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METRICS BASED PROJECT TIME MANAGEMENT – APPLICATION OF LINEAR PROGRAMMING

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Purpose: The purpose of the article is to develop an algorithm updating the estimated duration based on metrics and linear programming in the execution phase of the project. A secondary objective is to prove that the acceptance of the metrics-based approach by practitioners is highly probable.
Design/methodology/approach: We combine linear programming with metrics based project management and propose an algorithm updating the initial project duration estimation during project execution. Survey has been used to verify the knowledge and acceptance degree of metrics based management among project management practitioners. An computational example is used to illustrate the application and potential benefits of the proposed algorithm.
Findings: It has been shown that metrics based updating of initial project duration estimation can be extremely important for project time management, and thus project success, and that this approach is technically not difficult to implement in practice. It has been also proven that such an approach has high chances of being accepted in practice.
Research limitations/implications: In our research a theoretical example has been used with a limited selection of metrics. Real world cases and close cooperation with project managers and other stakeholders is needed in order to improve and adapt the approach to actual needs of practical project management.
Practical implications: The proposed approach may substantially improve the prediction quality of project duration and, consequently, increase project success probability.
Originality/value: An original algorithm for project duration updating during project execution has been proposed. This algorithm is based on metrics that should measure all the important phenomena that decrease the quality of the prediction of project duration, also human related ones, and on linear programming. No similar approach has been identified in the literature.

Keywords: project time management, metrics, linear programming, project duration estimation.

Category of the paper: research paper.

1. Introduction

The analysis of project duration and the differences between planned and actual duration of projects have received much attention in the project management literature. It is a problem that is of utmost importance in practice: underestimated project duration leads to delays, reaching several hundred percent of the originally planned duration in not few cases (The Standish Group, 2015), and delaying other endeavours in turn, overestimated one (a much more rare phenomenon) – to unnecessary blocked time and often to a certain relaxation and reduced efficiency at work. The differences between planned and actual project duration have many causes, which include optimism/pessimism bias, strategic misrepresentation or neglecting uncertainty.

By understanding the factors and consequences of project delays, project managers can develop strategies to mitigate problems and improve project performance. One way to do this is to improve the time estimation process in the planning phase of the project, and another way, to be applied in addition to the first solution, is to update the initial time estimation systematically, during project execution, on the basis of the information about the current project situation and the so far indices about the estimation quality. The updated information about the current situation in the project can be efficiently obtained thanks to metrics. Metrics in project management are indicators that objectively present selected information about the project as early as possible (Kerzner, 2017), which allows for some kind of forecast of the final results when changes in the project are still possible or low-cost. Taking the above into account, the use of metrics for project time management could prevent at least some of the negative consequences resulting from optimism/pessimism bias, strategic misrepresentation or neglecting uncertainty and erroneous estimation altogether, because the metrics might indicate to the project manager early enough during the project that some of those phenomena have taken place and remained unnoticed. The purpose of the article is thus to develop an algorithm updating the estimated duration based on metrics in the execution phase of the project. The algorithm will use a linear programming approach used in the planning phase of the project and modify it accordingly, using metrics. The secondary objective of the paper is to justify, on the basis of a survey, that the metrics-based approach has high chances to be implemented in practice.

The structure of the paper is as follows: in the 1. section we discuss the main reasons of the differences between the planned and actual duration of projects, in order to indicate the information that should be captured by the metrics during project execution. In section 2 we underline the importance of updating during the initial estimations during project execution, and in section 3 we present the state of art regarding project metrics that refer to time and the results of a survey that prove the importance of metrics to project managers and high chances of using this approach in practice. In section 4 we present the linear programming model that is the basis of our solution. Our proposal, the algorithm of updating the initial estimation of project duration during project execution, is described in section 5, and section 6 contains an example illustrating the proposed approach. The paper terminates with some conclusions.

2. Differences between projects planned and actual duration – their reasons and consequences

In the literature on project management, much attention is devoted to the analysis of project duration and the differences between the planned and actual duration of projects. These differences have their causes, including: optimism bias, strategic misrepresentation, or neglecting uncertainty, and, obviously, their often serious consequences.

