The Status Quo of Fourth Industrial Revolution (4IR) in the South African Higher Institutions

Thalente Lungile Nkosi, Jacob Adedeji, Nkosinathi Jele
Department of Civil Engineering Midlands,
Durban University of Technology, Pietermaritzburg, 3201,
Republic of South Africa.
thalenten@dut.ac.za, jacoba@dut.ac.za, nkosinathij@dut.ac.za

Abstract

Purpose- The paper aims to investigate the status quo of 4IR in the South African Higher Education Institutions
Design/methodology/approach- The study adopted a survey design with different South African university students in Gauteng province using quota-sampling method. This was done through structured questionnaire. Percentage, frequency mean score and exploratory factor analysis were used to analyse the collected data.

Findings- findings showed that the current status of 4IR is susceptible & made easy, the existing 4IR infrastructure needs to be mended, the universities have a blended learning approach, the nature of learning has not been transferred to digital learning, the full potential of 4IR has not being realised to outdated infrastructure and the 4IR adoption is very low due to its costs. The most rated benefits included the demographic effect of different socio-economic status affecting the students with adopting 4IR, the 4IR infrastructure is still under review & improvement in universities as well as that the infrastructure lack exclusive rights to many available technology innovations.

Practical implications- This research paper was conducted in Gauteng province. The findings therefore show a true reflection of the status quo of 4IR in the South African higher institutions.
Paper type- Research paper

Keywords:
Higher Education Institutions, Fourth industrial revolution, Current Status

Introduction

Higher education institutions in South Africa are failing to encounter the basics of digital students as educational schemes, commercial procedures, and learning simulations, which are not consumer dedicated (Schuetze and Slowey 2002). Witford (2006), stated that the educational infrastructure in classrooms is not developing in South African higher institutions. Therefore, it should be adjusted to keep pace with innovative and cultural changes. There is a need to gain the upper hand in this rapidly evolving world, and businesses should adopt the 4IR (Nayyar 2016). Hence, the Fourth Industrial Revolution should give a portion of the answers for such difficulties, as expanded effectively of the value chain using advances like information examination, sensors, computerized reasoning and the Internet of Things (IoT). Adendorff and Putzier (2018), pointed out that the absence of acquisitions by government and industries could lead to South Africa being lag behind "'without a friend in the world'" while different nations, including those of the African continent, grasp the 4IR ways. It enables the individuals to share information and access data and instruction. However, a general lack of abilities is one of the reasons for Africa's failure to take part in the 4IR development (City Press 2016). Adendorff and Putzier (2018), stated that issues lie in the absence of required skills if the country implements the 4IR. Therefore, this paper aims to investigate the status quo of the fourth industrial revolution in the South African higher institution.

Literature Review

The current status of 4IR in the South African Higher institutions

Incidences on costs

In HEIs, 4IR is not well implemented, training is low, and its effectiveness is not well recognized (Tymon 2013; Wang 2008). Moreover, Tymon (2013) and Wang (2008) stressed that it is essential to have enough knowledge of the diverse

constituents of 4IR in order to comprehend its roles and relevance in accelerating education and learning practices. According to Rüßmann et al. (2015), autonomous robotics, simulation, horizontal and vertical system integration, the Internet of things, cybersecurity, cloud, additive manufacturing, augmented reality, and big data and analytics are the nine pillars of digital innovation.

- Currently, the 4IR Infrastructure isn't only focused on computers

Tymon (2013) and Rüßmann et al. (2015) suggest that 4IR adoption is not confined to the use of computers only, or to the education sector. Furthermore, contemporary 4IR classifications may include prospects such as ecosystem expansion, which may promote the sharing of learning apparatus and data analytics to better understand student needs. According to Rüßmann et al. (2015) and Tymon (2013), the research implies that 4IR will disrupt and alter numerous operational processes, including the way people conduct business and deliver services.

