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RESEARCH ARTICLE

Factors influencing the performance of architects in construction projects

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Abstract

The construction industry has been accused of ineffectiveness and inefficiency because of delays, cost overruns and defects that are partly due to flaws in the design. As professionals responsible for design, architects should achieve optimum performance in the project delivery process. This study aims to investigate the factors that influence the performance of architects in construction projects. This study employs a questionnaire survey for data collection and partial least square structural equation modelling (PLS–SEM) for data analysis. Using a census method, a total of 222 useable responses are gathered from registered architects in Indonesia. Results reveal significant and positive relationships between working condition, organisational support and effective design process and the performance of architects. The strongest effect is found from the influence of effective design process on the performance of architects. Thus, these factors should be applied to enhance the performance of architects, thereby improving the project outcome.

Keywords:

Architects' performance, construction projects, design process, organisational support, working conditions, working relationships.

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Introduction

Performance is a vital indicator of productivity of an individual, viability of a company and competitive advantage of an industry. Thus, the construction industry has been seriously criticised for its substandard performance and appeals to identify strategies for performance improvement have been raised (Liao, Teo and Low, 2017; Hasan et al., 2018). In particular, the construction industry has been recognised to experience loss due to reworks, delays, defects and several other reasons involving professionals in the industry (Nawi et al., 2009; Hamza et al., 2019). Several scholars have argued that these problems are partly because of mistakes in design decisions (Nawi et al., 2009; Kärnä and Junnonen, 2017) and deficiencies in the design documents (Abdallah, Assaf and Hassanain, 2019); thus, architects have been indicted to be responsible for errors, which occur in buildings. Nawi et al. (2009) investigated the constructability concept in Malaysia and found that challenges such as delays and reworks are aggravated by the weaknesses of the designs produced by architects at the design stage. Similarly, a study in Finland revealed that clients exhibit low satisfaction towards the performance of architects, which is induced by flaws in the design, such as incompleteness, incompatibility and inconsistency of design documents (Kärnä and Junnonen, 2017). Design errors due to poorly prepared design documents have led to change orders, thereby generating considerable financial loss to clients (Abdallah, Assaf and Hassanain, 2019; Hamza et al., 2019).

As professionals with expertise, knowledge and experience, architects play a formidable role for determining project success (Oluwatayo and Amole, 2011). Architects are skilled professionals in the construction industry who are involved in creating new ideas and adopting new technology and innovation (Yusof, Ishak and Doheim, 2018). The quality of the design of an architect has a connection with various aspects of performance (Salvatierra et al., 2019). Architects must guide their clients to prioritise project objectives, provide advice on the project feasibility and project requirement, interpret the ideas of clients into design and help them achieve the overall project objectives (Luo, Zhang and Sher, 2017; Doheim and Yusof, 2020). Moreover, architects must help the building occupants to fulfil their basic needs for dwellings and help them improve their quality of life by creating a place that can accommodate their activities (Abisuga, Famakin and Oshodi, 2016; Afolabi et al., 2018). Therefore, the performance of architects is crucial for ensuring project success.

However, studies on the performance of architects remain scarce. Most studies have focused more on the performance of other construction stakeholders, such as contractors and clients, than on the performance of architects (Finnie, Ali and Park, 2018; Zedan and Miller, 2018; Iyer, Kumar and Singh, 2020). To date, little is known about the factors that can influence the performance of architects. Studies in architectural fields tend to focus on design tools (Li and Samuelson, 2020; Aburamadan and Trillo, 2020), design buildability issues (Van Phuong, 2017; Lee et al., 2018) and technology advancement that influence the profession (Luo, Zhang and Sher, 2017; Fürstenberg and Lædre, 2020). Furthermore, existing studies on the performance of architects fail to provide definitive evidence on which factors influence their performance. Oyedele (2010) identified working condition, organisational support and design process as the top three factors that influence the performance of architects. By contrast, Kärnä and Junnonen (2017) assessed the performance of architects through satisfaction rating of various project participants and found that good working relationship and effective design process are significant to the performance of architects. Similarly, Othman and Elsaay (2018) reviewed the literature and identified that lack of communication, coordination and design process as the main reasons for poor performance of architects.

This study primarily aims to determine the factors that enhance the performance of architects in construction projects. Liao, Teo and Low (2017) called for additional research to identify strategies for performance improvement. In particular, the present study investigates whether working condition, organisational support, working relationship and design process exhibit significant positive influences on the performance of architects. In terms of theoretical contribution, the current study adopts the works of Kärnä and Junnonen (2017) and Oyedele (2010) to provide further understanding on which of the aforementioned factors influence the performance of architects. Practically, findings guide architects, employers and the professional body of architects in the industry on the process of enhancing their performance and consequently achieving project success.

Performance of architects

Performance measurement aims to help individuals, organisations or companies to establish standards and targets, gain benefits and communicate the strategy. Performance can be defined as an optimal work performance by an individual or group, which relates to a certain expertise (Yin, Qin and Holland, 2011). Architects are design professionals in the construction industry where their performance is primarily related to the design quality (Adinyira and Dafeamekpor, 2015). However, the process of measuring the performance of architects remains unexplored. Previous studies have identified several criteria for the performance of architects. The objectives of project stakeholders should be identified to achieve a successful project (Afolabi et al., 2018; Salvatierra et al., 2019). To do so, architects should work closely with their clients to learn the project objectives that they prioritise (Adinyira and Dafeamekpor, 2015; Marisa, 2018). Architects must realise that the common objectives of clients are the completion of the project on time, on budget and at the best quality (Meng, 2012; Luo, Zhang and Sher, 2017). Therefore, the ability to identify and prioritise project objectives is an important criterion for assessing the performance of architects. Salvatierra et al. (2019) argued that the works of architects are evaluated on the basis of the quality of their designs. Given that a good design quality should be achieved in construction projects, the performance of architects should consider the quality and aesthetic value of their designs (Al-Saggaf, Nasir and Hegazy, 2020). Another performance criterion for architects involves the production of clear, complete and consistent specifications with drawings. Hamza et al. (2019) revealed that a thorough and high-functional design specification at the early project stage will help complete the project on time and reduce cost. A review of published articles from 1986 to 2016 found that the reasons for poor construction projects performance include the lack of specifications and incomplete drawings (Hasan et al., 2018). In such instances, the ability to balance between meeting the needs of clients and minimising design changes is important (Knotten, Laedre and Hansen, 2017). The construction process will not be disrupted when the design specification is thorough, clearly defined and consistent (Lubis and Yusof, 2016). Likewise, good coordination between design and construction is another criterion for the performance of architects (Korkmaz, Swarup and Riley, 2013). Architect should collaborate with contractors and structural engineers by providing assistance in the production of quality manuals for construction works (Oyedele, 2010). The conformity of an architectural design to regulations, codes and standards is another performance criterion for architects. A building design that fails to follow the building codes and standards may induce accidents during the construction and result in an unsafe building (Manu et al., 2019).

