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Technical Note:

Performance measurement in industrial organizations, case study: Zarbal Complex

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Abstract

Industrial organizations are complex systems' where the interactions among the various functions such as Sales, Distribution, Manufacturing, Materials, Finance, Human Resources and Maintenance have to be managed towards a common purpose of delivering the customers satisfaction. However, since most of these organizations have a `Functional Structure', each function or department works towards their own goals and objectives, rather than the organizational goals. This is further aggravated because information flow is restricted by functions, and even when other functions want to take a holistic view, they do not have the information to do so. These are the issues addressed by Enterprise Resource Planning solutions providing a common, consistent system to capture data organization wide, with minimum redundancy. ERP integrates the resources such as information across functions, and provides a set of tools for planning and monitoring the various functions and processes and ensuring progress towards a common purpose in direction of goals and strategies. In this paper, we introduce a model for performance measurement of an organization, which they are working in competitive, monopoly or attractive business environment, and have total system or use ERP solution. We developed a Performance Measurement system that based on organization's strategic and goals.

In the following sections, we describe a brief survey of performance models. Then, we focused on performance measurement process, developing performance indicators and metrics. Our approach is to develop a process and a model for performance measurement by assigning priorities to all goals with respect to organization strategies in specific business condition. The observation of using this model shows that it works very close to real world behaviors and can help senior managers for intelligent decision-making.

Keywords: Priority scored performance measurement; Performance measurement; Performance measurement models; ERP measurement; Industrial organization performance measurement

1. Introduction

"How to measure performance?" How often do you ask yourself this question? Once a week? Once a month? Never? If you are a successful manager in an efficient organization, you probably ask yourself this question every single day. However, measuring performance often isn't easy.

In the performance measurement arena, you don't always(or even often) get the results that you expect, want, or predict. After expending a great deal of energy collecting information, just when the results look acceptable, you find that you are measuring the wrong things.

There are two key words, although they won't completely solve your performance measurement problems, can put you on the path to success: disciplined approach. All too often performance measurement programs, created with the best intentions, fail because they were short sighted, ill conceived, and un-

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focused [12,29]. Most of these ailments can be traced to one source: the lack of an appropriate model and suitable approach to performance measurement from the start.

During the recent decade, a wide variety of performance measurement models from different point of view have been developed and used in many organizations. The most successful of them is BSC model, which has introduced by Kaplan and Norton [25,26,27]. In the following section, we briefly discuss about recent works on performance measurement. In Section 3, we try to illustrate the process of performance measurement system. Finally in the Section 4, we developed the priority scored performance measurement model and calculation the related metric and indexes for Zarbal Complex.

2. ERP performance measurement modeling

This topic is concerned with performance measurement and some modeling for measuring the performance of enterprise systems. It covers such aspects as customer satisfaction, performance measurement, and model of productivity and introduction of new approach to develop a model for performance measuring from a single point of view.

- Rosemann and Wiese suggest that the Balanced Scorecard, a framework originally developed in order to structure the performance measurement of an enterprise or a department, can use for the evaluation of these tasks. Controlling the ERP usage can be based on a classical "BSC (top down) and utilize the aggregation of ERP monitoring data (bottom up)". It should stress that this approach is not a typical Balanced Scorecard application. More often, the Balanced Scorecard evaluates the performance of an enterprise or a department [48,49].
- Wright et al. present a comprehensive Balanced Scorecard analysis of Compaq Computer Corporation. In one of their Balanced Scorecards, the ERP software SAP R/3 is a part of the innovation and learning perspective. However, it seems to be reasonable to apply the Balanced Scorecard also for the evaluation of software performance [55].
- Wu, Wang, Chang-Chien and Tai focus on user satisfaction is one evaluation mechanism for determining system success. Measuring ERP impact directly from costs and benefits, productivity improvements, competitive advantage and impact on decision-making would be ideal. In view of the difficulty such measurement entails, user satisfaction has received widespread acceptance as surrogate measure, and used in their study [56].
- To focus on enterprise sizes and industry sectors to compare their difference on enterprise resource planning implementation development, package selection, and user satisfaction in Taiwan [57]. They show a survey, using the measurement instrument, of two representative samples of “large size enterprise vs. medium size enterprise” and “electronics & science industry vs. traditional industry” are conducted to investigate different ERP implementation patterns and outcomes. A comparative analysis of ERP implementation rate, package selection, and user satisfaction based on business-related factors performed.
- The Balanced Scorecard, a framework originally developed in order to structure the performance measurement of an enterprise or a department, can use for the evaluation of these tasks [42-49].
- Buker, Poston and Grabski show that today manufacturing companies needs to establish effective operating systems and operating performance measurements to enable them to effectively manage business operations and meet business and financial objectives. These articles describe in detail one of the milestones that each company must achieve – a level of excellence knows as ""Class A" ERP. They focus on four level measurements: Top Management Planning, Operations Management Planning, Operations Management Execution, and Closed Loop ERP [10,11,23,39].
- Kueng, Meler and Wettstein [30] and Sato [50] show that Performance measurement has recognized as a crucial element to improve business performance. They believed that IT is an activator to create a multidimensional performance measurement system, which is based on automated data collection procedures. Several measurement approaches are discussed and evaluated against the needs of SMEs.
- As performance is a multidimensional concept, a PMS has to manage both financial and non-financial performance indicators(PIs). Depending on the PMS framework being applied (e.g. Bititci [7], Kaplan and Norton [25], Kueng and Krahn [29] and Adam [1]), different dimensions

and PIs are relevant. Therefore, it is necessary that PIs can be defined freely [16,21,30].