Even if the planning process is performed professionally and with care (which is not always the case (Hullet, 2016), projects frequently encounter unexpected hurdles that result in delays, causing frustration among stakeholders and potentially leading to budget overruns. The delays in projects, in all project domains and types, are often considerable. For example, the (The Standish Group, 2015) shows that almost 50% of IT projects are delayed by more than 100%; in (Espinoza, Presbitero, 2022) we can read that 60% of investment projects are delayed by at least one year, similar statistics are available for other industries. By understanding project delay factors and consequences, project managers can develop strategies to mitigate problems and improve project outcomes.

Optimism bias proved to be widely accepted as a major cause of unrealistic scheduling for projects (Prater et al., 2017). Optimism bias refers to the tendency of people to believe that they are less likely to experience (in their projects) negative events, and more likely to experience positive events than other people (in other projects). Flyvbjerg (2006) describes optimism bias as “a cognitive predisposition found with most people to judge future events in a more positive light than is warranted by actual experience”. Numerous authors (Flyvbjerg, 2006; Macdonald, 2002; Morris, Hough, 1987) underline in their works that the main reason of poor project performance was often not project execution but optimistic under-estimation of baselines.

Moreover, it is common knowledge that strategic project planners and managers not only underestimate cost, but also overestimate benefits to achieve approval for their projects intentionally, due to political reasons. This is called strategic misinterpretation. Optimistic planners and managers also do this, although unintentionally. Optimism bias and strategic misrepresentation reinforce each other, when both present in a project (Flyvbjerg, 2021).

While optimism bias tends to dominate project planning, pessimism bias can also impact project delays. Pessimism bias refers to an excessive tendency to expect negative outcomes and overestimate risks, which may result in overly conservative timelines and excessive caution. While optimism bias leads to underestimation that is obviously harmful to organisations, pessimism bias may be a problem too: it can lead to overestimation that unnecessarily blocks time that might be used for other endeavours undertaken by the organisation and weakens the motivation for efficient work.

Another common reason for substantial differences between the planned and the actual duration of projects is neglecting uncertainty, which may be understood as lack of full knowledge (Kuchta et al., 2023). Uncertainty may be a consequence of human- or project team related issues (Hulett, 2016), like the lack of competency of the experts or their unwillingness to admit their lack of knowledge. Also, issues like possible need for rework in a task, that would obviously delay it, are not always noticed, or admitted in the planning stage of projects, because of the lack of uncertainty management (Hulett, 2016). Uncertainty usually diminishes with project progress, but it is usually nonnegligible in the project planning phase. Constructing schedules based on one-point, crisp estimates, instead of probability or fuzzy distributions leads to unrealistic schedules that are then reported to be late, although in fact they may remain within the limits of certain confidence intervals that could be identified at the beginning if uncertainty management was applied (Hulett, Nosbisch, 2012). Metrics can be very helpful in detecting and updating uncertainty during project execution.

3. Updating initial project estimations

Project estimations serve as the roadmap for project managers, providing a baseline against which progress is measured. However, relying solely on initial estimations can be risky, as projects rarely unfold exactly as planned (Vytlačil, 2020). Because of the reasons listed in the previous section, project estimations are often far from reality. However, as the project proceeds, many of the factors causing inaccurate estimations either become visible or lose some of their significance, and the uncertainty is diminishing. For this reason, it is not advisable to stick to initial estimates without continuously performing adequate, up to date analyses. It is only by updating initial estimates each time it is justified or required that we may continue to have a fairly realistic vision of the final outcome of the project at any moment of project implementation. And the information of the necessity to update project estimates should be acquired by means of adequate project metrics, as indicated by the approach called metrics-based project management (Kerzner, 2013).