- 4IR's utility in universities

In line with World Economic Forum (2018), the fusion of human and technology intelligent systems with exceptional consequences across multiple education disciplines poses significant challenges to learning, teaching, and work. According to Garca-Pealvo, Fidalgo-Blanco, Sein-Echaluc (2018), and Tymon (2013), lecturers and students are not technologically proficient. The previous three industrial revolutions have brought about the mass manufacturing of educational services, the creation of creative curriculum, and the acceptance of online learning on a global scale (Chang and Wills, 2013).

- **Blended learning**

A blended learning approach, which combines e-learning and classroom-based learning, may increase student performance and accomplishment by about 15% (Chang and Wills 2013). While the traditional face-to-face classroom teaching and learning has been neglected, the internet and other forms of developing technology have helped facilitate competency-based and self-directed learning while enhancing diversity, including the speed at which information is provided to learners regardless of their location (Bayne 2015; Brown 2010; Ng'ambi et al. 2014). Tutor and student communication is enhanced by digital technology, according to Beetham and Sharpe (2013).

- **Many technologies are available to HEIs, but they lack exclusive rights to them**

Higher education institutions use mobile devices and social media platforms more frequently (Ng'ambi et al. 2014). The use of technology to facilitate teaching and learning has been limited to digitization, but academic institutions have unregulated their design of numerous available technology innovations and tools (Ng'ambi et al. 2016), suggesting that the education sector lacks exclusive rights to these innovations and tools.

- **In order to improve 4IR infrastructure, lecturers and students play a crucial role**

Over the past decades, technology has changed teaching and learning dynamics (Rashid and Asghar 2016). Whether technology influences teaching quality or develops students' performance is the question. Cooperative e learning contributes to enhancing teaching and learning experiences (Chang 2013). According to Chamg (2013), students and tutors are essential in providing structured and ordered e-learning that raises students' motivation, competency, and satisfaction with their education.

- **Inconsistency in digital technology application**

Selwyn (2011) concluded that the education sector lacks substantial evidence of organizational learning. It was observed that the use of digital technology in higher education did not transform teaching and learning. A lack of coherent policy on the roles of technology in education is one of the reasons that Ng'ambi et al. (2014) argues that the use of technology in Africa is fragmented and focused on computer-assisted instruction (CAI). Moreover, little is known about motivations, barriers, and implications that support the adoption and diffusion of 4IR in education (Rashid 2016).

Research methodology

This study investigates the status quo of 4IR in the South African higher education institutions. It employed quantitative research design, which is numerically orientated collected data in a form of numbers (Punch 2005). Bryman and Bell (2007), stated that it’s a method that implement a detached and objective approach in conducting experiments and observing phenomena, the collected data is used to expand existing theories, falsify, support or build new theories. Quantitative approach was employed because of its ability to cover a large portion of the sample

population in a short period and that it makes use of fixed procedures and standard research design, which makes it possible to be, replicated (De Vos et al. 2005).

Findings and Discussions

The status of 4IR in South African Higher institutions

The findings of the survey that assesses the current state of 4IR in South African higher education institutions are shown in this section. By using Cronbach's alpha, the section's reliability is measured at 0.910, over the required 0.7, indicating its reliability.

4.1.1 Descriptive statistics

Table 1 presents the Mean Item Score (MIS) ranking and the Standard Deviation (SD) of the respondents' opinion on the status quo of 4IR on higher education institutions in South Africa. The respondents ranked the variables using a Five-point Likert scale: 1= Strongly disagree; 2= Disagree; 3= Neutral; 4= Agree; 5= Strongly Agree. Variables are the demographic effect of different socio-economic statuses effecting students with adapting to 4IR ways (this was ranked first with a MIS of 4.04 and an SD of 0.984); 4IR infrastructure is under continual review & improvement in universities (this was ranked second by the respondents with an MIS of 3.95 with an SD of 1.107); Universities lack consistency in the application of digital technology (this was ranked third by the respondents with an MIS of 3.93 and with an SD of 1.086). Furthermore, in that universities lack exclusive rights to many available technology innovations with an MIS of 3.92 and an SD of 1.135 and that the existing 4IR infrastructure needs to be mended (this was ranked fifth by the respondents with a MIS of 3.92 and a SD of 1.196).

