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Sustainable Metrics in Project Financial Risk Management

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Abstract: The objective of this study is to propose an approach that would increase the efficiency and efficacy of project financial risk management. The starting point of this research is an original detailed list of project financial risk categories, as it was observed that financial risk is described in the literature far too generally. Following a survey of project managers, it is shown that all the identified project financial risk categories are significant and early warning signals may play an important role in their prevention or mitigation. Additionally, the main causes for project financial risks are identified and their importance assessed. Following a literature review on metrics-based and financial risk management in projects, as well as an analysis of the causes assessed in the survey, it is hypothesised that sustainability principles, combined with metrics-based management, may increase the efficiency and efficacy of project financial risk management. A corresponding method is proposed, which should be embedded into the traditional process of project financial risk management. This method consists of generating metrics with a warning and preventive potential for each combination of three elements (financial risk category, risk cause, sustainability principle). This approach introduces into project financial risk management elements going beyond the financial optics, which may considerably increase its potential.

Keywords: project risk; project cost; project revenues; metrics-based project management; sustainable project management; project financial management

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1. Introduction

Project risk management is an important process in project management. Its proper implementation is one of the project success factors [1]. Financial project risk management is a subprocess of project risk management and is an important project success factor in terms of project finance or profit. The main goal of this paper is to propose an improvement in the efficiency (understood as producing a result in the most economical way) and efficacy (understood as the ability to produce the desired result) of project financial risk management using a sustainability approach [2] as well as metrics-based project management [3].

We will refer to the six principles of sustainability [4]:

i. Sustainability is about balancing or harmonising social, environmental, and economic interests;
ii. Sustainability is about both short- and long-term orientation;
iii. Sustainability is about both local and global orientation;
iv. Sustainability is about consuming income, not capital (including human capital);
v. Sustainability is about personal value and ethics.

The aim of this study was motivated on one hand by the statistics found in various sources, which show how often projects encounter serious financial problems. For example, according to a webpage from 2022 [5], 70% of projects fail and 55% of project managers cite budget overrun as a reason for project failure. On the other hand, there may be a path leading towards an at least partial remedy, whose existence forms the second motivation of this research: metrics-based project management [3]. Metrics are understood here as measurable project attributes that have a predictive or comparative capability [6].

The most important aspect of metrics in this work is their predictive capability, because "projects do not become distressed overnight" [3]. In the financial area in particular, we can hypothesise that disasters or other problems rarely occur all of a sudden, but are usually preceded by warnings, e.g., the liquidity problems of one of the stakeholders and the worsening of general economic indices. For example, the EVM (Earned Value Method) [7] proposes several metrics (especially EAC (Estimate At Completion) or VAC (Variance At Completion)) that are intended to warn about financial problems that are approaching, but have not yet occurred. This is consistent with the sustainability principle of combining short- and long-term orientation. The Earned Value Method, however, does not propose an exhaustive set of metrics, as several, although limited, attempts of its generalisation indicate [8–10]. It hardly considers, e.g., purely human or social aspects, which may indicate that a financial problem is approaching. For this reason, in this paper we aim at expanding metrics-based financial risk project management using a sustainability approach.

Sets or lists of metrics exist that can help in achieving project success [3,6], and what is striking about them is their sustainability, even if they are not explicitly described in that way. The literature distinguishes "things metrics" that relate to elements such as project deliverables, plans, and contracts, as well as project quality, risk, monitoring, etc., in addition to "people metrics", taking into account human resources, as well as their features and behaviour, and "enterprise metrics", where phenomena concerning the organisation implementing the project and its present and future conditions are reflected. If we examine some of the extensions of the Earned Value Method and the corresponding metrics [8,10], we can observe that—in contrast to the original Earned Value Method, where the metrics are purely "things metrics" and are based on elements related to project finance, plan, and monitoring—financial risk is also controlled by "people metrics" (measuring, e.g., the mood in a project team) or metrics that might be referred to as planet metrics, tracking the quality of materials purchased as well as the waste.

Thus, the ultimate objective of our paper is to propose a model of metrics-based, sustainable project management for project financial risk. Our thesis is that sustainability (thus considering not only profit-related, but also planet- and people-related aspects) in the choice of metrics for project financial risk management can make this process much more efficient and efficacious.

In order to accomplish this objective with some anchoring in the practice of project management, we conducted a survey among project managers, with the aim of answering the following questions:

Q1: Which project financial risk categories occur most often and have the most severe consequences (impact)?

Q2: Is it justified to expect that a metrics-based system will be accepted and viewed as helpful in the practice of project financial risk management?

Q3: Should this system be based on sustainability and, if so, which sustainability-related metrics should form the basis of the system?

The answer to Q1 is necessary in order to propose specific relevant metrics. A literature survey showed that financial risk with respect to projects is usually analysed globally, thus without considering individual risk categories (such as salaries and wages, various purchase types, etc.) (see Section 2.1). Our aim was to be more concrete in the analysis of project financial risk.

