

## Hunting the Popular Construction Apps

Tong Liu<sup>1\*</sup>, Anuradha Mathrani<sup>1</sup>, Jasper Mbachu<sup>2</sup>

<sup>1</sup> Institute of Natural and Mathematical Sciences

<sup>2</sup>School of Engineering and Advanced Technology  
Auckland, New Zealand

\*t.liu@massey.ac.nz

**Abstract**—Mobile computing offers several benefits which could help construction workers improve efficiency and productivity. However, the uptake of the technology is quite low in the industry, with little research on key constraint factors and the priority needs of the construction workforce. This study aimed to achieve three key objectives: 1) to identify the smartphone operating systems used by construction workers; 2) to identify barriers to greater uptake of mobile app technology in New Zealand Construction Industry; and 3) to determine the popularity of construction apps and their key features. Through interview-based exploratory survey method, feedback received from members of the Registered Master Builders Association of New Zealand was analyzed using content analysis and descriptive statistics methods. Results showed that 70% of the smart phones used by construction workers were based on iPhone's iOS, while 28% were based on Android platform, with other platforms having a small market share. Six factors were found to constrain the uptake of mobile apps in the industry, the most influential being cost of software and licensing. Findings in relation to the popular apps and their key features showed that PlanGrid – a cloud-based project collaboration and management system – was the most popular with a rating of 5/5. Others included JobFlex – an estimating and tendering software, Procore – used for project management, and SmartBidNet – used for bid management. The findings could help app developers understand the specific needs of construction workers, and improve wider uptake of mobile apps in the industry.

**Keywords**—construction industry; smartphone; apps; smartphone app; mobile apps; productivity; project management; smart phone; mobile phone

### I. INTRODUCTION

The use of information and communication technologies (ICT) in construction industry has become increasingly popular. Previous researches prove that ICT can improve productivity [1-3]. The advances in mobile computing has changed everyday lives and pervaded into our busy professional lives. Professional work environments are pluralistic and comprise of social, communal, technological, mathematical, managerial and governmental sides amongst others, where different levels of information are required. The construction workers (CWs) professional workspace is mainly at building sites which are not confined to a specific office location. Hence, mobile computing offers CWs a quick and simple platform, devoid of technical details, to help them communicate relevant on-site information to other stakeholders situated in different location sites. Moreover

mobile devices offer targeted communication, whereby messages delivered are in a straight and concise format between the user and the mobile device (e.g., smartphone, tablet, PDA) without the extra frills (like big file size, report headers, etc.) as are present in computer based applications.

An *app* is an application (or software program) developed to run on smart phones. As of July 2015, there were 1.5 million Apple's apps and 1.6 million Android apps and available for download in leading App stores. These numbers are increasing rapidly with Android apps having increased to 2 million by February 2016 [4]. This trend is expected to grow, and this year alone (i.e., 2016), about 63% of population worldwide are using mobile phones [4]. With almost three-quarters of all adult New Zealanders owning smart phones, this offers us an excellent opportunity to explore adoption and selection of apps by CWs.

The aim of this study was to achieve three key objectives as follows: (1) to identify the smartphone operating systems used by construction workers; (2) to identify challenges in relation to greater uptake of smartphone app technology in New Zealand Construction Industry; and (3) to identify the popular apps for a construction worker and their key features. This section has laid the background of this study and stated the research objectives. The next section discusses relevant literature on current scope of the construction sector within New Zealand, existing mobile technologies and barriers towards adoption of these technologies in the construction sector. We discuss our research design next, which involved interviews with CWs who are members of RMANZ (Registered Masters Builder Association of New Zealand). The findings from the interviews revealing a general lack of awareness by CWs regarding current popular apps used within construction sector are discussed next. These findings led us then to conduct a global web search to explore current apps dominating the construction sector domain. We present the results from our global web search next. Finally we propose some recommendations on how we can help CWs identify popular apps within their workspace context. This study gives a much needed view on the hows and whys regarding selection of smartphone apps in the professional work environment of a construction worker.

