

Evaluating the public institutional performance using trend analysis

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Abstract

Purpose – The purpose of this paper is to evaluate the public institutional performance by identifying and classifying the different cases of its growth and deterioration, according to the trend analysis of the performance results, its growth or deterioration values, and the ratios of these values.

Design/Methodology/approach – Quantitative and statistical analysis was used to determine and classify the different cases of the institutional performance, according to the trends of the performance results, its growth or deterioration values, and the ratios of these values.

Findings - Using trend analysis in reformulating the results of the institutional performance of any public organization in a linear form may help in determining the direction of this performance, and it may illustrate that there are many interpretations of the public institutional performance results which may help in identifying and classifying the possible and impossible cases of growth and deterioration of the performance.

Originality/value – There is a scarcity in the research and academic studies which discuss the public institutional performance directions. This paper attempts to introduce an academic contribution in this subject by using trend analysis as a statistical technique in identifying and classifying the different cases of the growth and deterioration of the public institutional performance according to its values, ratios and their trends. The classification methodology used in this study may not have been used before in classifying the cases of the growth and deterioration of the public institutional performance.

Keywords - Public institutional performance, Time series, Trend analysis.

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I. Introduction

The increase of the contemporary factors and variables which affect the public institutional performance make managers and decision makers face many different cases of the institutional performance results (growth, deterioration, stability, or fluctuation). Any public organization, usually evaluates its institutional performance at the end of each period to determine how far its objectives were achieved. The traditional methodologies and techniques which are usually used by the institutional performance evaluators do not accurately determine the effects of the past and present performance in the future performance, therefore, the public institutional performance evaluators need evaluation techniques can introduce strong future indicators to illustrate how far the future performance will be affected by the past and present performance.

Identifying and classifying the different cases of the growth and deterioration in the public institutional performance may make the decision makers of any organization determine accurately and easily the current institutional performance case of their organization, and analyze the causes of any deviation between the actual performance and the target performance, therefore, they can take the suitable decisions at the suitable time. That is what this paper tries to do.

II. The research problem:

The main methods of evaluating the institutional performance, like balanced scorecards and benchmarking, don't interest in the future dimension of the evaluation process. Using trend analysis may help in making the evaluation process more efficient by illustrating the future effects of the past and present performance results of any organization in its future performance. Classifying the cases of growth and deterioration of the public institutional performance using trend analysis may help in determining the performance case of any organization and its future effects, that may help the decision makers to deal with any performance deviations.

III. The theoretical framework of the study

The theoretical framework of this study had been designed according to the relationships between the performance results, their variance values and ratios, and also the trends of all of them. The performance results

may grow, deteriorate, fluctuate, or to be stable from period to period; the variance value between the results of every two periods and the ratios of the variance values may increase, decrease, fluctuate, or to be constant from period to period; On the other hand, the trends of all of the performance results, variance values, and their ratios may be upward, downward, or stable.

Identifying and classifying the cases of the growth and deterioration in the public institutional performance results will be according to the following four elements:

- 1) Performance results.
- 2) Values of the growth or deterioration.
- 3) Ratios of the growth or deterioration.
- 4) Trends of both of the performance results, and the values and the ratios of the growth or the deterioration.