The importance of updating project estimations has been noticed by the authors of the Earned Value Method (Fleming, Koppelman, 1997) that is considered a valuable technique for monitoring and controlling project progress. If EVM is applied, several metrics are calculated systematically during the project course. They provide information on the current relationship between the actual and planned cost and time, and, what is still more important, on this relationship as forecasted for the future, when the project is finished. Although EVM is efficient above all for cost-related issues, it also provides indications concerning the current status of other project aspects (e.g. expected project duration (Vanhoucke, 2010), that is our main subject in this paper), especially in its extended versions (there exists, e.g. Green Earned Value Method (Koke, Moehler, 2019) that uses metrics related to sustainable management and helps remaining up to date as far as expected project sustainability parameter values are concerned, or Customer Earned Value (Kim, Ballard, 2002) that, on the basis of current customer-related values, assesses future satisfaction of the customer).

The present paper focuses on project time management. As mentioned above, EVM offers several metrics serving to predict project duration during project execution, especially several generalizations of the method (Batselier, Vanhoucke, 2017; Vanhoucke, 2010) do so. However, they are fundamentally based on the relationship between the planned and the actual duration of project tasks that have been already (up to the control moment) executed. As mentioned above, reasons for project delays are varied and not limited to simple mistakes in the estimation value. They comprise more profound phenomena, like optimism and pessimism biases and possibly many more human-related issues. Therefore, other metrics related to time management than those included in the EVM should be considered. This topic is discussed in the next section.

4. Project metrics based management with respect to project duration

In project management based on metrics (Kerzner, 2022), of which the Earned Value is a special case (rather old and limited), at systematic intervals during project execution, the values of several metrics are calculated. These metrics should inform project managers and other stakeholders about the current status of the project and, above all, give them some insight about the final results of the project (that are still to come in future) in the context of its objectives and success criteria. The proper choice of the metrics is essential for project control efficiency.

In this paper we concentrate on one of the main project success criteria, that of keeping the planned deadline. Thus, we are interested in metrics that would grasp, during project execution, possibly all issues that might, in the future, have an influence on the difference between the planned and the actual project duration.

On the basis of literature review, we identified 34 potential metrics supporting project management, which are presented in Table 1. Metrics 13 and 14 are part of the Earned Value Method, other metrics are not used in the scope of this method.

Table 1.
Potential project metrics identified through literature review

No of the metric	Description of the metric
1	Number of resources allocated versus planned
2	Quality of resources allocated versus quality planned
3	Project complexity index
4	Level of customer satisfaction with the project result
5	Level of customer satisfaction with project progress
6	Level of customer satisfaction with project communication
7	Number of commitments kept to the customer in relation to the number of total commitments
8	Number of critical constraints
9	Number of cost adjustments made
10	Number of critical assumptions
11	Number of hours without allocated human resources
12	Percentage of total overtime hours worked
13	Deviation of costs
14	Schedule deviation
15	Cost performance index
16	Schedule performance indicator
17	Compliance with accepted quality indicators
18	Quality of implementation of the risk management plan
19	Quality of project management
20	Quality of management of customer expectations
21	Quality of management of customer interactions
22	Number of changes to the project scope
23	Degree to which the opinions of individual project team members are taken into account
24	Quality of defining and communicating roles to individual project team members
25	Opportunity for personal and professional development of team members
26	Level of understanding of the client and its industry by the project team
27	Degree to which the project contributed to establishing or strengthening the company's position in the industry (additional opportunity generation)
28	Degree to which it succeeded in timely invoicing and obtaining payments
29	Amount of wasted/unproductive time
30	Level of knowledge and competences of the project team in project management
31	Quality of supplier monitoring
32	Degree to which the project team looked after the client's interests
33	Degree of implementation of occupational health and safety rules
34	Number of tasks (work packages) completed according to plan

Source: own work.

The challenge consists in selecting the right metrics, and assuring both their measurability and adequate communication of their values to the relevant stakeholders. Another challenge is to implement the approach in practice, which means convincing project managers and stakeholders that it may be useful in every day project management. For this reason we conducted a research examining the potential of using also non-standard (those not belonging to the Earned Value Method) time related metrics in project control in practice.