The search for an answer to Q2 was based on another question: do project managers frequently notice (or later become aware of) early warnings about approaching financial risks in practice? If not, there would be no need for a financial risk metrics-based project management method and there would be no high chance of finding acceptance for such a method. However, if they do, attempting to formalise those warnings in the form of a metrics-based method is justified.

The search for an answer to Q3 was to follow from that to the question about the causes most frequently noticed by project managers for individual financial risk categories. If these causes were not purely financial, but were also linked, e.g., to human, social, or

resource usage aspects, sustainability-related metrics would be appropriate for the method. Moreover, by making use of the causes identified in the survey, it would be possible to include concrete proposals of metrics in the method that should form the final product of the present paper.

The structure of this paper is as follows: in Section 2 we provide basic information on project risk management as well as the usage of metrics in project management and we describe the research method used. In Section 3, we present the results for individual project financial risk categories. Section 4 contains discussion and proposal of a metrics-based sustainable project financial risk management method. This work ends with conclusions as well as perspectives on further research.

2. Materials and Methods

2.1. Project Financial Risk Management—Basic Definitions and State of the Art

Risk is defined in the literature in many ways. Here, we adopt the following definition [11]: Risk is an uncertain event that, if it occurs, has a negative effect on project objectives or other project success criteria. Based on the same study [11], we can state that each risk has a cause and a consequence (or several causes and consequences). The consequences may have negative impacts on the fulfilment of project objectives or other project success criteria. The causes must also be considered in project risk management. Without identifying the causes, it is usually difficult to manage events that may negatively influence project success. That is why various tools supporting the identification of causes are recommended for application to project risk management [12].

Project risk management comprises several steps, presented, e.g., as [11]: identification, assessment, risk response development, and risk response control. In the assessment process, the risks identified are evaluated according to the following formula:

$$\text{Risk Value} = \text{Probability} \cdot \text{Impact} \cdot \text{Non-Detectability} \quad (1)$$

where Probability is an evaluation (on a selected discrete bounded scale) of the probability of the occurrence of the risk (the lower the value, the lower the probability), Impact is an evaluation (on a similar scale) of the impact of the consequences of the risk for project success (the lower the value, the lower the impact), and Non-Detectability is an evaluation of the non-possibility of detecting the approaching risk earlier, before it actually occurs (the lower the value, the easier it is to receive an early warning that the risk is about to occur in the near future), thanks to warnings that precede the actual risk occurrence.

The last component of (1), which is often overlooked in the project management literature, may be crucial for project outcomes. It may make a big difference to be aware in advance that, e.g., electricity expenditures will increase drastically in two months or to be surprised by this event. Being warned allows the project manager or the members of the steering committee to search for additional funds, negotiate prices with the customer, or change the project scope or realisation formula, while the project is not too advanced yet to allow for far-reaching changes.

The components on the left-hand side of Formula (1) are often determined subjectively. However, if data from a previous project or other relevant ones are available, they should be used for their evaluation [13].

The risk response development process is applied to those risks for which the *Risk Value* exceeds an assumed threshold. For those risks, an attempt is made to avoid, mitigate, or transfer them, or prepare for their materialisation.

Financial risks are those that have an impact on project cost, profit, or liquidity, and thus on project expenditures and incomes, as well as on expenditures on tangible and intangible assets. The essential categories of project expenditures include salaries and wages, supplies and services, taxes and other government-imposed (public) expenditures [14]. Tangible and intangible asset acquisitions are essential too as they may give rise to high cash flows. In those projects (mainly profit-oriented ones) where revenues occur, financial risks are also linked to sales. The list of financial risks provided here is by no means

complete, but contains the main categories, which may be refined by each organisation and for each project.

In order to be able to analyse and manage project risks (financial ones included), it is important to identify their causes and the circumstances that provoke them. The causes and circumstances should be precisely described and related to specific risk types, so that an early and well-targeted reaction is possible. In the literature, very little information on the causes of financial risks can be found. We performed a literature search of the Scopus and Science Direct databases searching for strings "project AND risk AND (salaries OR wages OR salary supply OR service OR assets OR revenues OR cost) AND ((change OR increase) OR (cause OR reason))" relating to article titles and abstracts. We found out that project financial risk causes or reasons are identified practically only for construction, medical, and petroleum projects [15–18], and without considering individual financial risk types. Our aim is thus to analyse specific types of project financial risk using the concepts of metric-based and sustainable project management.

In the following, a financial risk will be understood as the event of the increase (with respect to the budget or plan) either of salary, supplies and services, taxes and other public expenditures, or asset-purchase-linked payments; or as the event of a decrease (with respect to budget or plan) of sales revenues. The causes of these events will be analysed, and their consequences will be measured in terms of the size of those increases. Their occurrence probabilities and degrees of non-detectability will also be the subject of analysis.

2.2. Sustainable Project Management

Nowadays, it is generally accepted that there is a positive correlation between sustainable project management and project success [19]. It is thus important to apply sustainable project management in practice. There arises, however, the question of how to do this. The answer to this question is rather complex. According to the literature, sustainability in project management is used in two basic roles [20]: to define and assess project results and project impact and to enhance and improve project management processes. This is in line with two research questions posed by G. Silvius in his study [21]:

1- To what extent do the scope and objectives of the project provide opportunities for integrating sustainability?
2- To what account do the actual processes of delivering and managing the project provide opportunities for integrating sustainability?

