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Industry, and Augmented Reality Study Impact on Sustainable Development in the Era of Crises

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Abstract Innovation and technological growth play an important role in every organization the idea of Industry 4.0 is a new reality in the modern economy. Industry 4.0 has changed the design, procedures, activities and infrastructure of goods and production systems substantially. Yet rapid economic and industrial changes and population growth in Bahrain are related to rises in energy demand and emissions of greenhouse gases. In contrast, emerging technologically driven technological innovations like Augmented Reality (AR), and Virtual Reality (VR) were new drivers of progress in industries. Certainly, the implementation of the concepts has further consequences for sustainable development of Kingdom of Bahrain. Hence, the objective of the present paper is to investigate the effects of industry and reality on sustainable development. Additionally, not enough research has been conducted to ascertain the effects of industry and augmented reality on sustainable development in Bahrain. To do so, a structured survey was conducted for receiving observations of 210 entrepreneurs in Bahrain and to analyse the effect. The data is analysed and hypothesis is tested by using IBM-SPSS-AMOS package 25.0. The study found that the direct effects of industry and augmented reality on sustainable development in Bahrain are positive and significant. The originality of the manuscript goes back to studying the concept in the Arab world. On the basis of the result, this research endorsed that, the development in Bahrain is heavily in line with consistent growth of industrialization and augmented reality model implementation though there is some environmental consequences.

Keywords Industry, Reality, Sustainability, Development, Augmented Reality (AR), Virtual Reality (VR), Kingdom of Bahrain

1. Introduction

Bahrain's Kingdom is an archipelago of 33 Arab Gulf islands. These islands are 770 km2 long and are connected west by the Fahd Causeway to the Kingdom of Saudi Arabia. A density of 2,100 (P / Km2) is present at the country with a population of approximately 1,6 million (Bahrain Human Development Report, 2018). Bahrain, governed by the HM King Hamad bin Isa Al-Khalifa, is a constitutional monarchy.

Bahrain is a double bahr, which is meaning sea in Arabic. The island has two types of surrounding water: hot liquid springs and salty water. The name derives from the topography of the region. The atmosphere in Bahrain during the summer is hot and humid, and the rainfall is cool during the winter. Bahrain is faced with marginal farmland by the largely arid desert land mass. The water around the island, though, includes natural resources, primarily fish and pearls. Bahrain also contains oil and natural gas (Bahrain Human Development Report, 2018).

Before the modern era, the economy of Bahrain depended heavily on pearl plunge. Bahrain's economy has shifted since the 1930s to oil dependency and, since the 1970s, it has diversified into other industries such as oil processing and refining, aluminium production, hospitality, retail business and banking and finance, in particular Islamic finance. In the last decade the country's economy has risen at $32 billion over 2016, with real GDP growth of 3.2 per cent in 2015.

Since 2000, Bahrain has undergone a number of fundamental transformations, including economic reforms, affecting all facets of everyday life. In 2008 Bahrain officially launched a Economic Vision with a long-term goal of turning Bahrain from a natural-resource economy into a diversified and competent system with a view to coordinating economic reforms and making good use of synergies (Bahrain Human Development Report, 2018). The plan has three guiding principles: prosperity, innovation and justice, which would undoubtedly make the project a progenitor of the SDGs. The SDGs have stressed that productivity and skills are the drivers of economic activity and diversification by focusing on existing high-potential industries (Bahrain Human Development Report, 2018).

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Hence, there are also already the situations in certain businesses and sectors of the economy in the latest technologies, mainly related to digitization. The processes take effect at different rates, primarily due to economic growth, investment opportunities and technology environment, although the pattern is evident and of crucial significance. The Industry 4.0 definition suggests that the gaps between people's and machinery's jobs blurred. The second has brought electricity into the industry as well as automated the uniform tasks of line workers, as the first industrial revolution has improved manufacturing operations. The fourth has improved the management of information and decision making.

