

## **Impact of Proper Financial Strategy on Project Prosperity**

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### **Abstract**

*The most prominent factor to achieve prosperity in mega-projects is payment method, which allows for an adequate cash reserve to inject into the project in case. Methods of payment are related to progress measurement (PMS) and forecasted cash flow, which are both determined in a preliminary project stage. This case attempts to indicate deficiency of the milestone (0/100) method, which caused negative cash flow in the procurement phase, whereas only this method is reliable for the employer to accept the contractor invoice. In this respect, the preliminary data analysis will be applied for normality and descriptive tests. Thereafter, an independent samples t-test should recognize the accuracy of the contractor's claim due to negative cash flow as a result of significant differences between physical progress and former milestone methods. Hence, modified milestones are introduced to compensate the contractor's negative cash flow which considers the employer's interest as well. Results of this research are based upon data collected from one of the EPC contractors undertaking oil and gas refinery in the south of Iran.*

**Keywords:** PMS, CPI, Milestone (0/100), Physical Progress, Earned Value

### **1. Introduction**

Method of payment is one of the most challenging issues between employers and general contractors. In one perspective, employers are satisfied and therefore confident in payment to main contractors whenever they meet a distinct milestone. From another point of view, general contractors split the project into specific segments, in order to assign the professional sub-contractors who are eager to be paid based on their physical progress, whilst general contractors receive cash in compliance with assigned milestones by an employer, which conceivably might result in a negative cash reserve if milestones are not determined precisely. In order to avoid this problem, it is preferred that obtained progress based on the milestone method becomes close to physical progress. Accuracy or discrepancy between such methods can be realized clearly after the project set up; in accordance with financial cost ratios which clarify the cash reserve condition and accuracy of payment methods.

In this case, one Iranian general contractor in the oil and gas industry has been chosen. The contract of this mega project is estimated to be worth \$3000 million, which consists of all engineering, procurement and construction phases. Further, the main contractor is paid based on physical progress in the construction phase (Unit rate), while being paid according to the milestones method during both the engineering and procurement phases. As result of the payment method in procurement phase, this contractor has encountered a negative cash reserve based on financial reports. In this case study, the following steps should be applied with the purpose of achieving modified milestones in favor of the general contractor to eliminate its negative cash flow.

- Illustrating required budget for contractor based on the employer's plan.
- Evaluating CV, CPI as the main financial ratios in projects.
- Compiling related research.

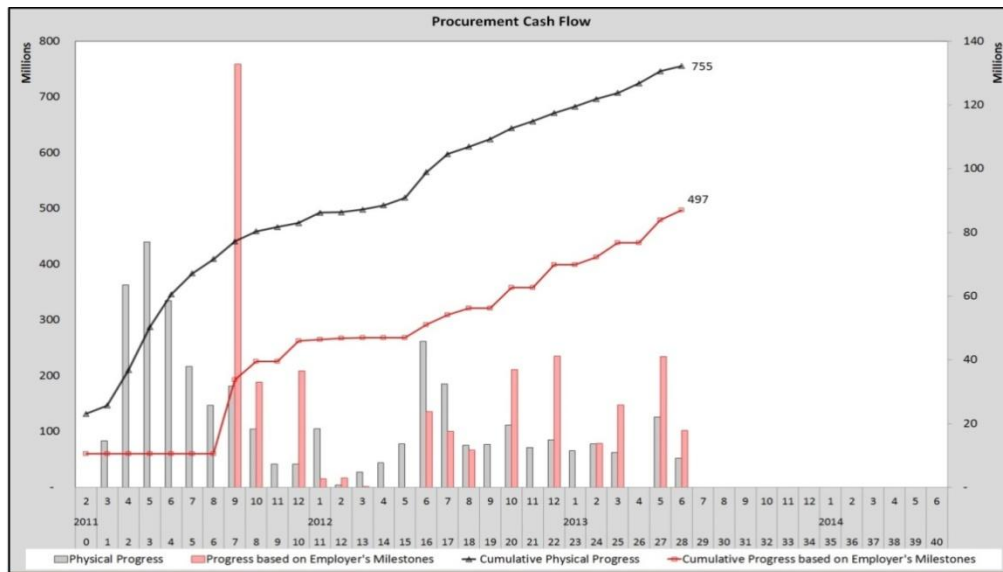
- Comparing methods of payment based on employer’s milestones and physical progress.
- Suggesting improved milestones in order to reduce discrepancy between milestone method and physical progress.
- Evaluating the required cash flow in compliance with physical progress and employer’s milestone

