

Factors Influencing Homebuilders' Intentions to Use Ready Mixed Concrete When Building Private Houses

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Abstract-The objective of this study is to investigate factors influencing homebuilders' intentions to use Ready Mixed Concrete (RMX) instead of site mixed concrete when building private houses in Vietnam. The study finds out that attitude, subjective norms, perceived behavioral control and perceived consequences have significant effects on homebuilders' intentions to use RMX concrete. They are all proportional to the intention, and they explain 61.90% of variance in homebuilders' intentions. These results may enforce the Theory of Planned Behavior that is used in the construction business field. The findings also show no significant difference in the intentions towards using RMX concrete among homebuilders' characteristics such as age, experience and education.

Keywords- JEL; Homebuilders; Ready Mixed Concrete; Factors; Building; Vietnam

I. INTRODUCTION

In parallel with the Vietnam's economic growth, urbanization occurs in many parts of Vietnam at high speed, including extension of big cities such as Hanoi and HoChiMinh city. According to a report on strategic housing development to 2020 and Vision 2030 by the Vietnamese Ministry of Construction in 2011, the number of current dwellings is about 16.7 m² per capita; the whole country needs to build one more billion square meters of floor area from now to 2020 to achieve 25 m² per capita by the year 2020. Therefore, there will be more residential projects to come in which private houses are included. In practice, the fact shows that many residential projects allocate much of the land area for town houses and villas; it reflects the situation whereby a significant number of Vietnamese prefer owning a separate house to owning an apartment. Unlike multi-storey buildings wherein the use of ready mixed (RMX) concrete is compulsory, using RMX or site mixed concrete to build private houses is more likely a volitional choice of homebuilders. Approaching private house segments effectively and efficiently enables RMX concrete suppliers to lessen idle production time and to improve profitability and cash-flow.

These issues provide the rationale of this study to explore and understand factors that influence homebuilders' intentions to use RMX concrete instead of site mixed concrete. For data collection, a questionnaire was developed and used to interview directors of small contractors and their chief engineers who are representatives of homebuilders. Findings from this study may support the theories of Reasoned Action (TRA) and Planned Behavior (TPB) developed by Ajzen and Fishbein [1] and Ajzen [2] that are used in the construction business field.

The paper is structured into five sections: first, the Introduction; Part Two is the literature review; the next part is the research methodology; Part Four presents the empirical results and finally a conclusion.

II. LITERATURE REVIEW

RMX concrete is a kind of technical product, and, therefore, a brief introduction of concrete and definitions of related terms is assumed necessary.

Concrete is mixture of hydraulic cement, aggregates, and water, with or without admixtures, fibers, or other cementitious materials [3]. In general, concrete is made up of three basic components: water, aggregates (rock, sand, or gravel) and cement. Cement, usually in powder form, acts as a binding agent when mixed with water and aggregates. *Concrete mix design* is the proportions of materials to produce one cubic meter of concrete. The proportion of each material in the concrete mix design affects the properties of the final hardened concrete that determines concrete strength normally measured by Mpa (Megapascal), also called *concrete grade*. Quality of a specified concrete grade depends on not only well combined between materials (cement, aggregates, water and admixtures) in proportion, but also the quality of each material input.

If the concrete is mixed at site, it is named site mixed concrete whereas it is mixed at a batching plant and delivered to a job site (location at which construction takes place) by truck mixers; it is called ready mixed concrete (RMX concrete). Basically, every batching plant has its own quality control and quality assurance procedure to control over the input of materials as well as performance of equipment batching concrete at plant in order to ensure that the proportions of each material in a specific mix design are precisely measured, including water-cement ratio. In contrast, a formula to mix a specified concrete grade at job site could vary from one homebuilder to another, based on the homebuilders' experience, rules of thumb or their interpretation

of the cement manufacturer's recommendation printed on the bag which may be different from cement manufacturers' recommendation, especially a loose control of water-cement ratio, because workers tend to overdose water for the ease of pouring concrete job. But, this ratio is sensitive to concrete strength; in particular, when the water to cement ratio increases, the strength and durability of hardened concrete decreases. To increase the strength and durability of concrete, decrease the water-cement ratio – this is a general rule that could be found in materials referring to basic concrete properties; it is also seen in the document of Concrete Basics by Cement Concrete & Aggregates Australia [4]. In addition, RMX concrete is mixed at batching plants with a speed much higher than concrete mixed at the job site (site mixed concrete). It consumes 3-5 minutes to complete a batch of 6m³ RMX concrete whereas it takes about 30 minutes to mix 1m³ site mixed concrete.