The fourth industrial revolution, which applies to every area of life, is different from the original. In the scope of this industry the information exchange between people, persons, items and also between artifacts itself is processed and commercialized (Oláh et al., 2017). The web definition enables the material to be purchased, assembled, performed and distributed at any point during the cycle without human involvement (Oláh et al., 2018). To order to reach new customers and new employees, industrial companies are forced to invest to modern technology and leadership systems. Therefore, the objective of the present paper is to present the effect of industry 4.0 on sustainable development of Bahrain (Stverkova and Pohludka, 2018).

In contrast, digital technologies such as Augmented Reality (AR) and Virtual Reality (VR) are the pioneers for change in business models (BMI) and sustainable development (Casadesus-Masanell and Ricart 2011). This is particularly true in the high-speed Internet environment in which business models need to be changed frequently to meet new challenges. In many industries in the coming years these technologies are expected to provide substantial income opportunities (Ebert et al. 2017). Nonetheless, new technologies–such as AR / VR–have no obvious business argument most of the time (Chesbrough 2010) and their effect on sustainable development is little understood. Zottet al. (2011) states that sustainable development academic research continues to be lagging behind implementation, as well as that prior independent model systems cannot adequately resolve SDGs problems. The second goal is "to study the effects on sustainable development in Bahrain of reality engineering.

2. Literature Review

2.1. Industry 4.0

Power generation software such as robotics and automation has long existed according to Wang et al. (2016). However, the Internet, through networking robotics and automated devices, revolutionizes process management. Internet and technology creation produces an interconnected network of people, hardware and businesses, so that a fully customized brand can now be created for the customer through constantly distributed value-creating processes. We mean the smart networking of industrial products and processes with Industry 4.0. In 2013, the Frauenhofer Institute analysed businesses leveraging Industry 4.0 innovations ' efficiency and development potentials. It has five main technological areas in which it is influenced: integrated systems, smart manufacturing, solid networks, cloud computing and IT security (Bauer et al., 2018).

Nevertheless, in the Fourth Industrial Revolution, Rüßmann et al. (2018) collected nine technologies that characterize leading companies. Technical instruments and methods are included. These include autonomous robotics, modelling, convergence of horizontal and vertical structures, industrial IoT, cyber security, cloud services, 3D (additive) printing, augmented perception and big data processing.

Machines are linked as a shared group in today's Industry 4.0 plant. These advances need to be carried out by way of sophisticated forecasting methods so that knowledge can be converted into details efficiently to clarify uncertainty and thus take informed decisions. The conclusion is that Industry 4.0 describes various changes in the manufacturing systems, primarily driven by information technology (IT). These developments have a multifunctional organizational implications as well as technological (Lasi et al, 2014).

According to Hermann et al. (2016), however, Industry 4.0, which now covers a new, relatively wide conception, included new technologies and concepts for the organization of the value chain, is the actual digitization of the industry. Industry 4.0 creates a modular, smart plant that monitors physical processes, maps the physical world in the virtual world and decentralizes operational decision-making (self-employed machinery). This means a Cyber Physical System (CPS).

The view of emerging technologies ' profitability was affected, on the one hand, by the estimates of the company level indicating that innovation in Industry4.0 significantly increased the efficiency of shareholders (Bughin, 2016). The ability to misinterpret the findings can be seen in the pacing of the experiments. Most major investments in 2010, which meant that those observations could not be generalized or even forecast at a macro level, were carried out by well fitted, high-performing leading companies with a good capital base. Simultaneously, the national economic calculations, including the reference, have been carried out (Graetz et al., 2018), which clearly demonstrate, by studying 17 countries, the effects on economic growth and productivity gains of industrial robots. The use of IT technologies increases production, leading to increased revenue, benefit and quality of products and output by introducing new technology (Popp et al. 2018).

In their analysis Geissbauer, Vedso and Schrauf (2018) analyzed the investments made by industry 4.0 in each industry and found that the electronics industry is now making the biggest investments and is expected to continue in sustainable development. Accelerated industrial digitalization aims to adapt to customer needs which change

rapidly. The product lifecycle is shortened considerably due to ever new product variants expected by customers and the production technology must be kept up to date on innovation. It is not only necessary to renew the product itself occasionally, but also to create a production technology, flexibly modifiable with the constantly changing specifications of customer products (Herrmann etal., 2014). The impact on manufacturing sectors can be important due to industrial digitization: major reductions in production and distribution prices as well as processing of goods, shorter lead times and less supply during shipment (Heynitz et al, 2016). In line with the changing needs which will lead to sustainable development, industry 4.0 technology users at company levels should increase capability utilization and more quickly market their new products (Burmeister et al., 2016). Generally, we can assume that the whole supply chain of the business is protected by Industry 4.0—although many value chains are called production-based, likely complemented by operational activities that can make a significant contribution to sustainable development.