The discussion above identifies the eight criteria for the performance of architects, namely, ability to design within budget, time, quality and with good aesthetic; to prioritise project

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objectives; to produce clear and concise specifications in drawings; to assist in construction commissioning and testing programme; to reduce and rework deficiency and conform the design to the codes and standards. This study applies these criteria.

Factors influencing the performance of architects

The factors that influence the performance of architects can be classified into i) working condition (Sinesilassie Tabish and Jha, 2017; Böckerman and Ilmakunnas, 2019), ii) organisational support (Young and Young, 2012; Lai, Yusof and Kamal, 2016), iii) working relationship (Kärnä and Junnonen, 2017; Afolabi et al., 2018) and iv) design process (Kärnä and Junnonen, 2017; Assaf, Hassanain and Abdallah, 2018; Othman and Elsaay, 2018). These factors are subsequently discussed in detail.

WORKING CONDITION

Working condition in a construction project refers to the quality of working facilities that are acquired by the people which covers psycho–social, organisational and physical working environments (Oyedele, 2010). Challenging tasks were important for individuals' psychological need satisfaction at work (Arshadi, 2010). Böckerman and Ilmakunnas (2019) further found that individuals are willing to work when the work condition suits them. Therefore, organisations should encourage subordinates to participate in the decision making and experience various assignments that help them feel competent and thereby influence their performance (Arshadi, 2010). Another criterion for working condition is the physical environment. Böckerman and Ilmakunnas (2019) described that a good physical working condition deals with the satisfaction of individuals in terms of level of lighting, noise, temperature and hazards, among others within their work environment. This criterion includes sufficient equipment or tools required by individuals to perform their work (Sinesilassie, Tabish and Jha, 2017). Therefore, a preferable working condition is important to influence the performance of architects. Preferable working condition helps individuals to increase satisfaction towards their work and consequently improves their performance (Oyedele, 2010; Sinesilassie, Tabish and Jha, 2017). Hence, the first hypothesis of this study is proposed as follows:

H1. *Working condition positively influences the performance of architects.*

ORGANISATIONAL SUPPORT

Organisational support focuses on the extent to which individuals in an organisation believe that their contributions are valued and on the level of concern of the organization towards individual's well-being (Baran, Shanock and Miller, 2012). According to Batra (2020), organisational support in the form of providing monetary and non-monetary benefits for the individuals will have an impact on their commitment to accomplish the project goals. Organisational support is revealed through guiding individuals to execute their work (Young and Young, 2012). Miao (2011) suggested that the performance of employees can be enhanced through implementing organisational policies and procedures that value their efforts for work. For example, innovative ideas and risk tolerance should be supported to encourage innovation and boost performance (Lai, Yusof and Kamal, 2016). Kennedy and Daim (2011) proposed that firms must learn about the needs of individuals, such as for self-development or monetary compensation, to ensure that the provided support will yield improved performance. Given that organisational support is acknowledged as the most important factor for project success (Young and Young, 2012), it positively affects the performance of architects (Oyedele, 2010). Therefore, organisational support is important to influence the performance of architects. The second hypothesis is presented as follows:

H2. *Organisational support positively influences the performance of architects*

WORKING RELATIONSHIP

Good working relationship in the workplace is a factor that can influence performance. Construction projects involve various parties. The performance of architects is determined at the design phase and during the presentation of the final product, which fulfils the functional, environmental and economics solutions stated in the design (Kärnä and Junnonen, 2017). Thus, communication, harmonious relation and commitment are amongst the criteria for a good working relationship. Given that communication is vital to establish a good working relationship (Khanyile, Musonda and Agumba, 2019), individuals in the project team should communicate to ensure successful project completion. Thus, architects should have the capability to communicate verbally and graphically with the project team members. A harmonious team relationship is one of the critical success factors within the construction industry (Yap, Leong and Skitmore, 2020). A harmonious working relationship enables project team members to discuss design issues that arise during the implementation process. Good working relationship is also reflected through the commitment amongst project participants. Mba and Agumba (2018) proposed that commitment amongst project participants is important to ensure successful project performance. However, the working relationship amongst project participants is typically problematic and generates adverse effect to project performance (Kärnä and Junnonen, 2017). Rose and Manley (2011) and Afolabi et al. (2018) emphasised the quality of working relationship amongst project stakeholders for performance improvement. Similarly, Meng (2012) found that the working relationship between individuals and parties in projects contributes to improved performance. Therefore, the present study argues that working relationship with different parties and amongst the design team is important and significantly influences the performance of architects. The third hypothesis of the study is stated as follows.

