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SUSTAINABLE OPERATIONS MANAGEMENT: ADDRESSING ENVIRONMENTAL BURDEN THROUGH INNOVATION AND EFFICIENCY

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Abstract

The study aims to analyze the impact of sustainable operations management on the environmental burden through the mediating role of innovation and efficiency. A model was built using structural equation modeling and analyzed using statistical methods for regression analysis and modeling. Data was collected from a sample of university professors. The study reached a set of conclusions, the most important of which is that operations management sustainable will be more effective in reducing the environmental burden if innovation and efficiency are used to support economic, environmental and social processes. Also, shows the urgent need for international cooperation and integrated efforts to achieve a healthy and sustainable environment for current and future generations.

Keywords: Sustainable operations management, environmental burden, innovation, efficiency.

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Introduction

Humans in the current era are facing a major problem that requires the combined efforts of everyone to reduce and address it, which is environmental pollution and the environmental burden. The problem increases the seriousness of humans, who have a clear role in increasing these risks through their various activities that have become a threat to human life (Hoffman , 2019). In recent years, there has been growing awareness about the environmental, social and cultural impact of modern practices such as the inefficient use of petroleum-derived synthetic inputs, soil erosion and salinization, water pollution and the increase of global greenhouse gases (Tyler & King, 2020). Other practices have caused the loss of traditional crops, and an increase in pests and diseases, among others (Altieri, 2008). Likewise, the increase in area devoted to agriculture has caused loss of habitats and associated biodiversity, and with it loss of ecosystem services (Alteri & Toledo, 2011). Modern agriculture has also increased the marginalization of rural populations, who are seeing their living standards deteriorate, especially with regard to working conditions and food levels. As well as the effects caused by various industries and wrong practices for both companies and society, which directly affected the environment (Machado et al., 2016).

Eliminating environmental problems is a major issue faced by people all over the world. It is the damage that people do to the environment, like when they use too many natural resources or make too much trash and pollution (Edelling et al., 2020). In this context, one of the main challenges faced by companies is managing environmental pressures, including gas emissions, industrial waste and natural resource consumption (Kelly et al., 2021).

Accordingly, the current research aims to identify how sustainable operations management addresses environmental burdens through innovation and efficiency.

Literature Review

Sustainability

Sustainability has been proposed as a paradigm that requires profound social, economic, and environmental transformations to the neoliberal capitalism model, in such a way that it preserves natural capital for the usufruct and well-being of present and future generations (Ganesan, 2018). The world has reached a consensus that achieving sustainable development requires focusing on issues related to climate change, energy, food, population growth, and the development of multiple production systems. And protect ecosystem products and services. Diversity of methodologies, indicators and lists of indicators used to assess sustainability at global, national, regional, urban, agricultural and crop levels. (Pintér & Hansen, 2008), There is no agreement on the number and type of indicators or variables and the level of sustainability of these variables. Methods and indicators for designing and assessing sustainability have been proposed in various fields, but have not yet been quantified in agroecosystems, and the social, economic and environmental dimensions of sustainability are rarely integrated. (Casas et al., 2010).

To put it simply, sustainability means using resources in a way that meets present needs without hurting future ones. In the governance framework, this takes into account economic and social growth as well as protecting the environment. Sustainability first assumes that nature and the environment are not endless

resources that need to be cared for and utilized in a smart way. Second, sustainability means working to improve society and find a balance between community and culture. In this way, it aims to reach a good level of health, education, and quality of life. Third, sustainability helps the economy grow and makes sure everyone has the same amount of money without hurting the environment. (Stanley & Lambert, 2020). Sustainability means meeting today's needs without making it harder for future generations to do the same. It means making sure that economic growth, environmental protection, and social well-being all work together in harmony. Sustainability can be seen as a paradigm because it helps to understand a complicated process (Casas et al., 2010) and come up with a theory that takes into account the system's social, economic, and environmental trends. To do sustainable development correctly it needs to move from a theoretical framework to one that is based on numbers and actions, this is because we need to know what factors cause the necessary changes in society, the economy, and the environment. Ganesan (2018) says that sustainability science is not a branch of the natural or social sciences but instead it is integrative and transdisciplinary, and the ideas, methods, and approaches are still being worked on. To make sustainability around the environmental, social, and economic dimensions, we need to come up with new plans and units and a certain structure or change an existing one (Edeling et al., 2020).