2.2. Reality

New technological innovations and business models (Baden-Fuller and Haefliger 2013) are inextricably linked and BMI can be transferred to responsive managing management by new digital technology such as August reality (AR) or virtual reality (VR) (Euchner 2016). Most entrepreneurs do not understand enough what business models are and lack the skills needed to devise suitable models as market conditions change or fail to innovate business models. Further work is therefore required.

A conservative forecast anticipates that AR or VR's market volume will increase from $3 billion in 2016 to $40 billion by 2020 (SuperData, 2017). Gartner (2016) has placed AR / VR on its top ten strategic technological trends, stating that "there are, or have, the highest inflation expectations at or over the transparently immersive technologies identified in the field and that they are ready today for real productivity." Such forecasted results are based on the assumption that AR or VR have achieved ample technical accessibility (Ebert et al. 2017) to generate more credible AR or VR applications than ever before (Billinghurst et al. 2015). It is important that AR or VR are widely used across industry. AR or VR is widely considered to be potential new repair and deployment learning platforms (Gavish et al. 2015). AR or VR also promise that they will benefit from education. Innovation Marketers can use AR to create immersive brand experiences, generate more interactive advertising, and allow consumers to experience products and spaces in new ways which help to create sustainable development (Scholz and Smith 2016), many of the largest companies in the world have already incorporated AR and VR into marketing strategies.

2.3. Sustainable Economic Growth

The concept of sustainable economic growth is intrinsically linked to the dimensions of environmental sustainability and human development. In retracing the introduction of the concept of sustainable development, an important related landmark was the so-called Brundtland Report (“Our Common Future”, Oxford University Press 1987) which discussed interrelated and interdependent national sustainable development paths and built on the UN’s 1972 Stockholm Conference on (human) environment, which had introduced environmental concerns to the formal political development discussion, by conceptualizing environment and development as intrinsically intertwined dimensions.

This addressed the shortfalls of literally all preceding economic growth concepts and theories that had either ignored or neglected the dimension of environmental sustainability. Other related key events include the 1992 Rio Earth Summit on Environment and Development, the 2002 Johannesburg Earth Summit on Sustainable Development, the 2012 Rio Earth Summit (Rio+20), and the 2015 Paris COP conference on climate change. The recently introduced 2030 Agenda embraces and reflects the goals and principles enshrined in the various declarations and action plans, and synthesized them in the form of a global set of Sustainable Development Goals along with targets that can be operationalized and measured, at the local (i.e., national and sub national) level. In following the definition coined by the Brundtland Commission, sustainable development means meeting the needs of the present without compromising the ability of future generations to meet their own needs. This implies an obligation of the current generation to future generations, thus incorporating the notion of intergenerational equity, responsibility and justice in terms of “doing business” in the economic realm. This has obvious implications for consumption and lifestyle patterns and production processes and systems, including the use of finite resources and public goods, as well as the design and content of the education, health and social systems.

2.4. Underpinning Theory

The COR theory emphasizes resource accretion that is essential to the promotion of sustainable development (Hobfoll, 1989). The COR principle (i.e. Conservation of assets philosophy), emphasizes that additional resources can be used to promote the capitalization of available resources for better results, as stated by Xanthopoulou, Bakker & Fischback (2013). This study has therefore used COR's theory, which is illustrated by the fact that when organizations have management support, time availability and organizational outlook, these act positively and have positive effects, such as sustainable development.

