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The Great Misalignment in Construction Contracting: Best Practices and Software

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Abstract:
Construction software's promise of efficacy has been significantly unfulfilled. Although Information and Communication Technology (ICT) has been commonly used for over thirty years, many problems have existed relatively unchanged. There are several reasons for this, but one is overlooked: the absence of contractor best practices embedded in the industry's software. The primary cause appears to be developers' commercial interest. This paper used a literature review and an industry survey to study possible contributing factors. This paper quantifies this lack of software capability to support valuable processes. Currently, surveyed professionals perceive over 40% difference between the value of the practices tested and the enabling ability of the respondent's software. The industry is in a new age with the emergence of Artificial Intelligence (AI) and Quantum Computing. Will the same problems exist after these advanced technologies are widely adopted? This research contributes to the body of knowledge by identifying a gap between the value of industry-accepted practices and the commercial software support required to execute them. The paper asserts that government, associations, researchers and construction organisations should facilitate reengineering of existing ICT to reflect contractor processes. This will make the coming transformation of technology more valuable to all stakeholders.

1 INTRODUCTION

Although Information and Communication Technology (ICT) has been increasingly utilised for over thirty years, many persistent problems in the construction industry have persisted during that time, including unsatisfactory safety performance, poor quality outcomes, cost overruns, and schedule delays. Researchers have distilled several reasons for this, but one is significantly overlooked: the absence of contractor's best practice-enabling modules in the industry's commercial software.

The construction industry globally has been relatively slow to adopt Information and Communication Technology (ICT). Stevens and Smolders (2023) have pointed out more than a dozen barriers to innovation, including unique business characteristics with clients and vendors. Andújar-Montoya et al. (2020) echo this: construction is more complicated than any other sector due to one-of-a-kind production. The industry has many ad-hoc production control methods, most of which are informal due to approximately 98% of organisations being small and medium enterprises with 20 employees or less (ABS, 2022). This lack of structured thinking and installation process creates uncertainty that prevents smooth production flow (Dave et al., 2016).

ICT is designed to streamline contract processes, enhance compliance, and promote better alignment among project stakeholders (Bamgbose et al., 2024). However, the extent to which these tools effectively address the root causes of misalignment remains largely underexplored. Moreover, academics and software vendors have provided several reasons for the low implementation of technology solutions in the industry, including high acquisition costs, ongoing investment, and the time required for mastery. However, this paper asserts one more reason: construction software does not robustly support contractors' business and project practices. One indirect effect is that software firms do not promote and educate best practices via their customer training and sales presentations.

There may be a perverse incentive and, thus, a misaligned relationship. Contractors suffer from the highest bankruptcy rate in most countries, and software developers cannot afford to lose 1/3rd of their income. The authors' industry experience is that construction software firms have three common income sources: 1) Licensing, 2) Training, and 3) Custom Programming. This third revenue source would be reduced if their product supported best practices, and thus special modules would need to be created. The result appears to be reduced perceived value (total cost of ICT versus profit enhancement over spreadsheets) for contractors.

2 LITERATURE REVIEW

Despite its critical role in global economic activity, the construction industry faces significant management challenges (Őri & Szabó, 2024). Andújar-Montoya et al. (2020) state that projects produce significant information that must be processed and stored with efficacy, creating a ready market for software developers. The core challenges include the pervasive misunderstanding between contractual terms, objectives, and stakeholder expectations at the project level. This phenomenon exacerbates disputes, delays, cost overruns, and inefficiencies in delivery (Solli-Sæther et al., 2015). Best practices in construction contracting have been proposed to mitigate misalignment, emphasising transparent communication, equitable risk allocation, and the adoption of standard contract forms (Ogunbayo et al., 2024). However, despite these efforts, misalignment persists, often rooted in inconsistencies in contract interpretation, inadequate stakeholder engagement, and insufficient flexibility to adapt to changing project conditions (Sande & Haugland, 2015). Digital tools and contract management software advancements have introduced promising solutions to bridge these gaps (Ye et al., 2022).