### II. LITERATURE REVIEW

The construction sector is the fifth largest sector in the New Zealand economy and a key driver of economic growth in New Zealand. The annual revenues from this industry sector are over \$30 billion [5]. Currently, one in 12 jobs in

New Zealand is in construction, and almost 194,000 people are employed in the sector [5]. While it is acknowledged that construction industry is a rather labour intensive [5], the productivity within this sector is still low and the New Zealand Government has identified productivity growth as a priority [5, 6].

The use of smart phone can provide more opportunities for faster data collection and thereby improve efficiency [7]. Smart phones can increase productivity by reducing the time spent on support functions [8]. It is estimated that there may be nearly 13,000 construction, development and design related apps presently on the market [9]. The available construction industry related smartphone apps range from simple calculations to detailed architectural renderings [10]. Here listed are typical areas of utilization of smartphone apps as part of construction SMEs' routine business or jobsite operations:

- Quality Management,
- Subcontractor Management,
- Health and Safety Management,
- Productivity and Performance Management,
- Customer Relations Management
- Project Planning, Scheduling and Coordination,
- Procurement and Tender Management,
- Budgeting, Estimating, Cash Flow and Cost Management,
- Contract Management
- CAD, BIM and Drawing Documentation,
- Document Control and Record Keeping
- Logistics and Supply Management, including GPS Tracking

Previous researches in construction field have been limited, mainly confined to areas such as (1) Building information modelling (BIM), which is a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle [11-18], (2) Use of mobiles for information management on construction sites [19], (3) Application of mobiles technologies in construction processes, like CAD Data visualization [20], security and safety of wireless network [21], construction defect management[22] and construction activity monitoring system [23], and (4) Impact of apps/ICT in construction industry in two African countries [24, 25]. Despite increasing proliferation of apps within the construction industry, the visibility of popular construction apps is not much. How do construction workers choose their smartphone apps? How can they be made aware of popular apps adopted in their sector? Hence, this has provided us an opportunity to explore both the visibility and awareness of popular apps in the current New Zealand Construction industry sector.

Table I shows examples of apps used in areas such as project management, calculators, CAD, design, drawing, or making estimations on a construction site.

TABLE I. EXAMPLES OF CONSTRUCTION APPS

Functional Area	Construction Apps
Project Management	Fieldwire BuilderTREND Fieldlens for Construction Procure PlanGrid – for Construction Co-construct
Calculators	Handyman Calculator Handy Construction Calculator Constructing Calculator Construction Calc Pro Construction Calculator
Safety	Safety App Zero Harm Core Safety CCS Safety 2.0
Integrated Construction Cost & Accounting	CostCon Xero MYOB CatGroup Viewpoint
Construction Site Operations	Bubble Level Raken Daily Reporting Clinometer + bubble level Construction Daily Log App Construction Manager
CAD, Design and Drawing	DWG FastView-CAD Plan Viewer Home Design 3D - FREEMIUM AutoCAD 360 Floor Plan Creator CAD Touch Free
Estimating	Construction Estimator Material Estimator Calculator Civil Quantity Estimator Building Materials Calculators Construction Estimator App

### III. METHOD

Exploratory survey method was adopted for the study. The choice of this research method was justified on two grounds. Firstly, exploratory surveys are suitable for research where the aim is to generate constructs or theories which will be validated in future quantitative research [26]. Secondly, the method is suitable for empirical data that are qualitative in nature and for which scale of measurement is ordinal [27]. The sampling frame for the data gathering comprised interviews from 14 members from the Registered Master Builders Association of New Zealand which has over three thousand members. Empirical data were analysed using content analysis and descriptive statistics method [28].