2.5. The Conceptual Framework

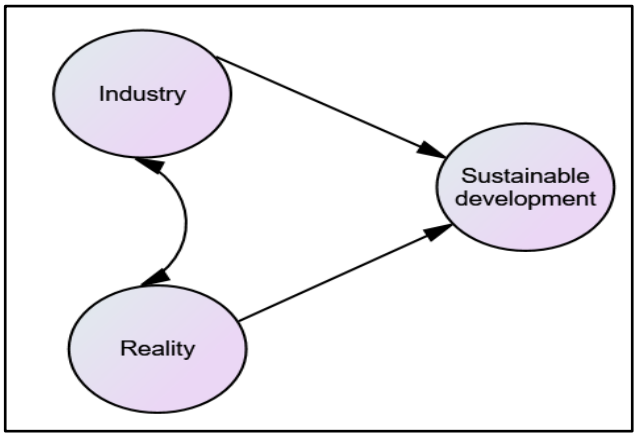

Figure 1. Research Framework

3. Research Methodology

In five different areas of Bahrain a self-administered survey was conducted, and a maximum of 210 available questionnaires were issued. Based on gender, male accounted for 92,86%, while 8,14% of the sample population was women. Industry measures 4.0 are assessed by means of a measuring tool developed by Hornsby et al. (2015) with 4 components. In comparison, six things by Hagal and Duane (2018) evaluate fact. In this research, Hajek and Henriques (2017) have also used a6-point scale divided into two dimensions for the calculation of sustainability. Answers and prices are rendered with a 5-point interval scale, 1 being very disagreeable and 5 strongly agreeing with the assertion of things. SEM is a second generation technique of multivariate analysis (Hoque et al., 2017C) used for the researchers of this study using IBM-SPSS-AMOS 25.00 software for the analysis and the testing of hypothesis. In SEM, after validating the measurement model, the researchers execute the path model procedure.

4. Results

4.1. Measurement Model

At the beginning of the validity, reliability and unidimensionality study, the validation of the measurement model is required (Hoque et al., 2017b; Hoque et al., 2017c; Yusof et al., 2017; Awang et al. 2015). Hoque et al. (2017a); Hair et al. (2014); mentioned in their studies the unidimensional charging of all items as positive as 0.6. Whereas, if the measurement model meets the Incremental fit, Absolute fit, and Parsimonious fit criterions then the Construct validity is achieved. Furthermore, the Discriminant validity is achieved where no correlation exists between all constructs (Awang 2015; Hair et al. 2014; Fornell and Larcker 1981). On the other hand, Awang et al. (2017a); Awang et al. (2017b); Awang (2015); Hair et al. (2014); Fornell and Larcker (1981) stated that Construct reliability is achieved through the values of CR and AVE and for that the minimum value requirement is 0.6 and 0.5 correspondingly.

