Computer Aided Training Needs Analysis And Performance Improvement Measurement(Ca- Tnapim) System

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Abstract

The purpose of training is to facilitate learning skills and knowledge required. Success or failure of any education and training will depend to a very large extent on the accuracy and effectiveness of the needs analysis. The outcome of training is acceptable performance on these tasks. In this research an algorithm is established in order to build a computer aided training needs analysis system based on 360 º-feedbacks approach for performance appraisals. This system is called CA- 360º **TNAPIM**. Mathematical model is designed in this work in order to analyze training needs which is used to calculate the performance gap of each trainee and of each management level in the organizational hierarchy, The performance gap at each performance objective of each employee, all performance objectives of each employee, each performance objective of all employees and Performance gap of factory or an organization The system has been tested in (State Company for Electrical Industries), in (Motors of Air-Cooler Factory), and showed Performance gap of factory before   training was 26.77%, Performance level was 73.23%, after training was 19.87%, 80.13% and Performance improvement level was 25.70% .

بناء نظام معان بالحاسوب لتحليل الاحتياجات التدريبية وقياس تحسين الأداء (CA- TNAPIM)

الخلاصة

إن الهدف من التدريب هو تسهيل تعلم المهارات والمعرفة المطلوبة, وان نجـــاح أو فـــشل أي عملية تدريب يعتمد إلى درجة كبيرة على دقة وكفاءة تحليـــل الاحتياجـــات التدريبيـــة وان مـــردودات التدريب هو الأداء المطلوب للمهام لأي منظمة. في هذا البحث تم أنشاء خوارزمية لغرض بناء نظـــام معان بالحاسوب لتحليل الاحتياجات التدريبيـــة بالاعتمـــاد علـــى تقنيـــة تقيـــيم الأداء والتـــي تعـــرف بـ(feedbacks approach º 360) وقد تم تصميم موديلات رياضية لغـــرض تحليـــل الاحتياجـــات التدريبية معتمدا على قياس فجوة الأداء (الفرق بين الأداء الفعلــي والأداء المـــستهدف , لكـــل عامـــل وللمستويات الوظيفية للمنظمة ككل وفق كل معيار من معايير الأداء) وكذلك قيـــاس مـــستوى تحـــسين الأداء, وقد سمي هذا النظام (TNAPIM º 360- CA).تم تطبيق هذا النظـــام فـــي الـــشركة العامـــة للصناعات الكهربائية معمل محركات المبردات , حيث تم تحليل الاحتياجات التدريبية للعاملين وللمعمل وقياس مستوى تحسين الأداء بعد أجراء العملية التدريبية. كانت فجـــوة الأداء للمعمـــل قبـــل العمليـــة التدريبيـــة هـــي 26.77%, مـــستوى الأداء 73.23%,وبعـــد العمليـــة التدريبيـــة هي 19.87%, 80.13% ومستوى تحسين الأداء 25.70%.

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1-Introduction

Globalization and rapid technological development have changed the conditions for companies and increased competition in the world market [1]. Education and training enables to face the challenges of technological change and commercial integration. Through its capacity to provide skills and enable effective participation in the workforce [2]. Training is the approach of preference for preparing people to perform specific tasks or jobs. Training and development is planned, continuous effort by management to improve employee competency levels and the organization work environment. Through training, skills level will be changed to that of qualified operator [3]. The organization attempts to provide experiences, which will help the individual, perform more effectively on the job. A training program is meant to structure these experiences in such away that the appropriate skills are required and developed [7].

The quality of company's human resources is the key driver for sustained top level performance. Manycompanies and other organizations around the world have been giving Training and development is planned, continuous effort by management to improve employee competency levels and the organization work environment. Through training, skills level will be changed to that of qualified operator [3]Well-trained employees do better, and perform better, than untrained ones, in any organization [8,9] The organization attempts to provide experiences, which will help the individual, perform more effectively on the job. A training program is meant to prominence to its employees being the most valuable asset [10].

