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Combination of Decision Logics for Green Innovations in Saudi Arabian based Small and Medium Enterprises Experience

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Abstract: Background: Small and medium enterprises (SMEs) in developing countries encounter numerous challenges that obstruct the goal of greenness in their innovations. These challenges cause over-featuring, delays, or abandon projects; in a way they consume resources without reaching objectives.
Objective: To examine project manager's decision logics in relation to green innovation.
Method: This study applies effectuation lens and examines 523 questionnaire-based responses of SMEs' project managers in Kingdom of Saudi Arabia (KSA).
Results and Analyses: Analysis has been conducted through SPSS 24 Process macro model-4. Results suggest that four principles of project manager's effectuation decision logic – Means, Affordable loss, Pre-commitment, and Exploiting contingencies are positively moderated by causation decision logic to achieve green innovation.
Conclusion and Contributions: This study extends scope of effectuation theory to green innovation literature through combining experience of SMEs that rely on effectuation, and green innovation that relies on causation principles. Also, it brings experience of KSA which is a developing economy and effectuation lens has been largely applied to western developed economies. To practitioners, study suggests amalgamating effectuation principles with causation logic to gain utility. However, emphasis on causation logic must not be high else results may not be achieved. This study is original and is among the earliest empirical examinations to study effectuation theory aiming green innovation in a developing economy.

Keywords: Decision Logic; Developing Economy; Green Innovation; SMEs.

1 Introduction

Green innovations not only protect scarce resources but also minimize damages to ecological environment, hence, achieving a harmonious balance between human and nature coexistence. Green innovation is the significantly improved process that reduces natural resource consumption to produce novel product that is more sustainable and less harmful to the environment [1]. Innovations by definition are novel endeavors that encounters shortage of resources and needed information; therefore, innovation and uncertainty go alongside [2]. Speaking of small and medium enterprises (SMEs) in developing economies, they are resource short and with limited managerial capabilities and uncertainties appear at higher velocity [3]. Therefore, SMEs operating in developing economies face delays or completely abandoned their innovation driven projects [2]. By virtue of managerial limitations and uncertainty, SMEs in developing economies are noted to contribute to resource waste in terms of leakages [4], over-featuring [5], and restraining dynamic capabilities which pose serious challenges to sustainability.
To address risk and uncertainty, entrepreneurship literature suggests use of effectual and causal decision logics [6]; however, both mechanisms have been least studied, simultaneously, in innovation management domain [6]. In terms of green innovation, causal logic has dominated the literature [7]; whereas, to the best of author's knowledge effectuation logic was missing in making strategic decisions. Green innovations contribute to energy saving, waste recycling, pollution prevision, and environment management, on contrary, their failure could add to environmental hazards and resource waste. Therefore, accurate decisions are important to be made to increase propensity of green innovations. This study examines simultaneous application of project manager's use of both decision logics aiming green innovations in the

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Kingdom of Saudi Arabia (KSA) based SMEs.

Since Sarasvathy's [8], [9] groundbreaking work of effectuation theory, most of entrepreneurial literature has acknowledged its worth. Causation involves prediction-orientation with more focus on planning techniques to predict future. The underlying argument is that with proper and detailed planning SME can yield innovations [6]. Contrarily, effectuation has four principles – means experimentation, affordable loss to limit potential losses, flexibility towards contingencies, and gaining pre-commitments to control future [8], [9]. Effectuation is resource driven thinking that allows project manager to experiment available means and exploit prevailing contingencies to achieve goal of green innovations. Effectuation facilitates creative application of available resources to gain maximum returns in the face of prevailing contingencies [10]. Causation is a market sensing strategy with focus on detailed planning and return maximization [10]; therefore, provides an effective context for identifying potential partners and risk avoidance [6]. To achieve green innovations in KSA based SMEs', this study examines the moderating effect of causation decision logic on four principles of effectuation decision logic which has never been examined before.

1.1 Decision Logics

The theoretical underpinning of effectuation theory guides understanding of the constructs and relations in between. The theory directs project managers' actions and decisions and prioritizes control over the future [10], [11]. Effectuation theory advocates use of effectual logic during uncertainty, which is integral part of projects and innovations, over causal logic. Causal logic is inclined more towards planned strategies and envisioned consequences, whereas, effectual is an emerging strategy in project domain that evolves with prevailing contingencies with a non-predictive orientation [11], [12]. Causation logic takes a more rational think-first approach towards a set goal [11], [12]. These principles "take a particular effect as given and focus on selecting between means to create that effect" [8]; hence, following many-to-one mapping [13]. Causation logic conducts detailed market analysis, business planning, and exploiting preexisting knowledge [14] to control the future and maximize expected returns [13], [15], [16]. Much of innovation management literature revolves around set goals, planning, and exploiting knowledge repositories [17], [18].