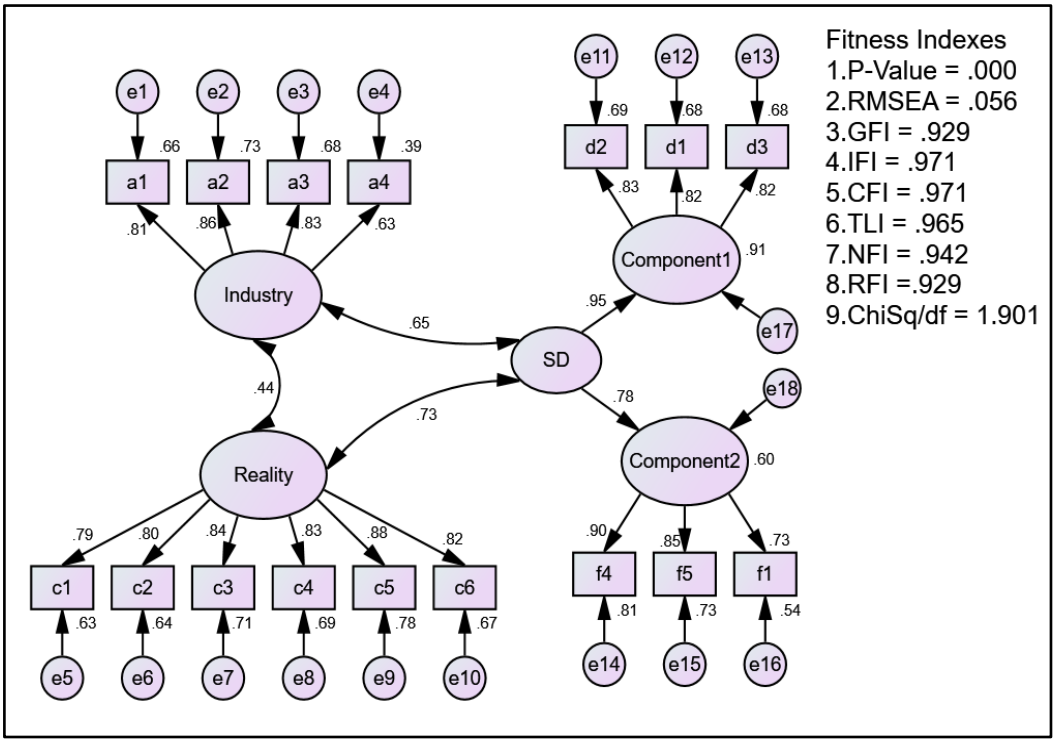

Figure 2. Pooled CFA Results and All Fitness Indexes

Table 1. Cronbach's Alpha, CR and AVE

Construct & Dimensions	Dimensions & Items	Item Factor Loading	Cronbach's Alpha	CR (above 0.6)	AVE (above 0.5)
Industry 4.0	A1	0.81	0.771	.866	.620
	A2	0.86			
	A3	0.83			
	A4	0.63			
Reality	C1	0.79	0.747	.928	.684
	C2	0.80			
	C3	0.84			
	C4	0.83			
	C5	0.88			
	C6	0.82			
Sustainable Development	Component 1	0.95	0.768	.860	.755
	Component 2	0.78			
Component 1	D1	0.82	0.869	.863	.678
	D2	0.83			
	D3	0.82			
Component 2	F1	0.73	0.903	.868	.688
	F4	0.90			
	F5	0.85			

In this analysis the inner reliability of the items is achieved because the minimum value of Cronbach Alpha is 0.7 or above (Fornell and Larcker, 1981; Nunnally, 1978). As, P-Value=.000; RMSEA=.056; IFI=.971; CFI=.971; TLI=.956; NFI=.942; RFI=.929; ChiSq/df=1.901 (shown in Figure 2) thus the measurement model of the industry, reality and sustainable development latent constructs have met the requirement as well as signifies a satisfactory fit to the data and result of all indexes was good. The construct accuracy of this thesis has therefore been reached (Hoque and Awang, 2016a; Awang et al., 2017a; Awang et al., 2017b; Awang, 2015).

Table 2. Discriminant Validity Index Summary

Construct	Industry	Reality	Sustainable Development
Industry	**0.787**		
Reality	0.44	**0.827**	
Sustainable Development	0.65	0.73	**0.868**

Unidimensionality; Convergent Validity, Internal and Construct Reliability have achieved variable charging for every component of three constructs comprising industry, reality and sustainability together with Cronbach Alpha, CR and AVE for every framework as shown in Table 1 showing all latent constructs. For the respective constructs, the diagonal value in the Discriminant Validity Index Table 2 is the value of √(2&AVE) , whereas other values represent the correlation between constructs. Since the √(2&AVE) for the respective structures is greater than their rows and columns in relation values, Discrimination in constructs validity for the model is thus achieved (Hoque et al., 2018a, Hoque et al., 2018b; Awang *et al.*, 2017a; Hoque *et al.*, 2017c, Hoque *et al.*, 2017d; Yusof *et al.*, 2017; Hoque and Awang, 2016a; Hoque and Awang, 2016b; Awang *et al.*, 2015; Fornell and Larcker, 1981).

4.2. The Structural Model

The theory H1 is endorsed, as shown in Figure 3. In H1, the direct effect of industry 4.0 on sustainable development in Bahrain is significantly positive (β=0.387, P=.001). In H2, the reality effect on sustainable development in Bahrain (β=0.456 and P=.001) is also strongly optimistic. The structural model explains 50.4% variance in sustainability.

Table 3. Squared Multiple Correlations (R^2)

Variable	Estimate (R^2)
Sustainable Development	**0.669**

Table 3 above indicates that 66.9% of its variation is explained by the indicator of sustainable development. In other statements, approximately 33.1 percent of the variance for sustainable development is the error variance.

