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Impact of cash flow management on the performance of construction project

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- možné techniky a strategie řízení peněžních toků použitelné ve stavebních projektech
- běžné problémy s peněžními toky ve stavebních projektech
- analýza případové studie (a výsledná doporučení/závěry)

Seznam doporučené literatury:

G.C. Christy: Free Cash Flow: Seeing Through the Accounting Fog Machine to Find Great Stocks, ISBN: 978-0-470-39175-4
J.K. Shim, J.G. Siegel: The Vest Pocket CFO, 3rd Edition, ISBN: 978-0-470-22705-3
R. Kenley: Financing Construction: Cash Flows and Cash Farming, ISBN-10: 0415232074

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Seznam použité literatury, jiných pramenů a jmen konzultantů je třeba uvést v bakalářské práci.

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Declaration

I declare that I developed this bachelor's thesis independently, only under the professional guidance of the supervisor of the bachelor's thesis, Mr. Ing. Radan Tomek, MSc, Ph.D.I further declare that all the sources listed in the list of used literature.

22 May 2023, Prague

Teimuraz Janashia

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**IMPACT OF CASH FLOW MANAGEMENT ON THE
PERFORMANCE OF CONSTRUCTION PROJECT**

Abstract

The dynamic nature of the construction industry places a premium on effective cash flow management as a crucial driver of project success. This thesis investigates the impact of cash flow management on the financial performance of construction projects. The research offers an in-depth understanding of cash flow management in construction projects, its importance, and the various techniques and strategies that can be adopted. Common challenges are identified, alongside potential solutions to address them. A case study approach is used to underline the issues causing cash flow problems in the construction industry and to propose possible solutions. The findings of this study provide actionable insights that could optimize cash flow management in construction projects, thereby bolstering financial performance.

Keywords

Cash flow; Cash flow management; Construction project; Payments; Liquidity

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1 Introduction

The construction industry is one of the most significant contributors to global economic development, creating infrastructures crucial for societal growth and advancement. Throughout history, construction contributed significantly to the GDPs of nations worldwide. The graph below shows what percentage of GDP was accounted to the construction industry in these European nations in 2021:

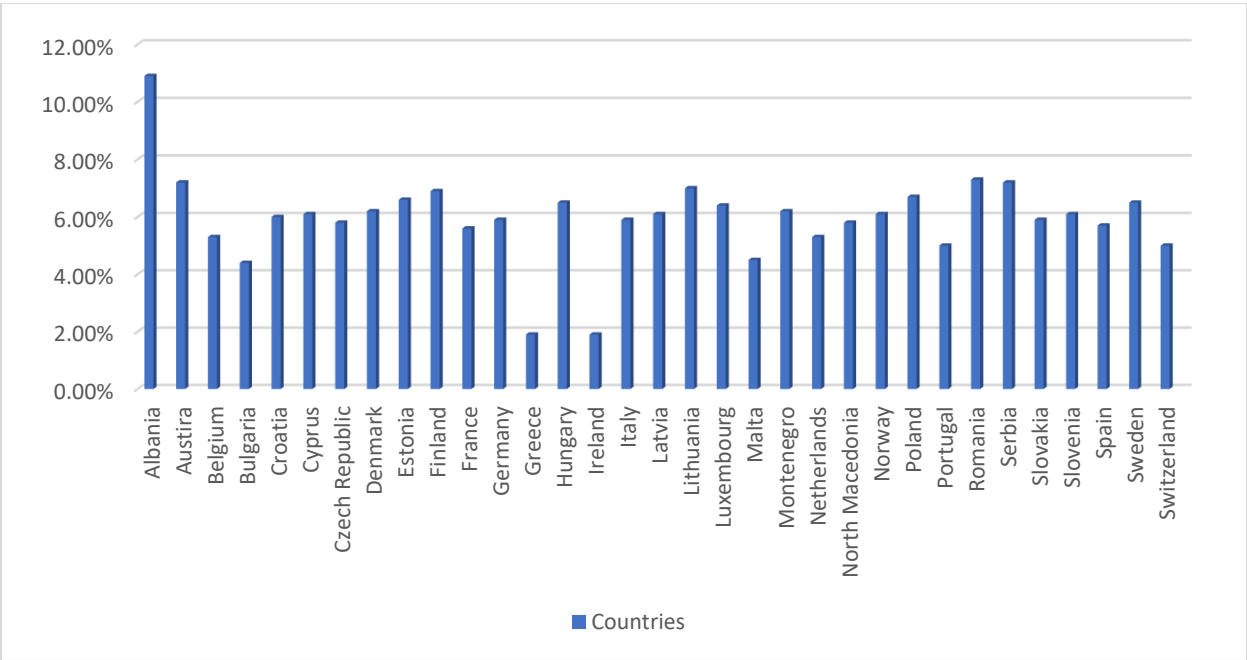


Figure 1: (Statista, 2022)

However, the industry is fraught with complexities and uncertainties, particularly in the area of financial management. Numerous factors can significantly affect the financial performance of construction projects, among which cash flow (hereafter CF) management is notably pivotal. The management of CF - the inflow and outflow of cash - is a crucial determinant of a project's profitability, liquidity, and overall financial stability.

Despite its importance, many construction projects need help with effective CF management, leading to delays, cost overruns, and in some instances, complete project failures.

In this research, I endeavor to explain the intricate relationship between CF management and the financial performance of construction projects. I aim to comprehensively investigate the significance of effective CF management, its strategies and techniques, and the challenges encountered in its practice in the construction industry. In addition, I aspire to contribute to the existing body of knowledge and provide insights that could potentially enhance financial management practices in the construction industry.

The second chapter of the thesis presents a detailed overview of CF management within the context of construction projects, providing a foundation for understanding the subsequent discussions. The third chapter delves into an in-depth analysis of the role of CF management in construction projects, specifically its impact on project profitability, liquidity, and financial stability. The fourth chapter evaluates various CF management techniques and strategies that can be employed in construction projects, offering a practical guide for industry practitioners. Recognizing that the real-world implementation of CF management is often fraught with challenges, the fifth chapter of the thesis identifies common problems encountered in managing CFs in construction projects and proposes potential solutions. Finally, the thesis culminates in the case study analysis of the reports conducted by Levelset to display the practical use of the theoretical knowledge discussed in the preceding chapters.

Through this investigation, I seek not only to fulfill an academic requirement but also to contribute meaningfully to the understanding and practice of CF management in the construction industry. By the end of this thesis, I hope to have provided valuable insights that can be used to improve the financial performance of construction projects, thereby promoting the overall growth and sustainability of the construction industry.

2 Definition and Overview of CF Management in the Context of Construction

2.1 Definition of CF Management

CF management is a critical financial concept that concerns the administration of a company's inflows and outflows of cash. Its primary objective is to ensure that a business maintains sufficient liquidity to meet its operational expenses while also fostering long-term financial stability.

CF represents the amount of cash entering and exiting a business over a certain period. It varies from an income statement, as the latter can include revenue that is already accounted for but has yet to be received. A CF statement, on the other hand, documents all cash or cash equivalents that a construction firm has received or expended. To understand their current financial liquidity, many businesses generate CF statements at regular intervals such as monthly, quarterly, or annually.

CF can be categorized into three types: Operational, investment, and financing.