- Most ERP systems are ill equipped to deal with the demand of slow moving items such as spare parts. Based on data from a Fortune 500 company, presents the development and evaluation of a spare parts inventory control model and compares the proposed model with the results achieved using the forecasting and inventory management modules of a popular ERP system [41].

Now due to the last experiences on performance measurement, we offer three disciplined, systematic approaches for performance measurement in any organizations:

- The first approach: The performance measurement process.
- The second approach: Developing performance indicators.
- The third approach: Developing performance metrics.

Note that we offer a model that integrates indicators, metrics and yields useful information for decision makers for improvements his in organization under different market situations. Different organizations have different needs, so providing multiple approaches allows an organization to choose which approach, or combination of approaches, is right for it.

A sound approach to performance measurement is a necessary element for ensured success, but it by itself is not sufficient. You will also need to know what to do with performance measurement data once it has been collected.

3. Development processes

The use of performance measures in business is hardly new. Companies have been measuring costs, quality, quantity, cycle time, efficiency, productivity, etc., of products, services, and processes as long as ways to measure those things have existed. What is new to some extent is having those whom the work determine some of what should be measured in order that they might better control, understand, and improve what they do.

The concepts introduced here apply anywhere in an organization, from the highest levels of a company(strategic level) down to the area where a specific task is accomplished(operational level).

3.1. Performance measurement process

Performance measures are recognized as an important element of all Total Quality Management programs [3,5,13,51,53]. Managers and supervisors directing the efforts of an organization or a group have a responsibility to know how, when, and where to institute a wide range of changes. These changes cannot sensibly implement without knowledge of the appropriate information upon which they are based. In addition, among many organizations, there is currently no standardized approach to developing and implementing performance measurement systems. As a result, performance measures have not been fully adopted to gauge the success of the various quality management programs practiced by members of organizations [24,35,36]. This paper provides a brief explanation of how to develop performance measurements at any level within an organization with respect to market situations and how to evaluate their effectiveness.

The implementation of performance measurements for a specific process should involve as many cognizant employees as possible to stimulate ideas and reinforce the notion that this is a team effort requiring buy-in from all involved in order to succeed. Substantial benefits are realized by organizations implementing performance measurement programs. All employees realize these benefits almost immediately through an improved understanding of processes. Furthermore, individuals get an opportunity to receive a broadened perspective of the organization's functions, rather than the more limited perspective of their own immediate span of control [4,15].

As a process, performance measurement is not simply concerned with collecting data associated with a predefined performance goal or standard. Performance measurement is better thought of as an overall management system involving prevention and detection aimed at achieving conformance of the work product or service to your customer's requirements [3]. Additionally, it is concerned with process optimization through increased efficiency and effectiveness of the process or product. These actions occur in a continuous cycle, allowing options for expansion and improvement of the work process or product as better techniques are discovered and implemented.

Performance-based management is a systematic approach to performance improvement through an ongoing process of establishing strategic performance objectives; measuring performance; collecting, analyzing, reviewing, and reporting performance data; and using those data to drive performance improvement [29,33,38]. Flowing from that definition are the

six steps to establishing a performance-based management program, which has been shown in Figure1:

Step 1. Define organizational mission and strategic and priority of performance objectives.

Step 2. Establish an integrated performance measurement system.

Step 3. Establish accountability for performance.

Step 4. Establish a process/system for collecting performance data to assess performance.

Step 5. Establish a process/system for analyzing, reviewing, and reporting performance data.

Step 6. Establish a process/system for using performance information to drive improvement.

3.1.1. What are performance measures?

Performance measures quantitatively tell us something important about our products, services, and the processes that produce them. They are a tool to help us understand, manage, and improve what our organizations do. Performance measures let us know:

- How well we are doing,
- If we are meeting our goals,
- If our customers are satisfied,
- If our processes are controlled statistically,
- If we are acquiring innovation and promotion,
- How well we are using ICT in an organization,
- If our suppliers are in the right way,
- If our employee are satisfied,
- If and where improvements are necessary, etc.

They provide us with the information necessary to make appropriate decisions about what we do.

A performance measure is composed of a number and a unit of measures. The number gives us the magnitude (how much) and the unit gives the number a concept (what). Performance measures are always tied to a goal or an objective (the target) related to organization strategies [2,19].