We also found specific—and not always wholly harmonised—pieces of information about applying sustainable approach in projects, e.g., [2,20,22,23]:

- Applying sustainability means taking responsibility for the impact of project or company activities on customers, employees, shareholders, communities, and the environment through all aspects of the project or company operation;
- Sustainability is assuring the balance between economy-related, social, and environmental issues;
- In order to integrate sustainability practices into project management, corporations have to set sustainability expectations first.

Not all of the above approaches are applied at the same time in each context. In order to justify this statement, let us distinguish the following three frameworks for using a sustainable approach in project management:

(F1) More emphasis is put on sustainable project results and impact, and less on sustainability in project management processes (e.g., a responsible treatment of employees may not be taken very seriously);

(F2) More emphasis is put on sustainability in project management processes, and less on sustainable project results and impact (e.g., the employees are treated highly respectfully, but the sustainability of project results is not a priority issue). In [24,25], it was shown that sustainability in project management processes may contribute to project success seen in a non-sustainable way (e.g., only from the point of view of finance);

(F3) Emphasis is put on both aspects.

In the case of frameworks F1 and F3, it is necessary to balance economy-related, social, and environmental issues and to set sustainability expectations beforehand. In the case of framework F2, sustainability may mean above all taking responsibility for the impact of project activities on the human, social, and physical environment.

In this paper, we are located in framework F2: our objective is to improve the process of project financial risk management thanks to the application of sustainability, above all in the sense of considering the impact of project activities on the human, social, and physical environment in project financial risk management processes.

2.3. Metrics-Based Project Management

Metrics-based project management has been recommended and described in detail for some time already [3,6,26]. Here, we provide only basic relevant information.

As mentioned above, metrics can be defined as measurable project attributes that have a predictive or comparative capability. They should provide the information, on a continuous basis throughout project implementation, as to whether there are chances for project success (defined in each case individually) and what may prevent a project from being successful. Of course, it will never be possible to know the exact performance of a project in the future. However, as Kerzner [3] states, "good metrics can provide a close estimate". Still citing Kerzner, we can claim that metrics are indispensable for efficacious and efficient project management, as "without effective metrics, project managers tend to wait until the project is far off track before considering relevant action".

Metrics can be measured as either observations (ordinal or nominal data, ranges of values, etc.) or human judgement. All the metrics, including those related to human judgement, in the final analysis, should be based on concrete, measurable scales (e.g., similar to Likert scales). They should provide managers with opportunities for improvement in the management of the project. This means that if a metric takes a value that is considered unsatisfying, it should be known exactly which actions in which project area and by whom should be taken. The set of metrics selected for a project should be able to inform the project manager, among others, about whether resources are being used properly and if the project is going in the desired direction. They should help to answer the questions "where are we today?" and "where will we end up if we continue in the same way as so far?".

Some metrics should be applied throughout the whole project and others in selected moments or phases (e.g., metrics measuring the progress of the project are not used in the project initiation phase).

Metrics are not a recent discovery. Humans have been measuring organisation and project performance for years, but many essential aspects used to be difficult to measure (e.g., commitment, creativity, satisfaction, stress level, teamwork, etc.). For this reason, sets of metrics were incomplete and thus seemed not very useful in management. Nowadays, however, almost every aspect has become measurable, even if not perfectly. We have at our disposal notebooks, smartphones, and technological and graphical possibilities to receive immediate, one-click or voice replies regarding a person's mood, satisfaction, stress, and so on, from hundreds or even thousands of persons. It is advised that much effort should be placed into the graphical design of metrics collection systems and on their personalisation, so that each person is given the possibility to provide the relevant answer in the way most adapted to their preferences and habits (notebook, smartphone or personal computer, a selection from among numbers, colours, emoticons, smileys, arrows, etc.). A great deal of work should also be put into the choice of metrics, especially for those "unmeasurable" aspects, so that they become measurable as far as possible and the relevant measurements can be obtained without human resistance and difficulties. For example, we cannot directly ask a customer about their mood, but we can ask project team members how often a customer complained each week.

All this creates a holistic sustainable project metrics system (i.e., one taking into account things and people, present and future, qualitative and quantitative aspects), covering

an almost arbitrary large set of stakeholders/respondents. There is no longer any excuse for not using project metrics in project management, although their selection and implementation requires a great deal of time and effort by all project stakeholders.

Each metric must be assigned recipients who need the relevant information and are both authorised and have the necessary resources to take relevant actions if the metric shows unsatisfactory values or unsatisfactory tendencies. The metrics assigned to each recipient should form their own personal dashboard, which permits them to fulfil their role in the project in the most efficient and efficacious way.

The process of metrics selection is a very difficult one. Too many or too few metrics, their inadequacy, as well as incompleteness, or lack of their acceptance on the side of their recipients or other project stakeholders, will prevent their usage from being successful. As Kerzner points out, brainstorming is not an adequate method to be used here. The generation and selection method of the metrics should be more structured, so that not only metrics that are the easiest to apply or best known are proposed, but those which together will provide useful and user-friendly dashboards for key project decision-makers.