Entrepreneurial decision logic is very much relevant to innovation management because of the logic they apply to evade uncertainty and solve complexity. Effectuation is an act-first problem solving logic with focus on control where the concern of project manager is what can be achieved with available resources [8], [19]. Sarasvathy [8] grouped four behavioral principles into a single effectuation theory – experimenting the means instead of setting a goal; affordable loss instead of profit maximization; strategic alliances instead of competitive analysis; and exploiting contingencies instead of exploiting preexisting knowledge. In projects future is unpredictable, therefore, effectuation aims on controlling rather predicting it. Based on Sarasvathy [8] work, Chandler et al., [11] developed a measurement scale and found that effectuation is a multi-dimensional formative construct with the four as sub-dimensions. Effectuation theory has been largely applied in entrepreneurship literature with considerable appearance in strategy and finance [13], [15], [16]. Innovation management has been recently gaining attention of effectuation decision logic; whereas, in terms of green innovations the lens is still scarce. Therefore, it is critical to explain the experience of green innovations in developing economy through the lens of effectuation. Sarasvathy [8], [9] argued that both strategies are distinct in their nature and could occur simultaneously. Similar empirical results have been reported by Smolka et al [15] in entrepreneurship and Vanderstraeten [6] in innovation management literature; however, interaction effect was not examined in developing economies, specifically, in relation to green innovation. Therefore, this study examines the utility of four principles of effectuation decision logic under the influence of causation to predict green innovation in KSA based SMEs.

1.2 Green Innovation

Green innovations are process and product improvements with respect to lesser energy consumption, waste recycling, pollution prevention, and corporate's efforts to manage environment [20]. Green innovation efforts embody environmental protection perspective into design, production, and packaging activities. Green innovation is a way to satisfy environmental regulation conditions and achieve environmental management objectives [7]. Organizations adopting to environment management and green innovations would have to embark on new business organizations models with changed competitive rules that value energy savings and waste recycling [20]. Green innovation can be sub-divided into green process innovation and green product innovation; where the earlier centers on production cycle and later focuses on the end product [21]. Previously did not regard the green element in their production process as necessary; however, to gain legitimacy and trust in the society now they have good reason to invest in green production [22].

SMEs are pillar of economic progression, especially innovations, in developing economies [23] such as KSA [24]. Therefore, it is critical to examine the case of green innovation in the Kingdom of Saudi Arabia. Innovative projects entail higher degrees of uncertainty and prediction become more challenging; therefore, require lesser process familiarity and

controls than routine projects [25], [26]. When encountered with uncertainty, project managers retort with policies and strategies aiming to respond and adopt to the changed environment or shape the environment in a way (s)he executes the project [27]. Considering their relative vulnerabilities of being resource constrained, SMEs will opt for adoptive strategies. SMEs adopt effectuation more with relative applications of causation strategies; resource and managerial constraints push them to execute projects in collaboration and seek pre-commitments aiming to evade failures, likewise, deep market research and planning are costly strategies and are avoided as dominant logics [27]. Therefore, parallel use of effectuation and causation principles is of much value to SMEs because of resource limitations. Alzamora-Ruiz et al., [28] examined independent use of effectuation and causation principles to measure innovation performance in SMEs; this study takes their discussion a step forward through integrating both logics in green innovations.

1.3 Dimension of Means

The dimension of means push SME to critically evaluate resources at hand and make the best possible and creative use of it through experimentation [15]. Due to resource limitation, SME is very cautious in resource consumption which enforce creative applications and enables the learning-by-doing apparatus resulting in exploring and exploiting resource at hand [28], [29]. Means dimension encourages project manager to creatively use them considering the resource scarcity element and as well as its implications on the environment ultimately greening the process and product [22]. Exploration and exploitation minimize challenges in innovation driven projects that upgrades SMEs ability to effectively respond to environmental needs [7]. The innovation process itself drives SME to conduct careful experimentation that the resources permit; hence, proper market analysis and planning are advisable [28]. Focus of green may not yield maximum profits in short run; however, they minimize quantity of resources dedicated to environment protection which in long run yield benefits [22]. Similarly, when profit maximization is aimed then exploitation is a goal-orientation and becomes more effective; proper resource management would enable SME to identify means that may potentially yield maximum returns. Saudi Arabia is a developing economy and SMEs are inherently in need of information. Uncertainty in the shape inadequate information regarding customers' preferences and aggressive competition can restrain SME to deliver innovative products [30]. Under the influence competitive analysis, it is more feasible to conduct effective experimentation as competitive analysis brings the much needed information regarding customers' needs and competitors' offerings [28], [29]. Therefore, means experimentation under the stimulus of causation principles would elevate green innovations in SMEs.

H1: Causation decision logic has a positive moderation effect on the relationship between means experimentation and green innovations.