2-PerformanceAppraisal Techniques

A number of different performance structure these experiences in such away that the appropriate skills are required and developed [4].

Training is the process of changing employee behavior and attitudes through some type of guided experience [5]. It refers to providing instruction to develop skills that can be used immediately on the job. It has narrow focus and should provide skills that will benefit the organization [6].

Rapid technological change, continuous product improvement and relentless competitions, require companies continuously to upgrade the competence levels of their human resources [4] The quality of human resources is the key driver for sustained top-level performance, it has important to continually invest in human resources development in order to guarantee success in the global market place [1]

Appraisal techniques are available as shown in figure (1). Some techniques focus more on employee behavior others are more results oriented and emphasize the results of employee behavior (to which an employee reaches goal or objectives). Some of the methods are based on relative rankings, whereas others rely more on an absolute ratings.

2-1 360 – degree feedback approach

360˚feedback or multi-source feedback or multi-rater assessment, is a powerful developmental method and quite different to the traditional manager –subordinates [11]. It combines self appraisals, peer appraisals, management appraisals, and often external third –party appraisals [12,5,13]. Who form a circle around the employee [12,14] as shown in figure (2). The growing interest in 360

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Degree Feedback approach appears to result from a belief that it has the ability to meet the needs of structural, organizational and business change.

3- The algorithm of Training Needs Analysis (TNA)

To ensure that training process is organized efficiently to close the performance gap, training Needs Analysis (TNA) should consist the following sub- modules, which show the algorithm steps of the entire function of the system, as shown in figure (3).

4-Training Needs Analysis Module

The function of *(TNA)* module, based on an analysis of the level of the performance of current state, will be compared with the required or target level of performance to determine the performance gap, as shown in figure (4).

1-Establish feedback criteria (performance objectives): The first step in designing a multiple source assessment to select performance objectives; table (1) represents these objectives.

2-Usually each of objectives is not of equal importance, thus it is appropriate to assign a weighting factor to each objective, as follow[15] :

a- An objective tree can be used to give a reliable assignment of weighting factors to each criterion

b- The highest level, overall objective is given value (1.0).

c- At each lower level the objectives are given weights relative to each other.

 d- Use pair comparison technique, each objective is listed and compared to every other objective.

5- Calculation of Performance Level

Calculations of the performance levels of employees before training and after training are based on the mathematical model [16], which is illustrated in figure (5), and the algorithm steps as follow:

Step -1 One employee - one rater (Top-Down) evaluation approach:

This approach includes calculate the following:

1- The performance gap at each performance objective of each employee (PiG)

2- The performance gap of all objectives of each employee (PTG)

3- The performance gap at each performance objective of all employees ($\overline{P_i}$ G)

4-Performance gap of factory or an organization ($\overline{P_T}$ G)

Step -2 One- employee- Multi-raters based on 360° feedback approach:

This approach is used If the trainee is evaluated by m any sources (nR), it is including to calculate the following:

1- The performance gap at each performance objective of each employee ($\overline{P_i}$ mG).

2- Calculate the performance gap of all objectives of each employee ($\overline{P_{mT}}$ G)

3- The performance gap at each performance objective of all employees ($\overline{P_{mi \bullet G}}$).

-Calculation the level of improvement:

Compare the levels and the performance gaps before training and after training:

PGE = PGB – PGA   …..(1)

LI = (PGB -PGA / PGB)* 100   ….(2)

 where:

   PGE: Performance gap enclosed

   PGA : performance gap after training

   PGB :   performance gap before
              raining

   L.I : Level of Improvement

6- Practical Application

The practical application of **CA-360°** *TNA* **s**ystem has been applied in an industrial organization, the (Motors of Air-Cooler factory), of (the state company of electrical Industries). The company was qualified the employees of this factory through providing training program concerned with **ISO 9000**.