### IV. RESULTS AND DISCUSSIONS

The exploratory nature of the study meant, we wanted to first capture characteristics of the smart phones used and the overall business settings. Interviewees were asked the type of smart phones they utilized for their business so the operating systems or platforms could be deduced. Our study found 70% of the smart phones ran on iPhone's iOS, while 28% ran on Android operating system (OS). Thus iPhone and Android phones are dominant over other phones among CWs in New Zealand. Interviewees were asked to comment on

potential barriers to the adoption of smartphone apps in the New Zealand construction industry. Their responses indicated that none of construction professionals consider cost of the phone or maintenance to be issues at all (refer Figure 1). Moreover, majority (60%) did not think that cyber security, connectivity or cost of customization to be issues either. However, over half of CWs said that the cost of getting adequate training and purchasing the right software and subsequent licensing fees to have some impact on the use (or on the lack of use) of apps in their sector.

According to JBKnowledge, 40% of construction companies do not have a dedicated IT department [29]. New Zealand construction sector are predominately small and medium-sized enterprises, which has less than 20 employees [5] [30]. It would be an expensive cost for a small or medium-sized New Zealand construction company to have an IT department. Without proper IT support, choosing appropriate apps would not be an easy task for a construction worker. When the interviewees were asked about how they choose the apps, 50% interviewees said they don't know, 43% interviewees use search engines, and 29% interviewees choose apps through training or word of mouth. There are millions apps which are available free of cost. If these apps are designed in a user friendly manner allowing for ease of use, then training cost will not be considered an issue.

In relation to the third objective of identifying popular apps for a construction worker and their key features, interviewees seemed not to have knowledge of other available apps in the industry. In order to augment the empirical information, we conducted a search on Google to find the most popular apps and their key features. Mobile-broadband penetration levels are about 86.7% in developed

countries [31]. Google partnered with Nielsen used surveys and metered data to understand customers' mobile habits. They found that consumers are spending time researching on their smartphones (15+ hours a week) and their research starts with a search engine [32]. Search is a driver of app discovery, and 1 in 4 app users discover apps through search engines [33]. 43% technology apps are discovered through search engines [33]. Recommendations and interest/fun level are top reasons to download apps [33]. A search on "best construction apps" listed 9 recommender websites which further made 519 app recommendations.

The breakups of these apps are as follows:

- Capterra (a web service founded in 1999 connecting buyers and sellers of business software) listed 237 apps [34].
- Software Advice (a company that provides research and user reviews on software applications for small and mid-sized businesses in markets ) listed 185 apps [35].
- SmartBidNet (a construction bid software product for commercial general contractors, one of the JBKNOWLEDGE technology solutions for construction and insurance) listed 20 apps [36]
- The Daily Reporter (a publishing company which provides Wisconsin business, construction and development news) listed a total of 44 apps over 4 years (16 apps in 2016 [37], 15 apps in 2015 [38], 14 apps in 2014 [9] and 13 apps in 2013 [39]).
- The balance (a company provides financial advice ) listed 10 apps [40]
- tSheets (a software company ) listed 9 apps [41].

