An Integrated Framework for Construction Project Analytics Using Autodesk Construction Cloud and Power BI

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ABSTRACT

This study aimed to develop an integrated digital platform to improve the effectiveness of cost control in construction projects. Cost control is an important process in construction project management to ensure expenses remain within the budget. However, cost control using manual methods often leads to numerous problems, including inaccurate cost estimates and delays in project finances. Therefore, there is a need for a digital system to resolve these problems. In this study, an integrated digital cost control platform that combines Autodesk Construction Cloud (ACC) and Power BI Analytics was proposed. ACC is responsible for storing and managing the collected project data, while Power BI helps to generate a dashboard and report to show the project performance. By combining these two tools, project teams can monitor cost data in real time and make better decisions. This study included the system's development and demonstrated its application. The results of this study showed that the new system can resolve problems caused by the manual method, such as reducing human error, improving the accuracy of cost data, and ensuring transparency in cost reporting. Based on the findings, this study highlights the importance of adopting the integrated digital cost control platform to improve cost control in construction projects.

Keywords: Digital Cost Control, Construction Project Management, Real-Time Data Monitoring, Power BI Analytics, Autodesk Construction Cloud (ACC), Building Information Modelling, Built-Environment, Construction Information Technology

INTRODUCTION

The most challenging aspect of construction is managing project costs when the organisation is still using outdated methods, such as spreadsheets and paper-based documents, to track labour, materials, and subcontractor claims. This method seems like an easier, simpler way, but it often leads to fragmented data, slow updates, and human errors. These problems can leave a manager unable to understand the actual financial status in real time and prevent them from responding quickly to emerging cost risks (Pishdad & Onungwa, 2024).

In this era, digital technologies have transformed the way construction project data is collected and managed. Cloud-based platforms such as Autodesk Construction Cloud (ACC) have enabled cost management by centralising budgeting, contract administration, and expense tracking into a single platform. This can eliminate the inefficiencies of scattered spreadsheets (Rodrigues, Alves, & Matos, 2022) and enhance communication among teams responsible for decision-making related to costs (Pishdad & Onungwa, 2024). In addition, Business intelligence (BI) dashboards help to turn raw data into useful information that can be used to make it easier for managers to understand cost and project performance and can help make faster decisions

Previous studies show that combining digital tools such as Building Information Modelling (BIM) with BI dashboards can improve cost monitoring and help project teams respond more quickly to site changes (Rodrigues, Alves & Matos, 2022). However, many organisations still do not fully understand and use these digital tools to control costs. Pishdad and Onungwa (2024) found that BIM is often used without integration with other systems, such as progress tracking and payment management, which limits its usefulness. Furthermore, the

new technologies, such as digital twins, which can show the real-time project performance, are rarely used for cost control and have not been widely studied (Che Haron & Muhd Zafir, 2025)

These issues reveal a clear gap between the digital tools available and how construction organisations actually use them. Cost data is often kept in a separate system, making it difficult to obtain accurate, up-to-date information. Therefore, there is a need for an integrated digital system that can combine cost data and support better decision-making. This study aims to propose an integrated project cost control and decision-making system using Autodesk Construction Cloud and a Business Intelligence dashboard. The objective of this project is to improve the accuracy and transparency of project cost data, support real-time monitoring of construction costs, and assist project managers in making faster, better cost-related decisions.

Problem statement

Digital tools abound in the construction industry, yet in many projects, cost control continues to rely on manual or semi-manual techniques, such as spreadsheets and e-mail-based updates, which contribute significantly to delays in financial reporting. This will lead to human errors and fragmented cost data distributed across various systems, making it difficult to disseminate accurate cost information consistently throughout a project life cycle (Olawale & Sun, 2015; Malkanthi et al., 2017).

Firstly, studies by Ismail et al. (2021) and Shah et al. (2023) found that slowing the revision and re-equip process increases the cost of information and makes it harder for project managers and teams to observe their financial results on time, without long delays. When compared and differentiated against cost data that is regularly amended or inconsistent across multiple sources, the identification and recognition of cost variances and discrepancies becomes difficult and burdensome. This restricts and limits well-informed decision-making and weakens the effectiveness and potency of corrective actions and measures, leading to an increased risk of budget overruns, schedule slowdowns and delays.

