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Creativity mindset as the organizational capability: the role of creativity-relevant processes, domain-relevant skills and intrinsic task motivation

Creativity mind-set as the organizational capability: The role of creativity-relevant processes, domain-relevant skills and intrinsic task motivation

Abstract

Purpose- The objective of this study is to examine the structural relationship between creativity-relevant processes, domain-relevant skills, intrinsic task motivation, creativity and the moderating effect of social environment (sufficient resources, workgroup support, realistic work pressure and lack of organizational impediments).

Design/methodology/approach- A total of 289 valid questionnaires was collected from engineering students in Malaysian universities to test the measurement as well as the structural model using partial least squares (PLS) path modelling.

Findings- While the statistical results support the structural relationships (direct effects), the social environment shows the insignificant moderating effect (except creativity relevant process to sufficient resource to creativity). This study reveals that while a high level of domain-relevant skills, intrinsic task motivation and creativity-relevant processes influence creativity among the sample of engineering students, social environment acts as an irrelevant moderator to the creativity perception. Work-group support, sufficient resources and lack of organizational impediments, as the three factors of the social environment, will not have any effect on creativity of upcoming engineers.

Originality/value- While businesses in the emerging markets mostly neglect the concept of developing creative mind-sets among engineering students, in the competitive world of business that is extremely fast-paced, being creative within a business setting will act as a paramount criterion to differentiate. Practical and theoretical implications are discussed.

Keywords: creativity-relevant process, intrinsic task motivation, social environment, creativity

1. Introduction

Creativity and its significance within the engineering realm is rather blatant in today's competitive market, since it acts as a crucial step towards producing constant innovation for companies. There is a highlight on boosting creativity among future engineers since creativity operates as a pivotal function in engineering as a profession (Blashki *et al.*, 2007). Despite the fact that the importance of demographic in the entrepreneurship realm is undeniable (Vuorio, 2017), interestingly, there is an agreement among 65% of engineers who are holding a position in manufacturing, application and mechanical engineering firms, that there is a need for more creative and innovative engineers today, who can compete in the global market (Charyton *et al.*, 2011). As a result, the prominent need for engineering students' creativity gained some attention in the research field as well. As (Liu and Schönwetter, 2004) stated teaching creativity to engineering students can be considered as a crucial matter since it will help engineers meet the professional expectations in parallel with fulfilling the individuals' intellectual development. This need has been articulated by engineering alumni as well. Engineering students are gaining more awareness toward needing creativity in their careers (Sun *et al.*, 2017). Zampetakis *et al.* (2007) additionally stated that 77% of engineering students expressed their willingness in taking a creativity and creative problem-solving class (Charyton *et al.*, 2011). This acts as an evidence of how essential it is to consider, incorporate and embed creativity in the engineering arena from the initial stage. However, creativity seems to be neglected in the early stages of engineers' professional lives. While engineering students have an increasing tendency toward creativity Zampetakis *et al.* (2007), but the engineering curriculum is filled with the basic sciences like mechanics, physics and mathematics in order to teach students the problem-solving techniques that are specified in engineering realm. 87% of students who are currently studying in an engineering major agreed that creativity is a necessary skill in the engineering realm as well (Charyton *et al.*, 2011). Despite the fact that academician, alongside, educators, researchers and organisations focused on engineering are all in agreement that we need necessary improvements in engineering education regarding methods of training to help foster creativity (Tekmen-Araci and Mann, 2018), there is barely a concrete body of research that looked closely into creativity at that level. The aspect that has been neglected by many businesses is individuals and expanding creative mind-sets (Amabile and Khaire, 2008). While creative mindsets are essential, but it is also paramount to bear in mind that creativity does not happen in a vacuum. There is a need to see how an environment can influence creativity and its journey to innovation. Hoegl and Parboteeah (2007b), Jeffries (2007) and Wilpert (2008) stated the componential model of creativity by Amabile (1996) as a creativity model that has been frequently used. Three components of individual components of creativity in the componential theory of creativity, including domain-relevant skills, creativity-relevant processes, and intrinsic task motivation were introduced. There was a desire to develop a model of creativity at an individual level, which looks at the creative behaviour. Sitaridis and Kitsios (2017) discussed the entrepreneurial intentions of information technology students using the theory of planned behaviour. As it can be observed, many studies have looked into the magnitude of creativity and its relationship to individual components (Hoegl and Parboteeah, 2007b; Eder and Sawyer, 2008; Hauksdóttir, 2011), while others studies (Kuo, 2011; Inchamnan *et al.*, 2012; Liu and Schönwetter, 2004; Amabile, 2012; Gehani, 2011) accredited the element of the environment as a factor that can influence creativity. This element subsists outside the realm of an individual. Such researches act as a proof to exhibit the importance of creativity (from the perspectives of within as well as outside a human being). Additionally, recent investigations like (Khalili, 2020) took it one-step further by looking closely at into creativity from an indivual lenses and its implication and contributions to innovation as its fruit of labour. Therefore, there is a need for a study that looks deeper into creativity from both levels and examining it within a theoretical framework while looking into the detailed-level in engineering students.

Looking into three individual components, generally, domain-relevant skills in an environment, refer to a person's knowledge of the job as well as having the ability in performing the needed tasks (Eder and Sawyer, 2008). The specific knowledge of the domain is also playing a significant role in creativity. Hoegl and Parboteeah (2007a) looked at the domain knowledge as needed skills. Relevant skills which exist in the specific domain should be mixed with divergent thinking (Charyton *et al.*, 2011; Chako, 2000). Studies by (Tierney and Farmer, 2002; Eder and Sawyer, 2008) looked at domain-relevant skills and creativity-relevant processes while Villalba (2008) only took domain-relevant skills into account. When an individual is encouraged to perform a task, the variables that bring motivation are referred to as intrinsic task motivation or passion. This component is the drive behind starting and keeping up with the creative process (Amabile, 1983; Inchamnan *et al.*, 2012). While domain-relevant skills and creativity-relevant processes are two significant components of individual components of creativity, but intrinsic task motivation determines what task a person can really carry out. It is not just important that a person has the knowledge and could go through the creative process mentally, but also, it is essential that he/she enjoys the task at hand (Amabile, 1997). There is also a component outside the individual which can be discussed. Amabile (2012) mentioned that the factor outside a person ‘s territory is the social environment. Many theorists, including (Amabile, 1983; Woodman *et al.*, 1993) developed theories considering personality, motivation and cognitive variables along with social elements to understand the creative outcome since it is rather a complex phenomenon to be analysed. This element has all outer motivators that affect intrinsic task motivation, on top of some other environmental elements, which act as either an impediment or as a nourishment to creativity and task motivation that comes from within (Amabile, 2012). This model was particularly chosen for this research since it embodies creativity from both individual and organizational level. There is need to investigate creativity (from both within and outside the indivual level) among engineering students and further investigation of this theory within the scope of engineering students has barely been investigated previously, as a result, this body of research can be highly beneficial to close the gap.