Also, the current status of 4IR is susceptible & made easy was ranked sixth by the respondents with an MIS of 3.87 and an SD of 1.126; Universities have a blended learning approach (this was ranked seventh by the respondents with an MIS of 3.85 and an SD of 1.055); Nature of learning has not been transferred to digital learning ranked eighth by the respondents with an MIS of 3.82 and an SD of 1.246; The full potential of 4IR not being realized due to outdated infrastructure (this was rated ninth by the respondents with a MIS of 3.81 and a SD of 1.141); while the lowest-ranked by the respondents is 4IR infrastructure is very low due to its costs with an MIS of 3.79 and an SD of 1.157.

Table 1. Descriptive Analysis of status quo of 4IR in higher education institutions

Status quo of 4IR	Mean	Std. Deviation	Rank
The demographic effect of different socio-economic status effecting students with adapting to 4IR ways	4.04	0.984	1
4IR infrastructure is under continual review & improvement in universities	3.95	1.107	2
Universities lack consistency in the application of digital technology	3.93	1.086	3
Universities lack exclusive rights to many available technology innovations	3.92	1.135	4
The existing 4IR infrastructure needs to be mended	3.92	1.196	5
The current status of 4IR is susceptible & made easy	3.87	1.126	6
Universities have a blended learning approach	3.85	1.055	7
Nature of learning has not been transferred to digital learning	3.82	1.246	8
The full potential of 4IR not being realised due to outdated infrastructure	3.81	1.141	9
4IR infrastructure is very low due to its costs	3.79	1.157	10

4.1.2 Exploratory factor analysis

Using SPSS version 27 software, Exploratory Factor Analysis (EFA) was performed on all factors that had been found about the 4IR status quo for higher education institutions in South Africa. When performing the exploratory factor analysis, the eligibility of the data was determined by looking at the correlation matrix to identify the coefficient value of 0.3 and above suitable for the factor analysis, as shown in Table 2.

Table 2. Correlation Matrix

	B1	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**
B1	**1.000**									
B2	0.656	**1.000**								
B3	0.426	0.429	**1.000**							
B4	0.386	0.416	0.534	**1.000**						
B5	0.722	0.680	0.436	0.498	**1.000**					
B6	0.643	0.728	0.412	0.389	0.686	**1.000**				
B7	0.495	0.635	0.589	0.566	0.597	0.701	**1.000**			
B8	0.535	0.547	0.427	0.469	0.652	0.690	0.591	**1.000**		
B9	0.458	0.561	0.281	0.529	0.595	0.556	0.594	0.543	**1.000**	
B10	0.369	0.437	0.133	0.183	0.363	0.411	0.221	0.363	0.380	**1.000**

The Kaiser-Mayer-Olkin (KMO) test is required to determine the appropriateness of the value distribution before proceeding with the EFA. According to Pallant (2011), a data distribution measure of <0.5 is unacceptable for EFA, however >0.6 is acceptable. Table 3 shows that the KMO value is 0.895, which is acceptable because it is greater than 0.6. Additionally, Bartlett's test of sphericity demonstrates statistical significance in all variables with a value of 0.000, which is less than 0.050, indicating that they are factorable. The correlation matrix table suggested that the data was suitable for factor analysis because the correlation coefficient was >3, supporting the KMO and Bartlett's test.

Table 3. KMO measure and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1200.493
	Df	45
	Sig.	0.000

Table 4 shows communalities of all variables that are determined by their extraction with values that are not less than 0.300. This indicates that all variables fit well in their components and that there is no variance in variables. Factor grouping is valid if each of the variables do not have low extraction value. As indicated in table 4, all variables consist of values that are greater than 0.300.

