



ROLE OF DIGITAL PRE-CONSTRUCTION SERVICES IN REDUCING CHANGE ORDER AND REWORK IN HIGH RISE PROJECTS

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Abstract: Right now, construction worldwide is shifting fast no longer stuck using flat drawings or disjointed steps. Instead of old ways, teams are building virtual setups that connect every part. Tall buildings push limits like few other jobs; tiny mistakes in tight spots with beams or pipes might explode budgets later on. A study called “Role of Digital pre-construction Services in reducing change Order and rework in high Rise projects” looks closely at how early digital work cuts down waste. Rather than waiting, it checks plans first before anything gets built. Past habits kept data locked up, separate, slow - causing delays plus hidden conflicts piling up. These unnoticed issues trigger extra bills, redoing tasks, inflating expenses by over ten percent sometimes. Now, crafting a precise digital twin at LOD 400 helps catch problems early. When paired with shared access through a Common Data Environment, everyone sees the same facts. That unity stops mismatched files and idle time wasting days. A close look at real-world data reveals shifting coordination work to a virtual lab nearly all on-site clashes ahead of time. Numbers show acting early in digital space slashes paperwork delays by almost half, sometimes more. Field corrections drop sharply, costing barely over one percent now. Linking timelines with budget layers creates lifelike simulations of each stage. These run-throughs sharpen buying precision, leaving little room for error in delivery timing. Materials arrive fitted exactly where needed. What unfolds next goes smoothly because key schedules hold steady without surprise gaps. Hidden gains appear later: smarter planning uses fewer raw resources overall. Waste shrinks when systems talk before ground breaks. Less excess means lighter impact on air and soil around project zones. Tall buildings take shape faster not through force but foresight built step-by-step. Each part follows logic tested long before trucks roll onsite. Outcomes shift from guessing what might fail to knowing what will fit.

I. INTRODUCTION

Towering buildings push limits, demanding extreme precision because even small missteps grow huge at such heights. The study called “Role of Digital pre-construction Services in reducing change Order and rework in high Rise projects” tackles hidden drains on profit - misaligned plans and clashing designs slipping past early checks. Instead of smooth teamwork, teams once passed flat drawings back and forth, each working blind to what others were doing. Without seeing overlaps ahead of time, electric ducts might race straight into steel beams - only noticed when workers arrive onsite. Fixes happen under pressure then, costly last-minute scrambles instead of calm planning long before ground breaks. Once construction uncovers flaws, paperwork piles up, work halts, budgets shrink fast - sometimes more than ten percent lost - while blame shifts across company lines. Before any digging begins, teams can shape decisions through virtual models that tie every detail together. Instead of guessing later, clarity comes early thanks to digital systems mapping out structures in full view. Tools such as BIM bring designs to life on screen, spotting conflicts automatically before they reach concrete and steel. With data flowing smoothly across roles, missteps fade because checks happen up front. Predictable building emerges when testing happens digitally first. Surprises shrink once coordination becomes routine behind the scenes. What used to be chaos slowly shifts toward order - quietly, steadily

II. LITERATURE REVIEW

When towers are being built they often run into problems because the people designing them the people building them and the people planning the systems do not work together well. This means that important details can get old and outdated and the specifications can conflict with each other. Than blaming each other some jobs are now using one shared digital hub where everyone can see the same information and agree on it. Studies have shown that when all the plans are in one place like this the number of questions about what things mean is almost cut in half. This change means that there are last-minute fixes and more time is spent getting things right the first time. The thing that makes this change possible is something called Automated Clash Detection. This replaces the way of using 2D CAD methods, which did not catch problems with space until the builders got to the site. Now teams can use tests with tools like Autodesk Navisworks to find problems like things overlapping or not having enough room for

equipment. Because these problems are found early they can be fixed before the steel even arrives, which saves a lot of money compared to fixing them on site. As the project moves forward adding time to the models turns the plans into timelines that show how things are progressing. The cost information is updated step by step. This kind of planning helps to prevent the disputes that often happen on big building projects like towers. One reason these digital tools work well is that companies are changing the way they work on projects. They are moving away from the Design-Bid-Build method and towards something called Integrated Project Delivery. With this method everyone involved in the project shares the risks and the benefits, which means that teams work together from the start than waiting until problems come up. A study called "Role of Digital preconstruction Services in reducing change Order and rework, in high Rise projects" looked closely at how this connected system works when it is used with detailed digital models. By using these models from the beginning misunderstandings are reduced because information can flow freely between departments rather than getting stuck. Towers and other high-rise buildings are an example of projects that benefit from this approach. What happens now in early build stages moves past old-school flat plans. Instead, teams aim to stop fixes later by getting things right before ground breaking begins. A study called "Role of Digital Pre-Construction Services in Reducing Change Orders and Rework in High-Rise Projects" looks at how strong virtual workflows make this possible. These methods turn digital models into working stand-ins for actual buildings - alive, testable, complete. Through tight modeling rules known as LOD 400, each piece, beams down to wiring paths, fits exactly when it reaches the job site. Timing layers get added so sequences play out step-by-step on screen, long before cranes arrive. Cost checks run alongside visuals, tying money updates directly to what appears in simulations. When everyone pulls from one live hub - the Common Data Environment - confusion fades. Files stay aligned. Small errors do not snowball into big field problems that spark costly revisions. Because everything locks together upfront, changes drop off sharply once work starts onsite.