Therefore, the current study is aiming at examining the structural relationship between creativity-relevant process, domain-relevant skills, intrinsic task motivation, creativity and the moderating effect of social environment (lack of organizational impediments, workgroup support, sufficient resources, and realistic work pressure) among engineering research students. This study has four sections. In the first part, we present the literature review and hypotheses development that investigates the theoretical foundation of our study. After proposing the model, we discuss and review the methodology and statistical approaches. In the third section, we present the empirical results and discussions. Finally, we explore the theoretical and practical implications of our research.

2. Literature review and hypotheses development

There is not a worldwide agreement about the entity of creativity on both individual and organizational levels of analysis (Valaei *et al.*, 2016). Reisman (2013) highlighted the significance of creativity. The importance of creativity is rather obvious in terms of thinking, problem-solving and making a better-quality life in general terms and it has been reflected in the works of many authors. The last category has its focus on the product regarding various qualities and outcomes of creative attempts in works done by (Martins and Terblanche, 2003), which is an essential part of engineering in practice. There are studies in existence on how creativity needs to be taught and exercised for the education in the engineering realm. But, the number of researches that looked deeply into the implications, challenges and details are still very limited (Tekmen-Araci and Mann, 2018). In the area of research regarding creativity, personal issues as well as contextual factors, have been studied (Paramithaa and Indartib, 2014). Studies like Nazzal and Kauffman, 2020 paved the way by observing the various stages of creative problem solving and how they associate with one another in regards to the overall creativity that engineering alumni exhibit. Nevertheless, the question that remains here is how creativity and innovation are being influenced by the individual and out of managerial components (Andersen and Kragh, 2015; Duarte Alonso *et al.*, 2018). Therefore, when a response, product or solution that is novel and appropriate is being produced, it can be called creativity (Amabile, 2012). For engineers to successfully practice creativity in the workforce there is a need to provide detailed research on how creativity is being treated in the future engineers. Thus, it is beneficial to ask that question and see whether or not engineering students, who will be the future engineers, get to practice and foster creativity and what impediments they might encounter. There is an increasing perception of the need for graduates of engineering to be creative thinkers and innovators. It is however, not clear how creativity can be nurtured or fostered within students or how it can be assessed. Many engineering alumni highlighted the role of creative thinking and its significance to tackle problems that are complex. Tackling such complexity may need explicit idiosyncrasies that are essential to individual creativity and innovation they can exhibit (Khalili, 2020). To draw a clearer picture, there is a need to conduct a study to look at creativity from both point of views within this population. As the next step, we need to study within-the-indivual components of creativity in engineering students.

2.1 Domain-relevant skills

As a fundamental component, domain-relevant skills refer to knowledge, talent, intelligence, and expertise as well as technical skills within a specific domain where the person, who solves the problem, works. These skills include the raw resources, that an individual can get assistance from, in the creative process. These elements combine together to create plausible responses and expertise to pass judgment on the practicality of possible responses (Amabile, 2012). The term “expertise”, as a part of domain-relevant skills, is pointed out as the foundation of all the creative work. To solve a given problem or even to carry out a given task, a set of cognitive pathways is being utilised. The components of expertise could be the memory of knowledge, which is factual, technical skills, and unique talents within the intended work realm (Amabile, 1997). As Amablie (1996) defined, domain-relevant skills is a performance starting point in a considered domain.

The knowledge in the domain is the key to generating a solution, which is suitable (Duarte Alonso *et al.*, 2018). Talking about domain-relevant skills, it suffices to say that they form the basis, which is needed when any performance ought to be carried on. What this component does is that it integrates factual knowledge as well as technical expertise and unique talents that lie within a particular domain. Works of (Amablie, 1996) showed that supports of supervisors or lack of the support in conjunction with opportunities for education (both formal and informal) affect the existing knowledge on the field and technical skills. These are the needed themes that an individual brings to a job and they will affect the creative preparation process. Amablie (1996) looked at domain-relevant skills in the organizational setting and its link to employees’ personal cognitive abilities. The importance of domain-relevant skills was extensively discussed in the literature review while it stated that there was a lack of studies to look at the direct relationship between the domain-relevant skills and creativity components. Having stated that knowledge has shown a positive relationship with creativity was only covered by very few studies, while its significance was highlighted in the literature. Discovering whether, having knowledge of the field is positively related to creativity is in need of further investigation. As a result, hypothesis H1 is being formed as:

H1: Individuals with a high level of domain-relevant skills exerts the influences (H1a) domain relevant skills, (H1b) intrinsic task motivation and (H1c) creativity.

2.2 Creativity-relevant processes

As the second component to be discussed, creativity-relevant processes apply to personality characteristics and cognitive style, which will pave the path toward risk-taking, independence, and taking new standpoints on problems, besides a disciplined work style and skills to generate ideas. The personality processes include self-discipline and a tolerance for ambiguity" (Amabile, 2012). Taggar (2002) views creativity-relevant processes like the intersection, which has been created by two new paths. The interest of developing creative ideas within a team and its internal process can facilitate the creative process.

Creativity-relevant processes in work setting were investigated by Dacey and Lennon (1998). It is defined as developing a work style which results in creative production. Cognitive style besides the applying heuristics to investigate new concepts that comprise creativity-relevant processes (Amabile, 1983). Creativity-relevant processes will bring an extra flavour to creative performance. If we assume that an individual has motivations to carry out a task, the outcome is expected to be technically acceptable or sufficient if the required expertise exists at the place. Nevertheless, if the creative thinking skills are not present, creative work will not be produced even if the person's expertise is at a high level (Chako, 2000). These needed skills encompass some cognitive styles, that will help in taking new viewpoints on problems. They also will explore new cognitive methods for the application of techniques. In addition, it will assist with a working style, which leads to being a determined, energetic follow up on an individual's work (Amabile, 1997). Creativity-relevant skills and processes are one's innate and developed abilities to come up with creative ideas in order to recognize, to explore, and to solve problems in a creative way. Creativity-relevant processes provide engagement as well as involvement in creative thoughts and creative experiences that include creativity training (Eder and Sawyer, 2008). Previous research indicate that there are challenges when there are attempts to foster creativity within the realm of engineering design education. The body of research also pinpoints the issues that arise from implementing those creative solutions (Tekmen-Araci and Mann, 2018).