Ideally, performance measures should be expressed in units of measure that are the most meaningful to the users and decision makers based on those measures [40].

Most performance measures can be grouped into one of the following first seven general categories [18]. However, certain organizations may develop their own categories as appropriate depending on the organization's mission. We extend these areas into thirteen categories:

1. Effectiveness,
2. Efficiency,
3. Quality,
4. Productivity,
5. profitability,
6. Process,
7. Flexibility,
8. Reliability,
9. Timeliness,
10. Social responsibility,
11. Growths and innovation,
12. IT or ICT usage level,
13. Employee living standards.

Performance data must support the mission assignment(s) from the highest organizational level (strategic) downward to the performance level (operation). Therefore, the measurements that are used should reflect the assigned work at that level [6].

3.1.2. What is the foundation for a performance measurement system?

Successful performance measurement systems must have the following principles:

1. Measure only what is important,
2. Focus on customer's needs,
3. Keep integrated measurement approach in mind,
4. Involve employees (workers) in the design and implementation of the measurement system.

There is a feedback loop in a systematic series of steps for maintaining conformance to goals/standards by communicating performance data back to the responsible worker and/or decision maker to take appropriate action(s) [33,34,38]. The overall steps of this process will be discussed in the following section.

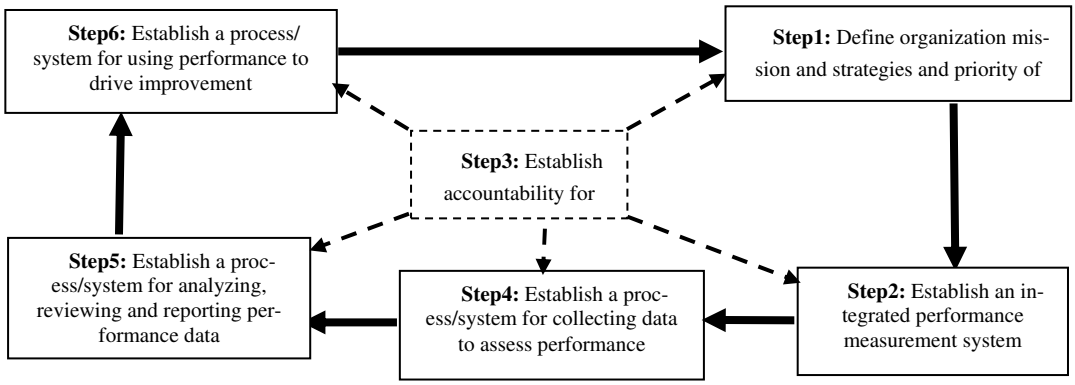

Figure 1. Steps of performance measurement management.

3.1.3. Process overview

A brief description of the process steps is as follows:

1. Identify the process flow. If your employees cannot agree on their process(es), how can they effectively measure them or utilize the output of what they have measured?
2. Identify the critical activity to be measured. The critical activity is the culminating activity where it makes the most sense to locate a sensor and define an individual performance measure within a process.
3. Establish performance goal(s) or standards. All performance measures should be tied to a predefined goal or standard, even if the goal is at first somewhat subjective. Having goals and standards is the only way to meaningfully interpret the results of your measurements and gauge the success of your management systems.
4. Establish performance measurement(s). In this step, you continue to build the performance measurement system by identifying individual measures.
5. Identify responsible party(s). A specific entity (as in a team or an individual) needs to be assigned the responsibilities for each of the steps in the performance measurement process.
6. Collect data. In addition to writing down the numbers, the data need to be pre-analyzed in a timely fashion to observe any early trends and confirm the adequacy of your data collection system.
7. Analyze/report actual performance. In this step, the raw data are formally converted into performance measures, displayed in an understandable form, and disseminated in the form of a report.
8. Compare actual performance to goal(s) upon organization strategies. In this step, compare performance, as presented in the report, to predetermined goals or standards or baselines and determine the variation (if any).
9. Are corrective actions necessary? Depending on the magnitude of the variation between measurements and goals, some form of corrective actions may be required.
10. Make changes to bring back in line with goal if necessary. The actual determination of the corrective action is part of the quality improvement process, not the performance measurement process. This step is primarily concerned with improvement of your management system.
11. Are new goals needed? Even in successful systems, changes may need to be revised in order to establish ones that challenge an organization's resources, but do not overtax them. Goals and standards need periodic evaluation to keep up with the latest organizational processes.

3.2. Developing performance measures: a systematic approach

Change might be inevitable, but all too often it occurs like an unguided missile seeking an elusive target at unpredictable speeds. For most activities, it is far better to manage change with a plan–one that includes clear goals and useful indications of progress toward a desired objective. Participants in an activity need to know what outcome is expected, where their work contributes to the overall goal, how well things are progressing, and what to do if results are not occurring as they should. This approach places performance measures right where they should be: integrated with the activity [7,8].