Moreover, manual data management and operations pose a high risk of human error in cost calculation and estimation, reporting, and clarification. After that, errors and mistakes in cost data are likely to result not only in inaccurate financial predictions and performance reports, but also in unproductive and unsuccessful decision-making. This can, over time, affect resource distribution and allocation, cash flow planning and arrangements, and the project's financial feasibility (Olawale & Sun, 2015; Malkanthi et al., 2017).

Furthermore, distributing cost information across different, incompatible systems does not enable precision or coordination and disrupts the processes for the project's involved parties and teams. When project participants and contributors call for different versions of cost information, communication gaps, misunderstandings, and misalignment may arise, damaging and undermining trust in the reporting of costing findings. Next, without proper integration and incorporation, this lack of coordination has a negative, gloomy impact on collaboration. It limits the capacity and proportions of project teams to cope with and survive emerging cost-related risks (Shah et al. 2023).

On the whole, these problems indicate, specify, and show domestic failings and weaknesses in the construction cost control practices and firm that influence the quality of the decision-making process and, in turn, the performance of the project. Lastly, construction projects are highly unprotected and exposed to financial incompetence and disorganisation, which increase unreliability and unpredictability in the absence of timely, accurate, and integrated cost information. Their foundational cost control issues cannot be disregarded, passed over, or ignored.

Review Of the Current Approach

In many construction projects, cost control is still carried out manually using spreadsheets, handwritten records, and email, as these methods are simpler and more familiar to project teams. However, it has been identified as a major cause of errors and inaccuracies in project cost management (Alkaissy et al., 2022). In manual methods, the same information may need to be entered several times for different uses and calculations. This repetitive

data entry increases the likelihood of errors and inaccurate cost records. It may cause further problems when project teams rely on them, leading to an adverse impact on the project (Elghaish et al., 2019).

According to Elsanadedy et al. (2021), there is a lack of a centralised platform that helps to store cost data in an orderly manner. Cost data is usually collected and stored by different people at different locations. This causes project teams to spend time and effort finding the data they need. In some cases, the data they obtain is incomplete or outdated, which can easily lead to delays in cost reporting and incorrect decision-making. Furthermore, manual methods reduce transparency in cost data management (Negendahl, 2015; Zhang & Burton, 2021). It is difficult to find previous cost data records, and when costs change, it is difficult to track those changes. When disputes occur, it is also difficult to determine who made the error and who should be held responsible. Thus, manual methods increase the time required to prepare cost reports and reduce overall efficiency in managing cost issues.

Table 1 lists the methods currently used in practice and their identified weaknesses in different aspects. Among them, the most critical issues are scattered data storage, the need for manual updates to cost information, and the lack of centralised records. This is because they directly affect data accuracy, slow down cost analysis, and reduce transparency in construction projects. Overall, manual cost control methods are no longer suitable for construction projects. Their limitations highlight the need for a more integrated, digital approach to improve cost monitoring.

Table 1: Limitations of the Current Cost Control Approach

Aspect	Current Practice	Identified Weakness
Data Collection	Handwritten logs, paper forms	High risk of errors, missing information
Data Storage	Multiple Excel files and email attachments	Fragmented and inconsistent datasets
Updating Cost Information	Manual re-entry by QS and engineers	Time-consuming, duplicated work
Report Preparation	Manual consolidation across documents	Causes delays and outdated reporting
Transparency	No centralised record or version control	Difficult to track changes and responsibility