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The trainees were divided into four groups; each group had taken the same training program objects. The period of the training program was four weeks for each group. The sample that was taken for this research **31 trainees** of different levels according to the hierarchy levels of the factory as shown in figure (6):

CA-360° *TNA* system according to the 360° feedback approach, each trainee is rated by three raters, (the supervisor, himself and peer). They rated the trainees as follow:

- **Before training** program in order to find training needs based on calculation performance gap and performance level.

- **After training** program, on job to evaluate the level of the performance improvement.

6-1.   Training Need Analysis (TNA) Module Window

Training need analysis **(TNA)** window has two options are as follow:

a- Performance appraisals by one rater **(top-down)**

b- Performance appraisals by multi- raters (360° feedback approach)

In the testing of the system, option (b) was selected as shown in the table (2) and (3).where (E) mean employee, (R_1) mean rater (1), (R_2) mean rater (2), (R3) mean rater (3),and (O) mean the performance objective.

7. Results and Discussions

The final results are shown in the figures(7), (8), (9), (10), (11), (12), and tables (2), (3) and(4).

The systems can **Analyze Training Need** according to the points, target value, performance level and performance gap of the following:

1- Factory at each objective, as shown in the figure(7)

2- Factory of total objectives, as shown in the figure(8)

3- Each employee at each objective, as shown in the figure(9)

4- Employee of total objectives. , as shown in the figure(10)

In the Figure (7)for example The system presents the results of the Training Need Analysis according to the Performance gap of each objective of the factory, performance level, and summation of points

The system also represents the results graphically

In the Figure (7) the system represents the results of the Total Training Need Analysis

Also the system presents matrix which contains the following :

1- The upper left window in figure (11)   includes the results of (GB, GA, Ge and Li) for each employee:

-GB: presents the performance gap of each objective at training need analysis step

-GA: presents the performance gap of each objective after training **.**

-**Ge:** presents the performance gap enclosed of each objective according to the training program.

-**Li** : presents the level of improvement at each objective

The system calculates the total current level improvement , which is presented in the current level improvement field.

2- The lower left window in figure (12), includes the results of (GB, GA, Ge and Li)of factory:

-GB: represents the performance gap of each objective before training program..

-GA: represents the performance gap of each objective after training. program.

-**Ge:** presents the performance gap enclosed of each objective after training program.

-**Li** : represents the level of improvement at each objective.

- Total level improvement command:

The system evaluate the total level of performance improvement of factory automatically as shown in the left window in figure (12)

-Draw level improvement:

The system draws graphically the level of improvement, as shown in the in figure (12).

According to the final results of Li calculations, the system give the following recommendations;-

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1- If Li is less than **25%** and summation of points **< 60%,** the employee needs basic training program.

2- If **25% < Li <50%** and summation of points **60%< sum. pi < 80%** , the employee needs medium training program

If **50% <Li <75%** and summation of **points> 80%,** the employee needs advanced training program.

8- Conclusions

CA -360º (TNA) system offers good tool for training need analysis based on performance criteria to identify the performance gap before training. Then the same criteria must be used to evaluate the performance after th training program based on the following:

a- Performance appraisals by one rater **(top-down)**

b- Performance appraisals by multi- raters **(360˚ feedback approach)**

The system can Analyze Training Need according to the points, target value, performance level and performance gap of the following:

1-Factory at each objective.

2-Factory of total objectives.

3-Each employee at each objective.

  4- Employee of total objectives.

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Table (1) Performance Objectives Database [17]

Employee's performance evaluation	
Employee's name:	Employee's job:
Type of evaluation	Rater's name:
Rater's job:	Date of evaluation

Criteria of performance appraisals	Weight of criteria	D_1	D_2	----	D_n	Points = w * D
Quality of work: a-Accuracy of work. b-Complete work c-Make use of training program.						
Job knowledge: a-Possess knowledge& skill required b-Understand relationship to another jobs						
Quantity of work: a-Efficiency of time b-Raise output c-Consider amount of work produced.						
Customer services						
Safe work practices: a-Apply safe information. b-Continue to develop knowledge of safety information c-Don't make accident.						
Dependability: a-Put extra effort when needed. b-Performs reliability.						
Attendance						
Initiative						
Team work: a-Work effectively with others b-Supports& respects others.						
Task management.						