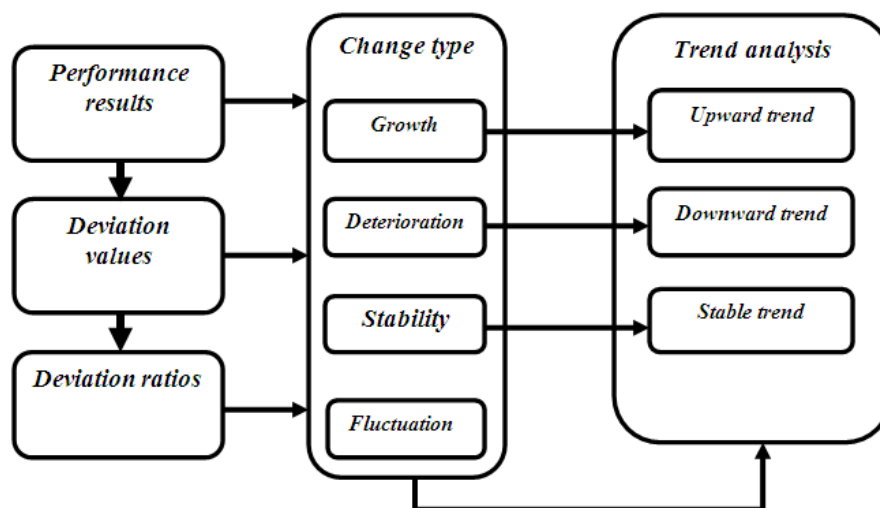


Figure 1. The theoretical framework

IV. Literature review

Many research papers had discussed the evaluation of the public institutional performance, these papers were in many different directions. Some papers discussed the performance evaluation in specialized organizations, these research papers had illustrated that the evaluation process was different according to the specialization of each organization, for example, the international manufacturing networks (IMN) (Junior & Fleury 2018), small and medium enterprises (SMEs) (Ahmad & Alaskari, 2014), facilities management (FM) organizations (Amaratunga, Baldry, 2002), welfare service organizations (Sillanpää, 2011), public services organizations (Greiling, 2006), the oil and gas industries (Kazemi, Andersen, 2013), healthcare organizations (Bamford, Chatziaslan, 2009) & (Elg, Broryd, Kollberg, 2013), universities (Aloch, 2017), and construction engineering organizations (Robinson, Anumba, Carrillo, AlGhassani, 2005). Some other papers had introduced a new approach or technique to improve or develop the public institutional performance evaluation, as the model of total quality-based performance measurement (Sinclair, Zairi, 1995), systems approach as a technique for the sustainable development performance evaluation (Searcy, Karapetrovic, McCartney, 2008), the performance measurement system as an approach for creating a culture of high performance (Robson, 2005), the technique of Jennifer A. Farris & et al (Farris, Aken, Letens, Chearksul and Coleman, 2011), another research papers tried to discuss a model or a methodology for a specific performance measurement as applying the balanced scorecard in multi echelon repair inventory systems (Garg, Deshmukh, 2012), Performance measurement for green supply chain management (Hervani, Helms, Sarkis, 2005). Many research papers tried to discuss the application of an approach or a model or a technique in some country, like the welfare service organizations in Finland (Sillanpää, 2011), Utilizing performance measurement to modernize the Greek public sector (Sotirakou, Zeppou, 2006). There are also the review papers, for example, the dynamics of performance measurement systems (Bititci, Turner, Begemann, 2000), Integrated performance measurement systems: a development guide (Bititci, Carrie, McDevitt, 1997), The fundamentals of performance measurement systems: A systematic approach to theory and a research agenda (Choong, 2014), Public-Private Partnerships: a review of theory and practice of performance measurement (Liu, Love, Smith, Regan, Sutrisna, 2014), Humanitarian supply chain performance management: a systematic literature review (Abidi, Leeuw, Klumpp, 2014).

Although there are many research and academic studies about the evaluation of the institutional performance, most of research and studies had been interested just in evaluating the results of the past and

present performance. There is a scarcity in the research and academic studies which discuss the future directions of the institutional performance, such as the studies discussed how to use the performance measurement in changing the strategic plans (Feurer, Chaharbaghi, 1995), or to use the performance measurement as an early warning system (Kazemi, Andersen, 2013).

V. The Future dimension in the research papers of the public institutional performance evaluation

Forecasting for planning is usually done using the present data to determine the future objectives, or for improving the future performance, but forecasting for evaluating is done using the present data for determining the direction of the present and future performance to correct or support the deviations between the forecasted performance and the target performance.

Several studies have discussed to the future dimension in institutional performance evaluation. Many of them tried to study how to use the evaluation results in preparing the future plans; for example, in the balanced scorecards, the future dimension of the performance evaluation is represented in the innovation and learning perspective, which meant the continual improvement in existing products and processes, and the ability to introduce new products with expanded capabilities (Kaplan & Norton, 1992), that means that the balanced scorecard evaluates the institutional performance just to improve it in the future, not for forecasting the future performance to determine the deviations with the planned performance to correct or support it.

Benchmarking is another method depends on the comparison between the performance of the organization and the performance of its competitors, or any external standards. This comparison is done for improving the performance of the organization (Camp, 1989).

Benchmarking is not interested in the present or the future direction of the performance, so the future dimension in benchmarking method is only for determining how the organization improves or develops its performance to be better than or at least equal to the best performance of any competitor.

Cost-benefit analysis is a method for evaluating policy, project, or organization. In evaluating the institutional performance, cost - benefit analysis tries to determine if the benefits of the organization performance is more than its costs. It is usually used for evaluating the past and present performance results, it may be used for future planning to determine how much the benefit must be more than cost, it is also used in the comparison among the different decision alternatives, but it is not used for evaluating the forecasted future performance results according to the results of the past and present performance (Dreze & Stern, 1987).

These three main methods and others don't interest in determining how will the future performance be affected by the past and present performance, decision makers need to determine this effect to take the suitable decisions.

Many statistical research focused on using the trend analysis in interpreting the past and present data, and forecasting future (Gensine & Reinert, 2010), (Awokuse & Ilvento, 2017), (Stoffer & Shumway. 2016), (Gor, 2012). That means that the trend analysis can be used in evaluating the public institutional performance, especially in the future.