Technological Solution

Microsoft Power BI Dashboard

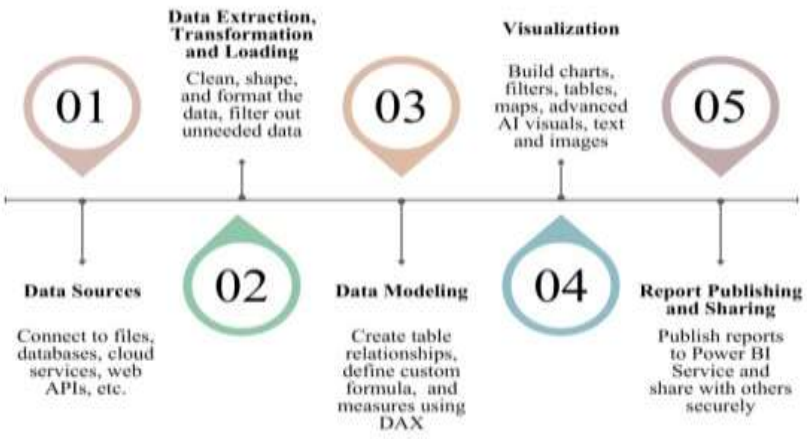


Fig.1. Flowchart for Microsoft Power BI

Microsoft Power BI is a Business Intelligence (BI) and data visualisation tool developed by Microsoft to support data-driven decision-making (Gonçalves et al., 2023; Zamil et al., 2024). Starting with the 2013 edition, Microsoft created Power BI using several "Power" Excel add-ons (Becker & Gould, 2019). This evolution allows the researchers to analyse patterns in the large and noisy dataset using interactive dashboards and basic data slicers and filters (Carlisle, 2018). The Power BI interface is highly intuitive, which can ease use for users who are not experienced in data science or programming, as well as the visualisations. Additionally, a wide range of resources, such as Azure, Excel, cloud-hosted data, and SQL services, can be automatically connected to Power BI models to address disconnected financial information across project teams (Carlisle, 2018).

From the cost perspective, Power BI's DAX (Data Analysis Expressions) engine facilitates financial statement analysis, variance reporting, budget forecasting and cost centre analytics (Zamil et al., 2024). These functions help users monitor updated information through online dashboards rather than waiting for manual reports. Besides, Power BI's real-time features can help project managers and quantity surveyors make quick, informed decisions (Gajera, 2023). Consequently, the project teams can detect problems early by visualising cost trends and variations in clear charts, graphs, and dashboards. Hence, the Microsoft Power BI Dashboard is a business analytics platform that helps an organisation turn data into actionable insights. It offers integrated tools and services to share, connect, and visualise data across organisations, improving cost transparency and supporting informed cost-control decisions throughout the project lifecycle.

Autodesk Construction Cloud (ACC)

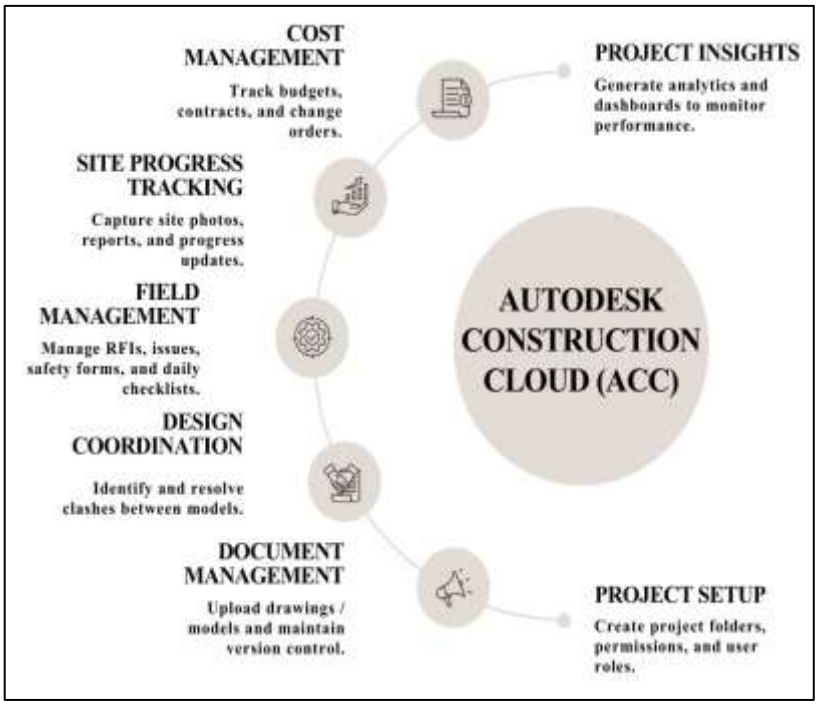


Fig.2. Flowchart for Autodesk Construction Cloud (ACC)

Autodesk Construction Cloud (ACC) is a cloud-based construction management platform that supports workflows at every stage of the construction process, from planning and design to construction and operations. It increases collaboration among teams in the construction industry, such as clients, architects, engineers, and quantity surveyors. In the cost management context, ACC centralises project and financial data by allowing users to upload, store and share all project documents, drawings and payment records in one secure place (Da Silva & Boton, 2025). This centralised function is designed to reduce data fragmentation, which often leads to cost discrepancies and report delays in construction projects.