In the research was conducted in April 2023 on a sample of 100 project managers from 100 organizations in the form of a telephone interview, the question of the present and potential usability of the above metrics was studied. The first part of the questions in the questionnaire concerned the frequency of the current use of individual metrics in projects in the surveyed organizations. Figure 1 shows the distribution of responses.

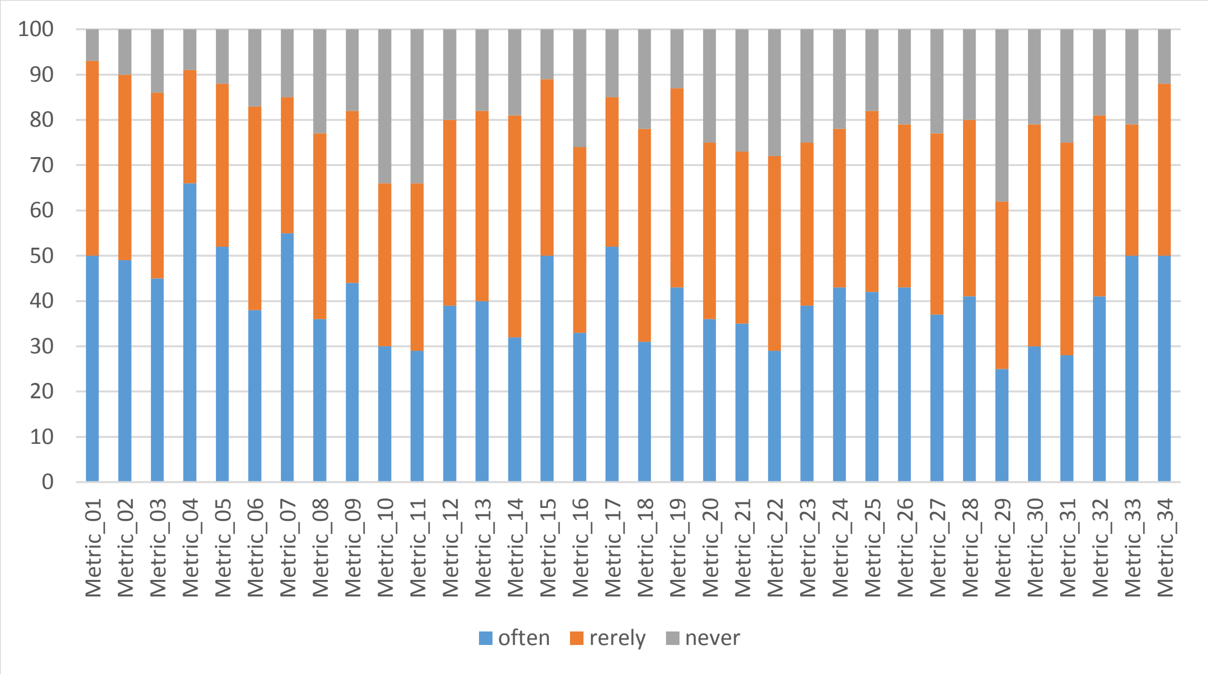

Figure 1. Frequency of use of the metrics in projects in the surveyed organizations – distribution of responses.

Source: own work.

According to over 50 respondents, metrics that were often used in projects in their organization were metrics (ordered by the frequency of use): 4,7,5,17,1,15,33 and 34. The remaining metrics were identified as often used in projects in the organization by less than 50 respondents (range from 25 to 49 respondents).

According to only less than 30 respondents, metrics that were rarely used in projects in their organization were metrics 33 and 4. The remaining metrics were identified as rarely used in projects in the organization by less than 30 respondents (range from 30 to 49 respondents).

According fewer than 40 respondents, metrics that were never used in projects in their organization were metrics 29,10 and 11. The remaining metrics were identified as never used in projects in the organization by fewer than 30 respondents (range from 7 to 28 respondents).

The next question concerned the opinion of the respondents whether it would be beneficial to use the respective metrics for project management.