Construction is characterised by factors that affect schedule, resource allocation and quality, including single-digit percentage margins, 2% or less market share of the industry leaders, fluid workforce dynamics (the highest "lost last job" of all Australian sectors) and a high percentage of bankruptcy. It is considered a complicated and information-based industry primarily based on the accuracy of interpreting varied issues based on a project's unique inputs (Wu et al., 2012). Prior studies have identified the construction sector's various working methods as the main barrier to implementing an industry improvement (Dubois & Gadde, 2002). Hartmann et al. (2012) noted that existing project management best practices guide understanding and supporting BIM implementations at the operational level of an organisation. This group of researchers have advocated for tailoring software to support these best practices for over a decade.

Industry	Does Not Own Product Until Sold	Not Fixed Asset Based	Product Design Created by Each Client	Highest Bankruptcy Rate	Most Significant Insolvency Deficiency $ Average	Highest % "Lost Last Job" Employee Rate	Highest % of Contract Employees
Agriculture,	No	No	No	No	No	No	No

Forestry and Fishing							
Construction	Yes	Yes	Yes	Yes*	Yes*	Yes*	Yes*
Manufacturing	No	No	No	No	No	No	No
Mining, Oil & Gas	No	No	No	No	No	No	No

Table 1. The Business Characteristics and Risks of Good-Producing Industries in Australia
*ABS 2023 compared to all (16) Australian Industries

Constructing a project is a process dependent on hundreds of ordered tasks. The products installed are mostly non-exclusive to competitors. Systematising operations is critical to lowering costs, elevating quality, consistently meeting schedule dates, and lessening employee frustration (Kalsaas and Sacks 2011).

First, some perspective is needed to frame the dynamics properly. Construction is considered a goods-producing industry, not a service, as defined by the U.S. Bureau of Labor Statistics (n.d), along with agriculture, forestry, fishing, hunting, mining, oil, gas, and manufacturing. Interestingly, architecture and engineering are considered service industries. Table 2 shows the process innovation metrics and activity by the Australian Industry for two years ending June 2021. The construction industry ranks second of the four industries in the value of intellectual property, which includes software.

Industry	Revenue	Value of Intellectual Property*	Intellectual Property / Revenue	Value Added**	Value Added / Revenue	IP / Value Added
Agriculture, Forestry and Fishing	$120,542	$345	0.3%	$35,585	29.5%	0.9%
Construction	$259,030	$2,090	0.8%	$135,451	28.4%	3.1%
Manufacturing	$447,124	$4,811	1.1%	$116,004	25.9%	4.1%
Mining, Oil & Gas	$392,966	$1,009	0.3%	$250,948	63.9%	0.4%

Table 2. Goods-Producing Industries' Measures in Australia FYE 2020 & 2021 - Average. (Source: ABS 2022) Average utilised to minimise COVID disruption effects. *Includes ICT Software **Valuation of products less cost to produce - expressed in current prices in millions AUD

Rapid standardisation and automation are possible with software tools and digitalised business processes (Matt & Rauch, 2014). The transformational potential is apparent to many researchers in the efficacious re-engineering of workflows in both the planning and execution stages. Moreover, industry leaders, including software developers, have tried to improve the current situation (Faghihi et al., 2015). It is important to note that some of this effort is manifesting. The Australian Bureau of Statistics (2024) shows a decrease in the Administrative and Support Services sectors by 18.5% from FYE 2020 to 2024—the most of any industry in Australia. The investment community concluded that the reduction is real and the opportunity significant. McKinsey and Company (2023) reported that an estimated $50 billion was invested in AEC tech between 2020 and 2022, 85 per cent higher than the previous three years. During the same period, the number of deals in the industry increased 30 per cent to 1,229.

Construction managers must interpret and process voluminous data for proper, up-to-date decision-making in effectively running a project. Therefore, the project's success depends on the increased reliance on technology. However, individuals' readiness to adopt technology has four dimensions: optimism, innovativeness, discomfort and insecurity. The four are independent; optimism and innovativeness encourage people to use and hold a positive attitude toward technological products and services, while a lack of comfort and security prevents their adoption (McNamara et al., 2022).

Since 2002, articles reflecting ICT have been trending downward, resulting in fewer journal articles in 2015. (Adwan and Al-Soufi 2016). Additionally, minimal research has been conducted to capture the issues barring technological adoption among small firms (Clermont et al. 2020) to help them identify their real needs and wants, including their challenges. This identification can help companies make changes and better address pressure from competitors (Lasni & Boton, 2022).