Additionally, it speeds up project management by enabling real-time tracking of actual costs, managing change orders, and analysing updated data. This function can improve overall construction progress efficiency. The BIM-based cost management system is often known as "5D BIM". It combines cost information with building models to facilitate ongoing cost tracking, payment administration, and cost estimation. The combination of BIM and

ACC aims to improve cost visibility and control throughout the project lifecycle (Pishdad & Onungwa, 2024). Overall, ACC functions as a digital cost control platform by enhancing cost transparency, improving the coordination of financial information, and supporting timely cost-related decision-making, which has the potential to revolutionise construction project management (Chaisaard, 2025).

Proposed System Development

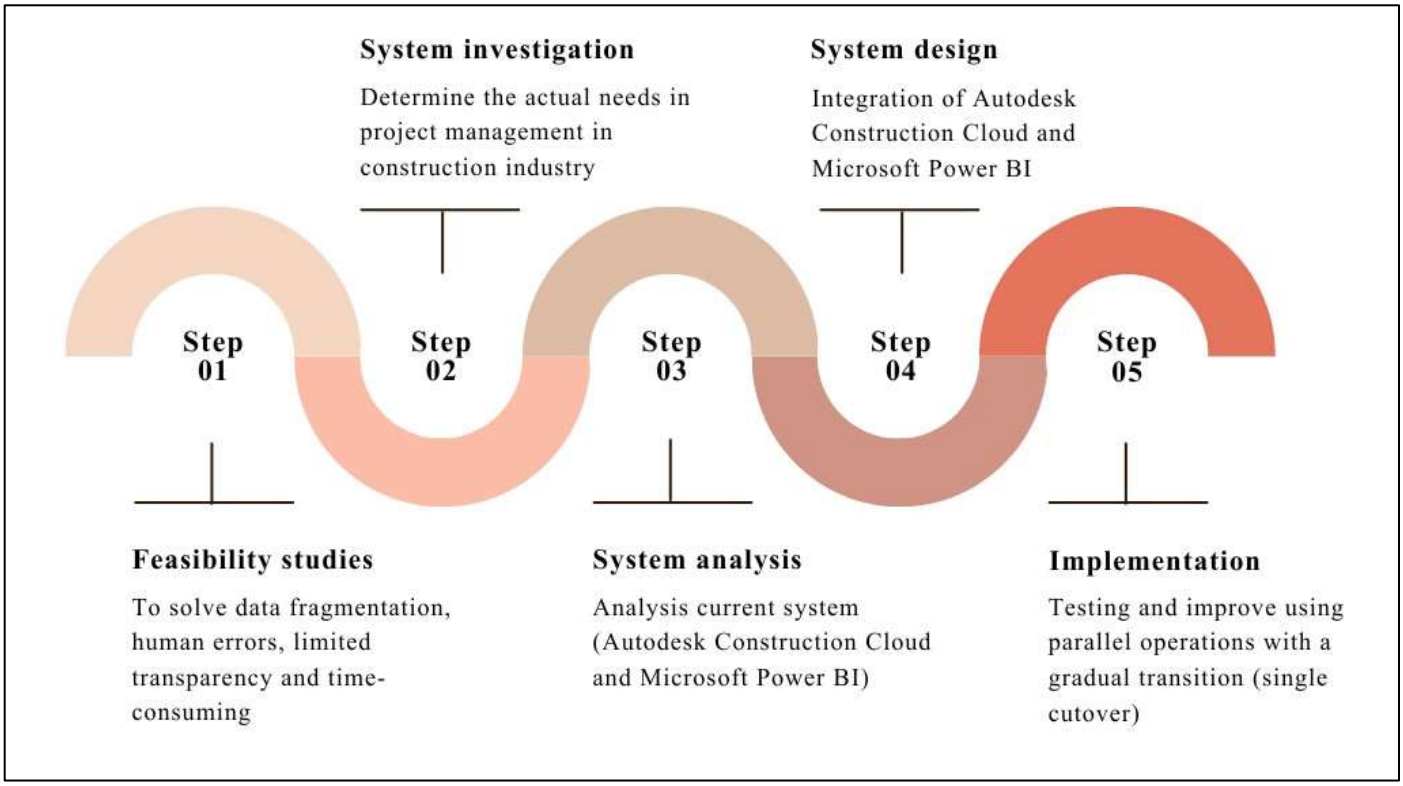


Fig.3. Information System Development Life Cycle (SDLC) Framework

Table 2 : SDLC Framework

Feasibility studies	Identify the issues commonly faced in the construction industry, including data fragmentation, human error, limited transparency, and time-consuming processes. Then propose a solution that genuinely solves these issues.
System Investigation	Determine the real needs of construction project cost management. The techniques used include examining existing documents, interviewing, using questionnaires and observing present methods of work. This objective was to ensure the analyst clearly identifies what functions the new system must deliver.