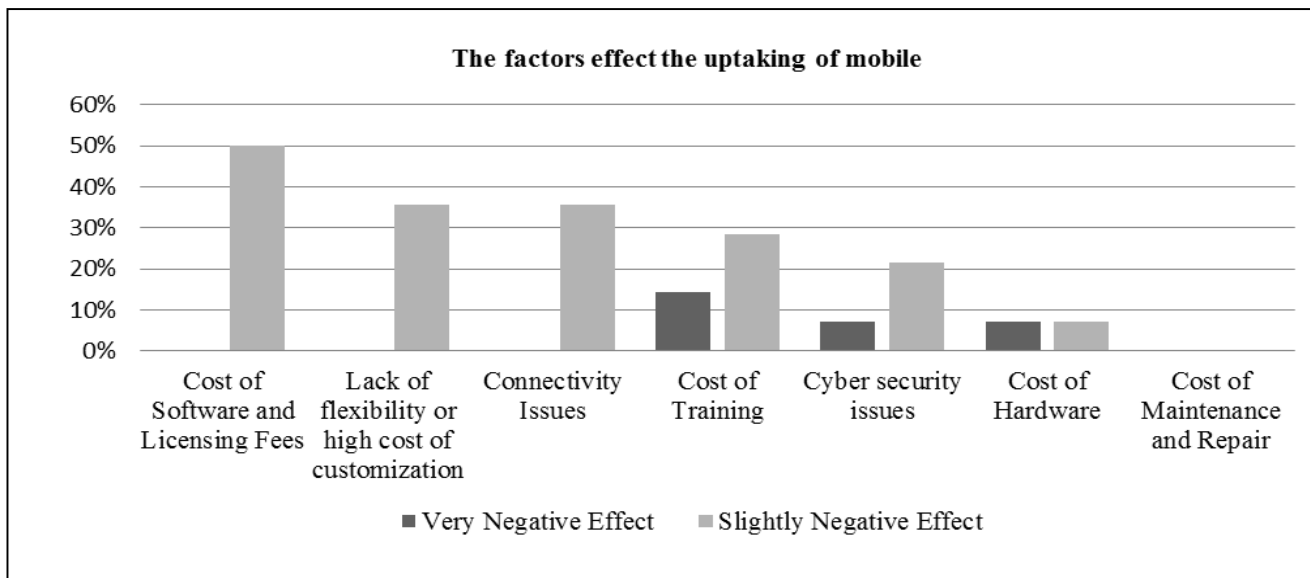


Figure 1. The possible barriers for adopting of apps

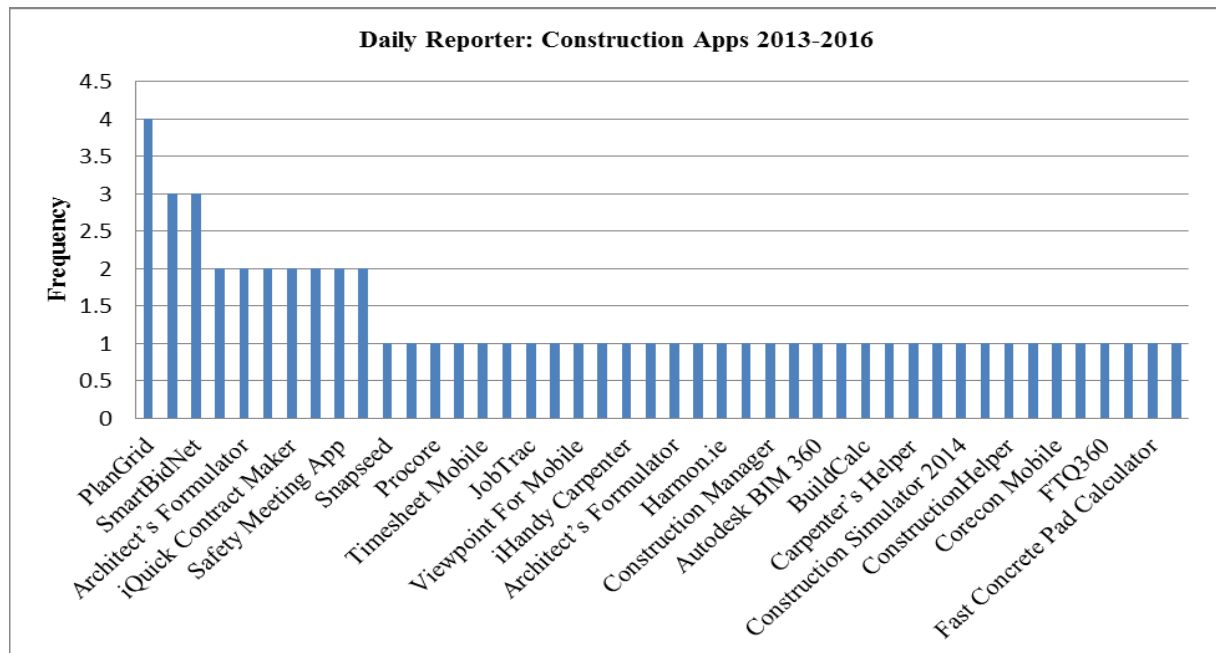


Figure 2. The Daily Reporter Recommended Construction apps from 2013 to 2016

In order to find the extent of changes in construction apps over the years, we first investigated the 44 apps which have been recommended by Daily Reporter website since 2013. An interesting snapshot of apps lifecycle was revealed. We found that 2% apps have been on the list for the last four years, 5% apps for the last three years and 16% apps for two years. We realised that not many good apps are recommended continuously for last four years (see Figure 2). A further search on 5 other different websites recommending construction apps along with the 2016 Daily Reporter recommendation revealed 479 apps (see word cloud in

comprising 479 apps further exposed the search results to be disjointed having zero to minimal commonality. There seemed to be no standard selection criteria among the apps from the recommender websites. We found nil percentages of overlap among recommended apps from all six and five websites, only 0.6% overlap among recommendations from 4 websites and 0.8% overlap among recommendations from 3 websites. Among these total 479 apps, only four apps (SmartBidNet, PlanGrid, Procure and JobFLEX) have been found to be recommended by more than two websites (see in Figure. 3).



Figure 3. Word cloud of recommended construction apps