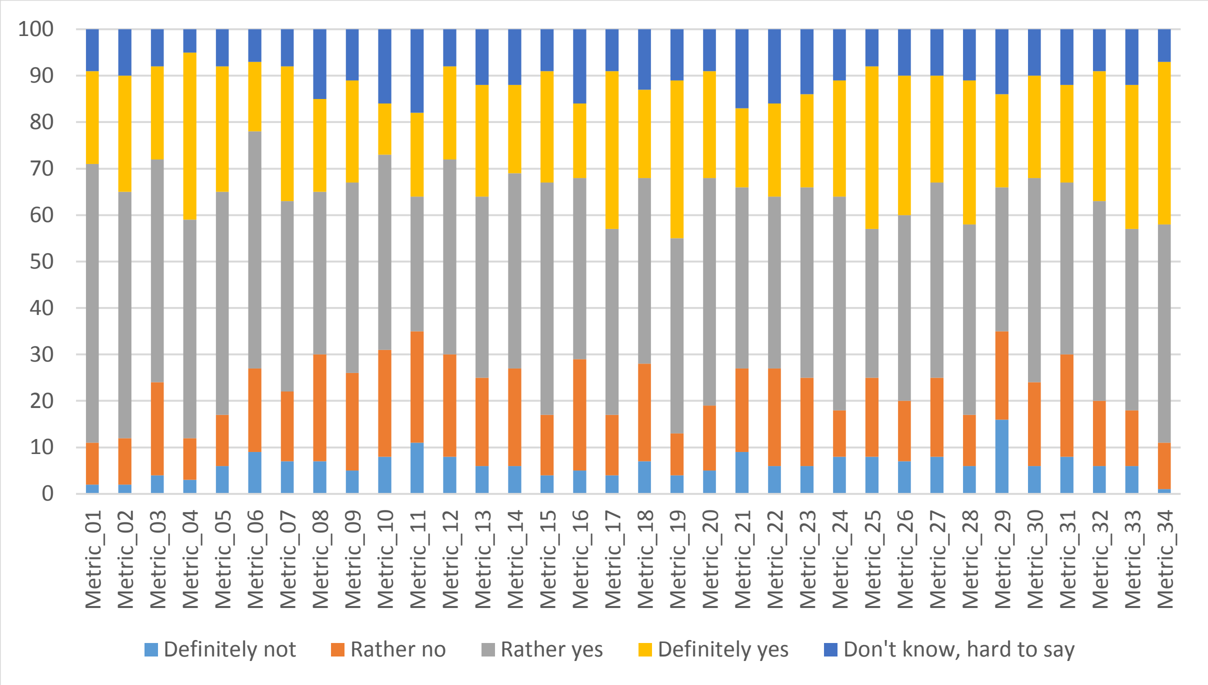

Figure 2. It would be beneficial and justified to use this metric? – distribution of responses.

Source: own work.

To the question: "Would it be beneficial and justified to use this metric?" for 33 metrics, over 50 respondents indicated the answer: "Rather yes" or "Definitely yes" (range from 51 to 83 respondents). For all metrics, only less than 35 respondents indicated the answer: "Rather no", "Definitely no" (range from 11 to 35 respondents).

It seems thus that the usage of metrics in practice has already been accepted and it has a clear growing potential. Numerous metrics from Table 1 should be taken into account in project time management. Their unfavourable values may indicate the fact that some tasks have been or, which is much more important, will be delayed. E.g., metrics 1, 2, 11, 12 may indicate shortage of resources or of qualified resources, which obviously may delay some project activities. Metrics 4, 5, 6, 7, 17, 20, 32 may imply the need to redo certain tasks, to prolong some of them or to add additional tasks, in order to have the additional time necessary for increasing the stakeholder or customer satisfaction or the compliance degree with previous arrangements. Metrics 14, 16, 22, 34 may point to general mistakes in project initial estimation and the need to update them. Other metrics might also be considered, e.g., the features or credibility of the experts who performed the estimation of project task duration: if an expert has turned out to be an optimist while estimating the tasks already completed, the estimated duration of the tasks still to be performed should probably be updated.