Today, software development is conducted in a chaotic environment. For example, Holmstrom et al. (2012) found disordered and dynamic markets, complicated and uncertain customer demands, shorter development cycle time pressures, and Moore's Law effects in most software development projects. Notably, twelve barriers in the industry dampen construction innovation. This results in suboptimal investment in new ideas, including software development (Stevens & Smolders 2023).

There is no standard software development process due to the differing characteristics of the organisations, products, and projects. The process is contingent on the knowledge and experience of the software research and design staff and the organisational guidelines, including the economic ones they must work within (Choi et al., 2017). In many software development firms, product managers struggle to get well-defined customer perceptions, needs and wants. Often, software value and utility validation occur after deployment. Furthermore, learning from customers is neither typically formalised nor continuous. As a result, the selection and prioritisation of utilities become suboptimal, and products are misaligned from what the customers need or want (Fabijan, 2015). Literature has established that the lack of programming management commitment has been one of the top reasons for the failure of Software Process Improvement (SPI) (Abrahamson 2000a). Their framework defines the levels of success achieved in SPI initiatives.

Agile software development is well-known for its focus on speeding project implementation by considering user requirements at stages in an iterative process (U.S. Digital Service, 2024). However, while it has succeeded in efficient programming, there is an urgent need to understand customer use, perceived value, and shortcomings. Continuous deployment delivers functional software consistently to customers while learning extemporaneously about customer usage. However, the transition towards short-cycle deployment involves several barriers (Holmstrom et al., 2012). Abrahamson (2000b) suggested five dimensions to gauge the success achieved in SPI: (1) project efficiency, (2) impact on the process user, (3) business success, (4) direct operational success and (5) process improvement fit. These were adapted from the project management literature and support Lean Construction principles.

Some implementation theories in construction management advocate a "push" strategy during which current practices must be radically changed to align with software functionality. Others advocate using well-accepted construction management planning, execution and measuring processes (Hartmann et al. 2012). Mobile Computing Apps appear to be part of the march toward better solutions for practitioners of all industries. Singularly focused individuals can author them and do not have to be integrated with other software modules (Weichbroth, 2020).

User-centred design (UCD) is a viable approach to usable software applications through comprehensive user studies (Mayhew, 1999). Compared with the agile approach, UCD outweighs the user analysis more in effectively eliciting user requirements for software engineering (Cockton et al. 2018). Given the complex and knowledge-based nature of the AECO industry, UCD is applicable for capturing essential user requirements to satisfy ICT solutions. Although the cost is higher in UCD, its cost-benefit is obvious from a long-run perspective to ensure usability (Park et al. 2022). It has been proposed that integrating UCD in agile development helps to efficiently satisfy users' requirements (Cockton et al. 2018).

Despite the cited literature, most software programs have been deemed insufficient to meet user requirements. Several comprehensive studies have been conducted to determine usability. Usability engineering lifecycle (Mayhew, 1999) provides practical guides for software engineering professionals to adopt into their ICT projects, including BIM. Moreover, the Software Usability Measurement

Inventory (SUMI) survey is specific to answering value-oriented questions. It uses 50 questions, making use of five defined subscales for a) Efficiency, b) Affect, c) Helpfulness, d) Control, and e) Learnability to query users' attitudes toward the software. The work on SUMI began in 1986 with Kirakowski, who was entrusted with a project with two objectives: examine the competence scale of the Computer User Satisfaction Inventory and create an international standardisation for a new questionnaire.

3 METHOD

The researchers created an anonymous online survey for industry professionals. Their university's Human Ethics Committee approved the instrument in all respects. Online questionnaires are administratively efficient, and anonymity is correlated with a higher percentage of honest disclosure. Our demographic questions centered on qualifications, experience, and current intensity regarding the use of ICT. This approach facilitated more thorough analysis and increased sensitivity to any inconsistencies in the data (Stantcheva 2023). Links were shared on social media such as Linkedin and The Construction Network of Building Researchers (CNBR) and internally to the researcher's student cohort, many of whom work in the industry while studying. The survey asked:

1. Nine demographics, such as position and years of experience, and software use, such as weekly hours and discipline focus.
2. Presents the practice statements and queries for each item below in none, low, medium and high
    a. The value of the practice
    b. The performance of each practice by their firm
    c. How strongly is it embedded in the firm's software
3. What practices are not in the software you are familiar with? (text response)
4. What mobile computing applications (Apps) are needed? (text response)
5. Do you have any other thoughts you would like to share? (text response)

Stevens and Smolders (2023) listed the practices below as efficacious for construction contracting operations. Stevens (2012) discovered valuable processes as perceived by the industry and their relative effect on Overhead/Project Cost efficiency.

