on profitability analysis and cost analysis (O'Mahony & Lyon, 2016), models that allow allocating resources for business risk management (Paulo, Fernandes, & Silva, 2017), choosing the best alternatives through optimization, using computing and evolutionary algorithms (Almeida, Valdivia, Vellasc, & Pacheco, 2007).

Soyo Port Company is located in Angola, in the municipality of Soyo, province of Zaire. The definition of an optimal management model for the Port Company of Soyo is based on a diagnosis made, which allowed us to identify problems such as:

- Net profit with an average annual decrease of 127.7%;
- Average annual growth of receivable accounts of 273.5%;
- Average annual growth of payable accounts of 69%;
- Average annual growth of availabilities in the order of 50.5%;
- Decisions made based on regulations published in the Diário da República, of problems already typified, making it difficult to make decisions on problems outside the company's experiences;
- Tendency to adopt administrative decision models (based on rules and regulations well defined and respected by members of the organization) and political (which is based on the power and influence of the players).

Profit maximization is the objective desired by companies, as it demonstrates the execution of the company's tasks effectively and efficiently. Although this is the wish, it is not always achieved, because companies sometimes do not use the most appropriate techniques to achieve the objective. As the results, the research question was, "what decision-making model can help to improve the management at Soyo Port Company?"

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The paper aimed to propose a decision-making model to improve the management of the Soyo Port Company.

MATERIALS AND METHODS

Basic concepts

Landlord Port: is a port, in which the infrastructures are owned and controlled by the public agent and the superstructures, including equipment, and port work are controlled and managed by the private sector. The public agent by the concession of public service of the infrastructures, puts the exploitation of port terminals in the private sphere for a certain period (Rocha, 2012). This is the Port Management model adopted by Soyo Port Company.

Regression model: is a statistical methodology that allows the establishment of mathematical relationships between the variable of interest \hat{y} (dependent) and one or more independent variables x_1, x_2, \dots, x_n , and is used to predict the behavior of the interest variable from the knowledge of the independent variables (Pedrosa & Gama, 2014). Its general representation formula is $\hat{y} = f(\hat{a}_0, \hat{a}_1, \dots, \hat{a}_n | x_1, x_2, \dots, x_n)$ for all real values x_i and estimated parameters \hat{a}_i , with $i = 0, \dots, n$, and can be adapted to linear, quadratic or other models (Simbo & Xilau, 2015). This model is only adopted when the degree of adjustment between the estimated and observed values results in a determination coefficient above 0.5 and parameters \hat{a}_i is statistically significant, whose Student t is $|t| \geq 2$ and p-value ≤ 0.05 .

Linear programming model with constraints: Let x_1, x_2, \dots, x_n decision variables, $c_1, c_2, \dots, c_n; a_{11}, a_{12}, \dots, a_{1n}; a_{21}, a_{22}, \dots, a_{2n}; \dots; a_{m1}, a_{m2}, \dots, a_{mn}; b_1, b_2, \dots, b_m$ decision parameters of a problem, is called linear programming model with constraints to every expression in the standard way:

$$\text{Max (or Min) } z = c_1x_1 + c_2x_2 + \dots + c_nx_n$$

Subject to:

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n &= b_1 \\ a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n &= b_2 \\ &\vdots \\ a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n &= b_m \\ x_j &\geq 0 \end{aligned}$$

Where:

- Presence of decision variables, $x_i, i=1, 2, \dots, n$;
- Presence of decision parameters, c_i, a_{ij} and b_j , with $j = 1, 2, \dots, m$;
- The linear objective function z to be optimized;
- Linear constraints, where the sign "=" can be replaced by the signs " \geq " or " \leq " depending on the situation;
- The non-negativity ($x_j \geq 0$) of the decision variables (Pizzolato & Gandolpho, 2009).

Decision: is a process of choosing a solution to a problem, when there are at least two alternative solutions (Rodriguez & Fronti, 2004).

Decision-making: is a process of identifying and solving problems (Cunha, Rego, Cunha, & Cardoso, 2007).

Optimization: is an act, process or methodology of making something (such as a design, system or decision) as perfect, functional or effective as possible (Merriam-webster, 2020).

Income (positive component of results): are the increases in economic benefits, creating wealth for the entity (Guerreiro, 2016). It is also referred to as money (or equivalent value) that an individual or company obtains in exchange for providing a good or service or through capital investment.

Costs: expenses related to goods and services used in the production of other goods and services. (Tepa, 2013). Is the decrease in economic benefits, reducing the entity's wealth (Guerreiro, 2016).