- Operational CF - cash received or spent due to the company's business operations/activities.
- Investment CF - cash received or spent through investing activities
- Financing CF - cash received through debt or paid out as debt repayments

Cash Flow Statement	
[Time Period]	
Cash Flow from Operations	
Income	\$ -
COGS	\$ -
Payroll expense	\$ -
Interest expense	\$ -
Tax expense	\$ -
Other operational expenses	\$ -
Subtotal: Operational cash flow	\$ -
Cash flow from Investing	
Asset purchases	\$ -
Asset sales	\$ -
Investment income	\$ -
Investment expense	\$ -
Subtotal: Investment cash flow	\$ -
Cash flow from financing	
Loan income	\$ -
Loan expense	\$ -
Stock income	\$ -
Dividends	\$ -
Other financing activities	\$ -
Subtotal: Financing cash flow	\$ -
Net cash flow	\$ -

Figure 2: Sample CF Statement (Killough, 2021)

The CF can be either positive or negative. When a business has more income than expenditure, it demonstrates positive CF, while negative CF signifies that the company's expenses surpass its earnings. Various financial indicators can be used to assess a business's health. However, firms with negative CF might face liquidity issues, implying they might lack immediate cash for immediate obligations such as salaries, insurance, material costs, and other project-related expenses.

A construction business may still have negative CF despite being profitable. This occurs when a company's accounted revenues surpass its costs, yet it still needs to collect all of its income. In the construction sector, this can arise due to factors like retainage, delayed payments, extensive capital investments, or inefficient invoicing systems. Conversely, a construction firm can be unprofitable yet have positive CF, emphasizing the importance of considering multiple financial health indicators.

Lastly, businesses typically examine both CF statements and CF forecasts. The former provides an understanding of past cash movements, while the latter offers an estimate of future cash movements. Businesses can identify potential future CF deficiencies by evaluating known and anticipated expenses and revenues. In such cases, they may opt for debt financing or modify project schedules to ensure sufficient cash availability to meet their commitments.

In the context of construction projects, CF management takes on a unique set of challenges and characteristics. Essentially, CF in construction refers to the balance of the amount expended on a project against the income it generates over a given period. It is a dynamic process, marked by periods of significant expenditure, such as during the procurement of materials or the hiring of labor, followed by phases of income, such as milestone-based client payments.

Effective CF management in construction projects is more than merely balancing income and expenditure. It involves careful planning and controlling cash inflows and outflows to ensure the project has the financial resources to meet its obligations at every stage. This includes anticipating and managing potential payment delays, effectively controlling costs, and making strategic decisions about when and where to invest resources.

In practice, CF management may involve strategies such as accelerating invoicing to hasten cash inflows, negotiating favorable payment terms with suppliers to delay cash outflows, and maintaining a cash reserve to cover unexpected costs or delays. It also includes using tools and techniques to forecast future CFs, allowing project managers to anticipate potential cash shortfalls and take corrective action before they become problematic.

Importantly, CF management in construction is not a standalone process. Instead, it is intimately connected with other aspects of project management, such as project scheduling, risk management, and contract administration. For instance, delays in project schedules can lead to delayed payments, impacting CF. Similarly, the type of contract used in a project can affect the timing and amount of cash inflows.

Given these complexities, CF management in construction projects requires a deep understanding of financial management principles, a keen grasp of the project's specifics, and a proactive approach to problem-solving. In the following chapters, we will delve deeper into these aspects, exploring the importance of CF management for the financial performance of construction projects, evaluating different management techniques, and discussing common challenges and potential solutions.

2.2 Contextualizing CF Management in Construction Projects

The construction industry is characterized by its cyclical nature, significant capital investments, long project durations, and a multitude of stakeholders, each with differing interests and objectives. In this complex environment, the management of CF assumes a heightened level of importance, making it a critical success factor for projects.

Within the context of construction projects, CF management revolves around the strategic planning and control of money to fulfill the project's financial obligations and generate profitability. Construction projects typically involve substantial upfront costs for procuring materials, labor, and equipment, making it critical to effectively manage the timing and amount of cash inflows and outflows.

Furthermore, the construction sector is marked by a tiered payment system, with payments often being disbursed in stages upon the completion of specific project milestones. This can lead to gaps between when costs are incurred and when payments are received, adding a layer of complexity to CF management. Additionally, given the long-term nature of many construction projects, changes in project scope, cost overruns, and unexpected delays can further disrupt the planned CF.

Contractual arrangements also play a vital role in shaping CF management. For instance, different contract types, such as lump-sum, turnkey, cost-plus, or guaranteed maximum price contracts, can significantly impact cash inflows' timing, quantity, and certainty. Moreover, payment terms with suppliers and subcontractors can also influence the management of cash outflows.

In the broader economic context, market conditions can influence the financial performance of construction projects. For example, fluctuations in interest rates, inflation rates, and exchange rates can all impact the cost of capital, making CF management even more vital.

Lastly, the regulatory environment can also impact CF management. For instance, prompt payment, retentions, and dispute resolution policies can affect the timing and certainty of cash inflows and outflows.

CF management within the context of construction projects is a multifaceted discipline that goes beyond the simple balancing of income and expenditure. It requires careful planning, strategic decision-making, and continuous monitoring and control. The following chapters will further explore the importance of effective CF management for the profitability, liquidity, and financial stability of construction projects.

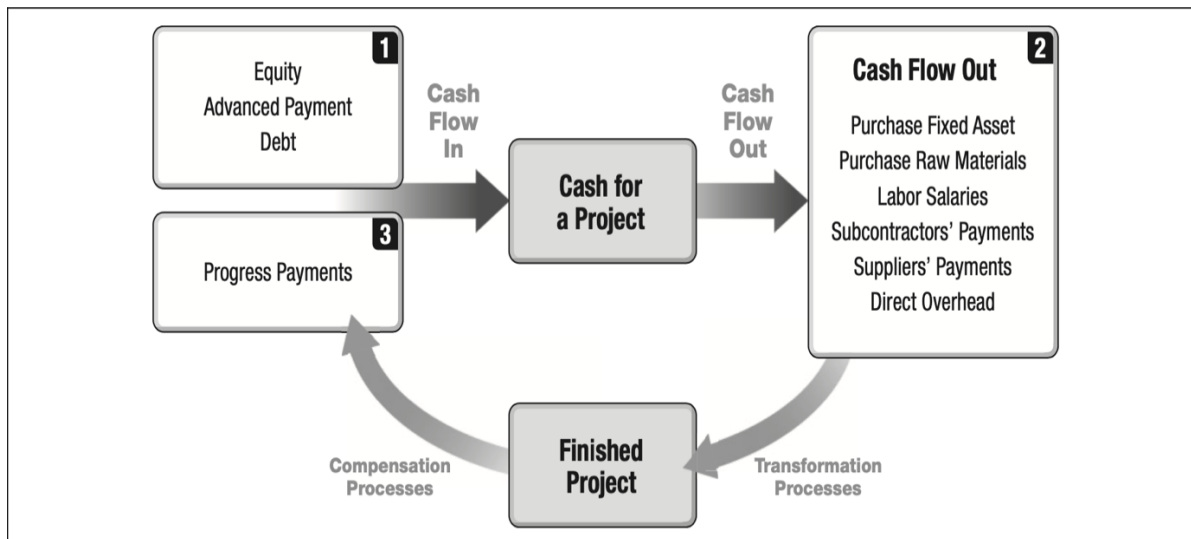


Figure 3: Cash Flow Cycle (Shash & Qarra, 2018)

2.3 Literature Review

The literature on CF management in construction projects is extensive, reflecting the importance of this topic for the industry's financial performance and sustainability.