Sustainable Operations Management

The term “sustainable operations management” is one of the modern terms that appeared in the writings of Kleindorfer in 1980, was one of the first researchers to

point out the importance of this term that goes beyond business organizations to reach ethics for the actions and participation of individuals and communities (Belvedere & Grando 2017) At the beginning, it focused only on environmental research, and then gradually its interest increased its main objective is to emphasize the objectives and indicators of environmental and social performance. The quality of products, in addition to the importance of achieving integration between human resources management and organizational practices, and emphasis on implement more effective, sustainable operations through high-quality power chain management (Fu et al., 2016). Sustainable operations management is defined as a common business philosophy it is applied across business organizations, and its goal is to solve problems, improving the performance of work teams, monitoring production, improving time capabilities, training workers by introducing them to intensive work courses that are appropriate to their work, and their participation in their opinions. In order to improve production processes, improve safety and working conditions, and reduce of waste on the production line, recycling and sharing social. (Piercy,2015).

Sustainable operations management is a common work philosophy applied across organizations and its goal is to solve problems, improve the performance of work teams and monitor production, and improve the capabilities of workers by introducing them to intensive work tools that are appropriate for the work they do, and involving them in expressing their opinions to improve production processes. Improving safety and working conditions, waste reduction, recycling and community engagement. It is a set of concepts and skills that seek to create or modify daily practices and decision-making models based on economic, social,

environmental and cognitive dimensions. (Machado el., 2017). It improves efficiency and optimizes the use and recycling of resources to reach efficient and innovative environmental production processes (Yazan & Fraccascia, 2020). It refers to the planning, coordination and control of all communication operations. A system that creates or adds value to customers in an efficient manner and at low costs. The emphasis should not only be on reducing costs, but also on the environment by reducing emissions through activating the electronic fingerprint intent and reduce the costs of reverse logistics services and remanufacturing limit damage (Shahsavari & Akbari,2018). Therefore, managing sustainable operations is an approach based on to adopt innovative practices aimed at achieving integration between the factors and managing human resources to motivate them to perform daily tasks accurately without any influence on the internal and external environmental factors of the organization (Qu et al., 2020).

Accordingly, sustainable operations management can be defined as strategies, plans and activities related to the production and distribution of goods, and reducing the consumption of materials, pollution and waste, in which economic, social and environmental issues are integrated into the management of the company's operations with the aim of enhancing the performance and organizational sustainability of the company, as well as adopting cognitive processes in presenting creative ideas in design and present the product.

Dimensions Of Sustainable Operations Management

Benkent et al. (2013) presented a model to identify the main dimensions of sustainable operations management, which consists of three basic dimensions:

economic operations management, social operations management, environmental operations management) (Hubbard, R., & Vetter,2023), and these dimensions can be explained as follows:

Economic Operations Management

Economical operations management refers to all procedures and processes that ensure their economic performance in the long term, and investment in integrated social and environmental strategies that provide compliance with a variety of regulatory requirements, and that sustainable operations management aims to produce non-polluting products and conserve energy and natural resources to be economically viable, safe and healthy for workers, society and consumers (Machado et al., 2012). The management of the economic operations of each system in any company is achieved not only by providing capabilities, but also by increasing their quality and entering the market with new projects and services. (Peris-Ortiz et al, 2019).

Social Operations Management

These are all plans and activities that aim to develop positive relationships with all current, future and potential stakeholders. It also relates to aspects of corporate governance, health and safety, and employee aspirations, social capital development (Belvedere & Grando 2017). The management of social processes is generally viewed as ambiguous and subjective, however, given that sustainability is directly and indirectly concerned with the well-being of individuals in society and cannot be separated from the values, beliefs, cultural traditions and meanings of the actors involved (Benkert et al., 2013). The need for a social operations tool

in the industrial sector highlights that there is a strong desire to protect and preserve resources for future generations. Therefore, companies must work to form a set of values, standards and behaviors that work to achieve sustainability (Rasmussen, 2011).

