Application of the Triple Bottom Line (TBL) concept to measure the maintenance performance of buildings

Prof. Dr. Hatem Khaleefah Breesam¹,3 and Zahraa Abdul Kadhim Jawad²,4

¹Professor of Construction Management Engineering, Department of Civil Engineering, University of Baghdad, Baghdad.
²MSc. Student, Department of Civil Engineering, University of Baghdad, Baghdad, Iraq.

dr.hatem.kh@coeng.uobaghdad.edu.iq

Abstract. Measuring maintenance performance is necessary to ensure that maintenance achieves the required goals and to enhance the preservation of the building, as most government institutions rely on traditional financial measurement methods to measure performance and this is not sufficient, as the social and environmental aspect play a prominent role in improving work performance, preserving the environment and achieving user satisfaction. This study aims to find out the applicability of the Triple Bottom Line (TBL) methodology to measure maintenance performance of government buildings in Iraq. A questionnaire was conducted for professionals in the field of building maintenance. Analysis of the questionnaire that was answered by (75) engineers revealed that the most influential factors in applying the Triple Bottom Line (TBL) methodology; are the quality and age of work and its impact on the environment, income (wages), the raw materials used in the work, user satisfaction, the age and quality of the building, management quality, the financial performance of the company. Also, the indicators that can be applied locally according to the questionnaire are; occupational safety practices, professional development, materials, contribution to the field of unemployment problems, transportation, the indirect economic impact on society, human rights (child labour), product responsibility (user’s safety), suppliers, security aspects, transparency, products, and services. We found that the most important obstacles that hinder performance measurement, are multiple and conflicting priorities and objectives. Three case studies were taken for government building maintenance projects, to obtain more accurate and realistic data for the factors and indicators obtained from the questionnaire, by analysing case studies, we find that the most important factors are; They are the age, build quality, quality, working life and its impact on the environment and financial performance. Also, the indicators that are most applicable to local institutions; are occupational safety practices, human rights (child labour), product liability, professional development, and participation in the field of unemployment, materials, and transportation. Therefore, it can be said that the Triple Bottom Line (TBL) methodology can be applied in measuring the maintenance performance of government buildings in Iraq, thus developing the reality of government building maintenance developed.
1. Introduction
Building Projects face many problems due to the deterioration of their components. The maintenance and renovation of buildings is a prerequisite for the role of buildings in community development. The authorities in Iraq allocate certain amounts annually for the maintenance of buildings and often not enough for the maintenance and renovation of buildings is a prerequisite for the role of buildings in community development. The authorities in Iraq allocate certain amounts annually for the maintenance of buildings and often not enough for the maintenance. The measure of a building’s function is its ability to provide the required environment for a particular activity, so the deterioration of the building’s components makes it necessary, to take appropriate measures, to preserve the desired building characteristics, which provide comfort and safety (Odediran et al. 2012). Preserving the building in its structural, aesthetic and functional condition is the main goal of the maintenance process [2].

2. Maintenance
There are several definitions of maintenance in the previous literature. It can be defined as all administrative and technical procedures that ensure that all elements and parts of the building are in an acceptable standard to perform the desired [3]. Maintenance is all administrative and technical procedures, including supervision, to preserve the item or return it to a location that enables it to perform the function for which it was made [4]. Reducing all negative impacts of inactivity and maximizing attachment at a lower cost [5]. There are five main factors affecting the maintenance of public buildings: lack of preventive maintenance, insufficient amounts allocated for building maintenance, lack of a standard for building maintenance, lack of spare parts and components, and lack of response to maintenance requests[6]. Residential building users indicated in the survey that the causes of maintenance problems are: faulty workmanship, design accuracy appropriate to user needs, use of inexpensive and low-level materials; the most influential factor in residential building maintenance is the lack of funding for building maintenance[7]. Cobinah identified another type of factor responsible for poor public building maintenance: age of buildings, insufficient funds, lack of maintenance culture, high maintenance costs, pressure from a number of users on the building, and poor construction and maintenance work carried out by maintenance personnel in the organization[8].