Rational Model: is a model which logic is applied to given premises for reaching its conclusions, considers only premises justified from rational arguments and uses empirical evidence with impartiality when judging statements about concrete facts (Fiani, 2009). It can be described as defending the "think first" rule (Cunha, Rego, Cunha, & Cardoso, 2007). The main characteristics of this model are: use of science, structured and detailed information, rationality and support for operational research.

Administrative Model: is a model based on rules previously established, implying the existence of rules and regulations well defined and respected by the members of the organization. Recruitment in companies that adopt this model is based on kinship,

trust and loyalty (Tamo, 2012). The predominant characteristics of the model are: discipline, specialization of functions, standards, legal authority (norms), vertical career and formalization (Salm, Tomasi, & Amboni, 2013).

Political Model: as developed by Allison (1971), is a kind of game, because the actions must be analyzed considering the players, the positions of the players and the influence of each player. The main characteristics of this model are: existence of conflicts, personal interest, power, divergence of ideas, influence, cunning, negotiation, opportunism and competition.

METHODOLOGY

In order to carry out the research, information was collected in the Reports and Accounts of the Soyo Port Company that covers the time horizon from 2009 to 2018. Two questionnaires were applied to 57 individuals, one for 15 members of the management team, which aimed to determine how the decisions are taken at the Company and, another to 42 workers that aimed to ascertain the workers' perception of the decisions making process. Three dimensions (Basic assumptions, Hybrid model execution, and Expected results) was measured in diagnosis, including in them nominal variables, using the Likert scale, related to administrative, rational, political models and to decision problems solutions. IBM-SPSS, R Studio and MATLAB softwares were used for the treatment of questionnaire data, forecast models design and for solving optimization model of gross profit. The questionnaire applied to managers has a reliability of 72.9%, with a total of 50 analysis variables, thus being within the admissibility range of Cronobach's Alpha, with reasonable internal data consistency, and the questionnaire applied to workers has a 70% reliability, with a total of 24 variables, thus being within the admissibility range of Cronobach's Alpha, with a moderate internal consistency. In the diagnosis, the respondents' opinions were extracted based on the analysis of normality of the data and of the Main Components. The variables did not have a normal behavior, they had distributions around their median because the p-values were below 0.05 and the answers stood very often on the extremes. For the extraction of the variables with the highest weight, they were extracted based on the admissible values of the Kaiser-Meyer-Olkin sample adequacy coefficient and the Bartlett sphericity test. In the case of managers, this measure was 76.2% with a p-value of 0.0 for the Bartlett test. For the workers, this measure was 50% with a p-value of 0.0 for the Bartlett test. Crosstabs and Pearson Chi-square test were used to determinate the level of association between the variables of the hybrid model, resulting p-values less than 0.05, confirming the good association between administrative, rational, political models and decision problems solutions variables. Based on the findings of the diagnosis, a rational-administrative-political hybrid model was developed. The forecasting models of income and costs over time, were obtained by linear regression due to the fact that the determination coefficients result in 79.2% and 53.6% respectively, values above 50%. The optimization of gross profits was made using a deterministic linear optimization model with constraints, whose parameters were obtained based on annual trends over the period observed (2009 to 2018) and in the proportionality relations between total income and total costs with the respective decision variables and parameters in the current economic scenario in Angola.

Hybrid decision-making model

In order to optimize the results obtained in the diagnosis, it becomes relevant to include a hybrid decision model that combines the elements of the rational, administrative and political model to solve the decision problems. The hybrid decision model simultaneously uses rationality, science, structured information, the support of operational research, standards, norms, discipline, authority, legality, the interests of those involved, the power and influence of ideas, that allow to predict the consequences of the actions and consequently contribute to the improvement of the results. Although all these elements are included, less importance will be given to the standards and the power of the members, as these tools must be used in conditions where it is extremely necessary. For a better understanding, we present below the hybrid decision conceptual model, which aims to improve the decision-making process at Soyo Port Company.