A seminal work in this area is the study by Navon (1998), which examined the possibility of forecasting CF through earned value management (EVM). This approach provides a quantitative method for planning, cost collection, and performance measurement. Navon's work has become foundational in the field, as it suggested that accurate CF forecasting can significantly enhance a construction company's financial stability and profitability.

Subsequent research has expanded upon Navon's findings. For example, the study by El-Sabaa (2001) emphasized the importance of accurate CF forecasting in maintaining adequate liquidity levels. In addition, this research identified several critical factors affecting CF in construction projects, such as change orders, progress payments, and the cost of materials.

The role of CF management in mitigating financial risk in construction projects has also been extensively studied. A significant contribution in this area is the work of Kenley (2003), which introduced the "Flowline" theory. The theory suggests that optimizing workflow and matching it with CF can minimize the risk of cost overruns and project delays.

Recently, the focus of the literature has shifted toward the impact of external factors on CF management. For example, studies by Zhao et al. (2019) and Song et al. (2020) explored how market conditions, economic trends, and environmental factors can influence CF management strategies. This research underlines the need for construction companies to adapt their CF management practices to the external environment continually.

Building economics has always had a steady trickle of papers resulting from the international research effort. Still, it has never been particularly significant, for example, exceeding 10% of papers in the *Journal of Construction Management and Economics*

(Kenley, 2003). Such research is likely to be considered tangential to the real problems of production efficiency and service responsiveness.

As the field moves forward, future research is likely to focus on developing more sophisticated CF management techniques, leveraging digital technologies, and exploring the impact of emerging global trends and challenges on CF management in construction projects.

3 Analysis of the Importance of CF Management in Construction Projects

3.1 Project Profitability

The profitability of a construction project is directly influenced by how effectively the project's CF is managed. CF is the lifeblood of any project, affecting every aspect of a construction operation, from the procurement of materials to the payment of contractors and workers.

One of the primary aspects that contribute to project profitability is effective cost management. Cost management involves monitoring, reducing, and controlling costs while maximizing the project value. It is closely linked with CF management because a substantial portion of the project's cash outflows are associated with labor, materials, and equipment costs.

If cash inflows (payments from the client) are not adequately managed to align with the cash outflows (costs), there can be significant discrepancies that can lead to a shortage of funds. This, in turn, can lead to delays in payment to suppliers or workers, resulting in work stoppages, demotivated staff, and a potential increase in costs due to penalties or price escalations. All these factors can negatively impact the profitability of the project.

Research has been carried out to find the linear correspondence between the operational CF and the current ratio and project profitability by Pordea et al. (2020). Data was taken from companies operating exclusively in western Romania and was related to a single year. Results did not reveal any statistical significance, but as the authors state, more profound research with data spread over more extended periods and more companies is called for. It would be valuable for the construction management community to have such an experiment in the meta-analysis format. If there was such a synthesis of the vast amount of data coming from the various relevant research, it would challenge the above-mentioned hypothesis more precisely.

3.2 Project Liquidity

Liquidity refers to the ability of a project to meet its short-term financial obligations as they fall due. A liquid project has sufficient cash to pay its suppliers, contractors, and other creditors promptly, helping to maintain good relationships and ensuring the smooth flow of materials and services necessary for project activities. Poor CF management can lead to liquidity problems, resulting in late payments, strained relationships with project stakeholders, and in severe cases, legal action that could disrupt project activities and incur additional costs.

Effective CF management enhances project liquidity by ensuring that cash inflows and outflows are well-coordinated. This involves scheduling project expenditures in line with expected cash inflows and securing short-term financing for periods when cash outflows exceed inflows. By doing so, CF management helps maintain the project's financial health and prevent liquidity crises that could jeopardize project completion.

3.3 Financial Stability

Financial stability is a longer-term concept related to the project's ability to sustain its activities and meet its financial obligations throughout its lifecycle. A financially stable project has adequate funding sources and a healthy balance between its assets and liabilities.

CF management contributes to financial stability by preventing financial imbalances that could derail the project. For instance, it helps avoid excessive borrowing that could lead to unsustainable debt levels. It also prevents over-reliance on a single funding source, which could expose the project to financial risk if that source becomes unavailable. Through accurate CF forecasting, cost control, and financial risk

management, CF management fosters financial stability and increases the project's resilience to economic shocks.

In conclusion, effective CF management is of paramount importance in construction projects. It enhances project profitability, liquidity, and financial stability, thereby improving the project's financial performance and increasing the chances of successful completion. Despite its significance, CF management is often overlooked or poorly implemented in construction projects, leading to financial difficulties that could have been avoided with better CF planning and control. This underlines the need for a deeper understanding of CF management and its role in construction project management, which is the focus of the subsequent sections of this thesis.

4 Evaluation of CF Management Techniques and Strategies in Construction Projects

4.1 CF Forecasting

CF forecasting is a fundamental CF management technique in construction projects. It entails predicting future cash inflows and outflows over the project lifecycle. This predictive tool provides a roadmap of when and how much cash will be needed and where it will come from, thereby allowing project managers to plan for future financial needs and avoid potential cash shortages or excesses.

Forecasting in construction projects usually involves a two-step process. The first step is to predict the project's costs and revenues based on the project plan, contracts, and other relevant information. This includes estimating the costs of labor, materials, equipment, and other resources, as well as predicting revenues from client payments and other sources. The second step is to schedule these costs and revenues over time based on the project schedule, creating a forecast of the project's cash inflows and outflows.

CF forecasting in construction projects is inherently uncertain due to the complexities and uncertainties associated with these projects. These uncertainties can stem from various sources, such as changes in project scope, delays, cost overruns, and fluctuations in market conditions. Consequently, CF forecasts need to be regularly updated to reflect the actual performance of the project and revised projections of future CFs.

Effective CF forecasting offers several benefits. It provides early warnings of potential cash shortages, enabling proactive measures to secure additional funding if needed. It also identifies periods of cash surplus, allowing for the strategic investment of excess cash to generate additional income. Moreover, it supports better decision-making regarding project financing, cost control, and risk management.

However, CF forecasting also has limitations. Its accuracy is dependent on the quality of the underlying cost and revenue estimates and the project schedule. Errors in these inputs can lead to inaccurate forecasts, leading to financial mismanagement. Additionally, CF forecasting can be time-consuming and requires financial expertise, which may not always be available to the project team.

Despite these challenges, CF forecasting remains an essential CF management technique in construction projects. By providing a forward-looking view of the project's financial needs, it supports proactive financial management and contributes to the financial success of the project.