Environmental Operations Management

Environmental operations management aims to reduce the environmental impacts that occur as a result of corporate activities. These include aspects of resource use, emissions to air, water and land, waste generation and disposal, and life cycle impacts of products, as well as its effects on biodiversity (Benkert et al, 2013) .

Environmental operations management aims to develop the level of community well-being by protecting raw resources that are used to meet personal needs, and also by preventing various effects resulting from waste. Environmental operations management programs in companies can be divided into two areas: increasing awareness of environmental sustainability and reducing pollution, Companies benefit from the ways they move towards managing environmental processes to achieve competitive advantage (Kucukoglu & Pınar., 2016).

Environmental Burden

This theory came from studies conducted on attention, concentration, and information processing, and one of the results of excessive stimulation is that individuals' attention is narrowed and limited so that it is focused on one stimulus, and attention is reduced to other stimuli that are more marginal but closely related to the organism's performance of its function (Hertog et al., 2021). It was developed by (Cohen 1968 & Milgram, 1970). This process of narrowing and

confining attention to models addresses most of the data collected on exposure to new and unwanted environmental stimuli, they proposed the idea that individuals have a limited ability to process information, when information from the environment increases and exceeds the individual's ability to process the importance and relationship to a particular topic, an increase in attention occurs information burden (Tyler & King, 2020). The primary strategy for dealing with this burden or excessive tolerance is to ignore some of the inputs from the stimuli, and it is this ignoring of the inputs that explains the positive and negative effects of excessive environmental stimulation or of overriding this stimulation. Cohen 1968 presented four facts (Hertog et al., 2021):

1. People have a limited ability to process the stimuli they are exposed to and can only invest effort in attending to inputs simultaneously.
2. When environmental inputs overwhelm an individual's ability to attend to them, the usual strategy is to ignore those inputs that are less important and devote more attention to inputs that are of greater importance or have a closer relationship to the topic being addressed, and steps are often taken to prevent distracting or less important stimuli from occurring (Stanley & Lambert, 2020).
3. When a stimulus occurs that requires some kind of adaptive response, the stimulated individual monitors and makes a decision about the response responses if he will use any of them. thus, as the intensity of an input increases, it cannot be predicted or controlled.
4. The amount of attention available to a person is not constant and may be temporarily depleted after a long period of burden or excessive load on him.

After paying attention to certain demands for a long period, the ability to pay attention to other demands may suffer (Klam & Townsend, 2021).

Innovation And Efficiency

Innovation is making something new within a certain amount of time by utilizing one's experience and thinking in a good ways rather than copying others to create something that is acceptable and meets the needs of both the individual and society. This must be possible with a number of productive factors present, including realism, originality, and generalizability (Kahn, 2018). Efficiency means making the best use of resources to get a certain amount or level of outputs at the lowest cost. It is one of the most important ways for organizations to see how well they are doing at reaching their goals. Efficiency is how well an organization uses its resources in a way that is rational, optimal, and cost-effective. Effectiveness is how well an organization meets its goals at the lowest cost and in the shortest amount of time . The interaction of innovation with efficiency means that innovation contributes to enhancing efficiency in processes and activities. When innovation is applied in an effective and intelligent way, it can have a positive impact on efficiency, likewise, efficiency leads to innovation (Kelly et al., 2021).

Methods

The research used qualitative data through a questionnaire that was distributed to a sample of (76) experts and specialists in Iraqi universities, in order to test the hypotheses and relationships contained in the model in Figure 1, which consists of three variables: the independent variable (IV) and its dimensions (IV1, IV2, IV3), the mediating variable (MV1 , MV2) and the dependent variable (DV).