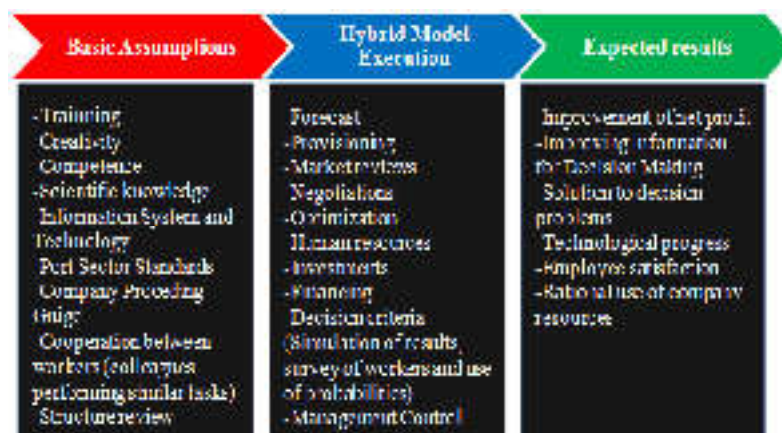


Figure 1: Hybrid decision model to be applied at Soyo Port Company

Forecast model for the hybrid model: Taking the historical data in the period 2009 to 2018, considering the years as time periods $x = 1, 2, \dots, 10$, was found the followings linear regression models for income and costs:

Table 1: Income and cost regression Statistic

Regression statistics	Income	Costs	
Multiple R	0.89	0.732	
R Square	0.792	0.536	
R square adjusted	0.766	0.478	
Standard error	159.54	217.52	
Observations	10	10	
Coefficients of Income		Stat t	p-value
intercepts	-0.733	-0.007	0.995
Variable x	96.9	5.517	0.001
Coefficients of Costs		Stat t	p-value
intercepts	40.3	0.271	0.793
Variable x	72.9	3.043	0.016

The equation that best fits the income data is $\hat{y} = 96.2x$, for $x = 1, 2, 3, \dots, 20$. While for costs the equation is $\hat{y} = 72.9x$, for $x = 1, 2, 3, \dots, 20$. The forecast period was from 2019 to 2028, that is, for $x = 11, 12, \dots, 20$.

Profit optimization model

To optimize the company's profit in the current scenario, an optimization model was designed, as described below:

Decision variables:

Income: x_1 (Provision of services); x_2 (Other operating income and gains); x_3 (Other non-operating income and gains); x_4 (Financial income and gains); x_5 (Extraordinary income and gains);

Costs: y_1 (Personnel costs); y_2 (Depreciation for the year); y_3 (Other operating costs and losses); y_4 (Financial Costs and Losses); y_5 (Other non-operating costs and losses); y_6 (Extraordinary costs and losses).

Decision parameters: $P(x)$ = Total income; $C(y)$ = Total costs.

Table 2. Decision Parameters

Total Income (in millions of Kwanzas)		Total Costs (in millions of Kwanzas)	
Lower bound	Upper bound	Lower bound	Upper bound
Minimum	Mean	Minimum	Mean
1,064.77	1,500.66	841.79	1,169.69

Objective function: The objective of the model is to maximize the gross profit of Soyo Port Company, so it will be necessary to maximize Total income and minimize Total costs. "Therefore" the gross profit is given by the following expression:

$$L(x, y) = P(x) - C(y) = x_1 + x_2 + x_3 + x_4 + x_5 - y_1 - y_2 - y_3 - y_4 - y_5 - y_6$$

Constraints

Most of the constraints were designed considering the weight of each variable in relation to the respective decision parameters in the historical data, in this way the coefficients in the constraints (2; 3; 4; 5; 6; 9; 10; 11; 12; 13 and 14) were obtained (See the Optimization model). Constraint 7 was designed considering that, the costs borne by the company represented 83% of the income, therefore, 83% of the income must be greater than or equal to the total costs. Constraints 1 and 8 were designed considering the minimum and mean value of the forecasts in the current scenario of income and costs, respectively. Constraints 15 and 16 obey the non-negativity of the decision variables, as illustrated in the definition of the optimization problems.

Gross Profit optimization model

$$\text{Max } L(x, y) = x_1 + x_2 + x_3 + x_4 + x_5 - y_1 - y_2 - y_3 - y_4 - y_5 - y_6$$