One of the features of creativity-relevant processes is the ability to focus for long periods when it comes to time. Creative people are known to have characteristics like perseverance, self-discipline, being unorthodox and possessing the ability to postpone gratification (Inchamnan *et al.*, 2012). Another feature that distinguishes problem solvers is that they can activate their relevant knowledge in an automatic manner, which is connected to the experience they gained from solving problems in the past. Besides, creative thinkers prefer to think and to originate new ideas and perspectives. Therefore, employees with creative cognitive styles have more tendency to be creative at work (Miron *et al.*, 2004). Birdi *et al.* (2014) observed the importance of creativity-relevant processes of creativity while (Eder and Sawyer, 2008; Inchamnan *et al.*, 2012) took the creative process along with other variables into the research. Amablie (1996) stated that conducting playful activities or engaging in fantasies which can positively affect the engagement of creativity-relevant processes (Inchamnan *et al.*, 2012). Individuals, who have more creative and innovative cognitive styles, get pleasure from approaching their tasks with different, original, and undisciplined ways (Miron *et al.*, 2004). The results of a study by Valaei *et al.* (2017) show a positive association between top managers' explorative learning capability and improvisational creativity. Valaei (2017) also finds that sense-making activities of employees are conducive to improvisational and compositional creativity. As it can be observed, a creativity-relevant process was not studied in terms of its relationship with creativity sufficiently. However, there is a requirement to observe if there is a positive relationship between creativity-relevant processes and creativity. As a result, hypothesis H2 will be formulated as follows:

H2: Individuals with a high level of creativity-relevant processes exerts the influences of creativity.

2.3 Intrinsic Task Motivation

Intrinsic task motivation, in agreement with Amabile (1996), can be interpreted as the passion and motivation to carry out a work or to solve a problem mainly because it seems challenging, interesting or even satisfying on a personal level. The distinction is that in intrinsic task motivation, there is a motivation that derives from within an individual rather than extrinsic motivation. People are at their most creative level when their motivations come mainly from sources like "interest, enjoyment, satisfaction, and the challenge of the work itself" and not necessarily by motivators, which are outside (i.e. extrinsic). As studies have outlined, intrinsic motivation can dramatically change when forces that support it are present or absent (Amabile, 2012). Amabile's componential model of creativity proposes that a creative work is judged as an act that is creative, by an individual that has adequate information about that area of expertise (Wilpert, 2008). According to Amabile's theory, both internal and external factors affect the creative process of an individual (Hauksdóttir, 2011). Jeffries (2007) argued that the componential model of creativity has been suggesting that the occurrence of creativity is the circumstance in which motivation and expertise are both present there.

Zhang and Gheibi (2015) asserted that since there have been various researches on intrinsic task motivation, in the literature of creativity; most studies heavily relied on the theory which is developed by (Amabile *et al.*, 1996). Another important perspective to discuss is that intrinsic task motivation can even compensate for expertise or even creative thinking skills. Studies have suggested that when the intrinsic task motivation is to a high degree, it could make amends in regards to a lack of expertise or even skills on creative thinking. A person, who has the higher intrinsic motivation, will find other domains for getting the required skills. In addition, the person puts a huge deal of effort on getting essential skills in the domain in which they function at (Amabile, 1997). Intrinsic task motivation has been rarely assessed while the significance of intrinsic task motivation in the creative process has been accentuated. Culpepper (2010) stated that researches by Amabile, which took place in 2007, look through the concept of understanding the progress, which increases the sense of motivation in an individual. In the current study, we will take a step-in order to bridge the mentioned gap, which is left by infrequent assessment of intrinsic task motivation in the previous studies. In order to close the stated gap, there is a need to observe whether there is a positive relationship between intrinsic task motivation and creativity or not. As a result, hypothesis H3 is outlined:

H3: Individuals with a high level of intrinsic task motivation exerts the influences of (H3a) creativity relevant process and (H3b) creativity.

2.4 Social Environment

It is noteworthy to develop an understanding of creativity from interaction processes (Kuo, 2011). The model proposed by Amabile (1983) on the relationship between social/environmental variables and creative behaviour in an individual was utilized by many researchers. While it is true that the social environment can influence an individual 's sense of expertise and creative–thinking skills and how they are being developed, but the motivation is the factor which receives the most direct as well as the strong influence that is provided by the environment (Inchamnan *et al.*, 2012). Moreover, works by (Azizi-Nejad, 2014; Paramithaa Anggia and Nurul, 2014) clearly state that social environment needs to be further investigated since its moderating effect on creativity receives attention and interest from various research workers in the field. The path to creativity and its prosperity is being paved by a suitable social environment (Hauksdóttir, 2011). Some investigations were conducted by Cropley (2006) on the weight of understanding what role society actually plays on both the quantity along with the quality of creativity in a specific place and time, whereas the work by Ruiz-Moreno *et al.* (2008) additionally substantiates the influence that environment has on creativity. Looking at works by (Amabile, 1988; Sternberg, 1999; Zhang and Bartol, 2010) declares the point that when an environment acts as a stimulant to creativity, its role gets accentuated. Four elements of the environment (Workgroup support, lack of organizational impediments, realistic work pressure, and sufficient resources) can be outlined and defined as follows. Workgroup support refers to "diversely skilled work groups, in which people communicate well, are open to new ideas, constructively challenge each other's work, trust and help each other, and feel committed to the work they are doing" (Amabile, 2012, p. 102). In addition, lack of organizational impediment is referring to *"*An organizational culture that does not impede creativity through internal political problems, harsh criticism of new ideas, destructive internal competition, an avoidance of risk, and an overemphasis on the status quo" (Amabile, 2012, p. 102). Furthermore, sufficient resources are the distractions from creative work (Ghobadian *et al.*, 1995). Therefore, this study hypothesizes as follows.

H4a-c: Lack of organizational impediments moderates the relationship between (H4a) domain-relevant skills (4b) creativity-relevant processes and (H4c) intrinsic task motivation on creativity.

Intrinsic task motivation is the result of a positive reaction to task qualities (Amablie, 1996). Researchers, in the past thirty years, have failed to make a general agreement on the effect of motivation on creativity (Eisenberger and Shanock, 2003). Previous studies (Tierney *et al.*, 1999; Eisenberger and Rhoades, 2001; Shin and Zhou, 2003; Aselage, 2005) looked at intrinsic task motivation in employees' creativity empirically, but it was stated that while the central prediction of the componential model of creativity was on intrinsic task motivation, but there is still a lack of empirical reaches within this area. Interestingly, when it comes to intrinsic task motivation, works by Eisenberger and Cameron (1996) outlined that task motivation plays a challenging role in creativity. As an instance, Amabile (1988) and Shalley (1991) looked at motivation among employees.

