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TOOLS FOR LABOR COST ESTIMATION IN INTERNATIONAL PROJECT TEAMS

Abstract:

Estimating labour costs in international projects is crucial for effective resource management. Differences in salaries, economic conditions, legal regulations, exchange rates and cultural norms require the use of advanced and flexible tools. The aim of this article is to analyse the available methods and tools for estimating labour costs and to assess their effectiveness in the context of cross-border cooperation. The research was based on interviews with international project managers, which allowed us to identify practical challenges and needs related to improving the tools used. The results will be used to develop more precise solutions to support labour cost management in international project teams.

Keywords:

AI, Building information modelling, Cost breakdown structure (CBS), Cultural differences, Exchange rate fluctuations, International project management, Labor cost estimation, Machine learning, Productivity variation, Risk breakdown structure (RBS)

JEL Classification: F23, J31, D24

1. Introduction

In recent years, it has become increasingly clear that the implementation of research projects, including experimental and laboratory projects, has become more complex due to their interdisciplinary and international nature. Such projects require not only the integration of knowledge from different sources and disciplines, but also the cooperation of geographically dispersed teams operating in different economic, cultural and institutional conditions (Adamantiadou and Tsironis, 2025). This complexity can sometimes make project management difficult in financial terms, especially when it comes to accurately estimating the costs of working in international research teams(Fazil, Lee and Muhamad Tamyez, 2021).

One of the key challenges that managers of such projects may face is estimating labour costs. It is worth remembering that this process can be somewhat more complex in international environments. This is due to a number of factors, including significant differences in salary levels, local labour regulations, availability of skills and exchange rate volatility. It seems that estimating costs requires not only technical knowledge, but also tools for modelling contextual variables such as team performance, tax regulations, local working time standards and the cost of living in a given country (Pishdad and Onungwa, 2024). Furthermore, the lack of uniform methodologies and the dispersion of cost information hinder the standardisation of the estimation process(Fazil, Lee and Muhamad Tamyez, 2021).

2. Cost management in an international context: challenges and best practices

Effective cost management is a key element of the success of any project carried out in an international context. Projects of this kind are particularly susceptible to factors that disrupt financial stability, such as currency fluctuations, differences in local wage rates, inconsistent tax and legal regulations, and culturally conditioned approaches to work efficiency and task completion times. In such a complex environment, the traditional, intuitive approach to cost estimation becomes insufficient. To achieve this, it is necessary to apply structured cost management methodologies that facilitate not only estimation, but also ongoing control and real-time adjustment of costs.

A proven method for harmonising the approach to cost management in multi-level projects is the implementation of integrated cost breakdown structures (CBS) and risk breakdown structures (RBS). According combining both approaches provides a comprehensive picture of project costs (Cerezo-Narváez et al., 2020). This is achieved by taking into account not only planned expenditures but also potential deviations resulting from project uncertainty. This facilitates better resource allocation management and more realistic cost forecasting in international project environments. The model proposed by the authors is based on the gradual integration of CBS and RBS, which facilitates the identification, assessment and assignment of risk directly to specific cost estimate elements. In practice, this means that

managers can more easily identify those components of labour costs that are most vulnerable to external factors, such as labour market volatility in a given country or differences in labour productivity. This approach is particularly important in the context of international research teams, where diversity in legal and economic conditions is the norm rather than the exception. The integration of CBS and RBS structures facilitates the precise determination of budget reserves and the creation of scenario models that take into account variable factors such as exchange rates and local hourly rates. This article makes an important contribution to the development of tools supporting cost management in complex projects and can serve as a catalyst for the development of similar frameworks in the context of scientific research and laboratory projects carried out by international teams.

In the context of projects carried out in an international environment, uncertainty poses a key challenge in cost management. Exchange rate volatility, discrepancies in local remuneration systems, tax regulations and logistical delays can have a significant impact on initial budget estimates, potentially causing significant deviations. High volatility and the difficulty of accurately predicting many operational parameters directly reduce the accuracy of labour cost estimates, especially in geographically dispersed teams.