In summary, characteristics of RMX concrete are better quality control, quality consistency and time-saving compared to those of site mixed concrete.

A. Choice of Theories Constructing Research Model and Hypotheses

With a view to building a research model for this study, it is crucial to establish appropriate theories as theoretical fundamentals. Although there is no previous research, to the best of the researcher's knowledge, on RMX concrete or a similar kind of construction materials in Vietnam, the researcher is convinced that constructs of the cognitive models, namely theories of reason action, planned behavior and theory of interpersonal behavior, are applicable for the study for three reasons. First, dealing with house construction, homebuilders are supposed to deliberately use of or not use of one product; they hold some beliefs about attributes of object for decision making. In this aspect, it matches with the assumption of these theories that individuals are rational actors. Second, these theories, especially TRA and TPB, have been used successfully to predict and explain in various content domains, including individual behaviors related to health, food, voting, internet use ... [2] and [5], and purchase of household products such as consumers' repurchase intention towards an automobile brand [6] besides these theories have been applied for small-medium enterprises where the decision is made autonomously as indicated by Southey's bibliography [7]. Lastly, building private houses is a job of engineers and mostly carried out by small construction companies (homebuilders) in practice; thus it is reasonably assumed that the decision making is autonomous according to Sheth [8] and [9].

Theories of reason action, planned behavior and theory of interpersonal behavior will be discussed in the following sections in turn.

1) Theories of Reasoned Action and Planned Behavior:

According to Ajzen & Fishbein [1] and Ajzen [2], theories of Reasoned Action (TRA) and Planned Behavior (TPB) make the assumption that people are "rational actors" who will process information and think about the implications of behavioral actions before deciding perform or not to perform a behavior. TRA and TPB focus on theoretical constructs concerned with individuals' motivational factors as determinants of the likelihood of performing a specific behavior, and both assume the direct predictor of a behavior is behavioral intention.

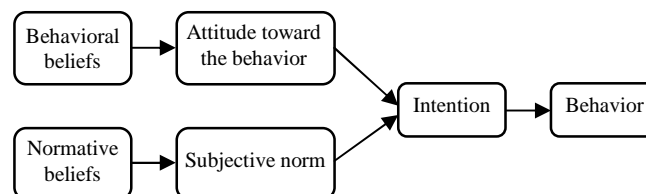


Figure 1 Schematic representation of the TRA [1]

TPB is an extension of the TRA. It includes two additional constructs, namely control belief and perceived control over performance of the behavior, to overcome the limitation of TRA and improve the predicting power of the model when predicting behaviors that people have incomplete volitional control as well as to better explain human intention and behavior.

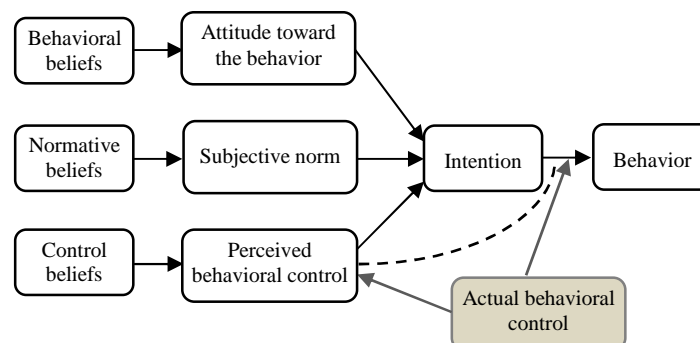


Figure 2 Schematic representation of the TPB [10]

Predicting Intention: According to Ajzen [2], intention is assumed to capture the motivational factors that influence a

behavior, and indicate how people are willing to try and how much effort they are willing to put forth in order to perform a given behavior. In TPB, intention is determined by attitude toward the behavior, subjective norm and perceived behavior control.