Kuo (2011) stated that creativity from views of individual traits and beliefs was the focus of many researchers like (Ivcevic, 2009). Some researchers such as (Pirola-Merlo and Mann, 2004; Kazerounian and Foley, 2007; Allen and Coleman, 2011; Keibler, 2014) looked at creativity in the individual realm, while others like (Amabile, 1983; Inchamnan *et al.*, 2012) put an emphasis on the value of investigating creativity from both individuals and groups in social settings that are relevant to them. Others like Csikszentmihalyi (1999) pointed out the significance of factor confluences to produce creativity. Elements that are connected to a domain, field and individuals should get together so that creativity can happen as a result. In most of the previous researches, which were mentioned in the literature review, the relationship of each individual component of creativity was taken into the account. When it comes to the componential theory, it is unique in various respects. The reason is that this theory takes both individual components (like motivation, covering skills and related scope) and an external component (i.e. social environment) into account (Amabile, 2012; Nandakumar *et al.*, 2010). Therefore, this study hypothesizes as follows:

H5a-c: Workgroup support moderates the relationship between (H5a) domain-relevant skills (5b) creativity-relevant processes and (H5c) intrinsic task motivation on creativity.

Intrinsic task motivation has been rarely assessed, while the significance of intrinsic task motivation in the creative process has been accentuated. Intrinsic task motivation was referred to as the mechanism which paves the path towards the achieved empirical results (Oldham and Cummings, 1996). Culpepper (2010) stated that researches by Amabile, which took place in 2007, look through the concept of understanding the progress which increases the sense of motivation in an individual. In the current study, we will take a step in order to bridge the mentioned gap, which is left by infrequent assessment of intrinsic task motivation in previous studies. While some studies have shown a positive relationship between intrinsic task motivation and creativity, there are others, which outlined a negative relationship between intrinsic task motivation and creativity. Since such a relationship was barely assessed within the setting of universities, there is an obvious need for further investigations. The essential role of environment in creativity (Csikszentmihalyi, 1996) makes changes in the environmental conditions, therefore, it will be easier to increase creativity rather than making an effort to make people think in a creative way. Also, creativity from the situational elements' standpoint was the realm of many researchers (Ivcevic, 2009; Kuo, 2011). On the other hand, there are some factors that help in stimulating creativity. Some factors that are related to the environment and can embellish creativity are a sense of freedom, great sense of challenge, cooperative teammates, who inspire creativity and authorities, who welcome creativity. These can be listed as creativity stimulant elements (Amabile, 2012). Therefore, Hypotheses 6a, 6b and 6c are formulated as follows:

H6a-c: Sufficient resources moderates the relationship between (H6a) domain-relevant skills (H6b) creativity-relevant processes and (H6c) intrinsic task motivation on creativity.

Employees are more interested in carrying out their tasks and enjoying them when they can experience intrinsic task motivation at a high level. As a result, employees, who have the intrinsic task motivation, are more open to exploring "new ideas, take risks, and exhibit creative performance" in comparison with the counterparts who experience a lower level of motivation. Intrinsic task motivation of each employee depends on the personality as well as the social environment. While the person should enjoy the task, the social environment will play a predominant part on his/her intrinsic task motivation level. It has been stated that the level of intrinsic task motivation could encompass a considerable influence on the creativity of an individual (Amabile, 2012). Also, Ivcevic (2009) emphasized the fact that an abundant number of researches in creativity were conducted with a concentration on individuality. Work by Mumford (2003) stated that creativity is strongly affected when there is an interest to do a task which is also known as intrinsic task motivation (Eisenberger and Shanock, 2003). This will act as proof of the significance of such a research.

Simultaneously, the 21st century and its global market requirements have been creating the need for individuals to exhibit creativity, critical-thinking skills and innovation, as employees. In higher education systems, it can be seen that there is an increasing level of attention being paid to creativity (Allen and Coleman, 2011; Kazerounian and Foley, 2007). Furthermore, looking at engineering education and the role of creativity in it, the existing approach of in-the-box thinking, will not pave the way for creativity to be embellished and what they teach is even close to what happens in the real world conditions (Brown, 2007; Charyton *et al.*, 2011). The creativity of engineering students in universities is an essential matter. Nowadays, looking at universities and their engineering education programs, we can note the expectations for supporting as well as encouraging creativity and the opportunities for that are higher. As far as the engineering students are concerned, universities are expected to provide those possibilities (Liu and Schönwetter, 2004). Additionally, there are inadequate opportunities for creativity in the environment that engineering students are exposed to (Brown, 2007). Therefore, the following hypotheses are formulated:

H7a-c: Realistic work pressure moderates the relationship between (H7a) domain-relevant skills (H7b) creativity-relevant processes and (H7c) intrinsic task motivation on creativity.

3. Research method and data analysis

In order to examine the hypotheses we proposed, a sample of engineering students, who were studying in a Malaysian public university in undergraduate level, participated in the study. Based on the pilot test, out of 60 questionnaires that were sent out, 45 of them were returned to the researcher. Out of 45 cases, only 35 questionnaires were complete. As a result, based on the pilot test, there was a 58% rate of return. One of the most modernized methods to determine the sample size is suggested by Hair *et al.* (2013), which is called G*Power. G*Power has been found as a useful program in social and behavioural sciences in the last decade (Baeza and Stotz., 2003). The current research is based on the fixed-predictor model (i.e. it is to assume that the predictors *X,* like creativity, are fixed and known). The fixed-predictor model is often more suitable to be utilized in an experimental research, because an experimenter normally assigns the known predictor values to the participants (Faul *et al.*, 2009). The procedures for the fixed-predictor model will be mostly determined by the General Linear Model (GLM), which includes the bivariate linear model (Cohen *et al.*, 2003). Consequently, as it was supported by the literature, G*Power 3.1 is a suitable sample size instrument for the current study.

Since this research is having a one-tailed test, that level will be used. With the effect size of 0.15, the power of 0.80 and alpha error of 0.05, the sampling procedure was set. The number of predictors is determined based on the model. The highest number of components on a formative construct in the model is the predictor. According to the research model, 14 is the highest number of the construct (that is organizational encouragement), which is used to determine the sample size in G*Power 3.1. The results imply a sample size of 135. It means, in order to conduct the current study, there is a need for a minimum of 135 cases.