H3. *Working relationship positively influences the performance of architects.*

DESIGN PROCESS

Effective design process refers to realistic expectation from clients or project objectives, design decisions that are consistent with project objectives, minimum design changes and effective structure for design tasks (Lee et al., 2018). The success of buildings depends on the process of creating the design (Yin, Qin and Holland, 2011). Intrinsically, competencies within the design team is crucial to ensure effective design process (Hamza et al., 2019). Competency refers to the need for work effectiveness, the use of energy efficiency in work and to perform tasks at hand well (Arshadi, 2010). Architects, as one amongst the professionals in the industry, should demonstrate their capabilities in design (Oluwatayo and Amole, 2011). Effective design process can be demonstrated through clear project definition, planning and process of achieving the project goals. Effective project process includes compatibility between design decisions and the project objectives (Salvatierra et al., 2019). An unrealistic project can occur when clients fail to commit to the scheduled time and design decisions. Therefore, architects should be able to interpret the needs of clients and ensure that the end products fulfil these needs and the market demand. Effective design process also includes good coordination within the design team (Assaf, Hassanain and Abdallah, 2018). Coordination refers to the process of scheduling and sequencing all project activities, which involves reliance of various expertise and resources (Assaf, Hassanain and Abdallah, 2018; Mitropoulos and Tajima, 2019). This reliance should be considered and understood for design development, because a well-coordinated design process can prevent expensive errors that may occur during project implementation (Yin, Qin and Holland, 2011). The discussion above suggests that the performance of architects is influenced by effective design process. Therefore, the following hypothesis is proposed.

H4. *Design Process positively influences the performance of architects.*

Methodology

This study employs a quantitative method using questionnaire survey as the research instrument for data collection because of several reasons. Taylor, Sinha and Ghoshal (2011) explained that a questionnaire survey seeks to understand a particular facet of a defined population through directing the inquiry to the sample given that the population is large and that the study aims to achieve descriptive purposes and seeks to understand phenomena by identifying influencing factors. In the present study, the population is considered large because it involves all registered architects (328 architects) in Medan, Indonesia. Therefore, the use of questionnaires is apparently suitable for gathering necessary information from respondents who are busy and have limited time to participate in the research. Secondly, the questionnaire survey is conducted for explanatory purposes, that is, questions are often devised to assess the relationships between variables to identify correlations (Taylor, Sinha and Ghoshal, 2011). The current study has an explanatory purpose because it aims to identify the strength of the relationships between working condition, organisational support, working relationship, design process, and performance of architects. Therefore, survey is an appropriate methodological strategy for this study.

This study uses self-evaluation, wherein the respondents assess their own performance (Zell and Krizan, 2014). Roch, McNall and Caputo (2011) argued that self-evaluation is accurate if it is connected with performance evaluation that exhibits behavioural aspects. In this study, the respondents are expected to evaluate whether the four aforementioned factors influence their performance in construction projects. Self-evaluation can also provide important feedback and increase the feedback accuracy needed by the employers (Roch, McNall and Caputo, 2011). Therefore, using self-evaluation is appropriate in the study.

MEASUREMENT OF CONSTRUCT

The questionnaire comprises three sections. The first section aims to gather information on the background of the respondents in the study. The second section consists of four constructs that measure the factors for the performance of architects with 23 reflective items. These constructs are working condition (six items), organisational support (seven items), working relationship (four items) and effective design process (six items), which are operationalised using a five-point scale from 1 (not important) to 5 (extremely important) that was adopted from Lubis and Yusof (2016).

The third section measures the performance of architects in construction project with eight formative items, namely, ability to prioritise project objectives; ability to produce clear and concise specifications with drawings; ability to design the project within budget, time, quality, without rework; assist in construction commissioning and testing programme and conform to codes and standard. These items are operationalised using a five-point scale from 1 (very poor) to 5 (excellent). Table 1 provides the constructs and sources.

Table 1 Constructs and sources

Constructs	Items	Scale	Sources
Architects' Performance	8 (formative)	five-point scale from 1- very poor to 5 - excellent.	Oyedele (2010); Adinyira and Dafeamekpor (2015)
Working condition	6 (reflective)	five-point scale from 1-not important to 5-extremely important	Sinesilassie, Tabish and Jha (2017); Böckerman and Ilmakunnas (2019)
Organizational support	7 (reflective)		Baran, Shanock and Miller (2012); Lai, Yusof and Kamal (2016)
Working relationship	4 (reflective)		Meng (2012); Kärnä and Junnonen (2017)
Design process	6 (reflective)		Yin, Qin and Holland (2011); Assaf, Hassanain and Abdallah (2018)

DATA COLLECTION

This study selected Medan as the location for data collection. Medan is the capital city of North Sumatera Province and has 21 districts and 151 villages (Badan Pusat Statistik Medan, 2019). The city has been developing rapidly to support the community life in the city. However, the development of urban areas has not been accompanied by the growth of green space and water catchment areas (Fahreza and Restu, 2016).

The targeted respondents are registered architects with the Ikatan Arsitek Indonesia (IAI) who worked in Medan. IAI is a long-standing organisation established in 1959 that embodies professional architects in Indonesia. This organisation is active in local and international activities through its memberships with Construction Service Development Board (LPJK), Architects Regional Council ASIA (ARCASIA) and Union Internationale de Architectes (UIA). These architects are members of the parties that determine the development and growth of the city.

During the time of study period, the information obtained from the secretariat of IAI indicated that 328 architects were registered with IAI in Medan. The study attempted to cover the entire population (a census method) and 328 registered architects were contacted. A total of 300 respondents have shown their willingness to cooperate in the study and were sent the questionnaires. Questionnaires were administered personally to targeted respondents because this method allows the collection of completed responses within a short period. A total of 231 responses were returned, however 222 were valid for further analysis. This study analysed the 222 responses using PLS-SEM technique. The researchers used the inverse square root method to calculate the minimum sample size and indicate the representativeness of the results

(Hair et al., 2019; Kock and Hadaya, 2018). The calculation results in 221 required sample size (0.197 absolute significant path coefficient, significance level of 0.05 and 90% power level). This result indicates that the 222 useable responses in this study surpass the cut-off point.