VI. Trend analysis as a tool to evaluate the organization's performance:

Trend analysis nowadays is one of the most common and easiest tools which are used in many fields. It can be used to transform the performance results to statistical formats which can help in interpreting the performance results and forecast it in the future. If simple linear regression depends on two components: a dependent variable and one or more independent variables, the trend is an algebraic and descriptive expression of the relationship between regular time units as an independent variable, and the data of a phenomena or a field as a dependent variable, thus, the trend is a special case of the simple linear regression, where the independent variable in trend analysis is always a time series.

Identifying the direction of the performance using the trend analysis may help evaluators and decision makers to determine the deviations between the planned performance and the actual performance, also it may help in predicting the future performance.

Trend analysis usually includes the results of all periods of the product time series, but performance of public organizations is often unstable, according to many political, economic, and social factors and variables which affect them, so, depending on the results of the whole past periods of the plan or program in analyzing the trend may make the line of trend takes an unrealistic direction, because the time series may include some past periods with uncorrelated results, and thus give the evaluators an unrealistic and deceptive indication, which may make the future performance forecasts far from the actual performance, thus , performance evaluators must interest in the results of the last periods which have the minimum RMSE (the minimum deviation between the estimated performance and the actual performance) it will make the trend more appropriate and close to reality, and thus can build more accurate and effective predictions about the performance of the organization.

Trend analysis can not only be used in determining the past and present performance direction of the organization, or in forecasting its future performance, but also may be used also in determining the performance directions of the competitors to be compared with the performance direction of the evaluated organization.

VII. Study assumptions

- 1) The main assumption of this study is that all of the performance results, values of performance growth (or deterioration), and ratios of performance growth (or deterioration) for all types of organizations are in non-negative values (more than or equal to zero), that the nature of any outputs (goods or services) are always more than or equal to zero. If the performance direction is positive, negative, stable or fluctuated, its values are always positive or at least equal to zero.
- 2) The performance results are more effective than the growth (or deterioration) values and ratios.
- 3) The growth (or deterioration) values are more effective than their ratios.
- 4) The values of deviations are absolute values (positive values).
- 5) Trend analysis is a tool for performance forecasting as a part of the performance evaluation process, not for planning.

VIII. Foundations of the public institutional performance classification:

Classifying the public institutional performance results according to the trends of both of the performance results, results variance values, and results variance ratios, may make the process of evaluating the institutional performance more effective and efficient.

The methodology used in classifying the growth and deterioration cases of the public institutional performance depends on the following quantitative and statistical steps

- 1- Preparing the results' time series of the public institutional performance.
- 2- Computing the variance value between the results of every two periods in the performance results time series.
- 3- Computing the ratio of every variance value as follows
- 4- Computing the trend of the results, variance values, and variance ratios.
- 5- Determining the different possible cases of the three components: results, variance values, and variance ratios, according to the trend of all of them.

The public institutional performance will be classified according to four components:

- 1) Performance results.

It is the first and the main basis of the classification, and it is divided into four categories:

- A) Increase of performance results from one period to the next.
- B) Decrease of the performance results from one period to the next.
- C) Fluctuation of performance results, that the results of the periods are randomly different with no specific direction (positive, negative or stable).
- D) Stability of performance results, that results are almost in the same value for all periods, so that the deviation between the results of any two periods is almost zero.

- 2) Values of deviations between the performance results of any consecutive periods.

$$\text{deviation value} = \text{period results} - \text{previous period results}$$

- 3) Ratios of the deviations between the results of any two consecutive periods.

$$\text{Deviation ratio} = \frac{\text{period results} - \text{previous period results}}{\text{previous period results}}$$

- 4) Trend lines for results, deviation values, and deviation ratios.

Trend of any time series is calculated as follows

Where,

$$y = a + bx$$

$$a = \bar{y} - b\bar{x} \quad , \text{ and} \quad b = \frac{N\sum xy - \sum x \sum y}{N\sum x^2 - (\sum x)^2}$$

Where y is the dependent variable (results – development values – development ratios),

x is the independent variable (time periods),

a is the constant part in the linear equation, or the first observation (results – values – ratios),

b is the rate of the observations change (results, values, ratios). If $b > 0$ that means that trend line is in a positive direction, that indicates to increasing predicts, if $b < 0$ that means that trend line direction is in a negative direction, that indicates to decreasing predicts, if $b = 0$ that means that the trend line is in a straight direction, with equal predicts.

IX. The main directions of public institutional performance:

The public institutional performance is usually in one of following four main directions

9.1 Growth direction.

9.2 Deterioration direction.

9.3 Fluctuation direction.

9.4 Stability direction.

Each direction will be discussed in details below

9.1 Growth direction.

Growth direction includes cases where performance results are increasing from period to period.

The growth direction is divided into eight cases:

9.1.1 Growth with increasing values and increasing ratios.

It is the best case of institutional growth, where the organization performance results is growing from time to time, and there are no disadvantages for this case unless the growth achieved is less than the target in the plan of the organization, or there are other organizations in the same field achieve better results.