3.1 Data collection procedure

Moreover, researchers use purposive sampling as the most popular type of non-probability sampling, that encourages analysts to pick the case studies, which are rich in information (Merriam, 2009). The present work used purposive sampling method because the researcher needs the respondents to fit into a certain domain with specific norms. The conditions are specified in a purposive sampling method and for this study: respondents should fulfil three major criteria to be qualified as the appropriate population. Three main factors were taken into considerations: A respondent should be an undergraduate student in the engineering field of one of the Malaysian public universities. In order to ensure that these criteria were taken into account, the purposive sampling method is utilized and its application has been justified. The questionnaire is aiming to find out the creativity that individual undergraduate engineering students exhibit when they do their assignments and projects in the university they study. Therefore, the unit of analysis for the current study is an individual level, while the research is trying to find the level of creativity of each individual engineering student in the environment of the universalities. In order to conduct this study, there is a need to have a minimum of 140 samples that were determined in the sampling procedure. That is why a larger number of questionnaires were sent out so the needed number of samples could be obtained. However, as the common method variance exists in the survey methodology and survey method, the current work targets the issues as a potential area of research and it follows the directions proposed by the previous studies (Zheng *et al.*, 2012; Podsakoff *et al.*, 2003; MacKenzie and Podsakoff, 2012). In order to get the desired number of samples, which were completely done, the researcher sent out 510 questionnaires to all the public universities with engineering schools in Malaysia. The number of questionnaires was distributed equally among universities equally (30 cases per each university). All the questionnaires which were distributed to the campuses were returned to the researcher, while fewer numbers of online questionnaires from students were returned that was also observed in the pilot test. Out of 510, 339 questionnaires were returned to the researcher. As it was predicted by the pilot test, due to the judgment and error of students, only 289 cases of the answered questionnaires were usable, since 50 of them were incomplete, mainly in two middle pages. They were not usable since they included too much missing data, which could cause inconsistency in the results. Consequently, with a response rate of 85.25 %, 289 samples are acceptable as the sample for the present research.

3.2 Instrument design

In order to measure domain-relevant skills, the questions are developed from (Sawyer, 1992). Domain-relevant skills are measured via 5 questions in the current study. The questions are a 7-point Likert-type scale interpreted as (of Not Certain at all (1), Rarely Certain (2), Somehow not Certain (3), Certain (4), Rather Certain (5), Somehow Certain (6) and Very Certain (7)). To measure creativity-relevant processes, the mostly accepted instrument is a survey, which was developed for the purpose of measuring creativity-relevant processes, by Amabile (1983) and it was further developed more by Perry-Smith (2006) and Reiter-Palmon and Illies (2004). The instrument comprises of 11 questions, in which respondents should choose from a 5-point Likert-type scale as (1=Never, 2=Rarely, 3=Occasionally, 4=Frequently and 5=Very Frequently) for each item to be rated. In order to measure the intrinsic task motivation as a construct of individual components of creativity in this research, an instrument which was originally developed by Amabile (1985), is being utilized. The current instrument was adopted later by (Tierney *et al.*, 1999). Accordingly, intrinsic task motivation in this research is measured via 3 questions using a 5-point Likert-type scale (1=Never, 2=Rarely, 3=Occasionally, 4=Frequently, and 5=Very Frequently). KEYS, as an instrument to measure creativity, were utilized in this research. Creativity is measured via 6 questions in the current study. The questions are a 4-point Likert-type scale (1=Never, 2=Sometimes, 3=Often, 4=Always). KEYS items were used with a prior permission of the Center for Creative Leadership. It is noteworthy to mention that KEYS instrument, as a measurement to assess creativity, is a suitable instrument, which was selected from reviewing five prominent instruments. KEYS was one of only two climate instruments that is acceptable in terms of scientific quality. The instrument is well documented in peer-reviewed literature (Mathisen, & Einarsen, 2004). Also, The third part of the KEYS is focusing on outcome of the work, including creativity due to (McElvaney, 2006). Culpepper (2010) mentioned at page 15 that “The KEYS user’s manual Amabile et al. (1999) also reports a 1998 construct validity study conducted with principals and other personnel from public schools. In light of the findings, Amabile contends KEYS is valid for use in measuring administrators’ perceptions of school environments, although mean scores tended to be higher than those in workplace environments.” This is a valid proof that this instrument is suitable to conduct the current study in university setting.

3.3 Evaluation of Partial Least Squares (PLS) results

The research hypotheses were tested via utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) method. To measure both reflective (Creativity/individual components of creativity dimensions) and formative constructs (Social environment dimensions/individual components of creativity), PLS-SEM is utilized and it is appropriate for the sake of this study (Henseler *et al.*, 2009; Henseler *et al.*, 2011). PLS-SEM is a substitute for CB-SEM (Hair *et al.*, 2012; Henseler *et al.*, 2014) as an analytical method. Since the number of indicators for both individual components of creativity and social environment, in their lower-order constructs, were dissimilar, the current study utilized a two-stage approach, in order to shun the fact that the outcome might be biased. This would also assist in achieving the results that are more reliable (Becker *et al.*, 2012; Ringle *et al.*, 2012; Sumaco *et al.*, 2014). Afterwards, in the second step, the second-order construct will be replaced by the score that was achieved from the first step. The significance of the direct and moderating effects was measured by bootstrapping re-sampling method using 2000 replications (Chin and Newsted, 1999).

Via utilizing WarpPLS 5.0, The results of PLS-SEM software (Kock, 2012) are depicted in Figure 1. PLS-SEM is suitable for exploratory research in the assessment of the models that are complex as well as large (Gefen *et al.*, 2000; Westland, 2007; Chin *et al.*, 2003; Sarstedt, 2008), because the "PLS algorithm allows each indicator to vary in how much it contributes to the composite score of the latent variable" (Chin *et al.*, 2003, p. 25). In this study, convergent validity, construct validity, and discriminant validity is performed to assess the constructs reliability along with measurement items (see Table 1 and Table 2). Furthermore, to measure the reliability of latent reflective constructs, all three of composite reliability (CR), AVE and Cronbach's Alpha were considered as well.

Table 1: Construct validity (Insert here)

As it has been depicted in Table 1, the Cronbach's Alpha of all the study's constructs and their results indicate a high value of all the constructs. These results indicate that for further analysis, these results are good values and they are reliable. Looking at AVEs, they normally act as an indicator to evaluate both discriminant validity and convergent validity and their assessments. Tests of unimodality Rohatgi-Székely (top) and Klaassen-Mokveld-van Es (bottom) and the tests of normality: Jarque–Bera (top) and robust Jarque–Bera (bottom) are depicted in Table 2. Furthermore, the variance inflation factor (VIF) and full collinearity values show an acceptable value for indicators with P-Values < 0.05 and Standard Error (SE).

Table 2a: Tests of unimodality: Rohatgi-Székely (top) and Klaassen-Mokveld-van Es (bottom) (Insert here)

Table 2b: Tests of normality: Jarque–Bera (top) and robust Jarque–Bera (bottom) (Insert here)

Table 3: Correlations among l.vs. with sq. rts. of AVEs (Insert here)

As it can be observed in Table 3, the AVEs in the discriminant validity is proved to be related to the latent construct correlations, based on the discriminant validity that was established by Fornell-Larcker. Looking at the matrix, the off-diagonal values are the correlations which exist between the latent constructs and diagonal. They are also the square roots values of AVEs, as the table shows.