As Reyes-Picknell (2016) notes, using single deterministic values as the basis for cost estimates can lead to difficulties, especially in cases where they do not take into account natural fluctuations or unpredictable events (Torp and Klakegg, 2016). In practice, this approach can result in significant discrepancies between predicted and actual expenditures. The author proposes alternative solutions based on scenario analysis estimating optimistic, pessimistic, and most likely values, which increases the flexibility of forecasts and enables risk modelling at an earlier stage of project management. Furthermore, it is important to periodically review cost estimates in line with the changing dynamics of the project environment. In this context, Reyes-Picknell emphasises the need to implement mechanisms for dynamically adjusting cost estimates based on current market data, such as exchange rates and local wage rates(Torp and Klakegg, 2016). The use of such methodologies, combined with carefully formulated budget reserves, can significantly reduce the impact of uncertainty on the achievement of project financial objectives. Therefore, cost management in an international context requires not only precise calculation tools, but also a systematic approach to risk analysis and budget flexibility. The integration of these elements is becoming a prerequisite for ensuring financial stability in transnational research projects(Torp and Klakegg, 2016).

3. Overview of tools and technologies supporting cost estimation in international projects

Accurate cost estimation is a key challenge in international project management, especially in a context characterised by a high degree of economic, legal and organisational volatility.

In recent decades, advances in information technology and analytical methods have significantly expanded the range of tools available to support this process, from simple spreadsheets to complex systems integrated with machine learning and building information modelling (BIM).

It is clear that spreadsheets (e.g. Microsoft Excel) are still the most commonly used tool for estimating labour costs in the context of projects. These tools facilitate the creation of basic cost models, flexible adjustment of assumptions, and the use of mathematical and statistical formulas. The advantages of such software include its widespread availability, low entry threshold, and the ability to quickly adapt it to the needs of a specific project. However, in the context of international projects, the use of spreadsheets often proves insufficient due to their inability to systematically take into account uncertainty, risk and data variability (Torp and Klakegg, 2016). Furthermore, they are unable to process information in real time, such as automatically downloading data on exchange rates or local wage rates.

A potential alternative to conventional methodologies is the implementation of systems characterised by increased structural complexity, whose basic elements are based on the principles of cost breakdown structure (CBS) and risk breakdown structure (RBS). The integration of these approaches allows potential risks to be assigned to specific cost elements, enabling managers to more accurately predict budget deviations and implement preventive measures. As demonstrated in the study (Cerezo-Narváez *et al.*, 2020)the integration of CBS and RBS is particularly beneficial in environments characterised by a high degree of uncertainty, where labour costs may be dependent on external factors such as exchange rate fluctuations, local regulations or changes in the availability of human resources. The model proposed by the authors is applicable not only in the construction sector, but also in research and technology projects.

In the context of cost management, the use of building information modelling (BIM) technology is becoming increasingly important, especially in the so-called 5D modelling version, which integrates spatial data (3D), schedule (4D) and costs (5D). The use of such tools facilitates not only the precise mapping of project structures, but also the dynamic simulation of cost scenarios in real time. As shown by Pishdad and Onungwa (Pishdad and Onungwa, 2024), building information modelling (BIM) can be used to calculate labour costs in international projects, taking into account differences in local rates, exchange rates and labour availability. Building information modelling (BIM) software facilitates the rapid identification of changes affecting financial expenditure and improves the exchange of information between project stakeholders (Pishdad and Onungwa, 2024).

One of the most innovative approaches to estimating project costs, including labour costs, is the use of methodologies based on machine learning (ML) and artificial intelligence (AI). A review of the literature indicates that machine learning (ML) algorithms, including artificial

neural networks, support vector machines (SVMs) and decision trees, facilitate the development of highly accurate forecasting models. These models have the ability to detect non-linear relationships between cost variables, making them particularly useful in an international context where data is diverse and difficult to capture using classical methods.

In the article 'Cost Estimation and Prediction in Construction Projects,' the authors propose the use of machine learning (ML) algorithms to automate cost estimation processes based on data from previous projects (Tayefeh Hashemi, Ebadati and Kaur, 2020). These models have proven particularly effective in conditions of uncertainty due to their ability to adapt to changing input data, predicting not only point values but also probability distributions of costs.

4. Research methodology, procedure and results
4.1. Research methodology and process

The research conducted in this article aimed to identify the challenges associated with estimating labor costs in international project teams. The study sought to explore the tools employed in labor cost estimation, as well as the difficulties arising from wage discrepancies, labor standards, and the impact of exchange rate fluctuations on the costs of projects executed in an international context.