1.4 Dimension of Affordable Loss

Affordable loss defines the threshold of incremental investments an SME may bear to invest and forbad additional losses [12]. Innovation based projects are widely subject to delays and failure that can threaten survival of SMEs [2], [31]. Effectual logic of incremental investment allows SME to examine the explored opportunity and acquire recommendation for modifications earlier prior to completement investment at a lesser cost [15]. Thereby allowing SME to examine its processes and retune them in accordance with environmental concerns, timely. Avoiding excessive costs reduces risk of going bankrupt and modify the project to avail innovations [32], [33]. The incremental injection of investment also complement exploiting the available means which further facilitate innovative products [28], [29]. A firm devoted to green innovation gains competitiveness and raise resource productivity that curtails resource excessive consumption [22] thereby keeping its losses at minimal. Causal logic is also relevant for the affordable loss dimension of effectuation. Through affordable loss lead experimentation, SME is able to identify areas of success and areas for improvement. Subsequently, competitive analysis of external market complement these observation and enable SME to decide whether to invest further or abandon the project timely without losing further money [15]. Top management concern for environment is very much relevant. Well-defined policies relating to environment integrates various departments to reexamine their processes and final product in relation to total resource consumption [22]. Likewise, detailed planning also identifies much needed and relevant activities that facilitate project scheduling and costing to overcome unintended delays and costs [34], [35]. Also the set goal drives SME in a foreseeable direction; these sets of information helps project manager to decide how closer or far away s(he) is from the objective of greenness and effectively allocate further resources [26].

H2: Causation decision logic has a positive moderation effect on the relationship between affordable loss and green innovations.

1.5 Dimension of Pre-Commitments

This dimension centers on SME's efforts to make alliances with suppliers, competitors, customers, and other stakeholders to acquire resources and reduce uncertainty [8], [10], [11]. Lack of necessary information is a serious obstruction for SMEs

to deliver innovative products which pushes them to scan the market and gain pre-commitments [36]. Literature suggests that firms should consider the interests of other stakeholders while formulating strategies which earn their trust and support [37]. If enterprise focuses on economic goal, merely, then incorporating environmental perspective into strategy remains implausible. Therefore, partnering with relevant stakeholders in necessary for green process and green product innovation [22]. Uncertainty is the result of missing information [38] and a critical factor that move along with innovation in SMEs [33], [39]. Therefore, SMEs partner with numerous stakeholders who share resources to complete the project and risks to bear costs [40]; sharing knowledge and resources facilitate novel solutions and innovative products [3], [15], [29]. Access to technology and knowledge also enables SME to effectively exploit and explore new opportunities [41], hence, resulting in innovative solutions [31]. Successful pre-commitments are also subject to causal logics of detailed market research and planning. SME needs to scan the market for potential key players who can provide necessary assistance and synergize the outcome [15], [42]. When executed together the project is more competitive and innovative because of the knowledge and expertise acquired from multiple experts which minimize costs and gain efficiencies [4], [43]. Opinions from external expert sources also modifies the intended goal and realign it according to available resources [44]. Incorporate environmental apprehensions earns support from other institutions who offer their expertise to make the process greener and add to competitive advantage [22]. Finally, SME envisions to maximize returns and market share which invite more partners for the successful delivery of innovative products [45]; therefore, positive moderation effect of causal logic between pre-commitments and green innovation is expected.

H3: Causation decision logic has a positive moderation effect on the relationship between pre-commitments and green innovations.

1.6 Dimension of Exploiting Contingencies

This dimension leverages flexibility; more flexible structures efficiently exploit contingencies through exploitative and explorative practices to gain innovations [32], [46]. Flexibility is also critical for managing uncertainty that obstructs innovations [3], [47]. SMEs in developing countries exploit prevailing contingencies to become more flexible in their operations and sustain innovation performance [48]. Recently, environmental concerns have arisen and project managers through exploiting contingencies can experiment new ways to make their processes more environment friendly. So as, they are more now flexible to part away from conventional environment hazardous products and produce more environment friendly goods. Experimentation improvise creativity through internalizing new knowledge that subsequently support innovativeness [49], [50]. Similar to earlier assumptions, causal logic also provides a baseline support for exploiting contingencies to elevate project innovativeness. Market research brings new ideas that support detailed planning and all together enable SME to effectively exploit the prevailing opportunities [15], [29]. With the use of market knowledge and firm's flexibility, SME can avail greenness in its products through product redesign and durability with respect to environmental concerns.

H4: Causation decision logic has a positive moderation effect on the relationship between exploiting contingencies and green innovations.