System Analysis	Analyse the existing system (Autodesk Construction Cloud (ACC) and Microsoft Power BI in detail to understand the workflows and limitations. The findings will show the functional gaps that the new system must address.
System Design	Integrate Autodesk Construction Cloud (ACC) with Microsoft Power BI to address issues identified during feasibility studies. The new system will focus on new functions such as real-time data synchronisation and analysis.
Implementation	The new system can be tested using parallel operations to ensure accuracy and stability. Users can gradually transition from the old process to the new system, allowing feedback to be collected while minimising risk. After successful testing and improvement, the system is ready to fully replace the old process.

This study focuses solely on system design and conceptual development. The SDLC framework is used to demonstrate the structured, systematic development of a proposed integrated cost management system.

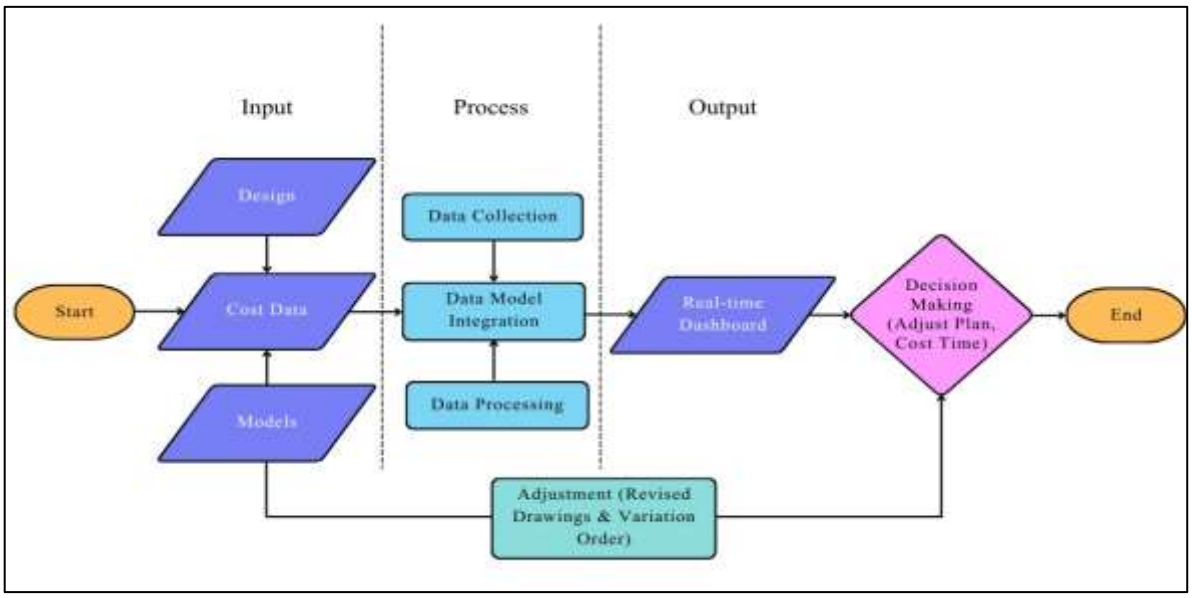


Fig. 4. Flowchart for the Integration of Autodesk Construction Cloud (ACC) and Microsoft Power BI

Currently, Autodesk Construction Cloud (ACC) and Microsoft Power BI are used separately. This may result in data duplication, slow reporting and inconsistent cost information. Manual data extraction and cleaning will cause delays and increase the risk of human error. This creates challenges in achieving real-time project monitoring and accurate cost control in today's construction industry. Hence, in this study, a new system is proposed to automate data transfer between ACC and Power BI for real-time updates.