4.1.1 S-Curve

The S-curve graph gets its name from the pattern it depicts, which mirrors the lifecycle of projects. At the onset, projects progress at a relatively slow pace, then gradually increase in intensity during the middle phase of project execution, and finally decelerate as the project reaches completion, thereby creating an "S" form. This model is beneficial for monitoring and juxtaposing certain parameters over a period, such as the progression of work in relation to the projected timeline, actual costs in comparison to budgeted expenses, or expenses in relation to the advancement of the project. A typical cost S-curve can be derived more accurately than a value curve (Kaka & Price 1991.)

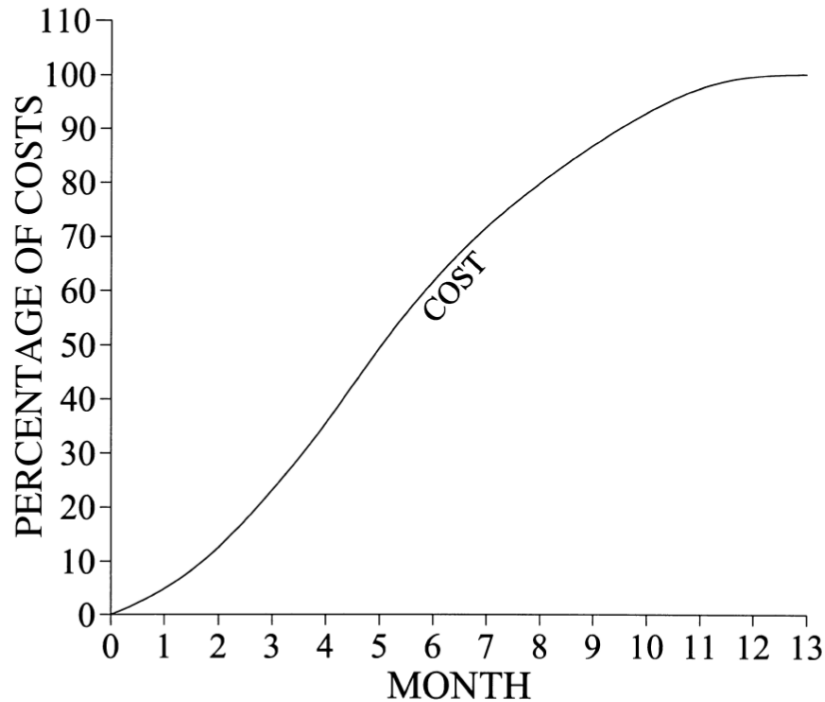


Figure 4: Cost Curve (Peterson, 2014)

4.2 Cost Control

Cost control is another critical technique for CF management in construction projects. It refers to monitoring and managing project costs to ensure they do not exceed the budgeted amounts. Effective cost control can significantly enhance a project's CF management by preventing cost overruns, reducing the need for additional financing, and improving the project's profitability.

Cost control involves several key activities. The first is cost estimating, which involves predicting the costs of various project activities. Accurate cost estimates form the basis of the project budget and the CF forecast, guiding the allocation of financial resources across different project activities.

The second activity is cost monitoring, which involves tracking actual costs against budgeted costs. This helps identify budget deviations, providing early warnings of potential cost overruns. Regular cost monitoring also allows project managers to

understand the reasons for these deviations, whether due to changes in project scope, price increases, inefficiencies, or other factors.

The third activity is cost reporting, which involves communicating cost performance information to project stakeholders. Cost reports typically include information on budgeted versus actual costs, cost variances, and the projected final cost of the project. These reports give stakeholders the information they need to understand the project's cost performance and make informed decisions.

Finally, cost control involves taking corrective actions when deviations from the budget occur. These actions can include reducing costs, increasing the project budget, adjusting the project schedule, or changing project scope. The choice of corrective action depends on the cause of the deviation, the project's overall financial situation, and the project objectives.

Cost control can be challenging due to the complexities and uncertainties associated with construction projects. For example, cost estimates can be inaccurate due to unknowns in the project scope, unforeseen site conditions, and fluctuations in material and labor prices. Furthermore, cost control requires ongoing effort and diligence to track costs, report performance, and implement corrective actions.

Despite these challenges, cost control is an essential CF management technique that can significantly enhance the financial performance of construction projects. Keeping project costs in check ensures that cash resources are used efficiently, contributing to the project's profitability and financial stability.

4.3 Financial Risk Management

The proper handling of financial risk, inherent in every construction project, forms a pivotal aspect of CF management. The uncertainty of elements like fluctuating prices of materials, variability in interest rates, hold-ups in payment, and disputes arising out of contracts are all instances of financial risks that could impede the CF of a project. This makes the process of recognizing, evaluating, and countering these risks a fundamental aspect of sustaining a robust CF in a construction project.

The initial step in proactive financial risk mitigation is identifying potential risks. This involves the process of understanding and acknowledging the prospective financial risks that could impede the CF. This could be achieved by critically analyzing project contracts, financial documentation, market trends, and other significant data sources to identify possible threats.

Subsequently, we have the stage of risk evaluation. This step is about determining the potential impact of identified risks and their likelihood of occurrence. This could be done through a variety of methods such as quantitative analysis, for instance, sensitivity analysis or Monte Carlo simulations, or through qualitative methodologies such as expert opinions and risk matrices. The primary objective is to rank these risks based on their potential effect on the CF, which assists in concentrating on the risks that could cause significant damage.

Finally, the process of risk mitigation entails formulating strategies to address these identified risks. A multitude of risk mitigation tactics can be employed in construction projects. One approach is risk avoidance, which involves modifying the project's plans to eliminate the risk entirely. Another technique is risk transfer, which means shifting the responsibility of the risk to a different party through contracts or insurance. Yet another tactic is risk acceptance, which involves acknowledging the risk and formulating contingency strategies to manage it if it materializes.

Proactive financial risk mitigation goes beyond mere reaction to financial problems as they arise; it is aimed at averting these issues in the first place or reducing their impact. This proactive approach can enhance the financial performance of the project by decreasing the chances of financial surprises and ensuring that there are established strategies to deal with any financial issues that may arise.

While its importance is evident, proactive financial risk mitigation can be challenging due to the uncertainties associated with construction projects. Recognizing and evaluating financial risks requires a deep understanding of the project and its context, as well as expertise in financial analysis. Moreover, the effectiveness of risk mitigation strategies may be uncertain and may require cooperation from other parties, such as contractors and insurance companies.

Nonetheless, proactive financial risk mitigation remains a vital strategy in CF management in construction projects. By managing financial risks proactively, it can enhance the financial stability and resilience of a project, contributing to the overall success of the project.

4.4 Payment Management

Payment management is a vital part of CF management in construction projects. Given that a project's cash inflow mainly comes from client payments, managing these payments effectively is critical for maintaining a healthy CF. Conversely, a project's cash outflow primarily involves payments to suppliers, contractors, and employees, which must be managed efficiently to avoid cash shortages and sustain the smooth execution of the project.

In the context of cash inflows, payment management involves negotiating favorable payment terms with clients, invoicing promptly and accurately, and following up on overdue payments. Favorable payment terms include upfront payments, progressive payments linked to project milestones, or shorter payment periods. Prompt and accurate invoicing ensures that the client is billed as soon as they are liable for payment, while follow-ups on overdue payments help to secure the cash inflow and mitigate the risk of bad debts.