Behavioral Beliefs and Attitudes towards Behaviors: According to Ajzen and Fishbein [1] and [11], *behavioral beliefs* result in an *attitude toward behavior* and refer to a person's beliefs about the likely negative or positive consequences or outcomes of performing a given behavior. As a result, people prefer behaviors that bring in favorable consequences and ignore behaviors associated with unfavorable consequences. In order to assess individual's attitude toward behavior, there are two ways: direct or indirect measure [9]. The direct way is to ask questions directly in order to obtain people's overall attitude toward behavior. In an indirect way, Fishbein's Expectancy-value model (EVM) is employed to evaluate people's attitude toward behavior according to the following equation:

$$A \propto \sum_{i=1}^n b_i e_i$$

Where: the strength of each salient belief (b) is multiplied by the subjective evaluation (e) of the belief's attribute. A person's attitude (A) is directly proportional (α) to the sum of the resulting products over n salient beliefs

Normative Beliefs and Subjective Norms: According to Ajzen and Fishbein [1], *normative beliefs* result in *subjective norms* and reflect the likelihood that important individuals or groups (referents) will approve or disapprove of the behavior in question. Thus, subjective norms refer to social pressures that may arise from performing or not performing a behavior. With the same way measuring attitude toward behavior, subjective norms can also be measured directly or indirectly through an equation. The equation for subjective norms is presented in the equation below:

$$SN \propto \sum_{i=1}^n n_i m_i$$

In the equation, the strength of each normative belief (n) is multiplied by a person's motivation to comply (m) with the important referents. Subjective norm is directly proportional (α) to sum of products over n salient referents [2].

Control Beliefs and Perceived Behavioral Control (PBC): Control beliefs are factors that may facilitate or impede a performance of the behavior. These control beliefs - in combination with the perceived power of each control factor - generate the perceived behavioral control. These control factors may be affected by past experience with the behavior or by second-hand information about the behavior through other people's experience such as acquaintances, friends ... [2]. Generally, the more resources, opportunities and confidence individuals have, and fewer obstacles they feel, then the greater should be their perceived control over the behavior. Theoretically, PBC may moderate the effect of intention on behavior, that is, a positive intention will only lead to behaviors when PBC is strong enough.

As with measuring an attitude toward the behavior and subjective norms, PBC can also be measured directly or indirectly through an equation as below:

$$PCB \propto \sum_{i=1}^n c_i p_i$$

In the equation, the strength of each control belief (c) is multiplied by the perceived power (p) of a particular control factor that facilitates or hinders performance of the behavior. The perceived behavioral control is directly proportional (α) to the sum of products over n control beliefs [2].

2) Theory of Interpersonal Behavior:

Similar to TRA and TPB, the Theory of Interpersonal Behavior [12] describes an attitude-intention-behavior relationship. It comprises seven factors: effect, social factors, perceived consequences, habit, facilitating conditions, intention and behavior. The model, as presented in Figure 3, postulates that the probability of performing an act (behavior) is a function of Habit, Intention to perform the act and Facilitating Conditions. The intention of performing a particular behavior is a function of Perceived Consequences, Social Factors and Affect.

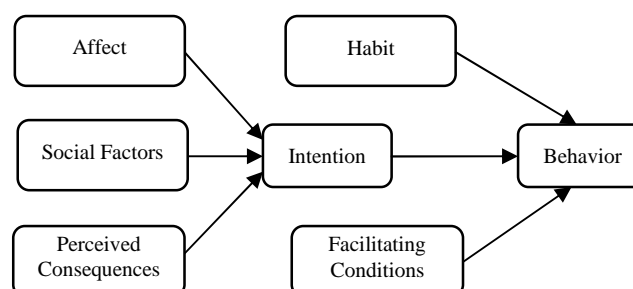


Figure 3 Schematic representation of the TIB [13]