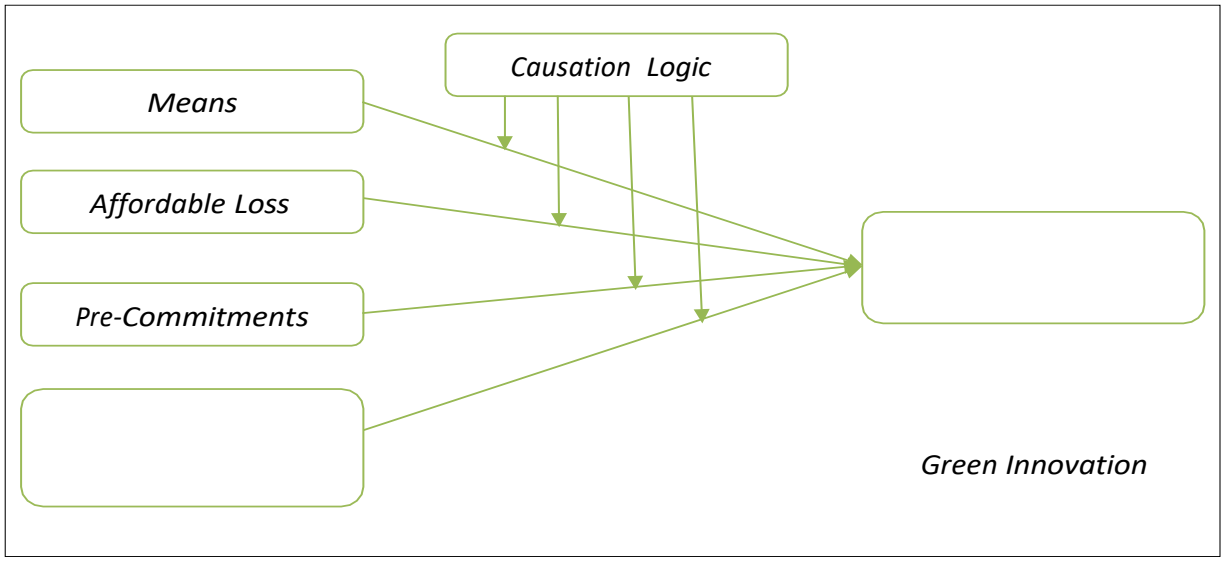

Fig. 1: Conceptual Model.

2 Methodology

2.1 Research Design

Case of KSA based projects is relevant for several reasons; first, effectuation theory has been largely tested in western economies where level of uncertainty is relatively low. KSA is a developing economy with higher uncertainty [24] which will add a new experience to the effectuation theory. Second, SMEs are the backbone of any industry and innovation driven projects are executed to achieve intended goals. Third, KSA aims to switch its focus for fossil fuel to other economic substitutes such as tourism and infrastructure development. On the basis of aforementioned factors, author believes KSA based projects by SMEs are most suitable to test our conceptual model.

2.2 Measures and Questionnaire Validation

The constructs are operationalized through validated measures. Effectuation and causation logics were measured through a scale adapted from Chandler et al., [11]. There scale has been widely used in entrepreneurship [13], [15] and innovation management literature [3], [28]. Effectuation has four dimensions; Means (3 items), Affordable loss (3 items), Pre-commitments (2 items), and Exploiting contingencies (3 items). Causation is a composite variable with 5 items. Items measuring green innovation were adapted from Utterback and Abernathy [21] and has 6 items. These items were pilot tested through Cronbach alpha (α) for validation; Means scored .83, Affordable loss .88, Pre-commitments .84, and Exploiting contingencies .84. Therefore, all the items were retained during large scale data collection. Likert-five scale has been used for data collection where 1 represented extremely disagree and 5 represented extremely agree.

SME size, age, R&D expenditure, industry, environmental uncertainty, and project management experience were added as control variables. Environmental uncertainty was measured through six items adapted from Yu *et al*., [3].

2.3 Sampling Technique

In the current study researcher took project executed by SME in the Kingdom of Saudi Arabia as a unit of analysis. Author evaluated survey questionnaire through three assistant professors in the management science department who often work in corporate sector. They translated the English version of questionnaire in to Arabic and discussed their translation to reach agreement. The questionnaire was randomly emailed to approximately 900 project managers with the help of industry directory across the major cities of KSA during March – June 2022. Researcher received 537 responses; after data filtering author excluded 14 responses due to incomplete or extreme choices (respondents marked a single score either for whole construct or the questionnaire). The model was analyzed with 523 valid responses.

3 Analyses and Results

3.1 Demographics

Table 1 depicts firm and project manager level demographics of the sample; 73 SMEs had less than 10 employees, 193 between 10 – 50, 149 between 50 – 150, and 108 between150 – 250; 97 SMEs were younger than 10 years of age, 120 between 05 – 10, 191 between 10 – 15 and 115 SMEs were older than 15 years age; 258 SMEs designated less than 10% of their revenue to research and development initiatives, 181 between 10% – 20%, and 84 more than 20%, 96 SMEs were in construction sector, 123 tourism, 108 pharmaceutical, 127 ICT, and 69 from other industries. Similarly, 378 project managers were male and 145 were female; 314 had project management related certification and 209 did not; 104 project managers had less than 05-year project management experience, 180 between 05 – 10, 131 between 10 – 15, and 108 more than 15 years.

Table 1: Demographics.