The research method employed in the study was in-depth interviewing, a qualitative data collection technique that involves conducting individual conversations with study participants. Unlike traditional surveys, where respondents choose answers from a predefined list, in-depth interviews focus on allowing full freedom in responses while ensuring that all key issues are covered. The interviewer directs the conversation in such a way as to allow the respondent to freely elaborate on topics they find significant (Miński, 2017).

In-depth interviewing was chosen as the research method due to its capacity to gather detailed, subjective responses, which can provide valuable insights into the complex issues related to international project management and labor cost estimation. This method was particularly justified, as the study concerned issues requiring a thorough analysis of the practical experiences of project managers. The interview enabled participants to express their opinions on the tools and methods employed in the context of the challenges they encounter in their daily work.

The interviews were conducted between March 1 and March 30, 2025, and the respondents were 17 project managers, each of whom had experience in managing international projects across various industries, such as IT, engineering, automotive, mobile app development, and e-commerce. The research questionnaire consisted of 10 questions regarding the respondents' experiences in managing international projects and

the challenges related to labor cost estimation. The questions were designed to elicit detailed qualitative responses that could be used for a deeper analysis of the issue at hand.

The interviews were semi-structured, meaning that researchers prepared an initial set of questions that served as the foundation for the conversation, but also allowed participants the freedom to express their opinions and expand on topics they considered important. This approach provided flexibility and depth in data collection, enabling the researchers to obtain more detailed information than would have been possible with traditional closed-ended surveys.

One notable limitation of the study is the relatively small number of participants in relation to the broader population of project managers involved in international projects. Although the selected group of 17 respondents provided rich and insightful data, the limited sample size makes it difficult to generalise the findings to the wider industry context. Additionally, the sample may not fully reflect the diversity of organisational practices, regional differences, or sector-specific challenges present in global project environments. As a result, the conclusions drawn from the interviews should be interpreted with some caution, especially when applying them beyond the scope of the participants' specific experiences.

4.2.   Research results
4.2.1. Characteristics of the study participations: their experience in international projects

The following part gives more detailed look into who the study participants were, especially in terms of their involvement in international projects. Their past experience provides important context for evaluating the relevance and depth of their answers.

The first question addressed to the managers concerned their professional experience with international projects. On average, the respondents had from 7 to 16 years of experience in managing international projects, which allowed them to gather a broad knowledge about the challenges and specifics of such initiatives. Most of them occupied managerial positions, such as Project Manager, IT Project Manager, Process Engineer, Business Development Director, which shows their big responsibility and experience in managing complex projects, often of global range. Working with international project teams required adapting management processes to different cultural, geographical, and legal conditions. In particular, project managers had to show a high degree of flexibility and ability to manage diversified teams whose members often came from various countries. This required adapting communication, work methods, as well as considering differences in working standards, which had an impact on the estimation of labour costs.

In this context, experience in different industries was also of significance. The project managers carried out projects in sectors such as IT, engineering, automotive, mobile app development, ERP system implementation, and e-commerce. So diversified projects demand different approaches to labour cost estimation, which proves that experience in managing international projects includes various challenges related to costs, which are hard to compare – especially in an international context. All of this demonstrates that the professional experience of project managers in international environments is both diverse and very rich. These managers not only lead teams, but they also need to make decisions which are crucial for the effectiveness of labour cost estimations in international projects.

The second question was related to the types of projects managed by the respondents. A broad range of projects emerged in the answers, all conducted in international context. The managers indicated different areas, including engineering projects, IT technologies, ERP systems implementations, mobile app development, and e-commerce platforms.

Engineering projects, such as those in the automotive industry, are particularly complex, as they require advanced technical skills and cooperation of international teams. These projects often include different production stages, such as designing, testing, manufacturing, and implementation, which makes it necessary to estimate labour costs precisely for each stage. In such cases, one must take into account not only salaries, but also working time, availability of specialists, and specific technological requirements. Additionally, in the automotive sector, variables like legal regulations or technological differences between countries can have a significant impact on the cost.