Generally, TIB contains all components of the TPB; however, a new component namely Habit enables to increase the model's predictive power [13], [14] and [15]. Each of these conceptual constructs is briefly defined below. *Affect* refers to a person's pure emotion that could be favorable feelings such as joy, elation, pleasure ... or unfavorable feelings like depression, distaste, discontentment, or hatred in regards to a particular behavior. Affect is similar to *attitude* in TRA and TPB, but only combines affective elements while *attitude* in TRA and TPB contains both cognitive and affective elements. *Social Factors* refer to a person's internalization of the reference group's subjective culture, perception, and specific interpersonal agreements on which he (she) has behaved with others, in specific social situations. *Perceived Consequences* is defined as each act (behavior) is perceived to generate potential outcomes that have positive or negative value, including a probability that the outcome will occur. *Habits* refer to behaviors that have been made repeatedly over time, and have become automatic; therefore they occur without self instruction, cognition and deliberation in response to specific situations. Habitual behavior is a form of automatic and routine behavior. Habit is a function of an individual's past experience and ability to perform a specific behavior or act. *Facilitating Conditions* is defined as objective factors within the environment, on which observers can agree, will make performance of the behavior with ease. Facilitating conditions are important to individuals with intention of accomplishing a certain act, but they may be unable to do so because the conditions of environment prevent the act from being carried out. *Intention* represents "an individual's conscious plan or self-instruction to carry out a behavior". *Behavior* refers to "the actual physical act of performing a particular behavior".

B. Research Model and Hypotheses

The study uses TPB model as a theoretical foundation. Ajzen [2] concluded "attitudes toward the behavior, subjective norms with the respect to the behavior, and perceived control over the behavior are usually found to predict behavioral intentions with a high degree of accuracy". In contrast, the conclusion also mentioned that issues around the relations remain unresolved, i.e. relation between behavioral beliefs and attitudes toward the behavior; relation between normative beliefs and subjective norms; relation between control beliefs and perceived behavioral control. Although the nature of these relations is described and widely accepted in terms of expectancy-value model, the exact forms of these relations are still uncertain and still retain much room for improvement. In the light of the said conclusion (Ajzen [2]), the study uses indirect measures of attitudes, subjective norms and perceived behavioral control to predict the behavioral intention. Identifying specific consequences of using RMX concrete drive homebuilders' intentions as a matter of interest. Therefore, the factor 'perceived consequences' is borrowed from Triandis's model incorporated with attitude, subjective norms and perception of behavioral control in TBP to form the research model presented in the figure below

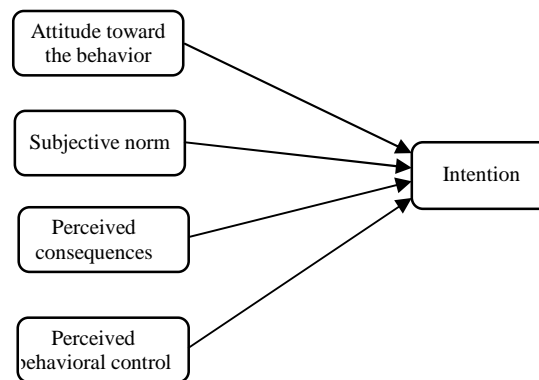


Figure 4 Proposed Research Model

According to the literature review, factors influencing homebuilders' intention to use RMX concrete when building private houses are hypothesized as follows:

H1: There is a positive relationship between attitude and intention of using RMX concrete

H2: There is a positive relationship between subjective norm and intention of using RMX concrete

H3: There is a positive relationship between perceived consequences and relationship with intention of using RMX concrete

H4: There is a positive relationship between perceived behavior control and intention of using RMX concrete

III. RESEARCH METHODOLOGY

Research design: The research is carried out in two stages: (1) qualitative research; (2) quantitative research. Seven participants were asked questions recommended by Ajzen [10] via an in-depth interview, the first step helped to understand belief elicitation homebuilders hold when using RMX concrete to build private houses. Based on the results of qualitative

research in the first step, a questionnaire of 18 items was developed and used to ask 5 respondents for wording adjustment in order that the questionnaire could be more understandable to respondents before it was exposed to interviewees in mass.

Data collection: Target respondents of the research were directors of small construction companies building private houses, and their job-site chief engineers in HoChiMinh city. They are representatives of homebuilders. Among 125 responses, there were 104 valid responses for data input after being filtered.