Variable	Frequency	Percentage
Firm Level Characteristics		
Number of Employees		
Less than 10	73	17
10 – 50	193	36.9
50 – 150	149	28.5

150 – 250	108	20.7
Age of SME (years)		
Less than 05	97	18.2
05 – 10	120	22.9
10 – 15	191	36.5
more than 15	115	22.0
R&D Expenditure		
Less than 10%	258	49.3
10% – 20%	181	34.6
More than 20%	84	16.1
Industry		
Construction	96	18.4
Tourism	123	23.5
Pharmaceutical	108	20.7
ICT	127	24.3
Others	69	13.2
Project Managers' Characteristics		
Gender		
Male	378	72.3
Female	145	2.7
Project Management Certification		
Yes	314	60.0
No	209	40.0
Project Management Experience (years)		
Less than 05	104	19.9
05 – 10	180	34.4
10 – 15	131	25.0
More than 15	108	20.7

**Demographics illustration of the respondents.*

3.2 Convergent Validity and Reliability

First, sampling adequacy is examined with Kaiser-Meyer-Oklin (KMO) and Bartlett's test of sphericity through SPSS 24. KMO must be above .5 and closer to 1; whereas Bartlett's test has to be significant. KMO value was .89 and Bartlett's test was significant.

Then exploratory factor analysis is conducted through principal component method. Resultant factors scored from .619 – .749, α .80 – .87, average variance extracted (AVE) .42 – .52, and composite reliability (CR) .68 – .83. Generally accepted thresholds for factor loading is minimum .6, α .7, AVE .5, and for CR it is .6; however, AVE as low as .4 is acceptable if corresponding CR exceeds .6 [51]. Therefore, constructs in conceptual model are reliable. For SPSS based analyses data must be normal; author examined skewness and kurtosis values and found that sample was normally distributed. Table 2 explicates details on the constructs.

Table 2: Convergent Validity and Reliability.

Variables / Items	Loadings	Skewness	Kurtosis
Means (α=.83, AVE=.49, CR=.73)			
Our projects' goals are defined by the resources we initially had.	.679	-.234	-.295
We started project based on the available resources rather than set goals.	.703	-.539	.467

The current shape of product is substantially different than what we initially imagined.	.720	-.706	.438
Affordable Loss (α=.80, AVE=.42, CR=.68)			
While deciding about the project, question of possible losses was crucial.	.619	-.420	.438
The decision about capital expenditure is based on possible risks of losses.	.646	-.117	-.298
Selection of opportunities, as potential projects, is evaluated against possible financial trouble our company may face in case of failure.	.687	-.468	-.150
Pre-Commitments (α=.84, AVE=.52, CR=.68)			
We reduce uncertainty through commercial agreements with partners, customers, and other stakeholders.	.722	-.454	.135
We reduce uncertainty through pre-commitments from customers as often as possible.	.722	-.35	.26
Exploiting Contingency (α=.84, AVE=.51, CR=.75)			
Despite delays, we are flexible and exploit opportunities as they appear.	.716	-.198	-.335
We are flexible enough to adapt our goals based on what we are achieving.	.749	-.327	.087
We avoid actions that restrain our flexibility and adoptability.	.677	-.018	-.439
Causation (α=.87, AVE=.48, CR=.82)			
Our project is based on already established goals that are aligned with company's strategic objectives.	.744	-.267	-.483
Decision on potential project is made based on the prospects of expected returns in long run.	.664	-.25	-.76
We evaluate risks and returns through exhaustive market analysis and predictions.	.655	-.19	-.94
We avoid delays and remain focused on timely accomplishment of the initially set goal.	.716	-.639	-.150
We have monitoring and control mechanism to ensure we meet objectives.	.669	-.094	-.194
Green Innovation (α=.87, AVE=.49, CR=.85)			
Our company chooses materials that produce least amount of pollution during product development or design.	.733	.22	-.82
Our company uses fewest materials for product development or design	.689	-.55	.22
Our company examines whether product is easy to recycle, reuse, and decompose.	.658	-.337	-.218
Our manufacturing process effectively reduces emission of hazardous substances or waste.	.716	-1.27	-.74
Our manufacturing process effectively reduces consumption of water, electricity, coal, or oil.	.696	-.13	-1.37

**Measure model validation*

Next discriminant validity is establish through Fornell and Larcker criteria [52]. The baseline argument is that square roots of respective AVE must be greater than any correlation among the constructs. Table 3 suggests that square roots of AVE (bold values) on the diagonal has higher values than the inter-construct correlations below the diagonal.

Table 3: Discriminant Validity.