Such integration makes it possible for performance measures to be effective agents for change. If the measures quantify results of an activity, one only needs to compare the measured data with desired goals to know if actions are needed. If you want to be able to identify effective corrective actions to improve products and services, results of all key processes must be measured. In this way, one can identify specific processes that need to change if progress is not satisfactory [9,17].

3.2.1. Structure and terminology

The point here is that achieving *goals* depends on the performance of interrelated sets of *activities* and *processes* that form a *system* to be managed. It follows that you can improve the selection of *performance measures* if they are based on the desired *outcomes* of the system and the *results* expected of each process in the system.

In turn, this suggests a systematic approach to develop performance measures. This methodology will be described in the following sections. Performance measures are quantitative evaluations of the products or services of a process or system. Metrics are standards of measurement (such as length, area, frequency, mass, and so on). In addition, there are terms such as Performance Indicators and Indexes [40,52,54]. Dealing with these gets complicated because people use them in very different ways, and there is no one standard to which we can appeal. Some use *indicator* and *measure* interchangeably, while others see *indicators* as subsets of *measures*. Others see *indicators* as sets of related measures. Still others prefer *indexes*, often thought of as sets of related measures (sometimes individually weighted) that track changes compared to a reference. These more sophisticated concepts are important, but they are beyond the scope of this document.

3.2.2. The process of developing performance measures

Developing performance measures has a definite relationship with Total Quality Management. Consider the following process steps:

Step 1. Describe the desired outcomes due to goals and strategies.

The first law of performance. If you try to be the best at everything, you'll be the best at nothing.

Why are we doing this work? The answer is to achieve some outcome or objective. However, they are very important because they set the direction for all processes in the system.

Essentially, objectives (or outcomes) are statements of the wants, needs, and expectations of customers and other stakeholders. Objectives are the warm and somewhat fuzzy expressions that should form the mind set for all who are involved in the system.

Realize that the desired outcome sets the strategic direction of an enterprise. Consequently, tactical decisions about what the business do, how it is done, and what gets measured must relate to this strategic statement [28,32]. The outcome or objective statement is a driving force for the selection of performance measures. In the end, what is done and measured somehow must connect with the desired outcome.

Step 2. Describe the major work processes involved.

The second law of performance. People are more important than the process, but a good process is important to people.

What are we doing, and how are we (or should be) doing it? Processes and their activities are the means to achieve the outcomes–the end results–identified in Step 1. To improve the chances of meeting objectives, be sure to understand the system, that is, the operational structure that underlies the effort. This task is not so obvious. The work we all do usually is part of a larger assignment that is, in turn, part of a larger job, and so on.

This part of the procedure is similar to benchmarking and should include interviews with the people, who are doing the work. People often achieve the desired results in spite of, not because of, the process that exists. Thus, examining work processes usually leads to the discovery of some that can and should be improved. Next, the products (results) of the individ-

ual processes have to be identified so that measures can be developed.

Step 3. Identify the key results needed.

The third law of performance. If you can't describe it, you can't improve it.

What is produced? The "products" or "services" are the outputs or results of each process in the system. Products of any given process are inputs to other related processes in the system. Ultimately, the final products or services of the system are those that meet the strategic results-the objective-desired by the company.

Step 4. Establish performance goals for the results.

The fourth law of performance. If you don't have a goal, you can't score.

How will I know when I get there? What will be done if progress isn't satisfactory? There are many questions to ask about this step. Setting goals is very important because you can spend many resources trying to meet them. You're familiar with "No pain, No gain"? The *PAIN* is worth, if the goals are [22,37]:

- Profitable (Is it worthwhile to improve this? Favorable Benefit/Cost?)
- Achievable (Can it be improved? How? Who will do it?)
- Important (Does it matter to anyone?)
- Numerical (Without a number, you won't know when you get there).

The *GAIN* is in reaching the goals, because: Goals Are Improvement Numbers [38]. There are various ways to determine goals. One of the best methods is to ask the customer for each of the product(s). In the system, the "customer" is the group or individual receiving the product. Therefore, determine the Critical Success Factors(CSF), which relate to each goal. CSFs are the few key points that must be right for the process to be successful in the stakeholders' view.

The goals should be stated in simple terms using numbers, such as "Deliver 500 completed products with fewer than three errors by the end of the month," or "Improve the average of repair time minimum of 15 minutes within six months." Be sure to differentiate among lofty goals, stretch goals, and realistic goals. It is best to establish realistic goals–those you have a decent chance to reach–and after reaching them, establish new ones.

For example, Zarbal Complex[1] Committee of the whole developed the goals listed in Table 1. For example, after researching available Poultry Meat supplies and performing a market survey, they decided that it would be reasonable for them to capture one fourth of the regional market, and that if the price is right, customers would purchase twice the amount of Zarbal products in the coming year. To achieve these goals and meet their prime objectives, they also found they would have to sell an average of 50 tons of Poultry Meat and other products each day at 12000 Rls/kg. This, they believe, would keep customers and themselves happy. The remaining goals are the corresponding improvements needed in the products of the enabling processes to help meet the primary goals.