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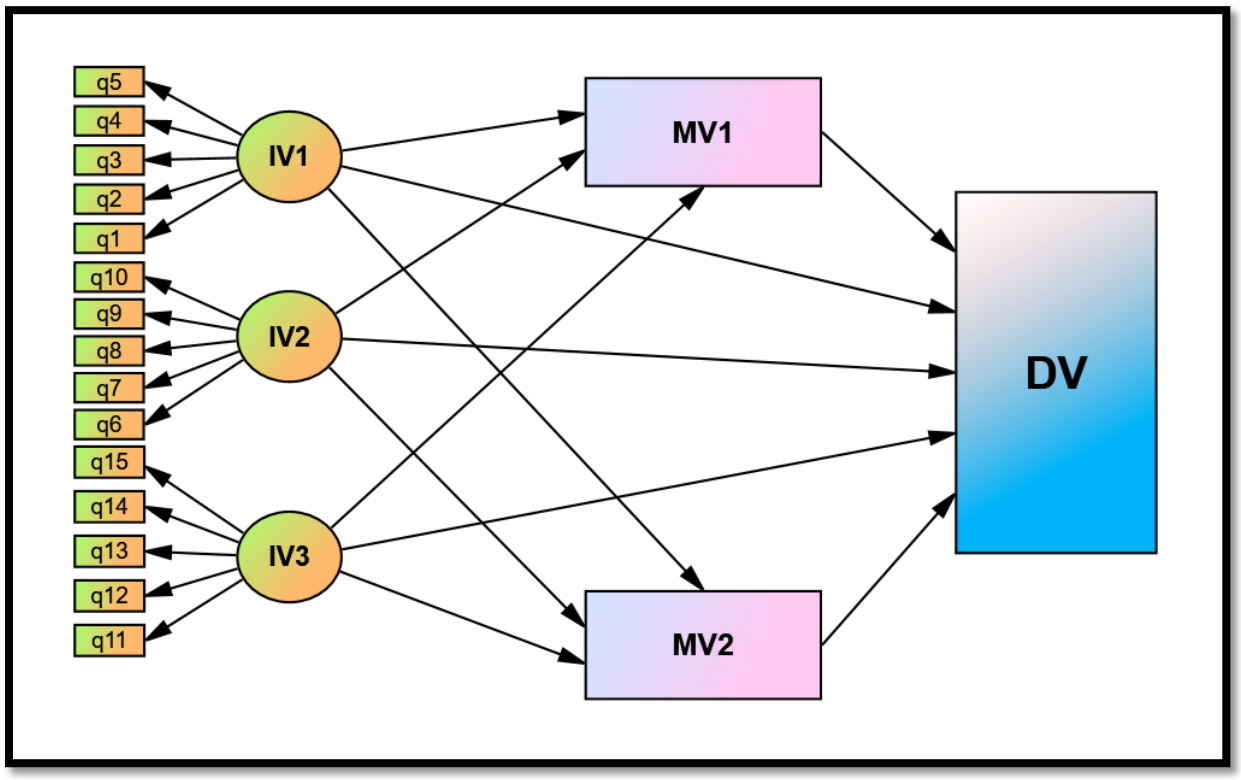

Figure 1: Study Model

Normal Distribution Test

The research used the normal distribution test through the coefficients of flatness and skewness, where their values are required to be between (-1.96) and (+1.96). It is clear from Table 1 that all values for the three variables are within the acceptable limits of the normal distribution, and this is supported by the histogram in Figure 2.

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Table 1: Normality Test Results

Variable	min	max	skew	c.r.	kurtosis	c.r.
q15	1.000	5.000	-.257	-1.056	-.515	-1.056
q14	1.000	5.000	-.496	-2.036	-.097	-.199
q13	1.000	5.000	-.618	-2.537	.154	.316
m2	1.000	5.000	-.464	-1.904	-.508	-1.042
q11	1.000	5.000	-.355	-1.458	-.001	-.002
q10	1.000	5.000	-.728	-2.985	.460	.944
q9	1.000	5.000	-.554	-2.272	-.166	-.340
m1	1.000	5.000	-.452	-1.853	-.354	-.726
q7	1.000	5.000	-.480	-1.971	-.103	-.212
q6	1.000	5.000	-.134	-.550	-1.093	-2.243
q5	1.000	5.000	-.579	-2.375	-.120	-.247
q4	1.000	5.000	-.484	-1.987	-.630	-1.293
q3	1.000	5.000	-.911	-3.739	.564	1.158
q2	1.000	5.000	-.688	-2.825	-.183	-.375
q1	1.000	5.000	-.714	-2.931	-.126	-.259
Multivariate					28.515	6.345