Constructs	Means	Affordable Loss	Pre-Commitments	Exploiting Contingencies	Causation	Green Innovation
Means	**.70**					
Affordable Loss	.38**	**.65**				
Pre-Commitments	.41**	.25**	**.72**			
Exploiting Contingencies	.53**	.41**	.34**	**.71**		
Causation	.54**	.39**	.36**	.47**	**.69**	
Green Innovation	.55**	.51**	.34**	.51**	.50**	**.70**

***All Pearson 2-tailed correlations are significant at .01.*

3.3 Structural Model Analyses

Hypotheses have been examined with SPSS Process macro 4 model 1. Process macro conducts bootstrapping and provides detailed analyses of the moderation effect, hence, is preferred for moderation models [53][54]. The influence of control variables was examined but other than R&D and environmental uncertainty all were insignificant to green innovation. Table 4 exhibits that environmental uncertainty is negatively significant to green innovation. R&D expenditure was negative significant when affordable loss was the independent variable; a possible reason could be that affordable loss restrict SME from spending more in R&D activities. Ultimately research is minimal and would adversely affect green innovation.

In table 4, four models are presented and all of them leads to green innovation with a separate independent variable. In first model, means is the independent variable and has a positive significant effect on green innovation (β=.26, t=5.6, p<.00), causation decision logic is also positively significant (β=.23, t=5.1, p<.00). The interaction effect of means and causation is significant (t=-5.3, p<.00); therefore, moderation effect of causation exists between means and green innovation. Further, coefficient of the interaction is negative (β=-.17) which suggests that the moderating effect will tend to decrease as causation logic gets strengthen. This behavior may be seen in table 5 and figure 2. At causation = -.99 (1 SD below the mean) green innovation =.43, as causation grows to .32 (at the mean) then green innovation drops to .21. Whereas, at causation =.97 (1 SD above the mean) the effect is insignificant.

In second model (table 4), affordable loss is the independent variable and has a positive significant effect on green innovation (β=.33, t=9.1, p<.00), causation decision logic is also positively significant (β=.27, t=6.7, p<.00). The interaction effect of affordable loss and causation is significant (t=-5.5, p<.00); therefore, moderation effect of causation exists between affordable loss and green innovation. Further, coefficient of the interaction is negative (β=-.19) which suggests that the moderating effect will tend to decrease as causation logic gets strengthen. This behavior may be seen in table 5 and figure 2. At causation = -.99 (1 SD below the mean) green innovation =.52, as causation grows to .97 (1 SD above the mean) then green innovation drops to .05.

In third model (table 4), pre-commitment is the independent variable and has a positive significant effect on green innovation (β=.14, t=3.5, p<.00), causation decision logic is also positively significant (β=.34, t=7.8, p<.00). The interaction effect of pre-commitment and causation is significant (t=-5.1, p<.00); therefore, moderation effect of causation exists between pre-commitment and green innovation. Further, coefficient of the interaction is negative (β=-.18) which suggests that the moderating effect will tend to decrease as causation logic gets strengthen. This behavior may be seen in table 5 and figure 2. At causation = -.99 (1 SD below the mean) green innovation =.31, as causation grows to .32 (at the mean) and .97 (1 SD above the mean) the effect becomes insignificant.

In fourth model (table 4), exploiting contingencies is the independent variable and has a positive significant effect on green innovation (β=.25, t=5.5, p<.00), causation decision logic is also positively significant (β=.28, t=7.1, p<.00). The interaction effect of exploiting contingencies and causation is significant (t=-5.0, p<.00); therefore, moderation effect of causation exists between exploiting contingencies and green innovation. Further, coefficient of the interaction is negative (β=-.16) which suggests that the moderating effect will tend to decrease as causation logic gets strengthen. This behavior may be seen in table 5 and figure 2. At causation = -.99 (1 SD below the mean) green innovation =.40, as causation grows to .32 (at the mean) then green innovation drops to .19; whereas, at .97 (1 SD above the mean) the effect becomes insignificant.

Table 4: Structural Model Analyses.

	Means			Affordable Loss			Pre-Commitment			Exploiting Contingencies		
Variable	**B**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**
SME Size	-.02	-.52	.59	.02	.64	.51	-.01	-.42	.67	-.03	-.81	.41

SME Age	.03	.91	.36	-.00	-.06	.94	.04	.93	.35	.03	.84	.40
R&D	.10	3.1	.01	-.11	-2.2	.04	.21	2.40	.03	.16	2.8	.04
Industry	.01	.47	.63	-.01	-.48	.63	.00	.02	.97	-.00	-.33	.73
Environmental Uncertainty	-.08	-.99	.01	-.09	-1.0	.29	-.11	-1.2	.22	-.10	-.24	.41
PM Experience	.03	.83	.40	.05	1.2	.21	.05	1.1	.24	.05	1.3	.18
I.V.	.26	5.6	.00	.33	8.0	.00	.87	6.2	.00	.24	5.5	.00
Causation	.23	5.1	.00	.27	6.7	.00	.35	6.3	.00	.27	6.7	.00
Int_1	-.17	-5.3	.00	-.19	-5.5	.00	-.18	-5.1	.00	-.15	-5.0	.00
R2	.63			.64			.56			.61		

*I.V. = Independent Variable; Int_1 = Interaction term; Outcome variable = Green Innovation; four models exhibiting analyses for each independent variable

Table 5: Conditional Effects.