Construction of questionnaire: The questionnaire was made up of two sections: Section 1: questions about variables of factors which measure homebuilders' intention to use RMX concrete, including Attitudes, Subjective norms, Perceived Consequences and Perception of Behavioral Control. Adapted to Ajzen's (2002) guide, questions were designed in this section using a 5-point Likert scale. In each question, Number 1 at one extreme corresponds with a respondent's total disagreement or strongly negative evaluation, and Number 5 at the other extreme corresponds with a respondent's total agreement or strongly positive evaluation. Number 3 in middle corresponds with a respondent's neutral, neither agreement nor disagreement. Section 2: questions are asked for collecting respondents' personal information such as name, age, years of experience, education and source of information seeking RMX suppliers.

IV. EMPIRICAL RESULTS

A. Statistical Analysis

Through 104 valid responses, respondent profiles are depicted in Figures 5, 6, 7 and 8. Most of the interviewed homebuilders (67 people; 64%) have more than 5 years' experience in business while only few homebuilders are freshmen (11 people; 11%) less than 2 years' experience. In congruence, majority of homebuilders are above 25 years old, altogether accounting for 97% as shown in Figure 6; and Figure 7 indicates 92% of homebuilders holding a college degree or above, approximately 11% have an educational level at high school or below – this reflects few homebuilders have developed their careers based solely on job experience. A link to reality, it is true that homebuilders are expected to have a certain experience, to be mature and to be equipped with a certain level of education in construction techniques; the implication could be considered that criteria exist in practice and apply to homebuilders:

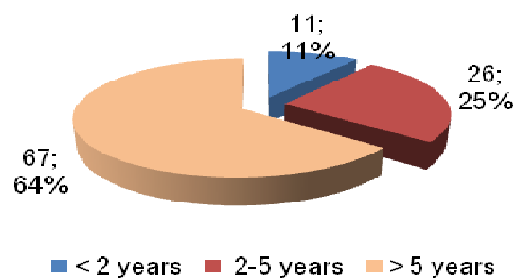


Figure 5 Years of Experience

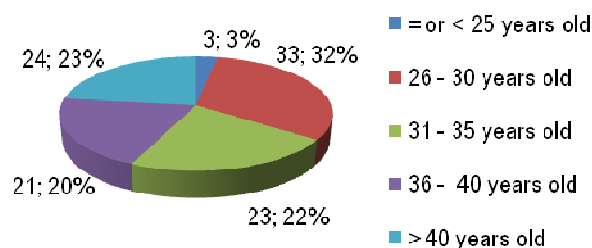


Figure 6 Respondents' Age

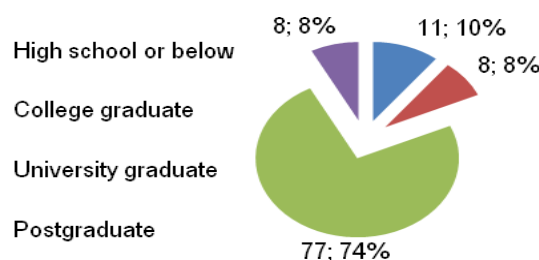


Figure 7 Respondents' Education

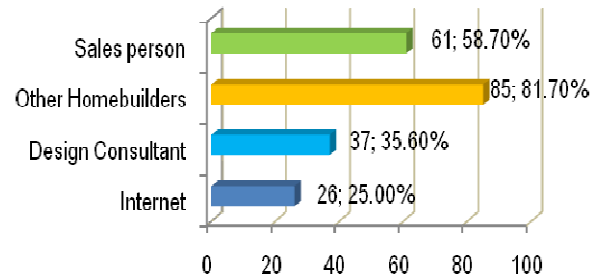


Figure 8 Sources to find RMX concrete suppliers

Examining Figure 8, when being asked a multiple choice question about sources to search RMX concrete suppliers, respondents mostly take a reference from other homebuilders -- up to 81.7%; second frequency by 58.7%, that is, they check with acquainted sales person of suppliers with whom they have worked before. The result implies that word of mouth and building customer relationships are good marketing tools to approach homebuilders efficiently. They deserve to take managers of RMX concrete suppliers into account.

ANOVA is applied to see whether or not there exist any significant differences of behavioral intention within respondent groups classified by age, experience and education. Results show that all Levene sig are above 0.05 as shown in Table I above. Thus, it can conclude that there is no significant difference of intention in respondent groups by age (sig. 0.134 > 0.05), by experience (sig. 0.160 > 0.05) and by education (sig. 0.134 > 0.05) respectively.