IT projects, such as development of e-commerce platforms or ERP implementations, also come with many challenges. For such projects, labour costs may vary depending on local skills and resources available on the job market. Respondents pointed out that differences in the technological advancement and experience level of teams in different regions of the world also play a key role in shaping the cost of labour. For a project manager, especially in the IT sector, this means the need to find suitable resources across the world, which can involve various labour costs, as well as challenges connected with communication and synchronization of team's work.

These projects differ not only by industry, but also by the team size, duration or technical requirements. For this reasons, managing labour costs in such projects is a challenge that requires special attention to variables like performance, currency exchange rates, salary differences, or level of team's advancement. In such projects, especially international ones, the accuracy of labor cost estimation becomes crucial for the success of the entire undertaking. The study participants were also asked about the types of projects they had managed. The answer presented a broad range of projects implemented in an international context. Project managers pointed to various areas, including engineering projects, IT technologies, ERP system implementations, mobile application development, and e-

commerce platforms. Engineering projects, such as those in the automotive industry, are particularly complex because they require advanced technical skills and cooperation between international teams. These projects often involve multiple stages of production, including design, testing, production, and implementation, which requires precise labor cost estimation at each stage. Such projects necessitate consideration not only of wages but also working hours, availability of specialists, and specific technological requirements. Additionally, in the automotive industry, variables such as legal regulations or technological differences across countries can significantly affect costs. IT projects, such as the development of e-commerce platforms or ERP system implementations, also present many challenges. In these projects, labor costs can vary depending on local skills and resources available in the labor market. Respondents indicated that differences in technological advancement and the experience of teams across different world regions also have a crucial impact on labor costs within the project. For a project manager, especially in the IT industry, this means the necessity to find suitable resources across various parts of the world, which can lead to different labor costs and challenges related to communication and synchronizing team work. These projects differ not only by industry but also by team size, duration, and technical requirements. For these reasons, managing labor costs in such projects is a challenge that requires particular attention to variables related to performance, exchange rates, wage differences, and team expertise. In such projects, especially international ones, the accuracy of labor cost estimation becomes crucial for the success of the entire endeavor.

4.2.2. Tools Used for Labor Cost Estimation in International Projects

The research participants were also asked about the tools they most commonly use for labor cost estimation in international projects. The following section presents the findings regarding the range of tools mentioned, their functionalities, and the advantages and challenges associated with each.

In response to the question "What tools do you most often use to estimate labor costs in international projects?" the participants provided a wide range of answers, reflecting the diversity of practices in the field. The most frequently cited tool was Microsoft Excel, which remains widely adopted across organizations. Respondents emphasized Excel's flexibility in enabling the creation of custom macros, scenario modeling, and internal databases, as well as its capacity to accommodate real-time adjustments. Despite not being specifically designed for labor cost estimation in international contexts, its adaptability and accessibility contribute to its continued popularity among project managers.

In addition to Excel, some organizations use more advanced systems such as MS Project, SAP CPM, Planview, or analytical tools based on historical data. The respondents mentioned that these systems allow for a more comprehensive approach to project management, enabling the consideration of various factors such as labor cost fluctuations,

resource availability, and exchange rates. Some organizations have also developed their own tools, such as integrated forecasting systems in SAP HR, tailored to the specific needs of the company.

The diversity of tools used by respondents indicates that there is no single standard applied in all organizations. Each tool has its strengths, but also limitations. Although Excel is very popular, challenges related to manually entering data often arise, which can lead to calculation errors and reduce process efficiency. On the other hand, more advanced tools like SAP and MS Project offer richer functionalities but require greater time and resource investments for implementation and maintenance. Tools dedicated to labor cost estimation in international projects should allow for integration with other systems, real-time monitoring of changes, and automatic inclusion of variables such as exchange rates or wages in different countries.

4.2.3. Centralized vs. decentralized labor cost estimation tools

Estimating labour costs in international projects requires appropriate tools, and respondents shared their experiences in this area. Their answers help to see what solutions are most commonly applied and how these tools support decision-making in complex project environments.

In response to the question about the centralization of labor cost estimation tools, the results clearly indicate that in most organizations, there is no single central tool for estimating labor costs. Instead, various solutions are used depending on the project, region, or department. The decentralization of tools leads to the fact that the labor cost estimation process is largely dependent on local guidelines and the specific characteristics of the region.