	Means			Affordable Loss			Pre-Commitment			Exploiting Contingencies		
Causation	**β**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**
-.99	.43	10.5	.00	.52	11.3	.00	.31	6.7	.00	.40	9.8	.00
.32	.21	4.0	.00	.27	8.9	.00	.13	3.4	.00	.24	5.5	.00
.97	.10	1.5	.13	.05	2.9	.00	-.3	-0.6	.53	.08	1.3	.18

* Conditional effects of focal predictor at three values of causation logic on Green Innovation; values of causation outside the brackets are mean centered whereas inside the brackets are original.

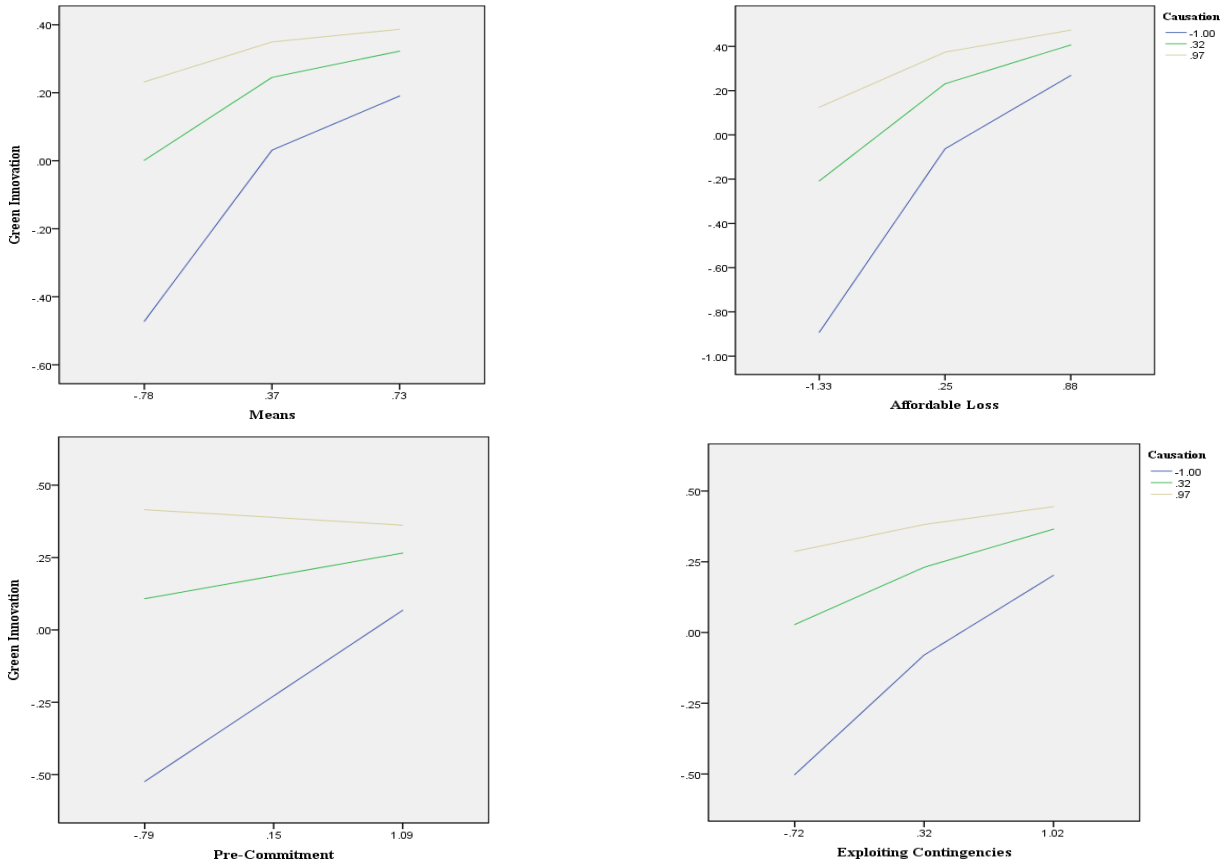

Fig. 2: Graphical Illustration of Conditional Effects.

4 Discussions

This study applies effectuation lens aiming green innovations through moderating role of causation decision logic on four principles of effectuation logic. The experience of a developing economy presents some fascinating results which are of interest to both scholars and practitioners in SMEs. Author found that causation logic and four principles of effectuation logic positively contribute to green innovations. Further, causation logic has a positive interaction with each effectuation principle such that positive behavior tends to drop as causation logic gets strengthen.

Our first assumption relates to causation decision logic positively moderating the influence of means on green innovation. Alzamora-Ruiz et al., [29] noted a positive effect of means on firm innovation performance but did not moderate it through causation logic. SMEs carefully utilized available resources to gain maximum utility in terms of creativity and innovation [18]. Project manager increases its green innovation performance through amalgamating causation principles with experimenting the available means. Planning activities which have remained an integral part of innovation management allows project manager to set a roadmap and utilized available resources in the forecasted direction.