Here, our aim is to apply metrics to project financial risks. In the existing literature [3] on project metrics, we can read about applying metrics to risk management, without specific details for financial risk. The only reference to metrics in the context of project financial risk management is made in the context of the Earned Value Method, as described above. Our aim is to present a wider perspective on the usage of metrics in project financial risk management. Our intention is to show that non-financial metrics, metrics that have not been used in the Earned Value Method, chosen according to the sustainability principle, can also significantly improve the management of project financial risks. The sustainability-based metrics collection should warn us as early as possible that a financial risk is or may be approaching, and allow us the time to take actions in order to mitigate it (reduce the probability or the consequences), completely prevent it, or prepare for its materialisation.

2.4. Research Method

In 2020, we applied a questionnaire, using the CATI (Computer-Assisted Telephone Interviewing) method [27], among 100 project financial managers (43% from small companies, 37% from middle ones, 20% from large ones) in Poland. In the questionnaire, we asked three questions with respect to the following project financial risk types in recently terminated projects they were financial managers of: increases in salaries and wages, expenditures for supplies and services, expenditures linked to taxes and other government-imposed fees, spending on tangible assets, and decreases in sales revenues. The questions were: what was the frequency of negative changes relating to the respective expenditure with respect to the plan? How large were these changes? How often were they signalled earlier by warnings? Additionally, the respondents were asked to indicate (from a list) the causes of respective risks. The list of potential causes was prepared on the basis of project cases known to the authors directly or from the literature. The scales used in the questionnaire are presented in Section 3. Statistical Package for the Social Sciences (SPSS) was used to process the data and arrive at the results described in Section 3.

Apart from the basic descriptive statistical analyses, logistic regression was used. The dependent variables represented the probabilities of the occurrence of negligible and non-negligible frequencies of negative changes and the probabilities of the occurrence of small and non-small negative changes in respective project expenditures or revenues, and the terms "negligible, non-negligible, small, non-small" will be defined in Section 3. The non-dependent variables represented the occurrence of individual potential causes of the negative changes in the expenditures or revenues.

The same data were analysed In a different context in [28], where the questionnaire items and the sample are described more extensively. In particular, the distribution of industries is presented, which is rather smooth: all the main industries are represented to a similar degree.

3. Results

3.1. Risk of Increases in Project Salaries and Wages

In the first part of the questionnaire, the respondents were asked about the frequency, size, and detectability of increases in project salaries and wages. Although most respondents (73%) described the frequency of salary expenditure increases as negligible (occurring practically never—1, very rarely—2, or rarely—3), almost one third (27%) of respondents described the frequency of increases in project salaries and wages in relation to plans as non-negligible (frequent—4, very frequent—5, permanent—6, undetermined—7). No outliers (atypical cases) were observed.

As far as the size of those changes was concerned, almost 40% of respondents assessed the growth in salary and wage expenditures as non-small (medium—3, high—4, or very high—5). The rest (61%) described the growth in salary expenditures in relation to plans as small (very small—1 or small—2). Two negative outliers (projects with very big or extreme changes in the area of salaries and wages) were observed.

With respect to the problem of risk detectability, the negative situation, increasing the risk value in (1), i.e., a considerable non-detectability, occurred in 70% of cases: that number of respondents stated that earlier signals were infrequent (occurred almost never—5, never—6, undetermined—7). Only 30% of respondents were of the opinion that they occurred fairly often (very often—1, often—2, rather rarely—3, rarely—4). Two outliers were observed (projects where the warning signals occurred very often).

The following potential events have been highlighted as the most frequent causes of project salary and wage increases: the dismissal of an employee (mentioned by 11% of respondents), change in employee due to a conflict or lack of competence (16%), an increase in the number of hours required to complete project tasks (39%), a change in the scope of the project (40%), and the need to repeat work due to errors/poor quality (11%).

Two significant logistic regression models were identified. They imply that:

- The probability of salary and wage increases caused by the "need to repeat work due to errors/poor quality" occurring in a project with a non-negligible frequency is 4.7 times greater than that of the negligible occurrence of such increases caused by the same event. The prediction accuracy of this (logistic) regression model is 78.9%.
- The probability of non-small increases in project salaries and wages caused by a "change in the scope of the project" is 3.6 times greater than that of negligible increases in project salaries and wages due to the same reason. The prediction accuracy of this regression model is 66.7%.

3.2. Risk of Increases in Project Supplies and Services Expenditures

Questions analogous to those discussed in Section 3.1 for project salary and wage increases were asked. In the description, we will also use the same definitions as in Section 3.1 of terms such as negligible, non-negligible, small, non-small, infrequent, fairly often, etc.

The percentages are similar to those in Section 3.1: 74% of respondents thought that increases in project supplies and services expenditures occurred with a negligible frequency, but 26% had a different opinion (they described the occurrence frequency of such increases as non-negligible). In terms of the size of the increases, 71% of respondents perceived it as small and 29% as non-small. Four negative outliers (projects with very and extremely frequent negative changes in project supplies and services expenditures) were observed, and they were in a way balanced by two positive outliers, where changes almost never took place.