Table (2): Results Before Training

Parameters	The stages	
	Need analysis	
	Employee	Factory
Summations of points	3.78	3.66
Performance levels	75.63%	73.23%
Performance gap	24.33%	26.77%

Table (3): The Final Results

Parameters	The stages	
	Performance Appraisals after training	
	Employee	Factory
Summations of points	3.92	4.005
Performance levels	78.4%	80.13%
Performance gap	21.6%	19.87%
Performance level improvement	11.22%	25.70%

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Table (4) The Final Results of Performance Level Improvement of each Objective of

Employee(1) and factory

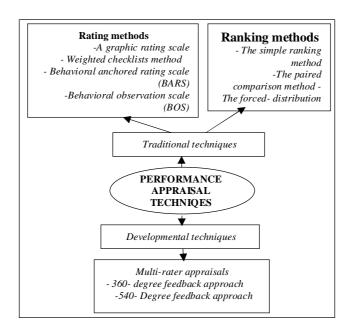| Criteria of performance appraisals	Performance level improvement of Employee (1)	Performance level improvement of Factory
Quality of work: a-Accuracy of work. b-Complete work c-Make use of training program.	63.64% 55.54% 15.38%	30.14 % 28.94 % 24.96 %
Safe work practices: a-Apply safe information. b-Continue to develop knowledge of safety information c-Don't make accident.	12.52% 0.00 28.52%	30.83 % 37.83 % 29.30 %
Customer services	0.00	26.91 %
Job knowledge: a-Possess knowledge& skill required b-Understand relationship to another jobs	25.01% 0.00	24.48 % 21.68 %
Quantity of work: a-Efficiency of time b-Raise output c-Consider amount of work produced.	0.00 0.00 0.00	25.55 % 24.22 % 25.81 %
Attendance	0.00	20.12 %
Dependability: a-Put extra effort when needed. b-Performs reliability.	17.5% 0.00	21.22 % 24.33 %
Initiative	0.00	26.01%
Team work: a-Work effectively with others b-Supports& respects others.	0.00 0.00	25.03 % 0.00
Task management.	0.00	45.23 %

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Figure (1) Performance appraisal techniques

Figure (2) Sources of Evaluation

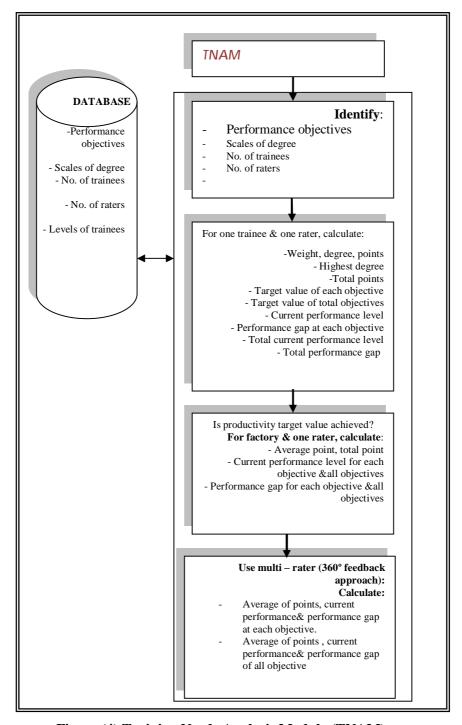**Figure (3) The Algorithm of Training Needs Analysis (TNA)**

TNAM

DATABASE

-Performance objectives

- Scales of degree
- No. of trainees

- No. of raters

- Levels of trainees

Identify:
- Performance objectives
- Scales of degree
- No. of trainees
- No. of raters
-

For one trainee & one rater, calculate:

-Weight, degree, points
- Highest degree
-Total points
- Target value of each objective
- Target value of total objectives
- Current performance level
- Performance gap at each objective
- Total current performance level
- Total performance gap

Is productivity target value achieved?
For factory & one rater, calculate:
- Average point, total point
- Current performance level for each objective &all objectives
- Performance gap for each objective &all objectives

Use multi – rater (360° feedback approach):
Calculate:
- Average of points, current performance& performance gap at each objective.
- Average of points , current performance& performance gap of all objective

Figure (4) Training Needs Analysis Module (TNAM).