Seeing such disjointed recommendations spurred us further to conduct a search using Google Play which is the official app store for Android smartphones and tablets. This revealed yet another completely different dataset of apps (i.e., Fieldwire, Handyman, Construction Estimator, Construction Estimator App and Construction Estimator) in its top 5 list (Figure 5) [42]. Most importantly, the 4 apps (Figure 4) by recommender websites were found to be not the same as the top search results from the official Android website (Figure 5).

Table II makes detailed comparisons of the 4 apps by recommender websites. As shown in Table II, the common features across these apps are listed next. (1) Cloud-based, so apps can be accessed anywhere. (2) Apps are available in iOS and/or Android platforms, which are the most common mobile platforms, (3) Apps usually have more than one version and which have been recently updated. Making regular updates helps to improve the quality of apps. An empirical study of frequently updated Android apps shows that users rank frequently-updated apps highly [43], while another research views that developers are constantly working towards improving their app designs [44]. (4) A rating around 4 or higher is preferred. ThinkWithGoogle found that 60% customers care about rating of apps [33].

Finally, it was also revealed that only 4 of the 27 apps (namely, My Inspection, iauditor, Bimx, LocknLoadHub, BuilderTrend, Basecamp, Workflow max, etc.) mentioned by the New Zealand interviewees were listed in the global search results. This could be due to the fact that some of these apps are localized within a specific country's environmental and business context (e.g., My Inspection from Auckland City Council or Xero Accounting Software)

However, construction workers in our study were found not to be using construction related apps extensively, leading us to speculate that training sessions may be needed for them.