While in some organizations there is a general framework or set of tools recommended by the central office, there is no single, consistent platform used across all international projects. In such conditions, organizations often choose tools for labor cost estimation based on the specifics of the project or region. For example, in IT projects, more advanced project management systems such as SAP CPM, MS Project, or Planview may be used, which provide full integration with other systems and allow for the inclusion of variables such as work hours, exchange rates, or resource availability.

In less complex projects, where flexibility and quick adaptation to changing conditions are crucial, simple tools like Excel are used, allowing for quick changes and data adjustments. However, the lack of a single central tool presents some challenges. First, due to the variety of tools used, the labor cost estimation process across different departments of the organization is not fully integrated. This makes comparing data across projects or monitoring results globally significantly more difficult. There is a risk that data on wages, exchange rates, or labor costs may be interpreted differently across regions, leading to

inconsistent cost estimates. Another problem is the lack of uniform standards and procedures for labor cost estimation, which may cause difficulties in risk management.

The decentralization of tools may also lead to inefficient data management because each department may collect data in different formats, making the integration of results and the analysis of labor costs on a global scale more time-consuming and complicated. Therefore, organizations that use diverse tools for labor cost estimation should consider pursuing greater centralization. Integrating tools within a unified platform would allow for easier project management and better comparison of results and data analysis at the global level.

4.2.4. Challenges in addressing wage discrepancies across countries

Asked about the greatest difficulties they face in accounting for wage differences between countries, respondents provided varied answers. One of the key challenges pointed out by respondents is accounting for wage differences between countries, which presents a difficulty both in labor cost estimation and in further monitoring and controlling the budgets of international projects.

One of the main problems related to wage differences is the variability of rates across countries, which is not always reflected in the available labor cost estimation tools. Respondents observed that in many cases, wages are estimated based on general, outdated data that do not account for specific local conditions. Additionally, wage variability is often related to different market conditions that change by region. For instance, in developed countries, wages are typically higher, but team productivity may also be higher, balancing out higher labor costs. In developing countries, however, where labor costs can be much lower, the problem arises of having to hire more people to achieve the same results. This phenomenon can make it difficult to forecast actual labor costs and affect the final project budget.

Another problem related to wage differences is the lack of uniform data sources that could be used to obtain accurate information on wages in different countries. Respondents indicated that in many cases, they have to rely on estimates and historical data, which may be inaccurate and not reflect real market conditions. The lack of access to accurate, up-to-date wage data makes the labor cost estimation process more risky and less precise. Therefore, organizations should strive to gain access to reliable wage databases that are updated regularly. Moreover, labor cost estimation tools should take into account differences in team productivity across countries, allowing for more accurate labor cost forecasting.

4.2.5. Managing currency exchange fluctuations during project execution

In international projects, fluctuations in currency exchange rates can have a significant impact on labour cost estimations. Therefore, it is important to understand how organisations deal with this issue in practice. The next question concerned the way

currency exchange rate changes are taken into account during the implementation of international projects. Most respondents indicated that exchange rate fluctuations are treated as a kind of project risk. In practice, this means that currency rates are not actively monitored by labour cost estimation tools. Instead, organisations that need to consider currency changes rely on manual input of exchange rate data, which can lead to errors, especially when the rates are changing fast. Moreover, some organisations introduce additional mechanisms for currency risk protection, such as creating reserves for exchange rate risk, which helps to minimise the impact of exchange rate volatility.

Even though some organisations use tools that track exchange rates in real time, such solutions are rarely applied and are not fully integrated with the labour cost estimation process. As a result, project managers need to monitor currency changes by themselves and include them in the project budgets. This way of managing currency risk creates an additional challenge in the context of precise labour cost estimation in international projects.

To make this process more effective, organisations should consider integrating labour cost estimation tools with real-time currency tracking systems. Introducing automatic currency updates into estimation tools could significantly improve the accuracy of labour cost forecasts and allow project managers to react faster for market changes.

4.2.6. Accounting for cultural differences, work norms, and productivity in cost estimation

In international projects, cultural context and work standards may significantly influence how teams perform and how long tasks take to complete. Understanding whether and how these factors are included in cost estimation tools is important for assessing the accuracy of labour cost planning. When answering the question about how cultural differences and labour norms are considered in the process of estimating labour costs, respondents pointed out that most available tools do not allow to include these elements directly. Although cultural differences, work norms, and productivity levels are important factors that influence task duration and team efficiency, in many cases they are treated more as elements of retrospective analysis, rather than as active components of the cost estimation process.