Step 5. Define measures for the goals.

The fifth law of performance. Measuring the activity usually improves the activity, but not the result.

What can you use to track progress? Measures are descriptions of the items to be monitored. At this stage, measures should be described with relative terms like "percentage of the market" and "average prices." While there is no specific formula for selecting performance measures, some characteristics are typical of the good ones. They:

- Reflect results, not the activities used to produce results,
- Relate directly to a performance goal,
- Are based on measurable data,
- Contain normalized metrics for benchmarking,
- Are practical and easily understood by all,
- Provide a continual self-assessment,
- Provide a benefit that exceeds the cost,
- Are accepted and have owners.

The first criterion is important because it is very tempting to select measures that are easy, while the right measures can be difficult.

Find appropriate measures by examining all the goals listed in the previous step. While selecting measures, it is wise to remember that the idea is to be

[1] Zarbal Complex is one of the biggest producers of Poultry Meat, that is placed in north of Iran. In 2005 organized and established Supply Chain Management with more than 100 suppliers.

able to track progress and to be able to change processes (or activities, or the system) as needed to improve results. Therefore, it will help to ask if the system measures you choose will be adequate to identify which process needs fixing. Also, consider what practical actions could be taken if any of the products are not progressing toward the goal fast enough [20,31].

Step 6. Identify the required metrics.

The sixth law of performance: If you know the score, you should be able to predict the outcome.

What specific things do I measure? Metrics should be obvious from the descriptions of the measures composed in the previous step. Examine the measures statements and the goals to identify the units required for each term.

For example, to support organization's goal to capture 25% of the regional market, the measure is the company's income compared with the total Rls spent by customers in the region. The comparison or ratio of two meaningful Rls figures creates a normalized measure that can be used for tracking and comparing with other similar businesses. Another way to normalize is to use a ration of actual versus planned results. Metrics for a measure of yield quality might be the number of acceptable units produced divided by the total number of units produced.

4. Developing priority scored performance measurement

Performance metrics should be constructed to encourage performance improvement, effectiveness, efficiency, and appropriate levels of internal controls. They should incorporate "best practices" related to the performance being measured and cost/risk/benefit analysis, where appropriate. In this section, we extend our discussion about the process, metrics and indexes used in developing effective priority scored performance measurement(PSPM).

4.1. The process

The first step in developing PSPM is to involve the people who are responsible for the work to be measured because they are the most knowledgeable about the work. The establishment of performance goals can best be specified when they are defined within three primary levels:

- **Objectives**: Broad, general areas of review. These generally reflect the end goals based on the mission of a function.
- **Criteria:** Specific areas of accomplishment that satisfy major divisions of responsibility within a function.

Table 1. Typical example of annual goals for Zarbal Complex.

Process	Product	Goals
Customers (output)	Income requirements	25% of the regional market twice last year's volume
Manage	Funding permits orders	+10% - 0% of budget request 95% timely availability 95% error free
Mobilize	Equipment documentation	85% uptime 95% error free
Produce and deliver poultry meat	Delivered poultry meat	Customer cost 12000 Rls/kg 50 tons/day
Evaluate and correct	Corrective actions surveys costs customer satisfaction	90% on-time completion positive perception 80% +0%, -10% of budget

- **Measures:** Metrics designed to drive improvement and characterize progress made under each criterion. These are specific quantifiable goals based on individual expected work outputs.

The SMART test is frequently used to provide a quick reference to determine the quality of a particular performance metric [14]:

- **Specific**: clear and focused to avoid misinterpretation.
- **Measurable**: can be quantified and compared to other data.
- **Attainable**: achievable, reasonable, and credible under conditions expected.
- **Realistic**: fits into the organization's constraints and is cost-effective.
- **Timely**: doable within the period given.

Table 2 contains the scope of measurement.

4.2. Performance indexes

Often it is necessary to present information from several related areas simultaneously. This is done to provide a statistical measure of how performance changes over time. The performance index is a management tool that allows multiple sets of information to be compiled into an overall measure.

This section provides an example of developing a performance index. For this purpose, a performance indicator (PI) is defined as the result of the comparative analysis of a performance measurement outcome to a corresponding performance goal. These measurements give an indication of performance. However, when you have too many indications to consider, performance indexing becomes a useful performance management tool. The philosophy behind using performance indexes is simple: they condense a great deal of information into one number. We know that when dealing with a small number of indicators, PI related information is easy to assimilate. However, what happens when you're not dealing with just one or two PIs? What happens if you have 10, or 15, or 20 separate but related indicators to review? With some increasing, and others decreasing, while others remain the same, how do you determine what is happening overall? The answer is to use an index.