Second assumption was also supported which states that causation logic positively moderates affordable loss principle to elevate green innovation performance. SMEs cannot afford to invest large sums of resources; therefore, incremental investment is a suitable strategy [55] to minimize probabilities to total failure [3]. Causation logic eases choices made by project manager through goal orientation and overcoming the unexpected [11]. Historically, SMEs are more inclined towards experimenting in new product development projects for the reason they can't afford access to every technology and resource [17]. Therefore, goal orientation keeps project manager on track and overcoming the unexpected restricts overinvestment ultimately affordable investments remain targeted and the goal of green innovativeness is achieved.

Third assumption regarding pre-commitments moderated by causal logic is also established. SMEs work in collaboration; collaborating with suppliers, competitors, customers, and other stakeholders to acquire resources and information that overcomes uncertainty. Being unable to acquire resources and information is a major reason of uncertainty and failure in innovation driven projects [2]. Conducting market and competitive analyses eases identification of potential partner that will also minimize losses and elevate expected returns in terms of green innovations and overall business.

Last assumption was that causation logic positively moderates the relationship between exploiting contingencies and green innovation and is empirically established. Exploiting contingencies make the firm more flexible, which Ritter- Hayashi et al., [48] found to positively contribute to firm innovation performance. Causation logic; competitive analysis and expected returns, allow project manager to exploit the prevailing opportunities which may appear as threats. Competitive analysis brings needed information and expected returns support experimentation and improvisation that altogether exploit the prevailing contingency to achieve greenness in innovations.

Lastly, researcher noted that moderation effect is positively significant at low and medium levels; whereas, turns insignificant at high level of causation logic. This behavior may be found in the contribution of Yu et al., [3], they noted that the interaction between effectuation and causation decision logics is positively significant at high degrees of environmental uncertainty only. Our contribution is parallel to general understanding of the effectuation theorem, which suggests that causation is an uncertainty avoidance strategy and effectuation is exploiting the uncertainty. At low levels of causation logic, certain degree of uncertainty prevails and hence the interaction of effectuation principles with causation logic remains positively significant. However, at high degrees of causation the phenomena reverses and the interaction turns insignificant.

This study makes original contribution through merging the experience of SME – rely on effectuation principles, and green innovations – relay on causation principles. Historically, SMEs have relied on effectuation principles due to their resource and managerial limitations; whereas, green innovation has benefited from causation principles due to inclination towards planning and control mechanisms. This study clubs both orientations and assists scholars to develop a baseline understanding of the interaction of both logics with the experience of a developing economy.

This study challenges the contributions of Alzamora-Ruiz et al., [29] who noted only levering contingency would positively contribute to firm innovation performance. This study concludes that all four principles of effectuation logic positively contribute to SME green innovation performance in Arabia peninsula. This contradiction may be attributed to several reasons; the subject of Alzamora-Ruiz et al., [29] investigation was Spanish technology sector which is a developed economy and examined firm level innovation. Whereas, this study examines KSA which is a developing economy and investigates green innovations. A prominent distinction between both economies is the level of prevailing uncertainty. In developing economies, the level of uncertainty is higher than that of a developed economy. Effectuation logic suits more to higher uncertainties, therefore, it is reasonable to expect that effectuation logics will prevail in developing economies.

This study also contributes to the discussion on amalgamation of both decision logics in various domains and adds green innovation to such discussions. Vanderstraeten [6] in innovation management, Smolka [15] in entrepreneurship, Braun and Seiger [13] in family business, and Reymen et al., [16] in business development model literature found a positive synergetic effect of both decision logics; all these studies have been conducted in developed western economies. This adds the flavor of green innovation in a developing economy to this discussion.

This study reports valuable implications for practice for SMEs operating in developing economies. Project managers must benefit from effectuation principles with a slice of causal decision logic. High intensity of causal logic may not be of use; however, low and medium use would amplify the benefits in effectuation principles in terms of green innovation.

SMEs can overcome the constraints of resource and managerial expertise through useful combinations of these principles that assist project managers to make accurate decision. Both, developing economies and green innovation, are largely challenged by environmental concerns. Project managers are advised to extract rents in the shape of synergetic use effectuation principles and causation logic.

This study is also of great importance to government agencies and policy makers who strive to successfully execute development and other projects to achieve long term goals. With the synergetic use of both decision logics policy makers can achieve novelty and innovations in their intended projects.

5 Conclusion and Future Research Directions

From this study the author concludes that all four principles of effectuation logic will be positively moderated by causation logic to elevate green innovations in SMEs. Author noted that causation principles do not yield its objectives when applied in a greater intensity. Future studies may apply case-study methodology to investigate in many details and discover reasons for this behavior. Also, longitudinal approach will add value through investigating these principles across various project stages. Author examined SMEs; future studies may bring the experience of large organization alongside the influence of environmental ethics.

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Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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