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Presenting Countermeasures against Deviations in Projects Progress, Using Improved S-Curve

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Abstract **-** One of the greatest issues of project-driven organizations is the delay in their completion. Delay which has a nature of deviation basis and sometimes look so normal. Delay which instead of playing the role of a caution to managers, acts as a repetitive action. In such a situation the managers prefer to use the control tools and management of projects so that they can take a step for betterment. From these kinds of graphs we can mention Bullet Graph, Bar Graph, Pie Graph and S-Curve. Among these tools, S-Curve can be mentioned as one the essential ones. In this article, first we are going to define this curve; analysing its different usages, we will start with evaluating the role of this curve in management of deviation in the project and identify the problems and issues related to the usage of this curve in the second place. Finally, we will consider solving this problem, develop the S-Curve and introduce a new curve with the title of OS-Curve and apply it in two different projects and present its conclusions.

Keywords**:** Project Planning- S Curve- Project control- Project Process – Monitoring and Control Tools – OS Curve- S Curve Chart Analysis

1. Introduction

Since, at the time of delay happening, the stakeholders criticize the project managers immediately, they try to consider quintuple Processes of Standard PMBOK at the beginning of the initiating phase and planning the project and use them as tools in order to minimize the adverse conditions of the project. It cannot be denied that deviation from the approved developing the schedule is an accepted act with high probability; there is no project manager who would not wish to complete a project without the presence of such problems though.

In order to take countermeasures against such conditions, project managers use the monitoring and controlling tools, Tools that are sometimes cautionary and sometimes reporting. Among various tools which are being used, Gant Chart Graph and S-Curve have always been two of the most significant and efficient mentioned. However, there are still many projects encountering the delay problem and this issue depicts the weakness of these tools. In this article, it is attempted that after identifying the flaws in planning phase, with betterment of the control phase of the project and representing solutions while solving them, introduce the Optimization S-Curve (OS-Curve).

2. The Basic Concepts

- Project

A project can be defined as a temporary endeavour undertaken to create a unique product or service. Projects are different from other on-going operations in an organization, because unlike operation, projects have a definite beginning and an end. They have a limited duration[1].

- Project managers

As a matter of fact, defining the project managers should take place before defining the project, thus one of the most essential principles of the project is that before its commencement, the project manager is chosen with the aim of management of the project. They make project goals their own and use their skill and expertise to inspire a sense of shared purpose within the project team.[2]

- **Milestone**

A milestone is a significant event in a project that occurs at a point in time. A milestone schedule uses deliverables as a platform to identify major segments of work and an end date.[3]

- **Monitoring and controlling**

The Monitoring and Control Process Group consists of those processes performed to observe project execution so that potential problems can be identified in a timely manner and corrective action can be taken, when necessary, to control the execution of the project.[4]

- **S-Curve**

S-Curve is defined as a tool to illustrate the distribution of expenses, working hours and other expected quantities against the expected period of time. Using the title S is generalized because the formed distribution of quantities against time has a shape similar to S in English. This means that this distribution takes a rough shape of straight line and in the middle has a curve shape.

3. The Importance of the Issue

Association with decreasing rate of economic growth, being keen for production decreases in sponsors as well. Rarely are there any sponsors whom regardless of the risk of financial ruin, in fragile economic conditions that have the tendency for production. Thus in such conditions, they try invest in stock and gold markets in the first place and secondly to lead to the project-based activities.

The projects having lower risk, is one of the reasons that keeps some of the sponsors away from the stock world and unpredictable economies. Although projects can be profitable for the sponsors in a known period of time and with lower risk, and that is why they are luckier than in production in fundraising, they may be disappointing without an accurate and exact planning.

For this reason, the title of project activities holds no meanings without a comprehensive planning. However, this plan is put into practice, after the confirmation of the project manager, it is through execution and one hundred percent success is not perfectly probable. In other words, at the beginning of a project, Gant Chart, demonstrates how the monitoring of the plan condition should be at the end of it. Nevertheless, it is often expected that the actual progress of the project soon deviates from the basic details of the plan. When this occurs, a revised schedule may be generated by constructing additional selection stages which represent the estimated state of the project at the current time [5]. Although the compensation plan can result in completion of the minimum cost and the least reduction of benefits, not only can it make it impossible to gain the predicted benefit in the initial plan, but also it may reverse a noticeable benefit to bankruptcy consequent upon the repetition cycle.