No significant difference on the intention within groups characterized by age, experience and education could interpret that to a certain extent, homebuilders have identical ideas about RMX concrete. They have a common evaluation on RMX concrete, it could be because they deliberately think about and assess the use of RMX concrete as well as its characteristics rather than they act on their impulse or emotion. With this regard, homebuilders are rational actors congruent with assumption of the proposed research model.

TABLE I SUMMARY OF TEST ON DIFFERENCE BY HOMEBUILDERS' CHARACTERISTICS

Respondent groups		Number	Test of Homogeneity of Variances	
			Levene Statistic	Sig.
By Age	≤ 25 years old	3	1.805	0.134
	26 - 30 years old	33		
	31 - 35 years old	23		
	36 - 40 years old	21		
	From 40 years old	24		
	Total	104		
By Experience	< 2 years	11	1.865	0.160
	2-5 years	26		
	> 5 years	67		
	Total	104		
By Education	High school or below	11	0.441	0.724
	College graduate	8		
	University graduate	77		
	Postgraduate	8		
	Total	104		

B. Cronbach Alpha and Exploratory Factor Analysis

Reliability Test on each factor and Exploratory Factor Analysis (EFA) are carried out. First, Cronbach's Alpha test is used to access internal reliability, essentially evaluating whether all items in a scale are measuring the same thing [16]. As a result, two items of 'Perceived Consequences' are eliminated to improve Cronbach Alpha coefficient to be 0.729 as indicated in Table II below. Next, EFA is applied because of three reasons: (1) item reduction, (2) inspection of convergent validity of proposed factors to see if any latent subsets (sub-constructs), (3) extraction of factors which become independent variables for a multi regression analysis. The remaining 16 items meet the requirement of factor loading ≥ 0.5 , and all factors have cumulative variance higher than 50%, meeting the requirement. The results are shown in Table II below.

TABLE II SUMMARY OF QUALIFIED VARIABLES FOR REGRESSION ANALYSIS

Factor	Code	Item	Mean	Factor loading
Factor 1: Attitude toward the behavior (ATT) <i>Cronbach Alpha: 0.861</i> <i>Cumulative %: 71.492</i>	ATT1	In general, when building private houses with RMX concrete, I feel (unsatisfied/satisfied)	3.94	0.870
	ATT2	For me, choosing RMX concrete to build a private house is (inconvenient/convenient)	3.71	0.797
	ATT3	Choosing RMX concrete to build private houses, I feel (worried/calm)	4.20	0.847
	ATT4	For me, choosing RMX concrete to build private houses is (wrong/right)	4.00	0.866
Factor 2: Subjective norms (SUN) <i>Cronbach Alpha: 0.803</i> <i>Cumulative %: 64.239</i>	SUN1	In general, people who are important to my work (e.g design consultant, supervision consultant engineer and homeowners) approve of my choosing RMX concrete to build the private house	4.00	0.866
	SUN2	Most design consultants recommend RMX concrete to homeowners	3.58	0.716
	SUN3	For me, most homebuilders like me prefer using RMX concrete to build private houses	3.59	0.787
	SUN4	Securely meet requirement of designed strength, important people to me think I should choose RMX concrete to build the private house	4.14	0.829
Factor 3: Perceived consequences (PEC) <i>Cronbach Alpha: 0.729</i> <i>Cumulative %: 55.504</i>	PEC1	Compared with site mix concrete, RMX concrete has the strength more stable and is more homogenous between batches ; bringing in a better quality of concrete pour	4.09	0.754
	PEC2	Using RMX concrete will shorten execution time significantly	3.95	0.704
	PEC3	For me when choosing RMX concrete, it requires me to spend much time for processing order and coordinating delivery	2.76	0.760
	PEC5	When using RMX concrete, I'm worried about on time delivery	2.32	0.760
Factor 4: Perceived behavioral control(PBC) <i>Cronbach Alpha: 0.798</i> <i>Cumulative %: 63.130</i>	PBC1	For me, choosing RMX concrete to build a private house is (difficult/easy)	3.47	0.803
	PBC2	I have full control over choosing RMX concrete when building a private house	3.78	0.805
	PBC3	If I want to, I will have no problem in use of RMX concrete to build a private house	3.63	0.844
	PBC4	Whether or not using RMX concrete to build private houses is mostly up to me	3.14	0.722