On the side of cash outflows, payment management involves scheduling payments in line with the project's cash inflow and negotiating favorable credit terms with suppliers and contractors. By coordinating payments with cash inflow, project managers can ensure that they have the necessary funds to meet their financial obligations. Favorable credit terms, such as longer payment periods or staggered payments, can provide additional flexibility and enhance the project's CF.

Effective payment management can enhance a project's financial performance by ensuring a steady cash inflow, preventing cash shortages, and optimizing the use of financial resources. However, it can also be challenging due to factors such as delays in

client payments, disputes over invoices, and strict payment terms from suppliers and contractors. Furthermore, effective payment management requires good negotiation skills, attention to detail, and strong relationships with clients, suppliers, and contractors.

Payment management is a vital CF management technique in construction projects. By managing both cash inflows and outflows effectively, it can enhance the project's liquidity, financial stability, and profitability, contributing to the overall financial success of the project. In the next section of this thesis, we will examine some of the common CF challenges in construction projects and potential solutions to these challenges.

4.5 Contingency Planning

Contingency planning is an essential technique in CF management for construction projects. A cash reserve, often referred to as a contingency fund, is a portion of the project budget set aside to address unexpected expenses or emergencies that may arise during the project execution. Effective contingency planning allows project managers to maintain liquidity, even in the face of unanticipated costs, thereby ensuring the smooth progress of the project.

Setting up a cash reserve begins with risk analysis, which is closely tied to the process of financial risk management discussed earlier. It involves identifying potential risks and uncertainties that may impact the project's finances and estimating their potential cost implications. These costs are then aggregated to determine the size of the cash reserve.

Factors influencing the size of a cash reserve include the complexity and size of the project, the level of uncertainty, the project's risk tolerance, and the financial capacity of the project owner. In general, more complex projects with high levels of uncertainty require larger cash reserves.

Regular monitoring and adjustment of the cash reserve are also critical. As the project progresses, some risks may be realized while others may be eliminated. This

changing risk landscape should be reflected in the cash reserve. If the cash reserve is drawn down to cover unexpected costs, efforts should be made to replenish it to the desired level.

Despite the clear benefits, maintaining a cash reserve comes with its challenges. Allocating funds to the cash reserve can be seen as holding idle cash, which could otherwise be invested for additional returns. It is a delicate balance that project managers must strike between holding sufficient cash for emergencies and efficiently using financial resources for maximum returns.

Contingency planning is an integral part of CF management in construction projects. It provides a safety net that ensures the continuity of project operations, even in the face of financial uncertainties. While it does come with its challenges, proper planning can significantly enhance the financial stability of a construction project.

5 Identification of Common CF Challenges and Potential Solutions in Construction Projects

5.1 High Payroll

Navigating the financial aspects of a construction project is not a small undertaking, and one key issue that often presents challenges is the management of high payroll costs. Payroll, as it refers to the total amount a company pays to its employees, is typically one of the most significant costs in construction projects, impacting the overall CF management.

High payroll costs can be a result of various factors, including high wage rates, overtime payments, employee benefits, and payroll taxes. In some cases, it might be due to overstaffing or inefficient utilization of human resources. Regardless of the cause, when payroll costs escalate beyond the projected budgets, it puts a strain on the project's CF, potentially affecting its financial performance.

High payroll costs not only increase cash outflows but also diminish the project's profitability. Furthermore, the consistent demand for cash to cover high payroll expenses can also deplete the working capital, potentially affecting the project's liquidity and ability to meet other financial obligations.

Managing high payroll costs, therefore, becomes critical for effective CF management. Here are some potential strategies:

- **Efficient Staffing:** Implementing efficient staffing strategies can ensure that the workforce is utilized optimally. This includes proper scheduling to avoid unnecessary overtime and hiring temporary workers or subcontractors for peak periods instead of maintaining a large permanent workforce.
- **Negotiation and Competitive Bidding:** Negotiating wage rates and encouraging competitive bidding for subcontracting work can help control labor costs.

- **Payroll Management Systems:** Leveraging modern payroll management systems can help automate payroll calculations, track overtime, and ensure regulatory compliance, reducing errors and inefficiencies.
- **Training and Development:** Investing in the training and development of employees can enhance their productivity and reduce errors and rework, leading to cost savings in the long run.

To encapsulate, high payroll costs pose a significant challenge to CF management in construction projects. However, by adopting strategic staffing practices, negotiating effectively, and leveraging technology, these costs can be controlled, contributing to improved CF management and the overall financial performance of the project. Further research is recommended to explore the impact of different payroll management practices on the financial performance of construction projects in various contexts.

5.2 Paying cash for assets

In the economic realm of construction, one critical aspect to consider is the mode of payment for assets. Cash purchases, while seemingly straightforward, can have considerable implications for the project's CF management.

Paying cash for assets, such as equipment, materials, or even land, represents a significant upfront expenditure. While it eliminates the need for financing and the associated interest expenses, it can also lead to a substantial reduction in available cash reserves. This drain on liquidity can potentially impact the project's ability to handle other immediate financial obligations, creating CF constraints.

The impact of such cash purchases extends beyond the immediate reduction in cash reserves. It also affects the overall financial performance of the project, impacting profitability and financial stability. The funds tied up in the purchased assets are

unavailable for other uses that might generate a better return or for unforeseen costs that may arise during the project.

To navigate the challenges associated with paying cash for assets, strategic planning, and financial management techniques can be applied. Here are a few suggestions:

- **Budgeting and Planning:** Detailed budgeting and financial planning can help ensure sufficient cash reserves are maintained even after making significant cash purchases. It is essential to consider the timing of cash outflows and maintain a buffer for unforeseen expenses.
- **Alternative Financing Options:** Considering debt financing or alternative financing options, such as leasing or installment buying, can help spread the cost of assets over time, reducing the immediate impact on CF and keeping a solid credit score to have lines of credit available.
- **Cost-Benefit Analysis:** Conducting a thorough cost-benefit analysis can help in decision-making. It is crucial to weigh the benefits of owning the asset against the CF implications and potential alternative uses of the funds.
- **Asset Management:** Efficient management of assets, including regular maintenance and optimal usage, can help maximize the value derived from the assets and reduce the need for premature replacement.

While paying cash for assets can seem like an attractive option in construction projects, it is critical to understand its potential impact on CF. Strategic financial planning, considering alternative financing options, conducting cost-benefit analysis, and efficient asset management can help mitigate the potential challenges associated with paying cash for assets, contributing to better CF management and the overall financial performance of the project.

5.3 Retention

Retention, as it is also known, refers to funds held back until the completion of a project, guaranteeing the work is executed according to job requirements. This practice, prevalent in the commercial construction sector, usually accounts for about 5-10% of the total contract value.

Suppose one's construction business is not accustomed to a fraction of each progressive payment being withheld until the project's conclusion, and they do not plan their budget accordingly. In that case, they are likely to encounter liquidity problems. Given that the average profit margins are a mere 5%, a 10% retention withholding implies that there is no wiggle room to cover overhead or other costs once payments have been received.

Front-end loading is one of the most effective ways to counterbalance retention. This technique, used by many contractors to improve the CF, gives out its strategy by its name. "Unbalancing of a bid occurs when a contractor raises the price on certain items and reduces the prices of others so that the bid for the total job remains unaffected. The most effective type of unbalancing is front-end loading. The main reason for front-end loading is to shift the project financing from the contractor to the owner by increasing the unit prices on early items and decreasing the unit prices on later ones. This influences the value curve significantly" (Kaka & Price, 1991).