1. *Dual Overhead Rate Application* is a methodology that precisely assigns overhead (Office G&A) costs to site labour, equipment, material, and subcontractors. This methodology is used in both project estimating and job cost reporting. Accurate costing improves Tender success and flows through to job cost and project return on investment. This reduces wasted work acquisition efforts and gives a project's construction cost.
2. *Job Sizing Adjustment*—tailoring overhead cost percentages due to the project size variation—the difference between the company's average job size and the tendered job—based on banking and industry data. Accurate costing improves Tender success and flows through to job cost and project return on investment. This reduces wasted work acquisition efforts.
3. *Predictive Tender Modelling* - a competitive practice that determines a competitor's price based on history. It utilises all the factors a constructor uses to adjust their price and systematises the process so the company does not grossly underbid. In other words, using it helps contractors leave less margin between their price and the competitors' price, predicting competitors' price and "leaving less money on the table." This improves profitability and reduces wasted work acquisition efforts.
4. *Forecasting Project Resource Demand* – limited and shared inputs such as cash, craftsperson, managers, and equipment must be placed where they produce the most benefit across the projects a constructor will build simultaneously. Forecasting from 6 weeks to 6 months ahead allows executives to ensure shared resources are available when needed. In addition, contractors

manage multiple projects at a time with limited resources. Therefore, getting more done with the same inputs positively impacts the company and its clients. This reduces wasted resources from quick decisions since planning starts six weeks in advance.

5. *Unit-Based Project Billing and Internal Reporting* – utilises a count-based number for all products installed in a building. Units include each for doors or toilets, square meters of concrete forming, cubic meters of concrete or excavation, and linear meters of handrail or coping. This allows precise progress determinations and billing calculations while encouraging quality completion of each unit. A method to estimate, cost and administrate projects more precisely. There is less conflict, especially with billing. This reduces arguments (wasted time) about physical progress and, thus, provides monthly payment justification.

6. *Task Completion Monitoring and Measuring* - all tasks to be completed are listed electronically and assigned to the employee responsible, such as planning or budgeting tasks. Construction firms may allocate many functions to the project manager for the job. Monitoring and measuring completion timeliness increases adherence. Teams build projects. Individual members complete critical tasks such as planning or procuring, which are best done in a pre-determined order. Accomplishing these tasks ultimately and timely increases multifactor productivity. This reduces wasted time and effort by keeping employees focused on critical tasks.

7. *Project Return on Investment* - a complex equation that determines the return on investment for a project using 22 factors, such as rent, equipment, payroll, client and supplier payment terms, profit, and allocated capital. These are measured against profit earned and annualised,

8. *Staff Load Balancing* – using a dozen or more factors, such as the number of duties, new clients, meetings, and project distance, to determine the relative utilisation of each staff member to ensure a relatively equal workload. People are the enablers of safety, quality, and productivity. Overloaded staff make mistakes; thus, rework negatively affects critical outputs. This keeps wasted time – the underutilisation of some employees, resulting in overburdening others – to a minimum.

9. *Calculating Organisational Multifactor Productivity Analysis*—one such as the KLEMS Model used by the Australian Bureau of Statistics. KLEMS is the same methodology standard used to determine the industry's resource efficiency. KLEMS stands for K-cash, L-labour, E-energy, M-material, and S-services. It can be a benchmark for contractors to compare against the industry in current and past years.

10. *Project Site Material Laydown Planning and Logistics* – since approximately 70% of lost time is due to material logistics factors such as delivery timing, counts, product quality and handling, this is a critical practice to improve productivity. Since approximately 70% of lost time is due to material logistics, i.e., timely delivery, counts, quality, and handling, it is critical to pre-plan onsite material storage, handling, and flow. This reduces wasted worker time and effort handling material on the job site.

The researchers utilised a Likert Scale of 1 to 5 (5 = highest) on three dimensions:

a) *Practice Value* (PV)-the process articulated is perceived to provide above-average results in four outputs: safety, quality, cost, and schedule.

b) *Firm Execution* (FE)-the firm's consistency and strength in performing the surveyed practice.

c) *Software Support* (SS)-the firm's ICT capability to organise and execute the surveyed practice.