Moreover, 39% of respondents were of the opinion that previous signals indicating approaching risks related to increased spending on supplies and services occurred fairly often, while 61% of respondents said that such signals occurred infrequently. One outlier was detected, where the respondents described the phenomenon of earlier signals as undetermined.

The following reasons were identified that may have an impact on increased spending on supplies and services: a change in supplier (25%), price increased by the supplier (62%), increased consumption of materials or service time (42%), change in the scope of the project (39%), and the need to repeat work due to errors/poor quality (43%).

One significative logistic regression model was identified, which indicates that the probability of a non-negligible frequency of increases in expenditure on supplies and services caused by "price increased by the supplier" is 3.7 times greater than the probability of negligible frequency due to the same reason. The prediction accuracy of the model is 75.4%.

3.3. Risk of Increases in Taxes and Other Public Expenditures

Analogous questions in the area of taxes and other public (government-imposed) expenditures were asked of the respondents. In terms of the frequency of increases in taxes and other public expenditures, 26% of respondents described it as non-negligible and the remaining ones (74%) as negligible. Six outliers were observed, where the increases were very or extremely frequent.

As for the size of the increases, 38% (thus almost 40%) of respondents described the growth in expenditures for taxes and other public fees as non-small. However, 62% of respondents defined the size of the increase in spending on taxes and other public fees as negligible. Two outliers were identified, with very large increases in the expenditures.

While 33% of the respondents were of the opinion that previous signals indicating the risk of increased spending on taxes and fees of a public nature occurred fairly often, 67% declared that such signals occurred infrequently. Three outliers were identified where the appearance of earlier signals was qualified as undetermined.

The following causes were identified for risk in this area: an amendment of the tax provisions introduced by the state (67%), change in the taxation method introduced by the entity implementing the project (15%), and tax planning mistakes (10%).

One significant logistic regression model was identified, from which we can conclude that the probability of a non-negligible frequency of taxes and other public fee increases due to a change in the method of taxation by the entity implementing the project is 3.82 times greater than the probability of negligible frequency of this type of increase caused by the same reason. The prediction accuracy of this regression model is 78.7%.

3.4. Risk of Increases in Cash Spent on Tangible Assets

In this part of the questionnaire, we change the perspective and try to analyse the risk not in relation to profit (which directly depends on the expenditures discussed in the previous section), but in the area of investment cash flows. Tangible assets may constitute an important part of project cash flows. They may be very expensive items, depending on the project (machinery, cars, laboratory equipment, etc.). Even a small change in the acquisition price with respect to the original budget in terms of percentage may represent a considerable amount of money and may threaten the project's liquidity.

The situation is here similar to that from the previously analysed areas, with 28% of respondents describing the frequency of increases in cash flows spent on tangible assets as non-negligible, and the remaining ones (72%) as negligible. Five outliers were identified, with very high frequencies of increases in this domain.

In addition, 28% of respondents qualified the size of the increases in cash flows spent on tangible assets as non-small. However, 72% termed the size of these increases as small. No outliers were observed.

Finally, 22% of respondents were of the opinion that previous warnings in the area occurred fairly often. In contrast, almost 80% declared that such signals occurred infrequently. The analysis of the outliers delivers interesting conclusions: projects where the respondents declared that early warnings occurred rather rarely were not atypical, but typical.

The following causes of increases in cash flows linked to the acquisition of tangible assets were selected by the respondents: price increased by the supplier (58%), a change

in the supplier (25%), a change in project scope (42%), or type of asset needed (32%). No logistic regression model with statistically significant parameters was identified for this case.

3.5. Risk of Decreases in Project Sales Revenues

In this part of the questionnaire, we change the perspective for the second time. We return to the profit optics, but from the point of view of revenues. Project sales revenues occurred in the case of 65% of respondents—the other projects were probably ones in which no sales took place (e.g., organisational projects). These respondents were asked about the frequency, size, and detectability of decreases in project sales. Here the percentages are slightly different from the previous areas.

Less than 20% of respondents described the frequency of occurrence of lower sales revenues with respect to the plans as non-negligible. The remaining ones (82%) described the frequency of decreased sales revenues in relation to plans as negligible. In this area, the situation is thus better than in the case of previously analysed financial risk types.

In addition, 33% of the respondents described the size of the decrease in sales revenues in relation to the plans as non-small and 66% as small. The situation in this area is thus similar to those discussed in the previous sections.

Finally, 12% of respondents were of the opinion that previous signals indicating the risk of lower sales revenue occurred fairly often and 88% said that such signals could be observed infrequently. The situation here is thus worse than those presented in the case of the other risk types.

The following causes of sales decreases with respect to plans were indicated: change in the number of units purchased by the customer (46%), sales price reduction forced by the customer (37%), and lower quality than planned (3%).

A regression analysis showed that the probability of a non-small size of decreases in sales revenues due to customer-forced price reductions is 3.1 times greater than the probability of small decreases in revenues due to such reductions. The prediction accuracy of this model is 66.2%.