Therefore, the competence of the project management is being questioned and the trust of the stakeholders to the approved plan is reduced. Despite of schedule validity, what attracted our attention after observing various projects were their rapid deviations from their initial routine. Since after confirming the developing the schedule plan, the monitoring and controlling have been the priority of planning and controlling team and based on the achieved results of this process, setting a compensation plan is critically required. With analyzing this process, we are going to identify the causes of majority of projects entering the delay phase.

Notwithstanding, it is not the first time that this idea is being considered, most of the previous activities in this field, have been focused on the improvement of weighing methods. However, as long as these methods are not capable of realizing the importance of critical activities from other activities, their improvement may not be sufficient, although it is significant. In other words, if we are going to prevent the delay happening, the critical activities ought to be considered before the activities holding more weight factors. This study has tried to prepare new tools in order to increase the capability of managers in the countermeasure process by the removal of insufficiencies in the mentioned controlling tools to prevent the delays.

4. Diagnosis

Entering the deviation period and then the delays in the project may not happen unless in conditions of less real development in accordance with the basic plan. Thus, it can be concluded that the delays in project or the affected consequences of the plan or even the affected incorrect data received in monitoring and controlling phase shall be the initial mistakes.

Considering this issue, the reasons of the delays occurrence can be found in the following points:

a. Lack of elaborate inspection over the performance by the team of project in planning phase

b. Changing the performance due to the discretion of executive experts without coordination with the planning team of the project
c. Unintended executing, administrative, financial problems in performing phase
d. The inability of the monitoring and controlling unit to provide useful information for the project manager and not predicting the future events in the project.

Among the mentioned points, what is worth being recognized and noticed, is the seal of approval which gained by project managers relying on the implicit authenticity of the presented plans from the experts and consequently leaving an incomplete plan to be executed. However this reason is substantial and pervasive, it should not be ignored that in many projects, the internal and external of the project are such that it is inconceivable to intercept this event.

Thus, although the reasons 1 to 3 generally occur in projects, their interception can be difficult. Whereas preventing the reason 4 to happen is also a possible and logical act. Based on this interpretation is to say:

Among the recognized reasons for projects to enter the delay phase, monitoring and controlling and the successful performance of this unit in project, owns an approximately higher status in comparison with other causes. Later on, we are to introduce this phase and analyze their existing problems.

5. Monitoring and Controlling the Project

If we assume the aim of the project, a destination we are travelling to, the comprehensive schedule plan plays the role of the map of the road. In order to travel, we may have to choose one specific road among several ones regarding to the existing limitations. From the obvious specifications of this road, the time, determined budget, distance, hardness of the road, the type of required car, consumable necessities and the provision programs are the ones to be mentioned.

However in order to reduce the potential risks, all the mentioned factors will be analyzed before the trip starts; without the presence of the existing cautionary signs on the way which inform us about the unpredicted dangers and raises some requirements and suggestions to successfully pass the way, there are still dangers you may encounter in your trip. Therefore, in order to succeed in project, after developing a comprehensive schedule, the observation and controlling utilize the cautionary and suggestive signs. For this purpose, various graphs, charts, and forms are being used. From this category of graphs, "Bullet Graph", "S-Curve", "Bar Graphs" and" Pie Graphs can be mentioned.

Conventionally, S-Curve has long been adopted as an important baseline in project control system to monitor the project performance most owners take it as part of contractual document to control the contractor progress, while contractors use it to manage progress and cash flow.[6]

Consequently it is to say that the initial, most essential and influential cautionary sign of the project condition, is S-Curve.

6. S-Curve

An S-Curve is defined as "a display of cumulative costs, labour hours or other quantities plotted against time." The name derives from the S-like shape of curve, flatter at the beginning and end and steeper in the middle that is typical of most projects. The beginning represents a slow, deliberate by accelerating start, while the end represents a deceleration as the work runs out"[7]. This Curve can be assumed as a picture of the project path by use of which managers focus on the compatibility of the predicted path and estimating the future condition of the project. One method to doing that is that we assign weight to each of the activities. Completing any of them, we calculate their weights and judge with respect to the total weights of all of the activities up to a specific time (Status Date).