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Step – 1:

P_{iG} calculations

$P_i = D_i * w_i$

Where: p_i = The point of each objective

w_i = weight of the objective

D_i = Degree assigned for each objective

$$T_{vi} = D_H *_{\ldots} w_i \qquad \text{.........................} \text{(4- 1)}$$

Where: T_{vi} = Target value for each objective

D_H = Constant (the highest degree in the selected scale)

$$P_{iL} = (P_i / T_{vi})*100 \quad \text{...............} \text{(4- 2)}$$

$$P_{iG} = 100 - P_{il} \quad \text{.........................} \text{(4- 3)}$$

Where: P_{iL} = Level of each objective

P_{iG} = Performance gap before training of each performance objective of current state .

P_{TG} calculations

$$P_T = \sum_{i=1}^{i=n} p_i \quad \text{.............................} \text{(4- 4)}$$

$$T_{vT} = D_H \sum_{i=1}^{i=n} w_i \quad \text{.........................} \text{(4-5)}$$

$$P_{TL} = (P_T / T_{vT})*100 \quad \text{....................} \text{(4-6)}$$

$$P_{TG} = 100 - CP_{TL} \quad \text{.......................} \text{(4-7)}$$

Where: P_T = Total points of all objectives

T_{vT} = Target value of all objectives

P_{TL} = The level of all objectives

P_{TG} = Total Performance value gap before training of all objectives

$\overline{P_i}_G$ calculations

$$\overline{P_i} = \sum_{i=1}^{i=n} P_i / n_t \quad \text{..............................} \text{(4 –8)}$$

Where: $\overline{P_i}$ = Arithmetic mean of points for each performance objective

n_t = Number of trainees

. P_i = Point for each performance objective

$$P_{iL} = (\overline{P_i} / T_{vi})*100 \quad \text{.....................} \text{(4-9)}$$

$$\overline{P_i}_G = 100 - P_{iL}$$

$\overline{P_i}_G$ = Performance gap before train

$$\overline{P_i} = \sum_{i=1}^{i=n} P_i / n$$

Where $\overline{P_i}$ = Arithmetic mean of all points of one objective

n = Number of trainees

. $\overline{P_T} = \sum_{i=1}^{i=n} \overline{P_i}$ ning of each performance objective of all employees $\overline{P_T}_G$ **calculations**

$$\overline{P_T} = \sum_{i=1}^{i=n} \overline{P_i} \quad \text{..............................} \text{(4- 10)}$$

$$P_{TL} = (\overline{P_T} / T_{vT}) * 100$$

$$\overline{P_T}_G = 100 - P_{TL} \quad \text{.........................} \text{(4 – 11)}$$

Where $\overline{P_T}$ = Total Arithmetic mean of points of all performance objective

Tv_T = Performance Target value of all objectives of the factory or organization

P_{TL} = The level of all objectives

= Total Performance value gap before training of the factory or organization $\overline{P_T}$

Figure (5) The mathematical model for performance appraisals [Researcher's work]

Step – 2:

$\overline{P}_{miG}$ **calculations**

$$\overline{P}_{mi} = \sum_{i=1}^{i=n} P_{mi} / n_R \quad \text{.....................} (4-12)$$

Where: $\overline{P}_{mi}$ = Arithmetic mean of points for each performance objective of one employee rated by multi-raters