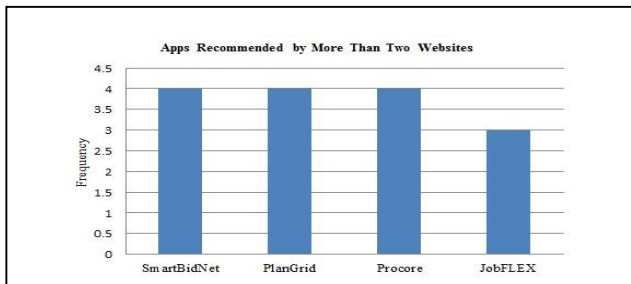


Figure 4. Apps recommended by more than two sites

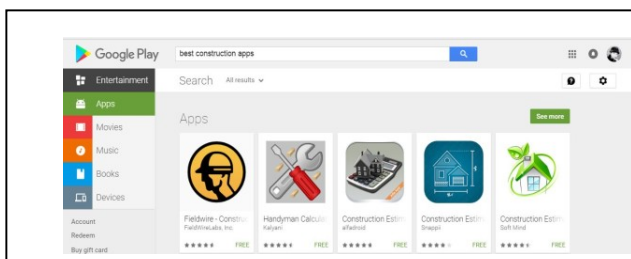


Figure 5. Results from Google Play

## V. CONCLUSIONS

This research has investigated smartphone operating systems used by construction workers, the challenges or barriers to greater uptake of mobile app technology in New Zealand Construction Industry; and the popular apps used by construction workers and their key features. Results showed that 70% of the smart phones were based on iPhone's iOS, while 28% were based on Android platform, with other platforms such as Blackberry OS, Windows OS and HP WebOs having small market share in the New Zealand construction work force.

Six factors were found to constrain the uptake of mobile apps in the industry; in diminishing order of mentions, these comprised cost of software and licensing (50%), inflexibility or user-interface issues (36%), connectivity issues (36%), cost of training (29%), cyber security issues (21%), and cost of hardware (7%). None of the interviewees believed that cost of maintenance was an issue.

Findings in relation to the most popular apps and their key features showed that PlanGrid was the most popular with a rating of 5/5. This cloud-based project collaboration management system operated mostly on iOS. JobFlex, a cloud-based estimating and tendering software was second most popular with a rating of 4.5/5. Procore, a project management software was the next in popularity with a rating of 4.3/5, while SmartBidNet – a cloud-based bid management system received the least rating of 3.8/5 for its Android-based version and 4/5 for the iOS version.

It could be concluded that New Zealand construction industry has a generally positive attitude towards adoption of smartphone phone apps. Though there are a huge number of apps in the market, but a common criterion is lacking for recommendation of apps suitable for construction business. Hence, selection of apps has become a rather difficult task. It is hoped that our findings will help app developers gather some ideas in regard to making their apps more popular. This study has illustrated the discrepancies across recommender websites regarding popular construction apps. Moving forward, we intend to build a schematic representation (or framework) identifying features and functionalities in app designs so as to provide a guide to construction workers and developers classify apps as popular in the current changing ICT workspace. ThinkWithGoogle found 52% of apps are discovered by friends, family, and colleagues [33]. This reiterates the need for promoting apps by targeting the right customers in the construction sector, and helping them in their hunt for popular Construction apps.

TABLE II. Features of Highly Recommended

Apps	Recommended apps							
	Description	Cloud-based	Platform	Rating	Review	Last Updated	Version	Price
SmartBidNet	Bid management system	Yes	iOS 6.0 or later	4	9	26-Aug-2016	3.4	Paid account
			Android: 4.0.3 and up	3.8	13	14-Oct-2016	3.5	Paid account
PlanGrid	Project collaboration management	Yes	iOS 9.0 or later	5	3164	12-Oct-2016	4.04	\$29.99
			Android; 4.0.3 and up,	4.2	1789	9-Sept-2016	1.14.1	\$1.17 - \$207 per item
Procore	Project management	Yes	OS 8.0 or later			15-Oct-2016	6.1.2	Free
			Android: 4.1 and up, web-based	4.3	174	17-Oct-2016	6.4.7	Free
JobFlex	Quoting and Estimating software	Yes	Web-based	4.5	228	30-Sept-2016	8.0.195	\$0 - \$ 39