Table 4: Model fit and quality indices (Insert here)

For the purpose of this research, as a suitable approach, PLS is being utilized for assessing reflective (Creativity/individual components of creativity dimensions) constructs (Henseler *et al.*, 2009; Henseler *et al.*, 2011). Afterwards, via using PLS software and the help of bootstrapping (samples of 2000), the path coefficients were calculated, so that the research hypotheses could be tested (Becker *et al.*, 2012). To measure the discriminant validity, the two criteria of loading and cross-loading were taken into consideration. As it is shown in Table 3, bold values stand for each item's loading, which is more than the value of 0.7. In addition, an item's loadings on its own variable should be and are higher than all of its cross-loadings, in comparison with the other variable. When the measurement model has proven to be both reliable and valid, the research continued with evaluating the structural model of this study. To evaluate the structural model, as it can be seen in table 4, model fit, including its quality indices, structural relationships and hypothesis testing among the constructs were looked into. On top of structural relationships and model fit, R^2 and Q^2 values have been illustrated for endogenous constructs. Table 4 represents the model fit and its quality indices and they are an acceptable fit along with being valid.

Figure 1: Structural result (β, P-values, and R^2 coefficients) (Insert here)

Lastly, the power analysis was also utilized in this study to test the rejected hypotheses. According to the existing literature, the effect size conventions for tetrachoric correlations were not put into the definition. On the other hand, the convention provided by Cohen (1988) for the bivariate normal model framework of correlations can be used as a rough reference. The effect size for G*Power 3.1 has two options of either Brown and Benedetti (1977) exact approach, which is the default option in the setting or Bonett and Price (2005) approximation. When it comes to α (alpha), it tests the level of confidence, which is tested via 1-α (also called confidence level). Statistically, it is utilized as (1- α)*100 which represents the confidence percentage of the interval of a parameter. In case of one-tailed test, it is significant at the .05 significance level (Park, 2008).

4. Discussion and conclusion

The magnitude of creativity and its importance to bringing innovation to life has been accentuated in previous researches. The essence of creativity lays within the fact that it brings novel solution and fresh perspective to the task at hand, which is crucial to the realm of engineering and innovative work they produce. If a firm is aiming for innovation, the prerequisite for it will be to consider employee creativity (Hon, 2012; Scott and Bruce, 1994;Han and Lui, 2015). Shalley and Gibson (2004) believe that flexibility and resilience that exist in creativity will heighten the turbulence, which is present within an environment. That can be named as a reason behind the fact that creativity is the subject of a vast number of researches (Hauksdóttir, 2011). In organizational as well as academic settings, looking at the existing literature of the present research will demonstrate how creativity proved to be one of the most challenging dimensions to be studied. That is in accordance with Martins and Terblanche (2003), who states that there is a rise in a change rate with a quick speed, mainly due to the fact that there is a growth of knowledge and idea generation along with global diffusion. The attempts behind creativity studies are to discover the enhancing and facilitating the factors that pave the way for creativity's embellishment. As this study pointed out, the magnitude of creativity research was observed by the works of many researchers as (Paramithaa Anggia and Nurul, 2014 ; Zhang and Gheibi, 2015) (Khalii, 2020), especially the environment, as an element that can influence creativity and draw a lot of attention in the research realm.

There is no agreement on whether the creativity is located within a person or it is located in a product or process (Mayer *et al.*, 1999). Various researchers, including (Keibler, 2014; Kazerounian and Foley, 2007; Allen and Coleman, 2011) conducted studies on creativity from an individual point. Most companies, according to Spender and Strong (2010), ought to boost their profit and growth and one way to achieve this will be through having tremendous ideas. Such great ideas are not going to shape in laboratories just over a period of one night. Employees, who have been involved in the business and tried hard for the growth of the company, are the ones who will bring such ideas to reality. Another issue to be considered is that if an employee is just a degree holder or a university graduate, this will not translate into being a successful workforce in such business world, which is highly competitive. Researches, which were conducted in the past, have shown the significance of intrinsic motivation to predict creativity in domains of work as well as non-work. As an instance, works by Ryan and Deci (2000) stated that the intrinsic task motivation has received extensive attention as an important antecedent of creativity (Zhang and Gheibi, 2015). Another study by Shalley and Perry-Smith (2001) provided some evidence that intrinsic task motivation had a mediating effect on the relationship between evaluation factor and creativity in college students. Previous studies (Shalley and Perry-Smith, 2001; Shin and Zhou, 2003) focused on intrinsic task motivation 's role as the mediator. The outcome of researches by (Shalley and Perry-Smith, 2001; Shin and Zhou, 2003; Shalley *et al.*, 2004) on the mediating role of intrinsic task motivation proved inconsistent results. This can further be observed as a proof of the significance of intrinsic task motivation in creativity. In line with previous researches, this study also indicates the importance of understanding how creativity happens and the influencing contributors. Understanding the significance of all three individual components of creativity and its contributions to corporate innovation will help managers facilitate creativity to reach innovation. Companies should develop an understanding that hosting the desire to exhibit creativity in each employee will benefit them in the long term.

As it can be observed in the previous studies, the role of creativity in engineering realm has proven to be rather blatant. In engineering education, teaching about creativity is important as much as the significance of general education. There is a need to incorporate psychology knowledge into engineering education mainly because engineering students ought to conduct creative activities and experience the reflection and their awareness of involved cognitive processes. Creativity will assist engineers to develop the ability to hold onto the judgment of various approaches. That will enable the engineers to be liberated from the rigid algorithms to solve a problem on hand (Amabile, 1997). Thus, engineering students are in the need to be aware of all these elements that affect their level of creativity to be well prepared for their careers. Conole *et al.* (2008) looked at this phenomenon as an inconsistent attempt in engineering education. Putting creativity into engineering education is not a consistent attempt (Charyton *et al.*, 2011) and this trend should be the focus of researchers. Finding out what factors, which come through for of engineering students' creativity level, will pave the way to train creative engineers in the near future. From what we have observed with the results of this research, creating a culture of being creative early on in the engineering realm will be essential.