Additionally, the survey asked respondents to indicate if they wish to receive a quarterly summary of results, which tends to boost response rates (Stantcheva 2023).

4. RESULTS

This data provided the researchers with evidence of current construction contractor software's general value and utility in work acquisition, project operations, financial management, and building information modelling.

The results show that none of the ten practices was supported significantly in the surveyed programming modules, as evidenced by our industry survey. However, for confidentiality and legal considerations, we did not disclose the names of the software packages. Most are popular with contractors and have been in the industry for five years or more.

Comparisons were made, and statistical tests were conducted. The tested practices' value (PV) is perceived higher than the firm's execution (FE) consistency and the enabling support (SS) from the respondent's software by its firm provides. See Table 3 (n=23).

Practice	PV	FE	SS	PV/|FE-PV|	PV/|SS-PV|
1	3.09	2.74	2.22	12.70%	39.22%
2	3.52	2.91	2.57	20.90%	37.29%
3	3.35	2.39	2.13	40.00%	57.14%
4	4.22	3.35	2.83	25.97%	49.23%
5	3.78	2.87	2.74	31.82%	38.10%
6	3.35	2.91	2.83	14.93%	18.46%
7	3.61	3.00	2.48	20.29%	45.61%
8	2.91	1.70	1.78	71.79%	63.41%
9	2.57	1.96	1.70	31.11%	51.28%
10	3.43	2.48	2.13	38.60%	61.22%

Table 3. Mean Ratings of Each Practice on Three Dimensions and % Comparisons

PV ranged between 2.57 and 4.22. This indicate moderate efficacy however, the average of FE was from 1.7 to 3.35 and SS between 1.70 and 2.83. The averages of the three dimensions ratings shows a relative disparity indicating relative value. Furthermore, the range of each, 1.65, 1.65 and 1.13, shows a statistically small variation and significant stability of perceptions.

The cumulative practices' rating on each dimension, i.e., Practices Value, Firm Execution, and Software Support, shows disparities. These appear to point to two dynamics: a) Firms are not executing practices they deem valuable. b) the firm's software does not support the practices at its assessed level of value. See Table 4.

Dimension	Totals	% Disparity To PV
Practice Value	33.83	NA
Firm Execution	26.30	-28.60%
Software Support	23.39	-44.61%

Table 4. Cumulative Rating on Each Dimension – All Surveys

Best practices are assessed more critically by experienced professionals regardless of industry. The researchers deem these survey participants to be more aware of practice value. The ratings from those who self-disclosed their experience of 20 years or more in the construction industry were significantly lower (27.33 versus 33.83). See Table 5.

Dimension	Totals	% Disparity To PV
Practice Value (PV)	27.33	NA
Firm Execution	21.33	-28.15%
Software Support	18.50	-47.75%

Table 5. Respondents with 20 Years or More Industry Experience

Those with high software familiarity found the disparity between software and its practice support even greater than the study average. These respondents use their firm's software for an average of 25 hours or more a week, rated enablement lower than the average (21.73 versus 23.39). This cohort is one that confirms the gap hypothessed. See Table 6.

Dimension	Totals	% Disparity To PV
Practice Value	32.53	NA
Firm Execution	25.25	-28.84%
Software Support	21.73	-49.69%

Table 6. Respondents who average 25 Hours of More Working with the Firm's Software

5. DISCUSSION

This paper's selection of effective practices represents critical contractor operational functions such as work acquisition, project operations, and financial management. Thus, the software brands investigated were more than one type. Since the perceived differences appeared consistently across this specialised software, there is credible evidence of the gap hypothesised. The researchers selected these practices based on their project manager and consultant experience.

Software businesses, in general, are economically oriented, like most for-profit organisations. They appear to be falling short of providing efficacy and, thus, value. Their construction clients seem to have found "workarounds" to perceived gaps. In the short term, this paper asserts that reprogramming is needed for the construction industry's ICT to support proven practices. In the long term, a robust research process appears required in order to document contractor best practices for consumption by construction professionals, including software developers.

Focusing software programming on construction contracting firms' overall operational practices is a slight departure from the project orientation that has been a consistent trend in academia and ICT. This paper asserts that the construction organisation is an enabler of the project outcomes. Critically, the contracting firm supports the project team, i.e., with office personnel assistance, their experience, coordination of company assets, and enforcing contract terms and conditions. Project teams can be likened to residing on an island where the limits of resources are constrained to the area they occupy. The corporation's members can connect the project team to capable resources, making task completion safer, faster, and higher quality. So, systematising company-wide practices with the support of ICT can minimise or eliminate stubborn problems such as efficient resource allocation. Software developers should be incentivised to fill the hypothesised gaps with increased sales.