Statistically and away from economic reality, this case of growth is an infinite growth, does not stop at a certain value or at a certain time.

By using trend analysis, the trend lines of both performance results, values and ratios of growth are always in upward trends, also one or more of recent performance results is usually in values higher than their estimated values according to the increasing ratios which make the last performance results always higher than the corresponding values on the trend line.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1} , b_{Rs} > 0$$

$$V_i < V_{i+1} , b_V > 0$$

$$Rt_i < Rt_{i+1} , b_{Rt} > 0$$

Where,

Rs : The performance results.

V : The value of the variance between every two consecutive performance results.

$$Rt_i = \frac{V_i}{Rs_i}$$

$$b_{Rs} = \frac{N \sum_{i=1}^n x_i Rs_i - \sum_{i=1}^n x_i \sum_{i=1}^n Rs_i}{N \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

$$b_V = \frac{N \sum_{i=1}^n x_i v_i - \sum_{i=1}^n x_i \sum_{i=1}^n v_i}{N \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

$$b_{Rt} = \frac{N \sum_{i=1}^n x_i Rt_i - \sum_{i=1}^n x_i \sum_{i=1}^n Rt_i}{N \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

x : Time periods.

N : Total number of periods.

n : The number of the last period.

i : The number of the first period in the equation

9.1.2 Growth with increasing values and stable ratios.

It is one of the best growth cases, where the organization is growing from time to time, but it is not better than the previous case, where growth is increasing at an increasing rate, not stable rate. Stable growth in this case determines the extent of achievement. This case has no disadvantages, unless the growth achieved is lower than the target in the organization plan, or there are other organizations in the same field achieve better results.

Statistically and away from economic reality, this case of growth is an infinite growth, does not stop at a certain value or at a certain time.

By using trend analysis, the trend lines for both performance and growth values always take upward trends, while the trend line of growth ratios is a stable trend, often corresponded to the baseline growth ratios.

Usually one or more of the last performance results is higher than the estimated values according to the trend line, due to the nature of the effect of increasing growth values at stable rates which make the last performance results always higher than the values on the trend line.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} < R_{S_{i+1}} &, b_{RS} > 0 \\ V_i < V_{i+1} &, b_V > 0 \\ R_{t_i} = R_{t_{i+1}} &, b_{Rt} = 0 \end{aligned}$$

9.1.3 Growth with increasing values and decreasing ratios.

It is one of the bad institutional growth cases, where the performance results are growing from one period to the next, but with decreasing ratios. This means that these increases in the results values will disappear in a certain period, that can be determined when the growth rate is near to zero, and then the performance results will be stable. At this time decision makers will determine if the organization will continue or stop according to the nature of its activity and its objectives.

Statistically and away from economic reality, in this case the growth of performance results will stop at certain value that can be determined when the growth rate is near to zero.

By using trend analysis, the trend lines of both performance results and growth values always takes an upward trend, while the trend line of growth ratios takes a decreasing trend.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} < R_{S_{i+1}} &, b_{RS} > 0 \\ V_i < V_{i+1} &, b_V > 0 \\ R_{t_i} > R_{t_{i+1}} &, b_{Rt} < 0 \end{aligned}$$

9.1.4 Growth with stable values and decreasing ratios.

It is one of the best institutional growth cases, that the organization will achieve the same value of growth in its performance results every period, so the ratios of growth will decrease every period till arrive near to zero due to constant growth values.

Statistically and away from economic reality, this case of growth is an infinite growth case, does not stop at a certain value or at a certain time.

By using trend analysis, the trend line of performance results takes a rising trend line that corresponds to the line of the performance results, due to the stability of growth values. Because of the growth values are constant at one value for all time periods, its trend line corresponds to the original line of growth values, the trend line of growth ratios takes a decreasing trend and is near to the original line of growth ratios due to the stability of growth values.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} < R_{S_{i+1}} &, b_{RS} > 0 \\ V_i = V_{i+1} &, b_V = 0 \\ R_{t_i} > R_{t_{i+1}} &, b_{Rt} < 0 \end{aligned}$$

9.1.5 Growth with decreasing values and ratios.

It is one of the poor institutional growth cases, where the organization is achieving decreasing growth from one period to the next, with decreasing growth rates, which means that this growth will stop at a certain period, that can be determined when the growth rate reaches zero, and then the performance results will be stable. At this time the decision makers will determine if the organization will continue or not according to the goals of the organization.

Statistically and away from economic reality, in this case, the growth of performance results will stop at certain value and certain time that can be determined when the growth rate is closed to zero.