Shalley and Gibson (2004) assert that the importance of intrinsic task motivation and its relation to creativity from a theoretical point of view has been mentioned by various researches (Shalley, 1995; Oldham and Cummings, 1996; Shalley *et al.*, 2000). On the other hand, studies done by (Tierney *et al.*, 1999; Shin and Zhou, 2003) can be considered as few studies, which measured the relationship that exists between the intrinsic task motivation and creativity in an empirical method (Dewett, 2007). Researches in the past thirty years have failed to make a general agreement on the effect of motivation on creativity (Eisenberger and Shanock, 2003). Previous researches (Tierney *et al.*, 1999; Eisenberger and Rhoades, 2001; Shin and Zhou, 2003; Aselage, 2005) looked at intrinsic task motivation in employees' creativity empirically, but it was stated that while the central prediction of the componential model of creativity was on intrinsic task motivation, but there is still a lack of empirical reaches within this area. It has been stated that the level of intrinsic task motivation could encompass a considerable influence on the creativity of that person (Amabile, 2012). Also, Ivcevic (2009) emphasized the fact that an abundant number of researches in creativity were conducted with a concentration on individuality. Work by Mumford (2003) stated that creativity is strongly affected when there is an interest to do a task, which is also known as intrinsic task motivation (Eisenberger and Shanock, 2003).

A range of researchers, including (Anderson *et al.*, 2014; Birdi *et al.*, 2014) tested creativity in the lights of componential theory. Looking at the works that were mainly examined creativity from the components within an individual, it can be observed that they mostly went down one road. A substantial body of research (Allen and Coleman, 2011; Pirola-Merlo and Mann, 2004; Kazerounian and Foley, 2007; Zhang and Gheibi, 2015) observed the relationship between individual components of creativity (as a whole) and creativity, whereas further works looked at the relationships which exist between one of the ICC components and creativity. To put it in an example, (Charyton *et al.*, 2011; Eder and Sawyer, 2008) investigated creativity and its relationship to domain-relevant skills, while (Baer *et al.*, 2003; Inchamnan *et al.*, 2012) studied creativity and its relationship to intrinsic task motivation. For creativity to take place, creativity-relevant processes, hand in hand, with domain-relevant skills need to be present, since a person will have the ability to comprehend where there is a need for the creative work and how the work can be carried out (Birdi *et al.*, 2014) within a particular context, which is the environment.

As it can be observed, creativity and its relationship with individual components of creativity were extensively studied in various studies (Aloulou 2017; Kazerounian and Foley, 2007; Keibler, 2014; Inchamnan *et al.*, 2012; Allen and Coleman, 2011; Pirola-Merlo and Mann, 2004). Some studies only consider one component in an individual context and its contribution to creativity. Furthermore, domain-relevant skills and its relation to creativity was observed by (Charyton *et al.*, 2011; Eder and Sawyer, 2008; Griffin and Wildman, 2010; Kuo, 2011), while creativity-relevant processes and creativity relationship was studied by previous studies (Tierney and Farmer, 2002; Hauksdóttir, 2011), but such a relationship on domain-relevant skills as well as creativity-relevant processes were barely observed in other studies. Besides, intrinsic task motivation and its link to creativity have been studied by (Inchamnan *et al.*, 2012; Birdi *et al.*, 2014). Nevertheless, there is still a need for a research to encompass all these three components and their relationships to creativity into account. In addition, previous studies (Eisenberger and Shanock, 2003; Mumford, 2003) studied the social environment effects (an outside of individual components) on only one component like intrinsic task motivation, as one of the within individual components (Paramithaa and Indartib, 2014; Culpepper, 2010) or how the environment affects domain-relevant skills and creativity relationship (Kuo, 2011). What other studies had not done is to observe the social environment effects as a moderator of the relationship between individual components of creativity and creativity, while investigating the moderating effect of social environment on all three components separately too. Furthermore, what other researchers had failed to observe is the social environment‘s effects as a moderator of the relationship between creativity, individual components of creativity, and each component in an educational setting. The current research seeks to fill the mentioned gaps.

Social environment, as a supporter of the process of creativity, is a must for employees, if they want to be creative in their work (Politis, 2002). This environment referred to as the understanding of individuals about norms and characteristics that existed within an organization. They viewed organizational climate as interactions that happened between the corporate members. Having an environment that fosters creativity is a must and the first step will be a need to assess how creative it is. Via doing this, there will be a clear picture of where to start and where to go to reach the destination. This is how the mutual relationship between environment and creativity can be observed: While creativity can bring about changes to an environment, in exchange, the environment will allow creativity to work and to manifest itself via leading to innovation and products. Within an individual, social environment is recognized as a kind of force that has a responsibility. In the meanwhile, it can act as a path to gain self-fulfilment.

The support of group work exhibited correlations with creativity. It has been stated by the previous research that each individual employee is more creative when there is an opportunity to work as a team together, as in comparison to the time that individual works on his own (Anderson et al., 2014; De Dreu and West, 2001; Hon and Chan, 2013, Han and Lui, 2015). The environment is regarded as one of the key elements of creativity. It is not related to the place where an individual works at, but it is mainly about an individual who gives himself/herself the permission of being creative (Politis, 2002). Examining the role that social environment plays on creativity, especially as a moderator, were under the scrutiny of many studies, but the shortcoming emerges from the fact that this role was observed on creativity on its own, or it was studied on the relationship between a component within an individual and creativity. The moderating effect that the social environment can play on domain-relevant skills and the relationship it has with creativity, was investigated by Kuo (2011). The effect of environment on the other two elements was also studied by Inchamnan *et al.* (2012). They looked at the moderating effect that the environment plays on both creativity-relevant process/creativity and intrinsic task motivation/creativity relationship. As Zhang and Gheibi (2015) stated, in a supportive environment, when an individual is already engaged in the creativity-relevant process, creativity can be boosted by the presence of intrinsic task motivation. Granting all this, while the significance of social environment and its positive outcomes it carries on creativity, has been agreed upon by many experts in the field, there is not adequate research on both ends that can benefit them. What has been observed is that these two areas have been studied separately. According to our findings, lack of organizational impediments and work support group do not necessarily act as a moderator to the occurrence of creativity. They might function as a part of an environment that creativity is exposed to, but on their own, they are not making a difference.

On the other hand, what we have observed by the current study is that sufficient resources might not necessarily facilitate the desirable environment, in which creativity is occurring. We can infer that while it is important the employees have access to sufficient resources, but managers cannot expect creativity to happen just because of the resources they provide. The interesting fact to consider is that sufficient resources act as a moderator to creativity-relevant processes. The indication of this result is that if a company gives employees enough resources, they will act as a catalyst to their creativity. If managers want to see innovation, they need to invest insufficient resources and provide them for their staff.