- The Problems of S-Curve

One of the existing problems in weighing methods is the equal importance of critical activities and other ones. This means it would be better to make the same criteria for activities and based on the criterion launch weighing, however the critical activities are more essential than others in terms of time and execution, sometimes they are less important based on the made same criteria than other activities. In such conditions, provided that the slack activities seem more important than other critical ones, in the passage of time during which more slack activities are being practiced, the project progress is more than the time the critical activities are done. Thereupon, the plan that was supposed to prepare a good vision for the managers, displays the first achievement more essential than the latter one because of its major progress, so it requires an accurate monitoring and controlling.

Hence, it can be pointed that in comprehensive developed schedules in such a form, the more less important activities are completed, the more steep the slope of project progress will be ; and the more critical activities are completed, the more

slow the slope of project progress will be. On the other hand it must noticed that generally the problems occurred while practicing the plan can give a wrong idea based on which a certain amount of deviation is accepted and trivia to managers.

For instance, in a project which is supposed to develop in a particular time interval of 7.2 % progress, a 6.9 % progress should indicate an implicit success in plans, whereas a 0.3% deviation, due to delay at the end of an activity , might be critical. Thus it must be considered that the conditions which sound prosperous, are about to face a lot of problems. In order to actually analyse this claim, a construction project of one twelve-floor concrete building and the same of one twenty two-floor building have been examined separately. Both of the projects have been weighed as physical weight value, according to the method of mixing three criteria of schedule, volume of tasks ad costs of activities. Their S-Curve is demonstrated below. The horizontal graph depicts weekly data (time) and the vertical graph depicts the progress. The red graph represents the procedure of project progress based on weighing to all of the activities and the blue graph shows the project progress based on progress of critical activities.

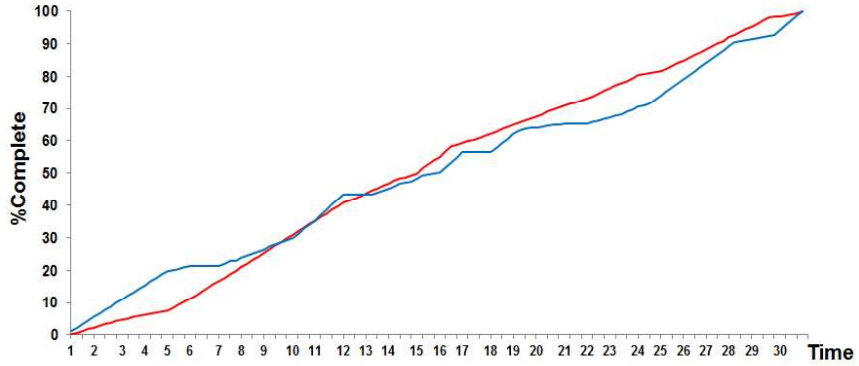

Fig. 1: Project 1.

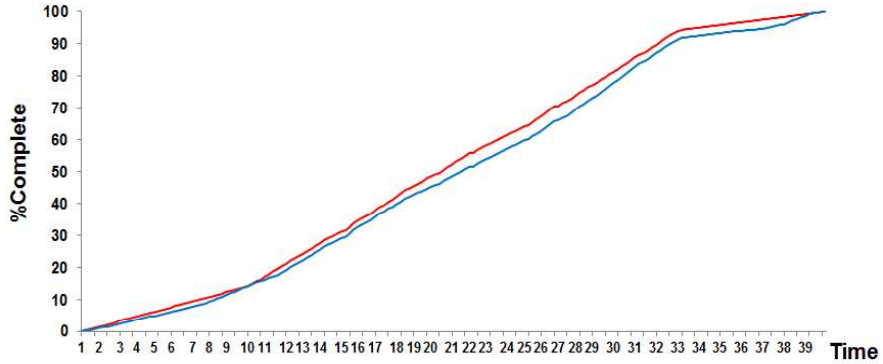

Fig. 2: Project 2.