3. The performance
The performance is the effectiveness and/or efficiency of the procedure. Performance measurement is the process or processes by which the goal is defined, as well as developing specific performance measures, collecting performance data, conducting analysis, preparing reports, interpreting and then reviewing them, to act on their basis (i.e. technical controls) [9]. Performance measurement: It defined by determining the value of the output or input or the level of activity for a process or event. Performance management depends on measuring performance, which leads to improvement in motivation, behaviour, and processes [10]. Several studies were discussed and several indications were suggested regarding the maintenance aspect of the performance of the origin. However, most of the proposed indicators are either not quantified or unable to demonstrate the degree of maintenance efficiency by the facility[11]. The application of mixed methods approaches achieves a greater understanding of environmental, social, and economic problems, as it is important, as it helps us exploit the strengths of the two approaches [12]. Non-financial metrics, such as organizational innovation and customer satisfaction, are guiding indicators and are the best estimator for future operating results. The Balance Scorecard (BSC) enables corporate managers to assess the effectiveness of strategic plans and activities, as it combines non-financial and financial metrics in the internal reporting process[13]. Performance is measured in different ways, The use of Post-works evaluation (POE) provides a mechanism for the mutual interaction between the aspirations of the user and the buildings and finding means to improve the environment required to accommodate these aspirations. Implementation of POE leads to standardization of best practices, increased accountability of facility managers, and an understanding of available opportunities, which improves future
projects[14]. The Key Performance Standards (KPS) is directly related to the organization's strategies, and is considered essential to the successful implementation of the strategy. The institution uses the KPS to check how well its indicators are achieving the goal. The Key performance indicators (KPIs) are non-financial and financial[15]. The Balance Scorecard (BSC) is an excellent tool that helps management understand that sustainable, seemingly very costly applications are a financially useful methodology, given their ability to correlate metrics and create value[13]. Building performance evaluation (BPE) helps improve building quality and construction project delivery. The use of BPE provides notes on the causes and effects of environmental issues affecting the building[16].

4. Triple Bottom Line (TBL)
The Triple Bottom Line (TBL) methodology deals with the principle of sustainability, in three dimensions: economic, environmental, and social. Therefore, TBL is defined as the joint assessment of environmental, social, and economic sustainability which is the basis for sustainability as well as efficient use of resources [17].

At the macro level, the best indicator of corporate responsibility behavior is cultural and social values. Whereas the next generation cares about the economic companies' responsibility in comparison with the environmental or social responsibility on the generational level[17]. According to the Global Reporting Initiative 2006, three main axes of TBL are: (Profit, Planet, People)[18]. The implementation of TBL is successful, if it leads to the development and diffusion of sustainable innovation by the company, thereby promoting economic growth and favoring an environmental and social responsiveness[19]. Measuring the social and environmental dimensions is one of the challenges facing the implementation of TBL, such as finding applicable data and how the policy or project contributes to sustainability. Also, there is a challenge related to the difficulty in comparing the accounts of the planet and people in terms of cash and the method of calculating profit[20].

4.1 The economic dimension
The economic dimension represents the impact of organizations' work practices on the economic system [21]. The economic dimension focuses, on the economic value that the organization provides to the surrounding system, in a way that develops and improves its ability to help the next generation, and the economic line can be considered as a link between the growth of the organizations and economic growth and the extent of contributing to its support. Capital flow, company financial performance, and economic participation in society fall within the economic dimension. Companies that use TBL reports adhere to principles developed internally and externally, so they focus on the impact of their operations on societies[18].

The economic dimension represents the project capital, so the capital must be managed efficiently. In order to enable economic sustainability, companies must avoid suffering from financial problems and provide a high level of profit to stakeholders[22]. It is concerned with the ability of the economic dimension, as a subsystem of sustainability, to future development and survival, to support the next generation[23].

4.2 The social dimension
Social performance deals with community participation, fair wages, and employee relations; It focuses on the interaction between the institution and society[18]. The social dimension of the TBL concept symbolizes the requirements for implementing beneficial and fair practices for work, society, and human capital. Where these applications give value to society such as health insurance and fair wages[24].

4.3 The environmental dimension
The efficient use of the energy source includes protecting ecological balance and reducing greenhouse gas emissions, among others[18]. The environmental dimension of the TBL framework guides subsequent generations to the practices that conserve environmental sources from hazards,
Environmentally sustainable institutions should be concerned with sustainable practices, such as reducing energy use, using renewable energy sources, using recyclable materials, and safe disposal of toxic waste[25].

5. Methodology
A field survey was conducted to achieve the research objectives, as follows:

5.1. A questionnaire
After reviewing the previous literature, a field survey was conducted. It is one way to collect the most non-quantitative information from the community. It was conducted in two stages:
The first stage: an open questionnaire, in which the prepared questionnaire form was discussed with a group of experts to know the accuracy and clarity of the questions asked, with the possibility of amending it for the research service.
The second stage: the closed questionnaire. The questionnaire was distributed to a group of engineers with no less than five years of experience, in different specializations related to the maintenance of government buildings, and various educational certificates, and they work in different departments in Iraq and with different positions of department managers, department heads and others. In line with statistical theories.