By using trend analysis, the trend line of performance results takes an upward trend due to the growth values despite the decreasing in these values from one period to the next. Consequently, the trend of values and growth ratios is decreasing by the impact of the decrease of growth values.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} < R_{S_{i+1}} &, b_{RS} > 0 \\ V_i > V_{i+1} &, b_V < 0 \\ R_{t_i} > R_{t_{i+1}} &, b_{Rt} < 0 \end{aligned}$$

9.1.6 Growth with increasing values and fluctuating ratios.

It is one of the best cases, the growth values are increasing from one period to the next, with no effect of trend of growth rates, which illustrates the direction of these ratios (increase - decrease - stability). This direction helps to predict future trends of performance, whether Tend to grow, deteriorate or stabilize. This case has three sub-cases:

9.1.6.1 Growth with increasing values, and fluctuating ratios in an upward trend.

It is one of the best sub-cases, with rising growth values and upward trends indicating increased growth predicts in the future.

This case can be shown mathematically as follows

$$RS_i < RS_{i+1} , b_{RS} > 0$$

$$V_i < V_{i+1} , b_V > 0$$

$$b_{Rt} > 0$$

9.1.6.2 Growth with increasing values and fluctuating ratios in a stable trend.

It is one of the best sub-cases, that rising growth values with steady ratios ensure increased growth predicts in the future.

This case can be shown mathematically as follows

$$RS_i < RS_{i+1} , b_{RS} > 0$$

$$V_i < V_{i+1} , b_V > 0$$

$$b_{Rt} = 0$$

9.1.6.3 Growth with increasing values, and fluctuating ratios in a downward trend.

It is one of the best sub-cases, according to the increasing growth values, but the downward trend of growth rates indicates that this growth may decrease in the future.

This case can be shown mathematically as follows

$$RS_i < RS_{i+1} , b_{RS} > 0$$

$$V_i < V_{i+1} , b_V > 0$$

$$b_{Rt} < 0$$

9.1.7 Growth with fluctuating values and decreasing ratios.

It is an ambiguous case, that just the trend of growth values determines the direction of performance results, which enable decision makers to predict the future.

This case has three sub-cases:

9.1.7.1 Growth with fluctuating values in an upward trend, and decreasing ratios.

It is one of the best sub-cases, the upward trend of growth values indicates to good predicts in the future, despite decreasing growth rates that indicate weak growth values in the future.

This case can be shown mathematically as follows

$$RS_i < RS_{i+1} , b_{RS} > 0$$

$$b_V > 0$$

$$Rt_i > Rt_{i+1} , b_{Rt} < 0$$

9.1.7.2 Growth with fluctuating values in a stable trend, and decreasing ratios.

It is one of the best sub-case, Stability of the growth values trend indicates to good predicts in the future, despite decreasing growth rates that indicate weak growth values in the future.

This case can be shown mathematically as follows

$$RS_i < RS_{i+1} , b_{RS} > 0$$

$$b_V = 0$$

$$Rt_i > Rt_{i+1} , b_{Rt} < 0$$

9.1.7.3 Growth in fluctuating values in a downward trend, and decreasing ratios.

It is one of the worst sub-cases, according to the downward trend of growth values. These negative predicts increase also with the decreasing of the growth rates, which may indicate that this growth may stop in the future.

This case can be shown mathematically as follows

$$\begin{aligned}Rs_i &< Rs_{i+1} , b_{Rs} > 0 \\b_V &< 0 \\Rt_i &> Rt_{i+1} , b_{Rt} < 0\end{aligned}$$

9.1.8 Growth with fluctuating values and ratios.

It is an ambiguous case, that the growth of performance results is determined by the trends of both growth values and ratios.

This case has nine sub-cases:

9.1.8.1 Growth with fluctuating values and ratios in upward trends.

It is the best sub-case at all, that the Growth with fluctuating values and ratios are in upward trends.

This case can be shown mathematically as follows

$$\begin{aligned}Rs_i &< Rs_{i+1} , b_{Rs} > 0 \\b_V &> 0 \\b_{Rt} &> 0\end{aligned}$$

9.1.8.2 Growth with fluctuating values in an upward trend, and fluctuating ratios in a stable trend.

It is a good sub-case, that the upward trend of growth values and stable trend of growth ratios indicates to a positive predicts in the future.

This case can be shown mathematically as follows

$$\begin{aligned}Rs_i &< Rs_{i+1} , b_{Rs} > 0 \\b_V &> 0 \\b_{Rt} &= 0\end{aligned}$$

9.1.8.3 Growth with fluctuating values in an upward trend, and fluctuating ratios in downward trend.

It is a good sub-case, that the upward trend of growth values indicates to positive predicts in the future even though the downward trend of growth ratios.