P_{mi} = Point for each objective of multi-raters

n_R = No. of Raters

$$P_{iL} = (\overline{P}_{mi} / T_{vi})*100 \quad \text{...................} (4-13)$$

$$\overline{P}_{miG} = 100 - P_{iL} \quad \text{.....................} (4-14)$$

Where:

$\overline{P}_{miG}$ = Performance gap before training of each performance objective *of one* employee

$$\overline{P}_{mT} = \sum_{i=1}^{i=n} \overline{P}_{mi}$$

$\overline{P}_{mT}$ $_G$ **calculation**

$$\overline{P}_{mT} = \sum_{i=1}^{i=n} \overline{P}_{mi} \qquad P_{TL} = (\overline{P}_{mT} / T_{vT}) * 100$$

$$\overline{P}_{mT}\ _G = 100 - P_{TL} \quad \text{...........................} (4-15)$$

Where: $\overline{P}_{mi}$ = Arithmetic mean of points of each performance objective for one employee

$\overline{P}_{mT}$ = Total mean points of all performance objectives for one employee

$\overline{P}_{mT}\ _G$ = performance gap of all objectives of one employee

$\overline{P}_{mi\bullet G}$ **calculation:**

$$\overline{P}_{mi\bullet} = \sum_{i=1}^{i=n} \overline{P}_{mi} / n_t$$

Where: n_t = No. of trainees.

$\overline{P}_{mi\bullet}$ = Grant average of each objective

$$P_{iL} = (\overline{P}_{mi\bullet} / T_{vi})*100 \quad \text{.....................} (4-16)$$

$$\overline{P}_{mi\bullet G} = 100 - P_{iL} \quad \text{.........................} (4-17)$$

Where:

$\overline{P}_{mi\bullet G}$ = Performance gap before training of each performance objective of fa

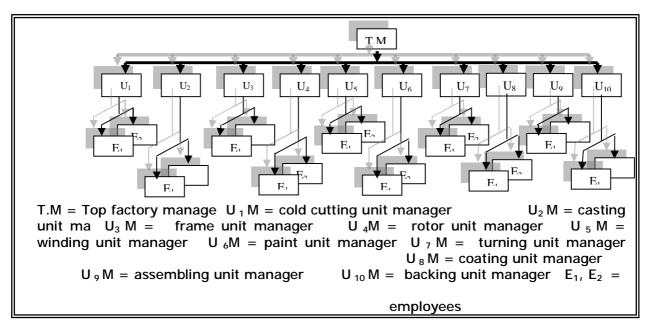**Figure (5) The mathematical model for performance appraisals [Researcher's work] (continued)**

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Figure (6) The hierarchy levels of the sample of trainees for practical application.
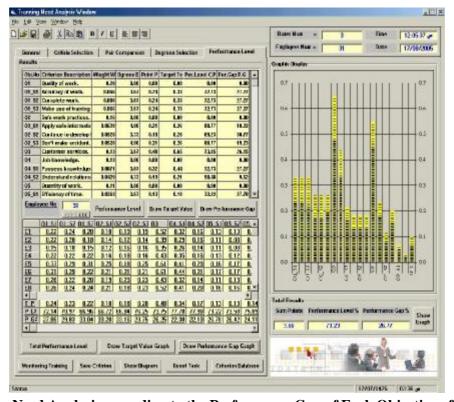