(100) copies of the questionnaire were distributed, and only (78) forms were returned, and (75) forms were approved, and 3 forms were ignored due to errors and incomplete information. The questionnaire consists of two axes, the first axis includes personal information (characteristics of the study population), and the second axis includes two questions, one of which is related to the factors affecting the application of the concept of the triple bottom line (TBL), while the second question relates to the possibility of applying the necessary indicators, to apply the concept of the triple bottom line (TBL) to enable the adoption of the Triple Bottom Line (TBL) concept to measure the maintenance performance of government buildings.
The data obtained were analyzed where the index of relative importance of factors and indicators was calculated for the purpose of knowing which are more important for the purpose of application in case studies. Tables (1) and (2) illustrate the results of the analysis. The Cronbach alpha test was calculated to measure the reliability of the questionnaire, and the result was equal to (0.883) for the entire questionnaire, which indicates an excellent level of reliability.
The important factors affecting the application of TBL, in measuring maintenance performance, appeared as follows: The quality and age of work and its impact on the environment (RII 0.88), we believe that the quality of work is important and influential in all aspects, whether environmental, social, or economic. Income (wages) (RII 0.87), we believe that wages and rewards stimulate the completion of work quickly and accurately. The raw materials used in the work (RII 0.87), we believe that the use of raw materials that are environmentally friendly, sustainable or recyclable, is very influential in the implementation of TBL, which pays great attention to the environmental aspect. User satisfaction (RII 0.85), it is considered important, especially in the early stages of maintenance, the needs of the users must be known because their use of the building makes them more aware of what you need. The age and quality of the building (RII 0.85), we believe this is important in determining the building's need for maintenance, in order to ensure that the building performs its function. Management quality (RII 0.85), we believe that good management follows the method of involving everyone and effective communication with all parties, thus achieving the goals of the project. The financial performance of the company (RII 0.84), it goes without saying that this factor is important, as any project is concerned with the financial aspect and works to improve financial performance.

As for the rest of the indicators, they have attained the second level of importance, which are; the impact of the local economy (RII 0.80), the impact of the location of the work activity, and its distance on the local environment (RII 0.80), reuse the building with the aim of preserving the environment (RII 0.77), transport efficiency in terms of its environmental impacts (RII 0.77), work injuries (RII 0.75), its quantitative and qualitative effects on local, national, and international resources (RII 0.74).

Table 1. Factors affecting the application of the Triple Bottom Line (TBL)

| Factors                                                                 | Mean | RII  | RII-Level |
|------------------------------------------------------------------------|------|------|-----------|
| Income (wages)                                                         | 4.33 | 0.87 | H         |
| Work-related injuries                                                  | 3.73 | 0.75 | M-H       |
| User satisfaction                                                      | 4.27 | 0.85 | H         |
| The impact of the local economy                                       | 4.01 | 0.8  | M-H       |
| The age and quality of the building                                   | 4.25 | 0.85 | H         |
| The quality and age of the work and its impact on the environment      | 4.4  | 0.88 | H         |
| The raw materials used in the work                                    | 4.33 | 0.87 | H         |
| The impact of the location of the work activity and its distance on the local environment | 4.01 | 0.8 | M-H |
| Reuse the building with the aim of preserving the environment         | 3.83 | 0.77 | M-H       |
| Quality of management                                                 | 4.27 | 0.85 | H         |
| Transport efficiency in terms of its environmental impacts            | 3.85 | 0.77 | M-H       |
| Its quantitative and qualitative effects on local, national and international resources | 3.69 | 0.74 | M-H |
| The financial performance of the company                              | 4.19 | 0.84 | H         |
All economic indicators mentioned in the questionnaire can be widely applied in government institutions, according to the opinion of the respondents, as they were at the first level (H), according to the index of relative importance, which is:

Worker practices such as occupational health and safety (RII 0.75), we believe that a health and safety indicator can be easily applied by providing a first aid box and educating workers on how to deal with emergency situations. The professional development of employees (RII 0.75), we believe that this factor can be applied through training and professional development. Materials (RII 0.75), it can be applied by using environmentally friendly materials and examining the existing materials to be used in the work. This is what is done in projects. Contribution to the field of unemployment problems (RII 0.73), by providing job opportunities for local workers and cooperation between the public and private sectors.