This type of overbilling is ethically questionable; if the contractor feels the need to incorporate it, he should consider two things. First is that most of the clients are aware of this technique, and exaggerated assessments should not be made, not only because it will alarm the client but also because of the severe underbilling at the end of the project, to counter the intense front-end loading at the start, CF might dry out. Any misuse of overbilling can be fatal. The second thing to consider is that your network is your net worth, and construction is a relationship industry. It is better to communicate and find a compromise rather than ruin a business relationship and potentially worsen your reputation. Like contractors identify and avoid slow payers (as they should), clients

do the same with contractors who try to shift financing towards their side and weaken their position.

5.4 Delayed Payments

One of the most common challenges that can significantly impact CF management in construction projects is the delay in payments. When payments on a construction project are delayed, it is not just inconvenient — late payments can get expensive. Each day that a contractor has to wait to collect, they lose money via inflation, debt interest, and opportunity cost. These are the carrying costs of slow payment in construction — the amount it costs to carry someone else's debt (Finity, 2023). These delays can arise from various sources and can disrupt the smooth flow of funds, creating financial strain on the project.

In terms of cash inflows, they might be a result of disagreements or disputes over the quality or scope of work, delays in the project schedule that push back milestone-linked payments, or simply the client's poor payment practices. Each of these scenarios can result in late or reduced payments, creating a shortfall in the expected cash inflow.

On the side of cash outflows, delays in payments can lead to a host of issues. Late payments to suppliers, subcontractors, and employees can strain relationships, possibly leading to work stoppages, legal disputes, or reduced productivity due to low morale. Furthermore, consistently late payments can tarnish the reputation of the company, making it difficult to secure favorable credit terms in the future.

To mitigate the impact of payment delays, it is essential to adopt a tailored approach. Here are a few potential solutions:

- **Effective Contract Management:** Clear contracts with explicit payment terms can prevent misunderstandings and disputes, ensuring that all parties understand

when payments are due and what work must be completed for these payments to be made.

- **Prompt Invoicing and Follow-ups:** Timely and accurate invoicing coupled with regular follow-ups can help ensure that the client is aware of their payment obligations and remind them of approaching due dates.
- **Contingency Planning:** Having a contingency plan in place can be very helpful in managing the effects of delayed payments. This could include maintaining a cash reserve to cover essential expenses during periods of delayed payment, having access to short-term financing options, or adjusting the project schedule or resources to adapt to the reduced cash inflow.
- **Building Strong Relationships:** Developing and maintaining good relationships with clients and suppliers can lead to more flexible payment arrangements, potentially reducing the impact of payment delays.

5.5 Inaccurate tendering

In the construction business, an accurate and strategic tendering process is crucial to ensuring financial success. However, inaccuracies in this initial phase can cause a domino effect, leading to issues in CF management later on.

Tendering, at its core, involves developing a comprehensive bid for a construction project, which includes a detailed breakdown of the anticipated costs and time frames. The accuracy of this process is critical; if initial cost estimates are too low or if the project timeline is overly optimistic, it can lead to a shortfall in CF as the project progresses.

There are several factors that can contribute to inaccurate tendering. These include underestimating the complexity of the project, failing to account for potential delays and disruptions, underpricing labor or materials, or not including a sufficient contingency for unexpected costs.

The implications of inaccurate tendering can be severe. It can lead to cost overruns, project delays, and reduced profitability. Moreover, it can strain relationships with clients and contractors if the project cannot be completed within the agreed budget or time frame.

To minimize the risk of inaccurate tendering, it is important to adopt a strategic and thorough approach. Here are a few key strategies:

- **Detailed Project Analysis:** A thorough analysis of the project requirements, including a comprehensive understanding of the scope, complexity, and potential challenges, can help create a more accurate tender.
- **Robust Cost Estimation:** Utilizing robust cost estimation techniques, including unit cost estimating, parametric estimating, or even historical cost data, can lead to more accurate cost predictions (Peterson, 2014).
- **Contingency Planning:** Including a contingency in the tender to cover unexpected costs can provide a buffer against unexpected events or expenses, protecting the project's CF.
- **Continuous Improvement:** Regularly reviewing and learning from past tendering experiences can help improve the accuracy of future tenders. This includes understanding where previous tenders have fallen short and implementing changes to improve.

In essence, inaccurate tendering can pose a significant risk to the financial performance of construction projects. However, through strategic planning, thorough analysis, and continuous improvement, these risks can be managed effectively, contributing to better CF management and the overall financial success of the project.

5.6 External Factors and Unforeseen Expenses

In the construction industry, external factors and unforeseen expenses can play a significant role in disrupting CF. These unpredictable elements present a unique challenge in CF management, often leading to unexpected outflows that can strain the project's financial resources.

External factors often lie outside the control of the project management team. These can include economic fluctuations leading to rising material costs or changes in labor rates, regulatory changes resulting in additional compliance costs, or even natural disasters causing project delays and damage. Each of these events can result in unexpected expenses, causing an unexpected drain on the project's cash resources.

Similarly, unforeseen expenses within the project can also create CF challenges. These might include cost overruns due to errors or inefficiencies, unanticipated maintenance or repair costs, or even costs resulting from accidents or safety incidents on the construction site. These unexpected expenses increase the cash outflows, creating pressure on the project's CF.

Managing the impact of external factors and unforeseen expenses requires a proactive and flexible approach. Here are a few strategies:

- **Risk Analysis and Contingency Planning:** A thorough risk analysis can help identify potential external factors that could impact the project. Having a contingency plan and cash reserve set aside can help manage the impact of these factors and cover unforeseen expenses.
- **Flexible Budgeting:** A flexible budget can provide some leeway to accommodate unexpected costs. This could include a buffer or contingency amount within the budget to cater to unanticipated expenses.

- Insurance: Appropriate insurance coverage can protect against a range of risks, such as natural disasters, accidents, and other events that could lead to unexpected costs.
- Regular Monitoring and Review: Regular monitoring of the project's financial performance and regular review of the project environment can help identify emerging external factors or growing expenses before they become significant problems.

External factors and unforeseen expenses are inherent aspects of construction projects that can significantly impact CF. However, through proactive management and strategic planning, these challenges can be effectively managed, minimizing their impact on the project's CF and overall financial performance. This resilience in the face of unpredictability can greatly contribute to the overall success of the project.

6 Case Study: Construction CF & Payment Reports by Levelset

6.1 Overview

Levelset was a construction software company based in the USA. Their mission was to improve the CF and optimize payment procedures for all the parties involved in the construction projects. On 3rd November 2021, it was acquired by Procore Technologies, Inc. (NYSE: PCOR) for \$500 million. After the acquisition, Levelset's software was incorporated into the Procore platform. In other words, their lien rights management and payment management software are now seamlessly integrated with Procore's other products, which cover every aspect of project management. A significant advantage also is the integration of companies' complementary data sets (Levelset, 2021).