Figure (7) Training Need Analysis according to the Performance Gap of Each Objective of the Factory.
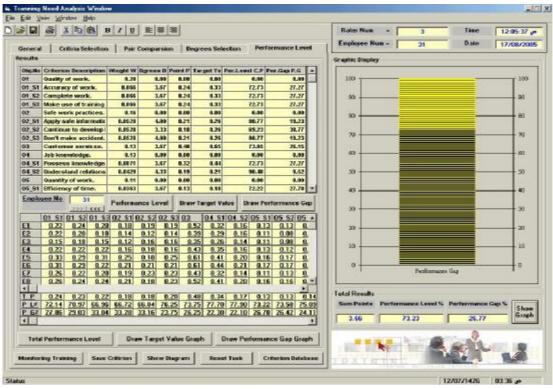
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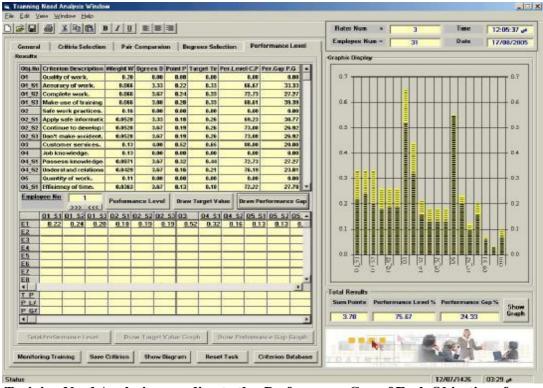**Figure (8) Total Training Need Analysis According to the Performance Gap of the Factory**

**Figure (9) Training Need Analysis according to the Performance Gap of Each Objective of
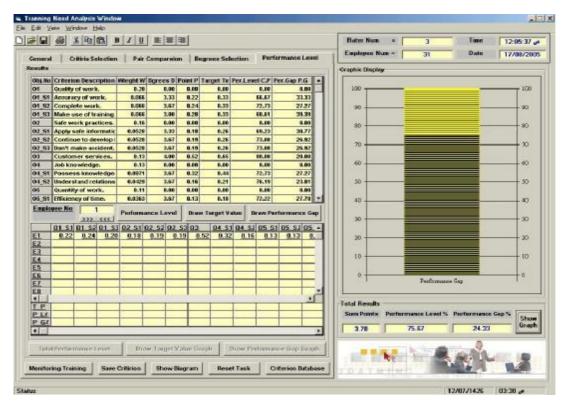the Employee (1).**

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**Figure (10) Training Need Analysis according to the Total Performance Gap of the Eemployee
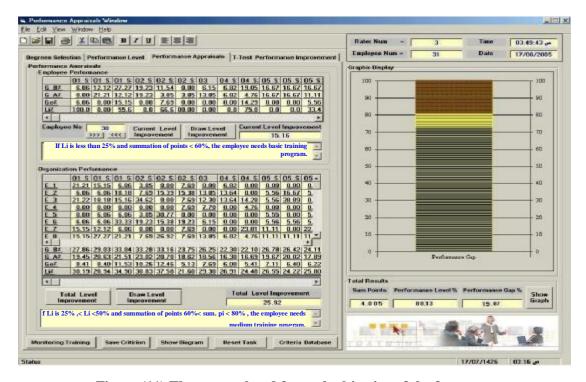(1).**

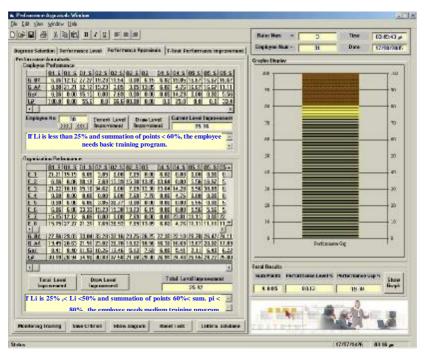**Figure (11) The gap enclosed for each objective of the factory.**
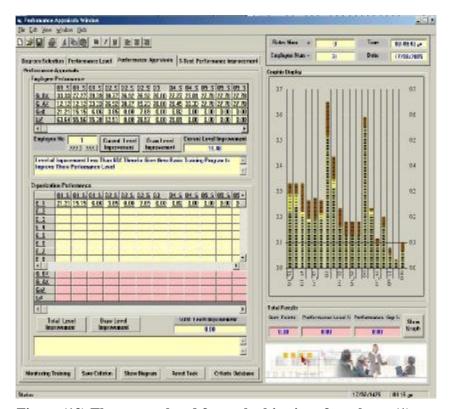
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Figure (12)The total gap enclosed of the factory.

Figure (13) The gap enclosed for each objective of employee (1)

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