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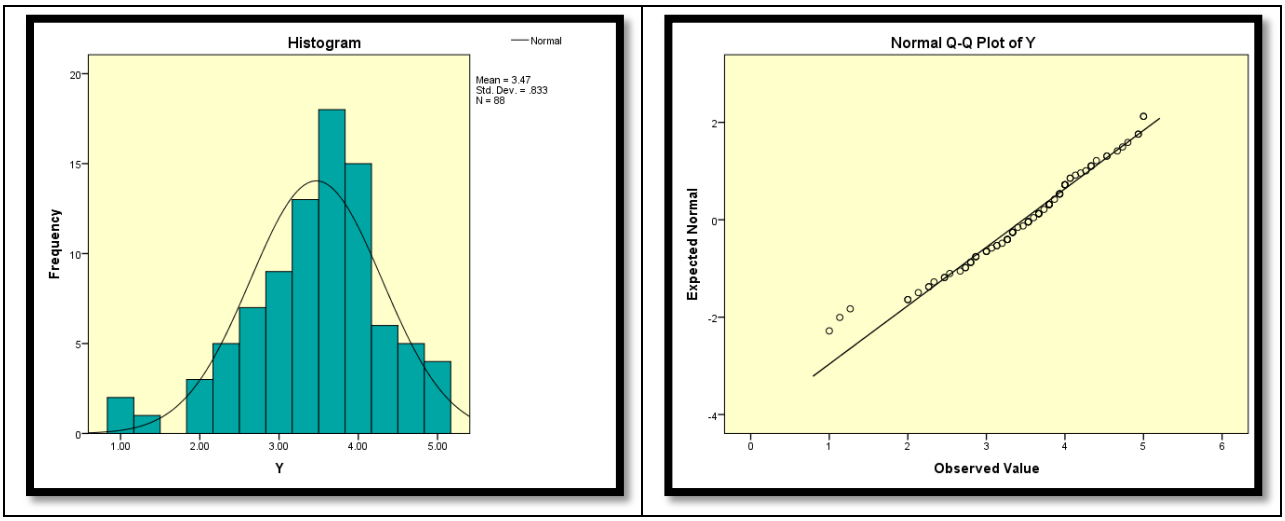

Figure 2: Normality Histogram

Confirmatory Factor Analysis And Modeling

In order to identify the conceptual validity of the items and their dependency on the dimensions within the models of the main variables included in the study, confirmatory factor analysis is adopted within the formulation of the models as it is the best way to identify the validity of the scale, and the loading values are good if they are greater than (0.50).

Table 2 and Figure 3 indicate that all loading values for the variables were higher than 0.50 and that these values are significant as the significance level was smaller than 0.05. also the god fit index were acceptable .

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Table 2: Good of fit measures

Good of fit	Index	Criteria
χ 2/d.f	2.088	<5.0
RMSEA	0.078	<0.08
GFI	0.935	>0.90
AGFI	0.931	>0.90
CFI	0.955	>0.95

χ 2 = Chi square , df= degree of freedom , RMSEA=Root mean square error , GFI = Good fit index , AGFI = Adjusted good fit index , CFI = Comparative fit index , TLI = Tucker Lewis index.