For the case study, Construction CF & Payment Reports conducted by Levelset in the years 2021 and 2022 will be analyzed. The goal is to analyze and compare the reports and recommend the most suitable solutions for the problems that plagued the American construction industry during those years. Also, for the context

6.2 Methodology

Levelset surveyed 764 and 519 respondents in 2021 and 2022, respectively. The respondents' demographics are all-rounded, which helps in showing the reality more explicitly. Questions are in multiple-choice format, and where applicable multiple selections are allowed. All questions are tailored to the payment management aspect of construction projects, the key determinant for the health of CF.

During the analysis of the reports, as colleagues at Levelset state themselves (Levelset, 2021), it should be considered that the pandemic, and the economic crisis it

created, significantly affected the industry, especially given the fact that the report is about the US construction industry as the US was affected by pandemic more severely than most of the countries (Coronavirus Statistics, 2023) and construction industry more than most of the other industries.

6.2.1 Demographics

Demographics are so well portrayed in this report that one could argue that the document is outstanding only thanks to them. Knowing the positions of the participants in their companies, the roles of their companies in the projects they work on, and the sector the projects belong to shows in which areas the problems are encountered from different perspectives. A different perspective is also crucial for proposed solutions as there will be a broad spectrum of them since participants' roles vary so much. A respondent from a legal division will go about the payment management solutions with different philosophy compared to a respondent from the accounting division. The charts below depict the job position allocation.

Job position

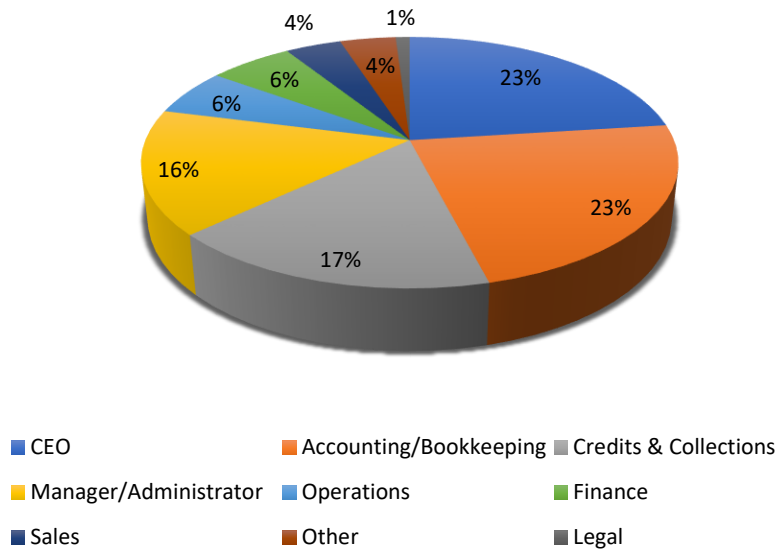


Figure 5: Job Position (Levelset, 2021)

Job position

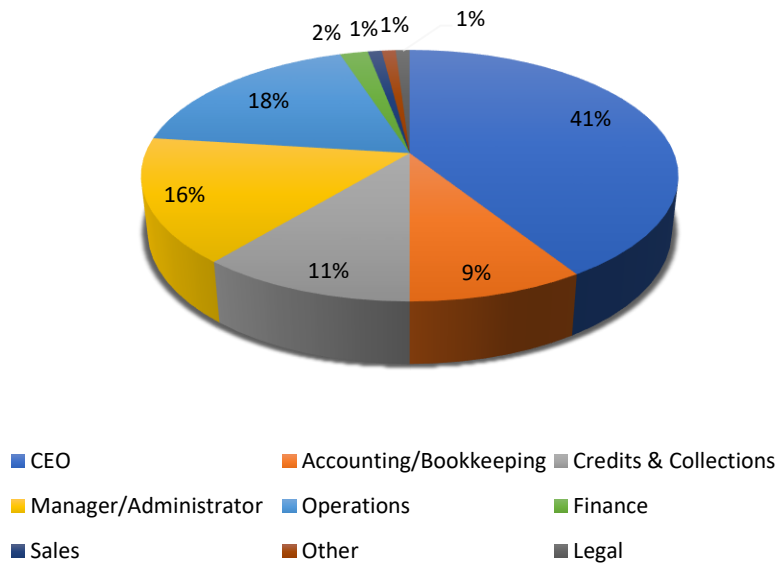


Figure 6: Job Position (Levelset, 2022)

Operations across the country are very well-tailored as well. Since the participant's companies function all over the country, the statistics given in the report become valid for the entire country. This has its drawbacks too. For example, retention is unregulated in some states; in others, it is capped to a certain amount (usually 5-10%) and even completely prohibited in New Mexico. This will falsify the data about retention if not filtered accordingly.

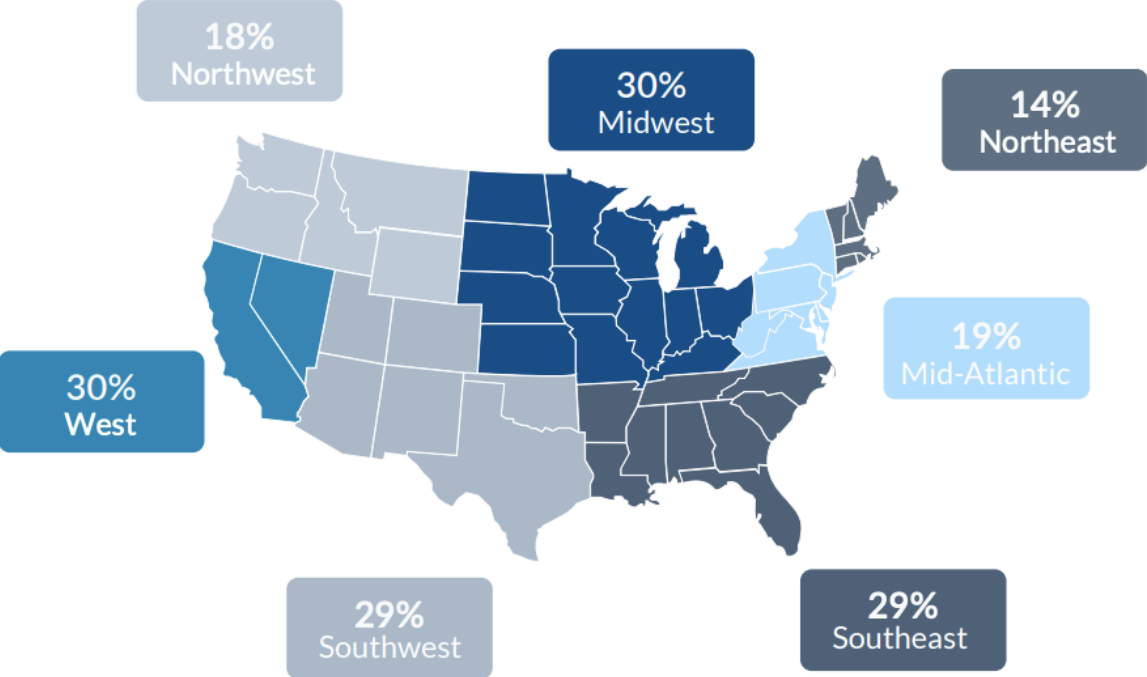


Figure 7: Respondents' project activity map (Levelset, 2021)

The range of the size of companies is very well distributed as well. Such distribution of the number of employees, projects completed, and the average value of the contracts allows us to observe the industry as a whole, not just an echelon. The statistics mentioned above, and from now on below as well, can be found in the reports attached in the addendums.