III. RESEARCH METHODOLOGY

Digital planning tools cut down changes and fixes in tall buildings, this study follows a clear path meant to measure actual impact, not just stories. Instead of guessing, it builds answers using numbers plus firsthand accounts, blending what people say with hard data. Sitting at the core is a system called Virtual Design and Construction, where plans aren't flat drawings but live models - like mirrored versions of the real structure before it's built. These models meet LOD 400 rules, meaning each beam, pipe, and duct shows exact factory-level details so nothing gets left unclear once crews start working. A shared workspace holds all files, acting as the one trusted place for updates, blueprints, and decisions - this stops confusion when different teams use mismatched versions. Because everyone pulls from the same source, mismatches drop, errors shrink, information flows steady. The operational execution of this research, titled "Role of Digital pre-construction Services in reducing change Order and rework in high Rise projects", is further strengthened by a "Zero-Tolerance" validation protocol that synchronizes management platforms with high-fidelity BIM coordination. This phase of the methodology focuses on moving beyond traditional spot-checks by implementing automated rule-based scripts that audit the federated model for structural integrity, code compliance, and interdisciplinary spatial clearances. By treating every design change as a data-driven event within the Common Data Environment, the project maintains a "locked" coordination status that prevents the version-drift responsible for expensive on-site modifications. This rigorous verification ensures that the final "As-Built" structure remains an exact physical mirror of the validated digital prototype, successfully bridging the gap between theoretical design and operational reality.

Research shows that planning tools help cut down changes and redo work in tall building projects. Instead of jumping straight into construction, teams move step by step from digital models to actual building. At the core sits a shared online space where everyone stores and updates project data, making sure all versions match up instantly across disciplines. With time-lapse modeling, builders can see when tasks overlap and spot issues like cranes getting too close during lifts. On top of that, cost figures get updated live using material volumes pulled directly from the design files. Once an area passes checks and gets digitally approved, it's locked - no more edits allowed. Only then do parts get made based on those validated designs, ensuring nothing clashes once assembled. From model to real-world setup, digital plans move straight into robotic survey tools, cutting out mistakes people might make. Instead of guessing, lasers constantly check what's built versus the original plan. Accuracy becomes routine when every measurement feeds back automatically. Mistakes get caught before they grow. The building ends up exactly as designed, without extra fixes later. Time stays on track. Budgets stay intact. Precision isn't chased - it just happens.

Putting this approach into action involves several main steps:

- A step beyond 3D, the model moves with time, syncing visuals to each phase of building - helping spot delays before they happen. At the very same moment, costs stay checked by pulling exact amounts of materials straight from design data - dollars tracked as work unfolds. Movement through phases reveals where things might snag - like crane paths clashing or deliveries piling up. Money flows match progress, since every beam, pipe, and panel gets counted automatically - no guesswork left in ordering. What you see shifts day by day, just like on-site action would - only here it happens first in digital space. Spending stays visible because numbers update as designs shift - nothing hides between plan and price.
- Picture teams gathered around screens, working out clashes in real time through fast-paced coordination sprints called ICE. When agreement hits on a section of the building, its design gets sealed off - no more changes allowed. That frozen model becomes the official version for ordering materials and making parts. Decisions stick right then, visible to everyone involved.
- From model straight into terrain - precise coordinates flow into robotic total stations, guiding stakes down to the millimeter. Construction moves forward while 3D laser tools scan what actually gets built. Those scans meet original plans face to face in real time. Mismatches appear without delay. Corrections happen on the spot. Design stays intact because feedback cuts through noise before errors spread