Transportation (RII 0.73), this indicator can be applied by avoiding crowded roads to avoid delays in transporting materials and equipment, moving away from internal roads to maintain the road, and taking transportation costs into consideration, especially if the maintenance project is outside the city. Indirect economic impact on society (RII 0.70), we believe that it can be implemented through the support of the local private sector such as quarry workers, food suppliers, and brick and cement factory workers, that is, those who benefit indirectly from the project. Human rights such as child labor (RII 0.70), by sending warnings to those responsible for carrying out the work, such as contractors and secondary contractors. Product responsibility such as customer health and safety (RII 0.70), we should be careful to read the brochures that come with products such as dyes and others, as well as the product can be compared with another product that has good standards, and to be careful to work with substances that are not harmful to the health of the user. Suppliers (RII 0.69), working to

| Factors                                                   | Mean | RII | RII-Level |
|-----------------------------------------------------------|------|-----|-----------|
| Indirect economic impact on society                       | 2.12 | 0.7 | H         |
| Provides transparency                                     | 2.07 | 0.68| H         |
| Worker practices such as occupational health and safety    | 2.28 | 0.75| H         |
| Human rights such as child labour                         | 2.12 | 0.7 | H         |
| Product responsibility such as customer health and safety  | 2.11 | 0.7 | H         |
| The professional development of employees                 | 2.28 | 0.75| H         |
| Contribution to the field of unemployment problems        | 2.21 | 0.73| H         |
| Materials                                                 | 2.28 | 0.75| H         |
| Emissions                                                 | 1.89 | 0.62| M         |
| Liquid wastes and residues                                | 1.97 | 0.65| M         |
| Products and services, including sustainable resources in production, their availability and application of production standards and charters | 2.04 | 0.67| H         |
| Transportation                                            | 2.2  | 0.73| H         |
| Suppliers                                                 | 2.08 | 0.69| H         |
| Environmental assessment                                  | 1.99 | 0.66| M         |
| Security aspects                                          | 2.09 | 0.69| H         |
reduce the delivery time through pre-booking with sufficient time and dealing with reliable and efficient suppliers. Security aspects (RII 0.69), by ensuring the presence of lighting at the site and securing the guard. Transparency (RII 0.68), through the functioning of a monitoring system, to reduce financial and administrative corruption, as well as clarity in giving instructions. Products and services, including sustainable resources in production, their availability and application of production standards and charters (RII 0.67), we believe that project members can be educated on the use of sustainable materials, find appropriate standards for local application, and monitor their application. As for the indicators that can be applied in local institutions, according to the opinion of the respondents, and which fall within the second level (M), in relation to social indicators: Environmental assessment (RII 0.66), emissions (RII 0.65), liquid wastes and residues (RII 0.62).

5.2. case study

Three case studies were selected, for the purpose of realistic implementation of the results reached, and the projects were (Anfal School in Wasit Governorate / Al Kut, College of Veterinary Medicine / Wasit University in Wasit Governorate / Al Hayy District, and Tahrir School in Wasit Governorate / Al Muwafiqia District ), Due to the researcher's ability to do so. Access to important and necessary data, and the presence of a large number of government buildings that need maintenance in these government institutions, and because they suffer from the lack of financial allocations for maintenance work that takes place at the same time, so the maintenance projects for these institutions are selected suitable to verify the validity of the results.

5.2.1. Al-Anfal School
Anfal School consists of 24 classrooms, an administrative wing, and a hall, two floors, established in 1988, located in Wasit / Kut / Khajia Governorate, the condition of the building's structure is good, but it needs a comprehensive restoration, the cost of the maintenance project is 50 million Iraqi dinars, the implementing agency for the work is the Directorate of Education Wasit, by Amana implementation method, followed the traditional management control system to measure the maintenance performance of the project.

5.2.2. Wasit University / College of Veterinary Medicine
The College of Veterinary Medicine is located in Wasit Governorate / Hay District, with an area of 2000 square meters, the last year the building was maintained in 1993, the cost of the maintenance project is 500 million Iraqi dinars, the work was carried out using the bidding method, the performance measurement system used in the project, the traditional administrative control

5.2.3. Al-Tahrir School
Al-Tahrir School is considered one of the old schools, as it was built in 1972, but the building is in good condition. It is located in Wasit governorate / Hay Al Hayy, specifically in Al Mawfkia district (Al Tahrir Village). The number of classes is 6 classes, the area of the school is 3500 square meters, the cost of the restoration is 45 million Iraqi dinars. The work was carried out by the Wasit Education Directorate, using the method of implementing the secretariat, the traditional budget system followed in measuring the maintenance performance of the project. A set of questions were directed to the supervising authority of the above-mentioned projects, and the results of the answers were analyzed as shown in tables (3), (4).
A triple scale was used (important, average, not important), by analyzing the factors that affect the application of the Triple Bottom Line (TBL) as a tool for measuring maintenance performance, we note that the general mean of factor averages is (2.43), which means that it lies between important.