As illustrated by

Fig 1, there is a significant difference in achieving specific progress between the employer and general contractor. As a matter of fact, there are some predecessors which take time to award PO (Purchase Order), while such steps have been neglected by the employer as milestones for payment to the general contractor. Due to the aforementioned issue this project has not been paid for these periods, which leads to a significant gap at the earlier stage.

In order to create a PO, the following steps should be undertaken respectively:

- MR (Material Requisition): defined as the engineering documents to conduct procurement sector for purchasing equipment.
- Bid: An offer made by the employer and general contractor to procure equipment. The bid will clarify the contract price at which a sub-contractor is willing to buy the equipment, and the quantity intended for purchase.
- TBE (Technical Bid Evaluation): covers all detailed technical analyses which are required to award the PO.
- CBE (Commercial Bid Evaluation): refers to determine sub-contractors in aspect of its financial pretension related to contract.(Baron, 2010)



**Fig 1: Comparison of Progress Based on Employer’s Milestone with Physical Progress**

However, the general contractor is logically able to claim its own progress by starting the mentioned steps, which aims to release the procurement invoice, but according to employer’s approach, the procurement invoice is only payable after PO. Procurement milestones after PO are split into various stages, depicted in the table below.

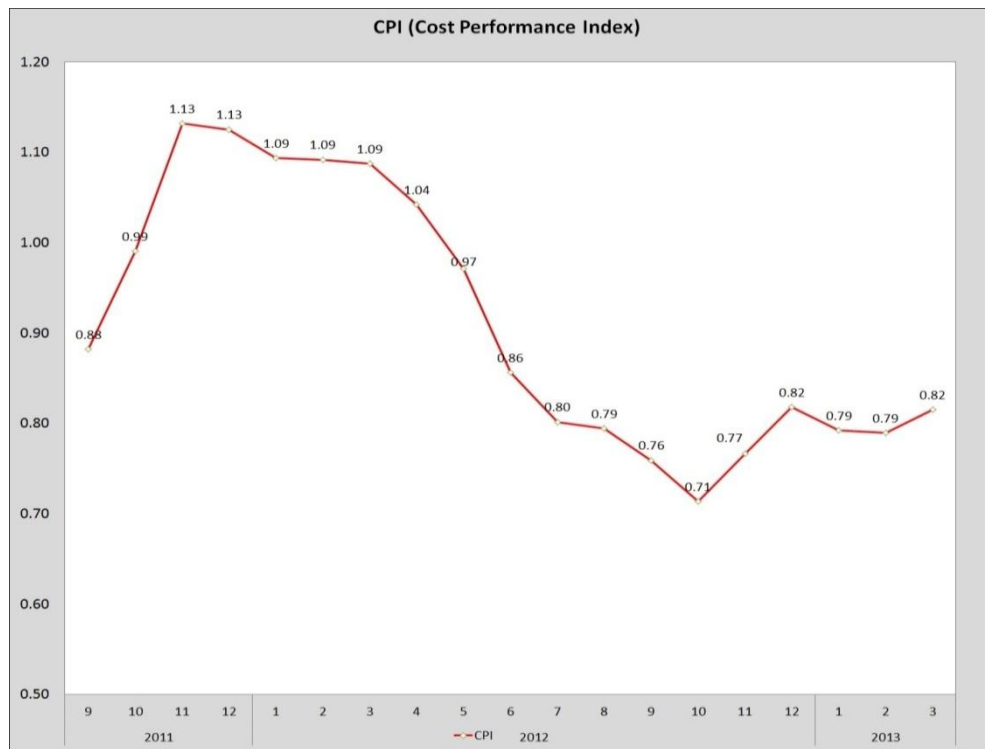
**Table 1: Procurement Milestones Assigned by Employer**

|         | Milestones | PO  | Preparation of 70% Raw Material at Vendor Shop | Achievement of 70% Progress In Fabrication | Achievement of 100% Progress In Fabrication | Delivery at Site |
|---------|------------|-----|--|--|---|------------------|
| Inside  | Progress   | 22% | 17%  | 17%  | 6%  | 38%              |
| Outside | Milestones | PO  |  |  |   | Delivery at Site |
|         | Progress   | 20% |  |  |   | 80%              |