4.1 Limitation and directions for future researches

This study has some limitations, like any other work in the research realm. The first limitation might concern the bias in the research since we collected the data from the engineering students in Malaysian public universities. Given the cultural differences, various results might be obtained when this research is being conducted in another country. The other limitation might derive from the fact that the survey was distributed among engineering students and despite the fact that the instructions asked them to pay a close attention to each question, there might be some oversights in answering each question meticulously as well. In addition, generalizability might not apply to this study, since there was no opportunity to conduct the same study of the same population within the period of four years to compare results. Consequently, the best direction for future research areas is to conduct a longitudinal study, comparing the results of the same sample while they are at university and when they are working as engineers in the corporate world. Moreover, there can be further researches to compare the results between Malaysian and the Western world students to observe for new contributors to the creativity in the engineering realm.

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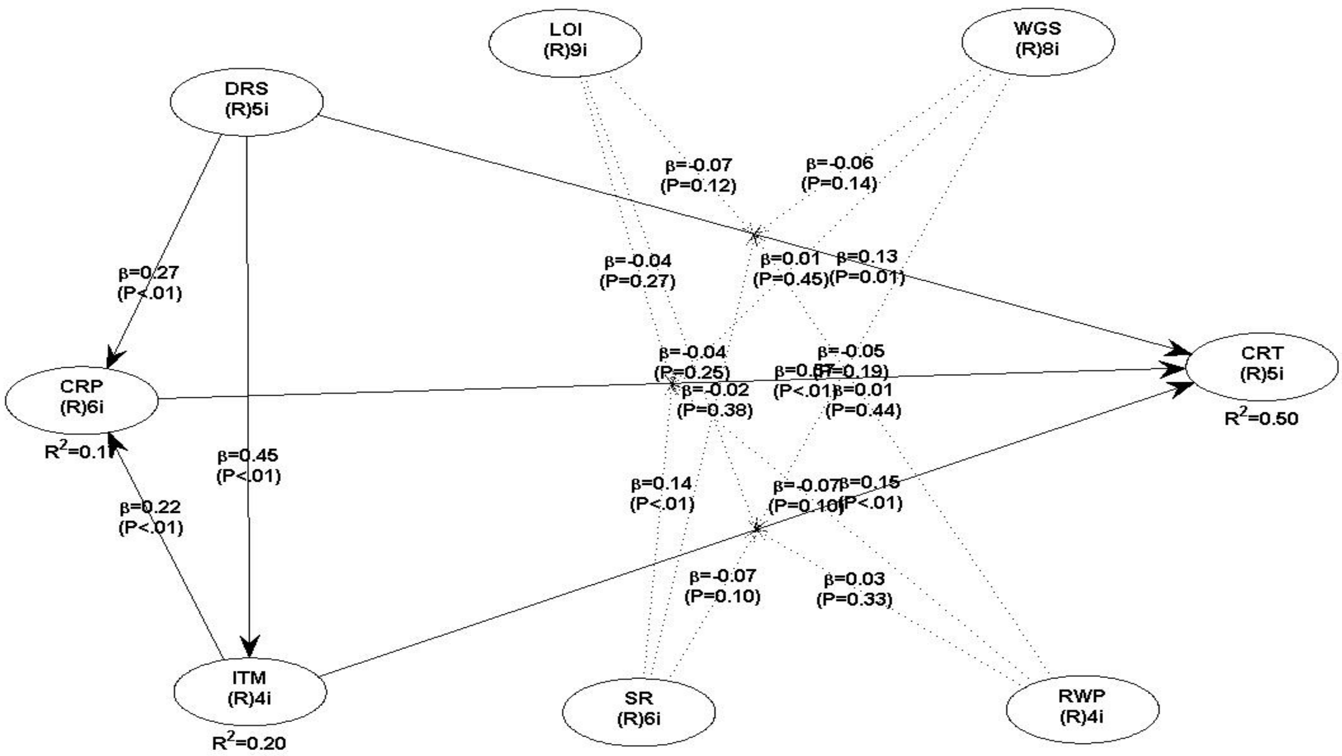
Figure 1: Structural result (β, P-values, and R^2 coefficients)



Q-squared coefficients

CRT	CRP	ITM
0.515	0.179	0.2

Table 1: Construct validity

Measure	CRT	CRP	DRS	ITM	WGS	LOI	SR	RWP
Composite reliability coefficients	0.834	0.871	0.831	0.836	0.881	0.765	0.874	0.756
Cronbach's alpha coefficients	0.75	0.822	0.744	0.738	0.846	0.658	0.825	0.569
AVE	0.506	0.53	0.518	0.561	0.503	0.498	0.538	0.538
Full collinearity VIFs	2.092	1.994	1.598	1.761	1.514	1.364	1.48	1.34

Table 2a: Tests of unimodality: Rohatgi-Székely (top) and Klaassen-Mokveld-van Es (bottom)

CRT	CRP	DRS	ITM	WGS	LOI	SR	RWP
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2b: Tests of normality: Jarque–Bera (top) and robust Jarque–Bera (bottom)

CRT	CRP	DRS	ITM	WGS	LOI	SR	RWP
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Correlations among l.vs. with sq. rts. of AVEs (Insert here)

	CRT	CRP	DRS	ITM	WGS	LOI	SR	RWP
CRT	0.712	0.660	0.377	0.400	0.394	-0.029	0.300	0.145
CRP	0.660	0.728	0.351	0.336	0.362	0.062	0.299	0.149
DRS	0.377	0.351	0.706	0.436	0.330	0.210	0.424	0.218
ITM	0.400	0.336	0.436	0.749	0.514	0.110	0.332	0.130
WGS	0.394	0.362	0.330	0.514	0.695	0.064	0.247	0.146
LOI	-0.029	0.062	0.210	0.110	0.064	0.530	0.157	0.308
SR	0.300	0.299	0.424	0.332	0.247	0.157	0.734	0.340
RWP	0.145	0.149	0.218	0.130	0.146	0.308	0.340	0.662

Note: Square roots of average variances extracted (AVEs) shown on diagonal.

Table 4: Model fit and quality indices (Insert here)

Average R-squared (ARS)=0.293, P<0.001

Average adjusted R-squared (AARS)=0.281, P<0.001

Average block VIF (AVIF)=1.938, acceptable if <= 5, ideally <= 3.3

Average full collinearity VIF (AFVIF)=1.804, acceptable if <= 5, ideally <= 3.3

Tenenhaus GoF (GoF)=0.320, small >= 0.1, medium >= 0.25, large >= 0.36

Sympson's paradox ratio (SPR)=0.722, acceptable if >= 0.7, ideally = 1

R-squared contribution ratio (RSCR)=0.960, acceptable if >= 0.9, ideally = 1

Statistical suppression ratio (SSR)=1.000, acceptable if >= 0.7

Nonlinear bivariate causality direction ratio (NLBCDR)=0.750, acceptable if >= 0.7