Table 4. Communalities

	Initial	**Extraction**
4IR infrastructure is very low due to its costs	1.000	0.624

The existing 4IR infrastructure needs to be mended	1.000	0.715
4IR infrastructure is under continual review & improvement in universities	1.000	0.676
Universities have a blended learning approach	1.000	0.647
Nature of learning has not been transferred to digital learning	1.000	0.729
Universities lack exclusive rights to many available technology innovations	1.000	0.748
The current status of 4IR is susceptible & made easy	1.000	0.744
Universities lack consistency in the application of digital technology	1.000	0.623
The demographic effect of different socio-economic status effecting students with adapting to 4IR ways	1.000	0.554
The full potential of 4IR not being realised due to outdated infrastructure	1.000	0.640
Extraction Method: Principal Component Analysis.		

Table 5 shows the total variance of all variables indicating their eigenvalues according to Kaiser's criterion. The first two components are reckoned as their values are above 1.0 which mean they meet the criteria under the initial eigen value column. These two components explain a cumulative percentage of 66.989.

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.614	56.141	56.141	5.614	56.141	56.141	5.176
2	1.085	10.848	66.989	1.085	10.848	66.989	2.903
3	0.708	7.083	74.073				
4	0.626	6.259	80.332				
5	0.514	5.139	85.471				
6	0.465	4.647	90.118				
7	0.311	3.108	93.226				
8	0.256	2.564	95.790				
9	0.236	2.355	98.145				
10	0.185	1.855	100.000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Figure 1 shows the scree plot that revealed the factors with eigenvalues above 1 on the steep side of the graph, while factors with eigenvalues below one is on the lower side of the plot.

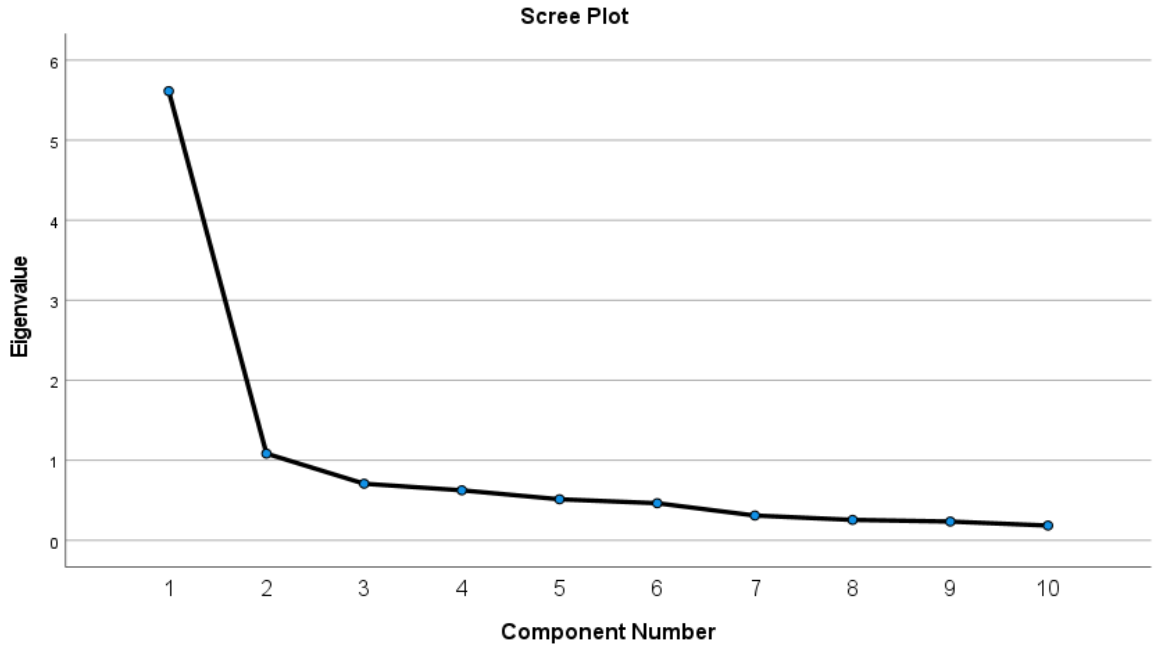

Figure 1. Scree plot on the status quo of 4IR in higher education institutions

Table 6 shows the pattern matrix with 10 variables identified from the literature, factored into two clusters and interpreted based on the inherent relationship of variables in that cluster.