As indicated by Table 1, there are two categories, which indicate whether the PO is created inside or outside of Iran. If the PO is awarded to outside sub-contractors, the general contractor will be paid 20% of equipment value at first, the remainder being paid after delivery of whole equipment package at site, while sub-contractors are willing to be paid in compliance with their physical progress due to lack of affordability to cover their expenditures.

**2. Interpretation of CPI Related to Project**

CPI is defined as the ratio to indicate cost efficiency of budgeted resources, which can be estimated by dividing earned value by actual cost (PMBOK, 2013). CPI indicates the financial condition of each project which absolutely affects EAC (Estimate At Completion). Hence, future required budgets of each project can be anticipated by considering the CPI. However, in order to demonstrate the financial performance, CPI related to procurement sector is illustrated in Fig 2.



**Fig 2: General Contractor cost Performance**

As mentioned previously, the procurement invoice for such a company was payable by the lag of some months; therefore the CPI of this project is negative at the earlier stage, gradually reaching positive values. Although payment to the contractor caused positive cash flow, imperfection of assigned milestones led to negative cash reserve continuously.

**3. Literature Reviews**

Contract, constructability, cost and resource management should be considered in the set up stage in account of their significant impacts on other stages of the project lifecycle. These aspects of scheduling might be assessed generally in the preliminary step and become more prominent in evaluating when the project makes further progress. Financial assessments are affected by a contract, which is a bid in accordance with plans and other specifications with a fixed duration of time (AACE, 2003). Earned value intends to clarify the relationship between work performed and incurred actual cost in a specified period. In other words, an evaluation between the amount of planned budget and what was actually spent is the main objective of the earned value calculation. In order to analyze earned value, the following three basic elements should be considered:

- BCWS (Budget Cost of Work Performed) or PV (Planned Value) is the planned budget to spend in each period of the project.

- ACWP (Actual Cost of Work Performed) indicates the actual cost which is incurred based on work performed.
- BCWP (Budget Cost of Work Performed) or EV (Earned Value) is defined as the value of work which has been actually performed during a given period (PMBOK, 2013).

These three components are applied with the aim of assessing whether or not the project is going ahead in compliance with plan.

There are various tools in managing portfolios; however, project managers are increasingly concerned about how desirable benefits can be achieved by stakeholders more efficiently.

In order to manage a portfolio efficiently there should be a precise overview of the ongoing state of the portfolio. Thereafter, problem areas should be determined. The last and most important part is rectifying current problems regarding proper resource allocation. Therefore, there are trade-offs between schedule, cost and performance. In other words, appropriate balance among such mentioned components enables project prosperity to continue. (Ordonez et al., 2004)

Park, et al (2005) offered a new model of cash flow with respect to the contractor's viewpoint, which provides a practical tool during the construction phase regarding earned value and actual incurred cost. Most previous models have been collaborated with contractors to anticipate cash flow in the early stage of project. According to their findings, the critical question to forecast cash flow is how to prepare a realistic cash-out and cash-in model along with time lags in payment procedure.

Yau Wen Soon (2007) expressed that delay in the construction industry would almost be inevitable. He conducted his research over 150 respondents with regard to both causes and effects of project delays. According to his research some of the most important causes of delay were revealed as follows: improper plan of contractor, problems with sub-contractor and inadequate client cash reserve to pay for work performed. Therefore, the main reason of falling behind the schedule can be defined as improper financing by both the contractor and the employer. Furthermore, time and cost overruns were figured out as the main effects of such mentioned causes.