C. Regression Analysis

As shown in Table III, R square (0.633) is greater than adjusted R square (0.619). Conservatively, adjusted R square is chosen to state that 61.9% of variance in homebuilders' intention of RMX concrete is explained by the set of independent variables (Attitude, Subjective norm, Perceived consequences and Perceived behavioral control). In this research, Durbin-Watson is 1.974 (approximately 2); it proves that no autocorrelation in the residuals affects the result of multiple regression analysis.

TABLE III MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0.796 ^a	0.633	0.619	0.61763318	1.974
a. Predictors: (Constant), PBC, PEC, ATT, SUN				
b. Dependent Variable: INT				

In Table IV, all beta coefficients of factors are positive; it supports the research hypotheses that all independent variables have a positive relationship with intention. With sig. less than 0.05, it is said that Attitude, Perceived consequences and Perceived behavioral control have a statistically significant impact on Intention at a 95% level of significance. In respect of Subjective norm, the sig. is equal to a threshold of 0.05 not exceeding 5%. It could be considered acceptable at a 95% level of significance too. In short, all 4 independent variables have statistically significant influence on Intention, and they are directly proportional to Intention. Thus, hypotheses in the research model are all supported.

TABLE IV COEFFICIENTS

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	7.176E-17	0.061		.000	1.000		
ATT	0.338	0.105	0.338	3.217	0.002	0.335	2.989
SUN	0.221	0.111	0.221	1.987	0.050	0.301	3.327
PEC	0.168	0.068	0.168	2.459	0.016	0.794	1.259
PBC	0.256	0.075	0.256	3.433	0.001	0.665	1.504

a. Dependent Variable: INT

Variance Inflation Factor (VIF) values are less than 10, so multicollinearity is not problematic in the research model.

Attitude toward the behavior (ATT) has a positive effect on the Intention. In general, it can be interpreted that homebuilders

hold an overall positive evaluation on RMX concrete; for instance, they judge the use of RMX concrete is 'right' and it will bring in a sense of 'calm' (peace of mind). In congruence with the RMX concrete's features discussed in Chapter 2, RMX concrete is produced with modern equipment at batching plants and better control over production process that could logically explain the reason for homebuilders' assessment of RMX concrete quality over site mixed concrete.

Subjective norms (SUN) impact on homebuilders' intention of using RMX concrete in a direct proportional way. It means homebuilders perceive that they had better use RMX concrete to ensure the designed strength and please the important people (design consultant, homeowner and supervision consultant), keeping away from quality problem. They also strongly believe that these important people will approve of their use of RMX concrete. As a result, it could be true that the important people partly exert homebuilder's predisposition to using RMX concrete to build houses.

Perceived consequences (PEC) have a positive relation with the intention of homebuilders towards using RMX concrete. Overall, the homebuilders evaluate the positive outcomes of using RMX concrete. The implications are deduced that RMX concrete suppliers should improve the time for order process and timely delivery, because the home builders negatively assess these issues as weak points (mean values of PEC3 = 2.76 and PEC5=2.32 respectively).

Perceived behavioral control (PBC) has a positive effect on the intention of homebuilders. Generally speaking, homebuilders think that they could make decision on using RMX concrete at ease, all mean values of variables in this construct are slightly higher than neutral (3) on positive side of a 5-point Likert measurement scale.

V. CONCLUSION

Results of multiple regression analysis denoted that all four factors - Attitude, Subjective norms, Perceived behavioral control and Perceived consequences listed in descending order of importance - have a positive effect on homebuilders' intention. Altogether, the four factors explained 62% of variance in homebuilders' intention of using RMX concrete. It leads to the conclusion that all constructs and hypotheses of the research model are supported. Besides, ANOVA shows that no significant difference of the intention towards using RMX concrete by homebuilders' characteristics such as age, experience and education. This is also in line with the assumption of the research model that homebuilders are rational actors. They think about the possible outcomes or consequences when deciding to use RMX concrete to build houses instead of site mixed concrete rather than they act impulsively.

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