DATA ANALYSIS AND TECHNIQUE

This study analyses the data using PLS–SEM with the help of WarpPLS 6.0 software because of three reasons. Firstly, the study aims to identify the factors that affect the performance in construction projects. The study is predictive in nature, and thus, PLS–SEM is suitable (Rigdon, 2016). Secondly, the conceptual model of the study consists of reflective and formative constructs, which should select PLS–SEM according to Hair et al. (2019). Thirdly, the data were not normally distributed (Hair et al., 2019). The researchers conducted a Shapiro–Wilk test to validate the third reason. The result showed that the Shapiro–Wilk was significant at 0.012; therefore, the data were significantly departed from a normal distribution and the data were not normal (Razali and Wah, 2011). All these reasons justify the use of PLS–SEM in the analysis.

The study has four reflective exogenous constructs (working condition, organisational support, working relationship and design process) and one formative endogenous construct (performance of architect). Therefore, the steps in the PLS–SEM modelling of Hair et al. (2019) were performed. Step 1 refers to the measurement model assessment for reflective constructs; Step 2 is the measurement model assessment for formative constructs; Step 3 is the structural model assessment. These steps are subsequently elaborated.

Step 1 - Measurement model assessment of reflective constructs

The measurement model assessment of the reflective constructs involved three tests, namely, internal consistency reliability, convergent validity and discriminant validity (Hair et al., 2019). This study used composite reliability (CR) to test for internal consistency reliability; factor loading was used to test convergent validity, and discriminant validity was tested using Fornell and Larcker's criterion. The result shows that the CR and loading values of all reflective variables were above 0.7, thereby fulfilling Hair et al. (2019)'s conditions. The discriminant validity test showed that the square root of the AVE (where AVE must be greater than 0.5) of the variable was larger than the value of the correlations between model variables, which fulfils the criteria of Ramayah et al. (2018). Results indicated that the reflective variables satisfied the reliability and validity requirements. Table 2 presents the results of measurement model assessment of reflective constructs.

Table 2 Measurement model assessment of reflective constructs

Variable/Item	CR	Item loadings	Discriminant Validity (Fornell-Larcker criterion)			
			WCond	OS	WR	DP
Working Condition	0.849		0.697*			
WCond1		(0.729)				
WCond2		(0.696)				
WCond3		(0.658)				
WCond4		(0.666)				
WCond5		(0.770)				
WCond6		(0.653)				

Table 2 continued

Variable/Item	CR	Item loadings	Discriminant Validity (Fornell-Larcker criterion)			
			WCond	OS	WR	DP
Organisational Support	0.832		0.639	0.646*		
OS1 OS2 OS3 OS4 OS5 OS6 OS7		(0.655) (0.706) (0.602) (0.714) (0.579) (0.704) (0.542)				
Working Relationship	0.852		0.639	0.558	0.771*	
WR1 WR2 WR3 WR4		(0.599) (0.842) (0.861) (0.755)				
Design Process	0.846		0.496	0.598	0.507	0.693*
DP1 DP2 DP3 DP4 DP5 DP6		(0.711) (0.657) (0.724) (0.724) (0.737) (0.593)				

Notes: CR = composite reliability, *Square root of the AVEs on the diagonal.

Step 2 - Measurement model assessment of formative constructs

Assessing the measurement model of the formative constructs comprises three steps, namely, convergent validity, the significant and relevance of the formative indicators' weights (Hair et al., 2019) and indicator collinearity. The full collinearity variance inflation factor (VIF) of the formative construct is 1.470, which is lower than 3.3. Therefore, no multicollinearity exists in the study, which fulfils Kock's (2017) convergent validity criteria. The weights of all the items were more than zero with significant P values (p value < 0.05), and the VIFs for the formative items were less than 3.3, thereby fulfilling the limit of Kock (2017). Results satisfied the formative variable requirements. Table 3 presents the results of the assessment of the measurement model for the sole formative construct.

Table 3 Assessment of the measurement model for formative construct

Variable	Weight	P value	VIF	Full collinearity VIF
Architect Performance				1.470
ArchPerf 1	0.225	<0.001	1.658	
ArchPerf 2	0.225	<0.001	1.666	

Table 3 continued

Variable	Weight	P value	VIF	Full collinearity VIF
ArchPerf 3	0.205	<0.001	1.491	
ArchPerf 4	0.194	0.002	1.550	
ArchPerf 5	0.185	0.002	1.518	
ArchPerf 6	0.172	0.004	1.437	
ArchPerf 7	0.193	0.002	1.615	
ArchPerf 8	0.173	0.004	1.291	

Step 3 - Structural model assessment

The structural model assessment involves lateral collinearity, the significance and relevance of the structural model relationships, the coefficient of determination (R^2) and predictive relevance (Q^2) tests (Chin, 2010; Hair et al., 2019). This study assessed the lateral collinearity using Average block Variance Inflation Factor (AVIF) and Average Full collinearity Variance Inflation Factor (AFVIF) values. The values revealed 1.789 for AVIF and 1.801 for AFVIF, which were below the threshold of 3.3. Therefore, the study lacks collinearity issues (Kock, 2017). The path coefficient was significant ($P \leq 0.001$) with an R^2 of 0.338, thereby demonstrating a moderate level of predictive accuracy (Chin, 2010). Stone–Geisser Q^2 (cross-validated redundancy) was also examined as the other predictive relevance evaluation (Ramayah et al., 2018) and recorded 0.339 for Stone–Geisser Q^2. Therefore, a strong predictive power is evident. The Simpson's paradox ratio of the model was 1.00, which satisfied Kock and Gaskins' (2016) threshold. These results showed a strong predictive relevance and satisfactory fit of the structural model. Figure 1 presents the structural model results on the relationships between working condition (WCond), organisational support (OS), working relationship (WR), design process (DP) and architect performance (ArchPerf).