## REFERENCES

- [1] V. Peansupap and D. Walker, "Factors affecting ICT diffusion: a case study of three large Australian construction contractors," *Engineering, Construction and Architectural Management*, vol. 12, pp. 21-37, 2005.
- [2] D. Walker and K. Hampson, *Procurement strategies: A relationship-based approach*: John Wiley & Sons, 2008.
- [3] D. Pilat and F. C. Lee, "Productivity Growth in ICT-producing and ICT-using Industries," 2001.
- [4] statista. (2016, Oct 10, 2016). Mobile phone user penetration as percentage of the population worldwide from 2013 to 2019\*. Available: <https://www.statista.com/statistics/470018/mobile-phone-user-penetration-worldwide/>
- [5] Ministry of Business, Innovation & Employment, "Construction in New Zealand," 2015.
- [6] The University Of Auckland, "Identifying Canterbury Rebuild Project KPI's – Baseline Report," 2012.
- [7] S. Bowden, A. Dorr, A. Thorpe, C. Anumba, and P. Gooding, "Making the case for mobile IT in construction," in *International Conference on Computing in Civil Engineering*. L. Soibelman & F. Pena-Mora, eds., ASCE, 2005.
- [8] C. T. Haas, R. L. Tucker, K. S. Saidi, and N. A. Balli, "The value of handheld computers in construction," *A report of Centre for Construction Industry Studies, the University of Texas*, 2002.
- [9] J. Yovino. (2013, Oct 10, 2016). 14 construction apps for 2014. Available: <http://dailyreporter.com/2013/12/27/14-construction-apps-for-2014/>
- [10] Top Apps. (2013, May 14). Top Android Apps for Construction Industry. Available: <http://www.topapps.net/android/top-android-apps-for-construction-industry.html/>
- [11] B. Succar, "The five components of BIM performance measurement," in *CIB World Congress*, 2010.
- [12] J. Park, Y. Cho, and K. Kim, "Field construction management application through mobile BIM and location tracking technology," in *Proc., 33rd Int. Symp. on Automation and Robotics in Construction and Mining (ISARC 2016)*, International Association for Automation and Robotics in Construction (IAARC), Auburn, AL, 2016.
- [13] R. Eadie, M. Browne, H. Odeyinka, C. McKeown, and S. McNiff, "BIM implementation throughout the UK construction project lifecycle: An analysis," *Automation in Construction*, vol. 36, pp. 145-151, 2013.
- [14] B. Yoo, H. Yoon, Y. Kim, and K. M. Lee, "Stepwise Application of BIM-based Parametric Modeling to Tapered Slip-Form System," *Procedia Engineering*, vol. 145, pp. 112-119, 2016.
- [15] C. Eastman, C. M. Eastman, P. Teicholz, R. Sacks, and K. Liston, *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*: John Wiley & Sons, 2011.
- [16] R. Issa and P. Suermann, "Evaluating industry perceptions of building information modeling (BIM) impact on construction," *J. Inf. Technol. Constr.*, vol. 14, pp. 574-594, 2009.
- [17] B. Succar, "Building information modelling framework: A research and delivery foundation for industry stakeholders," *Automation in construction*, vol. 18, pp. 357-375, 2009.
- [18] H. Penttilä, "Describing the changes in architectural information technology to understand design complexity and free-form architectural expression," ed: ITcon, 2006.
- [19] Y. Chen and J. M. Kamara, "A framework for using mobile computing for information management on construction sites," *Automation in Construction*, vol. 20, pp. 776-788, 2011.
- [20] S. W. Yang, Y. Choi, and H. C. Lee, "CAD data visualization on mobile devices using sequential constrained Delaunay triangulation," *Computer-Aided Design*, vol. 41, pp. 375-384, 2009.
- [21] R. Strachan and P. Stephenson, "Futuristic construction communication infrastructures: secure and safe with no wires," *Journal of Information Technology in Construction*, vol. 14, pp. 526-539, 2009.
- [22] A. Dong, M. L. Maher, M. J. Kim, N. Gu, and X. Wang, "Construction defect management using a telematic digital workbench," *Automation in Construction*, vol. 18, pp. 814-824, 2009.
- [23] D. Rebolj, N. Č. Babič, A. Magdič, P. Podbreznik, and M. Pšunder, "Automated construction activity monitoring system," *Advanced engineering informatics*, vol. 22, pp. 493-503, 2008.
- [24] Y. J. Ekow and O. G. Kofi, "Awareness and Utilization of Construction Related Smart Mobile Device Applications in the Construction Industry," *Science and Technology*, vol. 6, pp. 1-7, 2016.
- [25] D. I. Ikediashi, A. C. Ogwueleka, and T. Haupt, "Assessing the use of ICT systems and their impact on construction project performance in the Nigerian construction industry," *Journal of Engineering, Design and Technology*, vol. 14, 2016.
- [26] W. G. Zikmund, B. J. Babin, J. C. Carr, and M. Griffin, *Business research methods*: Cengage Learning, 2013.
- [27] A. Bryman and E. Bell, *Business research methods*: Oxford University Press, USA, 2015.