Such an approach may lead to inaccurate labour cost estimates, because it does not take into account real differences in how teams work across different regions. For example, in countries with higher level of development, labour norms can be more demanding and team productivity higher, which results in higher labour costs. On the other hand, in developing countries, although wage rates may be lower, team productivity might also be less, which in the end leads to higher total costs.

Therefore, labour cost estimation tools should be developed in the direction of including cultural differences, labour norms, and productivity variations between countries.

Integration of these factors into estimation tools could improve the accuracy of labour cost predictions and allow better alignment of resources to the project needs.

4.2.7. Effectiveness of current labor cost estimation methods in budget accuracy and control

Another important aspect explored in the study was the practical usefulness of labor cost estimation methods in international projects. It was essential to understand how project managers evaluate the reliability of the tools they use in everyday work.

The project managers were also asked about the effectiveness of the current labor cost estimation methods, and the responses indicated that the key to success is the precision of the input data. Respondents emphasized that the tools used for labor cost estimation are effective as long as the data used in the process is accurate and up-to-date. However, even with advanced tools such as SAP or MS Project, errors in input data, such as outdated wages or exchange rates, can lead to significant errors in labor cost estimates. Therefore, the effectiveness of labor cost estimation methods largely depends on the quality of the data input. Respondents noted that without proper data updates, even the best labor cost estimation tools will not be able to provide precise results. An example is the situation in which wage changes in a given country are not reflected in the tools, leading to budget overruns in the project.

4.2.8. Use of Artificial Intelligence and automation in labor cost estimation

In light of the rapid development of artificial intelligence, the participants in the study were asked about the use of AI and automation in labor cost estimation. Specifically, the research explored how these technologies influence the accuracy, efficiency, and costs associated with employment across various industrial sectors.

Only a small group of respondents indicated the use of artificial intelligence (AI) in labor cost estimation, though some organizations have tested such solutions. In most cases, the labor cost estimation tools relied on simple automation mechanisms, such as templates based on historical data or predefined scenarios. AI is still in the testing phase in the context of labor cost estimation, even though it has the potential to bring substantial benefits, such as better cost forecasting based on market data or resource allocation optimization.

Respondents noted that although AI has the potential to automate data analysis and cost forecasting, its full implementation still faces barriers, such as the lack of proper input data, complex integration with existing systems, and the need for advanced data analysis skills. Nevertheless, the use of AI in the future may become a key element in the labor cost estimation process, allowing for faster and more accurate forecasts.

4.2.9. Functional gaps in current labor cost estimation tools

As part of the study, project managers were also asked to evaluate the limitations of current tools used for estimating labour costs in international project teams. Their responses highlighted several recurring issues, which show that existing solutions, although widely used, are far from ideal in addressing the complexity of global project environments.

Current tools for estimating labour costs in international project teams, even though commonly used, have many gaps that reduce their effectiveness in the context of international project management. Respondents pointed out several key areas which should be improved so that the tools would better respond to the needs linked with the many variables that have to be considered when estimating labour costs in projects carried out across different countries.

One of the most often mentioned gaps was the lack of productivity indicators across countries. Labour cost estimation tools focus mostly on salary analysis, while they do not consider differences in work productivity, which has a major impact on total project costs. In countries with higher levels of technology and professional experience, teams may deliver tasks faster, which (even with higher wage rates) leads to lower labour costs. On the other side, in developing countries, although the wage rates are lower, it might be necessary to hire more people or extend the task duration, which in result increases the total labour costs of the project. Labour cost estimation tools should be able to take these variables into account to enable more accurate forecasting of the real costs connected with teams working in different regions. Without such indicators, project managers may make wrong decisions by selecting cheaper teams that are not always the most efficient.

Another important gap pointed out by respondents was the difficulty in integrating labour cost estimation tools with HR systems and analytical platforms. Most available labour cost estimation tools operate in isolation from other human resource management systems, which makes it harder to retrieve precise data on wages, employment status, or labour standards. For instance, Excel, although very popular in project management, does not offer direct integration with HR systems that store wage information and employment data. Because of that, project managers often need to manually enter wage-related data, which can lead to mistakes and distort actual cost estimates. Integration of labour estimation tools with HR systems could significantly increase the accuracy of cost forecasts, allowing for automatic data collection regarding wages and other variables, which would shorten the preparation time and improve the quality of the results.