So, what is exactly an index? Simply put, an index is a statistical measure of how a variable, or set of variables, changes over time. The purpose of an index is to give a quick, overall picture of performance. The power of using indexes as management tools clearly resides in their ability to capture the information contained in a large number of variables in one number. For instance, economists can use one number, the Consumer Price Index (CPI), to capture pricing information on several hundred different consumer products. Now, instead of having to track over 400 different prices, they only need to track one number-the CPI.

How do you create an index? This is not an easy question to answer because there is no one set formula or algorithm for generating indexes. However, there are certain concepts that apply to all indexes, the most important being that all indexes are designed for a particular purpose, and that the design process involves choosing the correct (related) indicators and then combining them in a manner that supports the intended purpose of the index.

Now, simply because there is no patent method for producing an index does not mean that creating one has to be a complicated matter. In fact, it can be as simple as computing the ratio between two numbers or weighted average of many numbers. Here we use this two way to create indexes we need.

4.3. Priority determination

Every company is working in one of three business environments: Competitive, Monopoly or Attractive. In each condition, they must have special strategies and goals, which depend on business environments. In first step of performance measurement, we define company's priorities for main areas of activities upon the business situations. We assign different priority scores P_{ij} to each areas (i) upon the above three business situations (j). After calculations, each index for all areas that were mentioned in pervious sections (i=1 to 13), you can find Priority Score performance measure index for an organization as follow:

$$PSPM = \sum_{i} P_{ij} * index_i \,, \qquad (1)$$

where j is competitive, monopoly or attractive.

The next step is the calculation of indexes for each of the above areas.

Table 2. Classification of performance metrics.

Measure of areas	Measures...	Expressed as ratio of...
Efficiency	Ability of an organization to perform a task.	Actual input/ planned input
Effectiveness	Ability of an organization to plan for output from its processes.	Actual output/ planned output
Quality	Whether a unit of work was done correctly. Criteria to define the customer establish "Correctness".	Number of units produced correctly/total number of units produced**.**
Productivity	The amount of a resource used to produce a unit of work.	Outputs/inputs
Profitability	How much compliance with budgets, what is TOC, ROI?	Budgets-actual cost or revenue
Process	Ability to improve the internal business processes.	Decrease process time in each stage
Flexibility	Ability to respond to changes.	Meantime to adapt or react against changes
Reliability	On time delivery and without defects products, availability of equipment and resources.	No of defects/ total defect, MTBF/(MTTF+MTTR)
Timeliness	Whether a unit of work was done on time. Criteria to define "on-time" are established by the customer(s), lead time duration?	Number of units produced on time/total number of units produced.
Social responsibility	How are the rate of environment pollution?	Amount of pollution was add to environment
Growths and innovation	Reduction of lead time in producing new product, the amount of sales per total revenue, scale of reputation.	Time to design and develop new product, rate of reputation with respect to last years
IT and ICT usage level	How do IT and ICT affect on total revenue and costs, speed of process?	Sales/total revenue, cost/total revenue, unit time/product
Employee living standards	How much average salary increased with respect to CPIs and last year?	Salary average, total employee cost/total cost or revenue

4.4. Index calculation

Essentially, for example in each area, the index is a linear combination of weighted parameters or weighted average as below:

$$Index_i = \sum_j w_{ij} A_{ij} , \quad \forall\, i \tag{2}$$

or

$$Index_i = \frac{\sum_j w_{ij} A_{ij}}{\sum_j w_{ij}}, \quad \forall\, i \tag{3}$$

where w_{ij} are constant weighting factors and A_{ij} are individual measurable items of areas *i* such as quality, productivity etc., with measurable values of item *j* in sub area (such as total production cost). When determining the weighting factors, the probability risk assessment, cost / benefit analysis or expertise opinion could be taken into account. Notice that if you want to compare many indexes, it is necessary normalizes all indexes.

4.5. Developing a priority scored performance matrix for Zarbal

Zarbal Complex is one of the biggest suppliers of Poultry Meat in the north of Iran. In recent years the increasing number of other producers and government imports, they have been faced with complex market and unstable situations. To get rid of these conditions the top managers of Zarbal decided to reorganize and establish new systems by performing Business Reengineering Process. Under these conditions planning and control of the organization was very difficult.

In 2000, Zarbal assigned a team to start Business Process Reengineering all over the company. The main goals of this project were focused on establishment of Supply Chain Management. After two years, the Zarbal's SCM was deployed and started to work throughout the country.

For evaluation of performance in these new conditions, they need to have a performance measurement system that measures all processes and the overall organization's performance. For this purpose, we use initial basic BSC model [27] and develop a model that includes the environments and strategic criteria. All indexes prove that after BPR and deployment of SCM in Zarbal, the performance of Zarbal was improved.

The first step of our process involves developing a priority scored performance matrix that shows goals and ranges of performance for several metrics. Therefore:

Step 1. Select indicators that are related to and that measure progress in the area (13 areas here) for which you intend to develop an index.