Integrating Autodesk Construction Cloud (ACC) and Microsoft Power BI aims to create a comprehensive digital system for cost control. This integration enables automatic data transfer and synchronisation between ACC and Power BI. It can be achieved through the cloud-based data connectivity and data-sharing capabilities provided by the two platforms. For example, project cost data stored in ACC can be exported or connected to a central cloud database. Then Microsoft Power BI can connect to this database via its built-in data connection feature to automatically retrieve and update project cost information. This eliminates the need for manual data transfer and can ensure the cost information in both systems remains consistent and up-to-date.

The process begins with key project inputs, such as design, cost data, and BIM models. These inputs are collected from site activities, consultant submissions, and contractor cost records. At this stage, data represent the latest project scope, quantities and cost-related information. Then, the inputs are collected and validated before being merged through a data model integration process to ensure consistent, accurate information. Data collection ensures that information from different project sources is brought into a single workflow rather than being handled separately. At this stage, the Extract, Transform, and Load (ETL) process is applied to clean, organise, and standardise the data. The ETL process ensures that the ACC data format is compatible with the Power BI data model. This step enhances data accuracy and prevents duplication or inconsistency before visualisation.

Later, the data will undergo integration into a data model. It will display data in graphs and charts, allowing project teams to view the project's financial situation clearly and instantly. Graphs and charts present cost trends, budget comparisons and variation impacts in a clear and understandable format. The Power BI dashboard will automatically refresh at predetermined intervals or synchronise with the cloud to refresh in real time. This automatic refresh feature ensures that all visual content reflects the latest project cost data, eliminating the need for manual updates.

Based on the dashboard results, project teams can monitor project financial performance clearly and instantly. They can easily track projects that are over budget or behind schedule and take quick action. Once any adjustments, such as revised drawings and a variation order, are issued, the data will then be fed back into the

system. It is to ensure real-time updates and a closed-loop improvement cycle for cost and time changes. For example, when a variation order is approved in the ACC system, the updated cost data will be automatically synchronised through the cloud database and displayed on the Power BI dashboard. This allows the project team to assess the financial impact and take immediate action if necessary.

This proposed new system offers transparency as all project teams involved can view the same data information in real time. Integrating ACC and Power BI aims to create a data-driven cost control system that enables parties involved to manage costs more efficiently, make decisions faster, and support the digital transformation of the construction industry. Besides, this integration also helps reduce manual work, minimise errors, and support faster decision-making. Overall, the new system enhances the accuracy, transparency and the ability to make informed decisions throughout the project lifecycle.