In the first project, based on S-Curve of the project plan, the beginning of the project with steep slope and final project will happen with a slow slope. While these two periods of time, in these two projects have the greatest amount of critical activities and more than other activities, make the project susceptible to fall in delay holes. The cause of this issue can be due to the shortage in work field and feasible processes in the project. This issue can be noticed in various time intervals, in the curve obtained from drawing the critical progress path.

Comparing these two graphs shows that although at the beginning of the project the weekly progress is less than other times, this period of time is so significant because of it high degree of being critical. Therefore, the illustrated S-Curve, to explain all of existing facts at the beginning of the project is associated with a lot of deficiencies. Besides, although the curve of project progress illustrates that the invariable procedure of it is from the fourth to the twentieth week; the critical path of curve has presented a less detailed report and it shows that we are facing three repeated five-week time intervals. This curve also depicts the greatest slack is of the project in the 10% of the eighth and the least slack is in the 10% of the second.

The second project though, gives us other results. In this project, in all the stages, approximately the two drawn graph are together. In a large part of the path, the curve of the critical path has had a slow slope and ultimately in a two-week time interval it makes up the existing difference.

Analyzing these two projects from the same view, showed us that although it is not possible to conclude the same about all the projects with drawing the curve of the critical path, in any of the two cases it is possible to notice the deficiencies. In better words, S-Curve may not be expressive of every important event of the project without using the critical path.

According to what was said it could be concluded that the low weight gained from different methods of weighing for critical activities is feasible to make project managers, observing a few tenth of a percent at the beginning of the project, assume it natural and be hopeful to the future condition of the project. As a matter of fact, they are not aware that this little deviation is the start of such big delays.

One of the other cases that can be thought of as a problem of S-Curve is displaying the path in front of the project without considering the special situations, which occur throughout the path of the project. If, given the nature of the S-curve on completion of the project, we accept that the progress of a project shall be possible on the path of S-Curve, but we will be facing various dangers; we can get to the conclusion that one of the weaknesses of S-Curve is its disregarding to “risky points". These points do not necessarily need to have the same nature as critical points. For instance, it is possible that at one specific time interval many of the activities would happen at the same time and this unexpected pressure requires more human resource, Inasmuch as, none of these activities are critical. This problem will be discoverable with charts cursory reading of allocations.

Thus it is required that even the most efficient curves against the managers, depict the major parts of the path to them. Considering these points, we can categorize the problems of S-Curve.

1. The activities can make this curve incapable of distinguishing the critical to non-critical activities.
2. With too much attention to the general view of the project, this curve draws away the attention of managers from the major points on the path and leads to the unreal attitude of the conditions of the project.

7. The Hidden Capacities

If for example, we head to the destination, while passing the intercity roads, before arriving to the dangerous area, we always see signs that warn us about the exact place of dangerous areas. So we can name one of the capacities of this curve the "depicting the crucial predecessor activities".

This title refers to those predecessors, the successor activities of them, are the dangerous and critical ones. As many of the projects, belong to the repetition cycle of a series of activities, what makes the activities critical or non-critical is the time and place of locating in that project cycle. That is why here we get to define the semi-critical activities and we introduce it as "Activities from the critical activities kind with the same specifications but not the same nature."

One of the other hidden capacities of S-Curve is showing the milestones of the project. However, milestones allocate the zero time to themselves and showing them in Gant chart gives an appropriate vision of delivering a collection; so depicting them in S-Curve is essential too. According to the pointed factors, we can name the hidden capacities of S-Curve as follows:

1. Showing the semi-critical points
2. Showing the crucial predecessor
3. Showing the milestones

All the mentioned points can be counted, as hidden capacities of S-Curve, notwithstanding, this should not be ignored that the overcrowding of the curve can cause the confusion and reduction of interest in using them. This issue is in contrast with the spirit of simplicity and eloquence of S-Curve. Thereupon, among the mentioned points, we put illustrating the milestones in priority and as long as in a project the two other capacities were required, we are to analyse some determined graphs along with drawing them. In the present circumstances, we have set the betterment of S-Curve in priority anyway.

8. Improvement of S-Curve

After S-Curve being recognized as one of the most efficient tools, in order to, prevent deviation in projects, to manage a project; it was determined that with the improvement of this curve some more useful results can be purveyed to the project managers. We are going to improve this curve. To simplify the words this curve will be mentioned as “OS-Curve".