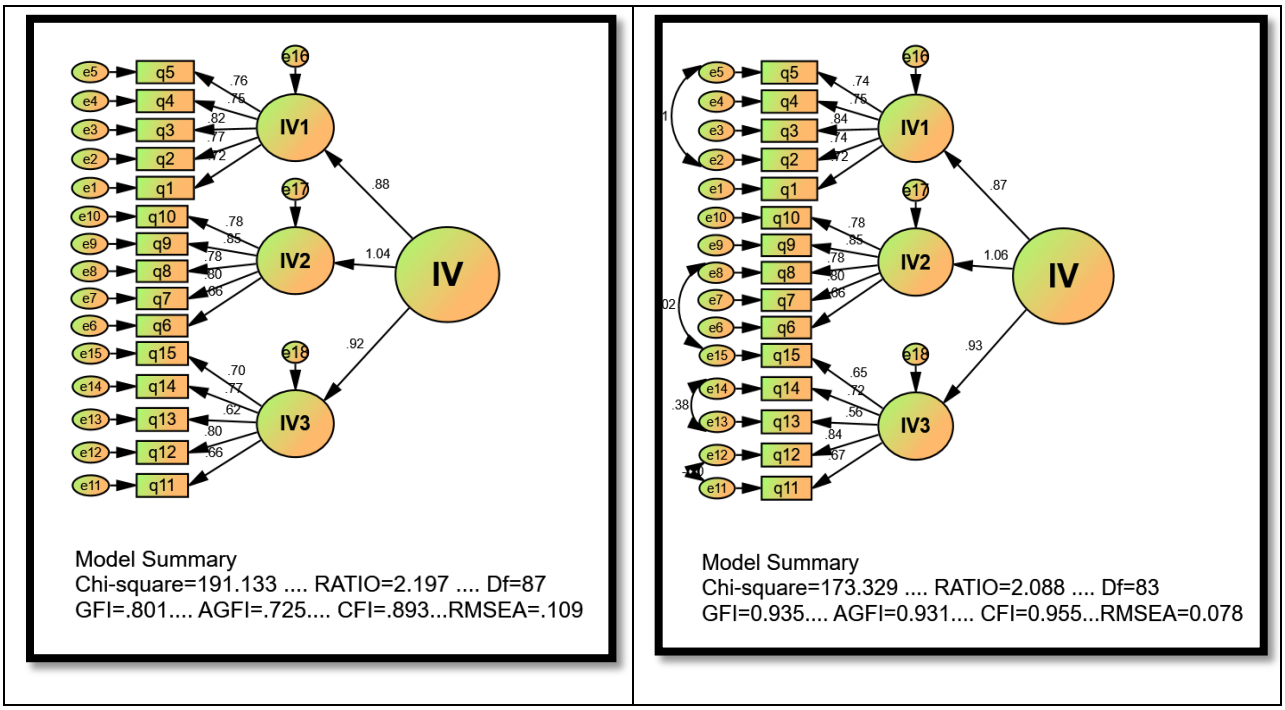

Figure 3: Structural Equation Modeling

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Results

Table 3 show significant effect for (IV) on (DV), constant α (0.191) indicates that a change of one standard deviation unit will lead to a change in the increase of the dependent by an amount of beta (β) (0.993), and value of coeficent of determination R^2 The value of (0.732) refer to that the variable is able to explain (73.2%) of dependent variable, study sample, while the remaining percentage is due to the contribution of other variables that were not included in the linear regression model. Also, F test for the simple linear regression model was greater than the tabular F value at ($\alpha \leq 0.01$), which refer to the effect at 1% significance level, and this supports Hypothesis 1.

Also, that there is a significant effect of (IV1) on (DV), constant α (0.528) indicates that a change of one standard deviation unit will lead to a change in the increase of the dependent by an amount of beta (β) (0.783), and value of coeficent of determination R^2, the value of (0.616) refer to that the variable is able to explain (61.6 %) of dependent variable, from the opinion of study sample, while the remaining percentage is due to the contribution of other variables that were not included in the linear regression model. Also, F test for the simple linear regression model was greater than the tabular F value at ($\alpha \leq 0.01$), which refer to the effect at 1% significance level, and this supports Hypothesis 1-1.

and that there is a significant effect of (IV2) on (DV). constant α (0.457) indicates that a change of one standard deviation unit will lead to a change in the increase of the dependent by an amount of beta (β) (0.838), and value of coeficent of determination R^2 The value of (0.669) refer to that the variable is able to explain (66.9%) of dependent variable, from the opinion of study sample, while the

remaining percentage is due to the contribution of other variables that were not included in the linear regression model. Also, F test for the simple linear regression model was greater than the tabular F value at (α≤0.01), which refer to the effect at 1% significance level, and this supports Hypothesis 1-2.

regarding IV3 that there is a significant effect of (IV1) on (DV). constant α (0.346) indicates that a change of one standard deviation unit will lead to a change in the increase of the dependent by an amount of beta (β) (0.856), and value of coeficent of determination R^2 the value of (0.526) refer to that the variable is able to explain (52.6 %) of dependent variable, from the opinion of study sample, while the remaining percentage is due to the contribution of other variables that were not included in the linear regression model. Also, F test for the simple linear regression model was greater than the tabular F value at (α≤0.01), which refer to the effect at 1% significance level, and this supports Hypothesis 1-3