Comparison Between The Current Process And The New Process

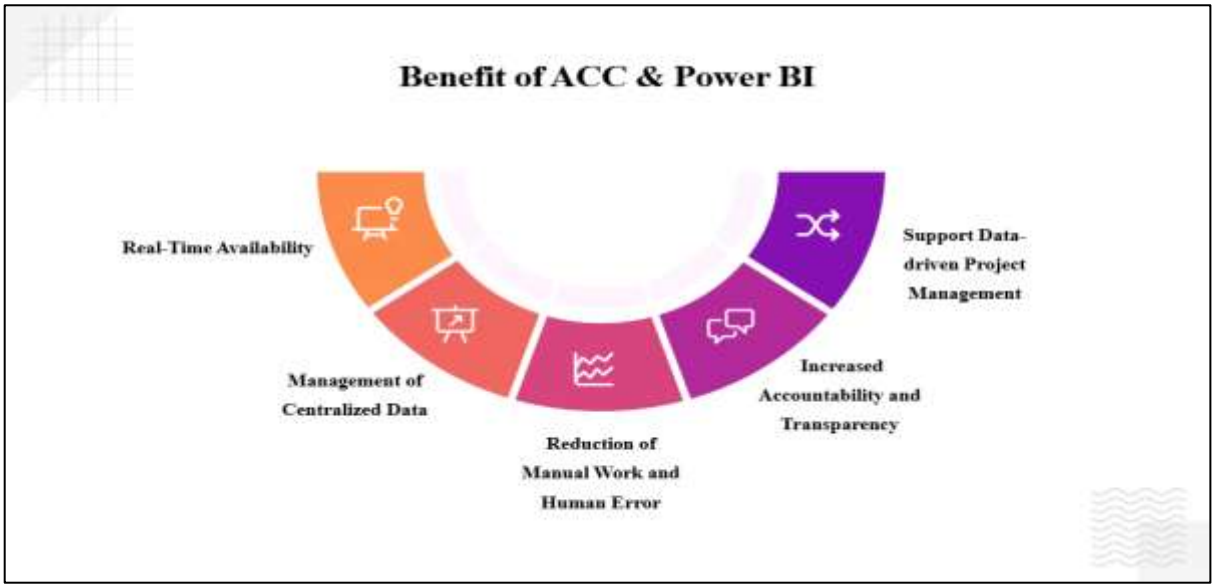
Currently, cost control in construction projects relies mainly on manual methods, such as spreadsheets, handwritten records, and email-based data collection. It requires repeatedly entering the same data, which increases time and the risk of human error. Furthermore, the process of compiling cost reports is slow, reducing the overall work efficiency. This is because the data is only updated after engineers or quantity surveyors have completed data compilation, which makes it difficult to detect cost issues in time and delays decision-making.

On the contrary, the new process has integrated Autodesk Construction Cloud (ACC) and Power BI Analytics. All project data is uploaded and stored in an organised manner on the ACC platform, and it can be accessed in Power BI via built-in data connectors or application programming interfaces, reducing the need to enter the same data repeatedly. When project changes occur, such as changes to drawings or new cost data, the relevant information can be directly updated in the system instead of rekeying the same data. This method also ensures that all stakeholders can access the latest data at any time, eliminating the need to collect data from multiple sources manually and reducing delays and improving overall work efficiency.

Once the data is entered in ACC, Power BI can automatically convert it into dashboards, allowing project teams to see the cost performance more clearly. This data connection allows data to be uploaded automatically, so Power BI always shows the latest cost information. The real-time dashboards help project teams conduct cost analyses, enabling them to identify cost overruns or delays and take timely action. Overall, compared to the current approach, the new integrated approach improves data accuracy, shortens reporting time, and enhances more effective decision-making.

Benefits of the Proposed System

Fig.5. Benefits of the Integration of Autodesk Construction Cloud (ACC) and Microsoft Power BI



The proposed combination of Autodesk Construction Cloud (ACC) and Microsoft Power BI will offer numerous benefits, increasing efficiency, accuracy, and transparency in cost control across construction projects. First and foremost, the proposed system provides real-time information to support decision-making and resolution. ACC, combined with Microsoft Power BI, will enable near real-time access to project cost and performance levels through automatic data synchronisation and visual dashboards. Furthermore, the regular availability of updated information can help project teams better monitor cost performance and detect budget variances earlier, enabling timely decisions (Eastman et al., 2011; Love et al., 2019).

Besides, it also centralised information through a Common Data Environment (CDE). It is to demonstrate the concept of CDE, which provides a centralised digital repository for project data, including design documents, cost data, and Building Information Modelling (BIM) models. Other than that, previous studies have shown that CDE reduces data and information fragmentation and maintains information consistency by providing a single source of truth for all project stakeholders (Eastman et al., 2011).

Furthermore, automation will reduce human error and manual labour. The automation of data processing and dashboard generation minimises reliance on manual data entry and reporting. Manual data processing can lead to errors and inconsistencies in cost reporting, whereas automated systems increase data reliability and efficiency (Whyte & Hartmann, 2017; Bryde et al., 2013). This resulted in greater transparency for the project's stakeholders. Besides, shared dashboards will enable contractors, consultants, and clients to visualise the same project cost and performance data. The same transparency can lead to better communication and less friction around conflicting or outdated data, since all project decision-making is based on the same data (Love et al., 2019; Azhar, 2011).