Utilising low-code spreadsheets can achieve profitable standardisation and automation. Some SME contractors rely on customising computer spreadsheets to calculate the supporting information needed to execute some practices. In contrast, others are unaware of the methods or have not taken this additional step. Software developers can improve this apparent inconsistent application and execution by creating interfaces that raise sufficient practice use levels. However, some need to know more about best practices before programming.

Lastly, this previously documented gap in most software (all industries) raises the question, "What else has been overlooked in the programming of construction software?" The researchers sense that an association-sponsored panel for each construction segment is needed. It might formally report on best practices to enlighten the industry and software developers.

6 CONCLUSIONS AND RECOMMENDATIONS

This paper delved into a widespread misalignment problem in construction contracting with computer software, examining its underlying causes, consequences, and potential remedies. The study established that misalignment in construction contracting arises from conflicting stakeholder goals, varying interpretations of contractual terms, and limited flexibility to accommodate changing project dynamics. Such misalignments frequently result in disputes, operational inefficiencies, and chaotic project completions, emphasising the urgent need for strategic intervention to address these challenges and enhance contract management practices. The industry survey data highlighted best practices focused on fostering transparent communication, promoting fair distribution of risks, and utilising standardised frameworks. Although these approaches effectively mitigate certain aspects of misalignment, their implementation is often constrained by organisational dynamics and cultural challenges.

Moreover, digital tools and advancements in constructor-centric software offer considerable potential to address these challenges by streamlining contract processes, enhancing stakeholder cooperation, and improving compliance oversight. Contracting software has the potential to solve the industry's stubborn problems, such as disproportionately high bankruptcy rates, low profitability, and stagnant multifactor productivity. There are many sources of these issues; however, this paper asserts that tailoring construction software to enable effective practices could lessen these problems.

The study hypothesised that a substantial gap exists between most construction software modules and well-accepted practices. This assertion appears credible. The survey analysis found a significant blind spot in the industry. Furthermore, academics studying the construction software industry have found it chaotic, and its firms choose commercial priorities, such as revenue generation. Finally, the practices articulated in the survey have existed for decades and are considered valuable by many industry professionals, showing a blind spot for programmers they should realise.

Adopting supporting modules for the ten practices list would be a modest start to improvement. Subsequently, intense conversations and other information-gathering approaches would discover and confirm processes that contractors believe are best. Developers should create APIs to add to their offerings. ICT salespeople and trainers should be educated in contractor practices, their effects, and how their software enhances execution.

Professional associations and governmental authorities should pursue “nudge” policies that add to the knowledge systems, intellectual property and technological capability to the construction industry and its software partners. Engaging these two industries can only result in fewer blindspots, iterative innovation and, at times, breakthroughs benefitting both parties. This ultimately would improve the built environment and the world’s quality of life.

By their nature, researchers are interested in future possibilities. However, some backfilling is necessary in construction ICT to increase safety, reduce waste, and produce more value. Of course, realising the software’s full potential now helps future stakeholders maximise new technologies such as AI and Quantum Computing. Also, developers that capture and systematise contractor practices best can grow their revenue. The researchers’ future investigation should include a) collecting and articulating better construction processes, b) a deeper exploration of the software’s indirect effect on best practice adoption, and c) life cycle cost against business benefit.

7 REFERENCES

Abrahamsson, P. (2000a) 'Is management commitment a necessity after all in software process improvement?' Proceedings of the 26th Euromicro Conference. EUROMICRO 2000. Informatics: Inventing the Future, pp. 246-253 vol.2, httpsdoi: 10.1109/EURMIC.2000.874425.¥

Abrahamsson, P, (2000b). Measuring The Success of Software Process Improvement: The Dimensions. Eurospi'00, Copenhagen, Denmark. https://doi.org/10.48550/arXiv.1309.4645

Adwan, E. & Al-Soufi, A. (2016) A Review of ICT Technology in Construction (November 22, 2016). International Journal of Managing Information Technology (IJMIT) Vol.8, No.3/4, Available at SSRN: https://doi.org/ssrn.com/abstract=3237181

Ahuja, H. N., Dozzi, S.P.and AbouRizk. S.M. (1994). Project management: Techniques in planning and controlling construction projects. New York: Wiley

Andújar-Montoya, M., Galiano-Garrigos, A., Echarri-Iribarren, V., & Rizo-Maestre, C. BIM-LEAN as a methodology to save execution costs in building construction-An experience under the Spanish framework, Appl. Sci. (Switz.) 10 (6) (2020) 1–21, https://doi.org/10.3390/app10061913 .