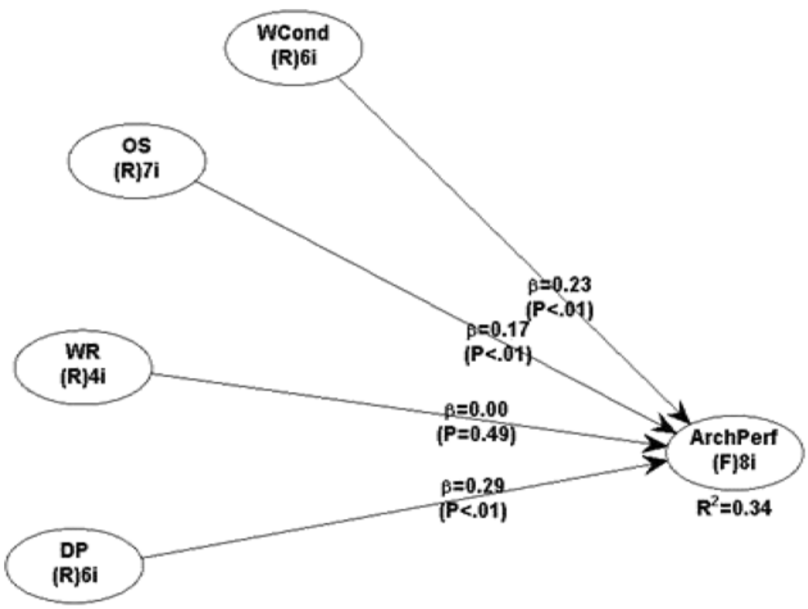

Figure 1 Structural model results

Results and discussion

Most of the respondents were experienced in the construction industry for 5–10 years (40.5%), 11–15 years (29.7%), less than five years (16.7%), 16–20 years (11.7%) and three of them (1.4%) had experience of more than 20 years in the industry. Most of the respondents worked in private firms (96.8%). Most of the firms have been established for 11–15 years (50%), 25.2% of the firms have been established for 5–10 years, followed by the 9% that have been established for 16–20 years; 8.6% of them have been established for more than 20 years, and 7.2% of the firms were established in less than five years.

The hypothesis was accepted if $P \leq 0.05$, in a one-tailed P value hypothesis test and the T ratio were more than 1.64 (Kock and Hadaya, 2016). Three paths were significant: WCond->ArchPerf path was positive ($\beta = 0.233$) and significant ($P \leq 0.001$ and T ratio $\geq \pm 1.64$), OS-> ArchPerf path was positive ($\beta = 0.172$) and significant ($P \leq 0.004$ and T ratio $\geq \pm 1.64$) and DP-> ArchPerf path was positive ($\beta = 0.285$) and significant ($P \leq 0.001$ and T ratio $\geq \pm 1.64$). The highest effects were obtained from DP-> ArchPerf where $f^2 = 0.142$, thereby signifying a medium effect (Cohen, 1988). By contrast, the WR-> ArchPerf path was not significant with p value = 0.494, and T ratio was 0.016, which is below the 1.64 threshold. Therefore, H1, H2 and H3 were supported. Table 4 shows the results of the hypotheses tests.

Table 4 Results of the hypotheses tests

Hypothesis	Relationship	Path coefficient (β)	Std. error	*P value*	*T* ratios	Effect size	Supported?
H1	WCond->ArchPerf	0.233	0.064	<0.001	3.618	0.112	Yes
H2	OS-> ArchPerf	0.172	0.065	0.004	2.649	0.083	Yes
H3	WR-> ArchPerf	0.001	0.067	0.494	0.016	0.000	No
H4	DP-> ArchPerf	0.285	0.064	<0.001	4.479	0.142	Yes

Results reveal that effective design process positively influences the performance of architects. Thus, their performance in construction projects improves when clear project definition and planning are conducted, design decisions are in line with the project objectives, a competent and well-coordinated design team exists, realistic project expectations are specified by clients and a realistic project schedule is followed. A possible reason is that design is the core service of architects, and their final product substantially depends on the ability to realise the expectations of clients (Kärnä and Junnonen, 2017) and the effectiveness of the process in creating such designs (Yin, Qin and Holland, 2011). Therefore, the availability of an effective design process can significantly increase the performance of architects. The result is consistent with the findings of Oluwatayo et al. (2018), who found that competency, ability to understand and fulfilment of the needs of clients are amongst the top factors that influence their satisfaction towards architectural service.

Results also revealed that working condition positively influences the performance of architects. Thus, that the presence of sufficient freedom and tolerance for executing the work, sufficient resources (e.g. software and hardware), a challenging atmosphere, adequate participation in the decision making, various assignments or tasks and good physical working condition benefits the performance of architects. One possible reason is that the majority of the respondents in the present study are from private firms. Adinyira and Dafeamekpor (2015) described that the private sector is profit-oriented wherein cost-cutting measures that limit the freedom of architects, availability of resources and physical working environment may be placed to maximise profit. Therefore, quality work facilities, such as design space, thermal comfort, sufficient resources and freedom for executing their work to explore new approaches to achieve the project objectives increase the performance of architects, which supports Oyedele (2010) findings.

Organisational support in terms of top management concerns towards employees' safety and welfare, commitment towards employees' development, empowerment of employees to set goals and achieve them, encouragement towards creativity and new ideas, appropriate feedback mechanisms and good organisational policies for effective project completion positively influence the performance of architects. Such support from top management promotes positive feelings of appreciation and secured wellbeing amongst architects, thereby increasing their performance. The result is consistent with the findings of Young and Young (2012), who revealed that support from the top management is the most important factor for a successful project and thus performance of architects.

However, the current study fails to provide sufficient evidence to support H3 (working relationship positively influences the performance of architects). One possible explanation for this result is that architects are involved with various parties throughout the construction process. Kärnä and Junnonen (2017) explained that architects work with clients more during the planning and design phase than during the production phase, whilst they work closely with contractors and subcontractors at construction sites during the production phase. Therefore, a good working relationship with clients, contractors and subcontractors is equally important to good working relationship with superiors, co-workers and design team members. In a similar vein, Mba and Agumba (2018) also found that a long-term working relationship demonstrated via commitment from parties involved in the project fails to influence construction project outcome.