Subject to:

$$1,064.77 \leq x_1 + x_2 + x_3 + x_4 + x_5 \leq 1,500.66 \quad (1)$$

$$0.16x_1 \geq 0.84(x_2 + x_3 + x_4 + x_5) \quad (2)$$

$$0.86x_2 \geq 0.14(x_1 + x_3 + x_4 + x_5) \quad (3)$$

$$0.99x_3 \geq 0.01(x_1 + x_2 + x_4 + x_5) \quad (4)$$

$$0.999x_4 \geq 0.001(x_1 + x_2 + x_3 + x_5) \quad (5)$$

$$0.999x_5 \geq 0.001(x_1 + x_2 + x_3 + x_4) \quad (6)$$

$$y_1 + y_2 + y_3 + y_4 + y_5 + y_6 \leq 0.83(x_1 + x_2 + x_3 + x_4 + x_5) \quad (7)$$

$$841.79 \leq y_1 + y_2 + y_3 + y_4 + y_5 + y_6 \leq 1,169.69 \quad (8)$$

$$0.41y_1 \leq 0.59(y_2 + y_3 + y_4 + y_5 + y_6) \quad (9)$$

$$0.93y_2 \leq 0.07(y_1 + y_3 + y_4 + y_5 + y_6) \quad (10)$$

$$0.8y_3 \leq 0.2(y_1 + y_2 + y_4 + y_5 + y_6) \quad (11)$$

$$0.999y_4 \leq 0.001(y_1 + y_2 + y_3 + y_5 + y_6) \quad (12)$$

$$0.87y_5 \leq 0.13(y_1 + y_2 + y_3 + y_4 + y_6) \quad (13)$$

$$0.999y_6 \leq 0.001(y_1 + y_2 + y_3 + y_4 + y_5) \quad (14)$$

$$x_1 \geq 0; x_2 \geq 0; x_3 \geq 0; x_4 \geq 0; x_5 \geq 0 \quad (15)$$

$$y_1 \geq 0; y_2 \geq 0; y_3 \geq 0; y_4 \geq 0; y_5 \geq 0; y_6 \geq 0 \quad (16)$$

RESULTS AND VALIDATION

Results

The questionnaire applied to the managers found that the simulation of the expected results and the probability of success in the decisions making by calculi, the survey to hear the opinion of the company's employees are not applicable. The results of tests and interviews and scientific knowledge have a low incidence. Therefore, rationality has a weak impact on the company. In the Decision-making process, it was found that the quality vote has been used moderately. The personal intuition of managers and the power of members have a high incidence. For the succession of the Board Directors, there has been the appointment by the Minister of Transport, as it is a Medium-sized Port. The elements pointed out are from the Political decision model. It was also found that, the norms related to the port sector, the company's standards have a high incidence. In the act of recruitment, the degree of kinship or affinity has a high incidence, the competence and the level of training of the candidates have a moderate incidence, illustrating the presence of Administrative decision model elements. The questionnaire illustrated also, recruitment based on degree of kinship or affinity, lack of the results optimization of the company, few meetings between the staff and Technicians assigned to each area, low level of scientific knowledge, high demonstration of the members' power, poor provisioning, strict compliance with company standards, privilege in the short term forecast, lack of company culture and weak consideration of information from the commercial area. Workers feel satisfied with their job, although they do not benefit from training for career development, and with the salary earned, many are unable to cover their essential expenses, which they are checking periodically the loss of its purchasing power. It was also found that the company does not have a guide of procedures, the actions are not carried out uniformly by all workers. Workers are not motivated to investigate on their own to increase their skills, thus illustrating their weak creativity in carrying out their tasks. The other requirement to be considered in this analysis are the variables that negatively influence the motivation of workers, such as job satisfaction, training to perform tasks with better quality, colleagues who perform similar tasks (same level), household income subsidy, food subsidy and salary behavior. The company tends to adopt the administrative decision model, based on rules and regulations well defined and respected by the members of the organization and politician decision model which is based on the power and influence of the players, not applying the optimization of results, thus having net profits with a negative trend, which is considered inappropriate for the company. With the skills, they will be able to maximize the profit of Soyo Port Company from 2019 to 2028, as shown in Table 3.

Table 3: Results of the optimization model of proposed model from 2019 to 2028

Decision Variables	Algebraic representation	Millions of Kwanzas
-Provision of services	x_1	1,271.30
-Other Operating Income	x_2	210.09
-Other non-operating income and gains	x_3	15.01
-Financial income and gains	x_4	2.13
-Extraordinary income and gains	x_5	2.13
-Personnel costs	y_1	461.30
-Depreciation for the year	y_2	58.93
-Other operating costs and losses	y_3	210.45
-Financial costs and losses	y_4	0.84
-Other non-operating costs and losses	y_5	109.43
-Extraordinary Costs and Losses	y_6	0.84
Gross Profit	$L(x,y)$	658.87

Table 3 illustrates that, with the application of the optimization model results, the annual company's gross profit will be 658.87 millions of Kwanzas. The model illustrates that, the provision of services, the company's main revenue will be around 1,271.30 millions and the cost with personnel, the highest cost borne by the company will be around 461.30 millions of Kwanzas. These values refer to a trend, so the variations to be seen in the next 10 years are around these.