Australian Bureau of Statistics (ABS) (2024) Job vacancies, change from February 2020 to August 2024, industry, original.

Australian Bureau of Statistics (AB3) (2022) TABLE 02. Value of Construction Work Done, by Sector, Current Prices, Australia. 8755.0 Construction Work Done, Australia, Preliminary.

Australian Bureau of Statistics (ABS) (2023) Table 2 Process innovation, industry by employment size – 2 years ended 30 June 2021. Data Table 81580DO004_202021 Characteristics of Australian Business, 2020-21, Businesses that introduced any new or significantly improved (methods).

Australian Securities and Investment Commission (ASIC) (2023) ASIC Insolvency Statistics Series 3.1. Accessed July 13, 2023.

Australian Bureau of Statistics (ABS) (2022), '8165.0 Counts of Australian Businesses, including Entries and Exits, June 2017 to June 2022'

Bamgbose, O. A., Ogunbayo, B. F., & Aigbavboa, C. O. (2024). Barriers to Building Information Modelling Adoption in Small and Medium Enterprises: Nigerian Construction Industry Perspectives. Buildings, 14(2), 538. https://doi.org/10.3390/buildings14020538

Choi, S., Kim, S., & Kim, J. (2017). A Technique Identifying Reusable Software R&D Process Assets for Software Process Tailoring. International Information Institute (Tokyo). Information, 20(10B), 7857-7864.

Clermont, S., Lefebvre, G. and Boton. C. (2020). "Understanding the diffusion of building information modeling among contractor SMEs in the Quebec construction industry." In Proc. of the 38th Int. Con. of CIB W78, 762–772. Luxembourg: Luxembourg Institute of Science and Technology.

Cockton, G., Lárusdóttir, M., Gregory, P., Cajander, Å. (2018). Integrating User-Centred Design in Agile Development. Springer International Publishing. ISBN:9783319812113, 3319812114

Dave, B., Kubler, S., Främling, K., & Koskela, L., (2016). Opportunities for enhanced construction management using Internet of Things standards. Automation in Construction, Volume 61, Pages 86-97, ISSN 0926 5805, https://doi.org/10.1016/j.autcon.2015.10.009 .

Dubois, A., & Gadde, L. (2002). The construction industry as a loosely coupled system: Implications for productivity and innovation. Construction Management and Economics, 20(7), 621-631. https://doi:10.1080/01446190210163543

Fabijan, A., Olsson, H.H., Bosch, J. (2015). Customer Feedback and Data Collection Techniques in Software R&D: A Literature Review. In: Fernandes, J., Machado, R., Wnuk, K. (eds) Software Business. ICSOB 2015. Lecture Notes in Business Information Processing, vol 210. Springer, Cham. https://doi.org/10.1007/978-3-319-19593-3_12

Faghihi, V., Nejat, A., Reinschmidt, K. & Kang, J. (2015). Automation in construction scheduling: a review of the literature, Int. J. Adv. Manuf. Technol. 81 (9–12)1845–1856, https://doi.org/10.1007/s00170-015-7339-0 .

Hartmann, T., Van Meerveld, H., Vossebeld, N., & Adriaanse, A. (2012). Aligning building information model tools and construction management methods. Automation in construction, 22, 605-613.

Holmström Olsson, H., Alahyari, H., Bosch, J. (2012). Chapter 1 Climbing the Stairway to Heaven. In: Bosch, J., Carlson, J., Holmström Olsson, H., Sandahl, K., Staron, M. (eds) Accelerating Digital Transformation. Springer, Cham. https://doi.org/10.1007/978-3-031-10873-0_2

Kalsaas, B. T., & Sacks, R. (2011). Conceptualization of interdependency and coordination between construction tasks. Proceedings of the IGLC-19. Lima, Peru.