The lack of automatic updates of currency exchange rates is another issue that was noticed by project managers. Currency fluctuations have a critical impact on labour costs in international projects, yet most tools do not offer the function of real-time exchange rate monitoring. Instead, project managers are forced to manually input exchange rate data,

which is time-consuming and opens space for errors in calculations. Automatic tracking of exchange rates and direct integration with labour estimation tools could minimise the risk of inaccuracies caused by outdated data and allow for faster budget adjustments in response to exchange rate changes. Thanks to this, project managers could continuously monitor how currency fluctuations affect costs, and make decisions in a more dynamic way.

Respondents also pointed to the lack of features addressing cultural differences and labour norms across countries, which forms a significant gap in currently available cost estimation tools. Cultural differences, local work regulations, and legal standards affect how projects are managed and how work is organised, but most tools do not take these variables into consideration. For example, different countries may have different working day lengths, overtime rules, or number of annual leave days, which all influence the actual time teams need to deliver their tasks. In countries where work conditions are more flexible, projects may be completed faster, but in countries with stricter labour norms, work may progress slower and that has a direct impact on labour costs. Including such variables in labour cost estimation tools could allow project managers to better forecast task durations and project costs, leading to more effective budget planning.

Another critical limitation mentioned by respondents was the limited flexibility in testing different cost scenarios. Existing tools, such as Excel templates or SAP systems, allow for basic cost estimation, but they often do not provide easy features for building and testing multiple scenarios. In international projects, where variables may shift quickly, for example, when wages or exchange rates are unstable, project managers need tools that let them rapidly create and assess different scenarios to adjust budgets in line with changing conditions. The lack of such functionality forces managers to recalculate multiple cost variants manually, which takes time and may result in errors. Tools should therefore allow for building and testing many cost scenarios in real time, enabling faster reactions to changes and better optimisation of project budgets.

4.3.   Conclusion and recommendations

Based on the interviews conducted with international project managers, the analysis points to several key conclusions regarding the challenges associated with labor cost estimation in such projects. The collected data allows identifying areas that need improvement and potential directions for the development of tools supporting the cost estimation process. The first conclusion that can be drawn from the analysis is the lack of a unified, central tool for labor cost estimation in international projects. Most organizations use various tools, often selected ad hoc based on the specifics of the region or project type. This approach leads to fragmentation of estimation processes and makes data integration and cost comparison across projects more difficult. As a result, project managers have to spend a lot of time adjusting tools to different requirements and manually updating data such as

exchange rates or wage rates. Organizations should consider implementing more unified tools or platforms that would allow for better data integration and standardization of estimation processes across different departments and regions.

The second key conclusion is the difficulty in accounting for wage and productivity differences between countries. Respondents pointed out a significant problem related to the lack of access to accurate, up-to-date wage data in different countries, which results in managers having to rely on rough estimates. Additionally, the nominal rates used in labor cost estimation tools do not reflect the actual team efficiency. An example is the situation where cheaper teams require more people to perform the same task, leading to higher costs than hiring more expensive but more efficient employees. Labor cost estimation tools should account not only for wages but also for productivity indicators and other factors related to cultural differences and work norms that may influence task completion time. Furthermore, it is necessary to develop tools capable of dynamically accounting for changes in these aspects during the course of the project, which would improve the accuracy of estimates.

Another conclusion is related to the issue of accounting for exchange rate fluctuations in the labor cost estimation process. Exchange rate fluctuations were treated by most project managers as project risk, rather than an element actively monitored and considered in cost estimation tools. Although some organizations use currency hedging mechanisms or manually update exchange rate data, there is still a lack of tools that would automatically track exchange rate changes in real-time and include them in cost estimates. The introduction of such functions could significantly improve the accuracy of estimates and reduce the risk of errors resulting from inaccurate data. Additionally, project managers could gain better control over currency risk, allowing for more effective budget management.