Odeyinka, et al (2008) clarified the impact of risk factors on deviation between the forecast and actual cash flow. Their study was focused on UK contracting organizations, which were categorized into three subsets of small, medium and large according to their annual turnover. Their methodology was based on mean response analysis and univariate analysis of variance (ANOVA) to examine variation of opinions among respondent's subsets. In regard to their findings risk factors were classified into three categories: changes in specifications and design, project complexity and project environment. Based on their findings, there is no significant difference among the opinion of different groups regarding such impacts on forecasting the cash flow.

Fleming and Koppelman (1998) expressed earned value transfer as a signal to forecast the final required budget to accomplish the project. The main predecessors to compute the precise earned value would be an accurate progress measurement method, which affects both earned value and payment to contractors. According to his research, in order to estimate an accurate progress measurement method the project should be fully defined. In other words, a bottom up plan is the most important factor to measure the performance during the entire period of project's life cycle. In further details, such mentioned tools provide reliable interpretation of project's performance whenever the PMS reaches 15 percent of the whole. This interpretation consists of performance regarding anticipation of how much cost is incurred to complete the projects.

Concerns of the employer and the contractor are different from one another with respect to project cash flow. In more detail, although the employer should be aware that adequate access to the cash reserve must remain available up until the end of the project due to various opportunities to accomplish activities, contractors worry about the overall cost of project which has already been contracted (Sol and Litchfield, 1980).

There are two approaches toward progress measurement and methods of payment. First, the employer is not interested in a position where the main contractor becomes overpaid, because this means unearned profit for the actual work performed. On the other hand, the contractor wouldn't like to be underpaid which causes lack of cash flow that might interrupt the project progress. Main reasons of underpayment to contractors are:

- Slow payment to contractor by owner due to shortage of capital.
- Employer-mandatory delay of payment to compel the contractor into expediting the project.
- Project delay regarding the contract variation order.

Therefore, the employer is interested in using milestone methods to avoid overpayment and the contractor would like to achieve the budget for all actual work performed (Fisk, 1997).

Whitticks (1994) stated the fundamental expectation of the employer toward a project. Although execution in compliance with specifications, on or ahead of schedule and on, or under budget are the main goals of the owner, the contractor would like to be paid on time, which is related to methods of payment. No employers would pay the whole amount of a contractor's invoice without verification. There should be an agreement on methods of payment, such as progress payment against achieved milestones, or accepted progress per month.

Fleming and Koppelman (1998) believed that progress payments should be based on physical progress of the work performed. Otherwise, an agreement must exist between employer and contractor about the proper payments. It is suggested that both contractor and employer follow a measurable plan to support future payments. For instance, SOV (Schedule of Value) is one tool applied in construction. SOV indicates the breakdown of material, labor and activities along with their values to use throughout the project lifecycle with the purpose of measuring the physical performance.

There are many methods to measure the progress of a project, which will be further explained: Unit Completed Method, Milestones Method, Start/Finish Method, Opinion Method, Cost Ratio and Weighted or Equivalent Method (AACE, 2003a).

**Unit Completed Method:** this type of progress measurement is appropriate for activities that are repeatable. In more detail, concrete pouring can be one proper example of using this method. If 80,000 cubic meters of concrete is needed for one structure, and 8,000 cubic meters of concrete have been poured, the completed percent by using this method is founded by dividing 8,000 cubic meters over 80,000 cubic meters, which indicates 10 percent complete.

**Milestones Method:** this method is applicable for activities that should be developed in sequence. In this method, in order to meet specified milestones, which represent a certain percentage of a whole project, required subtasks related to the milestones should be completed. The allocated percentage to each milestone is a combination of cost and estimated work hours to perform related subtask.

**Start/Finish Method:** this method is appropriate for activities that are not easily definable into incremental milestones. In the direction of measuring progress for such activities, 100 percent is considered when tasks are completed in very short duration, and for longer times it might be assigned 50 percent/50 percent to the Start/Finish percentages.

**Opinion Method:** in this kind of method, an expert determines a percentage complete for activities. Therefore this method depends on personal judgment. In other words, optimistic and pessimistic attitudes are the major problem of this method, such as temporary facilities which can be measured by a representative of the employer.