To draw OS-Curve, first with the application of weighing methods for all the little defined activities in WBS, we calculate a certain weight. Then with the usage of predicting the project progress in specific time intervals, we draw S-Curve. Next, we distinguish the non-critical activities from critical ones and calculate their weight against zero.

In such circumstances, we face the work breakdown structure in which just the critical activities are weighed. Surely, the obtained integrative weight will be less than 100%. To compensate this deficiency, we will increase the weight of critical activities in certain proportion, as the integrative weight increases to 100. The best job to do in such circumstances is to use proportional ratio. After this stage, by calculating the project progress again in previous time intervals, we draw the progress curve of critical path next to S-Curve.

To identify the project milestones, we also compute the project progress based on the initial specified weights till the time of any milestone happening and demonstrate them as diamond, square or circle on the plan S-Curve. To calculate the progress there is no need to calculate the progress for both paths and it would be enough to draw the project progress based on the plan progress path of S-Curve. We are going to mention two actual examples resulted from the implementation of OS-Curve.

9. Practical Samples

The picture below displays the framework of one residential project including three twelve floor- towers. In this project for the first time, with arranging the project team, the OS-Curve was used. The blue graph representing the planned progress based on consolidated weighing shows the costs and human resource. The green graph representing the project progress based on consolidated weighing to critical activities and the black curve depicts the actual progress situation of the project. The black triangles also show the milestones. As it is illustrated, using the OS-Curve made the management team pay attention to critical reports in addition to the usual reports of the controlling and monitoring unit of the project and the administrative plans of workshops were communicated to the execution contractors and they were asked to arrange their execution procedure based on the received notifications and not based on their common working convention. The result of these predicted reactions to the events will be delivering the project 1 month sooner the planned schedule.

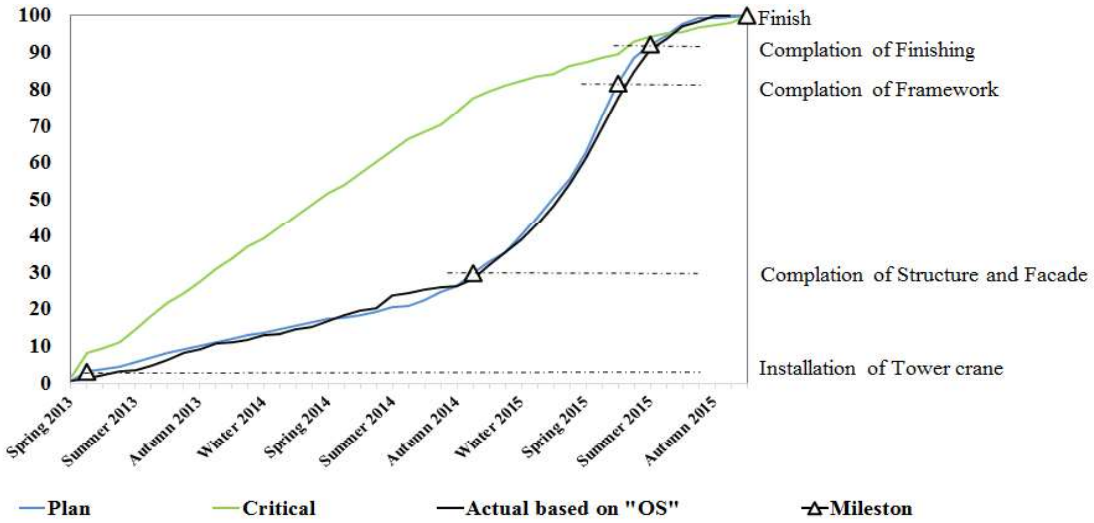

Fig. 3: Implementation of OS-Curve from the commencement of the project.