In the following, we will propose the inclusion of metrics into the linear programming model that determines the expected project duration. First, we will discuss the original model that does make use of metrics. Secondly, in Section 6, we will apply the model to project metrics-based control.

5. Linear programming model determining the expected project duration in the planning and execution phase of the project

Let us assume that we have a project network with a total of *n* nodes, where *n* represents the number of events in the project network. An event is the moment when one or more activities (called also tasks) with the same predecessors are started and all their predecessors are finished, or the moment when the project starts, or finally the moment when the project terminates. Project start moment is assumed equal to 0 and is represented by the 1st node in the network. Its moment of occurrence is denoted as x_1, where $x_1 = 0$. The n^{th} event, represented by the last node, stands for the project end. Its occurrence time $x_n = Z$ represents the moment when all the project tasks are ended. This moment is crucial in our linear programming model and constitutes the objective function that should be minimized. The value of this objective function represents the shortest possible project duration under the given information on project activities estimated duration, and activities predecessors of the Finish-to-Start type (other predecessor types are not considered in the model, but their inclusion would be straightforward in a generalised model).

The expected project duration will be estimated systematically, in different moments *t*, $0 \leq t \leq AT$, where AT stands for the actual project duration, and *t*=0 for project start and all the planning period preceding it. The magnitude *t* will be a parameter of the model and will correspond to the moment when the model will be applied. In fact, *t* will be selected among systematic control moments $t_k, k = 1, \dots K, 0 \leq t_k < AT$, in which the values of selected metrics will be collected and certain decisions on the project should be taken, with $t_1 = 0$ representing the planning stage of the project and $t_k < t_{k+1}, k = 1, \dots K-1$.

We have thus the following objective function:

$$Z(t) = X_n(t) \rightarrow min \tag{1}$$

Let $A_{(i,j)} \epsilon A$, where A is the set of all project tasks, represent a single project task. $A_{(i,j)}$ starts in the i^{th} node and finishes in the j^{th} node, $i, j = 1, \dots n$. $D_{(i,j)}(t), i, j = 1, \dots, n$ represents the duration of activity $A_{(i,j)}$ as known in moment t, where $0 \leq t \leq AT$. Duration $D_{(i,j)}(t)$ may be the estimated one or the actual one, depending on whether in moment *t* the respective activity has already been completed or not. Durations $D_{(i,j)}(0)$ are the durations estimated in the planning phase of the project. For reasons discussed above, they should be subject to possible adjustment during project execution, on the basis of selected metrics.

The constraints of the model will be as follows:

$$x_j \geq x_i + D_{(i,j)}(t) \text{ , } A_{(i,j)} \epsilon A \tag{2}$$

$$x_i >= 0, i = 1 \dots n, \tag{3}$$

$Model(t)$ for a selected t, $0 \leq t \leq AT$ will denote model (1)(2)(3) with the parameter t. The optimal value of the objective function (1) of $Model(t)$ will be denoted as *PD(t)* – the duration of the projects as seen in the moment *t*.

6. Algorithm updating project estimated duration, based on metrics and linear programming

As mentioned above, facing the lack of credibility and stability of initial time estimations in projects, it is generally accepted that the initial estimates should be updated during the project course, and this should be done in regular time intervals, in selected control moments $t_k, k = 1, \ldots K, 0 \leq t_k < AT$, on the basis of carefully chosen metrics. We assume that project stakeholders have decided to use L metrics, M_l, $l = 1, \ldots L$, the value of each of them acquired in moment *t* will be denoted as $M_l(t)$, *l*=1, …, *L*. The metrics can be chosen from Table 1 or be original proposals of project managers or organisations execution the projects. The following algorithm will allow us to know $PD(t_k)$, $k = 1, \ldots K$, an updated information on the expected duration of the whole project as seen in the control moment $t_k, k = 2, \ldots K$. The quality of this information will the higher, the better metrics will be chosen.

The following algorithm should be applied:

1st step. Before the project start ($t_1 = 0$), determine the project network, composed of nodes $i = 1, \ldots, n$ and arcs representing project activities $A_{(i,j)}, i, j = 1, \ldots, n, A_{(i,j)} \epsilon A$.