**Cost ratio Method:** this method is appropriate for activities which take a long time, or last as long as the project life, such as quality control and project control.

**Weighted or Equivalent Units Method:** this is applicable for tasks which take a long time and consist of two or more activities; each of these is measured with various work units. In pursuance of this method each activity is weighted based on its estimated work hours and cost. After measuring work progress of a single item, the overall percent completion for the whole project should be determined. Each activity in the project has its own work hours and budget which is applied, in order to calculate the overall progress of project.

$$\text{Overall Progress of Performed Work} = \frac{\text{Work hours or Cost of all Performed Activities}}{\text{Work hours or Cost of all Activities}}$$

Accuracy in progress measurement depends on the validity of data collected and total scope of work. However, in order to improve the accuracy of data collected, physical quantities which are applied to measure progress should be detailed precisely. Moreover, baselines should be revised periodically in order to increase validity of the total scope of work.

The objective of a project management system is to enable the scheduler to evaluate why a project is falling behind the baseline. The number of items in WBS, accuracy of measurement for each activity and the number of activities which alter in the measurement of progress in each period affect the accuracy of the total scope of work. Such findings are in compliance with the 'law of compensating errors'(Smith, 1989).

Under a lump sum contract, the contractor is paid in accordance with performed work regarding the authorized budget. To do so, in order to analyze earned value, the actual cost incurred by the contractor should be included; otherwise the cost performance index (CPI) cannot be estimated. However, a contractor is not generally interested in revealing its own profit to employer; on the other hand, the employer is entitled to be aware when the contractor is incurring a loss, which in turn leads to project loss in the future. (Fleming and Koppelman, 1998).

Clarification of progress payment is the most crucial issue in cash flow management. As a matter of fact, contractors are entitled to know the frequency of progress payment from the employer due to payments to labor, material and subcontractors, which helps the general contractor to determine conceivable financial problems and interest payments for short term loans (Lowe and Helen, 1993).

Copare (1990) expressed the major reasons for project failure, including insufficient budget, synchronized projects, inaccurate estimation, poor management, inadequate employer resources, personnel traits, and industry risks.

**Insufficient budget:** the contractor should have sufficient budget to cover its expenditures, such as cost of project start up, overhead and labor. However, advance payment won't be paid for almost one month to the contractor after effective date of contract; therefore, it should finance all expenditures by its own financial reserve, credit and other resources until progress payment is paid by the employer.

**Synchronized projects:** some contractors start new projects simultaneously, disregarding its own capacity and resources, which leads to contractor failure if any delay in payment occurs. Put another way, if a contractor keeps all budgets related to various projects in a single account, it cannot analyze precisely profits and losses due to lack of cost records exclusively for each project.

**Inaccurate estimation:** contractors sometimes underestimate budgets either deliberately or accidentally due to different reasons. It may underestimate intentionally to win in a bid; additionally, it may not consider unit labor cost for each item, unit cost of material and overhead cost due to lack of experience in participating bids, which causes business failure.

**Poor management:** the most important factor of project failure is poor management in planning, organizing and leading. Not all the reasons for project failure result from lack of budget and resources: managing and monitoring in resource allocation are both crucial factors in project prosperity.

**Inadequate employer resources:** in order to accomplish a project, the employer should have sufficient budget which is provided based on a feasibility study before project start up. Employers may sometimes run out of budget before the project is completed, which will lead to a partially completed project without the resources to continue.

**Personal traits:** some contractors are not able to cope with employers and subcontractors effectively, which may pose a problem in their mutual interactions.

**Industry risks:** some industries are categorized as hazardous business. Contractors may face this challenge when they undertake a new project. Contractor success may easily become failure by a single defeated project even after much prosperity in various projects. Weakness in one project can lead to loss of all profits which were accumulated over time.