4. Discussion

4.1. Preliminary Discussion

We analysed the risks of increases in project salaries and wages, in addition to expenditures for supplies and external services, taxes and other public fees, and of cash outflows linked to the purchases of tangible assets, as well as decreases in project sales revenues. The risks were analysed from the point of view of their occurrence probability, size, and the possibility of being foreseen or, at least, guessed, before their actual materialisation. In addition, their causes were identified and analysed with respect to their impact on the above-mentioned parameters.

The course of further analysis will depend on the thresholds of division between individual degrees of evaluation given by the respondents in the questionnaire that constituted the basis for our research. These thresholds will depend on individual decisions in each organisation. Which is a greater cause for concern: expenditure increases or revenue decreases that occur frequently and are at least of medium size—or perhaps we should already be alerted by projects in which expenditure increases or revenue decreases occur rarely or are small? This depends on the project type. In some projects, especially those financed with public money, where budgets may be rigid, even very small and extremely rare negative deviations in expenditures, revenues, and cash flows may create serious problems. In this paper, however, we made the following assumptions:

- Negative deviations (increases in expenditures and decreases in revenues with respect to the plan) are considered unacceptably probable if they are at least frequent;
- The size of those negative deviations is considered to be unacceptable if it is at least medium;

- The detectability is unacceptable if the early signals warning about risks that are approaching occur in a project rarely, almost rarely, or never.

The findings for individual risk types are summarised in Table 1, using the above assumptions.

Table 1. Summary of features of financial risk of in individual categories (frequencies).

	Salary and Wage Increase	Supplies and Services Expend Increase	Taxes and Other Public Fees Increase	Tangible Assets Spending Increase	Sales Revenue Decrease
Unacceptable probability	app. 30%	app. 25%	app. 25%	app. 30%	app. 20%
Unacceptable consequences	app. 40%	app. 30%	app. 40%	app. 30%	app. 30%
Unacceptable detectability	app. 70%	app. 60%	app. 70%	app. 80%	app. 90%

The table should be interpreted as follows: e.g., the first column tells us that approximately 30% of respondents reported risks of salary and wage increases characterised by unacceptable probability, approximately 40% noted risks in the same category of unacceptable consequences, and approximately 70% cited risks in the same category characterised by unacceptable detectability.

The answer to question Q1 can be formulated as follows: all the financial risk types analysed here should be considered important, if we use the frequency of their unacceptable probability and consequences as a measurement. The outliers and the results of regression analysis presented in Section 2 strengthen this statement. This means that all the analysed risk categories need to be included in our proposal for improving project financial risk management through the usage of metrics.

We can see, however, that non-satisfactory detectability frequency is the main issue: it assumes high values. Several outliers indicated by the respondents were characterised by extremely high values in this area. This increases the values calculated in (1) and in this way, apart from the obvious consequences for the project manager of not being warned in due time about approaching risks, decreases the efficiency of project financial risk management—more risks than necessary surpass the threshold and require seeking mitigation, avoidance, or acceptance.

The detectability is, however, not always considered in project risk management procedures. Very often in the project management literature, Formula (1) contains only two components: probability and consequences. In our opinion, this is not the correct approach, but may have contributed to the fact that, in project management practice, the warnings are not noticed, registered, analysed, etc. In other words, our respondents may have been unaware of some warnings or signals that in fact occurred because they were not used to paying attention to them. A lack of a systematic approach to the detection of early warnings may account for not noticing them. Thus, the actual non-detectability numbers may be lower than those in Table 1. This means that a metrics-based project risk management, which would decrease some risk values calculated by means of Formula (1), might lower the effort required by risk management in the phase before the project starts—fewer risks will surpass the threshold and project managers will be able to wait to react until a warning occurs, which may never happen. In addition to increasing project financial risk management efficiency, being aware of financial problems that will arise in the future in time will also increase project financial risk management efficacy: very often some reactions and changes are possible only up to a certain moment in time. This means, in the context of question Q2, that a method providing early warnings about project financial risks has large changes to be accepted in practice, from the point of view of both efficiency and efficacy. This positive answer to question Q2 can additionally be confirmed by the fact that

early warnings in project financial risk management are not an alien notion for the project managers who took part in this study—even if not always very often, they do notice them and are aware of their presence.

Question Q3 concerns the metrics to be used in order to increase the awareness of early warnings. In this case, we are interested above all in non-financial metrics, as the theme of financial metrics is fairly well-covered by the literature, mainly on the Earned Value Method. Our aim is to draw conclusions from our study on non-financial metrics to be used in the management of financial risks.

We decided to reach these conclusions by means of the identification of the main causes of financial risks. The identification of project risk causes [29] is a primordial aspect of project risk management. Only by identifying the real root of the problems can we manage them. We expect the metrics to indicate that a cause has already occurred or is about to do so.

In the literature, analyses of risk causes exist for specific projects, but no systematic analysis has been identified for the different types of financial risks analysed here. In our research, we have been able to identify the most important causes for individual risk categories. Table 2 shows those causes that were mentioned in at least 30% of cases or that turned out to be significant for one of the risk's features (the probability of occurrence or consequences of negative changes) in a significant logistic regression model.