The next benefit is that it can improve accountability in cost control and reporting. Sharing project data through a digital platform will allow stakeholders to understand the roles and responsibilities in cost management. It lends to accountability because decisions and cost cuts can be made to ensure documented, verifiable project data (Whyte & Hartmann, 2017), which, in turn, ties to studies on digital project governance— last but not least, supporting anticipatory planning and data-driven project management. Project managers who utilise Power BI visualisation tools for analysis also enable the discovery of hidden cost and schedule challenges, for example, through variance analysis, trend monitoring, and performance indicators. In a nutshell, many data-driven monitoring approaches enable proactive planning and informed resource allocation, rather than reactive management (Bryde et al., 2013; Love et al., 2019).

To wrap it up, these benefits and solutions suggest modernising outdated, manual, and poorly integrated cost control methods into a better-integrated, automated system. Whilst it increases efficiency, accuracy, and transparency, enabling their teams to act better, more quickly, and smarter, it can also maximise overall project efficiency.

Limitations Of The Proposed System

The suggested digital framework offers many benefits but also has significant problems. One limitation is that users need to be well-trained. Staff who have been used to doing things by hand and reporting in spreadsheets may encounter wrinkles when they try to use cloud-based data systems. If users do not receive proper training or ongoing technical support, they may find it difficult to make full use of the system's many features. This will affect how well the system performs. Therefore, it is essential to conduct structured training programs and implement planned change management strategies so the workforce can move seamlessly from its old ways to this new digital environment.

Additionally, Autodesk Construction Cloud (ACC) and Power BI operate in the cloud and require an excellent internet connection to access dashboards, reports, and project documentation. In construction, network issues can slow data sharing, make communication more difficult, and sometimes prevent workers from accessing crucial project information. This limitation can make it more challenging to collaborate in real time, delay the communication of progress, and reduce the accuracy of crucial data analysis. The records are also less accurate when employees cannot update site diaries, issues, or assessments right away.

The company also needs to move all of its current spreadsheets, cost records, and other documentation into ACC before the new system can be used effectively. This process includes cleaning the data, deleting copies, and

ensuring the format used remains the same. Employees need to use both the new and the previous systems simultaneously to avoid data loss. However, using both systems simultaneously can be cumbersome and cause problems if data is edited in one system but not the other. All data to be transferred to the new system must be carefully encrypted and protected to prevent unauthorised access and ensure its safety during transmission.

In addition, other limitations include the possibility that the data obtained may not be accurate or may not have long-term effects. This study was conducted to increase transparency and cost accuracy in construction projects. However, this study could not demonstrate the accuracy and applicability of cost estimates across many project life cycles. It is a challenge because it is necessary to determine the long-term benefits, which are cost savings over time or overall operations becoming more efficient.

CONCLUSION

This study was based on previous studies on digital cost control in construction using Autodesk Construction Cloud (ACC) and Microsoft Power BI. These studies were mostly focused on a single system and did not combine both systems. This study shows that combining both systems provides many advantages, namely the ability to display and collect data within the system, making it more efficient. This study also suggests a system that enables employees to obtain more information and to determine the overall cost of their current projects more easily.

The study findings show that the combined system, ACC and Microsoft Power BI, provides real-time dashboards, centralised data management and automated reporting. These characteristics can reduce human error, clarify issues, and help project managers identify and address unusual costs more quickly and make decisions faster. Apart from that, this system can also support organisational planning and accountability, which are important tools for the construction sector to transition from traditional to digital.

However, this study has several limitations. Employees need appropriate training because not all can use or get used to the technology if they are accustomed to it differently. This technology can work well if internet access is stable and very fast. This becomes a problem when the work is done at a construction site. This is because most construction sites often experience an unstable internet connection. Other problems include employees needing to transfer existing data to the new system without losing or duplicating the data.

An improvement to increase system use is to provide effective employee training. In addition, investing in ensuring fast and stable internet access. Companies also need to increase their use of new technologies, such as digital twins and AI-based analysis, to improve forecasting efficiency and project monitoring. Construction companies improve their existing systems to move towards a more effective, efficient cost management system.

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