Project cash flow is categorized into “summary” and “detail” to describe different aspects. Summary cash flow indicates the total budget for long-term planning, while detail cash flow is applied for short-term planning and for prediction of summary cash flow. Unrealistic cost estimation causes deviation of actual cost from the planned budget, which leads to project delays. (Williams, 2001)

An employer seeks to develop cash flow in order to determine the interest payment for short-term loans, certify sufficient budget to complete the project and choose the optimized plan to finance the project (Lowe and Helen, 1993).

#### **4. Research Methodology**

As mentioned previously, in order to achieve precise progress payments, there should not be significant differences between progress payment and physical progress of work performed. Hence, data used in this study were collected from one oil and gas refinery which operates in southern Iran. A Lump Sum Turn-Key Contract (LSTK) has been signed between the employer and general contractor to perform this project.

As a result of differences between physical progress and milestone method in this project, the general contractor claims losses due to ambiguous milestones which do not cover all the work performed by sub-contractors. Therefore, the general contractor intends to improve progress payment in two steps. First, it should demonstrate that there is a significant difference between physical progress and the milestone method. Second, it should notify new milestones close to physical progress which aim to accompany general contractor in payment to sub-contractor as well. To do so, an independent samples t-test is applied with the purpose of comparing the results of physical progress and milestones method to clarify that there is a significant difference between the two methods. Therefore, new milestones, which have been determined based on average payments to sub-contractors are introduced to improve the accuracy of payment method and provide an acceptable level for both employer and contractor. Finally, modified milestones method and physical progress are compared by using the independent samples t-test to indicate that the modified milestones method can be used as a substitute for physical progress.

**4.1 Descriptive Statistics**

In order to realize the main features of the data, descriptive statistics are applied for each sample. Descriptive statistics provide information on two aspects of the collected data: its central tendency and dispersion. Although mean, median, and mode are major means of determining the center of a dataset, the mean is most often used.

**4.2 Independent-Samples T-Test**

This kind of test is applied as a statistical examination in order to compare two population means. The most important assumption is that the variance of each group should be similar with each other. This condition is known as homogeneity of variances. The second condition is that both samples should be drawn from normally distributed populations.

**Hypotheses test**

**H<sub>0</sub>:** There is no significant difference between physical progress and milestones method.

**H<sub>1</sub>:** There is a significant difference between physical progress and milestones method.

**5. Data Analyses**

According to descriptive statistics, which are provided in Table 2, the following results can be extracted:

**Table 2: Descriptive Statistics of Physical Progress Along with Old and New Milestone**

| Descriptives |                                  |             | Statistic | Std. Error |
|--------------|----------------------------------|-------------|-----------|------------|
| Physical     | Mean                             |             | .3894     | .01508     |
|              | 95% Confidence Interval for Mean | Lower Bound | .3582     |            |
|              |                                  | Upper Bound | .4207     |            |
|              | 5% Trimmed Mean                  |             | .3895     |            |
|              | Median                           |             | .3883     |            |
|              | Variance                         |             | .005      |            |
|              | Std. Deviation                   |             | .07232    |            |
|              | Minimum                          |             | .27       |            |
|              | Maximum                          |             | .50       |            |
|              | Range                            |             | .23       |            |
|              | Interquartile Range              |             | .13       |            |
|              | Skewness                         |             | .052      | .481       |
|              | Kurtosis                         |             | -1.428    | .935       |
| OldMilestone | Mean                             |             | .2123     | .01417     |
|              | 95% Confidence Interval for Mean | Lower Bound | .1829     |            |
|              |                                  | Upper Bound | .2417     |            |
|              | 5% Trimmed Mean                  |             | .2147     |            |
|              | Median                           |             | .2061     |            |
|              | Variance                         |             | .005      |            |
|              | Std. Deviation                   |             | .06797    |            |
|              | Minimum                          |             | .04       |            |
|              | Maximum                          |             | .33       |            |
|              | Range                            |             | .29       |            |
|              | Interquartile Range              |             | .09       |            |
|              | Skewness                         |             | -.301     | .481       |
|              | Kurtosis                         |             | .520      | .935       |
| NewMilestone | Mean                             |             | .3564     | .02510     |
|              | 95% Confidence Interval for Mean | Lower Bound | .3043     |            |
|              |                                  | Upper Bound | .4084     |            |
|              | 5% Trimmed Mean                  |             | .3620     |            |
|              | Median                           |             | .3503     |            |
|              | Variance                         |             | .014      |            |
|              | Std. Deviation                   |             | .12036    |            |
|              | Minimum                          |             | .04       |            |
|              | Maximum                          |             | .55       |            |
|              | Range                            |             | .51       |            |
|              | Interquartile Range              |             | .18       |            |
|              | Skewness                         |             | -.455     | .481       |
|              | Kurtosis                         |             | .626      | .935       |