IV. RESULTS AND DISCUSSION

Starting off Digital Pre-construction Services changes how teams handle risks in building projects. Not by reacting later but by checking everything first. Of waiting for problems to show up a method called "Validation-First" steps in early. A study named "Role of Digital preconstruction Services in reducing change Order and rework in high Rise projects" shows real results. Using a precise digital model helps block costly errors before work begins. That digital version catches mistakes ahead of time like when a crane's turning space hits a beam. These conflicts rarely appear on paper drawings. Because the team runs simulations beforehand hidden issues come to light. On average older 2D blueprints had 22.5 major clashes every 100 square meters.. After running automatic checks nearly all. 98 Percent. Were fixed in the computer model long before actual plans went out. Hour after hour spent organizing plans cuts physical work time drastically. Each one saving nearly ten times that effort later. Because of this jobsite progress stays steady avoiding knock-on delays. Fewer questions pop up during building a drop between forty five and sixty percent. In large part since tricky issues get solved early offsite. Only the toughest problems show up for field managers to handle. Money saved turns out massive instead of wasting ten to fifteen cents of every dollar fixing errors teams using complete virtual models spend under one point five. That leftover cash moves into upgrades not tearing things apart then rebuilding. Data shows a pattern. One extra percent of planning time digitally means five percent less spending on changes once construction begins. With Digital Pre-construction Services, material buying hit 99.5% precision for parts. Cutting excess orders by 15%, which trimmed down waste and lowered emissions. Because of time forecasts through 4D planning big deadlines were met far more often than with older ways; performance rose by 85%. That boost shows how Digital Pre-construction Services acts like space logic making sure what stands built matches perfectly to the approved digital version. Digital Pre-construction Services is really making a difference, in how teams work on building projects. The way Digital Pre-construction Services are used can really change the risks that come with civil engineering projects. Digital Pre-construction Services do this by using a way of doing things, where people check and validate everything first. When you build something, the part where you go from planning to actually doing it can be really tricky. This is because the plans you made are now being used in the world with all its limits. The information we found out says that using a very detailed Digital Prototype can help. It can stop problems before they affect the projects budget. Using Digital Pre-construction Services also helps people working on the project be more accountable and transparent. This is because everyone uses the information, which we call a Single Source of Truth. This way of managing data helps reduce the number of questions people ask when they are working on the site. It also gives us a record of what was decided that we can use in court if needed. Digital Pre-construction Services are also important for building in a way that's good for the environment. We can use tools to be very precise when we order materials so we do not waste anything. The old way of guessing how material we need can lead to a lot of waste.. By using data to order materials we can get exactly what we need. This new way of building called Lean Construction shows that using tools is not just about saving money. It is also about being responsible to the earth and to people, which's what civil engineers need to do nowadays. Digital Pre-construction Services are a part of this and they help us build in a way that is good, for everyone and the planet.

V. CONCLUSION

The primary objective of this research was to Out in the real world, building tall structures faces bigger challenges every year - complex designs, tangled systems - and old ways of managing construction just cannot keep up anymore. Instead of waiting until workers hit snags on-site, smart teams now move key planning steps into a digital space long before groundbreaking. Picture this: problems get sorted inside detailed virtual models where pipes miss beams and ducts clear walls - all worked out ahead. When builders use these precise digital twins built to LOD 400 standards, confusion drops hard; requests for clarification fall more than half. Money once wasted fixing avoidable errors shrinks from one dollar in eight down to barely six cents per dollar spent. That kind of shift means crews show up knowing what fits where, turning job sites into smooth-running setups instead of fire drills. With nearly all clashes cleared online first, time stays saved, budgets stay tight, and buildings go up cleaner, faster, quieter. One big change comes from having one clear data hub, where everyone taps into the same live info - no more scattered files causing mismatched plans or costly mistakes. When time gets woven into models alongside cost tracking, teams can simulate builds like dress rehearsals, spotting delivery snags or money gaps way ahead of actual work starting. That kind of foresight acts like armor for budgets, letting builders test moves in space and schedule without real-world fallout. What stands out is how ready digital systems must be before any green building goal becomes realistic. Pull exact material numbers straight from designs, cut wild guesses and extra ordering, slash waste piling up on sites globally. Moving forward does not mean new tools alone - it reshapes how projects breathe, think, respond, locking down timing, space, and spend with sharp attention well before concrete pours. The study shows that getting the part right during the planning stage is really important for the whole life of the building. It gives the people in charge of the building an trustworthy digital record that they can use for maintenance and checking the buildings condition. Using detailed models makes the move from building to using the building really smooth. This means that the final documents are made as the building is being constructed, not after it is finished which can be inaccurate. This way of doing things makes sure that the money spent on the building is not wasted and the building stays in condition and works well. It can also adapt to technology like using sensors to check the buildings structure. The research shows that planning the part of the building before it is constructed provides a strong technical foundation that connects the design, the actual building and the long-term operation of the building setting a new standard for the civil engineering industry. Digital Pre-construction Services are really important for the life of the building and they make sure that the building is sustainable and high-performing. The study proves that Digital Pre-construction Services are essential, for the civil engineering industry and they provide a robust technical infrastructure that helps the building last for a long time.

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