Another key aspect is the lack of consideration of cultural differences, work norms, and productivity levels in different countries. The responses collected indicate that available tools do not sufficiently account for these elements, which have a direct impact on the time required to complete tasks and the efficiency of teams. Cultural differences, work norms, and differences in productivity are treated more as additional factors, analyzed at the retrospective stage, rather than as active components of the cost estimation process. Tools for labor cost estimation should be expanded to include functions that allow for accounting for these aspects in real-time, so that managers can more accurately plan resource allocation and optimize budgets. Additionally, the introduction of productivity indicators that would account for the specifics of different countries could contribute to more precise cost estimation.

Another important conclusion is that the effectiveness of labor cost estimation tools largely depends on the quality of the input data. Most managers pointed to the problem of

inaccurate, outdated data, which leads to erroneous estimates and budgeting errors. The effectiveness of labor cost estimation tools can be significantly improved by automating the process of updating data such as wages, exchange rates, and variables related to team productivity. The introduction of systems that automatically collect data from various sources and update it in real-time could improve the accuracy of estimates and reduce the risk of errors resulting from outdated information.

Moreover, testing artificial intelligence (AI) in labor cost estimation is still in its experimental phase. Although some organizations have started implementing AI in estimation processes, the full potential of this technology has not yet been utilized. Respondents pointed out that AI is mainly used for cost forecasting based on historical data but has not yet become widely used in the production process. There is enormous potential in the development of AI in this field, especially when it comes to predicting variables related to labor costs and optimizing resource allocation in real-time. The development of predictive functions supported by artificial intelligence could enable faster and more accurate labor cost estimation and allow for dynamic budget adjustments based on changing conditions.

Finally, the lack of integration with data on team performance across countries represents a significant gap in labor cost estimation tools. Most available tools focus on wage costs but do not fully account for team efficiency across different regions. This leads to situations where cheaper teams are chosen based on lower wage rates, while their actual productivity is often lower than that of more expensive teams. Additionally, the lack of productivity indicators in different countries hinders the optimization of labor costs. Introducing productivity indicators into labor cost estimation tools could help better match resources to the actual needs of the project, which in turn would lead to cost optimization and more effective project management.

The introduction of dynamic cost risk reports that would account for changes in labor costs, exchange rate fluctuations, and cultural and product differences could significantly improve project managers' ability to predict risks and make more accurate decisions. There is also a need to develop tools that support predictive and optimization analyses, which would be more flexible and able to provide recommendations in real-time. Labor cost estimation tools for international projects need to be more integrated, automated, and assist managers in dynamically responding to changing market and project conditions.

These conclusions show that while available tools are useful, they still require further development to meet the challenges of labor cost estimation in international projects. Investments in automation, artificial intelligence, and better data integration could contribute to increased cost estimation accuracy, improved budget control, and optimized management processes for international projects.

5. Summary

This article discusses in detail the challenges faced by international project managers in the area of labour cost estimation. In particular, it draws attention to issues resulting from differences in salaries, exchange rate fluctuations, diverse legal regulations, and variations in team productivity across countries. It also points to the importance of using modern tools, such as Cost Breakdown Structure (CBS) and Risk Breakdown Structure (RBS), which allow for better managing uncertainty in such projects.

Despite significant technological progress, including the introduction of tools supporting cost estimation, like BIM or machine learning, there are still many challenges that require further research and development. It is especially important to take into account the variability of input data, such as differences in team performance or changes in legal regulations, which have a crucial impact on the accuracy of estimates.

In the context of dynamic market changes, like currency fluctuations, it is necessary to implement more integrated and automated tools that would allow continuous monitoring of these variables. Thanks to such solutions, project managers will be able to react more quickly to the changing conditions and make more precise decisions concerning budgets and resource allocation.

Moreover, a key challenge remains the integration of cost estimation tools with other management systems, especially with HR systems and wage databases, which could automatically provide up-to-date information about labour costs. Increasing the flexibility of such tools, as well as developing systems based on artificial intelligence, may significantly improve the efficiency of cost management processes in international projects.

From a future perspective, further development of tools that enable dynamic cost forecasting, and that also take into account cultural differences and labour norms in different countries, will become essential. Implementing such solutions will help better match resources to the specific needs of international projects, which can lead to more effective management of both projects and their budgets.

The conclusions from this article may serve as a base for further research in this field, and also as inspiration for development of new, more advanced tools for labour cost estimation, which will be more suited to global realities.

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