**Table 3: Normality Test of Physical Progress Along with Old and New Milestone**

|              | Tests of Normality              |    |       |              |    |      |
|--------------|---------------------------------|----|-------|--------------|----|------|
|              | Kolmogorov-Smirnov <sup>a</sup> |    |       | Shapiro-Wilk |    |      |
|              | Statistic                       | df | Sig.  | Statistic    | df | Sig. |
| Physical     | .160                            | 23 | .131  | .933         | 23 | .129 |
| OldMilestone | .125                            | 23 | .200* | .961         | 23 | .479 |
| NewMilestone | .134                            | 23 | .200* | .945         | 23 | .226 |

a. Lilliefors Significance Correction

\*. This is a lower bound of the true significance.

**5.1 Interpretation of Physical Progress**

- The mean is 0.3894 with a standard deviation of 0.07232.
- The median is 0.3983, which is very close to mean, which points out that data is quite symmetrical.
- The skewness is 0.52, which is within [-1, +1], therefore physical progress is quite symmetrical.
- The 95% confidence interval for population mean is [0.3582, 0.4207].

**5.2 Interpretation of Descriptive Statistics Related to Progress Based on the old Milestones Method**

- The mean is 0.2123 with a standard deviation of 0.06797.
- The median is 0.2061 and it is very close to mean, which indicates that progress based on the old Milestone method is quite symmetrical.
- The skewness is -0.301, which is within [-1, +1], therefore progress based on the old Milestones method is quite symmetrical.
- The 95% confidence interval for population mean is [0.1829, 0.2417].

**5.3 Interpretation of Descriptive Statistics Related to Progress Based on the New Milestones Method**

- The mean is 0.3564 with a standard deviation of 0.12036.
- The median is 0.3503 and it is very close to mean, which indicates that progress based on the new milestone method is quite symmetrical.
- The skewness is -0.455, which is within [-1, +1], therefore progress based on the new milestone method is quite symmetrical.
- The 95% confidence interval for population mean is [0.3043, 0.4084].

**5.4 Normality Test**

According to test of normality, all sample-physical progress and progress based on old and new milestones show no significant departure from normality. In the other words, the p-values (sig) for the Kolmogorov-Smimov Test and Shapiro-Wilk of normality for all samples are more than 0.05. Therefore null hypotheses, which are defined as normality of all samples, are not rejected.

**5.5 Independent Samples T-Test**

The independent samples t-test is applied in account of the existence of two different samples for one project. In more detail, the independent sample t-test is used to compare means for two groups of physical progress and old milestones method. Thereafter, such a test is applied again for two categories of physical progress and new milestones method, in order to evaluate whether or not there is a significant difference between the samples.

**Table 4: Independent Samples T-Test of Physical Progress Along with Old Milestone**

| Group Statistics |               |    |       |                |                 |
|------------------|---------------|----|-------|----------------|-----------------|
|                  | Progress type | N  | Mean  | Std. Deviation | Std. Error Mean |
| value            | Physical      | 23 | .3894 | .07232         | .01508          |
|                  | Oldmilestone  | 23 | .2123 | .06797         | .01417          |