This case can be shown mathematically as follows

$$\begin{aligned}Rs_i &< Rs_{i+1} , b_{Rs} > 0 \\b_V &> 0 \\b_{Rt} &< 0\end{aligned}$$

9.1.8.4 Growth with fluctuating values in a stable trend, and fluctuating ratios in an upward trend.

It is one of the sub-cases which have good growth predicts, that the stable trend of growth values and the upward trend of growth ratios indicate that no negative predicts in the future.

This case can be shown mathematically as follows

$$\begin{aligned}Rs_i &< Rs_{i+1} , b_{Rs} > 0 \\b_V &= 0 \\b_{Rt} &> 0\end{aligned}$$

9.1.8.5 Growth with fluctuating values and ratios in a stable trend.

It is a sub-case with stable growth predicts, that the steady trends of growth values and ratios indicate to stable predicts in the future, but any changes in any independent variable affect the performance of the organization will change the direction of the trend lines of growth values and ratios.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1}, b_{Rs} > 0$$

$$b_V = 0$$

$$b_{Rt} = 0$$

9.1.8.6 Growth with fluctuating values in a stable trend, and fluctuating ratios in downward trend.

It is one of the sub-case of growth that may indicate to negative predicts in the future.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1}, b_{Rs} > 0$$

$$b_V = 0$$

$$b_{Rt} < 0$$

9.1.8.7 Growth with fluctuating values in a downward trend, and fluctuating ratios in upward trend.

It is a sub-case with negative predicts, given the trend of growth values supported by the positive trend of growth ratios.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1}, b_{Rs} > 0$$

$$b_V < 0$$

$$b_{Rt} > 0$$

9.1.8.8 Growth with fluctuating values in downward trend, and fluctuating ratios in a stable trend.

It is a sub-case with negative predicts according to the negative trend of growth values, consistently supported by the stable trend of growth ratios.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1}, b_{Rs} > 0$$

$$b_V < 0$$

$$b_{Rt} = 0$$

9.1.8.9 Growth with fluctuating values and ratios in downward trends.

It is a sub-case with negative predicts according to the negative trends of both growth values and ratios.

This case can be shown mathematically as follows

$$Rs_i < Rs_{i+1}, b_{Rs} > 0$$

$$b_V < 0$$

$$b_{Rt} < 0$$

There are eight growth cases are impossible to occur mathematically and realistically:

- 1) Growth with stable values and increasing ratios.
- 2) Growth with stable values and ratios.
- 3) Growth with decreasing values and increasing ratios.
- 4) Growth with decreasing values and stable ratios.
- 5) Growth with decreasing values and fluctuating ratios.
- 6) Growth with stable values and fluctuating ratios.
- 7) Growth with fluctuating values and increasing ratios.
- 8) Growth with fluctuating values and stable ratios.

9.2 Deterioration direction.

Deterioration direction contains seven cases:

9.2.1 Deterioration with increasing values and ratios.

It is one of the worst and most dangerous case, where the organization is at risk of stopping activity, unless the plan or program of the organization involves this deterioration, such as health organizations which established to eliminate a specific disease, this type of organizations were established to achieve some goal and stops when it achieves its goal.

Statistically and away from economic reality, in this case the deterioration will stop when the performance results are near to zero.

By using trend analysis, the trend line of performance results is decreasing according to the increasing of both deterioration values and ratios, which appears in the upward trends of both.

This case can be shown mathematically as follows

$$\begin{aligned} R S_i &> R S_{i+1}, & b_{R S} &< 0 \\ V_i &< V_{i+1}, & b_V &> 0 \\ R t_i &< R t_{i+1}, & b_{R t} &> 0 \end{aligned}$$

9.2.2 Deterioration with stable values and increasing ratios.

It is one of the worst and dangerous cases, where the organization is at risk of stopping activity, but it is not worse than the previous case.

Statistically and away from economic reality, in this case the deterioration will stop when the performance results are near to zero.

By using trend analysis, the trend line of performance results is decreasing because the values of deterioration are constant for all periods with steady trend. The ratio of deterioration is increasing due to the stability of the deterioration values with an upward trend.

This case can be shown mathematically as follows

$$\begin{aligned} R S_i &> R S_{i+1}, & b_{R S} &< 0 \\ V_i &= V_{i+1}, & b_V &= 0 \\ R t_i &< R t_{i+1}, & b_{R t} &> 0 \end{aligned}$$

9.2.3 Deterioration with decreasing values and stable ratios.

It is one of the worst cases, but with slow decrease, that the results of performance tend to be stable over time, if these results don't achieve the minimum objectives of the organization decision makers must develop the plans or programs to increase performance results.

Statistically and away from economic reality, this case of infinite decrease does not reach zero, but if the value of production became part of one unit it can be considered a zero hypothetically.

By using trend analysis, the trend line of the performance results takes a downward trend driven by the values of deterioration, although they have been decreasing steadily from time to time. Thus, the values of deterioration take a downward trend, while the trend of decreasing rates is stable.