Table 2. Most important risk causes identified in the survey.

Risk Category (Increases or Decreases, Depending on Risk Type)	Considerable Mentioning Frequency (at Least 30%)	Significant Influence on the Occurrence Frequency of the Risks in the Category (Log. Regression)	Significant Influence on the Consequences of the Risks in the Category (Log. Regression)
Salaries and wages	"Increase of the number of hours required to complete project tasks" "Change in the scope of the project"	"Need to repeat work due to errors/poor quality"	"Change in the scope of the project"
Supplies and services	"Change in the scope of the project" "Increased consumption of materials or service time" "Price increased by the supplier"	"Price increased by the supplier"	
Taxes and other public fees	"Amendment of tax provisions introduced by the government"	"Change in the taxation method introduced by the entity implementing the project"	
Tangible assets spending	"Change in the type of asset needed" "Change in project scope" "Price increased by the supplier"		
Sales revenues	"Sales price reduction forced by the customer" "Change in the number of units purchased by the customer"	"Sales price reduction forced by the customer"	"Sales price reduction forced by the customer"

In order to propose relevant metrics and answer Q3, we need to identify possible metrics warning about or indicating the occurrence of the causes listed in Table 2. This will be addressed in Section 4.2.

4.2. Proposal of Sustainable Metrics-Based Project Financial Risk Management Method

The proposed method will be embedded into the classic project risk management process, as described in Section 2. An outline of the method is presented below.

A. In the process of risk identification, include all the risks from a pre-set organisational list of project financial risk categories, which has to incorporate salaries and wages, supplies and services, taxes and other public fees, tangible assets spending, sales revenues, and possibly others (e.g., intangible asset spending, if this is important in the projects in question), further divided according to important relevant stakeholders (e.g., the category "salaries and wages" would have to be divided into the categories "salaries and wages of individual, homogenous employees or workers group");

B. For each identified financial risk category, take the relevant causes from Table 2 (completed with some other causes seen as important) and select metrics addressing, if possible, all of the six sustainability principles (see Table 3), such that:
   - They would warn that the cause in question exists or is about to occur;
   - They would be acceptably easy to collect from project stakeholders at pre-set systematic time intervals;

C. In the process of project implementation, apart from the normal activities prescribed by project risk management, the values of the sustainable financial risk-related metrics are to be collected at pre-set intervals and analysed by relevant decision-makers on their personal dashboards. If a metric shows a negative value or tendency, the measures helping to mitigate, avoid, or accept the respective risk are to be taken.

Several examples for step B are included in Table 3.

Step B should take the form of a workshop. In Table 3, we did not include purely financial metrics, but only those non-financial ones that are likely to be named by the participants of a workshop where they would be asked, for each risk reason from the list, to associate non-financial metrics with the sustainability principles. These include aspects such as the respectful treatment of humans and ethical management, as well as the consideration of both the present and future, in addition to both the local and the global perspective. Aspects such as satisfaction or non-satisfaction signals or hesitations on the part of various project stakeholders may also be significant for project finance, leading to the actual occurrence of the risk cause and then, possibly, the risk itself.

The proposed method allows for integrating into the generation of metrics the popular brainstorming approach, which is per se not really recommended in this context (see Section 2), with a certain structure imposed by the sustainability principles. This structure would ensure, in spite of the usage of brainstorming, a holistic and balanced character of the set of metrics generated (purely financial metrics, especially those from the Earned Value Method, should be added to the list). Additionally, this approach would draw attention to aspects that are often disregarded by finance experts, but may still be of the utmost importance for project financial issues. In addition, this attention would be drawn early, not only before the risk occurs, but even before its reason occurs—which would provide more time for corrective or preventive actions.

Table 3. Most important risk causes and examples of metrics linked to sustainability principles.

Cause	Example of Metrics
”Increase of the number of hours required to complete project tasks”	M1: (to be applied at the beginning of each important project task): Do you feel well-introduced to the job? (Sustainability principles i. and v.)
	M2: (to be applied throughout each important project task): Do you feel motivated to work efficiently on the task? (Sustainability principles i., iv., and v.)
”Need to repeat work due to errors/poor quality”	M1—see the first row
	M3: (to be applied at the beginning of each important project task): Do you have all the necessary resources of adequate quality at your disposal?
”Change in the scope of the project”	M4: (to be applied throughout the initiation and planning phase of the project): To what extent do you feel that the scope has been definitely defined? (Sustainability principle ii.)
	M5: (to be applied throughout the project): How many changes in the scope has the customer required or suggested in a given period? (Sustainability principle ii.)
“Increased consumption of materials or service time”	M1, M3—see the second row
“Price increased by the supplier”	M6: (to be applied throughout the initiation and planning phase of the project): To what extent do you feel that the price named by the suppliers is fixed? (Sustainability principles ii. and iii.)
	M7: (to be applied throughout the project): Are any of the suppliers slow in issuing invoices? (Sustainability principles ii. and iii.)
“Amendment of tax provisions introduced by the government”	M9: (to be applied throughout the project): Is there any discussion in the press about changing taxation principles in the country? (Sustainability principle iii.)
“Change in the taxation method introduced by the entity implementing the project”	M10: (to be applied throughout the project): Is there any discussion in the financial services of the organisation about changing the taxation method? (Sustainability principle ii.)
“Change in the type of asset needed”	M11: (to be applied until the asset has been paid for): Is there any discussion about the asset type on the part of its future users? (Sustainability principle i.)
“Sales price reduction forced by the customer”	M12: (to be applied throughout the initiation and planning phase of the project): To what extent do you feel that the price determined with the customer has been fixed? (Sustainability principles ii. and iii.)
	M13: (to be applied throughout the project): Are any of the customers slow in accepting the work performed for them? (Sustainability principles ii. and iii.)
	M14: (to be applied throughout the project): To what extent do the customers seem to be satisfied with the results being delivered? (Sustainability principles ii. and iii.)
“Change in the number of units purchased by the customer”	M15: (to be applied throughout the initiation and planning phase of the project): To what extent do you feel that the number of units to be purchased determined with the customer is fixed? (Sustainability principles ii. and iii.)
	M13 and M14—see the previous row