Conclusion

This paper aimed to evaluate the factors that influence the performance of architects in construction projects. Results reveal significant and positive relationships between working condition, organisational support and effective design process and the performance of architects. The strongest effect is obtained from the influence of effective design process on the performance of architects, thereby confirming the studies of Oyedele (2010), Young and Young (2012) and Oluwatayo et al. (2018).

Theoretically, the findings offer an alternative solution to the work of Liao, Teo and Low (2017) through addressing performance issues in countries where the use of innovative methods, such as building information modelling remains lacking. Moreover, findings provide empirical evidence to Othman and Elsaay (2018) and Hamza et al. (2019) through identifying factors that influence the performance of architects. Practically, the study findings help architects, employers and clients through highlighting the importance of focusing on design process, working condition and organisational support to improve the performance of architects. Handling these factors in a proactive manner, such as considering these factors during project initiation, would contribute to improve their performance.

Furthermore, the professional body of architects, or IAI within the context of the present study, should provide a mechanism for boosting design process, organisational support and the working condition of architects. A lean (Othman and Khalil, 2018) or project governance (Young et al., 2019) approach of executing these three factors would help to improve their performance.

Although this study addresses its objectives, limitations exist. Firstly, this study uses questionnaire survey for data collection. Future studies should include in-depth interviews to improve understanding on other important factors to enhance the performance of an architect in a construction project. Secondly, the respondents are limited to registered architects in Indonesia. Future studies should include architects from other developing countries to obtain a thorough performance assessment, which can be generalised amongst architects in similar context to that within Indonesia. Thirdly, this study finds that working relationship is an insignificant factor. Therefore, the relationship between working relationship and the performance of architects remains vague and should further be investigated.

References

Abdallah, A., Assaf, S. and Hassanain, M.A., 2019. Assessment of the consequences of deficiencies in design documents in Saudi Arabia. *Architectural Engineering and Design Management*, 15(4), pp.282-96. https://doi.org/10.1080/17452007.2018.1561412

Abisuga, A.O., Famakin, I.O. and Oshodi, O.S., 2016. Educational building conditions and the health of users. *Construction Economics and Building*, 16(4), pp.19-34. https://doi.org/10.5130/ajceb.v16i4.4979

Aburamadan, R. and Trillo, C., 2020. Applying design science approach to architectural design development. *Frontiers of Architectural Research*, 9(1), pp.216-35. https://doi.org/10.1016/j.foar.2019.07.008

Adinyira, E. and Dafeamekpor, C.A., 2015. Clients' perceptions of architect performance on building projects in Ghana. *Journal of Professional Issues in Engineering Education and Practice*, 141(3). https://doi.org/10.1061/(asce)ei.1943-5541.0000218

Afolabi, A.O., Oluwatayo, A., Oyeyipo, O., Ojelabi, R. and Fagbenle, O., 2018. Assessment of designers' perception of post conflict housing schemes for internally displaced persons. *Construction Economics and Building*, 18(1), pp.27-47. https://doi.org/10.5130/ajceb.v18i1.5780

Al-Saggaf, A., Nasir, H. and Hegazy, T., 2020. An Analytical Hierarchy Process-based system to evaluate the life-cycle performance of buildings at early design stage. *Journal of Building Engineering*, 31, pp.101364. https://doi.org/10.1016/j.jobe.2020.101364

Arshadi, N., 2010. Basic need satisfaction, work motivation, and job performance in an industrial company in Iran. *Procedia-Social and Behavioral Sciences*, 5, pp.1267-72. https://doi.org/10.1016/j.sbspro.2010.07.273

Assaf, S., Hassanain, M.A. and Abdallah, A., 2018. Review and assessment of the causes of deficiencies in design documents for large construction projects. *International Journal of Building Pathology and Adaptation*, 36(3), pp.300-17. https://doi.org/10.1108/ijbpa-10-2017-0050

Badan Pusat Statistik Medan, 2019. *Kota Medan dalam Angka 2019*. Medan: BPS

Baran, B., Shanock, L. and Miller, L., 2012. Advancing Organizational Support Theory into the Twenty-First Century World of Work. *Journal of Business and Psychology*, 27. https://doi.org/10.1007/s10869-011-9236-3

Batra, S., 2020. Framework of socialisation, authentic leadership and effective commitment for construction professionals. *Construction Economics and Building*, 20, pp.77-99. https://doi.org/10.5130/ajceb.v20i1.6706

Böckerman, P. and Ilmakunnas, P., 2019. Do good working conditions make you work longer? Analysing retirement decisions using linked survey and register data. *The Journal of the Economics of Ageing*, pp.1-11. https://doi.org/10.1016/j.jeoa.2019.02.001.

Chin, W.W., 2010. How to Write Up and Report PLS Analyses. In: V. Esposito Vinzi et al. eds. *Handbook of Partial Least Squares: Concepts, Methods and Applications*. Berlin, Heidelberg: Springer Berlin Heidelberg. pp.655-90. https://doi.org/10.1007/978-3-540-32827-8_29

Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences* 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates.

Doheim, R.M. and Yusof, N., 2020. Creativity in architecture design studio. Assessing students' and instructors' perception. *Journal of Cleaner Production*, 249, p.119418. https://doi.org/10.1016/j.jclepro.2019.119418

Fahreza, W. and Restu, R., 2016. Analisis ruang terbuka hijau perumahan nasional di Kota Medan, *Jurnal Geografi*, 8(2), pp. 197-207.