Table 3. The analysis of the effect of factors affecting the use of the triple bottom line (TBL) according to case studies

| Questions                                                                 | mean |
|---------------------------------------------------------------------------|------|
| What is the impact of income (wages), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.33 |
| What is the impact (user satisfaction), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.33 |
| What is the impact (The age and quality of the building), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.67 |
| What is the impact (The quality and age of the work and its impact on the environment), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.67 |
| What is the impact (raw material used in your work), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.33 |
| What is the impact (quality management), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2   |
| What is the impact (the financial performance), on the project, so that we can apply the Triple Minimum (TBL) in measuring maintenance performance? | 2.67 |
| Average                                                                   | 2.43 |

Table 4. The analysis of applicability of TBL indicators according to cases studies

| Questions                                                                 | mean |
|---------------------------------------------------------------------------|------|
| The applicability of the indicator (economic impact is not directly on the community) in your so that we can apply the TBL in measuring performance for maintenance? | 1    |
| The applicability of the indicator (transparency) in your so that we can apply the TBL in measuring performance for maintenance? | 1.67 |
| The applicability of the indicator (Occupational Health and Safety Practices for Workers) in your so that we can apply the TBL in measuring performance for maintenance? | 2    |
| The applicability of the indicator (human rights such as child labour) in your so that we can apply the TBL in measuring performance for maintenance? | 2    |
| The applicability of the indicator (product responsibility, such as the health of customers, i.e. the beneficiaries of the work and their safety) in your so that we can apply the TBL in measuring performance for maintenance? | 2    |
| The applicability of the indicator (professional development of staff) in your so that we can apply the TBL in measuring performance for maintenance? | 2    |
A triple scale was used (possible, medium, not possible), we note by analyzing the TBL indicators, according to the case studies, that the total rate of the indicators was (1.81), meaning it is applicable. Through the analysis of case studies, it was found that the factors of the triple bottom line (TBL) concept are closer to being a task that lies between important and medium, as well as indicators that can be applied, so it can be said that the concept of the triple bottom line (TBL) can be used in measuring the maintenance performance of buildings government.

6. Conclusions
This study tried to present the concept of the triple bottom line as a tool as a methodology for measuring the maintenance performance of government buildings, like most projects, including maintenance projects for buildings, measure performance based on the traditional financial aspect, and do not take into account the environmental and social aspects. This study clarified through the results of the prepared questionnaire that the most important factors affecting the application of the concept of the triple bottom line as a methodology for measuring maintenance performance of government buildings are: The quality and age of work and its impact on the environment, income (wages), the raw materials used in the work, user satisfaction, the age and quality of the building, management quality, the financial performance of the company. As for the most locally applicable indicators according to the field survey: Occupational safety practices, the professional development, materials, contribution to the field of unemployment problems, transportation, the indirect economic impact on society, human rights such as child labor, product responsibility such as customer health and safety, suppliers, security aspects, transparency, products, and services. According to the case studies that have been taken, to realistically and more accurately identify the extent of the influence of the factors and the extent to which the indicators can be applied to the triple bottom line methodology, we find that the concept of the triple bottom line can be used as a tool to measure the maintenance performance of government buildings, and this means that it can be used to improve and develop the reality of performance Maintenance of government buildings in Iraq.

The most obstacles facing performance measurement in institutions, according to the opinion of the respondents, are poor strategic planning, insufficient training for current employees, fear of taking responsibility for the last evaluation, as some judges give (middle) evaluations that do not show the true level of performance, multiple and conflicting priorities and objectives, Lack of clarity of standards for managers and evaluators. The most obstacles facing performance measurement in
organizations according to case studies are multiple and conflicting priorities and objectives, failure to choose an accurate standard in the measurement process, evaluation forms that do not cover all aspects. Therefore, the obstacle of multiple and conflicting priorities and objectives is one of the most important obstacles that hinder performance measurement in institutions. According to the answers we got from the respondents, the improvements that must be made in organizations that want to introduce effective methodologies to improve their business performance, such as the three-point approach, for use in measuring performance, are: Training and educating working cadres, whether by holding specialized courses or making field visits to modern projects, in addition to setting goals and strategic planning, using modern technologies instead of the traditional methods used, communicating with international companies with high experience, using modern and sustainable materials, setting specific standards for measuring performance in such a way that they have the ability to apply locally, use quality standards, employ highly qualified and experienced people in jobs that require decision-making and guarantee workers' rights.

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