6.3 Description and Analysis

Payments were always a problematic aspect of the construction industry, but the global pandemic further worsened processes related to them. Compared to pre-pandemic levels, full payments and payments made on time are astronomically down; in 2021, 74% and 60%, respectively, which means that only 9% of the companies get paid on time, and 11% get paid in full. Obviously, this leads to severe CF problems, which directly affect the three main ingredients described in Chapter 3, project profitability, liquidity, and overall stability, to successfully bring the project to the finish line. Statistics slightly moved towards positive in the 2022 report. 15% of the companies were paid in full, and payments made on time bumped up to 9%.

The COVID-19 pandemic delivered positive outcomes too. Lockdowns pushed companies to adapt to electronic solutions. The construction industry is stubborn to integrating electronic solutions, which makes this step forward even more pleasant. Nevertheless, 12% of companies still do not support electronic payments, and 48% do not plan to invest in software and technology. Mechanic's lien and preliminary notices became a common practice. This fact should not be attributed only to the massive drop in payment productivity, which would simply leave no other choice for the contractors. It would have been the case for most of them, but not all of them. Construction is a business built on reputation and relationships, and since the lockdowns restricted physical presence, contractors became less hesitant to resort to such measures.

The reports show us that the lower participant is on the payment chain, the bigger the pressure on him. General contractors are four times more likely to get paid on time and twice more likely to be paid in 30 days. The statistics are much worse in the commercial and government sectors compared to the residential sector. Companies doing business in those sectors need to plan strategically to maintain healthy CF. It is advisable for the companies to take on the type of projects in which they have experience to maintain steady CF.

The pandemic brought on a tough time for the construction industry. Those who managed to survive received a once-in-a-lifetime experience that will help them in future CF management.

6.3.1 Solutions

These are the most often encountered challenges in the US construction industry and potential solutions to them:

- **Delayed Payments:** To increase the incentive for the client who is obliged to pay, the contractor can offer discounted early payments coupled with added interest rate. All of a sudden, it looks like a double bargain. Implement this method, punctual invoicing, and frequent checkups. Resort to mechanic's lien if necessary. Data tells us that participants do not send them out because it is a complicated process. Hiring a legal team would be a good investment in such a case. Subcontractors should not enter into paid-if-paid contracts.
- **Negative CF:** 20% of the companies have negative CF after the first 40 days of working on the project. In such cases, front-end loading should be implemented. Often it is deemed unethical, but not paying on the agreed terms is unethical too. Negotiate terms to settle outflows later.
- **Project financing:** Only 35% of the companies get the amount of credit they need for the materials. Companies have to make sure to keep strong credit scores in order to have access to lines of credit.
- **Retention:** 61% responded that collecting retainage is very important for the CF of their business. Retention bonds are one of the alternatives to face this challenge. However, for a retention bond to be a viable solution, the premium of the bond has to be lower than the retainage withheld by the client. Furthermore, the bond must preferably be conditional since if it is unconditional contractor has to rely on the goodwill of his client.
- **Optimistic thinking:** The survey indicates several times that the contractors expect to receive payment earlier than they should. Also, companies remain optimistic for 2023 despite the fears of rising costs and supply chain issues. Pessimistic thinking is better for CF in the construction business. Contingency planning should include the worst scenarios possible so the company can be ready financially to resist adversities.

7 Conclusion

The importance of effective CF management in the construction industry is evident from the extensive analysis conducted in this thesis. Managing the inflow and outflow of funds determines not only the project's survival but also its potential for profit, liquidity, and financial stability.

Throughout this research, it has been repeatedly emphasized that CF management in construction projects goes beyond merely tracking revenues and expenses. It involves a comprehensive approach, including precise CF forecasting, meticulous cost control, proactive financial risk management, and diligent payment management. By integrating these strategies, project managers can maintain the financial health of the project, enhancing its ability to meet financial obligations and invest in opportunities that arise.

Moreover, this thesis has highlighted common CF challenges in construction projects, such as inaccurate forecasting, payment delays, cost overruns, and insufficient working capital. These challenges can cause severe disruptions to the project's CF, possibly leading to financial distress. However, by adopting the appropriate strategies, these challenges can be addressed effectively, reducing their impact on the project's CF and overall financial performance.

The case study displayed issues construction industry workers experience in the US. Given statistics were interpreted and analyzed. Payment management, alongside other CF strategies, was utilized to offer practical solutions to the given problems.

This thesis showcases that CF management is not an isolated aspect of financial management but a crucial determinant of the financial performance of construction projects. Through a strategic approach to CF management, construction projects can significantly enhance their chances of financial success, contributing to the growth and stability of the construction industry as a whole.

Future research in this area could delve deeper into the impact of digital technologies on CF management, investigate the role of different stakeholders in managing CF, or explore how CF management practices vary across different types of construction

projects or in different countries and contexts. As the construction industry continues to evolve, it will be critical to continuously reassess and refine CF management practices to ensure their relevance and effectiveness in a rapidly changing environment.

References

- Coronavirus Statistics. (2023). *Coronavirus Statistics*. Worldometers. Retrieved May 17, 2023, from <https://www.worldometers.info/coronavirus/>
- Finity, J. (2023). *The Carrying Cost of Slow Payment in Construction*. The Carrying Cost of Slow Payment in Construction. Retrieved May 16, 2023, from <https://www.procore.com/library/carrying-cost-slow-payment-construction>
- Kaka, A. P. and Price, A. D. F. (1991). 'Net cashflow models: Are they reliable'? *Construction Management and Economics* 9: 291–308.
- Kenley, R. (2003). *Financing Construction: Cash Flows and Cash Farming* (1st ed.). Spon Press.
- Killough, D. (2021). *The Cash Flow Statement: Find Out Where Your Money Goes*. Level set. Retrieved May 21, 2023, from <https://www.levelset.com/blog/cash-flow-statement/>
- Level set. (2021). *Procore Completes Acquisition of Levelset to Simplify Lien Management Workflows for Construction*. Level set. Retrieved May 21, 2023, from <https://www.levelset.com/news/procore-completes-acquisition-of-levelset/>
- Peterson, S. (2014). *Construction Accounting and Financial Management* (3rd ed.). Pearson.
- Pordea, D., Delia, D., & Dorel, M. (2020). *THE IMPACT OF OPERATING CASH FLOW AND CURRENT RATIO ON THE PROFITABILITY IN CONSTRUCTION INDUSTRY* (Vol. 30).
- Shash, A. A., & Qarra, A. A. (2018). *Cash Flow Management of Construction Projects in Saudi Arabia* (Vol. 49). *Project Management Journal*. <https://doi.org/10.1177/8756972818787976>
- Value of the construction industry as a share of the gross domestic product (GDP) in Europe in 2021 by selected countries*. (2022). Statista. Retrieved May 15, 2023, from <https://www.statista.com/statistics/1309425/gdp-share-of-the-construction-industry-in-europe-by-selected-countries/>

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Addendums

Attachment 1: 2022 Construction Cash Flow & Payment Report by Levelset

Attachment 2: 2021 Construction Cash Flow & Payment Report by Levelset