Finnie, D., Ali, N.A. and Park, K., 2018. Enhancing off-site manufacturing through early contractor involvement (ECI) in New Zealand. *Proceedings of Institution of Civil Engineers: Management, Procurement and Law*, 171(4), pp.176-85. https://doi.org/10.1680/jmapl.17.00029

Fürstenberg, D. and Lædre, O., 2020. Application of BIM design manuals: a case study. *27th Annual Conference of the International Group for Lean Construction*, IGLC 2019. pp.145-56. https://doi.org/10.24928/2019/0147

Hair, J., Risher, J., Sarstedt, M. and Ringle, C., 2019. When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), pp.2-24. https://doi.org/10.1108/ebr-11-2018-0203

Hamza, M., Shahid, S., Bin Hainin, M.R. and Nashwan, M.S., 2019. Construction labour productivity: review of factors identified. *International Journal of Construction Management*, pp.1-13. https://doi.org/10.1080/15623599.2019.1627503

Hasan, A., Baroudi, B., Elmualim, A. and Rameezdeen, R., 2018. Factors affecting construction productivity: a 30 year systematic review. *Engineering, Construction and Architectural Management*, 25(7), pp.916-37. https://doi.org/10.1108/ecam-02-2017-0035

Iyer, K.C., Kumar, R. and Singh, S.P., 2020. Understanding the role of contractor capability in risk management: a comparative case study of two similar projects. *Construction Management and Economics*, 38(3), pp.223-38. https://doi.org/10.1080/01446193.2019.1590614

Kärnä, S. and Junnonen, J.M., 2017. Designers' performance evaluation in construction projects. *Engineering, Construction and Architectural Management*, 24(1), pp.154-69. https://doi.org/10.1108/ecam-06-2015-0101

Kennedy, E. and Daim, T.U., 2010. A strategy to assist management in workforce engagement and employee retention in the high tech engineering environment. *Evaluation and Program Planning*, 33, pp.468-76. https://doi.org/10.1016/j.evalprogplan.2009.12.001

Khanyile, N.S.M., Musonda, I. and Agumba, J.N., 2019. Evaluating the relationship between communication management practices and project outcomes: a case study of Eswatini (Swaziland) construction industry. *Construction Economics and Building,* 19, pp.197-219. https://doi.org/10.5130/ajceb.v19i2.6646

Knotten, V., Lædre, O. and Hansen, G.K., 2017. Building design management–key success factors. *Architectural Engineering and Design Management*, 13(6), pp.479-93. https://doi.org/10.1080/17452007.2017.1345718

Kock, N., 2017. Common Method Bias: A Full Collinearity Assessment Method for PLS-SEM. In. *Partial Least Squares Path Modeling*: Springer. pp.245-57. https://doi.org/10.1007/978-3-319-64069-3_11

Kock, N. and Gaskins, L., 2016. Simpson's paradox, moderation, and the emergence of quadratic relationships in path models: An information systems illustration. *International Journal of Applied Nonlinear Science*, 2(3), pp.200-34. https://doi.org/10.1504/ijans.2016.077025

Kock, N. and Hadaya, P., 2018. Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. *Information Systems Journal*, 28(1), pp.227-61. https://doi.org/10.1111/isj.12131

Korkmaz, S.M., Swarup, L. and Riley, D., 2013. Delivering sustainable, high-performance buildings: influence of project delivery methods on integration and project outcomes. *Journal of Management in Engineering*, 29, pp.71-78. https://doi.org/10.1061/(asce)me.1943-5479.0000114

Lai, K.S., Yusof, N.A. and Kamal, E.M., 2016. Organizational culture of the architectural firm: a case in a developing country. *International Journal of Construction Management*, 16(3), pp.197-208. https://doi.org/10.1080/15623599.2016.1166545

Lee, J.W., Cho, K., Hwang, T., Han, J.-y. and Kim, T., 2018. Process for Integrating Constructability into the Design Phase in High-Rise Concrete Buildings: Focused on Temporary Work. *International Journal of Concrete Structures and Materials*, 12(1), p.81. https://doi.org/10.1186/s40069-018-0317-9

Li, W. and Samuelson, H., 2020. A New Method for Visualizing and Evaluating Views in Architectural Design. *Developments in the Built Environment*, p.100005. https://doi.org/10.1016/j.dibe.2020.100005

Liao, L., Teo, E.A.L. and Low, S.P., 2017. A project management framework for enhanced productivity performance using building information modelling. *Construction Economics and Building*, 17(3), pp.1-26. https://doi.org/10.5130/ajceb.v17i3.5389

Lubis, A.M. and Yusof, N.A., 2016. What Matters Most: Performance Attribute Selection in the Design Project Delivery Process. In. *Managerial Strategies and Practice in the Asian Business Sector*: IGI Global. pp.220-37. https://doi.org/10.4018/978-1-4666-9758-4.ch012

Luo, J., Zhang, H. and Sher, W., 2017. Insights into architects' future roles in off-site construction. *Construction Economics and Building*, 17(1), pp.107-20. https://doi.org/10.5130/ajceb.v17i1.5252

Manu, P., Poghosyan, A., Mahamadu, A.-M., Mahdjoubi, L., Gibb, A., Behm, M. and Akinade Olugbenga, O., 2019. Design for occupational safety and health: key attributes for organisational capability. *Engineering, Construction and Architectural Management*, 26(11), pp.2614-36. https://doi.org/10.1108/ecam-09-2018-0389

Marisa, A., 2018. Analysis of architect's performance indicators in project delivery process. *IOP Conference Series: Earth and Environmental Science*: Institute of Physics Publishing. https://doi.org/10.1088/1755-1315/126/1/012106

Mba, M.F.B. and Agumba, J.N., 2018. Critical success factors influencing performance outcome of joint venture construction projects in South Africa: Comparison of first and second order models. *Construction Economics and Building,* 18, pp.74-94. https://doi.org/10.5130/ajceb.v18i3.5885

Meng, X. and Gallagher, B., 2012. The impact of incentive mechanisms on project performance. *International journal of project management*, 30(3), pp.352-62. https://doi.org/10.1016/j.ijproman.2011.08.006

Miao, R.T., 2011. Perceived organizational support, job satisfaction, task performance and organizational citizenship behavior in china. *Journal of Behavioral and Applied Management,* 12, pp.105-27.