Lasni, A., & Boton, C. (2022). Implementing construction planning and control software: A specialised contractor perspective. Journal of Construction Engineering and Management, 148(9) http://doi:10.1061/(ASCE)CO.1943-7862.0002330

Matt, D.T., and Rauch, E. (2014). Implementing lean in engineer-to-order manufacturing, in V. Modrak, P. Semanˇco (Eds.), Handbook of Research on Design and Management of Lean Production Systems, IGI Global, 2014, pp. 148–172, https://doi.org/ 10.4018/978-1-4666-5039-8.ch008

Mayhew, D., J. (1999). The Usability Engineering Lifecycle: A Practitioner's Handbook for User Interface Design (Interactive Technologies), 1st Edition. Morgan Kaufmann. ISBN-13 978-1558605619

McKinsey and Company (2023) From start-up to scale-up: Accelerating growth in construction technology. Accessed November November 28, 2024. https://www.mckinsey.com/industries/private-capital/our-insights/from-start-up-to-scale-up-accelerating-growth-in-construction-technology

McNamara, AJ, Shirowzhan, S & M.E. Sepasgozar, S (2022). Investigating the determents of intelligent construction contract adoption: a refinement of the technology readiness index to inform an integrated technology acceptance model, Construction Innovation, DOI 10.1108/ci-10-2021-0191.

Ogunbayo, B. F. & Aigbavboa, C.O. Ahmed S. and Stevens M., "Assessing Monitoring and Evaluation Effectiveness for Projects in the Construction Industry," 2024 International Conference on Science, Engineering and Business for Driving Sustainable Development Goals (SEB4SDG), Omu-Aran, Nigeria, 2024, pp. 1-10, https://doi.org/10.1109/SEB4SDG60871.2024.10630084

Őri, D., & Szabó, Z. (2024). A systematic literature review on business-IT misalignment research. Information Systems and e-Business Management, 1-31. https://doi.org/10.1007/s10257-023-00664-w

Sande, J. B., & Haugland, S. A. (2015). Strategic performance effects of misaligned formal contracting: The mediating role of relational contracting. International Journal of Research in Marketing, 32(2), 187-194. https://doi.org/10.1016/j.ijresmar.2015.02.002

SCOPUS (2024). 'SCOPUS: Empowering discovery since 2004' Accessed November 24, 2024. https://www-scopus-com.ezproxy.uws.edu.au/search/form.uri?display=basic#basic

Solli-Sæther, H., Karlsen, J. T., & van Oorschot, K. (2015). Strategic and cultural misalignment: Knowledge sharing barriers in project networks. Project Management Journal, 46(3), 49-60. https://doi.org/10.1002/pmj.21501

Stantcheva, S. (2023). How to run surveys: A guide to creating your own identifying variation and revealing the invisible. Annual Review of Economics, 15(1), 205-234.

Stevens, M. (2012) The Impact Of 154 Selected Practices On Overhead Efficiency For Specialty Construction Contractors. Doctoral Dissertation. University of Florida, Gainesville.

Stevens, M. & Smolders J. (2023). Understanding Australian Construction Contractors: A guide for emerging professionals. Routledge. London.

Weichbroth, P. (2020). "Usability of Mobile Applications: A Systematic Literature Study," IEEE Access, vol. 8, pp. 55563-55577, 2020, doi: 10.1109/ACCESS.2020.2981892 .

Wu, J. W., Tseng, J.C. Yu, W.D., Yang, J.B., Lee, S.M., and Tsai, W.N. (2012). "An integrated, proactive knowledge management model for enhancing engineering services." Autom. Constr. 24 (Jul): 81–88. https://doiorg.ezproxy.uws.edu.au/10.1016/j.autcon.2012.02.006.

Ye, X., Zeng, N., & König, M. (2022). Systematic literature review on smart contracts in the construction industry: Potentials, benefits, and challenges. Frontiers of engineering management, 9(2), 196-213. https://doi.org/10.1007/s42524-022-0188-2

U.S. Bureau of Labor Statistics (USBLS) (n.d.) Industries at a Glance. Accessed July 9, 2023. https://www.bls.gov/iag/tgs/iag06.htm

U.S. Digital Service. (2024). What is Agile Software Development | TechFAR Hub Handbook | USDS.gov. [online] Available at: https://techfarhub.usds.gov/pre-solicitation/agile-overview/. Accessed 27/Nov/2024