Step 2. For each of the component performance indicators, determine its relative importance and the impact priority (P_{ij}) due to business situation that it should have on the index. Write the value of the priority in the "P" column. The P-values for Zarbal, which against with competitive condition was, determine by the top managers are shown in Table 3.

Step 3. Establish the baseline value for each performance indicator. In the matrix, *level 7* represents the baseline. A good baseline might be a four-quarter average or something else if there are suitable data.

Step 4. Determine a goal for each measure. In the matrix, performance level 3 represents the goal.

Step 5. Determine a "stretch goal" for each performance indicator. This goal should be attainable, but only if your facility performs superbly. The stretch goal is represented by level 1 in the matrix.

Step 6. Establish intermediate goals for levels 4, 5 and 6 in the matrix. These may be specific milestones determined by line management, or they may be simple numeric increments between the baseline and the goal.

Table 3. P-values of Zarbal Complex.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	Sum
p-value	5	8	5	10	7	10	17	8	5	8	10	5	2	100

Step 7. Determine values for levels 8, 9, and 10. It is possible that performance can be worse than the baseline.

Step 8. Assign a value to Level 2 between levels 1 and 3.

Step9. Debug the matrix. Use stakeholder feedback and intentions to evaluate the initial selection of performance indicators, the performance levels, assigned priorities, and so on. Make necessary changes.

Step 10. Develop a system for scoring and displaying results. It is important to assign the responsibility for collecting, calculating, plotting, and disseminating performance index information. It is equally important to set up a mechanism for the periodic review and updating of each performance matrix.

It is important to understand how these indexes increases and decreases in each indicator relate to performance, and to determine the baseline values, goals, and stretch goals accordingly.

4.6. Calculating the priority scored performance index

The first step in calculating the index in given business situation (j) is to measure the current value for each performance indicator as shown by $index_i$.

Then, using the matrix, determine the corresponding performance levels. In situations where the value for a performance indicator falls between performance levels, choose the next higher level.

$$Set\,level_i = \begin{cases} i & if\ PI_{i-1} \le index_i \le PI_i\ and \\ & PI_i - index_i \le PI_{i-1} - index_i \\ i-1 & else \end{cases}$$

where $i = 1,\ldots,13$.

The score for each performance indicator is determined by multiplying the level times the priority.

Once this is done, the scores are added together to determine the composite results for $PSPM_{index}$.

$$Score_i = level_i * P_i \qquad \forall i,$$

$$PSPM_{index} = \sum_i Score_i .$$

Therefore, we can calculate the organization level (Org_L) due to business condition through the following equation:

$$Org_L = \left\lceil \frac{PSPM_{index}}{\sum_i P_i} \right\rceil .$$

4.7. Calculating Zarbal organization level

Based on the above process and using Zarbal Complex data in one year, we drive that the $Org_L = 6$. This means that Zarbal stands on level 6 and cannot reach his baseline goals. To find in which areas the weaknesses or strengths are, we must compare the

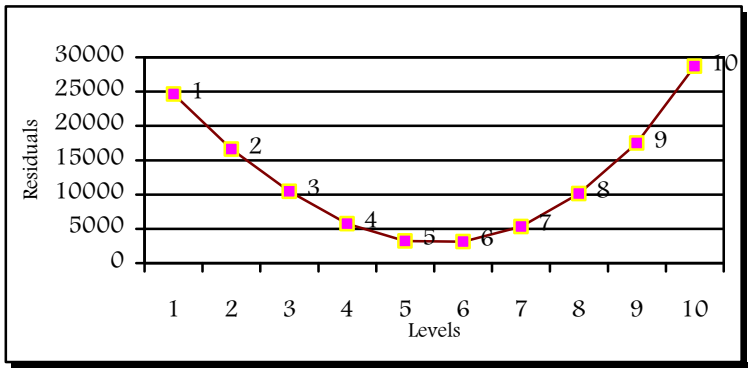

Figure 2. Residuals between actual performance indexes and level's values.