Mitropoulos, P. and Tajima, V., 2019. Constructability opportunities in the engineering design of marine pier structures: a case study. *International Journal of Construction Management*, pp.1-13. https://doi.org/10.1080/15623599.2019.1624677

Nawi, M.N.M., Kamar, K.A.M., Abdullah, M.R., Haron, A.T., Lee, A. and Arif, M., 2009. Enhancement of constructability concept: An experience in offsite Malaysia construction industry. *Proceeding in Changing Roles; New Roles, New Challenges*.

Oluwatayo, A., Akinola, A.O., Agomuo, I.U., Mozimo, S.O., Onwuka, C.C. and Okagbue, H.I., 2018. Survey dataset on factors that influence satisfaction of clients with architectural services in Lagos State, Nigeria. *Data in Brief*, 20, pp.118-25. https://doi.org/10.1016/j.dib.2018.07.055

Oluwatayo, A.A. and Amole, D., 2011. Architectural firms: workforce, business strategy and performance. *Australasian Journal of Construction Economics and Building*, 11(4), pp.21-44. https://doi.org/10.5130/ajceb.v11i4.2239

Othman, A.A.E. and Elsaay, H., 2018. A learning-based framework adopting post occupancy evaluation for improving the performance of architectural design firms. *Journal of Engineering, Design and Technology*, 16(3), pp.418-38. https://doi.org/10.1108/jedt-10-2017-0106

Othman, A.A.E. and Khalil, M.H.M., 2018. Lean talent management: a novel approach for increasing creativity in architectural design firms. *Engineering, Construction and Architectural Management*, 25(10), pp.1355-75. https://doi.org/10.1108/ecam-07-2017-0139

Oyedele, L.O., 2010. Sustaining architects' and engineers' motivation in design firms: An investigation of critical success factors. *Engineering, Construction and Architectural Management*, 17(2), pp.180-96. https://doi.org/10.1108/09699981011024687

Ramayah, T.J.C., Chuah, F., Ting, H. and Memon, M.A., 2018. *Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 3.0: An Updated Guide and Practical Guide to Statistical Analysis.* 2nd ed. Kuala Lumpur, Malaysia: Pearson.

Razali, N.M. and Wah, Y.B., 2011. Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and anderson-darling tests. *Journal of statistical modeling and analytics*, 2(1), pp.21-33.

Rigdon, E.E., 2016. Choosing PLS path modeling as analytical method in European management research: A realist perspective. *European Management Journal*, 34(6), pp.598-605. https://doi.org/10.1016/j.emj.2016.05.006

Roch, S.G., McNall, L.A., and Caputo, P.M., 2011. Self-judgments of accuracy as indicators of performance evaluation quality: should we believe them?. *Journal of Business and Psychology*, 26, pp.41-55. https://doi.org/10.1007/s10869-010-9173-6

Rose, T. and Manley, K., 2011. Motivation toward financial incentive goals on construction projects. *Journal of Business Research*, 64 (7), pp.765-773. https://doi.org/10.1016/j.jbusres.2010.07.003

Salvatierra, J.L., Gálvez, M.Á., Bastías, F., Castillo, T., Herrera, R.F. and Alarcón, L.F., 2019. Developing a benchmarking system for architecture design firms. *Engineering, Construction and Architectural Management*, 26(1), pp.139-52. https://doi.org/10.1108/ecam-05-2018-0211

Sinesilassie, E.G., Tabish, S.Z.S. and Jha, K.N., 2017. Critical factors affecting schedule performance: a case of Ethiopian public construction projects – engineers' perspective. *Engineering, Construction and Architectural Management,* 24, pp.757-73. https://doi.org/10.1108/ecam-03-2016-0062

Taylor, B., Sinha, G. and Ghoshal, T., 2011. *Research Methodology: A Guide for Researchers in Management and Social Sciences*. New Delhi, India: PHI Learning Private Limited.

Van Phuong, P.N., 2017. The assessment of building designs considering constructability factors. *Journal of Science and Technology in Civil Engineering (STCE)-NUCE*, 11(6), pp.61-69.

Yap, J.B.H., Leong, W.J. and Skitmore, M., 2020. Capitalising teamwork for enhancing project delivery and management in construction: Empirical study in Malaysia. *Engineering, Construction and Architectural Management*, pp.1-25. https://doi.org/10.1108/ecam-10-2019-0581

Yin, Y., Qin, S. and Holland, R., 2011. Development of a design performance measurement matrix for improving collaborative design during a design process. *International Journal of Productivity and Performance Management*, 60(2), pp.152-84. https://doi.org/10.1108/17410401111101485

Young, M. and Young, R., 2012. The rise and fall of project management: are we observing the birth of a new discipline? *Journal of Project, Program & Portfolio Management*, 3(1), pp.58-77. https://doi.org/10.5130/pppm.v3i1.2654

Young, R., Chen, W., Quazi, A., Parry, W., Wong, A. and Poon, S.K., 2019. The relationship between project governance mechanisms and project success: An international data set [in press]. *International Journal of Managing Projects in Business*. https://doi.org/10.1108/IJMPB-10-2018-0212.

Yusof, N.A., Ishak, S.S.M. and Doheim, R., 2018. Identifying factors for incorporating spatial data into BIM using the delphi method. *Construction Economics and Building,* 18, pp. 1-17. https://doi.org/10.5130/ajceb.v18i3.6031

Zedan, S. and Miller, W., 2018. Quantifying stakeholders' influence on energy efficiency of housing: development and application of a four-step methodology. *Construction Management and Economics*, 36(7), pp.375-93. https://doi.org/10.1080/01446193.2017.1411599

Zell, E. and Krizan, Z., 2014. Do people have insight into their abilities? A metasynthesis. *Perspective on Psychological Science*, 9, pp.111-25. https://doi.org/10.1177/1745691613518075