Model Validation: To elucidate the impact of applying the optimization model results, Table 4 illustrates the contribution of the optimization model, if adopted by the Soyo Port Company, to the Angolan State.

Table 4: Impact of the optimization model results to the National Economy

Period	Designations	Without Optimization (Millions of Kwanzas)	With Optimization (Millions of Kwanzas)
2019 to 2028	Gross profit	330,96	658,87
	Profit tax (30%)	99,29	197,66
	Net profit	231,67	461,21

Source: Authors comparison

If the company remains the same strategy, in the next 10 years, will obtain a gross profit of 330.96 millions of Kwanzas, which will contribute 99.29 millions to the State coffers, with a net profit margin estimated at 231.67 millions of Kwanzas. If the company change the strategy, applying the optimization model, the company will obtain an annual gross profit of 658.87 millions of Kwanzas, contributing to the State coffers of 197.66 millions of Kwanza, obtaining a net profit of 461.21 millions of Kwanza. As shown the results, it appears that the net profits may grow by 99.1%, illustrating the company's greater contribution to the State and the significant economic impact of the optimization model.

DISCUSSION

Considering the results obtained, a proposed decision model with greater inclusion capacity was conceived, searching for the most important elements founded in the Analysis of the Main Components and the level of association with solution of the decision problems, supplying those that negatively influence the good functioning of the company, giving greater emphasis to rationality. The basic assumptions are the elements that registered weaknesses in the company, and that their addition will allow them to solve the faced problems. In the model execution phase, the necessary tools have to be used to solve the company's problems. The expected results are the output of the model's tools, that is, what will improve after applying the model. It is worth noting that the proposed model is functional according to the problems founded in the company, and, for cases in which the problems are emergency, the problem will be identified, preceded by the diagnosis, survey of alternatives and implementation of the decision. The company's managers and workers will add skills to the exercise of their tasks, becoming vigilant to the risk and increasing the organizational resilience. Decision-makers will be required to have knowledge, skill or capacity, so that the model's implementation is gradual, motivating employees in the search for new skills. Simon argued that organizations can never be totally rational, because it has limitations in the processing of information and the skills of personnel (Morgan, 1996). Due to these limitations, a model was proposed, in addition to having rationality, includes the administrative and political models that aim to fill the gaps in organizational rationality.

The administrative model is relevant to the company, since (Simon H. , 1970) stated that administrative processes are decision-making processes, as they consist of the isolation of certain elements from the decisions of the organization's members. The reason for including the political model is based on the argument of (Silva M. S., 2011), who stated that a decision is the political ingredient that gives meaning and direction to the permanent structuring of the administrative fact and that defines organizational strategies for capturing, disposing and exploiting the factors of production. With these arguments, we infer that with the application of a hybrid decision model (rational, administrative and political) it will be able to improve the decision-making process of Soyo Port Company and give skills to the employees to apply the optimization, in order to maximize the profits of the company. For the optimization of financial results, it appears that its use provides better conditions for the risk management decision-making process, facilitating the positioning of managers in situations where the best decision also depends on the set of available financial resources (Paulo, Fernandes, & Silva, 2017). As it involves the analysis and construction of models that describe the relationships between variables, which translates into the search for optimal solutions, the results provided by the optimization model serves to support managers in the process taken, leading them to a rational management. With the proposed optimization model, the company's profits will grow by 99.1%, which implies an emerging need to adopt the model to improve the company's financial results.

CONCLUSION

In the period from 2009 to 2018, the Soyo Port Company, had a negative performance, as its yearly Net Results registered a decrease of 127.70%. For the inversion of this current scenario, a hybrid model (Rational-Administrative-Political) can be adopted, in which the managers and workers of the company will add skills for the exercise of their duties, tasks, becoming vigilant to risk and raising organizational resilience. Taking into account the workers and staff member opinions, this model was developed and will help on the solution of several problems observed in the company, such as: 1) the downward trend yearly net results; 2) insufficient liquidity to cover its debts in the short term; 3) the company higher amounts to receive and the reduced availability; 4) The

difficulties to face decision problems (optimization of the company's results); 5) The inefficiency of the decision models adopted by the company; 6) Limitation of the company's information processing capacity; 7) Little time available for the decision-making process; and 8) Conflicts of preference of decision makers.

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