Table 4. Standardized Regression Weights of Industry 4.0 and Reality on IP

Variable	Path	Variable	Estimate
Sustainable Development	←	Industry	**0.413**
Sustainable Development		Reality	**0.549**

In Table 4 of Figure 3 it has been shown that industry 4.0 has a 41.3 percent effect on sustainable development, and 58.7 percent have no affect. Moreover, the influence of

reality on sustainable development was 54.9% while 45.1% does not influence sustainable development.

The unstandardized weight of regression (that is, Figure 4) shows that the beta coefficient calculation that measures the effects of industry 4.0 and reality on the construction of sustainable development is focused on.

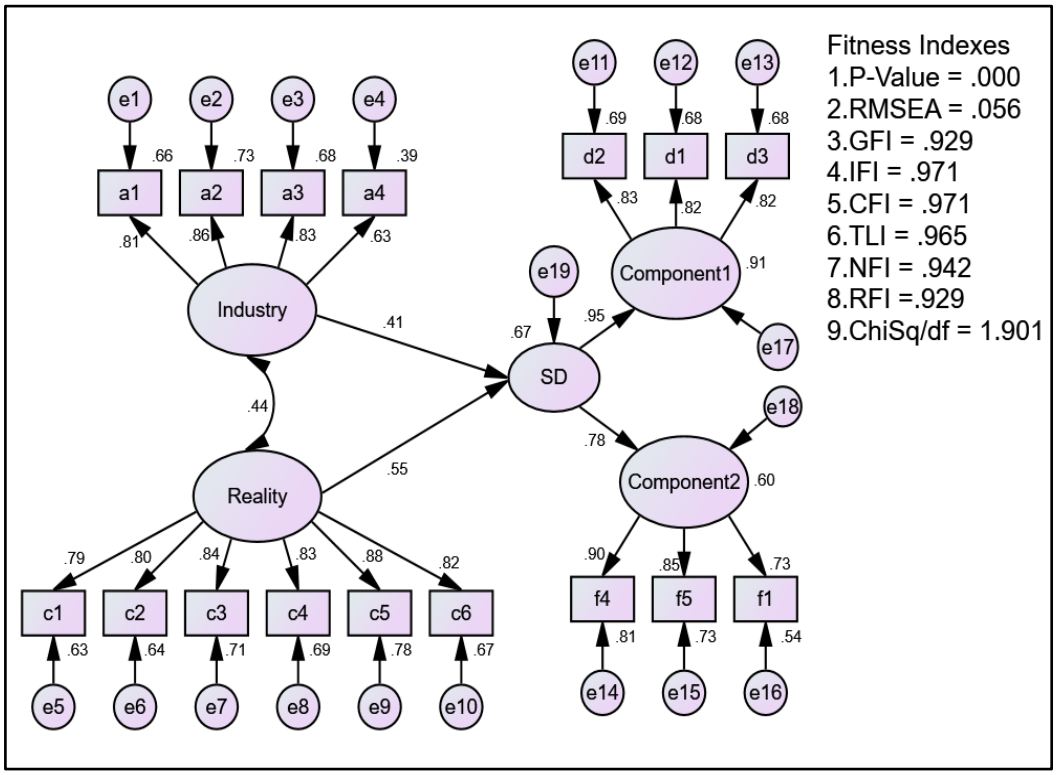

Figure 3. Standardized Regression Path Coefficient

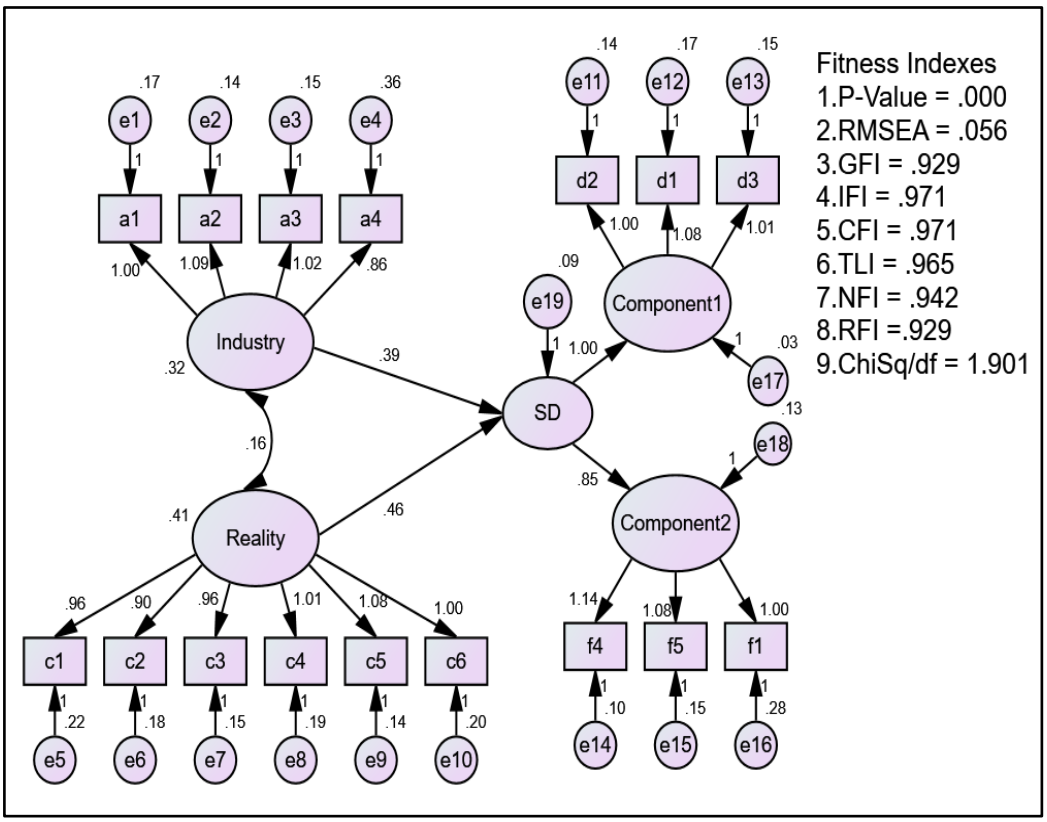

Figure 4. Unstandardized Regression Path Coefficient

Table 5. Regression Weight for Path Estimate

			Estimate	S.E.	C.R.	P	Result
sustainable development	←	Industry 4.0	.387	.056	6.901	0.001	Significant
sustainable development	←	Reality	.456	.052	8.730	0.001	Significant

This study's hypothesis was defined as: H1: The impact of Industry 4.0 on sustainable development in Bahrain is positive and significant. H2: Reality has a strong and significant effect on Bahrain's sustainable development. The conclusion of Table 5 shows that regression weight is important and the likelihood that an industry 4.0 will have an absolute weight of 6.901 is 0.001. In other words, industry 4.0 has highly significant effects on sustainable development in Bahrain. Consequently, for industry 4.0's impact on sustainable development, beta coefficient was 387, which means that sustainable development increased by .387 for each unit increase in industry 4.0.

The result in Table 5 showed therefore also that the degree of significance for regression weight shows the probability of reaching the absolute value of 8,730 is 0.001. In other terms, Bahrain has a significant impact on sustainable development. So, the beta-coefficient for the impact of reality on sustainable development was 456, which implies that sustainable development developed in fact for each unit by 456. Therefore, the beta coefficient for the sustainable development impact in nature was .456, which implies that sustainable development was improved by .456 for each unit of reality.

5. Conclusions

The paper examines the effect on sustainable development in Bahrain of Industry 4.0 and reality. The result of this report is that the impact on sustainable development in Bahrain from business 4.0 and fact are promising and very important. It can therefore be established that the growth, sustainability, creativity and sustainable development in Bahrain may be guided in business 4.0 and in fact. However, a report on Industry 4.0 and the introduction of a fact strategy could provide data on what could help to mediate or regulate the strategies of enhancing and sustaining the performance of the industry in Bahrain. While this analysis has demonstrated the significance of the position of industry 4.0 and the reality as the key factors of the industrial strategy, further work is also directed at improving the awareness of crucial industry 4.0.

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