**Table 5: Independent Sample T-Test of Physical Progress Along with Old Milestone**

|       |                             | Independent Samples Test                |      |                              |        |                 |                 |                       |   |        |
|-------|-----------------------------|---|------|------------------------------|--------|-----------------|-----------------|-----------------------|---|--------|
|       |                             | Levene's Test for Equality of Variances |      | t-test for Equality of Means |        |                 |                 |                       |   |        |
|       |                             | F                                       | Sig. | t                            | df     | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |        |
|       |                             |   |      |                              |        |                 |                 |                       | Lower                                     | Upper  |
| Value | Equal variances assumed     | 1.016                                   | .319 | 8.560                        | 44     | .000            | .17716          | .02070                | .13545                                    | .21887 |
|       | Equal variances not assumed |   |      | 8.560                        | 43.832 | .000            | .17716          | .02070                | .13545                                    | .21887 |

**Table 6: Independent Samples T-Test of Physical Progress Along with New Milestone**

| Group Statistics |               |    |       |                |                 |
|------------------|---------------|----|-------|----------------|-----------------|
|                  | Progress type | N  | Mean  | Std. Deviation | Std. Error Mean |
| value            | Physical      | 23 | .3894 | .07232         | .01508          |
|                  | NewMilestone  | 23 | .3564 | .12036         | .02510          |

**Table 7: Independent Samples T-Test of Physical Progress Along with Old Milestone**

|       |                             | Independent Samples Test                |      |                              |        |                 |                 |                       |   |        |
|-------|-----------------------------|---|------|------------------------------|--------|-----------------|-----------------|-----------------------|---|--------|
|       |                             | Levene's Test for Equality of Variances |      | t-test for Equality of Means |        |                 |                 |                       |   |        |
|       |                             | F                                       | Sig. | t                            | df     | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |        |
|       |                             |   |      |                              |        |                 |                 |                       | Lower                                     | Upper  |
| value | Equal variances assumed     | 3.978                                   | .052 | 1.130                        | 44     | .265            | .03308          | .02928                | -.02593                                   | .09208 |
|       | Equal variances not assumed |   |      | 1.130                        | 36.055 | .266            | .03308          | .02928                | -.02630                                   | .09245 |

First of all Levene’s test is run to evaluate the equality variances, as depicted by Table 6. The null hypothesis is not rejected and independent samples test is homogeneous. Based on the p-value for the test of mean and 95% confidence interval, there is a significant difference in measuring progress in compliance with physical and old milestone method due to p-value 0.00, which is lower than 0.05; in addition the confidence interval of the difference is [0.13545, 0.21887], which doesn’t include 0. Therefore, as mentioned previously, there is a significant difference between physical progress and progress based on the old milestone method.

As illustrated by

Table 7 Levene’s test is also run for both physical progress and progress based on the new milestone method to evaluate the equality variances. However, according to p-value = 0.052 of Levene’s test the null hypothesis, which points out the homogeneity of data, is accepted. Furthermore, based on p-value for the test of mean and 95% confidence interval, there is no significant difference in measuring progress regarding physical and new milestone method due to a p-value = 0.265, which is greater than 0.05; in addition the confidence interval of the difference is [-0.02593,0.09208] which does include 0.

**6. Conclusion**

Cost control is an essential part of project management with the purpose of financing projects precisely. As elaborated, the progress measurement method is the factor in influencing progress payments to the contractor. This study focused on discrepancies between the two methods of payment, which were based on physical progress and milestone methods. The results of this study showed there was a significant difference between the two mentioned methods due to different viewpoints of employer and contractor. The employer is entitled to choose a reliable way of measuring progress in order to determine progress payment to the contractor, while most of the time general contractors pay sub-contractors based on physical progress or the more detailed milestone method in account of their lower affordability compared with main contractors. This case aimed to determine one method of payment to fulfill both the expectations of the employer and the sub-contractors.

Therefore, independent samples t-test has been chosen to evaluate whether there is a significant difference between the two methods, and later, to identify an improved milestone method to meet the aforementioned expectations. According to clear differences between the physical progress and existing milestone method, one new milestone method was suggested in order to avoid negative cash flow.

Inevitably, at the earlier stage of the project, it is impossible to estimate accurate milestone methods for payment to the general contractor by the employer, because activities and tasks may not yet be assigned to sub-contractors. As time passes, inaccuracy in choosing milestones would be revealed because of payment to sub-contractors based on their capability and affordability. Hopefully, this study supports other projects with similar conditions.

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