The second project is related to the instruction of three luxurious fifteen-floor towers. Therefore, most of its expenses have been related to purchasing and executing the framework with a special kind of coverage. Considering the fact that the majority of these costs should have been paid at the beginning of the project, the critical path curve is placed higher than the planned progress curve. The importance of these expenses was not shown in the initial plan that was drawn based on S-Curve and this issue caused the deviation of the schedule. Thereupon, to solve this problem, the project managers decided to replace S-Curve with OS-Curve. After using this curve, the first issue in December 2013 was that it was confirmed that in the initial plan none of the purchases were mentioned in the agenda and just execution activities was noticed. This issue refers to the

project being new and the unclear path against the management team, which its consequences we have previously talked about.

Ultimately and after improving the plan and determining the critical activities, completing the framework, and after finishing floors walling were introduced as critical activities. Now, according to the order of the executive team walling had already been shut down until further notice. In the following figure, the black curve shows the condition of project progress after using OS- Curve.

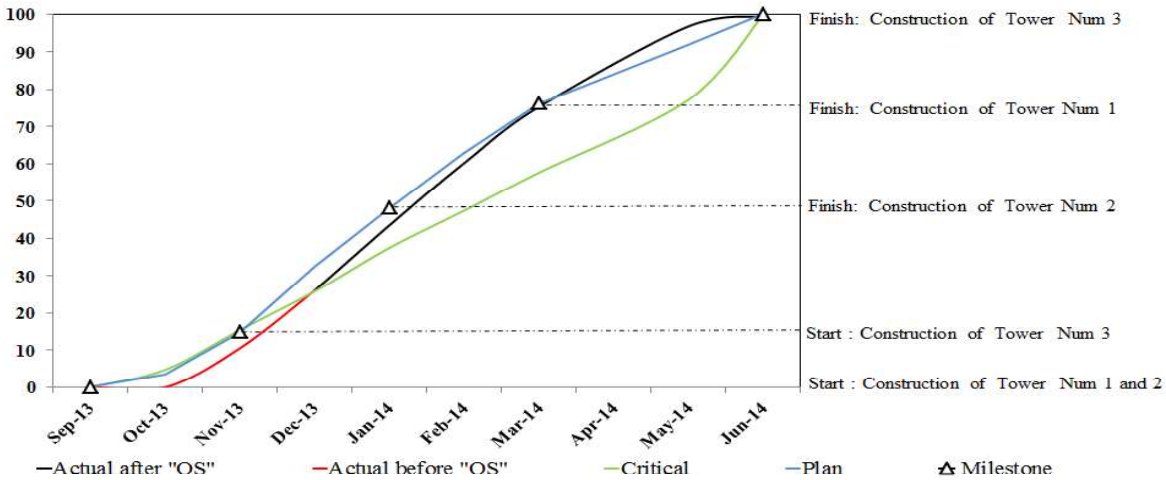

Fig. 4: Implementation of OS-Curve after the deficiency of S-Curve.

10. Conclusion

In this article, first we analysed the reason of entering a project to a deviation and delay period. Then by looking at the planning phase, controlling, and monitoring phase, we realized that the reports of the project-controlling unit have various deficiencies, which included in manager's imperfect or even wrong perception of the current and future situation of the project. As continued, we divided the reports in two Dynamic Statistical Information and Dynamic Analysis Information. By the fact that Dynamic Analysis Information is more important to project managers, we concluded that we ought to give priority to the analysis of this project, after the analysis done; S-Curve was recognized as the most efficient curve available for project managers. Next, we analysed the performance and the examination of obtained results of this graph and finally we noted its deficiencies as follows:

1. The inability to distinguish between critical and non-critical activities
2. Making an unreal vision of the project caused by disregarding the essential activities of the project

In order to solve this problem, after recognizing the hidden capacities of this curve, we suggested that aside with S-Curve of project progress based on weighing all the activities, another curve be drawn which illustrates the project progress based on the critical activities.

This curve helps the project managers to be aware of the condition of critical path, as well as monitoring the project progress so they will be able to prevent deviation leading to delay. Furthermore, it was recommended that milestones be displayed on the project progress curve so that the project managers to be more concentrated on the specific dates. Ultimately, the concluded curve, which includes the three, parts below:

1. The S-Curve of project progress
2. The S-Curve of critical path progress
3. Milestones

Was named and suggested as the optimized S-Curve and from then on was used instead of S-Curve. This curve will be called as OS-Curve from now on.

11. Appreciation and Gratitude

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