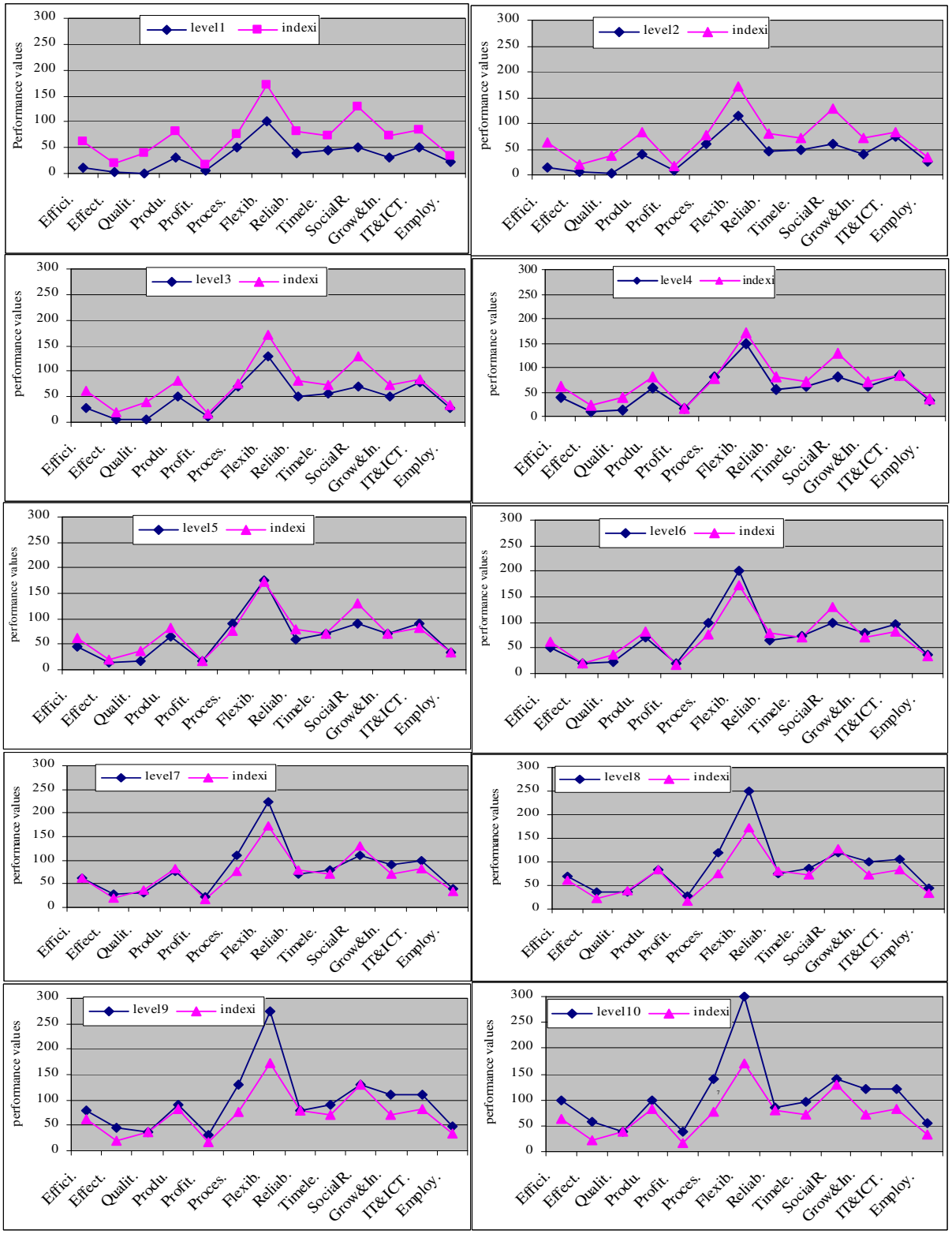

Figure 3. Actual performance indexes against each level's values.

level 6 values with $index_i$ and find what must be done to improve the outcomes in various areas. In Figure 2, you can see all level residuals from the performance indexes. These are square residuals, which calculated from the following formula. Minimum value appears in level 6.

$$residual_j = \sum_i (index_i - level_{ij})^2 \quad \forall j = 1,...,10.$$

Figure 3 includes some graphs that show the indexes against values of all levels. As you see in figure 3 (Graph 6) the minimum gap between goals level and performance indexes seen in level 6. That is, actual performance indexes converge to level 6 values in all areas.

This could be compared to a baseline value (performance level 7 for all indicators), and a goal value (performance level 3 for all indicators). Ideally, values for this index would be calculated every month, quarter, or whatever period is chosen, and tracked over time.

We examine the approach for each area and find the same results as an organization level. Therefore, this model can be applied for improvements in sub-area and specific items of performance indexes.

5. Conclusion

In this paper, we introduce a systematic approach to performance measurement based on priority scores due to business environments. Every organization works in one of the Competitive, Monopoly or Attractive business conditions in market. The main goal of this research was to design a suitable model for enterprise performance measurement. Performance measurement without considering business conditions and environment has no meaning; therefore, we include competitive, monopoly and attractive strategies in the model.

Using Zarbal Complex's data in model, we got very exciting results. The output of model analyzed and compared with the results of conventional approach of measurement. Organizations can drive the priority for 13 areas upon their mission and strategies and plans. The Priority Scored Performance Measurement shows the organization level and tolerances from the specific measures of Efficiency, process etc. Using this model and finding $index_i$ in each area, you can have a plan for improvements in organization continuously.

This model shows that the measures are very closer to reality rather than others. The results slightly show areas which enterprise must take some actions to improve the process. This model obviously illustrates the strengths and weakness of each process and sub-process. This model is a reliable decision making tool for managers in top level of organization. This model can be applied in any sub-activity and has no limitation.

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