Table 6. Pattern Matrix

	Component	
	1	**2**
The full potential of 4IR not being realised due to outdated infrastructure	0.836	
Universities lack exclusive rights to many available technology innovations	0.813	
The existing 4IR infrastructure needs to be mended	0.804	
Nature of learning has not been transferred to digital learning	0.763	
4IR infrastructure is very low due to its costs	0.752	
Universities lack consistency in the application of digital technology	0.678	
The demographic effect of different socio-economic status effecting students with adapting to 4IR ways	0.665	
4IR infrastructure is under continual review & improvement in universities		-0.759
Universities have a blended learning approach		-0.690
The current status of 4IR is susceptible & made easy		-0.559
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

a. Rotation converged in 19 iterations.

4.3.3 Naming of components/factors of the status quo of 4IR in higher education institutions

There are no rules for naming factors. However, it is important that names best represent the variables within the factors (Young and Pearce 2013).

Factor 1: Continuous development of 4IR infrastructure

As shown in Table 7, seven variables are loaded in factor 1. These variables include 'the full potential of 4IR not being realized due to outdated infrastructure' (83.6%) 'Universities lack exclusive rights to many available technology innovations' (81.3%) 'the existing 4IR infrastructure needs to be mended' (80.4%) 'Nature of learning has not been transferred to digital learning' (76.3%) '4IR infrastructure is very low due to its costs' (75.2%) 'Universities lack consistency in the application of digital technology' (67.8%) and the demographic effect of different socio-economic status effecting students adaptation to 4IR' with (66.5%). All mentioned variables in this factor relate to the development of infrastructure needed for 4IR. Therefore, this factor can be termed continuous development of 4IR infrastructure**.** This cluster accounted for 56.141% of the total variance.

Factor 2: Continuous development of 4IR learning

Loaded in factor 2 are three variables which are '4IR infrastructure is under continual review & improvement in universities' (-75.9%) 'Universities have a blended learning approach' (-69.0%) and 'the status of 4IR is susceptible & made easy' (-55.9%). Therefore, with a total variance of 10.848%, this factor can be labelled as continuous development of 4IR learning.

Table 7 shows the component correlation matrix with all clusters having values that are more than 0.300. This indicates that there is a strong relationship between all clusters.

Table 7. Component correlation matrix

Component	1	2
1	1.000	-0.362
2	-0.362	1.000
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

As shown in Table 8, a reliability test was done on all variable clusters using Cronbach's Alpha. A minimum value of 7 accepted. The table 8 indicated that all the variables measured fitted well in the clusters they were loaded into as they all had a Cronbach's Alpha value above 7.

Table 8. Reliability of components/factors

Clusters	**Cronbach's Alpha Coefficient**
Component 1 - CONTINUOUS DEVELOPMENT OF 4IR INFRASTRUCTURE	0.879
Component 2 – CONTINUOUS DEVELOPMENT OF 4IR LEARNING	0.776

Conclusion

The literature review in this section found that the fourth industrial revolution and its constituents are needful on HEIs infrastructure as it makes students attain good academic results with its recommended technology and innovation. For students to achieve excellent academic performance, the universities must overcome the challenges caused by the unenhanced educational infrastructure within the universities. Since it has been identified beyond reasonable doubt that HEIs are encompassed with challenges centred on inadequate educational infrastructure and, arguably, skilled personnel. 4IR is therefore required.

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