This case can be shown mathematically as follows

$$\begin{aligned} R S_i &> R S_{i+1}, & b_{R S} &< 0 \\ V_i &> V_{i+1}, & b_V &< 0 \\ R t_i &= R t_{i+1}, & b_{R t} &= 0 \end{aligned}$$

9.2.4 Deterioration with decreasing values and ratios.

It is one of the best cases, that the deterioration stop at a certain value, when the value of the deterioration becomes less than one unit of production, which may indicate that the decrease of the performance results will turn in the future to grow.

Statistically and away from economic reality, the performance results in this case tend to be constant when the values of deterioration are less than one unit of production.

By using trend analysis, the trend line of performance results is a downward trend due to the decrease in the values of deterioration from one period to another in decreasing rates, and thus the trend of both values and rates of deterioration is also decreasing.

This case can be shown mathematically as follows

$$\begin{aligned} R S_i &> R S_{i+1}, & b_{R S} &< 0 \\ V_i &> V_{i+1}, & b_V &< 0 \\ R t_i &> R t_{i+1}, & b_{R t} &< 0 \end{aligned}$$

9.2.5 Deterioration with decreasing values and fluctuating ratios.

It is one of the ambiguous cases, that the decrease of the deterioration values may be a good indicator of the positive evaluation of the deteriorating performance, but that if the trend of the decrease rates is negative, it is possible that this decrease will continue until it reaches zero, then the performance will start to increase. If the trend of the decrease rate is positive or stable, this indicates a continuation of the deterioration until it reaches the level of stopping of activity.

This case may be in one of the following sub- cases:

9.2.5.1 Deterioration with decreasing values, and fluctuating ratios in an upward trend.

This sub-case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ V_i &> V_{i+1} , & b_V &< 0 \\ b_{Rt} &> 0 \end{aligned}$$

9.2.5.2 Deterioration with decreasing values, and fluctuating ratios in a stable trend.

This sub-case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ V_i &> V_{i+1} , & b_V &< 0 \\ b_{Rt} &= 0 \end{aligned}$$

9.2.5.3 Deterioration with decreasing values, and fluctuating ratios in a downward trend.

This sub-case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ V_i &> V_{i+1} , & b_V &< 0 \\ b_{Rt} &< 0 \end{aligned}$$

9.2.6 Deterioration with fluctuating values and increasing ratios.

It is one of the worst cases of deterioration, that the positive trend of deterioration ratios indicates that the performance results will continue down till it reaches stopping point. Although the trend of deterioration values may be in a decrease trend, the increase of deterioration ratios may eliminate any positive indicator of the trend of deterioration values, but if the trend of decrease values is stable or upward, this may confirm the poor performance case which is in a downward trend.

This case may be in one of the following sub- cases:

9.2.6.1 Deterioration with fluctuating values in an upward trend, and increasing ratios.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ b_V &> 0 \\ R_{t_i} &< R_{t_{i+1}} , & b_{Rt} &> 0 \end{aligned}$$

9.2.6.2 Deterioration with fluctuating values in a stable trend, and increasing ratios.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ b_V &= 0 \\ R_{t_i} &< R_{t_{i+1}} , & b_{Rt} &> 0 \end{aligned}$$

9.2.6.3 Deterioration with fluctuating values in a downward trend, and increasing ratios.

This case can be shown mathematically as follows

$$\begin{aligned} R_{S_i} &> R_{S_{i+1}} , & b_{RS} &< 0 \\ b_V &< 0 \\ R_{t_i} &< R_{t_{i+1}} , & b_{Rt} &> 0 \end{aligned}$$

9.2.7 Deterioration with fluctuating values and ratios.

It is one of the ambiguous cases, that the goodness or badness of this case can be determined by the trend of both deterioration values and ratios which can be divided into 9 sub-cases:

9.2.7.1 Deterioration with fluctuating values and ratios in upward trends.

It is the worst sub-case at all, that the trend of performance results and trends of both deterioration values and ratios will be negative indicators with negative forecasts in the future.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V > 0$$
$$b_{Rt} > 0$$

9.2.7.2 Deterioration with fluctuating values in a stable trend, and fluctuating ratios in an upward trend.

It is one of the deterioration sub-cases with bad expectations, that the upward trend of deterioration ratios is a negative indicator. It means that the organization may stop working when the performance results are near to zero.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V = 0$$
$$b_{Rt} > 0$$

9.2.7.3 Deterioration with fluctuating values and ratios in a stable trend.

It is one of the deterioration sub-cases with bad expectations, that both the downward trend of performance results, and the stable trends of deterioration values and ratios indicate to non positive predicts.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V = 0$$
$$b_{Rt} = 0$$

9.2.7.4 Deterioration with fluctuating values in downward trend, and fluctuating ratios in upward trend.

It is a deterioration sub-case with positive expectations, due to the negative trend of the values of deterioration, despite the upward trend of the deterioration ratios.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V < 0$$
$$b_{Rt} > 0$$

9.2.7.5 Deterioration with fluctuating values in a downward trend, and fluctuating ratios in a stable trend.

It is one of the best sub-cases, according to the downward trend of the deterioration values, and the stable trend of the deterioration ratios. These trends indicate to positive expectations in the future.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V < 0$$
$$b_{Rt} = 0$$

9.2.7.6 Deterioration with fluctuating values and ratios in downward trends.

It is one of the best sub-cases with positive predicts in the future, according to the downward trends of the deterioration values and ratios.