2nd step. During the planning phase, collect from experts estimations of project activities durations $D_{(i,j)}(0), i, j = 1, \ldots, n, A_{(i,j)} \epsilon A$. Keep track of the experts responsible for the estimation of each activity and their features (e.g. history of past estimations and their accuracy). Obviously, this step has to be executed with the highest care and expertise possible, consulting the most knowledgeable experts.

3rd step. Apply $Model(0)$ to determine the estimated project duration $PD(0)$.

4th step. Adopt the metrics M_l, $l = 1, \ldots, L$ that might be helpful to control the estimation quality of activity durations, chosen previously.

5th step. Set $k := 1$.

6th step. Set $k := k + 1$. Either choose control moment t_k *or* STOP.

7th step. Analyse values $M_l(t_k), t = 1, \ldots, L$.

8th step. Calculate the possible influence of the information implied by $M_l(t_k) t = 1, \ldots, L$ on the estimation of the duration for those $A_{(i,j)} \epsilon A$ that have not been finished in moment t_k.

9th step. Calculate $D_{(i,j)}(t_k)$ for those $A_{(i,j)} \epsilon A$ that have not been finished in moment t_k, either taking $D_{(i,j)}(t_k - 1)$ or values updated on the basis of values $M_l(t_k)\ t = 1, \ldots, L$.

10th step. Apply model $Model(t_k)$ and calculate $PD(t_k)$. Analyse the obtained data.

11th step. Go to step 6.

The STOP in the 6th step will occur when the project will be so close to its termination that no new control point $t_k$will be need.

The algorithm will be illustrated by means of an example.

7. Computational example

Let us consider the following project. Estimations of individual activity durations were performed by 3 experts: X, Y, Z.

Table 2.
Example project – information retrieved in the planning stage $(t_1 = 0)$

Estimator	**Activity**	**Duration $D_{(i,j)}$**
Expert X	A(1,2)	5
Expert Y	A(2,3)	8
Expert Z	A(2,4)	7
Expert X	A(3,5)	10
Expert Z	A(4,5)	11
Expert Y	A(5,6)	6

Source: own work.

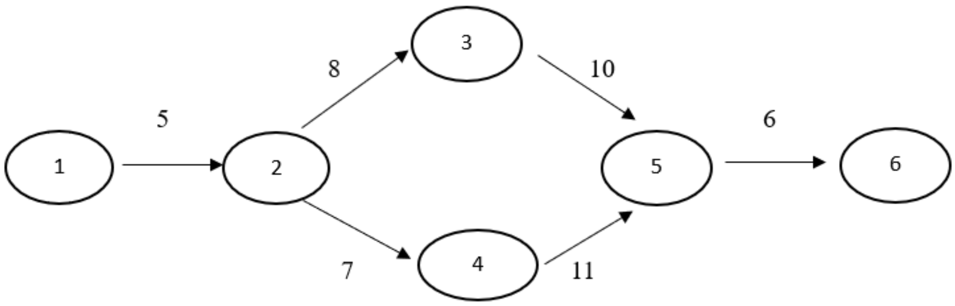

Figure 3. The network of the project example.

Source: own work.

We have thus $PD_{(0)} = 29$. This is the information we communicate to the customer and other stakeholders before the project start. It is an important commitment that may influence the "be or not to be" of the project, the decision on its acceptance or withdrawal.

Let us now assume that the project has been accepted for realisation and actually started. The record of project control during its execution is presented in Table 3 and explained afterwards.

Table 3.
Example project – information retrieved in the planning stage and in consecutive control moments

Estimator	**Activity**	$D_{(i,j)}(t_1)$ t_1=0	$D_{(i,j)}(t_2)$ t_2=8	$D_{(i,j)}(t_3)$ t_3=14	$D_{(i,j)}(t_3)$ t_4=15
Expert X	A(1,2)	5	8 (completed)	8 (completed)	8 (completed)
Expert Y	A(2,3)	8	8	6 (completed)	6 (completed)
Expert Z	A(2,4)	7	7	7	10 (completed)
Expert X	A(3,5)	10	**16**	16	16
Expert Z	A(4,5)	11	11	11	**14,5**
Expert Y	A(5,6)	6	6	**4,5**	4,5

Source: own work.