5. Conclusions

The contribution of the present paper is twofold: theoretical and practical. From the theoretical point of view, we start from the approach known from the literature: of applying sustainability principles to project management processes to improve general project performance. In contrast to the literature, we uniquely focus on the project financial risk management process and not on the project risk management process in general, which allows us to come to more specific conclusions. Moreover, in contrast to most of the literature, we take into consideration not only the risks themselves, but also their causes. The identification of the causes is performed using the sustainability concept: although the object of study is financial risks, we also search for human-, social-, and environment-related causes. In this context, we reach for another approach from the literature: metrics-based project management, meant to provide a set of due-time warnings about non-desired phenomena approaching the project. For the first time, to our knowledge, we combine financial risk causes identified in a sustainable way with the process of project metrics generation. The result of the proposed approach is a holistic list of metrics, covering all the areas and elements of the project and its environment, that would warn the project manager in due time about project financial problems in the future.

From the practical point of view, it has to be emphasized that the proposed approach, even though it is still in the initial stage of development, can already bring some advantages to project managers. If the holistic list of metrics is used during project implementation, it may significantly increase the efficacy and efficiency of project financial risk management. Efficacy, because, thanks to the holistic list of metrics, the objective of the financial risk management process, the minimisation of financial risk impact on the project, will be achieved to a higher degree: earlier warnings will allow the elimination, avoidance, or minimisation of more financial risks, and to a higher degree than would be the case if we had to wait with our reactions to a later moment. Efficiency, because earlier actions and decisions are usually cheaper than those taken, in the absence of the metrics-based warnings, at a later moment.

The method we propose is not inexpensive to implement. First, it requires a very detailed classification of risks. Second, the identification process of risk causes and the workshops where metrics for each triple risk category/risk cause/sustainability principle would be generated require much effort. In addition, the design of personal dashboards and the collection and interpretation of the metrics during all the project stages would also involve significant labour. Still, in our opinion the method is recommendable—not for all projects, of course, but for those whose financial failure would mean an important loss for the organisation. Our survey shows that financial risks in all the examined categories are often important, from the point of view of both probability and consequences. It also shows that warnings of financial risks are observed in practice, even if perhaps—for the moment—a posteriori. This justifies that the method may find acceptance with those project managers who have experienced serious problems in the financial aspect of their past projects and are closely familiar with the feeling "I could have done something about it if I had paid attention to this or that and were informed about this or that . . . ".

Our study has several limitations. The question of the difference between a risk cause and a warning signal is not always clear. Is the dissatisfaction of a project team member a warning signal or a cause of the risk of them quitting the organisation? An additional problem would be the exploration of the chain of causes and distinction among causes that the project manager has some influence on and that are outside the range of their manoeuvre possibilities.

In addition, in our survey we did not ask about the knowledge or usage of metrics. It was our decision to keep the questionnaire relatively short. A similar problem is related to the delays in sales revenues payments. We did not query the respondents about the causes of this phenomenon for the same reason, although this is an issue that requires further investigation.

Another limitation of this study is the still imperfect categorisation of project financial risks. On the one hand, the categorisation used in this paper does not cover the whole range of project financial risks. For example, spending on intangible assets, which holds an important position in the budget of certain projects (e.g., IT and research projects), was not considered. On the other hand, the division into categories is still not fine enough. For example, salaries and wages comprise several subcategories of employees and workers, which may appear with various frequencies, as well as having different impacts and causes.

The last limitation we need to mention is the one due to the too general nature of our sample. It represented all the industries and in the questionnaire no question was asked about the type of project the respondents had in mind. The financial risks, their causes, and, consequently, the metrics, will be different for each industry and each project and organisation type. Thus, further research is needed that would be oriented towards specific project types and the corresponding deep identification and analysis of financial risk categories and their features, (chains of) causes, and warning signals. All this would provide, in the final analysis, a system of sustainable metrics that could considerably increase the efficiency and efficacy of project financial risk management. We hope that our paper provides a modest incentive to follow this research path.

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