Table 3: Regression Analysis Results

IV	*α*	*β1*	*R^2*	*Adj-R^2*	*F*	*sig*
IV1	*0.528*	*0.783*	*0.616*	*0.611*	*137.33*	*0.000*
IV2	*0.457*	*0.838*	*0.669*	*0.665*	*173.51*	*0.000*
IV3	*0.346*	*0.856*	*0.526*	*0.520*	*95.65*	*0.000*
IV	*0.191*	*0.993*	*0.732*	*0.728*	*234.41*	*0.000*

As for the factorial effect, Table 4 and Figure 4 show significant effect for (IV1) on (DV) (0.28) and that the effect of (IV2) on (DV) is (0.51), which is a significant effect, as well as the effect of (IV3) in (DV) is (0.82) and is significant, as the

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significance level was α≤0.01, and this means that there is a significant effect at the 1% significance level.

Table 4: Direct Effect Results

Path			Sig.
IV1	-- >	DV	0.280
IV2	-->	**DV**	0.511
IV3	-->	DV	0.823

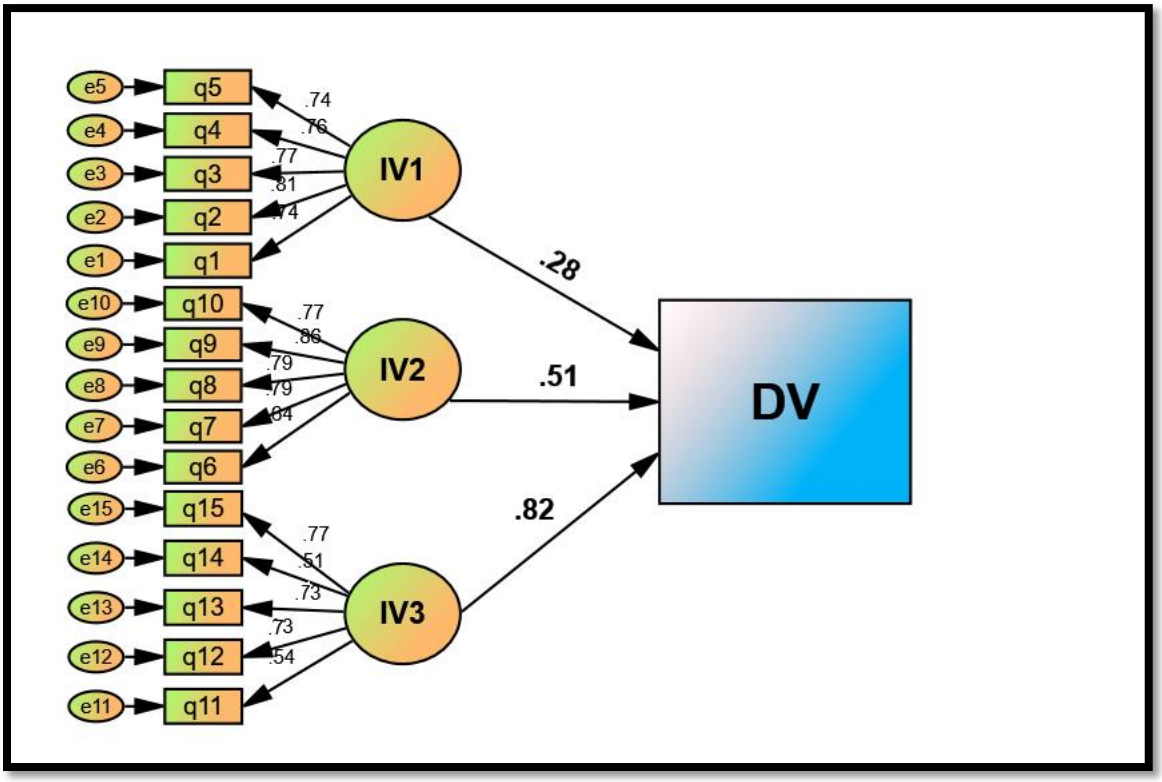

Figure 4: Structural Direct Effect

In regard to the mediating relationship Table 5 , Figure 5 indicate the following : The direct effect of (IV1) on (DV) is (0.14) and the indirect effect through (MV1) is (0.46). This indicates that the mediated relationship is better than the direct