Let us suppose the first control moment t_2 falls after 8 days. It turns out that the estimated duration of task A = 5 days was wrong, the task took in fact 8 days. This wrong estimation came from Expert X. It seems that this expert was too optimistic and possibly is characterised by the optimism bias. We can use the metric "optimism degree of expert X", calculated as the ratio of the actual and the planned duration of activity A(1,2), and apply this metric to the estimated duration of the yet unfinished activity A(3,5) that was estimated by the same expert. We might also apply the metric to the durations of all unfinished activities, but we assume that there is no reason yet to believe experts Y and Z are characterised by the same optimism degree as expert X.

In the control moment t_3=14 we find out that activity A(2,3) took 6 days instead of 8. Thus, expert Y turned out to be pessimistic. Performing an analogous step as below, we update the duration of activity A(5,6) estimated by the same expert. The same is repeated in t_4=15 for expert Z.

In Table 4 we can see how drastically the estimation of project duration was changing during project execution.

Table 4.
Example project –estimation of project duration from the planning stage, updated during project execution on the basis metrics representing experts features

Control moment	**PD(t_k)**	**Critical path**
t_1=0	29	1-2-3-5-6
t_2=8	38	1-2-3-5-6
t_3=14	34,5	1-2-3-5-6
t_4=15	37	1-2-4-5-6

Source: own work.

Taking into account the presented data, we can see how in real time the information about the expected project duration could be changed. The changes with respect to the initial estimation were close to 13%. It is important to underline that already on the 8. time unit of project duration the substantial misestimation committed in the planning stage was discovered, thanks to the application of adequate metrics and the proposed model. There was still time for negotiations or other steps before the project was finished and actually delayed.

The reason of such misestimations in the planning stage may be, as mentioned above, different; in the example we are modelling the personal features of each expert (optimism bias, pessimism bias), but many more phenomena have to be taken into account. The metrics have to be chosen to measure all phenomena that may influence the estimation quality.

8. Conclusions

Project estimations are often far from reality. Due to the lack of reliability and stability of initial time estimations in projects, it is generally accepted that initial estimates should be updated during the project course at regular intervals based on carefully selected metrics. The quality of this information will the higher, the better metrics will be chosen. It is therefore worth defining metrics that can be helpful in controlling the estimation quality of activity durations. Therefore, the article proposes an approach involving the inclusion of metrics determining the expected project duration into a linear programming model having project duration as the objective function and develops an algorithm updating project estimated duration in the planning and execution phase of the project.

With the increasing complexity and level of uncertainty in projects that we are currently seeing, the importance of metrics continues to grow. However, their definition and application in projects is extremely difficult, because in projects a significant role is played by phenomena that are difficult to measure and to a small extent predictable, in particular those related to optimism/pessimism bias, strategic misrepresentation or neglecting uncertainty. In the theory of project management based on metrics, great emphasis is placed on the thesis that even seemingly unmeasurable phenomena can be measured if metrics are properly defined. In this case, metrics could be used, for example, regarding the degree of optimism/pessimism or other features of experts involved in the project. Thanks to this, underestimation or overestimation of project duration or delays in project implementation can be minimised during project execution.

The model proposed here can comprise various metrics, related to various phenomena influencing project duration. Future research should concentrate on the identification of adequate metrics and on case studies, verifying the proposed approach in practice. It has to be underlined that linear programming model can be implemented in such widely accessible tools as Excel. The only constraints limiting its potential application are thus the acceptance of the metrics-based approach in practice (that, on the basis of the survey presented here, can be judged as having a high potential) and the selection of the appropriate metrics, preceded by a careful analysis of the reasons of delays and misestimations of project duration. Such an analysis should be both general (covering all projects) and branch- or organisation specific.

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