This case can be shown mathematically as follows

$$RS_i > RS_{i+1} , b_{RS} < 0$$
$$b_V < 0$$
$$b_{Rt} < 0$$

There are nine deterioration cases are impossible to occur mathematically and realistically:

- 1) Deterioration with increasing values and stable ratios.
- 2) Deterioration with increasing values and decreasing ratios.
- 3) Deterioration with increasing values and fluctuating ratios.
- 4) Deterioration with stable values and stable ratios.
- 5) Deterioration with stable values and decreasing ratios.

- 6) Deterioration with stable values and fluctuating ratios.
- 7) Deterioration with decreasing values and increasing ratios.
- 8) Deterioration with fluctuating values and decreasing ratios.
- 9) Deterioration with fluctuating values and stable ratios.

9.3 Fluctuation direction.

Fluctuation is the most popular case in the economic, political, social organizations, because of the different factors and variables affect them.

Fluctuation direction contains many possible cases, but the analysis of values and ratios of these cases is not meaningful analysis, so performance evaluators must depend on trend analysis to determine the direction of the performance; growth, deterioration, or stable.

By using trend analysis in this case; evaluators must depend on the last periods in the time series of the performance results have minimum *RMSE* (Root mean square error) in the evaluation process, and also in the forecasting process.

Fluctuation direction is divided into three sub-cases:

9.3.1 Fluctuation with an upward trend.

It is a good sub-case, that the upward trend of the performance results indicates good expectations in the future.

This case can be shown mathematically as follows

$$b_{RS} > 0$$

9.3.2 Fluctuation with a downward trend.

It is a bad sub-case, that the downward trend of the performance results indicates bad expectations in the future.

This case can be shown mathematically as follows

$$b_{RS} < 0$$

9.3.3 Fluctuation with a stable trend.

It is one of the ambiguous sub-cases, that evaluators by using trend analysis must depend on the last periods with minimum *RMSE* in their evaluation.

This case can be shown mathematically as follows

$$b_{RS} = 0$$

9.4 The stability direction.

In this case the performance results are almost constant, do not change over time. This kind of organizations is established to deal with a limited number of specific customers, that are difficult to change over time. If any change happened in the number of customers it will be very limited and non effective, Such as organizations established to serve specific customers, as school meal companies, factories of school clothes, and others.

This case can be shown mathematically as follows

$$\begin{aligned} RS_i &= RS_{i+1}, \quad b_{RS} = 0 \\ V_i &= 0, \quad b_V = 0 \\ Rt_i &= 0, \quad b_{Rt} = 0 \end{aligned}$$

X. Practical and Research implications

Using trend analysis in determining the direction of public institutional performance results (positive, negative, or stable), and classifying the cases of the public institutional performance growth and deterioration, will make any decision maker can easily determine the present performance case of his organization, expect its impacts in the future performance, and finally can take the suitable decisions efficiently and effectively.

Classifying the cases of the public institutional performance growth and deterioration needs more of analytical studies about the specific details of these cases, that every possible case can be analyzed in many sub-cases.

XI. Conclusion

Discussing the traditional evaluation techniques of the public institutional performance illustrated that most of these techniques don't determine how far the past and present performance affects the future performance. This study tried to illustrate that trend analysis as a statistical technique can formulate the results

of the public institutional performance in a linear form, to illustrate the direction of the performance results in the past and present, and the performance direction in the future.

Using trend analysis in determining the direction of the public institutional performance results helped also in classifying the growth and deterioration cases of this public institutional performance.

Classifying the growth and deterioration cases of the public institutional performance illustrated that there are 19 main possible cases (8 growth, 7 deterioration, 3 fluctuation, 1 stable), the case of any organization is one of these 19 possible cases; on the other hand, there are 17 impossible cases (8 growth, 9 deterioration), these impossible cases can't happen in any organization.

Classifying the cases of public institutional performance proved that not all the growth cases have positive indications, and not all the deterioration cases have negative indications.

Classifying the public institutional performance cases quantitatively will help the decision makers to determine the public institutional performance cases of their organizations, according to this classification, and to take the suitable decision according to this case.

Quantitative classification of public institutional performance cases needs more of analytical studies about the specific details of these cases.

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