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relationship, and this supports Hypothesis 2-1. and the direct effect of (IV2) on (DV) is (0.84) with mediated (MV1) indirect effect of (0.30), the mediation effect is better which support Hypothesis 2-2. Also, the direct effect of (IV3) on (DV) is (0.19) with mediated (MV1) indirect effect of (0.25), the mediation effect is better which support Hypothesis 2-3. and the direct effect of (IV1) on (DV) is (0.14) with mediated (MV2) indirect effect of (0.19), the mediation effect is better which support Hypothesis 2-4.and the direct effect of (IV2) on (DV) is (0.30) with mediated (MV2) indirect effect of (0.90), the mediation effect is better which support Hypothesis 2-5. Also, the direct effect of (IV3) on (DV) is (0.19) with mediated (MV2) indirect effect of (0.27), the mediation effect is better which support Hypothesis 2-6.

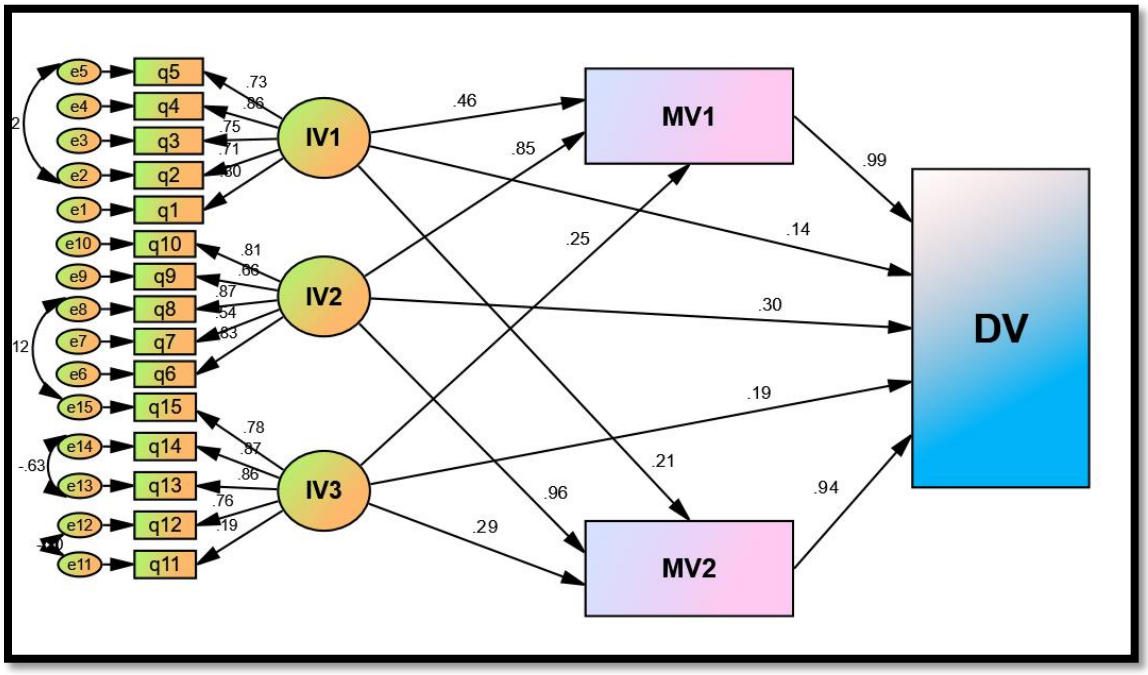

Figure 5: Structural Mediating Effect

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Table 5: Mediating Effect Results

Path			Sig.
IV1	-- >	MV1	0.46
IV1	-->	DV	0.14
IV2	-->	MV1	0.85
IV2	-->	DV	0.30
IV3	-->	MV1	0.25
IV3	-->	DV	0.19
IV1	-->	MV2	0.21
IV2	-->	MV2	0.96
IV3	-->	MV2	0.29
M1	-->	DV	0.99
M2	-->	DV	0.94
IV1--> MV1--> DV			0.46
IV2--> MV1--> DV			0.84
IV3--> MV1--> DV			0.24
IV1--> MV2--> DV			0.19
IV2--> MV2--> DV			0.90
IV3--> MV2--> DV			0.27

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