- [28] IBM Corporation. (2015). Statistical package for the social sciences (SPSS). Available: <http://www.ibm.com/analytics/us/en/technology/spss/>
- [29] JBKNOWLEDGE. TEchnology Solutions For Construction & Insurance. Available: <http://jbknowledge.com/>
- [30] Ministry of Economic Development, "SMEs in New Zealand: Structure and Dynamics 2011," 2011.
- [31] D. Chaffey. (2016). The best digital marketing statistics sources in 2016? Available: <http://www.smartinsights.com/marketplace-analysis/customer-analysis/digital-marketing-statistics-sources/>
- [32] Nielsen and Google. (2013, Oct 10, 2016). Mobile Path to Purchase: Five Key Findings. Available: <https://www.thinkwithgoogle.com/research-studies/mobile-path-to-purchase-5-key-findings.html>
- [33] thinkwithgoogle. (2015, July 3 , 2016). Mobile App Marketing Insights: How Consumers Really Find and Use Your Apps. Available: <https://think.storage.googleapis.com/docs/mobile-app-marketing-insights.pdf>
- [34] Capterra. (Oct 10,2016). Top Construction Management Software Products. Available: <http://www.capterra.com/construction-management-software/>
- [35] Software Advice. Compare Construction Management Applications (iOS & Android). Available: <http://www.softwareadvice.com/nz/construction/best-apps-comparison/>
- [36] SmartBid. (2015, Oct 10,2016). 20 Top Construction Apps to Use. Available: <http://smartbidnet.com/20-top-construction-apps-to-use/>
- [37] J. Yovino. (2016). 16 construction apps for 2016. Available: <http://dailyreporter.com/2016/01/15/16-construction-apps-for-2016/>
- [38] J. Yovino. (2015, Oct 10, 2016). 15 construction apps for 2015. Available: <http://dailyreporter.com/2015/01/09/15-construction-apps-for-2015/>
- [39] J. Yovino. (2012, Oct 10, 2016). 13 construction apps for 2013. Available: <http://dailyreporter.com/2012/12/28/13-construction-apps-for-2013/>
- [40] J. Rodriguez. (2016, Oct 10, 2016). Construction Apps that Every Builder Must Have. Available: <https://www.thebalance.com/construction-apps-for-builders-844901>
- [41] TSheets. (Oct 10, 2016). Top 10 Construction Apps. Available: <https://www.tsheets.com/best-construction-apps/>
- [42] Google Play. Available: <https://play.google.com/store/apps>
- [43] S. McIlroy, N. Ali, and A. E. Hassan, "Fresh apps: an empirical study of frequently-updated mobile apps in the Google play store," *Empirical Software Engineering*, vol. 21, pp. 1346-1370, 2016.
- [44] L. Villarroel, G. Bavota, B. Russo, R. Oliveto, and M. Di Penta, "Release planning of mobile apps based on user reviews," in *Proceedings of the 38th International Conference on Software Engineering*, 2016, pp. 14-24.